```
> restart:with(LinearAlgebra): with(GraphTheory):
```

For thermodynamic purposes based upon finite measurements, there are only two classes of finite topologies.

1. The Particle-like class of T0 topologies, where all singlet subsets are distinguishable.

2. The Wave-like class of Not-T0 topologies, where some, if not all, of the singlet subsets are indistinguishable.

For a set of N = 2 ingredients, X={a,b}, there are 2 T0, and 1 Not-T0 topologies.
For a set of N = 3 ingredients, X={a,b,c}, there are 5 T0, and 4 Not-T0 topologies.
For a set of N = 4 ingredients, X={a,b,c,d}, there are 16 T0, and 17 Not-T0 topologies.
For a set of N = 5 ingredients, X={a,b,c,d,s}, there are 63 T0, and 76 Not-T0 topologies.

In special cases the abstract symbols take on special meaning, especially when the ingredients are presumed to be exterior differential forms .
If A is a 1-form, then F=dA is a 2-form, H=A^F is a 3-form, and K=F^F is a 4-form.

For N= 4 ingredients there is a special T0 poset 3 disconnected topology. This topology has a Kuratowski representation in terms of the exterior differential, d, and the exterior product. This special, particle-like, T0 topology was discovered about 1987, and led to the analysis of non-equilibrium thermodynamic systems and irreversible processes based on the Grassman algebra. For irreversible processes the three form H = A^F = Topological Torsion must not be zero.

A program has been created (using the Maple 14 symbolic calculator) to automatically compute the properties of all finite Lattice Structures for N = 3, 4, and 5 ingredients (hand computations can be tedius). The computer program combines some of the techniques first developed by Didier Deses, but then was augmented with numerous modifications, additions, and corrections. This work was done R. M. Kiehn over the period November 20, 2009 until March 25, 2014.

When the Lattice Sets are presumed to be finite, the subsets of the power set can be identified as topological open sets. Then it possible to compute the interior, exterior, boundary, closure, and limit points for every subset of the power set generated by a lattice. The many topological solutions produced by the Maple program indicate that the finite latice topologies are of only two categories. The first category consists of those topologies that obey the Kolmogorov T0 separation axioms: All T0 singlet subsets have topological closures that are distinguishable. These distinguishable subsets can be used to define topological particles. The second category consists of those Not-T0 topologies where some, if not all, of the singlet subsets of the lattice are indistinguishable. These indistinguishable subsets can be used to define topological waves.
*****
There are Lattice Subsets that define topologies, with separation axioms, T0 and T1, and yet these topologies are NOT metrizable. If a topology is metrizable over the reals, the topology must be Hausdorff, T2, or stronger.
*****
In many instances the Lattice forms a planar graph, which means that the graph can be embedded by deformations into R2. However, Kuratowski proved that certain lattices, those that contain K3,3 or K5 sub-lattices, cannot be embedded in R2 as planar graphs. Such Lattices require R3 or more. A K3,3 sub-lattice consists of 6 vertices and 9 connecting arcs (or edges). The K5 sub-lattice consists of 5 vertices and 10 connecting arcs. These concepts have been used to understand chemical molecules, and concepts of topological chirality.
*****

A visual aspect of an embedding into R3 is given by a space curve that exhibits Affine torsion. Another, perhaps more general idea, is defined in terms of Topological Torsion, which is related to the Pfaff Topological Dimension = 3 (or class) of an exterior differential 1-form defined on a differential variety.
*****
Exterior differential 1-forms, A, that can not be embedded in R2 are such that the 3-form A^dA is not zero.
This constraint requires that the Frobenius Unique integrability theorem fails! Unique initial data do NOT produce Unique final data. Envelope solutions and edges of regression give visual examples of non-uniqueness.
*****

Exterior Differential 1-forms of Pfaff Topological Dimension 3 require a minimum of 3 independent functions (of an arbitrary geometric set) to capture their topological properties. An open question is: What Lattices cannot be embedded in R3?"
*
Geometric constraints based upon metric ideas imply that the underlying topology is Hausdorff T2. Finite Hausdorff spaces (the power set of X) are disconnected. Subsets of finite Hausdiorff spaces can be simply connected, or not simply connected. If the subsets of the power set form a T0 topology, it can be a connected topology or a disconnected topology. The disconnected T0 topologies have subsets that do not have boundaries (the boundaries are empty) . The connected T0 topologies do not have subsets without boundary,
*
The study of the detailed lattice and topological structures gives an insite into physical concepts that may not be distinguished in terms of geometrical constraints. Finite Homological features focus attention on simply connected or not simply connected concepts which are not Hausdorff and therefor do not depend upon geometrical ideas of size and shape.
*

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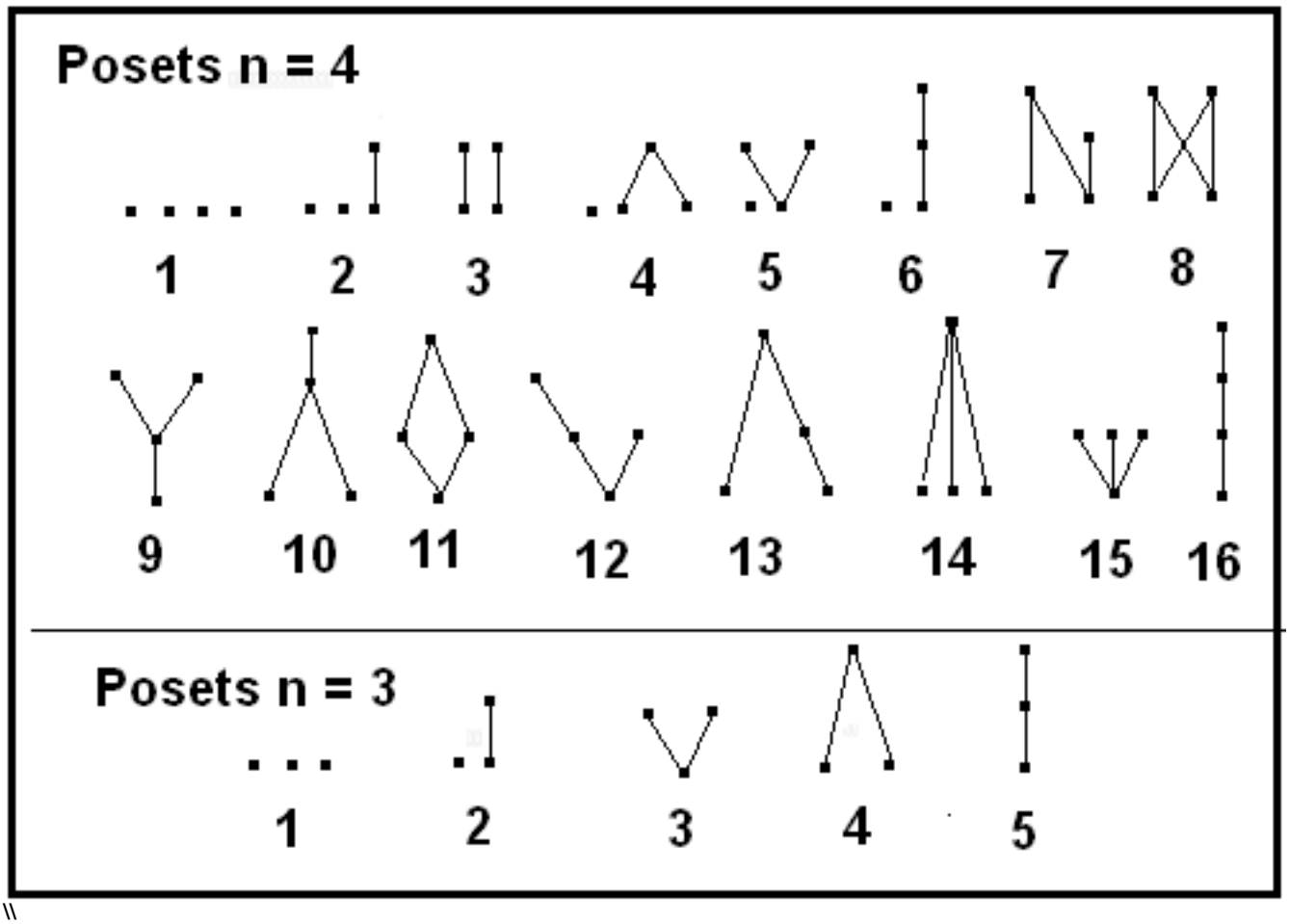
It has been established that T0 topologies that are not metrizable can be put into correspondence with non-equilibrium thermodynamics, and irreversible processes. The arrow of time is explained in terms of topologically continuous processes from thermodynamic states of higher topological dimension to thermodynamic states of lessor topological dimension. In addition, certain topological quantum features can be put into correspondence with deRham integrals over closed exterior differential forms that are not exact.

See http://www.lulu.com/kiehn for 6 monographs that describe the "Unusual effectiveness of topological thermodynamics".
*
Planck's Backbody radiation formula describes physical phenomena that are independent of metric, size, shape, material composition, or even internal microscopic structure. It is conjectured that such concepts are related to both those Finite Lattice Structures that are particle-like T0 topologies and to those Lattice Structures that are wave-like Not-T0 topologies, but are Lattice Structures which do not obey the Kolmogorov T0 separation axioms.
Such Lattice Structures have singlet subsets of the power set that are indistinguishable. If Lattice Structures obey the Kolmogorov T0 separation axioms, then all subsets of the power set are distinguishable.
*
The conjecture to be studied is :
Do the Not-T0 non-metrizable wave-like topologies describe such effects as Planck's Black Body radiation formula, the salient features of indistinguishable Bosons and Fermions, and the theory of collective states, that are the foundations of Quantum Theory.

****
The T0 (poset) particle-like structures are based upon distinguishable singleton closures.
Examples for X={a,b,c,d} and X={a,b,c} are given below:



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For a subset A of a Lattice space,
Int(S) = Interior of S = largest open set contained in S
Com(S) = Complement of S = topset X={a,b,c,d...} minus S = X mod S.
Ext(S) = Exterior of S = Int(Com(S)) = largest open set in the compliment of S.
Bnd(S) = Boundary of S = X mod Int(S) mod Ext(S).
Clo(S) = Closure of S = Int(S) union Bnd(S) = S union Lim(S)
Lim(S) = Limit points of S = points p such that {Clo(S mod p) intersect (p)} =/= the empty set.

Isolated points are of two types
Clo(S) minus Lim(S) = IsoClo(S)
and
{S}intersection{Lim(S)}=IsoCar(S), in the sense of Caratheodory

If S is an exterior differential 1-form, and the exterior differential, d, is a limit point generator then I call the non zero 3-form A^dA : Topological Torsion. Topological Torsion = 0 implies the differential 1-form admits an integrating factor. For a Kuratowski topology Topological Torsion is related to IsoCar.

A closed set either has no limit sets or contains its limit sets. A closed set S = Clo(S).

A set S with empty limit points and empty boundary points is defined as an isolated segregated point,
Bnd(S) = {} and Lim(S) = {} => {S}.Seg.

The disconnected points in the closures of a set are described as adherent points.

Press Enter to load Program subroutines:

```
#********************************  subroutines**********************
> issubset:=proc(A,B)
>   local a;
>   for a in A do
>     if not(member(a,B)) then RETURN(false); fi;
>   od;
>   RETURN(true);
> end proc:
# Closure of Union
>   clunion:=proc(T) local A,U;U:=T;
>   for A in T do
>     U:= U union map(`union`,U,A);
>   od;
>   if U=T then U; else clunion(U); fi;
> end proc:



# Closure of intersections
> clintersect:=proc(T)
>   local A,U;U:=T;
>   for A in T do
>     U:= U union map(`intersect`,U,A);
>   od;
>   if U=T then U; else clintersect(U); fi;
> end proc:

# Is the lattice a Topological basis
> topbase:=proc(X,SB)
>   clunion(clintersect(SB union {X,{}}));
> end proc:


> kinterior:=proc(A,X,T)
>   local i;global kINT;
>   kINT:={}:
>   for i to nops(T) do
>     if issubset(T[i],A) then kINT:={} union T[i]: fi:
>   od:
> end proc:


> kintext:=proc(A,X,T)
>   local i;global kINTEXT;
>   kINTEXT:={}:
>   for i to nops(T) do
>     if issubset(T[i],(X)minus(A)) then kINTEXT:={} union T[i]: fi:
>   od:
> end proc:


> isTopo:=proc(X,T)
>   clunion(T)=T and member(X,T) and member({},T) and clintersect(T)=T;
> end proc:



> akinterior:=proc(A,X,T)
>   local i;global kINTEXT;
>   kINTEXT:={0}:
>   for i to nops(T) do
>     if issubset(T[i],A) then kINTEXT:={0} union T[i]: fi:
>   od:
> end proc:

# Is the Topology connected?
```

```
> isConn:=proc(X,T)
>   evalb(CO(X,T)={X,{}});
> end proc:
> # Find the sets that are Open and Closed
> CO:=proc(X,T)
>   local A,W;W:={};
>   for A in T do
>     if member(X minus A,T) then W:=W union {A}; fi;
>   od;
>   W;
> end proc:
> #

> # Find the closure of T
> CLO:=proc(X,T)
>   {seq(X minus T[i],i=1..nops(T))};
> end proc:

> # The following are a set of procedures testing for some topological properties,
> # the used algorithms are simply exhaustive ones, all possibilities are checked.
> isT0:=proc(X,T)
>   local x,y,A,test;
>   for x in X do
>     for y in X minus {x} do
>       for A in T do
>         test:=evalb((member(x,A) and not(member(y,A))) or
>                 (member(y,A) and not(member(x,A)))):
>         if test then break; fi;
>       od:
>       if not(test) then break; fi;
>     od:
>     if not(test) then break; fi;
>   od:
>   test;
> end proc:
> isT1:=proc(X,T)
>   issubset({seq({X[i]},i=1..nops(X))},CLO(X,T));
> end proc:
> isHd:=proc(X,T)
>   local x,y,A,B,test;
>   for x in X do
>     for y in X minus {x} do
>       for A in T do
>         for B in T minus {a} do
>           test:=evalb(member(x,A) and member(y,B) and A intersect B={}):
>           if test then break; fi;
>         od:
>         if test then break; fi;
>       od:
>       if not(test) then break; fi;
>     od:
>     if not(test) then break; fi;
>   od:
>   test;
> end proc:


> # The exterior of a set is the interior of its complement
> exteriorb:=proc(A,X,T)
>   local i,C,ClX;
>   ClX:=CLO(X,T);
>   C:=X;
>   for i to nops(ClX) do
>     if issubset(A,ClX[i]) then C:=C intersect ClX[i]; fi;
>   od;
>   print(`Exterior`=C);
> end proc:
> # Subspaces are found by taking intersections with the open sets.
```

```
> subspace:=proc(A,X,T)
>   map2(`intersect`,A,T);
> end proc:
> # Given a list of sets this procedure finds all element in the cartesian product.
> expandcart:=proc(PX)
>   local C,P,i;
>   C:={};
>   P:=cartprod([seq([op(PX[i])],i=1..nops(PX))]);
>   while not P[finished] do C:=C union {P[nextvalue]()} od;
>   C;
> end proc:
> # Implementation of the inverse projections, this is needed in later procedures.
> iprj:=proc(k,S,PX)
>   local i,O;
>   for i to nops(PX) do
>     if i=k then O[i]:=S else O[i]:=PX[i] fi;
>   od;
>   expandcart([seq(O[i],i=1..nops(PX))]);
> end proc:
> # Procedure to find a subbasis for a product topology using inverse projections.
> prodbase:=proc(PX,PS)
>   local i,k,S;S:={};
>   for k to nops(PX) do
>     for i to nops(PS[k]) do
>       S:=S union {iprj(k,PS[k][i],PX)};
>     od;
>   od;
>   S;
> end proc:
> # Given a list of sets and a list of topologies, the product topology is found.
> prodtop:=proc(PX,PT)
>   topbase(expandcart(PX),prodbase(PX,PT));
> end proc:
> # A topology is weakly zero-dimensional iff the clopen sets form a base.
> isWzd:=proc(X,T)
>   evalb(topbase(X,CO(X,T))=T)
> end proc:
> # A topology is connected iff there are no proper clopen sets.
> #
> isConn:=proc(X,T)
>   evalb(CO(X,T)={X,{}});
> end proc:
> # A connection component is the largest connected subspace, containing a given point.
> K:=proc(x,X,T)
>   local i,S,SK;
>   SK:={};
>   S:=map2(`union`,{x},powerset(X));
>   for i to nops(S) do
>     if isConn(S[i],subspace(S[i],X,T)) then SK:=SK union S[i]; fi;
>   od;
>   SK;
> end proc:
> # A topology is totally disconnected if all connections components are singletons.
> isTotDisc:=proc(X,T)
>   local i;
>   for i to nops(X) do
>     if not(K(X[i],X,T)={X[i]}) then RETURN(false) fi;
>   od;
>   RETURN(true);
> end proc:
> prLatpt3:=proc(GS,NBR)
>   local VA,EA,De,i,j,k,LS3,LS:
>   global GA,G,H,Dee,SS3,SSS3,XS,ZS,QS,TS,TSdual,LS33:
>   LS:=GS;
>   if NBR=3 then
>     LS:=(LS)union({{a,b,c}});fi;
>   if NBR=4 then
>     LS33:=(LS)union({{a,b,c,d}});
```

```
>   fi;
>   XS:={{a},{b},{c},{a,b},{a,c},{b,c},{a,b,c}}:
>   ZS:=[a,b,c,ab,ac,bc,abc]:
>   j:=nops(LS)-1;QS:=LS[1];
>   for i to j do QS:=QS,LS[i+1]: od:
>   LS3:={QS}; k:=nops(LS3): TS:=0:
>   for j to k do
>     for i to 7 do
>       if LS3[j]=XS[i] then TS:=TS,ZS[i]; fi;
>     od;
>   od;
>   if nops(LS3)=2 then
>     print(`Nothing to draw`);
>   else
>     drawLat63pt([TS],NBR);
>   fi;
> end proc:
> LEXorder:=proc(LX,NBR)
>   local k,i,AA,BB,LEXsort:
>   global AAA,BBB:
>   k:=nops(LX): AA:=LX[1]:
>   for i to (k-1) do
>     AA:=AA,LX[i+1]:
>   od:
>   AAA:={AA}:
>   k:=nops(LX); BB:=AAA[1]:
>   for i to (k-1) do BB:=BB,AAA[i+1]: od:
>   BBB:=[BB]:
> end proc:
> drawLat63pt:=proc(TS,NBR)
>   local EA,i,j,k;
>   global GA,G,H,Dee,SS,SSS,XS,ZS,CLTop1,CLTop1dual,SS3,SSS3,VA,De,QS,LS7:
>   GA:=Graph([0,a,b,c,ab,ac,bc,abc]);
>   VA:=Vertices(GA);EA:=Edges(GA);
>   LS7:=TS; De:=[0,0];  k:=0;
>   if member(a,LS7) then De:=De,[a,0]; fi;
>   if member(b,LS7) then De:=De,[b,0]; fi;
>   if member(c,LS7) then De:=De,[c,0]; fi;
>   if member(ab,LS7) and member(b,LS7) then De:=De,[ab,b] fi;
>   if member(ab,LS7) and member(a,LS7) then De:=De,[ab,a] fi;
>   if member(ac,LS7) and member(a,LS7) then De:=De,[ac,a] fi;
>   if member(ac,LS7) and member(c,LS7) then De:=De,[ac,c] fi;
>   if member(bc,LS7) and member(b,LS7) then De:=De,[bc,b] fi;
>   if member(bc,LS7) and member(c,LS7) then De:=De,[bc,c] fi;
>   if member(abc,LS7) and member(ab,LS7) then De:=De,[abc,ab] fi;
>   if member(abc,LS7) and member(ac,LS7) then De:=De,[abc,ac] fi;
>   if member(abc,LS7) and member(bc,LS7) then De:=De,[abc,bc] fi;
>   j:=nops([De])-1;
>   Dee:=De[2]; for i to j do Dee:=Dee,De[i+1] od;
>   if Dee=0 then H:=Graph(VA): else H:=Digraph(VA,{Dee}):fi;
>   SetVertexPositions(H,[[0,0],[-1,1],[0,1],[1,1],[-1,2],[0,2],[1,2],[0,3]]):
>   HighlightVertex(H, Vertices(H), white);
> if member(a,LS7) then HighlightVertex(H,a,red) fi;
> if member(b,LS7) then HighlightVertex(H,b,red) fi;
> if member(c,LS7) then HighlightVertex(H,c,red) fi;
>   if member(ab,LS7) then HighlightVertex(H,ab,yellow) fi;
> if member(bc,LS7) then HighlightVertex(H,bc,yellow) fi;
> if member(ac,LS7) then HighlightVertex(H,ac,yellow) fi;
> HighlightVertex(H,abc,cyan);
> HighlightEdges(H, Edges(H), black);
>   SSS3:=DrawGraph(H);
> end proc:
```

```
**********************************************


> checkdual:=proc(GS,`title`,NBR) local i:
>  global LSdual,CLS,CLL,RCL,TS,SSCLL,X,LS,LSTopdual,TTS,ClLS,ClosLSd,ClosLatdual,ClosLS,SG;
        X:={a,b,c,d};                                                                    CLS:={{},{a},{b},{c},{d},{a,b},{a,c},{a,
   d},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{a,c,d},{b,c,d},{a,b,c,d}};
>  LS:=GS; LSTopdual:=CLO(X,LS);
> LSdual:=(CLS)minus(LS)minus(LSTopdual)union{{}}union({X});
>  SG:=Graph([a,b,c,d]);HighlightVertex(SG,[a,b,c,d],magenta);
> SetVertexPositions(SG,[[1,1],[2,1],[3,1],[4,1]]);
> print(`title`);print(`The input Lattice Structure, LS `=(LS));
>    print(`Is LS a Topology ?`=isTopo(X,LS));
>  print(`Is LS T0 ?`=isT0(X,LS));
>    Closure(X,LS);
> SSCLL:=RCL[2,5]; for i to nops(X)-1 do SSCLL:=SSCLL,RCL[i+2,5] od;
>    ClosLS:=SSCLL:
>  print(`The Top Down Lattice Structure for LS is: `);
>  print(prLatpt4(LS,4));
>   print(`The singleton closure set of the lattice Structure, LS, is `=ClosLS);
>  print({ClosLS});
> if nops({ClosLS})<4 then print(`NOT all singleton points are distinguishable`) else
>  print(`Display the T0 poset`);print(getPO({ClosLS})) ;fi;
> LAT4abcd(LS,`title`,NBR);  print(` `);
>  print(`The dual (compliment) Lattice Structure, LS* `=(LSTopdual));
>   print(`Is LS* a Topology ?`=isTopo(X,LSTopdual));
>  print(`Is LS* T0 ?`=isT0(X,LS));
> Closure(X,LSTopdual);
> SSCLL:=RCL[2,5]; for i to nops(X)-1 do SSCLL:=SSCLL,RCL[i+2,5] od;
>  ClosLSd:=SSCLL:
> print(`The DUAL Top Down Lattice Structure for LS* is: `);
>   print(prLatpt4(LSTopdual,4)); print(`  `);
> print(`The singleton closure set of the lattice Structure, LS*, is `=ClosLSd);
> print({ClosLSd});
>  if nops({ClosLSd})<4 then print(`NOT all singleton points are distinguishable`) else
>   print(`Display the T0 poset`);print(getPO({ClosLSd})) ;fi;
>
> print(` The Partition Dual: CLS-LS -LS* `=LSdual);
>  print(`Is the Partition Dual a Topology ?`=isTopo(X,LSdual));
>   print(`Is the :Partition Dual T0 ?`=isT0(X,LSdual));
>  Closure(X,LSdual);
>  SSCLL:=RCL[2,5]; for i to nops(X)-1 do SSCLL:=SSCLL,RCL[i+2,5] od;
> ClosLatdual:=SSCLL:
>  if LSdual = {{},{a,b,c,d}} then
> print(`Hence, the Partition Dual is the Indiscrete Topology `=LSdual);
>   print(`All singlet points {a},{b},{c},{d} are isolated`);
>     else
>   print(`The Top Down Lattice Structure for the Partition Dual is: `);
>    print(prLatpt4(LSdual,4));
>  fi;  print(` `)
>       end proc:
**********************************************************************
> Closure:=proc(GS,NBR) local k,i,LS034,X: global RCL,SCLL,SCL;
> if NBR=3 then X:={a,b,c}; fi;
> if NBR=4 then X:={a,b,c,d}; fi;
> if NBR=5 then X:={a,b,c,d,s}; fi;
> k:=nops(X)+1:RCL:=Matrix(k,6):LS034:=GS;
>  RCL[1,1]:=`Point`:
> RCL[1,2]:=`Interior`:
> RCL[1,3]:=`Exterior`:
> RCL[1,4]:=`Boundary`:
>  RCL[1,5]:=`Closure `:RCL[1,6]:= `Limit Set ` :
> for i to nops(X) do RCL[i+1,1]:={X[i]}: od:
>   for i to nops(X) do kinterior({X[i]},X,LS034);
```

```
> RCL[i+1,2]:={kINT}:kintext({X[i]},X,LS034):
> RCL[i+1,3]:={kINTEXT}:
> RCL[i+1,4]:=(X)minus(RCL[i+1,2])minus(RCL[i+1,3]):
>     RCL[i+1,5]:=(RCL[i+1,4])union(RCL[i+1,2]):RCL[i+1,6]:=(RCL[i+1,4])union(RCL[i+1,2])minus(RCL[i+1,1]):od:

>   RCL;
> if NBR=3 then SCLL:=(RCL[2,5],RCL[3,5],RCL[4,5]):fi;
> if NBR=4 then SCLL:=(RCL[2,5],RCL[3,5],RCL[4,5],RCL[5,5]):fi;
>   if NBR=5 then SCLL:=(RCL[2,5],RCL[3,5],RCL[4,5],RCL[5,5],RCL[6,5]):fi;
> end proc:
************************************************************

> LAT5abcds:=proc(GS,`title`,NBR)
> local i,j,LS09,LS07,CLS,V,G,VG: global RCL,LS00,k,X,Pos,Z,Link,LS,SCLL,CLosLS,LSCT;
> LS:=GS;
> X:={a,b,c,d,s}; LS09:={{},{a},{b},{c},{d},{s},{a,b},{a,c},{a,d},{a,s},{b,c},{b,d},{b,s},{c,d},{c,s},{d,s},{a,b,c},{a,b,d},{a,b,s},{a,c,
  d},{a,c,s},{a,d,s},{b,c,d},{b,c,s},{b,d,s},{c,d,s},{a,b,c,d},{a,b,c,s},{a,b,d,s},{a,c,d,s},{b,c,d,s},{a,b,c,d,s}};

> interface(rtablesize=60); Pos:=[0,0,0,0,0] ; Link:=[0,0,0,0,0,0,0,0,0,0]:
> Z:=Closure(LS,NBR);
> k:=31;
> RCL:=Matrix(32,8):
> RCL[1,1]:=`Subset S`:
> RCL[1,2]:=`Int(S)`:
> RCL[1,3]:=`Ext(S)`:
> RCL[1,4]:=`Bnd(S)`:
> RCL[1,5]:=`Clo(S)`:RCL[1,6]:=` Lim(S)` :RCL[1,7]:=`IsoClo(S)`:RCL[1,8]:=`IsoCar(S) `:

> i:=1;for i to k do RCL[i+1,1]:=LS09[i+1]: od:
> i:=1;for i to k do kinterior(LS09[i+1],X,GS);
> RCL[i+1,2]:=kINT:kintext(LS09[i+1],X,GS):
> RCL[i+1,3]:=kINTEXT:
> RCL[i+1,4]:=(X)minus(RCL[i+1,2])minus(RCL[i+1,3]):
>   RCL[i+1,5]:=(RCL[i+1,4])union(RCL[i+1,2]):



> LIMPT(RCL[i+1,1],LS,NBR); RCL[i+1,6]:=SCLL:RCL[i+1,7]:=(RCL[i+1,5])minus(SCLL):RCL[i+1,8]:=(SCLL)intersect
  (RCL[i+1,1]):

> od:
> interface(rtablesize=60);


> Z:=(RCL[2,5],RCL[3,5],RCL[4,5],RCL[5,5],RCL[6,5]): print(` `);
> print(`Is LS5:  a topology `=isTopo(X,LS),`  connected `= isConn(X,LS),`  Kolmogorov.T0`= isT0(X,LS),`  Hausdorff.
  T2`= isHd(X,LS));
> print(` `); print(RCL);
> if nops({Z}) < 5 then print(`Some singletons have the same closure and cannot be distinguished`);fi :

>   end proc:


> #
> LAT4abcd:=proc(GS,`title`,NBR)
> local i,j,LS08,LS07,CLS,V,G,VG: global RCL,LS00,k,X,Pos,Z,Link,LS,LSD,LSP,PLSX,ClosLS,LSU,LSP1,LSCT;

> LS:=GS;
> X:={a,b,c,d};LS08:={{},{a},{b},{c},{d},{a,b},{a,c},{a,d},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{a,c,d},{b,c,d},{a,b,c,d}}; LSD:=CLO
  (X,LS); LSP:=(LS08)minus(LS)minus(LSD)union{{}}union({X}); LSU:=(LS)union(LSD);  interface(rtablesize=20);
  LSP1:=(LS08)minus(LS)union{{}}union({X});
> Pos:=[0,0,0,0] ; Link:=[0,0,0,0,0,0]:
> k:=15; RCL:=Matrix(16,8):
> RCL[1,1]:=`Subset S`:
> RCL[1,2]:=`Int(S)`:
> RCL[1,3]:=`Ext(S)`:
> RCL[1,4]:=`Bnd(S)`:
```

```
> RCL[1,5]:=`Clo(S)`: RCL[1,6]:=`Lim(S)`:RCL[1,7]:= `IsoClo(S)`:RCL[1,8]:=`IsoCar(S)`:

>  i:=1;for i to k do RCL[i+1,1]:=LS08[i+1]: od:
> i:=1;for i to k do kinterior(LS08[i+1],X,LS);
> RCL[i+1,2]:=kINT:kintext(LS08[i+1],X,LS):
> RCL[i+1,3]:=kINTEXT:
> RCL[i+1,4]:=(X)minus(RCL[i+1,2])minus(RCL[i+1,3]):
> RCL[i+1,5]:=(RCL[i+1,4])union(RCL[i+1,2]):

>



> LIMPT(RCL[i+1,1],LS,NBR); RCL[i+1,6]:=SCLL: RCL[i+1,8]:=(RCL[i+1,1])intersect(SCLL): RCL[i+1,7]:=(RCL[i+1,5])
  minus(SCLL):
>
>  od:
>  Z:=(RCL[2,5],RCL[3,5],RCL[4,5],RCL[5,5]):k:=15:i=1: for i to k do if  (RCL[i+1,5])=(RCL[i+1,1]) then RCL[i+1,7]:= { }
  :fi; od;
> #print(` `);    print(`Clo(S) `=Z)   ;
> #print(`Lattice subsets, LS`=LS);   print(` `);print(` LS `=LS);
>  i:=1; k:=15;for i to k do if (RCL[i+1,6]) = { } and  (RCL[i+1,4])= { } then RCL[i+1,7]:=RCL[i+1,1].`Seg`; fi; od;    print(` `);

> print(`Is LS4:  a topology `=isTopo(X,LS),`      connected `= isConn(X,LS),`      Kolmogorov.T0`= isT0(X,LS),`     Hausdorff.
  T2`= isHd(X,LS));
>

>
> print(` `);
> print(RCL);

>

>  print(`The Closed-Open subsets of LS are `=CO(X,LS)); if nops({Z})< 4 then print(`Some singletons have the same closure
  and cannot be distinguished`);fi :         print(`The {1,2,3,4} array of CLOSURE elements is` =Z);

>
>
>  end proc:
```

```
> # *************************   Lattice Structure  3 points
> LAT3abc:=proc(GS,`title`,NBR)
>  local i,j,LS0,CLS,V,G,VG: global RCL,LS00,k,X,Pos,Z,Link,LS,CLosLS,LSCT;
> LS:=GS;                    print(` `):
> X:={a,b,c};
> LS0:={{ },{a},{b},{c},{a,b},{a,c},{b,c},{a,b,c}};
> interface(rtablesize=20);  Pos:=[0,0,0,0] ;  Link:=[0,0,0,0,0,0]:
>  k:=7;  RCL:=Matrix(8,8);
> RCL[1,1]:=`Subset S`:
> RCL[1,2]:=`Int(S)`:
> RCL[1,3]:=`Ext(S)`:
> RCL[1,4]:=`Bnd(S)`:
> RCL[1,5]:=`Clo(S)`: RCL[1,6]:=` Lim(S)`: RCL[1,7]:=`IsoClo(S)`: RCL[1,8]:=`IsoCar(S)`:

>  i:=1;for i to k do RCL[i+1,1]:=LS0[i+1]: od:
> i:=1;for i to k do kinterior(LS0[i+1],X,LS);
>  RCL[i+1,2]:=kINT:kintext(LS0[i+1],X,LS):
>   RCL[i+1,3]:=kINTEXT:
> RCL[i+1,4]:=(X)minus(RCL[i+1,2])minus(RCL[i+1,3]):
```

```
>      RCL[i+1,5]:=(RCL[i+1,4])union(RCL[i+1,2]):

>

> LIMPT(RCL[i+1,1],LS,NBR); RCL[i+1,6]:=SCLL:RCL[i+1,8]:=(RCL[i+1,1])intersect(SCLL);RCL[i+1,7]:=(RCL[i+1,5])
  minus(SCLL):
>
> od:
> Z:=(RCL[2,5],RCL[3,5],RCL[4,5]):k:=7:i=1: for i to k do if  (RCL[i+1,5])=(RCL[i+1,1]) then RCL[i+1,7]:= { }:fi; od;

> #print(` `);    print(`Clo(S) `=Z): print(` `);print(` LS `=LS);                                    #print(`Lattice subsets, LS`=
  LS);
> i:=1; k:=7;for i to k do if (RCL[i+1,6]) = { } and  (RCL[i+1,4])= { } then RCL[i+1,7]:=RCL[i+1,1].`Seg`; fi; od;   print(` `);

> print(`Is LS3     a topology `=isTopo(X,LS), `      connected `= isConn(X,LS),`      Kolmogorov.T0`= isT0(X,LS),`
  Hausdorff.T2`= isHd(X,LS));
> print(` `);print(RCL);print(`Closed-Open subsets of LS are `=CO(X,LS));
>
>
>  if nops({Z})< 3 then print(`Some singletons have the same closure and cannot be distinguished`);fi : print(`The {1,2,3,4}
  array of CLOSURE elements is` =Z);


>             end proc:
```

limit point test subroutine for each subset

```
> LIMPT:=proc(GS,LS,NBR) local i,LSCL,k,LS0,X;global SCLL,ZZ,LRCL;
> if NBR=3 then X:={a,b,c}; LS0:={{},{a},{b},{c},{a,b},{a,c},{b,c},{a,b,c}};   fi;
> if NBR=4 then X:={a,b,c,d};LS0:={{ },{a},{b},{c},{d},{a,b},{a,c},{a,d},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{a,c,d},{b,c,d},{a,b,c,d}};
    fi;
> if NBR=5 then X:={a,b,c,d,s}; LS0:={{},{a},{b},{c},{d},{s},{a,b},{a,c},{a,d},{a,s},{b,c},{b,d},{b,s},{c,d},{c,s},{d,s},{a,b,c},{a,b,
  d},{a,b,s},{a,c,d},{a,c,s},{a,d,s},{b,c,d},{b,c,s},{b,d,s},{c,d,s},{a,b,c,d},{a,b,c,s},{a,b,d,s},{a,c,d,s},{b,c,d,s},{a,b,c,d,s}};          fi;

> interface(rtablesize=20);LRCL:=Matrix(NBR+1,8):
>  LRCL[1,1]:=`Point p`:LRCL[1,2]:=`(GS-p)`:
> LRCL[1,3]:=`Int(GS-p)`:
> LRCL[1,4]:=`Ext(GS-p)`:
> LRCL[1,5]:=`Bnd(GS-p)`:
>  LRCL[1,6]:=`Clos(GS-p)`:LRCL[1,7]:=`Clos(GS-p)inter p`:  LRCL[1,8]:=`GS `;
> for i to nops(X) do LRCL[i+1,1]:={X[i]}: LRCL[i+1,2]:=(GS)minus(LRCL[i+1,1]):LRCL[i+1,8]:=(GS):od:

>   for i to nops(X) do kinterior(LRCL[i+1,2],X,LS);
>  LRCL[i+1,3]:=kINT:kintext(LRCL[i+1,2],X,LS):
>   LRCL[i+1,4]:=kINTEXT:
> LRCL[i+1,5]:=(X)minus(LRCL[i+1,3])minus(LRCL[i+1,4]):
>   LRCL[i+1,6]:=(LRCL[i+1,5])union(LRCL[i+1,3]):LRCL[i+1,7]:=(LRCL[i+1,6])intersect(LRCL[i+1,1]):od:

>
> if NBR=3 then SCLL:=(LRCL[2,7])union(LRCL[3,7])union(LRCL[4,7]):fi;
>  if NBR=4 then SCLL:=(LRCL[2,7])union(LRCL[3,7])union(LRCL[4,7])union(LRCL[5,7]):fi;

>  if NBR=5 then SCLL:=(LRCL[2,7])union(LRCL[3,7])union(LRCL[4,7])union(LRCL[5,7])union(LRCL[6,7]):fi;
> #print(LRCL);
```

```
> end proc:
```

The FiniteT0 (particle-like) class of topologies
and the Finite Not-T0 (wave-like) class of topologies
are suitable for measuring

Non-Equilibrium Thermodynamics

R. M. Kiehn 2009-2014
www.cartan.pair.com

Maple code download available on email request
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1. Examples of the 5 finite N=2 (T0) particle-like topologies embedded into N=3, {{},X} = {{ },{a,b,c}}.
Bnd(X) = { }

All Singleton closures are distinguishable.

```
> print(`    `);X:={a,b,c};LS2:={},{},{a},{b},{c},{a,b},{},{a,c},{b,c}; LS3:={LS2,X}; print(`LS3 = T0, particle-like topology, poset
  1`);LAT3abc(LS3,` N=3 Poset 1,  `,3);
```

$$X := \{a, b, c\}$$

$$LS2 := \{\ \}, \{\ \}, \{a\}, \{b\}, \{c\}, \{a, b\}, \{\ \}, \{a, c\}, \{b, c\}$$

$$LS3 := \{\{\ \}, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$$

LS3 = T0, particle-like topology, poset 1

` `

` `

Is LS3 a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = true

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{a\}$	$\{b, c\}$	$\{\ \}$	$\{a\}$	$\{\ \}$	$\{a\}.Seg$	$\{\ \}$
$\{b\}$	$\{b\}$	$\{a, c\}$	$\{\ \}$	$\{b\}$	$\{\ \}$	$\{b\}.Seg$	$\{\ \}$
$\{c\}$	$\{c\}$	$\{a, b\}$	$\{\ \}$	$\{c\}$	$\{\ \}$	$\{c\}.Seg$	$\{\ \}$
$\{a, b\}$	$\{a, b\}$	$\{c\}$	$\{\ \}$	$\{a, b\}$	$\{\ \}$	$\{a, b\}.Seg$	$\{\ \}$
$\{a, c\}$	$\{a, c\}$	$\{b\}$	$\{\ \}$	$\{a, c\}$	$\{\ \}$	$\{a, c\}.Seg$	$\{\ \}$
$\{b, c\}$	$\{b, c\}$	$\{a\}$	$\{\ \}$	$\{b, c\}$	$\{\ \}$	$\{b, c\}.Seg$	$\{\ \}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c\}$	$\{\ \}$	$\{a, b, c\}.Seg$	$\{\ \}$

Closed-Open subsets of LS are $= \{\{\ \}, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{b\}, \{c\})$ **(1)**

```
> print(`    `);X:={a,b,c};LS2:={},{},{b},{ },{c},{ },{},{a,b},{b,c}; LS3:={LS2,X};print(`LS3 = T0, particle-like topology, poset 2`);
  LAT3abc(LS3,` Poset 2 `,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\ \}, \{\ \}, \{b\}, \{\ \}, \{c\}, \{\ \}, \{\ \}, \{a, b\}, \{b, c\}$$

$$LS3 := \{\{\ \}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{a, b, c\}\}$$

LS3 = T0, particle-like topology, poset 2

` `

` `

Is LS3 a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\ \}$	$\{b, c\}$	$\{a\}$	$\{a\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{b\}$	$\{b\}$	$\{c\}$	$\{a\}$	$\{a, b\}$	$\{a\}$	$\{b\}$	$\{\ \}$
$\{c\}$	$\{c\}$	$\{a, b\}$	$\{\ \}$	$\{c\}$	$\{\ \}$	$\{c\}.Seg$	$\{\ \}$
$\{a, b\}$	$\{a, b\}$	$\{c\}$	$\{\ \}$	$\{a, b\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{a, c\}$	$\{c\}$	$\{b\}$	$\{a\}$	$\{a, c\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{b, c\}$	$\{b, c\}$	$\{\ \}$	$\{a\}$	$\{a, b, c\}$	$\{a\}$	$\{b, c\}$	$\{\ \}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c\}$	$\{a\}$	$\{\ \}$	$\{a\}$

Closed-Open subsets of LS are $= \{\{\ \}, \{c\}, \{a, b\}, \{a, b, c\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{c\})$ **(2)**

```
> print(`    `); X:={a,b,c};LS2:={},{},{b},{ },{c},{ },{},{a,b},{b,c}; LS3:={LS2,X};print(`LS3 = T0, particle-like topology, poset 2`)
;LAT3abc(LS3,` Poset 2, T0 `,3):   print(`This Lattice Structure appears to be a KURATOWSKI T0POLOGY \n with a limit point
operator that can be formulated interms of the exterior derivative, d,\n acting on exterior differential forms, A, F = dA, H = A^F.
Substitute {A,F,H} for the symbol set {a,b,c}.  \n Then a => A, a 1-form, b => F=dA, a 2-form with dF=0,  c => A^F = H, a 3-form.
\n Note that d(d(S)) => 0 but Bnd(Bnd(S)) =/=> 0.   d is an up operator: given A, F is determined as dA`):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\}, \{\}, \{b\}, \{\}, \{c\}, \{\}, \{\}, \{a, b\}, \{b, c\}$$

$$LS3 := \{\{\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{a, b, c\}\}$$

LS3 = T0, particle-like topology, poset 2

Is LS3 a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c}	{a}	{a}	{ }	{ }	{ }
{b}	{b}	{c}	{a}	{a, b}	{a}	{b}	{ }
{c}	{c}	{a, b}	{ }	{c}	{ }	{c}.Seg	{ }
{a, b}	{a, b}	{c}	{ }	{a, b}	{a}	{ }	{a}
{a, c}	{c}	{b}	{a}	{a, c}	{ }	{ }	{ }
{b, c}	{b, c}	{ }	{a}	{a, b, c}	{a}	{b, c}	{ }
{a, b, c}	{a, b, c}	{ }	{ }	{a, b, c}	{a}	{ }	{a}

Closed-Open subsets of LS are $= \{\{\}, \{c\}, \{a, b\}, \{a, b, c\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{c\})$

This Lattice Structure appears to be a KURATOWSKI T0POLOGY **(3)**

with a limit point operator that can be formulated interms of the exterior derivative, d,
acting on exterior differential forms, A, F = dA, H = A^F. Substitute {A,F,H} for the symbol set {a,b,c}.
Then a => A, a 1-form, b => F=dA, a 2-form with dF=0, c => A^F = H, a 3-form.
Note that d(d(S)) => 0 but Bnd(Bnd(S)) =/=> 0.   d is an up operator: given A, F is determined as dA

```
> print(`    `);X:={a,b,c};LS2:={},{},{a},{ },{c},{ },{},{ },{a,c}; LS3:={LS2,X};print(`LS3 = T0, particle-like topology, poset 3`);
  LAT3abc(LS3,` Poset 3, T0  `,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\ \}, \{\ \}, \{a\}, \{\ \}, \{c\}, \{\ \}, \{\ \}, \{\ \}, \{a, c\}$$

$$LS3 := \{\{\ \}, \{a\}, \{c\}, \{a, c\}, \{a, b, c\}\}$$

LS3 = T0, particle-like topology, poset 3

` `

` `

Is LS3 a topology = *true*, *connected* = *true*, *Kolmogorov.T0* = *true*, *Hausdorff.T2* = *false*

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{a\}$	$\{c\}$	$\{b\}$	$\{a, b\}$	$\{b\}$	$\{a\}$	$\{\ \}$
$\{b\}$	$\{\ \}$	$\{a, c\}$	$\{b\}$	$\{b\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{c\}$	$\{c\}$	$\{a\}$	$\{b\}$	$\{b, c\}$	$\{b\}$	$\{c\}$	$\{\ \}$
$\{a, b\}$	$\{a\}$	$\{c\}$	$\{b\}$	$\{a, b\}$	$\{b\}$	$\{\ \}$	$\{b\}$
$\{a, c\}$	$\{a, c\}$	$\{\ \}$	$\{b\}$	$\{a, b, c\}$	$\{b\}$	$\{a, c\}$	$\{\ \}$
$\{b, c\}$	$\{c\}$	$\{a\}$	$\{b\}$	$\{b, c\}$	$\{b\}$	$\{\ \}$	$\{b\}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c\}$	$\{b\}$	$\{\ \}$	$\{b\}$

Closed-Open subsets of LS are = $\{\{\ \}, \{a, b, c\}\}$

The {1,2,3,4} array of CLOSURE elements is = $(\{a, b\}, \{b\}, \{b, c\})$ **(4)**

```
> print(`    `);X:={a,b,c};LS2:={},{c},{a,c},{b,c}; LS3:={LS2,X};print(`LS3 = T0, particle-like topology, poset 4`);LAT3abc(LS3,`
  N=3 Poset 4, T2  `,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\}, \{c\}, \{a, c\}, \{b, c\}$$

$$LS3 := \{\{\}, \{c\}, \{a, c\}, \{b, c\}, \{a, b, c\}\}$$

LS3 = T0, particle-like topology, poset 4

` `

` `

Is LS3 a topology = true, *connected* = true, *Kolmogorov.T0* = true, *Hausdorff.T2* = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\}$	$\{b, c\}$	$\{a\}$	$\{a\}$	$\{\}$	$\{\}$	$\{\}$
$\{b\}$	$\{\}$	$\{a, c\}$	$\{b\}$	$\{b\}$	$\{\}$	$\{\}$	$\{\}$
$\{c\}$	$\{c\}$	$\{\}$	$\{a, b\}$	$\{a, b, c\}$	$\{a, b\}$	$\{c\}$	$\{\}$
$\{a, b\}$	$\{\}$	$\{c\}$	$\{a, b\}$	$\{a, b\}$	$\{\}$	$\{\}$	$\{\}$
$\{a, c\}$	$\{a, c\}$	$\{\}$	$\{b\}$	$\{a, b, c\}$	$\{a, b\}$	$\{c\}$	$\{a\}$
$\{b, c\}$	$\{b, c\}$	$\{\}$	$\{a\}$	$\{a, b, c\}$	$\{a, b\}$	$\{c\}$	$\{b\}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b\}$	$\{\}$	$\{a, b\}$

Closed-Open subsets of LS are = $\{\{\}, \{a, b, c\}\}$

The {1,2,3,4} array of CLOSURE elements is = $(\{a\}, \{b\}, \{a, b, c\})$ **(5)**

```
> print(`    `);X:={a,b,c};LS2:={},{a},{a,b},{ },{}; LS3:={LS2,X};print(`LS3 = T0, particle-like topology, poset 5`);LAT3abc(LS3,`
  N=3 Poset 5, T2  `,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\ \}, \{a\}, \{a, b\}, \{\ \}, \{\ \}$$

$$LS3 := \{\{\ \}, \{a\}, \{a, b\}, \{a, b, c\}\}$$

LS3 = T0, particle-like topology, poset 5

` `

` `

Is LS3 a topology = *true*, *connected* = *true*, *Kolmogorov.T0* = *true*, *Hausdorff.T2* = *false*

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{a\}$	$\{\ \}$	$\{b, c\}$	$\{a, b, c\}$	$\{b, c\}$	$\{a\}$	$\{\ \}$
$\{b\}$	$\{\ \}$	$\{a\}$	$\{b, c\}$	$\{b, c\}$	$\{c\}$	$\{b\}$	$\{\ \}$
$\{c\}$	$\{\ \}$	$\{a, b\}$	$\{c\}$	$\{c\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{a, b\}$	$\{a, b\}$	$\{\ \}$	$\{c\}$	$\{a, b, c\}$	$\{b, c\}$	$\{a\}$	$\{b\}$
$\{a, c\}$	$\{a\}$	$\{\ \}$	$\{b, c\}$	$\{a, b, c\}$	$\{b, c\}$	$\{a\}$	$\{c\}$
$\{b, c\}$	$\{\ \}$	$\{a\}$	$\{b, c\}$	$\{b, c\}$	$\{c\}$	$\{\ \}$	$\{c\}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c\}$	$\{b, c\}$	$\{\ \}$	$\{b, c\}$

Closed-Open subsets of LS are = $\{\{\ \}, \{a, b, c\}\}$

The {1,2,3,4} array of CLOSURE elements is = $(\{a, b, c\}, \{b, c\}, \{c\})$ **(6)**

2. Examples of the 4 finite N=2 (Not-T0) wave-like topologies embedded into N=3, {{ },X} = {{ },{a,b,c}}
Bnd(X) = { }

Some or All Singleton closures are indistinguishable.

```
> print(`  `);X:={a,b,c};LS2:={ }; LS3:={LS2,X};print(`LS3 = Not-T0, wave-like topology  1`) ;LAT3abc(LS3,` wave-like 1 `,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\ \}$$

$$LS3 := \{\{\ \}, \{a, b, c\}\}$$

LS3 = Not-T0, wave-like topology 1

Is LS3 a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c}	{a, b, c}	{b, c}	{a}	{ }
{b}	{ }	{ }	{a, b, c}	{a, b, c}	{a, c}	{b}	{ }
{c}	{ }	{ }	{a, b, c}	{a, b, c}	{a, b}	{c}	{ }
{a, b}	{ }	{ }	{a, b, c}	{a, b, c}	{a, b, c}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c}	{a, b, c}	{a, b, c}	{ }	{a, c}
{b, c}	{ }	{ }	{a, b, c}	{a, b, c}	{a, b, c}	{ }	{b, c}
{a, b, c}	{a, b, c}	{ }	{ }	{a, b, c}	{a, b, c}	{ }	{a, b, c}

Closed-Open subsets of LS are = {{ }, {a, b, c}}

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is = ({a, b, c}, {a, b, c}, {a, b, c}) **(7)**

```
> print(`    `);X:={a,b,c};LS2:={},{c},{}; LS3:={LS2,X};print(`LS3 = Not-T0, wave-like topology  2`);LAT3abc(LS3,` wave-like
  topology`,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\}, \{c\}, \{\}$$

$$LS3 := \{\{\}, \{c\}, \{a, b, c\}\}$$

LS3 = Not-T0, wave-like topology 2

` `

` `

Is LS3 a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\}$	$\{c\}$	$\{a, b\}$	$\{a, b\}$	$\{b\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{\}$	$\{c\}$	$\{a, b\}$	$\{a, b\}$	$\{a\}$	$\{b\}$	$\{\}$
$\{c\}$	$\{c\}$	$\{\}$	$\{a, b\}$	$\{a, b, c\}$	$\{a, b\}$	$\{c\}$	$\{\}$
$\{a, b\}$	$\{\}$	$\{c\}$	$\{a, b\}$	$\{a, b\}$	$\{a, b\}$	$\{\}$	$\{a, b\}$
$\{a, c\}$	$\{c\}$	$\{\}$	$\{a, b\}$	$\{a, b, c\}$	$\{a, b\}$	$\{c\}$	$\{a\}$
$\{b, c\}$	$\{c\}$	$\{\}$	$\{a, b\}$	$\{a, b, c\}$	$\{a, b\}$	$\{c\}$	$\{b\}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b\}$	$\{\}$	$\{a, b\}$

Closed-Open subsets of LS are $= \{\{\}, \{a, b, c\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b\}, \{a, b\}, \{a, b, c\})$

(8)

```
> print(`    `);X:={a,b,c};LS2:={},{a,b},{}; LS3:={LS2,X};print(`LS3 = Not-T0, wave-like topology 3`);LAT3abc(LS3,` wave-like
  topology`,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\}, \{a, b\}, \{\}$$

$$LS3 := \{\{\}, \{a, b\}, \{a, b, c\}\}$$

LS3 = Not-T0, wave-like topology 3

Is LS3 a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{b, c\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{a, c\}$	$\{b\}$	$\{\}$
$\{c\}$	$\{\}$	$\{a, b\}$	$\{c\}$	$\{c\}$	$\{\}$	$\{\}$	$\{\}$
$\{a, b\}$	$\{a, b\}$	$\{\}$	$\{c\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{\}$	$\{a, b\}$
$\{a, c\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{b, c\}$	$\{a\}$	$\{c\}$
$\{b, c\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{a, c\}$	$\{b\}$	$\{c\}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{\}$	$\{a, b, c\}$

Closed-Open subsets of LS are $= \{\{\}, \{a, b, c\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c\}, \{a, b, c\}, \{c\})$ **(9)**

```
> print(`    `);X:={a,b,c};LS2:={},{c},{a,b},{}; LS3:={LS2,X};print(`LS3 = Not-T0, wave-like topology 4`);LAT3abc(LS3,` wave-like topology`,3):
```

$$X := \{a, b, c\}$$

$$LS2 := \{\}, \{c\}, \{a, b\}, \{\}$$

$$LS3 := \{\{\}, \{c\}, \{a, b\}, \{a, b, c\}\}$$

LS3 = Not-T0, wave-like topology 4

` `

` `

Is LS3 a topology = *true*, *connected* = *false*, *Kolmogorov.T0* = *false*, *Hausdorff.T2* = *false*

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\}$	$\{c\}$	$\{a, b\}$	$\{a, b\}$	$\{b\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{\}$	$\{c\}$	$\{a, b\}$	$\{a, b\}$	$\{a\}$	$\{b\}$	$\{\}$
$\{c\}$	$\{c\}$	$\{a, b\}$	$\{\}$	$\{c\}$	$\{\}$	$\{c\}.Seg$	$\{\}$
$\{a, b\}$	$\{a, b\}$	$\{c\}$	$\{\}$	$\{a, b\}$	$\{a, b\}$	$\{\}$	$\{a, b\}$
$\{a, c\}$	$\{c\}$	$\{\}$	$\{a, b\}$	$\{a, b, c\}$	$\{b\}$	$\{a, c\}$	$\{\}$
$\{b, c\}$	$\{c\}$	$\{\}$	$\{a, b\}$	$\{a, b, c\}$	$\{a\}$	$\{b, c\}$	$\{\}$
$\{a, b, c\}$	$\{a, b, c\}$	$\{\}$	$\{\}$	$\{a, b, c\}$	$\{a, b\}$	$\{\}$	$\{a, b\}$

Closed-Open subsets of LS are = $\{\{\}, \{c\}, \{a, b\}, \{a, b, c\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is = $(\{a, b\}, \{a, b\}, \{c\})$ **(10)**

3. Examples of the 16 (T0) particle-like topologies embedded into N=4 {{ },X} = {{ },{a,b,c,d}} Bnd(X) = { }

```
> print(`    `);X:={a,b,c,d}; LS3:={},{a},{b},{c},{d},{a,b},{a,c},{a,d},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{a,c,d},{b,c,d}; LS4:={LS3,
  X};print(`LS4 is a T0 particle-like topology, poset 1 `);LAT4abcd(LS4,`    `,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\ \}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0 particle-like topology, poset 1

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = true

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b, c, d}	{ }	{a}	{ }	{a}.Seg	{ }
{b}	{b}	{a, c, d}	{ }	{b}	{ }	{b}.Seg	{ }
{c}	{c}	{a, b, d}	{ }	{c}	{ }	{c}.Seg	{ }
{d}	{d}	{a, b, c}	{ }	{d}	{ }	{d}.Seg	{ }
{a, b}	{a, b}	{c, d}	{ }	{a, b}	{ }	{a, b}.Seg	{ }
{a, c}	{a, c}	{b, d}	{ }	{a, c}	{ }	{a, c}.Seg	{ }
{a, d}	{a, d}	{b, c}	{ }	{a, d}	{ }	{a, d}.Seg	{ }
{b, c}	{b, c}	{a, d}	{ }	{b, c}	{ }	{b, c}.Seg	{ }
{b, d}	{b, d}	{a, c}	{ }	{b, d}	{ }	{b, d}.Seg	{ }
{c, d}	{c, d}	{a, b}	{ }	{c, d}	{ }	{c, d}.Seg	{ }
{a, b, c}	{a, b, c}	{d}	{ }	{a, b, c}	{ }	{a, b, c}.Seg	{ }
{a, b, d}	{a, b, d}	{c}	{ }	{a, b, d}	{ }	{a, b, d}.Seg	{ }
{a, c, d}	{a, c, d}	{b}	{ }	{a, c, d}	{ }	{a, c, d}.Seg	{ }
{b, c, d}	{b, c, d}	{a}	{ }	{b, c, d}	{ }	{b, c, d}.Seg	{ }
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{ }	{a, b, c, d}.Seg	{ }

The Closed-Open subsets of LS are $= \{\{\ \}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{b\}, \{c\}, \{d\})$ **(11)**

```
> print(`    `);X:={a,b,c,d}; LS3:={},{b},{c},{d},{a,b},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{b,c,d}; LS4:={LS3,X};print(`LS4 = T0
  particle-like topology, poset 2 `);LAT4abcd(LS4,`Poset 2 `,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{b, c, d\}$$

$$LS4 := \{\{\ \}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 = T0 particle-like topology, poset 2

` `

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{b}	{c, d}	{a}	{a, b}	{a}	{b}	{ }
{c}	{c}	{a, b, d}	{ }	{c}	{ }	{c}.Seg	{ }
{d}	{d}	{a, b, c}	{ }	{d}	{ }	{d}.Seg	{ }
{a, b}	{a, b}	{c, d}	{ }	{a, b}	{a}	{ }	{a}
{a, c}	{c}	{b, d}	{a}	{a, c}	{ }	{ }	{ }
{a, d}	{d}	{b, c}	{a}	{a, d}	{ }	{ }	{ }
{b, c}	{b, c}	{d}	{a}	{a, b, c}	{a}	{b, c}	{ }
{b, d}	{b, d}	{c}	{a}	{a, b, d}	{a}	{b, d}	{ }
{c, d}	{c, d}	{a, b}	{ }	{c, d}	{ }	{c, d}.Seg	{ }
{a, b, c}	{a, b, c}	{d}	{ }	{a, b, c}	{a}	{ }	{a}
{a, b, d}	{a, b, d}	{c}	{ }	{a, b, d}	{a}	{ }	{a}
{a, c, d}	{c, d}	{b}	{a}	{a, c, d}	{ }	{ }	{ }
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a}	{b, c, d}	{ }
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a}	{ }	{a}

The Closed-Open subsets of LS are $= \{\{\ \}, \{c\}, \{d\}, \{a, b\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{c\}, \{d\})$ **(12)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{c},{a,b},{a,c},{c,d},{a,b,c},{a,c,d};LS4:={LS3,X};print(`LS4 = T0 particle-like topology, poset 3 `);LAT4abcd(LS4,`LS =  N`,4);print(`This Lattice Structure appears to be a KURATOWSKI T0POLOGY \n with a limit point operator that can be formulated interms of the exterior derivative, d,\n acting on exterior differential forms, A, F = dA, H = A^F, K = F^F. Substitute {A,F,H,K} for the symbol set {a,b,c,d}.  \n Then a => A, a 1-form, b => F=dA, a 2-form with dF=0,  c => A^F = H, a 3-form,   F^F, a 4-form. \n Note that d(d(S)) => 0 but Bnd(Bnd(S)) =/=> 0.   d is an up operator: given A, F is determined as dA`);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{c\}, \{a, b\}, \{a, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a\}, \{c\}, \{a, b\}, \{a, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 = T0 particle-like topology, poset 3

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c, d}	{b}	{a, b}	{b}	{a}	{ }
{b}	{ }	{a, c, d}	{b}	{b}	{ }	{ }	{ }
{c}	{c}	{a, b}	{d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{a, b}	{c, d}	{ }	{a, b}	{b}	{ }	{b}
{a, c}	{a, c}	{ }	{b, d}	{a, b, c, d}	{b, d}	{a, c}	{ }
{a, d}	{a}	{c}	{b, d}	{a, b, d}	{b}	{a, d}	{ }
{b, c}	{c}	{a}	{b, d}	{b, c, d}	{d}	{b, c}	{ }
{b, d}	{ }	{a, c}	{b, d}	{b, d}	{ }	{ }	{ }
{c, d}	{c, d}	{a, b}	{ }	{c, d}	{d}	{ }	{d}
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{b, d}	{a, c}	{b}
{a, b, d}	{a, b}	{c}	{d}	{a, b, d}	{b}	{ }	{b}
{a, c, d}	{a, c, d}	{ }	{b}	{a, b, c, d}	{b, d}	{a, c}	{d}
{b, c, d}	{c, d}	{a}	{b}	{b, c, d}	{d}	{ }	{d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, d}	{ }	{b, d}

The Closed-Open subsets of LS are = {{ }, {a, b}, {c, d}, {a, b, c, d}}

The {1,2,3,4} array of CLOSURE elements is = ({a, b}, {b}, {c, d}, {d})

This Lattice Structure appears to be a KURATOWSKI T0POLOGY **(13)**

with a limit point operator that can be formulated interms of the exterior derivative, d,
acting on exterior differential forms, A, F = dA, H = A^F, K = F^F. Substitute {A,F,H,K} for the symbol set {a,b,c,d}.
Then a => A, a 1-form, b => F=dA, a 2-form with dF=0, c => A^F = H, a 3-form,   F^F, a 4-form.
Note that d(d(S)) => 0 but Bnd(Bnd(S)) =/=> 0.   d is an up operator: given A, F is determined as dA

> **print(` `);X:={a,b,c,d};LS3:={},{c},{d},{a,c},{b,c},{c,d},{a,b,c},{a,c,d},{b,c,d};LS4:={LS3,X};**print(`LS4 is a T0 particle-like topology, poset **4.`);LAT4abcd(LS4,`N.`,4);**

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{c\}, \{d\}, \{a, c\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\}, \{c\}, \{d\}, \{a, c\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0 particle-like topology, poset 4.

` `

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{ }	{a, c, d}	{b}	{b}	{ }	{ }	{ }
{c}	{c}	{d}	{a, b}	{a, b, c}	{a, b}	{c}	{ }
{d}	{d}	{a, b, c}	{ }	{d}	{ }	{d}.Seg	{ }
{a, b}	{ }	{c, d}	{a, b}	{a, b}	{ }	{ }	{ }
{a, c}	{a, c}	{d}	{b}	{a, b, c}	{a, b}	{c}	{a}
{a, d}	{d}	{b, c}	{a}	{a, d}	{ }	{ }	{ }
{b, c}	{b, c}	{d}	{a}	{a, b, c}	{a, b}	{c}	{b}
{b, d}	{d}	{a, c}	{b}	{b, d}	{ }	{ }	{ }
{c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b}	{c, d}	{ }
{a, b, c}	{a, b, c}	{d}	{ }	{a, b, c}	{a, b}	{ }	{a, b}
{a, b, d}	{d}	{c}	{a, b}	{a, b, d}	{ }	{ }	{ }
{a, c, d}	{a, c, d}	{ }	{b}	{a, b, c, d}	{a, b}	{c, d}	{a}
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a, b}	{c, d}	{b}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b}	{ }	{a, b}

The Closed-Open subsets of LS are $= \{\{\}, \{d\}, \{a, b, c\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{b\}, \{a, b, c\}, \{d\})$ **(14)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{c},{d},{a,c},{a,d},{c,d},{a,b,c},{a,c,d};LS4:={LS3,X};print(`LS4 is a  T0 particle-like
  topology, poset 5 `);LAT4abcd(LS4,` N`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{c\}, \{d\}, \{a, c\}, \{a, d\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a\}, \{c\}, \{d\}, \{a, c\}, \{a, d\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0 particle-like topology, poset 5

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c, d}	{b}	{a, b}	{b}	{a}	{ }
{b}	{ }	{a, c, d}	{b}	{b}	{ }	{ }	{ }
{c}	{c}	{a, d}	{b}	{b, c}	{b}	{c}	{ }
{d}	{d}	{a, b, c}	{ }	{d}	{ }	{d}.Seg	{ }
{a, b}	{a}	{c, d}	{b}	{a, b}	{b}	{ }	{b}
{a, c}	{a, c}	{d}	{b}	{a, b, c}	{b}	{a, c}	{ }
{a, d}	{a, d}	{c}	{b}	{a, b, d}	{b}	{a, d}	{ }
{b, c}	{c}	{a, d}	{b}	{b, c}	{b}	{ }	{b}
{b, d}	{d}	{a, c}	{b}	{b, d}	{ }	{ }	{ }
{c, d}	{c, d}	{a}	{b}	{b, c, d}	{b}	{c, d}	{ }
{a, b, c}	{a, b, c}	{d}	{ }	{a, b, c}	{b}	{ }	{b}
{a, b, d}	{a, d}	{c}	{b}	{a, b, d}	{b}	{ }	{b}
{a, c, d}	{a, c, d}	{ }	{b}	{a, b, c, d}	{b}	{a, c, d}	{ }
{b, c, d}	{c, d}	{a}	{b}	{b, c, d}	{b}	{ }	{b}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b}	{ }	{b}

The Closed-Open subsets of LS are $= \{\{\}, \{d\}, \{a, b, c\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b\}, \{b\}, \{b, c\}, \{d\})$

(15)

```
> print(`  `);X:={a,b,c,d};LS3:={},{},{c},{d},{b,c},{c,d},{a,b,c},{b,c,d};LS4:={LS3,X};print(`LS4 is a T0, particle-like topology,
  poset 6 `);LAT4abcd(LS4,`  N`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{\}, \{c\}, \{d\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{b, c, d\}$$

$$LS4 := \{\{\}, \{c\}, \{d\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 6

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{b}	{ }
{c}	{c}	{d}	{a, b}	{a, b, c}	{a, b}	{c}	{ }
{d}	{d}	{a, b, c}	{ }	{d}	{ }	{d}.Seg	{ }
{a, b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{ }	{a}
{a, c}	{c}	{d}	{a, b}	{a, b, c}	{a, b}	{c}	{a}
{a, d}	{d}	{b, c}	{a}	{a, d}	{ }	{ }	{ }
{b, c}	{b, c}	{d}	{a}	{a, b, c}	{a, b}	{c}	{b}
{b, d}	{d}	{c}	{a, b}	{a, b, d}	{a}	{b, d}	{ }
{c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b}	{c, d}	{ }
{a, b, c}	{a, b, c}	{d}	{ }	{a, b, c}	{a, b}	{ }	{a, b}
{a, b, d}	{d}	{c}	{a, b}	{a, b, d}	{a}	{ }	{a}
{a, c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b}	{c, d}	{a}
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a, b}	{c, d}	{b}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b}	{ }	{a, b}

The Closed-Open subsets of LS are $= \{\{\}, \{d\}, \{a, b, c\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{a, b, c\}, \{d\})$

(16)

```
> print(`  `);X:={a,b,c,d};LS3:={},{},{c},{d},{a,d},{c,d},{a,c,d},{b,c,d};LS4:={LS3,X};print(` LS4 is a T0, particle-like topology,
  poset 7, `);LAT4abcd(LS,` N `,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{\}, \{c\}, \{d\}, \{a, d\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\}, \{c\}, \{d\}, \{a, d\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 7,

` `

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{b}	{ }
{c}	{c}	{d}	{a, b}	{a, b, c}	{a, b}	{c}	{ }
{d}	{d}	{a, b, c}	{ }	{d}	{ }	{d}.Seg	{ }
{a, b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{ }	{a}
{a, c}	{c}	{d}	{a, b}	{a, b, c}	{a, b}	{c}	{a}
{a, d}	{d}	{b, c}	{a}	{a, d}	{ }	{ }	{ }
{b, c}	{b, c}	{d}	{a}	{a, b, c}	{a, b}	{c}	{b}
{b, d}	{d}	{c}	{a, b}	{a, b, d}	{a}	{b, d}	{ }
{c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b}	{c, d}	{ }
{a, b, c}	{a, b, c}	{d}	{ }	{a, b, c}	{a, b}	{ }	{a, b}
{a, b, d}	{d}	{c}	{a, b}	{a, b, d}	{a}	{ }	{a}
{a, c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b}	{c, d}	{a}
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a, b}	{c, d}	{b}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b}	{ }	{a, b}

The Closed-Open subsets of LS are $= \{\{\}, \{d\}, \{a, b, c\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{a, b, c\}, \{d\})$ **(17)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{},{b},{d},{b,d},{a,b,d},{b,c,d};LS4:={LS3,X};print(` LS4 is a T0, particle-like  topology,
  poset 8.  `);LAT4abcd(LS4,` N`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{\}, \{b\}, \{d\}, \{b, d\}, \{a, b, d\}, \{b, c, d\}$$

$$LS4 := \{\{\}, \{b\}, \{d\}, \{b, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 8.

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{b}	{d}	{a, c}	{a, b, c}	{a, c}	{b}	{ }
{c}	{ }	{a, b, d}	{c}	{c}	{ }	{ }	{ }
{d}	{d}	{b}	{a, c}	{a, c, d}	{a, c}	{d}	{ }
{a, b}	{b}	{d}	{a, c}	{a, b, c}	{a, c}	{b}	{a}
{a, c}	{ }	{b, d}	{a, c}	{a, c}	{ }	{ }	{ }
{a, d}	{d}	{b}	{a, c}	{a, c, d}	{a, c}	{d}	{a}
{b, c}	{b}	{d}	{a, c}	{a, b, c}	{a, c}	{b}	{c}
{b, d}	{b, d}	{ }	{a, c}	{a, b, c, d}	{a, c}	{b, d}	{ }
{c, d}	{d}	{b}	{a, c}	{a, c, d}	{a, c}	{d}	{c}
{a, b, c}	{b}	{d}	{a, c}	{a, b, c}	{a, c}	{ }	{a, c}
{a, b, d}	{a, b, d}	{ }	{c}	{a, b, c, d}	{a, c}	{b, d}	{a}
{a, c, d}	{d}	{b}	{a, c}	{a, c, d}	{a, c}	{ }	{a, c}
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a, c}	{b, d}	{c}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, c}	{ }	{a, c}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b, c\}, \{c\}, \{a, c, d\})$ **(18)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{c},{},{a,c},{},{a,b,c};LS4:={LS3,X};print(` LS4 is a T0, particle-like topology, poset 9. `)
  ;LAT4abcd(LS4,` N`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{c\}, \{\}, \{a, c\}, \{\}, \{a, b, c\}$$

$$LS4 := \{\{\}, \{a\}, \{c\}, \{a, c\}, \{a, b, c\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 9.

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c}	{b, d}	{a, b, d}	{b, d}	{a}	{ }
{b}	{ }	{a, c}	{b, d}	{b, d}	{d}	{b}	{ }
{c}	{c}	{a}	{b, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{a}	{c}	{b, d}	{a, b, d}	{b, d}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d}	{a, b, c, d}	{b, d}	{a, c}	{ }
{a, d}	{a}	{c}	{b, d}	{a, b, d}	{b, d}	{a}	{d}
{b, c}	{c}	{a}	{b, d}	{b, c, d}	{b, d}	{c}	{b}
{b, d}	{ }	{a, c}	{b, d}	{b, d}	{d}	{ }	{d}
{c, d}	{c}	{a}	{b, d}	{b, c, d}	{b, d}	{c}	{d}
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{b, d}	{a, c}	{b}
{a, b, d}	{a}	{c}	{b, d}	{a, b, d}	{b, d}	{ }	{b, d}
{a, c, d}	{a, c}	{ }	{b, d}	{a, b, c, d}	{b, d}	{a, c}	{d}
{b, c, d}	{c}	{a}	{b, d}	{b, c, d}	{b, d}	{ }	{b, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, d}	{ }	{b, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, d\}, \{b, d\}, \{b, c, d\}, \{d\})$ **(19)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{a,c},{a,b,c},{a,c,d};LS4:={LS3,X};print(` LS4 is a T0, particle-like topology, poset 10 `);
  LAT4abcd(LS4,`N `,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{a, c\}, \{a, b, c\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a\}, \{a, c\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 10

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{a, c, d}	{b}	{b}	{ }	{ }	{ }
{c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{b}
{b, d}	{ }	{a, c}	{b, d}	{b, d}	{ }	{ }	{ }
{c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{d}
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{b, c, d}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, d}
{a, c, d}	{a, c, d}	{ }	{b}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{ }	{b, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, c, d}	{ }	{b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{b\}, \{b, c, d\}, \{d\})$ **(20)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{d},{b,d},{c,d},{b,c,d};LS4:={LS3,X};print(`LS4 is a T0, particle-like topology, poset 11. `);
  LAT4abcd(LS4,`N `,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{d\}, \{b, d\}, \{c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\}, \{d\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 11.

` `

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{b}	{ }
{c}	{ }	{b, d}	{a, c}	{a, c}	{a}	{c}	{ }
{d}	{d}	{ }	{a, b, c}	{a, b, c, d}	{a, b, c}	{d}	{ }
{a, b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{ }	{a}
{a, c}	{ }	{b, d}	{a, c}	{a, c}	{a}	{ }	{a}
{a, d}	{d}	{ }	{a, b, c}	{a, b, c, d}	{a, b, c}	{d}	{a}
{b, c}	{ }	{d}	{a, b, c}	{a, b, c}	{a}	{b, c}	{ }
{b, d}	{b, d}	{ }	{a, c}	{a, b, c, d}	{a, b, c}	{d}	{b}
{c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b, c}	{d}	{c}
{a, b, c}	{ }	{d}	{a, b, c}	{a, b, c}	{a}	{ }	{a}
{a, b, d}	{b, d}	{ }	{a, c}	{a, b, c, d}	{a, b, c}	{d}	{a, b}
{a, c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b, c}	{d}	{a, c}
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a, b, c}	{d}	{b, c}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c}	{ }	{a, b, c}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{a, c\}, \{a, b, c, d\})$ **(21)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{b},{d},{},{a,b},{b,d},{},{a,b,d};LS4:={LS3,X};print(` LS4 is a T0, particle-like topology,
  poset 12.`);LAT4abcd(LS4,`N`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{b\}, \{d\}, \{\}, \{a, b\}, \{b, d\}, \{\}, \{a, b, d\}$$

$$LS4 := \{\{\}, \{b\}, \{d\}, \{a, b\}, \{b, d\}, \{a, b, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 12.

` `

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, d}	{a, c}	{a, c}	{c}	{a}	{ }
{b}	{b}	{d}	{a, c}	{a, b, c}	{a, c}	{b}	{ }
{c}	{ }	{a, b, d}	{c}	{c}	{ }	{ }	{ }
{d}	{d}	{a, b}	{c}	{c, d}	{c}	{d}	{ }
{a, b}	{a, b}	{d}	{c}	{a, b, c}	{a, c}	{b}	{a}
{a, c}	{ }	{b, d}	{a, c}	{a, c}	{c}	{ }	{c}
{a, d}	{d}	{b}	{a, c}	{a, c, d}	{c}	{a, d}	{ }
{b, c}	{b}	{d}	{a, c}	{a, b, c}	{a, c}	{b}	{c}
{b, d}	{b, d}	{ }	{a, c}	{a, b, c, d}	{a, c}	{b, d}	{ }
{c, d}	{d}	{a, b}	{c}	{c, d}	{c}	{ }	{c}
{a, b, c}	{a, b}	{d}	{c}	{a, b, c}	{a, c}	{ }	{a, c}
{a, b, d}	{a, b, d}	{ }	{c}	{a, b, c, d}	{a, c}	{b, d}	{a}
{a, c, d}	{d}	{b}	{a, c}	{a, c, d}	{c}	{ }	{c}
{b, c, d}	{b, d}	{ }	{a, c}	{a, b, c, d}	{a, c}	{b, d}	{c}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, c}	{ }	{a, c}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a, c\}, \{a, b, c\}, \{c\}, \{c, d\})$ **(22)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{d},{},{ },{b,d},{c,d},{},{},{a,b,d},{b,c,d};LS4:={LS3,X};print(` LS4 is a T0, particle-like
  topology, poset 13. `) ;LAT4abcd(LS4,` N`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{d\}, \{\ \}, \{\ \}, \{b, d\}, \{c, d\}, \{\ \}, \{\ \}, \{a, b, d\}, \{b, c, d\}$$

$$LS4 := \{\{\ \}, \{d\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 13.

` `

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\ \}$	$\{b, c, d\}$	$\{a\}$	$\{a\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{b\}$	$\{\ \}$	$\{c, d\}$	$\{a, b\}$	$\{a, b\}$	$\{a\}$	$\{b\}$	$\{\ \}$
$\{c\}$	$\{\ \}$	$\{a, b, d\}$	$\{c\}$	$\{c\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{d\}$	$\{d\}$	$\{\ \}$	$\{a, b, c\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{\ \}$
$\{a, b\}$	$\{\ \}$	$\{c, d\}$	$\{a, b\}$	$\{a, b\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{a, c\}$	$\{\ \}$	$\{b, d\}$	$\{a, c\}$	$\{a, c\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{a, d\}$	$\{d\}$	$\{\ \}$	$\{a, b, c\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{a\}$
$\{b, c\}$	$\{\ \}$	$\{d\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{a\}$	$\{b, c\}$	$\{\ \}$
$\{b, d\}$	$\{b, d\}$	$\{\ \}$	$\{a, c\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{b\}$
$\{c, d\}$	$\{c, d\}$	$\{\ \}$	$\{a, b\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{c\}$
$\{a, b, c\}$	$\{\ \}$	$\{d\}$	$\{a, b, c\}$	$\{a, b, c\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{a, b, d\}$	$\{a, b, d\}$	$\{\ \}$	$\{c\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{a, b\}$
$\{a, c, d\}$	$\{c, d\}$	$\{\ \}$	$\{a, b\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{a, c\}$
$\{b, c, d\}$	$\{b, c, d\}$	$\{\ \}$	$\{a\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{b, c\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{\ \}$	$\{a, b, c\}$

The Closed-Open subsets of LS are $= \{\{\ \}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{c\}, \{a, b, c, d\})$ **(23)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{},{d},{a,d},{b,d},{c,d},{a,b,d},{a,c,d},{b,c,d};LS4:={LS3,X};print(` LS4 is a T0, particle-like
  topology, poset 14 `);LAT4abcd(LS4,` N `,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{\}, \{d\}, \{a, d\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\}, \{d\}, \{a, d\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 14

`  `

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

`  `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{ }	{a, c, d}	{b}	{b}	{ }	{ }	{ }
{c}	{ }	{a, b, d}	{c}	{c}	{ }	{ }	{ }
{d}	{d}	{ }	{a, b, c}	{a, b, c, d}	{a, b, c}	{d}	{ }
{a, b}	{ }	{c, d}	{a, b}	{a, b}	{ }	{ }	{ }
{a, c}	{ }	{b, d}	{a, c}	{a, c}	{ }	{ }	{ }
{a, d}	{a, d}	{ }	{b, c}	{a, b, c, d}	{a, b, c}	{d}	{a}
{b, c}	{ }	{a, d}	{b, c}	{b, c}	{ }	{ }	{ }
{b, d}	{b, d}	{ }	{a, c}	{a, b, c, d}	{a, b, c}	{d}	{b}
{c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b, c}	{d}	{c}
{a, b, c}	{ }	{d}	{a, b, c}	{a, b, c}	{ }	{ }	{ }
{a, b, d}	{a, b, d}	{ }	{c}	{a, b, c, d}	{a, b, c}	{d}	{a, b}
{a, c, d}	{a, c, d}	{ }	{b}	{a, b, c, d}	{a, b, c}	{d}	{a, c}
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a, b, c}	{d}	{b, c}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c}	{ }	{a, b, c}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{b\}, \{c\}, \{a, b, c, d\})$ **(24)**

```
> print(` `);X:={a,b,c,d};LS3:={},{b},{c},{d},{b,c},{b,d},{c,d},{b,c,d};LS4:={LS3,X};print(` LS4 is a  T0, particle-like
  topology, poset 15. `);LAT4abcd(LS4,` N `,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{b\}, \{c\}, \{d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\ \}, \{b\}, \{c\}, \{d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a T0, particle-like topology, poset 15.

` `

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\ \}$	$\{b, c, d\}$	$\{a\}$	$\{a\}$	$\{\ \}$	$\{\ \}$	$\{\ \}$
$\{b\}$	$\{b\}$	$\{c, d\}$	$\{a\}$	$\{a, b\}$	$\{a\}$	$\{b\}$	$\{\ \}$
$\{c\}$	$\{c\}$	$\{b, d\}$	$\{a\}$	$\{a, c\}$	$\{a\}$	$\{c\}$	$\{\ \}$
$\{d\}$	$\{d\}$	$\{b, c\}$	$\{a\}$	$\{a, d\}$	$\{a\}$	$\{d\}$	$\{\ \}$
$\{a, b\}$	$\{b\}$	$\{c, d\}$	$\{a\}$	$\{a, b\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{a, c\}$	$\{c\}$	$\{b, d\}$	$\{a\}$	$\{a, c\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{a, d\}$	$\{d\}$	$\{b, c\}$	$\{a\}$	$\{a, d\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{b, c\}$	$\{b, c\}$	$\{d\}$	$\{a\}$	$\{a, b, c\}$	$\{a\}$	$\{b, c\}$	$\{\ \}$
$\{b, d\}$	$\{b, d\}$	$\{c\}$	$\{a\}$	$\{a, b, d\}$	$\{a\}$	$\{b, d\}$	$\{\ \}$
$\{c, d\}$	$\{c, d\}$	$\{b\}$	$\{a\}$	$\{a, c, d\}$	$\{a\}$	$\{c, d\}$	$\{\ \}$
$\{a, b, c\}$	$\{b, c\}$	$\{d\}$	$\{a\}$	$\{a, b, c\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{a, b, d\}$	$\{b, d\}$	$\{c\}$	$\{a\}$	$\{a, b, d\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{a, c, d\}$	$\{c, d\}$	$\{b\}$	$\{a\}$	$\{a, c, d\}$	$\{a\}$	$\{\ \}$	$\{a\}$
$\{b, c, d\}$	$\{b, c, d\}$	$\{\ \}$	$\{a\}$	$\{a, b, c, d\}$	$\{a\}$	$\{b, c, d\}$	$\{\ \}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a\}$	$\{\ \}$	$\{a\}$

The Closed-Open subsets of LS are $= \{\{\ \}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{a, c\}, \{a, d\})$ **(25)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{},{},{d},{c,d},{b,c,d};LS4:={LS3,X};print(` LS4 = T0, particle-like topology, poset 16.`);
  LAT4abcd(LS4,` N`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{\ \}, \{\ \}, \{d\}, \{c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\ \}, \{d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 = T0, particle-like topology, poset 16.

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a}	{a}	{ }	{ }	{ }
{b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{b}	{ }
{c}	{ }	{d}	{a, b, c}	{a, b, c}	{a, b}	{c}	{ }
{d}	{d}	{ }	{a, b, c}	{a, b, c, d}	{a, b, c}	{d}	{ }
{a, b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{ }	{a}
{a, c}	{ }	{d}	{a, b, c}	{a, b, c}	{a, b}	{c}	{a}
{a, d}	{d}	{ }	{a, b, c}	{a, b, c, d}	{a, b, c}	{d}	{a}
{b, c}	{ }	{d}	{a, b, c}	{a, b, c}	{a, b}	{c}	{b}
{b, d}	{d}	{ }	{a, b, c}	{a, b, c, d}	{a, b, c}	{d}	{b}
{c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b, c}	{d}	{c}
{a, b, c}	{ }	{d}	{a, b, c}	{a, b, c}	{a, b}	{ }	{a, b}
{a, b, d}	{d}	{ }	{a, b, c}	{a, b, c, d}	{a, b, c}	{d}	{a, b}
{a, c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, b, c}	{d}	{a, c}
{b, c, d}	{b, c, d}	{ }	{a}	{a, b, c, d}	{a, b, c}	{d}	{b, c}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c}	{ }	{a, b, c}

The Closed-Open subsets of LS are $= \{\{\ \}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d\})$ **(26)**

4. Examples of the 17 Not-T0 wave-like topologies, embedded in {{ }, X} = {{ }, {a,b,c,d}}. X = {a,b,c,d}

Some or All Singleton closures are not distinguishable.
Some indisinguishable subsets and their boundaries can be dense.

> **print(` `);X:={a,b,c,d};LS3:={};LS4:={LS3,X};print(` LS4** is a **Not-T0, wave-like Indiscrete topology. All subsets are indistinguishable. Ex 1 `); LAT4abcd(LS4,`Not T0` ,4);**

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}$$

$$LS4 := \{\{\ \}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like Indiscrete topology. All subsets are indistinguishable. Ex 1

` `

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{\ \}$
$\{b\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, c, d\}$	$\{b\}$	$\{\ \}$
$\{c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, d\}$	$\{c\}$	$\{\ \}$
$\{d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{\ \}$
$\{a, b\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{a, b\}$
$\{a, c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{a, c\}$
$\{a, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{a, d\}$
$\{b, c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{b, c\}$
$\{b, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{b, d\}$
$\{c, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{c, d\}$
$\{a, b, c\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{a, b, c\}$
$\{a, b, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{a, b, d\}$
$\{a, c, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{a, c, d\}$
$\{b, c, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{b, c, d\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{a, b, c, d\}$

The Closed-Open subsets of LS are $= \{\{\ \}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{a, b, c, d\}, \{a, b, c, d\}, \{a, b, c, d\})$ **(27)**

```
> print(` `);X:={a,b,c,d};LS3:={},{a,b,c};LS4:={LS3,X};print(`LS4 is a Not-T0, wave-like topology.  Ex 2 `);LAT4abcd(LS4,
  ` NOT-T0`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a, b, c\}$$

$$LS4 := \{\{\}, \{a, b, c\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology. Ex 2

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{ }
{c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, d}	{c}	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, c}
{a, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{b, c}
{b, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{d}
{c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, d}	{c}	{d}
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c}
{a, b, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, d}
{a, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, c, d}
{b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{b, c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{a, b, c, d\}, \{a, b, c, d\}, \{d\})$ **(28)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a,b}; LS4:={LS3,X};print(` LS4 is a Not-T0, wave-like topology  Ex 3 `);LAT4abcd
  (LS4,` NOT-T0`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a, b\}$$

$$LS4 := \{\{\}, \{a, b\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 3

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{ }
{c}	{ }	{a, b}	{c, d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b}	{c, d}	{c, d}	{c}	{d}	{ }
{a, b}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{c}
{b, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{d}
{c, d}	{ }	{a, b}	{c, d}	{c, d}	{c, d}	{ }	{c, d}
{a, b, c}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c}
{a, b, d}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, d}
{a, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{a, b, c, d\}, \{c, d\}, \{c, d\})$ **(29)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a};LS4:={LS3,X};print(`LS4 is a  Not-T0, wave-like topology  Ex 4`);LAT4abcd(LS4,`
  NOT T0, `,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{a\}$$

$$LS4 := \{\{\ \}, \{a\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 4

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{ }
{c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c}	{d}	{ }
{a, b}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b}
{a, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c}
{b, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, d}
{c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{c, d}
{a, b, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, d}
{a, c, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, c, d}	{ }	{b, c, d}

The Closed-Open subsets of LS are $= \{\{\ \}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{b, c, d\}, \{b, c, d\}, \{b, c, d\})$ **(30)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{a,b};LS4:={LS3,X};print(` LS4 is a  Not-T0, wave-like topology,  Ex 5 `);LAT4abcd
  (LS4,` NOT T0`,4);
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{a, b\}$$

$$LS4 := \{\{\}, \{a\}, \{a, b\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology, Ex 5

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{ }
{c}	{ }	{a, b}	{c, d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b}	{c, d}	{c, d}	{c}	{d}	{ }
{a, b}	{a, b}	{ }	{c, d}	{a, b, c, d}	{b, c, d}	{a}	{b}
{a, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{c}
{b, d}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{d}
{c, d}	{ }	{a, b}	{c, d}	{c, d}	{c, d}	{ }	{c, d}
{a, b, c}	{a, b}	{ }	{c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, c}
{a, b, d}	{a, b}	{ }	{c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, d}
{a, c, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{ }	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, c, d}	{ }	{b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{b, c, d\}, \{c, d\}, \{c, d\})$

(31)

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{},{a,b,c};LS4:={LS3,X};print(` LS4 is a  Not-T0, wave-like topology. Ex 6`);LAT4abcd
  (LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{a\}, \{\ \}, \{a, b, c\}$$

$$LS4 := \{\{\ \}, \{a\}, \{a, b, c\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology. Ex 6

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{ }
{c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b}
{a, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c}
{b, d}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{d}
{c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{d}
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{b, c, d}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, d}
{a, c, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, c, d}	{ }	{b, c, d}

The Closed-Open subsets of LS are $= \{\{\ \}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{b, c, d\}, \{b, c, d\}, \{d\})$ **(32)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a,b},{a,b,c};LS4:={LS3,X};print(` LS4 is a  Not-T0, wave-like topology, Ex 7 `);LAT4abcd
  (LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a, b\}, \{a, b, c\}$$

$$LS4 := \{\{\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology, Ex 7

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{ }
{c}	{ }	{a, b}	{c, d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{c}
{b, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{d}
{c, d}	{ }	{a, b}	{c, d}	{c, d}	{d}	{ }	{d}
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c}
{a, b, d}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, d}
{a, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{a, b, c, d\}, \{c, d\}, \{d\})$ **(33)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{b},{a,b};LS4:={LS3,X};print(` LS4 is a  Not-T0, wave-like topology, Ex 8 `);LAT4abcd
  (LS4,` NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{b\}, \{a, b\}$$

$$LS4 := \{\{\}, \{a\}, \{b\}, \{a, b\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology, Ex 8

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b}	{c, d}	{a, c, d}	{c, d}	{a}	{ }
{b}	{b}	{a}	{c, d}	{b, c, d}	{c, d}	{b}	{ }
{c}	{ }	{a, b}	{c, d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b}	{c, d}	{c, d}	{c}	{d}	{ }
{a, b}	{a, b}	{ }	{c, d}	{a, b, c, d}	{c, d}	{a, b}	{ }
{a, c}	{a}	{b}	{c, d}	{a, c, d}	{c, d}	{a}	{c}
{a, d}	{a}	{b}	{c, d}	{a, c, d}	{c, d}	{a}	{d}
{b, c}	{b}	{a}	{c, d}	{b, c, d}	{c, d}	{b}	{c}
{b, d}	{b}	{a}	{c, d}	{b, c, d}	{c, d}	{b}	{d}
{c, d}	{ }	{a, b}	{c, d}	{c, d}	{c, d}	{ }	{c, d}
{a, b, c}	{a, b}	{ }	{c, d}	{a, b, c, d}	{c, d}	{a, b}	{c}
{a, b, d}	{a, b}	{ }	{c, d}	{a, b, c, d}	{c, d}	{a, b}	{d}
{a, c, d}	{a}	{b}	{c, d}	{a, c, d}	{c, d}	{ }	{c, d}
{b, c, d}	{b}	{a}	{c, d}	{b, c, d}	{c, d}	{ }	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{c, d}	{ }	{c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, c, d\}, \{b, c, d\}, \{c, d\}, \{c, d\})$ **(34)**

```
> print(` `);X:={a,b,c,d};LS3:={},{a},{a,b},{a,c,d},{};LS4:={LS3,X};print(` LS4 is a Not-T0, wave-like topology  Ex 9 `);
  LAT4abcd(LS4,` NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{a, b\}, \{a, c, d\}, \{\}$$

$$LS4 := \{\{\}, \{a\}, \{a, b\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 9

` `

Is LS4: a topology = *true*, *connected* = *true*, *Kolmogorov.T0* = *false*, *Hausdorff.T2* = *false*

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{a\}$	$\{\}$	$\{b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{\}$	$\{a, c, d\}$	$\{b\}$	$\{b\}$	$\{\}$	$\{\}$	$\{\}$
$\{c\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{d\}$	$\{c\}$	$\{\}$
$\{d\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c\}$	$\{d\}$	$\{\}$
$\{a, b\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{b\}$
$\{a, c\}$	$\{a\}$	$\{\}$	$\{b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{c\}$
$\{a, d\}$	$\{a\}$	$\{\}$	$\{b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{d\}$
$\{b, c\}$	$\{\}$	$\{a\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{d\}$	$\{b, c\}$	$\{\}$
$\{b, d\}$	$\{\}$	$\{a\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{c\}$	$\{b, d\}$	$\{\}$
$\{c, d\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c, d\}$	$\{\}$	$\{c, d\}$
$\{a, b, c\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{b, c\}$
$\{a, b, d\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{b, d\}$
$\{a, c, d\}$	$\{a, c, d\}$	$\{\}$	$\{b\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{c, d\}$
$\{b, c, d\}$	$\{\}$	$\{a\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{c, d\}$	$\{\}$	$\{c, d\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{\}$	$\{b, c, d\}$

The Closed-Open subsets of LS are = $\{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is = $(\{a, b, c, d\}, \{b\}, \{c, d\}, \{c, d\})$ **(35)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{b,c},{a,b,c};LS4:={LS3,X};print(` LS4 is a  Not-T0, wave-like topology  Ex 10 `);
  LAT4abcd(LS4,` NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{b, c\}, \{a, b, c\}$$

$$LS4 := \{\{\}, \{a\}, \{b, c\}, \{a, b, c\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 10

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b, c}	{d}	{a, d}	{d}	{a}	{ }
{b}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{ }
{c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{a}	{ }	{b, c, d}	{a, b, c, d}	{c, d}	{a, b}	{ }
{a, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{ }
{a, d}	{a}	{b, c}	{d}	{a, d}	{d}	{ }	{d}
{b, c}	{b, c}	{a}	{d}	{b, c, d}	{b, c, d}	{ }	{b, c}
{b, d}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{d}
{c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{d}
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{b, c, d}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{c, d}	{a, b}	{d}
{a, c, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{d}
{b, c, d}	{b, c}	{a}	{d}	{b, c, d}	{b, c, d}	{ }	{b, c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, c, d}	{ }	{b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, d\}, \{b, c, d\}, \{b, c, d\}, \{d\})$

```
> print(`  `);X:={a,b,c,d};LS3:={},{a,b},{a,b,d},{a,b,c};LS4:={LS3,X};print(` LS4 is a Not-T0, wave-like topology  Ex 11 `);
  LAT4abcd(LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a, b\}, \{a, b, d\}, \{a, b, c\}$$

$$LS4 := \{\{\}, \{a, b\}, \{a, b, c\}, \{a, b, d\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 11

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{ }
{c}	{ }	{a, b, d}	{c}	{c}	{ }	{ }	{ }
{d}	{ }	{a, b, c}	{d}	{d}	{ }	{ }	{ }
{a, b}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{c}
{b, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{d}
{c, d}	{ }	{a, b}	{c, d}	{c, d}	{ }	{ }	{ }
{a, b, c}	{a, b, c}	{ }	{d}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c}
{a, b, d}	{a, b, d}	{ }	{c}	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, d}
{a, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c, d}	{b}	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{a, b, c, d\}, \{c\}, \{d\})$ **(37)**

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{},{b,c,d};LS4:={LS3,X};print(` LS4 is a  Not-T0, wave-like topology  Ex 12 `);
  LAT4abcd(LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{a\}, \{\ \}, \{b, c, d\}$$

$$LS4 := \{\{\ \}, \{a\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 12

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b, c, d}	{ }	{a}	{ }	{a}.Seg	{ }
{b}	{ }	{a}	{b, c, d}	{b, c, d}	{c, d}	{b}	{ }
{c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c}	{d}	{ }
{a, b}	{a}	{ }	{b, c, d}	{a, b, c, d}	{c, d}	{a, b}	{ }
{a, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{ }
{a, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c}	{a, d}	{ }
{b, c}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c}
{b, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, d}
{c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{c, d}
{a, b, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, d}
{a, c, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{b, c, d}	{a}	{ }	{b, c, d}	{b, c, d}	{ }	{b, c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, c, d}	{ }	{b, c, d}

The Closed-Open subsets of LS are = {{ }, {a}, {b, c, d}, {a, b, c, d}}

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is = ({a}, {b, c, d}, {b, c, d}, {b, c, d})

(38)

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{b},{a,b},{a,c,d};LS4:={LS3,X};print(` LS4 is a Not-T0, wave-like topology   Ex 13 `);
  LAT4abcd(LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{b\}, \{a, b\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a\}, \{b\}, \{a, b\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 13

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b}	{c, d}	{a, c, d}	{c, d}	{a}	{ }
{b}	{b}	{a, c, d}	{ }	{b}	{ }	{b}.Seg	{ }
{c}	{ }	{a, b}	{c, d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b}	{c, d}	{c, d}	{c}	{d}	{ }
{a, b}	{a, b}	{ }	{c, d}	{a, b, c, d}	{c, d}	{a, b}	{ }
{a, c}	{a}	{b}	{c, d}	{a, c, d}	{c, d}	{a}	{c}
{a, d}	{a}	{b}	{c, d}	{a, c, d}	{c, d}	{a}	{d}
{b, c}	{b}	{a}	{c, d}	{b, c, d}	{d}	{b, c}	{ }
{b, d}	{b}	{a}	{c, d}	{b, c, d}	{c}	{b, d}	{ }
{c, d}	{ }	{a, b}	{c, d}	{c, d}	{c, d}	{ }	{c, d}
{a, b, c}	{a, b}	{ }	{c, d}	{a, b, c, d}	{c, d}	{a, b}	{c}
{a, b, d}	{a, b}	{ }	{c, d}	{a, b, c, d}	{c, d}	{a, b}	{d}
{a, c, d}	{a, c, d}	{b}	{ }	{a, c, d}	{c, d}	{ }	{c, d}
{b, c, d}	{b}	{a}	{c, d}	{b, c, d}	{c, d}	{ }	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{c, d}	{ }	{c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{b\}, \{a, c, d\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, c, d\}, \{b\}, \{c, d\}, \{c, d\})$

(39)

```
> print(` `);X:={a,b,c,d};LS3={},{a},{b,c},{a,b,c},{b,c,d};LS4:={LS3,X};print(` LS4 is a  Not-T0, wave-like topology   Ex 14 `);
  LAT4abcd(LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$(\{\{\ \}\}, \{\{a\}\}, \{\{b\}\}, \{\{a, b\}\}, \{\{a, c, d\}\}) = \{\{\ \}\}, \{\{a\}\}, \{\{b, c\}\}, \{\{a, b, c\}\}, \{\{b, c, d\}\}$$

$$LS4 := \{\{\ \}, \{a\}, \{b\}, \{a, b\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology   Ex 14

` `

Is LS4: a topology = *true*, *connected* = *false*, *Kolmogorov.T0* = *false*, *Hausdorff.T2* = *false*

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{a\}$	$\{b\}$	$\{c, d\}$	$\{a, c, d\}$	$\{c, d\}$	$\{a\}$	$\{\ \}$
$\{b\}$	$\{b\}$	$\{a, c, d\}$	$\{\ \}$	$\{b\}$	$\{\ \}$	$\{b\}.Seg$	$\{\ \}$
$\{c\}$	$\{\ \}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{d\}$	$\{c\}$	$\{\ \}$
$\{d\}$	$\{\ \}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c\}$	$\{d\}$	$\{\ \}$
$\{a, b\}$	$\{a, b\}$	$\{\ \}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{a, b\}$	$\{\ \}$
$\{a, c\}$	$\{a\}$	$\{b\}$	$\{c, d\}$	$\{a, c, d\}$	$\{c, d\}$	$\{a\}$	$\{c\}$
$\{a, d\}$	$\{a\}$	$\{b\}$	$\{c, d\}$	$\{a, c, d\}$	$\{c, d\}$	$\{a\}$	$\{d\}$
$\{b, c\}$	$\{b\}$	$\{a\}$	$\{c, d\}$	$\{b, c, d\}$	$\{d\}$	$\{b, c\}$	$\{\ \}$
$\{b, d\}$	$\{b\}$	$\{a\}$	$\{c, d\}$	$\{b, c, d\}$	$\{c\}$	$\{b, d\}$	$\{\ \}$
$\{c, d\}$	$\{\ \}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c, d\}$	$\{\ \}$	$\{c, d\}$
$\{a, b, c\}$	$\{a, b\}$	$\{\ \}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{a, b\}$	$\{c\}$
$\{a, b, d\}$	$\{a, b\}$	$\{\ \}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{a, b\}$	$\{d\}$
$\{a, c, d\}$	$\{a, c, d\}$	$\{b\}$	$\{\ \}$	$\{a, c, d\}$	$\{c, d\}$	$\{\ \}$	$\{c, d\}$
$\{b, c, d\}$	$\{b\}$	$\{a\}$	$\{c, d\}$	$\{b, c, d\}$	$\{c, d\}$	$\{\ \}$	$\{c, d\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{\ \}$	$\{c, d\}$

The Closed-Open subsets of LS are = $\{\{\ \}, \{b\}, \{a, c, d\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is = $(\{a, c, d\}, \{b\}, \{c, d\}, \{c, d\})$

(40)

```
> print(`  `);X:={a,b,c,d};LS3:={},{a,b},{c,d};LS4:={LS3,X};print(` LS4 is a Not-T0, wave-like topology  Ex 15 `);LAT4abcd
(LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\ \}, \{a, b\}, \{c, d\}$$

$$LS4 := \{\{\ \}, \{a, b\}, \{c, d\}, \{a, b, c, d\}\}$$

LS4 is a Not-T0, wave-like topology Ex 15

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{c, d}	{a, b}	{a, b}	{b}	{a}	{ }
{b}	{ }	{c, d}	{a, b}	{a, b}	{a}	{b}	{ }
{c}	{ }	{a, b}	{c, d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b}	{c, d}	{c, d}	{c}	{d}	{ }
{a, b}	{a, b}	{c, d}	{ }	{a, b}	{a, b}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{ }
{a, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{b, c}	{a, d}	{ }
{b, c}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, d}	{b, c}	{ }
{b, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{a, c}	{b, d}	{ }
{c, d}	{c, d}	{a, b}	{ }	{c, d}	{c, d}	{ }	{c, d}
{a, b, c}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, d}	{c}	{a, b}
{a, b, d}	{a, b}	{ }	{c, d}	{a, b, c, d}	{a, b, c}	{d}	{a, b}
{a, c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{c, d}	{ }	{a, b}	{a, b, c, d}	{a, c, d}	{b}	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{a, b, c, d}	{ }	{a, b, c, d}

The Closed-Open subsets of LS are $= \{\{\ \}, \{a, b\}, \{c, d\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b\}, \{a, b\}, \{c, d\}, \{c, d\})$

(41)

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{b},{a,b},{a,c,d};LS4:={LS3,X};print(` LS4 is a  Not T0, wave-like topology   Ex 16 `);
  LAT4abcd(LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{b\}, \{a, b\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a\}, \{b\}, \{a, b\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 is a Not T0, wave-like topology   Ex 16

Is LS4: a topology = *true*, *connected* = *false*, *Kolmogorov.T0* = *false*, *Hausdorff.T2* = *false*

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{a\}$	$\{b\}$	$\{c, d\}$	$\{a, c, d\}$	$\{c, d\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{b\}$	$\{a, c, d\}$	$\{\}$	$\{b\}$	$\{\}$	$\{b\}.Seg$	$\{\}$
$\{c\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{d\}$	$\{c\}$	$\{\}$
$\{d\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c\}$	$\{d\}$	$\{\}$
$\{a, b\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{a, b\}$	$\{\}$
$\{a, c\}$	$\{a\}$	$\{b\}$	$\{c, d\}$	$\{a, c, d\}$	$\{c, d\}$	$\{a\}$	$\{c\}$
$\{a, d\}$	$\{a\}$	$\{b\}$	$\{c, d\}$	$\{a, c, d\}$	$\{c, d\}$	$\{a\}$	$\{d\}$
$\{b, c\}$	$\{b\}$	$\{a\}$	$\{c, d\}$	$\{b, c, d\}$	$\{d\}$	$\{b, c\}$	$\{\}$
$\{b, d\}$	$\{b\}$	$\{a\}$	$\{c, d\}$	$\{b, c, d\}$	$\{c\}$	$\{b, d\}$	$\{\}$
$\{c, d\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c, d\}$	$\{\}$	$\{c, d\}$
$\{a, b, c\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{a, b\}$	$\{c\}$
$\{a, b, d\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{a, b\}$	$\{d\}$
$\{a, c, d\}$	$\{a, c, d\}$	$\{b\}$	$\{\}$	$\{a, c, d\}$	$\{c, d\}$	$\{\}$	$\{c, d\}$
$\{b, c, d\}$	$\{b\}$	$\{a\}$	$\{c, d\}$	$\{b, c, d\}$	$\{c, d\}$	$\{\}$	$\{c, d\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{c, d\}$	$\{\}$	$\{c, d\}$

The Closed-Open subsets of LS are = $\{\{\}, \{b\}, \{a, c, d\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is = $(\{a, c, d\}, \{b\}, \{c, d\}, \{c, d\})$

(42)

```
> print(`  `);X:={a,b,c,d};LS3:={},{a},{b},{a,b},{c,d},{a,c,d},{b,c,d};LS4:={LS3,X};print(` LS4 = Not-T0, wave-like topology
  Ex 17 `);LAT4abcd(LS4,`NOT-T0`,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{b\}, \{a, b\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}$$

$$LS4 := \{\{\}, \{a\}, \{b\}, \{a, b\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$$

LS4 = Not-T0, wave-like topology Ex 17

Is LS4: a topology = true, connected = false, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b, c, d}	{ }	{a}	{ }	{a}.Seg	{ }
{b}	{b}	{a, c, d}	{ }	{b}	{ }	{b}.Seg	{ }
{c}	{ }	{a, b}	{c, d}	{c, d}	{d}	{c}	{ }
{d}	{ }	{a, b}	{c, d}	{c, d}	{c}	{d}	{ }
{a, b}	{a, b}	{c, d}	{ }	{a, b}	{ }	{a, b}.Seg	{ }
{a, c}	{a}	{b}	{c, d}	{a, c, d}	{d}	{a, c}	{ }
{a, d}	{a}	{b}	{c, d}	{a, c, d}	{c}	{a, d}	{ }
{b, c}	{b}	{a}	{c, d}	{b, c, d}	{d}	{b, c}	{ }
{b, d}	{b}	{a}	{c, d}	{b, c, d}	{c}	{b, d}	{ }
{c, d}	{c, d}	{a, b}	{ }	{c, d}	{c, d}	{ }	{c, d}
{a, b, c}	{a, b}	{ }	{c, d}	{a, b, c, d}	{d}	{a, b, c}	{ }
{a, b, d}	{a, b}	{ }	{c, d}	{a, b, c, d}	{c}	{a, b, d}	{ }
{a, c, d}	{a, c, d}	{b}	{ }	{a, c, d}	{c, d}	{ }	{c, d}
{b, c, d}	{b, c, d}	{a}	{ }	{b, c, d}	{c, d}	{ }	{c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{c, d}	{ }	{c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a\}, \{b\}, \{a, b\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a\}, \{b\}, \{c, d\}, \{c, d\})$

(43)

Special cases of the 139 different N=5 finite topologies.

5. Examples of Embedding N=3, T0, particle-like topologies into N=5, to produce N=5, NOT T0, wave-like, topologies.

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{b},{c},{},{},{b,c},{a,b,c};LS5:={LS3,X};print(`LS5 is a (Not-T0) wave-like topology `);
  LAT5abcds(LS5,`Embed N=3 to N =`,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{b\}, \{c\}, \{\}, \{\}, \{b, c\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{b\}, \{c\}, \{b, c\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{ }
{b}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{ }
{c}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a}
{a, c}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a}
{a, d}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d}
{a, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{s}
{b, c}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{ }
{b, d}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d}
{b, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{s}
{c, d}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{d}
{c, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a}
{a, b, d}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d}
{a, b, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, s}
{a, c, d}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, d}
{a, c, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, s}
{a, d, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d, s}
{b, c, d}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d}
{b, c, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{s}
{b, d, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d, s}
{c, d, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, s}
{a, b, d, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d, s}
{a, c, d, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, d, s}
{b, c, d, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{b},{c},{b,c},{a,b,c};LS5:={LS3,X};print(`LS5 is a (Not-T0)  wave-like topology`  );
  LAT5abcds(LS5,`Embed N=3 to N =`,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{b\}, \{c\}, \{b, c\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{b\}, \{c\}, \{b, c\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{ }
{b}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{ }
{c}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a}
{a, c}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a}
{a, d}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d}
{a, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{s}
{b, c}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{ }
{b, d}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d}
{b, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{s}
{c, d}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{d}
{c, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a}
{a, b, d}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d}
{a, b, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, s}
{a, c, d}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, d}
{a, c, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, s}
{a, d, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d, s}
{b, c, d}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d}
{b, c, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{s}
{b, d, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d, s}
{c, d, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, s}
{a, b, d, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d, s}
{a, c, d, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, d, s}
{b, c, d, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{b},{},{a,b},{},{b,c},{a,b,c};LS5:={LS3,X};print(`LS5 is a  (Not-T0) wave-like topology `)
  :LAT5abcds(LS5,` Embed N=3 to N = `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{b\}, \{\}, \{a, b\}, \{\}, \{b, c\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{b\}, \{a, b\}, \{b, c\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{ }
{b}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a}
{a, c}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{d, s}	{a, c}	{ }
{a, d}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d}
{a, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{s}
{b, c}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c}
{b, d}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, s}
{a, c, d}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{d, s}	{a, c}	{d}
{a, c, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{d, s}	{a, c}	{s}
{a, d, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d, s}
{b, c, d}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d}
{b, c, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, s}
{b, d, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, d, s}
{a, c, d, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{d, s}	{a, c}	{d, s}
{b, c, d, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{b},{},{},{},{a,b},{a,b,c};LS5:={LS3,X};print(`LS5 is a (Not-T0) wave-like topology `)
  :LAT5abcds(LS5,` Embed N=3 to N = `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{b\}, \{\}, \{\}, \{\}, \{a, b\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{b\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{ }
{b}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a}
{a, c}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c}
{a, d}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d}
{a, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{s}
{b, c}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c}
{b, d}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, s}
{a, c, d}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d}
{a, c, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, s}
{a, d, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d, s}
{b, c, d}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d}
{b, c, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, s}
{b, d, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, d, s}
{a, c, d, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, d, s}

Some singletons have the same closure and cannot be distinguished **(47)**

```
>
```

6. Examples of four N=3, NOT-T0, wave-like topologies which can be embedded into N=5, NOT-T0, wave-like topologies.

```
> print(` `);X:={a,b,c,d,s};LS3:={},{a,b,c};LS5:={LS3,X};print(` LS5  is a (Not-T0) wave-like topology`);LAT5abcds(LS5,` `,5)
  :
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c}
{a, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c}
{b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{d}
{c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c}
{a, b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d}
{a, b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, s}
{a, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d}
{a, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, s}
{a, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d}
{b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, s}
{b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, s}
{a, b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d, s}
{b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d, s}

Some singletons have the same closure and cannot be distinguished

(48)

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{c},{a,b,c};LS5:={LS3,X};print(` LS5 is a (Not-T0) wave-like topology`);LAT5abcds(LS5,
  ` `,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\ \}, \{\ \}, \{c\}, \{a, b, c\}$$

$$LS5 := \{\{\ \}, \{c\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{ }
{*b*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{ }
{*c*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{ }
{*d*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*}	{*s*}	{ }
{*a*, *b*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*}
{*a*, *c*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*}
{*a*, *d*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{*d*}
{*a*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{*s*}
{*b*, *c*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*b*}
{*b*, *d*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*d*}
{*b*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*d*}
{*c*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*, *s*}	{ }	{*d*, *s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*}
{*a*, *b*, *d*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*, *d*}
{*a*, *b*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*, *s*}
{*a*, *c*, *d*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *d*}
{*a*, *c*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *s*}
{*a*, *d*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{*d*, *s*}
{*b*, *c*, *d*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*b*, *d*}
{*b*, *c*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*b*, *s*}
{*b*, *d*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*d*, *s*}
{*c*, *d*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*, *d*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*, *s*}
{*a*, *b*, *d*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*, *d*, *s*}
{*a*, *c*, *d*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *d*, *s*}
{*b*, *c*, *d*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*b*, *d*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*, *d*, *s*}

Some singletons have the same closure and cannot be distinguished **(49)**

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{},{a,b},{a,b,c};LS5:={LS3,X};print(` LS5 is a (Not-T0) wave-like topology`);LAT5abcds
  (LS5,` `,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\ \}, \{\ \}, \{\ \}, \{a, b\}, \{a, b, c\}$$

$$LS5 := \{\{\ \}, \{a, b\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{ }
{*b*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{ }
{*d*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*}	{*s*}	{ }
{*a*, *b*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*}
{*a*, *c*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*c*}
{*a*, *d*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*d*}
{*a*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*s*}
{*b*, *c*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{*c*}
{*b*, *d*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{*d*}
{*b*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*d*}
{*c*, *s*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*, *s*}	{ }	{*d*, *s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*, *c*}
{*a*, *b*, *d*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*, *d*}
{*a*, *b*, *s*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*, *s*}
{*a*, *c*, *d*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*c*, *d*}
{*a*, *c*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*c*, *s*}
{*a*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*d*, *s*}
{*b*, *c*, *d*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{*c*, *d*}
{*b*, *c*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{*c*, *s*}
{*b*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{*d*, *s*}
{*c*, *d*, *s*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*, *c*, *d*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*, *c*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*, *d*, *s*}
{*a*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*c*, *d*, *s*}
{*b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*b*}	{*c*, *d*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{*a*, *b*, *c*, *d*, *s*}

Some singletons have the same closure and cannot be distinguished **(50)**

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{c},{a,b},{a,b,c}; LS5:={LS3,X};print(` LS5 is a (Not-T0) wave-like topology`);
  LAT5abcds(LS5,` `,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\ \}, \{\ \}, \{c\}, \{a, b\}, \{a, b, c\}$$

$$LS5 := \{\{\ \}, \{c\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a (Not-T0) wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{ }
{*b*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{ }
{*c*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{ }
{*d*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*}	{*s*}	{ }
{*a*, *b*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*}
{*a*, *c*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *d*, *s*}	{*a*, *c*}	{ }
{*a*, *d*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{*d*}
{*a*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{*s*}
{*b*, *c*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{ }
{*b*, *d*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*d*}
{*b*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*d*}
{*c*, *s*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*, *s*}	{ }	{*d*, *s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*}
{*a*, *b*, *d*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*, *d*}
{*a*, *b*, *s*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*, *s*}
{*a*, *c*, *d*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *d*, *s*}	{*a*, *c*}	{*d*}
{*a*, *c*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *d*, *s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*b*, *d*, *s*}	{*a*}	{*d*, *s*}
{*b*, *c*, *d*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*d*}
{*b*, *c*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{ }	{*c*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*d*, *s*}
{*c*, *d*, *s*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*, *d*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{ }	{*a*, *b*, *d*, *s*}
{*a*, *c*, *d*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *d*, *s*}	{*a*, *c*}	{*d*, *s*}
{*b*, *c*, *d*, *s*}	{*c*}	{ }	{*a*, *b*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*c*}	{*a*, *b*, *d*, *s*}

Some singletons have the same closure and cannot be distinguished **(51)**

7. Examples of N=4, T0, particle-like topologies which can be embedded into N=5, T0, particle-like topologies.

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{b},{c},{d},{a,b},{a,c},{a,d},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{a,c,d},{b,c,d},{a,b,c,d};LS5:=
  {LS4,X};print(`LS5 is a (T0) particle like topology`);LAT5abcds(LS5 ,` `,5):
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle like topology

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b, c, d}	{s}	{a, s}	{s}	{a}	{ }
{b}	{b}	{a, c, d}	{s}	{b, s}	{s}	{b}	{ }
{c}	{c}	{a, b, d}	{s}	{c, s}	{s}	{c}	{ }
{d}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{c, d}	{s}	{a, b, s}	{s}	{a, b}	{ }
{a, c}	{a, c}	{b, d}	{s}	{a, c, s}	{s}	{a, c}	{ }
{a, d}	{a, d}	{b, c}	{s}	{a, d, s}	{s}	{a, d}	{ }
{a, s}	{a}	{b, c, d}	{s}	{a, s}	{s}	{a}	{s}
{b, c}	{b, c}	{a, d}	{s}	{b, c, s}	{s}	{b, c}	{ }
{b, d}	{b, d}	{a, c}	{s}	{b, d, s}	{s}	{b, d}	{ }
{b, s}	{b}	{a, c, d}	{s}	{b, s}	{s}	{b}	{s}
{c, d}	{c, d}	{a, b}	{s}	{c, d, s}	{s}	{c, d}	{ }
{c, s}	{c}	{a, b, d}	{s}	{c, s}	{s}	{c}	{s}
{d, s}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{d}	{s}	{a, b, c, s}	{s}	{a, b, c}	{ }
{a, b, d}	{a, b, d}	{c}	{s}	{a, b, d, s}	{s}	{a, b, d}	{ }
{a, b, s}	{a, b}	{c, d}	{s}	{a, b, s}	{s}	{a, b}	{s}
{a, c, d}	{a, c, d}	{b}	{s}	{a, c, d, s}	{s}	{a, c, d}	{ }
{a, c, s}	{a, c}	{b, d}	{s}	{a, c, s}	{s}	{a, c}	{s}
{a, d, s}	{a, d}	{b, c}	{s}	{a, d, s}	{s}	{a, d}	{s}
{b, c, d}	{b, c, d}	{a}	{s}	{b, c, d, s}	{s}	{b, c, d}	{ }
{b, c, s}	{b, c}	{a, d}	{s}	{b, c, s}	{s}	{b, c}	{s}
{b, d, s}	{b, d}	{a, c}	{s}	{b, d, s}	{s}	{b, d}	{s}
{c, d, s}	{c, d}	{a, b}	{s}	{c, d, s}	{s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{s}	{a, b, c, d}	{ }
{a, b, c, s}	{a, b, c}	{d}	{s}	{a, b, c, s}	{s}	{a, b, c}	{s}
{a, b, d, s}	{a, b, d}	{c}	{s}	{a, b, d, s}	{s}	{a, b, d}	{s}
{a, c, d, s}	{a, c, d}	{b}	{s}	{a, c, d, s}	{s}	{a, c, d}	{s}
{b, c, d, s}	{b, c, d}	{a}	{s}	{b, c, d, s}	{s}	{b, c, d}	{s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{s}	{a, b, c, d}	{s}

(52)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{b},{c},{d},{a,b},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(` LS5
  is a (T0) particle-like topology`);LAT5abcds(LS5 ,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{ }
{b}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{ }
{c}	{c}	{a, b, d}	{s}	{c, s}	{s}	{c}	{ }
{d}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{c, d}	{s}	{a, b, s}	{a, s}	{b}	{a}
{a, c}	{c}	{b, d}	{a, s}	{a, c, s}	{s}	{a, c}	{ }
{a, d}	{d}	{b, c}	{a, s}	{a, d, s}	{s}	{a, d}	{ }
{a, s}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{s}
{b, c}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{ }
{b, d}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{ }
{b, s}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{s}
{c, d}	{c, d}	{a, b}	{s}	{c, d, s}	{s}	{c, d}	{ }
{c, s}	{c}	{a, b, d}	{s}	{c, s}	{s}	{c}	{s}
{d, s}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{d}	{s}	{a, b, c, s}	{a, s}	{b, c}	{a}
{a, b, d}	{a, b, d}	{c}	{s}	{a, b, d, s}	{a, s}	{b, d}	{a}
{a, b, s}	{a, b}	{c, d}	{s}	{a, b, s}	{a, s}	{b}	{a, s}
{a, c, d}	{c, d}	{b}	{a, s}	{a, c, d, s}	{s}	{a, c, d}	{ }
{a, c, s}	{c}	{b, d}	{a, s}	{a, c, s}	{s}	{a, c}	{s}
{a, d, s}	{d}	{b, c}	{a, s}	{a, d, s}	{s}	{a, d}	{s}
{b, c, d}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{ }
{b, c, s}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{s}
{b, d, s}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{s}
{c, d, s}	{c, d}	{a, b}	{s}	{c, d, s}	{s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{a}
{a, b, c, s}	{a, b, c}	{d}	{s}	{a, b, c, s}	{a, s}	{b, c}	{a, s}
{a, b, d, s}	{a, b, d}	{c}	{s}	{a, b, d, s}	{a, s}	{b, d}	{a, s}
{a, c, d, s}	{c, d}	{b}	{a, s}	{a, c, d, s}	{s}	{a, c, d}	{s}
{b, c, d, s}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, s}	{b, c, d}	{a, s}

(53)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{b},{d},{a,b},{b,d},{c,d},{a,b,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0)
  partice-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{\ \}, \{b\}, \{d\}, \{a, b\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{b\}, \{d\}, \{a, b\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) partice-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{*b*}	{*c*, *d*}	{*a*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{ }
{*d*}	{*d*}	{*a*, *b*}	{*c*, *s*}	{*c*, *d*, *s*}	{*c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{*a*, *b*}	{*c*, *d*}	{*s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *s*}	{*a*, *d*}	{ }
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{ }
{*b*, *d*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{ }
{*b*, *s*}	{*b*}	{*c*, *d*}	{*a*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{*a*, *b*}	{*s*}	{*c*, *d*, *s*}	{*c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{*a*, *b*}	{*c*, *s*}	{*c*, *d*, *s*}	{*c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*a*, *b*}	{*d*}	{*c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{*a*}
{*a*, *b*, *d*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*}
{*a*, *b*, *s*}	{*a*, *b*}	{*c*, *d*}	{*s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*c*, *d*}	{*b*}	{*a*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *s*}	{*a*, *d*}	{*c*}
{*a*, *c*, *s*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *s*}	{*a*, *d*}	{*s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*c*}
{*b*, *c*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*s*}
{*c*, *d*, *s*}	{*c*, *d*}	{*a*, *b*}	{*s*}	{*c*, *d*, *s*}	{*c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *c*}
{*a*, *b*, *c*, *s*}	{*a*, *b*}	{*d*}	{*c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{*a*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *s*}
{*a*, *c*, *d*, *s*}	{*c*, *d*}	{*b*}	{*a*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *s*}	{*a*, *d*}	{*c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *c*, *s*}

(54)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{c},{d},{a,c},{b,c},{c,d},{a,b,c},{a,c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(` LS5 is a (T0)
  particle-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{c\}, \{d\}, \{a, c\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{c\}, \{d\}, \{a, c\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{ }
{b}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{ }
{c}	{c}	{d}	{a, b, s}	{a, b, c, s}	{a, b, s}	{c}	{ }
{d}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{ }	{c, d}	{a, b, s}	{a, b, s}	{s}	{a, b}	{ }
{a, c}	{a, c}	{d}	{b, s}	{a, b, c, s}	{a, b, s}	{c}	{a}
{a, d}	{d}	{b, c}	{a, s}	{a, d, s}	{s}	{a, d}	{ }
{a, s}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{s}
{b, c}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, b, s}	{c}	{b}
{b, d}	{d}	{a, c}	{b, s}	{b, d, s}	{s}	{b, d}	{ }
{b, s}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{s}
{c, d}	{c, d}	{ }	{a, b, s}	{a, b, c, d, s}	{a, b, s}	{c, d}	{ }
{c, s}	{c}	{d}	{a, b, s}	{a, b, c, s}	{a, b, s}	{c}	{s}
{d, s}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{d}	{s}	{a, b, c, s}	{a, b, s}	{c}	{a, b}
{a, b, d}	{d}	{c}	{a, b, s}	{a, b, d, s}	{s}	{a, b, d}	{ }
{a, b, s}	{ }	{c, d}	{a, b, s}	{a, b, s}	{s}	{a, b}	{s}
{a, c, d}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{a, b, s}	{c, d}	{a}
{a, c, s}	{a, c}	{d}	{b, s}	{a, b, c, s}	{a, b, s}	{c}	{a, s}
{a, d, s}	{d}	{b, c}	{a, s}	{a, d, s}	{s}	{a, d}	{s}
{b, c, d}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, b, s}	{c, d}	{b}
{b, c, s}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, b, s}	{c}	{b, s}
{b, d, s}	{d}	{a, c}	{b, s}	{b, d, s}	{s}	{b, d}	{s}
{c, d, s}	{c, d}	{ }	{a, b, s}	{a, b, c, d, s}	{a, b, s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, b, s}	{c, d}	{a, b}
{a, b, c, s}	{a, b, c}	{d}	{s}	{a, b, c, s}	{a, b, s}	{c}	{a, b, s}
{a, b, d, s}	{d}	{c}	{a, b, s}	{a, b, d, s}	{s}	{a, b, d}	{s}
{a, c, d, s}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{a, b, s}	{c, d}	{a, s}
{b, c, d, s}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, b, s}	{c, d}	{b, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, s}	{c, d}	{a, b, s}

(55)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{c},{d},{a,c},{a,d},{c,d},{a,b,c},{a,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0)
  partice-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{a\}, \{c\}, \{d\}, \{a, c\}, \{a, d\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{a\}, \{c\}, \{d\}, \{a, c\}, \{a, d\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) partice-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{ }
{b}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{ }
{c}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{ }
{d}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{b}
{a, c}	{a, c}	{d}	{b, s}	{a, b, c, s}	{b, s}	{a, c}	{ }
{a, d}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{ }
{a, s}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{s}
{b, c}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{b}
{b, d}	{d}	{a, c}	{b, s}	{b, d, s}	{s}	{b, d}	{ }
{b, s}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{s}
{c, d}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{ }
{c, s}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{s}
{d, s}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{d}	{s}	{a, b, c, s}	{b, s}	{a, c}	{b}
{a, b, d}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{b}
{a, b, s}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{b, s}
{a, c, d}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, s}	{a, c, d}	{ }
{a, c, s}	{a, c}	{d}	{b, s}	{a, b, c, s}	{b, s}	{a, c}	{s}
{a, d, s}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{s}
{b, c, d}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{b}
{b, c, s}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{b, s}
{b, d, s}	{d}	{a, c}	{b, s}	{b, d, s}	{s}	{b, d}	{s}
{c, d, s}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, s}	{a, c, d}	{b}
{a, b, c, s}	{a, b, c}	{d}	{s}	{a, b, c, s}	{b, s}	{a, c}	{b, s}
{a, b, d, s}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{b, s}
{a, c, d, s}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, s}	{a, c, d}	{s}
{b, c, d, s}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{b, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, s}	{a, c, d}	{b, s}

(56)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{c},{d},{b,c},{c,d},{a,b,c},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`SL5 is a (T0) partice-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{c\}, \{d\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{c\}, \{d\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

SL5 is a (T0) partice-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{ }
{*c*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{ }
{*d*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*}
{*a*, *d*}	{*d*}	{*b*, *c*}	{*a*, *s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{ }
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*, *c*}	{*d*}	{*a*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*}
{*b*, *d*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{ }
{*b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{ }
{*c*, *s*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*}
{*a*, *b*, *d*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{*a*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*}
{*a*, *c*, *s*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *s*}
{*a*, *d*, *s*}	{*d*}	{*b*, *c*}	{*a*, *s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{*s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*b*}
{*b*, *c*, *s*}	{*b*, *c*}	{*d*}	{*a*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*, *s*}
{*b*, *d*, *s*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{*s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *b*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*, *s*}
{*a*, *b*, *d*, *s*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{*a*, *s*}
{*a*, *c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*b*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *b*, *s*}

(57)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{},{d},{a,d},{c,d},{a,c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0) particle-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{\}, \{d\}, \{a, d\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{d\}, \{a, d\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{ }
{*d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{ }
{*a*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{*b*}
{*b*, *d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*}
{*b*, *s*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{*b*}
{*a*, *b*, *d*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*}
{*b*, *c*, *s*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{*b*, *s*}
{*b*, *d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*}
{*a*, *b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{*b*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *s*}
{*a*, *c*, *d*, *s*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*, *s*}

(58)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{b},{d},{b,d},{a,b,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0) particle-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{\ \}, \{b\}, \{d\}, \{b, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{b\}, \{d\}, \{b, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{ }
{*d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*c*}
{*b*, *d*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{ }
{*b*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*, *c*}
{*a*, *b*, *d*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*}
{*a*, *b*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*c*}
{*b*, *c*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*c*, *s*}
{*b*, *d*, *s*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*s*}
{*c*, *d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *c*}
{*a*, *b*, *c*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*, *c*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *s*}
{*a*, *c*, *d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *c*, *s*}

(59)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{c},{},{a,c},{},{a,b,c},{},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0) particle-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{a\}, \{c\}, \{\ \}, \{a, c\}, \{\ \}, \{a, b, c\}, \{\ \}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{a\}, \{c\}, \{a, c\}, \{a, b, c\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{ }
{b}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{ }
{c}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{ }
{a, d}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d}
{a, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{s}
{b, c}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b}
{b, d}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d}
{b, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{s}
{c, d}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d}
{c, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b}
{a, b, d}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d}
{a, b, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, s}
{a, c, d}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d}
{a, c, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{s}
{a, d, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d, s}
{b, c, d}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d}
{b, c, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, s}
{b, d, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d, s}
{c, d, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, s}
{a, b, d, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d, s}
{b, c, d, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d, s}

(60)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{a,c},{a,b,c},{a,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0) particle-like topology`);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{a, c\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{a, c\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{ }
{c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b}
{b, d}	{ }	{a, c}	{b, d, s}	{b, d, s}	{s}	{b, d}	{ }
{b, s}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{s}
{c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d}
{c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d}
{a, b, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, s}
{a, c, d}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, s}
{a, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d}
{b, c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, s}
{b, d, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{s}	{b, d}	{s}
{c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, s}
{a, b, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d, s}

(61)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{d},{b,d},{c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0) particle-like topology`);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{d\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{d\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{ }
{*c*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*a*, *s*}	{*c*}	{ }
{*d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*a*, *s*}	{*c*}	{*a*}
{*a*, *d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{ }
{*b*, *d*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*}
{*b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*a*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{*a*}
{*a*, *b*, *d*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*a*, *s*}	{*c*}	{*a*, *s*}
{*a*, *d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*}
{*b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*}
{*a*, *b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *s*}	{*b*, *c*}	{*a*, *s*}
{*a*, *b*, *d*, *s*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *s*}
{*a*, *c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*, *s*}

(62)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{c},{ },{a,c},{a,b},{},{},{},{a,b,c},{},{},{},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0)
  particle-like topology`);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{c\}, \{\}, \{a, c\}, \{a, b\}, \{\}, \{\}, \{\}, \{a, b, c\}, \{\}, \{\}, \{\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{c\}, \{a, b\}, \{a, c\}, \{a, b, c\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{ }
{b}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{ }
{c}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{ }
{a, d}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d}
{a, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{s}
{b, c}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{ }
{b, d}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d}
{b, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{s}
{c, d}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b}
{a, b, d}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d}
{a, b, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, s}
{a, c, d}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d}
{a, c, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{s}
{a, d, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d, s}
{b, c, d}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{d}
{b, c, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{s}
{b, d, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d, s}
{c, d, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, s}
{a, b, d, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d, s}
{b, c, d, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d, s}

(63)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{d},{a,d},{b,d},{c,d},{a,b,d},{a,c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0)
  particle-like topology`);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{d\}, \{a, d\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{d\}, \{a, d\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{ }
{*d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{ }
{*a*, *c*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*s*}	{*b*, *c*}	{ }
{*b*, *d*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*}
{*b*, *s*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*s*}	{*a*, *b*, *c*}	{ }
{*a*, *b*, *d*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*}
{*b*, *c*, *s*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*}
{*a*, *b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*s*}	{*a*, *b*, *c*}	{*s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *s*}
{*a*, *c*, *d*, *s*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*, *s*}

(64)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{b},{c},{d},{b,c},{b,d},{c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0) particle-like
  topology`);LAT5abcds(LS5,` `,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{b\}, \{c\}, \{d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{b\}, \{c\}, \{d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{ }
{b}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{ }
{c}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{ }
{d}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{a}
{a, c}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{a}
{a, d}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{a}
{a, s}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{s}
{b, c}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{ }
{b, d}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{ }
{b, s}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{s}
{c, d}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{ }
{c, s}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{s}
{d, s}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{s}
{a, b, c}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{a}
{a, b, d}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{a}
{a, b, s}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{a, s}
{a, c, d}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{a}
{a, c, s}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{a, s}
{a, d, s}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{a, s}
{b, c, d}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{ }
{b, c, s}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{s}
{b, d, s}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{s}
{c, d, s}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{a}
{a, b, c, s}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{a, s}
{a, b, d, s}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{a, s}
{a, c, d, s}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{a, s}
{b, c, d, s}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, s}	{b, c, d}	{a, s}

(65)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{d},{c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a (T0) particle-like topology`);
  LAT5abcds(LS5,` `,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a (T0) particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{a}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{ }
{b}	{ }	{c, d}	{a, b, s}	{a, b, s}	{a, s}	{b}	{ }
{c}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{ }
{d}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{ }	{c, d}	{a, b, s}	{a, b, s}	{a, s}	{b}	{a}
{a, c}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{a}
{a, d}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{a}
{a, s}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{s}
{b, c}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{b}
{b, d}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{b}
{b, s}	{ }	{c, d}	{a, b, s}	{a, b, s}	{a, s}	{b}	{s}
{c, d}	{c, d}	{ }	{a, b, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{c}
{c, s}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{s}
{d, s}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{s}
{a, b, c}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{a, b}
{a, b, d}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{a, b}
{a, b, s}	{ }	{c, d}	{a, b, s}	{a, b, s}	{a, s}	{b}	{a, s}
{a, c, d}	{c, d}	{ }	{a, b, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{a, c}
{a, c, s}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{a, s}
{a, d, s}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{a, s}
{b, c, d}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{b, c}
{b, c, s}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{b, s}
{b, d, s}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{b, s}
{c, d, s}	{c, d}	{ }	{a, b, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{c, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{a, b, c}
{a, b, c, s}	{ }	{d}	{a, b, c, s}	{a, b, c, s}	{a, b, s}	{c}	{a, b, s}
{a, b, d, s}	{d}	{ }	{a, b, c, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{a, b, s}
{a, c, d, s}	{c, d}	{ }	{a, b, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{a, c, s}
{b, c, d, s}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{b, c, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, s}	{d}	{a, b, c, s}

(66)

7. Examples of Embedding N=3, T0, particle-like topologies into N=5, to produce N=5, NOT T0, wave-like, topologies.

```
> print(` `);X:={a,b,c,d,s};LS3:={},{a},{b},{c},{a,b},{a,c},{b,c},{a,b,c};LS5:={LS3,X};print(`LS5 is a Not-T0 wave-like topology
  `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\ \}, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}$$

$$LS5 := \{\{\ \}, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{*a*}	{*b*, *c*}	{*d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{ }
{*b*}	{*b*}	{*a*, *c*}	{*d*, *s*}	{*b*, *d*, *s*}	{*d*, *s*}	{*b*}	{ }
{*c*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{ }
{*d*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*}	{*s*}	{ }
{*a*, *b*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*d*, *s*}	{*a*, *b*}	{ }
{*a*, *c*}	{*a*, *c*}	{*b*}	{*d*, *s*}	{*a*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*a*}	{*b*, *c*}	{*d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{*d*}
{*a*, *s*}	{*a*}	{*b*, *c*}	{*d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*, *c*}	{*a*}	{*d*, *s*}	{*b*, *c*, *d*, *s*}	{*d*, *s*}	{*b*, *c*}	{ }
{*b*, *d*}	{*b*}	{*a*, *c*}	{*d*, *s*}	{*b*, *d*, *s*}	{*d*, *s*}	{*b*}	{*d*}
{*b*, *s*}	{*b*}	{*a*, *c*}	{*d*, *s*}	{*b*, *d*, *s*}	{*d*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*d*}
{*c*, *s*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*, *s*}	{ }	{*d*, *s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *b*, *c*}	{ }
{*a*, *b*, *d*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*d*, *s*}	{*a*, *b*}	{*d*}
{*a*, *b*, *s*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*d*, *s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*, *c*}	{*b*}	{*d*, *s*}	{*a*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *c*}	{*d*}
{*a*, *c*, *s*}	{*a*, *c*}	{*b*}	{*d*, *s*}	{*a*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*a*}	{*b*, *c*}	{*d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{*d*, *s*}
{*b*, *c*, *d*}	{*b*, *c*}	{*a*}	{*d*, *s*}	{*b*, *c*, *d*, *s*}	{*d*, *s*}	{*b*, *c*}	{*d*}
{*b*, *c*, *s*}	{*b*, *c*}	{*a*}	{*d*, *s*}	{*b*, *c*, *d*, *s*}	{*d*, *s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{*b*}	{*a*, *c*}	{*d*, *s*}	{*b*, *d*, *s*}	{*d*, *s*}	{*b*}	{*d*, *s*}
{*c*, *d*, *s*}	{*c*}	{*a*, *b*}	{*d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *b*, *c*}	{*d*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *b*, *c*}	{*s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*}	{*c*}	{*d*, *s*}	{*a*, *b*, *d*, *s*}	{*d*, *s*}	{*a*, *b*}	{*d*, *s*}
{*a*, *c*, *d*, *s*}	{*a*, *c*}	{*b*}	{*d*, *s*}	{*a*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *c*}	{*d*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*}	{*a*}	{*d*, *s*}	{*b*, *c*, *d*, *s*}	{*d*, *s*}	{*b*, *c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*d*, *s*}	{*a*, *b*, *c*}	{*d*, *s*}

Some singletons have the same closure and cannot be distinguished **(67)**

```
> print(` `);X:={a,b,c,d,s};LS3:= {},{},{b},{c},{a,b},{},{b,c},{a,b,c};LS5:={LS3,X};;print(`LS5 is a Not-T0 wave-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$LS3 := \{\ \},\ \{\ \},\ \{b\},\ \{c\},\ \{a, b\},\ \{\ \},\ \{b, c\},\ \{a, b, c\}$$

$$LS5 := \{\{\ \},\ \{b\},\ \{c\},\ \{a, b\},\ \{b, c\},\ \{a, b, c\},\ \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{ }
{b}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{ }
{c}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, d, s}	{b}	{a}
{a, c}	{c}	{b}	{a, d, s}	{a, c, d, s}	{d, s}	{a, c}	{ }
{a, d}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d}
{a, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{s}
{b, c}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{ }
{b, d}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d}
{b, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{s}
{c, d}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a}
{a, b, d}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d}
{a, b, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, s}
{a, c, d}	{c}	{b}	{a, d, s}	{a, c, d, s}	{d, s}	{a, c}	{d}
{a, c, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{d, s}	{a, c}	{s}
{a, d, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d, s}
{b, c, d}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d}
{b, c, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{s}
{b, d, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d, s}
{c, d, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, s}
{a, b, d, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d, s}
{a, c, d, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{d, s}	{a, c}	{d, s}
{b, c, d, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d, s}

Some singletons have the same closure and cannot be distinguished **(68)**

```
> print(` `);X:={a,b,c,d,s};LS3:= {},{},{b},{c},{},{},{b,c},{a,b,c};LS5:={LS3,X};print(`LS5 is a Not-T0 wave-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{b\}, \{c\}, \{\}, \{\}, \{b, c\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{b\}, \{c\}, \{b, c\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{ }
{b}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{ }
{c}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a}
{a, c}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a}
{a, d}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d}
{a, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{s}
{b, c}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{ }
{b, d}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d}
{b, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{s}
{c, d}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{d}
{c, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a}
{a, b, d}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d}
{a, b, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, s}
{a, c, d}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, d}
{a, c, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, s}
{a, d, s}	{ }	{b, c}	{a, d, s}	{a, d, s}	{d, s}	{a}	{d, s}
{b, c, d}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d}
{b, c, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{s}
{b, d, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d, s}
{c, d, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, s}
{a, b, d, s}	{b}	{c}	{a, d, s}	{a, b, d, s}	{a, d, s}	{b}	{a, d, s}
{a, c, d, s}	{c}	{b}	{a, d, s}	{a, c, d, s}	{a, d, s}	{c}	{a, d, s}
{b, c, d, s}	{b, c}	{ }	{a, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, d, s}	{b, c}	{a, d, s}

Some singletons have the same closure and cannot be distinguished **(69)**

```
> print(` `);X:={a,b,c,d,s};L3:= {},{},{b},{},{a,b},{},{b,c},{a,b,c};LS5:={LS3,X};;print(`LS5 is a Not-T0 wave-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$L3 := \{\}, \{\}, \{b\}, \{\}, \{a, b\}, \{\}, \{b, c\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{b\}, \{c\}, \{b, c\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*}	{*a*, *d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{ }
{*b*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{ }
{*c*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{ }
{*d*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*}	{*s*}	{ }
{*a*, *b*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{*a*}
{*a*, *d*}	{ }	{*b*, *c*}	{*a*, *d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{*d*}
{*a*, *s*}	{ }	{*b*, *c*}	{*a*, *d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*, *c*}	{ }	{*a*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{ }
{*b*, *d*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*d*}
{*b*, *s*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{*d*}
{*c*, *s*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{ }	{*a*, *b*, *c*}	{*d*, *s*}	{*d*, *s*}	{*d*, *s*}	{ }	{*d*, *s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*a*}
{*a*, *b*, *d*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*a*, *d*}
{*a*, *b*, *s*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{*a*, *d*}
{*a*, *c*, *s*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{*a*, *s*}
{*a*, *d*, *s*}	{ }	{*b*, *c*}	{*a*, *d*, *s*}	{*a*, *d*, *s*}	{*d*, *s*}	{*a*}	{*d*, *s*}
{*b*, *c*, *d*}	{*b*, *c*}	{ }	{*a*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*d*}
{*b*, *c*, *s*}	{*b*, *c*}	{ }	{*a*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*d*, *s*}
{*c*, *d*, *s*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*a*, *d*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{ }	{*d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*a*, *s*}
{*a*, *b*, *d*, *s*}	{*b*}	{*c*}	{*a*, *d*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *d*, *s*}	{*b*}	{*a*, *d*, *s*}
{*a*, *c*, *d*, *s*}	{*c*}	{*b*}	{*a*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*c*}	{*a*, *d*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*}	{ }	{*a*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*d*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *d*, *s*}	{*b*, *c*}	{*a*, *d*, *s*}

Some singletons have the same closure and cannot be distinguished **(70)**

```
> print(` `);X:={a,b,c,d,s};LS3:= {},{},{b},{},{},{},{a,b},{a,b,c} ;LS5:={LS3,X};;print(`LS5 is a Not-T0 wave-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{b\}, \{\}, \{\}, \{\}, \{a, b\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{b\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{ }
{b}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a}
{a, c}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c}
{a, d}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d}
{a, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{s}
{b, c}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c}
{b, d}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, s}
{a, c, d}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d}
{a, c, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, s}
{a, d, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d, s}
{b, c, d}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d}
{b, c, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, s}
{b, d, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, d, s}
{a, c, d, s}	{ }	{b}	{a, c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{b}	{ }	{a, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, c, d, s}	{b}	{a, c, d, s}

Some singletons have the same closure and cannot be distinguished **(71)**

```
> :
```

8. Examples of N=3, NOT T0, wave-like topologies which can be embedded into N=5, NOT T0, wave-like topologies.

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{},{},{},{},{},{a,b,c};LS5:={LS3,X};;print(`LS5 is a Not-T0 wave-like topology `);
  LAT5abcds(LS5,``,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{\}, \{\}, \{\}, \{\}, \{\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c}
{a, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c}
{b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{d}
{c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c}
{a, b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d}
{a, b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, s}
{a, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d}
{a, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, s}
{a, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d}
{b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, s}
{b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, s}
{a, b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d, s}
{b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{},{a,b},{},{},{},{a,b,c};LS5:={LS3,X};;print(`LS5 is a Not-T0 wave-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{\}, \{a, b\}, \{\}, \{\}, \{\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c}
{a, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c}
{b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, s}
{a, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, s}
{a, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d}
{b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, s}
{b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d, s}

Some singletons have the same closure and cannot be distinguished **(73)**

```
> print(` `);X:={a,b,c,d,s};LS3:={},{},{c},{a,b},{},{},{},{a,b,c};LS5:={LS3,X};print(`LS5 is a Not-T0 wave-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{\}, \{c\}, \{a, b\}, \{\}, \{\}, \{\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{c\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{ }
{b}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{a, d, s}	{b}	{ }
{c}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, b, d, s}	{ }	{a, b}
{a, c}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{ }
{a, d}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d}
{a, s}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{s}
{b, c}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{ }
{b, d}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d}
{b, s}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{a, d, s}	{b}	{s}
{c, d}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{a, b}
{a, b, d}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, b, d, s}	{ }	{a, b, d}
{a, b, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, b, d, s}	{ }	{a, b, s}
{a, c, d}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d}
{a, c, s}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{s}
{a, d, s}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d, s}
{b, c, d}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d}
{b, c, s}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{s}
{b, d, s}	{ }	{c}	{a, b, d, s}	{a, b, d, s}	{a, d, s}	{b}	{d, s}
{c, d, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{a, b, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{a, b, s}
{a, b, d, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{a, b, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d, s}
{b, c, d, s}	{c}	{ }	{a, b, d, s}	{a, b, c, d, s}	{a, d, s}	{b, c}	{d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, d, s}	{c}	{a, b, d, s}

Some singletons have the same closure and cannot be distinguished

9. Examples of N=4, T0, particle-like topologies which can be embedded into N=5, T0, particle-like topologies.

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{b},{c},{d},{a,b},{a,c},{a,d},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{a,c,d},{b,c,d},{a,b,c,d};LS5:=
  {LS4,X};print(`LS5 is a T0 particle-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b, c, d}	{s}	{a, s}	{s}	{a}	{ }
{b}	{b}	{a, c, d}	{s}	{b, s}	{s}	{b}	{ }
{c}	{c}	{a, b, d}	{s}	{c, s}	{s}	{c}	{ }
{d}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{c, d}	{s}	{a, b, s}	{s}	{a, b}	{ }
{a, c}	{a, c}	{b, d}	{s}	{a, c, s}	{s}	{a, c}	{ }
{a, d}	{a, d}	{b, c}	{s}	{a, d, s}	{s}	{a, d}	{ }
{a, s}	{a}	{b, c, d}	{s}	{a, s}	{s}	{a}	{s}
{b, c}	{b, c}	{a, d}	{s}	{b, c, s}	{s}	{b, c}	{ }
{b, d}	{b, d}	{a, c}	{s}	{b, d, s}	{s}	{b, d}	{ }
{b, s}	{b}	{a, c, d}	{s}	{b, s}	{s}	{b}	{s}
{c, d}	{c, d}	{a, b}	{s}	{c, d, s}	{s}	{c, d}	{ }
{c, s}	{c}	{a, b, d}	{s}	{c, s}	{s}	{c}	{s}
{d, s}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{d}	{s}	{a, b, c, s}	{s}	{a, b, c}	{ }
{a, b, d}	{a, b, d}	{c}	{s}	{a, b, d, s}	{s}	{a, b, d}	{ }
{a, b, s}	{a, b}	{c, d}	{s}	{a, b, s}	{s}	{a, b}	{s}
{a, c, d}	{a, c, d}	{b}	{s}	{a, c, d, s}	{s}	{a, c, d}	{ }
{a, c, s}	{a, c}	{b, d}	{s}	{a, c, s}	{s}	{a, c}	{s}
{a, d, s}	{a, d}	{b, c}	{s}	{a, d, s}	{s}	{a, d}	{s}
{b, c, d}	{b, c, d}	{a}	{s}	{b, c, d, s}	{s}	{b, c, d}	{ }
{b, c, s}	{b, c}	{a, d}	{s}	{b, c, s}	{s}	{b, c}	{s}
{b, d, s}	{b, d}	{a, c}	{s}	{b, d, s}	{s}	{b, d}	{s}
{c, d, s}	{c, d}	{a, b}	{s}	{c, d, s}	{s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{s}	{a, b, c, d}	{ }
{a, b, c, s}	{a, b, c}	{d}	{s}	{a, b, c, s}	{s}	{a, b, c}	{s}
{a, b, d, s}	{a, b, d}	{c}	{s}	{a, b, d, s}	{s}	{a, b, d}	{s}
{a, c, d, s}	{a, c, d}	{b}	{s}	{a, c, d, s}	{s}	{a, c, d}	{s}
{b, c, d, s}	{b, c, d}	{a}	{s}	{b, c, d, s}	{s}	{b, c, d}	{s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{s}	{a, b, c, d}	{s}

(75)

```
> print(` `);X:={a,b,c,d,s};LS4={},{b},{c},{d},{a,b},{b,c},{b,d},{c,d},{a,b,c},{a,b,d},{b,c,d},{a,b,c,d};print(`LS5 is a T0 particle-
  like topology `);LS5:={LS4,X};LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$(\{\{\}\}, \{\{a\}\}, \{\{b\}\}, \{\{c\}\}, \{\{d\}\}, \{\{a, b\}\}, \{\{a, c\}\}, \{\{a, d\}\}, \{\{b, c\}\}, \{\{b, d\}\}, \{\{c, d\}\}, \{\{a, b, c\}\}, \{\{a, b, d\}\}, \{\{a, c, d\}\}, \{\{b, c, d\}\}, \{\{a, b, c, d\}\}) = \{\{\}\}, \{\{b\}\}, \{\{c\}\}, \{\{d\}\}, \{\{a, b\}\}, \{\{b, c\}\}, \{\{b, d\}\}, \{\{c, d\}\}, \{\{a, b, c\}\}, \{\{a, b, d\}\}, \{\{b, c, d\}\}, \{\{a, b, c, d\}\}$$

LS5 is a T0 particle-like topology

$$LS5 := \{\{\}, \{a\}, \{b\}, \{c\}, \{d\}, \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{a, b, c\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{*a*}	{*b*, *c*, *d*}	{*s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{*b*}	{*a*, *c*, *d*}	{*s*}	{*b*, *s*}	{*s*}	{*b*}	{ }
{*c*}	{*c*}	{*a*, *b*, *d*}	{*s*}	{*c*, *s*}	{*s*}	{*c*}	{ }
{*d*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{*a*, *b*}	{*c*, *d*}	{*s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{ }
{*a*, *c*}	{*a*, *c*}	{*b*, *d*}	{*s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*a*, *d*}	{*b*, *c*}	{*s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{ }
{*a*, *s*}	{*a*}	{*b*, *c*, *d*}	{*s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*, *c*}	{*a*, *d*}	{*s*}	{*b*, *c*, *s*}	{*s*}	{*b*, *c*}	{ }
{*b*, *d*}	{*b*, *d*}	{*a*, *c*}	{*s*}	{*b*, *d*, *s*}	{*s*}	{*b*, *d*}	{ }
{*b*, *s*}	{*b*}	{*a*, *c*, *d*}	{*s*}	{*b*, *s*}	{*s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{*a*, *b*}	{*s*}	{*c*, *d*, *s*}	{*s*}	{*c*, *d*}	{ }
{*c*, *s*}	{*c*}	{*a*, *b*, *d*}	{*s*}	{*c*, *s*}	{*s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*s*}	{*a*, *b*, *c*}	{ }
{*a*, *b*, *d*}	{*a*, *b*, *d*}	{*c*}	{*s*}	{*a*, *b*, *d*, *s*}	{*s*}	{*a*, *b*, *d*}	{ }
{*a*, *b*, *s*}	{*a*, *b*}	{*c*, *d*}	{*s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*, *c*, *d*}	{*b*}	{*s*}	{*a*, *c*, *d*, *s*}	{*s*}	{*a*, *c*, *d*}	{ }
{*a*, *c*, *s*}	{*a*, *c*}	{*b*, *d*}	{*s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*a*, *d*}	{*b*, *c*}	{*s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{*s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{*a*}	{*s*}	{*b*, *c*, *d*, *s*}	{*s*}	{*b*, *c*, *d*}	{ }
{*b*, *c*, *s*}	{*b*, *c*}	{*a*, *d*}	{*s*}	{*b*, *c*, *s*}	{*s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{*b*, *d*}	{*a*, *c*}	{*s*}	{*b*, *d*, *s*}	{*s*}	{*b*, *d*}	{*s*}
{*c*, *d*, *s*}	{*c*, *d*}	{*a*, *b*}	{*s*}	{*c*, *d*, *s*}	{*s*}	{*c*, *d*}	{*s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*s*}	{*a*, *b*, *c*, *d*}	{ }
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*s*}	{*a*, *b*, *c*}	{*s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*}	{*c*}	{*s*}	{*a*, *b*, *d*, *s*}	{*s*}	{*a*, *b*, *d*}	{*s*}
{*a*, *c*, *d*, *s*}	{*a*, *c*, *d*}	{*b*}	{*s*}	{*a*, *c*, *d*, *s*}	{*s*}	{*a*, *c*, *d*}	{*s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{*a*}	{*s*}	{*b*, *c*, *d*, *s*}	{*s*}	{*b*, *c*, *d*}	{*s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*s*}	{*a*, *b*, *c*, *d*}	{*s*}

(76)

```
> sprint(` `);X:={a,b,c,d,s};LS4:={},{},{b},{d},{a,b},{b,d},{c,d},{a,b,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0
  particle-like topology `);LAT5abcds(LS5,` `,5):
```

$$sprint[\ `\ `]$$

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{\ \}, \{b\}, \{d\}, \{a, b\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{b\}, \{d\}, \{a, b\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

$$LS5\ is\ a\ T0\ particle\text{-}like\ topology$$

` `

$$Is\ LS5:\ \ a\ topology = true,\quad connected = true,\quad Kolmogorov.T0 = true,\quad Hausdorff.T2 = false$$

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{ }
{b}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{ }
{c}	{ }	{a, b, d}	{c, s}	{c, s}	{s}	{c}	{ }
{d}	{d}	{a, b}	{c, s}	{c, d, s}	{c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{c, d}	{s}	{a, b, s}	{a, s}	{b}	{a}
{a, c}	{ }	{b, d}	{a, c, s}	{a, c, s}	{s}	{a, c}	{ }
{a, d}	{d}	{b}	{a, c, s}	{a, c, d, s}	{c, s}	{a, d}	{ }
{a, s}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{s}
{b, c}	{b}	{d}	{a, c, s}	{a, b, c, s}	{a, s}	{b, c}	{ }
{b, d}	{b, d}	{ }	{a, c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{ }
{b, s}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{s}
{c, d}	{c, d}	{a, b}	{s}	{c, d, s}	{c, s}	{d}	{c}
{c, s}	{ }	{a, b, d}	{c, s}	{c, s}	{s}	{c}	{s}
{d, s}	{d}	{a, b}	{c, s}	{c, d, s}	{c, s}	{d}	{s}
{a, b, c}	{a, b}	{d}	{c, s}	{a, b, c, s}	{a, s}	{b, c}	{a}
{a, b, d}	{a, b, d}	{ }	{c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{a}
{a, b, s}	{a, b}	{c, d}	{s}	{a, b, s}	{a, s}	{b}	{a, s}
{a, c, d}	{c, d}	{b}	{a, s}	{a, c, d, s}	{c, s}	{a, d}	{c}
{a, c, s}	{ }	{b, d}	{a, c, s}	{a, c, s}	{s}	{a, c}	{s}
{a, d, s}	{d}	{b}	{a, c, s}	{a, c, d, s}	{c, s}	{a, d}	{s}
{b, c, d}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{c}
{b, c, s}	{b}	{d}	{a, c, s}	{a, b, c, s}	{a, s}	{b, c}	{s}
{b, d, s}	{b, d}	{ }	{a, c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{s}
{c, d, s}	{c, d}	{a, b}	{s}	{c, d, s}	{c, s}	{d}	{c, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{a, c}
{a, b, c, s}	{a, b}	{d}	{c, s}	{a, b, c, s}	{a, s}	{b, c}	{a, s}
{a, b, d, s}	{a, b, d}	{ }	{c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{a, s}
{a, c, d, s}	{c, d}	{b}	{a, s}	{a, c, d, s}	{c, s}	{a, d}	{c, s}
{b, c, d, s}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{c, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, c, s}	{b, d}	{a, c, s}

(77)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{c},{d},{a,c},{b,c},{c,d},{a,b,c},{a,c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0
  particle-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{c\}, \{d\}, \{a, c\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{c\}, \{d\}, \{a, c\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{ }
{*c*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{ }
{*d*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{ }
{*a*, *c*}	{*a*, *c*}	{*d*}	{*b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*}
{*a*, *d*}	{*d*}	{*b*, *c*}	{*a*, *s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{ }
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*, *c*}	{*d*}	{*a*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*}
{*b*, *d*}	{*d*}	{*a*, *c*}	{*b*, *s*}	{*b*, *d*, *s*}	{*s*}	{*b*, *d*}	{ }
{*b*, *s*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{ }
{*c*, *s*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*}
{*a*, *b*, *d*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*s*}	{*a*, *b*, *d*}	{ }
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*}
{*a*, *c*, *s*}	{*a*, *c*}	{*d*}	{*b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *s*}
{*a*, *d*, *s*}	{*d*}	{*b*, *c*}	{*a*, *s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{*s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*b*}
{*b*, *c*, *s*}	{*b*, *c*}	{*d*}	{*a*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*, *s*}
{*b*, *d*, *s*}	{*d*}	{*a*, *c*}	{*b*, *s*}	{*b*, *d*, *s*}	{*s*}	{*b*, *d*}	{*s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *b*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*, *s*}
{*a*, *b*, *d*, *s*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*s*}	{*a*, *b*, *d*}	{*s*}
{*a*, *c*, *d*, *s*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*b*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *b*, *s*}

(78)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{c},{d},{a,c},{a,d},{c,d},{a,b,c},{a,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0
  particle-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{c\}, \{d\}, \{a, c\}, \{a, d\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{c\}, \{d\}, \{a, c\}, \{a, d\}, \{c, d\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{ }
{b}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{ }
{c}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{ }
{d}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{b}
{a, c}	{a, c}	{d}	{b, s}	{a, b, c, s}	{b, s}	{a, c}	{ }
{a, d}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{ }
{a, s}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{s}
{b, c}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{b}
{b, d}	{d}	{a, c}	{b, s}	{b, d, s}	{s}	{b, d}	{ }
{b, s}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{s}
{c, d}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{ }
{c, s}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{s}
{d, s}	{d}	{a, b, c}	{s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{d}	{s}	{a, b, c, s}	{b, s}	{a, c}	{b}
{a, b, d}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{b}
{a, b, s}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{b, s}
{a, c, d}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, s}	{a, c, d}	{ }
{a, c, s}	{a, c}	{d}	{b, s}	{a, b, c, s}	{b, s}	{a, c}	{s}
{a, d, s}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{s}
{b, c, d}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{b}
{b, c, s}	{c}	{a, d}	{b, s}	{b, c, s}	{b, s}	{c}	{b, s}
{b, d, s}	{d}	{a, c}	{b, s}	{b, d, s}	{s}	{b, d}	{s}
{c, d, s}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, s}	{a, c, d}	{b}
{a, b, c, s}	{a, b, c}	{d}	{s}	{a, b, c, s}	{b, s}	{a, c}	{b, s}
{a, b, d, s}	{a, d}	{c}	{b, s}	{a, b, d, s}	{b, s}	{a, d}	{b, s}
{a, c, d, s}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, s}	{a, c, d}	{s}
{b, c, d, s}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, s}	{c, d}	{b, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, s}	{a, c, d}	{b, s}

(79)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{c},{d},{b,c},{c,d},{a,b,c},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0 particle-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{c\}, \{d\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{c\}, \{d\}, \{b, c\}, \{c, d\}, \{a, b, c\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{ }
{*c*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{ }
{*d*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*}
{*a*, *d*}	{*d*}	{*b*, *c*}	{*a*, *s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{ }
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*, *c*}	{*d*}	{*a*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*}
{*b*, *d*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{ }
{*b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{ }
{*c*, *s*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{*a*, *b*, *c*}	{*s*}	{*d*, *s*}	{*s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*}
{*a*, *b*, *d*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{*a*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*}
{*a*, *c*, *s*}	{*c*}	{*d*}	{*a*, *b*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *s*}
{*a*, *d*, *s*}	{*d*}	{*b*, *c*}	{*a*, *s*}	{*a*, *d*, *s*}	{*s*}	{*a*, *d*}	{*s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*b*}
{*b*, *c*, *s*}	{*b*, *c*}	{*d*}	{*a*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*, *s*}
{*b*, *d*, *s*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{*s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *b*}
{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*}	{*d*}	{*s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*, *s*}
{*a*, *b*, *d*, *s*}	{*d*}	{*c*}	{*a*, *b*, *s*}	{*a*, *b*, *d*, *s*}	{*a*, *s*}	{*b*, *d*}	{*a*, *s*}
{*a*, *c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*b*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *s*}	{*c*, *d*}	{*a*, *b*, *s*}

(80)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{},{d},{a,d},{c,d},{a,c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0 particle-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{\}, \{d\}, \{a, d\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{d\}, \{a, d\}, \{c, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{ }
{*d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{ }
{*a*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{*b*}
{*b*, *d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*}
{*b*, *s*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{*b*}
{*a*, *b*, *d*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*}
{*b*, *c*, *s*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*b*, *s*}	{*c*}	{*b*, *s*}
{*b*, *d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*}
{*a*, *b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*b*, *s*}	{*a*, *c*}	{*b*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *s*}
{*a*, *c*, *d*, *s*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*, *s*}

(81)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{b},{d},{b,d},{a,b,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0 particle-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{\ \}, \{b\}, \{d\}, \{b, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{b\}, \{d\}, \{b, d\}, \{a, b, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{ }
{*d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*c*}
{*b*, *d*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{ }
{*b*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*, *c*}
{*a*, *b*, *d*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*}
{*a*, *b*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*c*}
{*b*, *c*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*c*, *s*}
{*b*, *d*, *s*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*s*}
{*c*, *d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *c*}
{*a*, *b*, *c*, *s*}	{*b*}	{*d*}	{*a*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *c*, *s*}	{*b*}	{*a*, *c*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *s*}
{*a*, *c*, *d*, *s*}	{*d*}	{*b*}	{*a*, *c*, *s*}	{*a*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *c*, *s*}	{*b*, *d*}	{*a*, *c*, *s*}

(82)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{c},{},{a,c},{},{a,b,c},{},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0 particle-like topology
  `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{a\}, \{c\}, \{\ \}, \{a, c\}, \{\ \}, \{a, b, c\}, \{\ \}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{a\}, \{c\}, \{a, c\}, \{a, b, c\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{ }
{b}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{ }
{c}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{ }
{a, d}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d}
{a, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{s}
{b, c}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b}
{b, d}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d}
{b, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{s}
{c, d}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d}
{c, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b}
{a, b, d}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d}
{a, b, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, s}
{a, c, d}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d}
{a, c, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{s}
{a, d, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d, s}
{b, c, d}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d}
{b, c, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, s}
{b, d, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d, s}
{c, d, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, s}
{a, b, d, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d, s}
{b, c, d, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d, s}

(83)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{a,c},{a,b,c},{a,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0 particle-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{a, c\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{a, c\}, \{a, b, c\}, \{a, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{ }
{c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b}
{b, d}	{ }	{a, c}	{b, d, s}	{b, d, s}	{s}	{b, d}	{ }
{b, s}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{s}
{c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d}
{c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d}
{a, b, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, s}
{a, c, d}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, s}
{a, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d}
{b, c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, s}
{b, d, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{s}	{b, d}	{s}
{c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, s}
{a, b, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d, s}

(84)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{d},{b,d},{c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0 particle-like topology `);
  LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{d\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{d\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, s\}$	$\{a, s\}$	$\{s\}$	$\{a\}$	$\{\ \}$
$\{b\}$	$\{\ \}$	$\{c, d\}$	$\{a, b, s\}$	$\{a, b, s\}$	$\{a, s\}$	$\{b\}$	$\{\ \}$
$\{c\}$	$\{\ \}$	$\{b, d\}$	$\{a, c, s\}$	$\{a, c, s\}$	$\{a, s\}$	$\{c\}$	$\{\ \}$
$\{d\}$	$\{d\}$	$\{\ \}$	$\{a, b, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{\ \}$
$\{s\}$	$\{\ \}$	$\{a, b, c, d\}$	$\{s\}$	$\{s\}$	$\{\ \}$	$\{s\}$	$\{\ \}$
$\{a, b\}$	$\{\ \}$	$\{c, d\}$	$\{a, b, s\}$	$\{a, b, s\}$	$\{a, s\}$	$\{b\}$	$\{a\}$
$\{a, c\}$	$\{\ \}$	$\{b, d\}$	$\{a, c, s\}$	$\{a, c, s\}$	$\{a, s\}$	$\{c\}$	$\{a\}$
$\{a, d\}$	$\{d\}$	$\{\ \}$	$\{a, b, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a\}$
$\{a, s\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, s\}$	$\{a, s\}$	$\{s\}$	$\{a\}$	$\{s\}$
$\{b, c\}$	$\{\ \}$	$\{d\}$	$\{a, b, c, s\}$	$\{a, b, c, s\}$	$\{a, s\}$	$\{b, c\}$	$\{\ \}$
$\{b, d\}$	$\{b, d\}$	$\{\ \}$	$\{a, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{b\}$
$\{b, s\}$	$\{\ \}$	$\{c, d\}$	$\{a, b, s\}$	$\{a, b, s\}$	$\{a, s\}$	$\{b\}$	$\{s\}$
$\{c, d\}$	$\{c, d\}$	$\{\ \}$	$\{a, b, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{c\}$
$\{c, s\}$	$\{\ \}$	$\{b, d\}$	$\{a, c, s\}$	$\{a, c, s\}$	$\{a, s\}$	$\{c\}$	$\{s\}$
$\{d, s\}$	$\{d\}$	$\{\ \}$	$\{a, b, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{s\}$
$\{a, b, c\}$	$\{\ \}$	$\{d\}$	$\{a, b, c, s\}$	$\{a, b, c, s\}$	$\{a, s\}$	$\{b, c\}$	$\{a\}$
$\{a, b, d\}$	$\{b, d\}$	$\{\ \}$	$\{a, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a, b\}$
$\{a, b, s\}$	$\{\ \}$	$\{c, d\}$	$\{a, b, s\}$	$\{a, b, s\}$	$\{a, s\}$	$\{b\}$	$\{a, s\}$
$\{a, c, d\}$	$\{c, d\}$	$\{\ \}$	$\{a, b, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a, c\}$
$\{a, c, s\}$	$\{\ \}$	$\{b, d\}$	$\{a, c, s\}$	$\{a, c, s\}$	$\{a, s\}$	$\{c\}$	$\{a, s\}$
$\{a, d, s\}$	$\{d\}$	$\{\ \}$	$\{a, b, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a, s\}$
$\{b, c, d\}$	$\{b, c, d\}$	$\{\ \}$	$\{a, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{b, c\}$
$\{b, c, s\}$	$\{\ \}$	$\{d\}$	$\{a, b, c, s\}$	$\{a, b, c, s\}$	$\{a, s\}$	$\{b, c\}$	$\{s\}$
$\{b, d, s\}$	$\{b, d\}$	$\{\ \}$	$\{a, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{b, s\}$
$\{c, d, s\}$	$\{c, d\}$	$\{\ \}$	$\{a, b, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{c, s\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\ \}$	$\{s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a, b, c\}$
$\{a, b, c, s\}$	$\{\ \}$	$\{d\}$	$\{a, b, c, s\}$	$\{a, b, c, s\}$	$\{a, s\}$	$\{b, c\}$	$\{a, s\}$
$\{a, b, d, s\}$	$\{b, d\}$	$\{\ \}$	$\{a, c, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a, b, s\}$
$\{a, c, d, s\}$	$\{c, d\}$	$\{\ \}$	$\{a, b, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a, c, s\}$
$\{b, c, d, s\}$	$\{b, c, d\}$	$\{\ \}$	$\{a, s\}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{b, c, s\}$
$\{a, b, c, d, s\}$	$\{a, b, c, d, s\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d, s\}$	$\{a, b, c, s\}$	$\{d\}$	$\{a, b, c, s\}$

(85)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{b},{d},{},{a,b},{b,d},{},{a,b,d},{a,b,c,d};;LS5:={LS4,X};print(`LS5 is a T0 particle-like
  topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{b\}, \{d\}, \{\}, \{a, b\}, \{b, d\}, \{\}, \{a, b, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{b\}, \{d\}, \{a, b\}, \{b, d\}, \{a, b, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, d}	{a, c, s}	{a, c, s}	{c, s}	{a}	{ }
{b}	{b}	{d}	{a, c, s}	{a, b, c, s}	{a, c, s}	{b}	{ }
{c}	{ }	{a, b, d}	{c, s}	{c, s}	{s}	{c}	{ }
{d}	{d}	{a, b}	{c, s}	{c, d, s}	{c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{d}	{c, s}	{a, b, c, s}	{a, c, s}	{b}	{a}
{a, c}	{ }	{b, d}	{a, c, s}	{a, c, s}	{c, s}	{a}	{c}
{a, d}	{d}	{b}	{a, c, s}	{a, c, d, s}	{c, s}	{a, d}	{ }
{a, s}	{ }	{b, d}	{a, c, s}	{a, c, s}	{c, s}	{a}	{s}
{b, c}	{b}	{d}	{a, c, s}	{a, b, c, s}	{a, c, s}	{b}	{c}
{b, d}	{b, d}	{ }	{a, c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{ }
{b, s}	{b}	{d}	{a, c, s}	{a, b, c, s}	{a, c, s}	{b}	{s}
{c, d}	{d}	{a, b}	{c, s}	{c, d, s}	{c, s}	{d}	{c}
{c, s}	{ }	{a, b, d}	{c, s}	{c, s}	{s}	{c}	{s}
{d, s}	{d}	{a, b}	{c, s}	{c, d, s}	{c, s}	{d}	{s}
{a, b, c}	{a, b}	{d}	{c, s}	{a, b, c, s}	{a, c, s}	{b}	{a, c}
{a, b, d}	{a, b, d}	{ }	{c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{a}
{a, b, s}	{a, b}	{d}	{c, s}	{a, b, c, s}	{a, c, s}	{b}	{a, s}
{a, c, d}	{d}	{b}	{a, c, s}	{a, c, d, s}	{c, s}	{a, d}	{c}
{a, c, s}	{ }	{b, d}	{a, c, s}	{a, c, s}	{c, s}	{a}	{c, s}
{a, d, s}	{d}	{b}	{a, c, s}	{a, c, d, s}	{c, s}	{a, d}	{s}
{b, c, d}	{b, d}	{ }	{a, c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{c}
{b, c, s}	{b}	{d}	{a, c, s}	{a, b, c, s}	{a, c, s}	{b}	{c, s}
{b, d, s}	{b, d}	{ }	{a, c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{s}
{c, d, s}	{d}	{a, b}	{c, s}	{c, d, s}	{c, s}	{d}	{c, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{a, c}
{a, b, c, s}	{a, b}	{d}	{c, s}	{a, b, c, s}	{a, c, s}	{b}	{a, c, s}
{a, b, d, s}	{a, b, d}	{ }	{c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{a, s}
{a, c, d, s}	{d}	{b}	{a, c, s}	{a, c, d, s}	{c, s}	{a, d}	{c, s}
{b, c, d, s}	{b, d}	{ }	{a, c, s}	{a, b, c, d, s}	{a, c, s}	{b, d}	{c, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, c, s}	{b, d}	{a, c, s}

(86)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{c},{ },{a,c},{a,b},{},{},{},{a,b,c},{},{},{},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0
  particle-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{c\}, \{\}, \{a, c\}, \{a, b\}, \{\}, \{\}, \{\}, \{a, b, c\}, \{\}, \{\}, \{\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{c\}, \{a, b\}, \{a, c\}, \{a, b, c\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{ }
{b}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{ }
{c}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b}
{a, c}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{ }
{a, d}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d}
{a, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{s}
{b, c}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{ }
{b, d}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d}
{b, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{s}
{c, d}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b}
{a, b, d}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d}
{a, b, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, s}
{a, c, d}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d}
{a, c, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{s}
{a, d, s}	{a}	{c}	{b, d, s}	{a, b, d, s}	{b, d, s}	{a}	{d, s}
{b, c, d}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{d}
{b, c, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{s}
{b, d, s}	{ }	{a, c}	{b, d, s}	{b, d, s}	{d, s}	{b}	{d, s}
{c, d, s}	{c}	{a, b}	{d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, s}
{a, b, d, s}	{a, b}	{c}	{d, s}	{a, b, d, s}	{b, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a, c}	{ }	{b, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{d, s}
{b, c, d, s}	{c}	{a}	{b, d, s}	{b, c, d, s}	{d, s}	{b, c}	{d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, d, s}

(87)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{d},{a,d},{b,d},{c,d},{a,b,d},{a,c,d},{b,c,d},{a,b,c,d};;LS5:={LS4,X};print(`LS5 is a T0
  particle-like topology `);LAT5abcds(LS5,` `,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{d\}, \{a, d\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{d\}, \{a, d\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{a, c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{ }
{*d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{ }
{*a*, *c*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*s*}	{*b*, *c*}	{ }
{*b*, *d*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*}
{*b*, *s*}	{ }	{*a*, *c*, *d*}	{*b*, *s*}	{*b*, *s*}	{*s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*a*, *b*, *d*}	{*c*, *s*}	{*c*, *s*}	{*s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*s*}	{*a*, *b*, *c*}	{ }
{*a*, *b*, *d*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*b*, *d*}	{*a*, *c*, *s*}	{*a*, *c*, *s*}	{*s*}	{*a*, *c*}	{*s*}
{*a*, *d*, *s*}	{*a*, *d*}	{ }	{*b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*}
{*b*, *c*, *s*}	{ }	{*a*, *d*}	{*b*, *c*, *s*}	{*b*, *c*, *s*}	{*s*}	{*b*, *c*}	{*s*}
{*b*, *d*, *s*}	{*b*, *d*}	{ }	{*a*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*}
{*a*, *b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*s*}	{*a*, *b*, *c*}	{*s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*, *d*}	{ }	{*c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *s*}
{*a*, *c*, *d*, *s*}	{*a*, *c*, *d*}	{ }	{*b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*, *s*}

(88)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{b},{c},{d},{b,c},{b,d},{c,d},{b,c,d},{a,b,c,d};;LS5:={LS4,X};print(`LS5 is a T0 particle-like
  topology `);;LAT5abcds(LS5,`N`,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{b\}, \{c\}, \{d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{b\}, \{c\}, \{d\}, \{b, c\}, \{b, d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{ }
{b}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{ }
{c}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{ }
{d}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{a}
{a, c}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{a}
{a, d}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{a}
{a, s}	{ }	{b, c, d}	{a, s}	{a, s}	{s}	{a}	{s}
{b, c}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{ }
{b, d}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{ }
{b, s}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{s}
{c, d}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{ }
{c, s}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{s}
{d, s}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{s}
{a, b, c}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{a}
{a, b, d}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{a}
{a, b, s}	{b}	{c, d}	{a, s}	{a, b, s}	{a, s}	{b}	{a, s}
{a, c, d}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{a}
{a, c, s}	{c}	{b, d}	{a, s}	{a, c, s}	{a, s}	{c}	{a, s}
{a, d, s}	{d}	{b, c}	{a, s}	{a, d, s}	{a, s}	{d}	{a, s}
{b, c, d}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{ }
{b, c, s}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{s}
{b, d, s}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{s}
{c, d, s}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{a}
{a, b, c, s}	{b, c}	{d}	{a, s}	{a, b, c, s}	{a, s}	{b, c}	{a, s}
{a, b, d, s}	{b, d}	{c}	{a, s}	{a, b, d, s}	{a, s}	{b, d}	{a, s}
{a, c, d, s}	{c, d}	{b}	{a, s}	{a, c, d, s}	{a, s}	{c, d}	{a, s}
{b, c, d, s}	{b, c, d}	{ }	{a, s}	{a, b, c, d, s}	{a, s}	{b, c, d}	{s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, s}	{b, c, d}	{a, s}

(89)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{d},{c,d},{b,c,d},{a,b,c,d};LS5:={LS4,X};print(`LS5 is a T0 particle-like topology `);
  LAT5abcds(LS5,`N`,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{d\}, \{c, d\}, \{b, c, d\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS5 is a T0 particle-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{ }
{*b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{ }
{*c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{ }
{*d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*}
{*a*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*}
{*a*, *d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*}
{*a*, *s*}	{ }	{*b*, *c*, *d*}	{*a*, *s*}	{*a*, *s*}	{*s*}	{*a*}	{*s*}
{*b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*}
{*b*, *d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*}
{*b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*}
{*c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*}
{*a*, *b*, *d*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*}
{*a*, *b*, *s*}	{ }	{*c*, *d*}	{*a*, *b*, *s*}	{*a*, *b*, *s*}	{*a*, *s*}	{*b*}	{*a*, *s*}
{*a*, *c*, *d*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*}
{*a*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *s*}
{*a*, *d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *s*}
{*b*, *c*, *d*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*}
{*b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*b*, *s*}
{*b*, *d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *s*}
{*c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*c*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*}
{*a*, *b*, *c*, *s*}	{ }	{*d*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *s*}	{*a*, *b*, *s*}	{*c*}	{*a*, *b*, *s*}
{*a*, *b*, *d*, *s*}	{*d*}	{ }	{*a*, *b*, *c*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *s*}
{*a*, *c*, *d*, *s*}	{*c*, *d*}	{ }	{*a*, *b*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *c*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{ }	{*a*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*b*, *c*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *s*}	{*d*}	{*a*, *b*, *c*, *s*}

(90)

10. Examples of N=4, Not-T0, wave-like topologies which can be embedded into N=5, Not-T0, wave-like topologies X = {a,b,c,d,s}

Some or All Singleton closures are not distinguishable.

```
> print(` `);X:={a,b,c,d,s};LS4:= {},{},{},{},{a,b,c,d};LS5:={LS4,X};print(` A NotT0  wavelike topology embeds into LS5, a N=
  5, NOT T0, wave-like topology `) :;LAT5abcds(LS5,` N`,5);
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{\ \}, \{\ \}, \{\ \}, \{a, b, c, d\}$$

$$LS5 := \{\{\ \}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

A NotT0 wavelike topology embeds into LS5, a N=5, NOT T0, wave-like topology

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{ }
{d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c}
{a, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, d}
{a, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c}
{b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, d}
{b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{c, d}
{c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{s}
{d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{s}
{a, b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c}
{a, b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d}
{a, b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, s}
{a, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d}
{a, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, s}
{a, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, d, s}
{b, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d}
{b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, s}
{b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, d, s}
{c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d}
{a, b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, s}
{a, b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d, s}
{b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{},{a,b,c},{a,b,c,d};LS5:={LS4,X};print(` A NotT0  wavelike topology embeds into LS5, a
  N=5, NOT T0, wave-like topology `) :;LAT5abcds(LS5,`N`,5);
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{\ \}, \{\ \}, \{a, b, c\}, \{a, b, c, d\}$$

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A NotT0 wavelike topology embeds into LS5, a N=5, NOT T0, wave-like topology

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c}
{a, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c}
{b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{d}
{c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c}
{a, b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d}
{a, b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, s}
{a, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d}
{a, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, s}
{a, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d}
{b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, s}
{b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, s}
{a, b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d, s}
{b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{},{a,b},{a,b,c,d};LS5:={LS4,X};print(` A NotT0  wavelike topology embeds into LS5, a
  N=5, NOT T0, wave-like topology `) :;LAT5abcds(LS5,`N`,5);
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{\}, \{a, b\}, \{a, b, c, d\}$$

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Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c}
{a, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c}
{b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d}
{b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{s}
{a, b, c}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, s}
{a, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, s}
{a, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d}
{b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, s}
{b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d}
{a, b, c, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d, s}

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```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{},{},{a,b,c,d};;LS5:={LS4,X};print(` A NotT0  wavelike topology embeds into LS5, a N=
  5, NOT T0, wave-like topology `) :;LAT5abcds(LS5,`N`,5);
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{\}, \{\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

A NotT0 wavelike topology embeds into LS5, a N=5, NOT T0, wave-like topology

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Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{ }
{c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{ }
{d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b}
{a, c}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{b, c}
{b, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{b, d}
{b, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{s}
{c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{c, d}
{c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{s}
{d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, s}	{d}	{s}
{a, b, c}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c}
{a, b, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d}
{a, b, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, s}
{a, c, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, s}
{a, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{b, c, d}
{b, c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{b, c, s}
{b, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{b, d, s}
{c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d}
{a, b, c, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, s}
{a, b, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, d, s}	{ }	{b, c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{a,b},{a,b,c,d};LS5:={LS4,X};print(` A N=4, NOT T0, wave-like topology embeds into
  LS5, a N=5, NOT T0, wave-like topology.`);;LAT5abcds(LS5,`N`,5);;
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{a, b\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{a, b\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

A N=4, NOT T0, wave-like topology embeds into LS5, a N=5, NOT T0, wave-like topology.

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b}
{a, c}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c}
{b, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d}
{b, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{s}
{a, b, c}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, s}
{a, c, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, s}
{a, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d}
{b, c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, s}
{b, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d}
{a, b, c, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{b},{a,b},{a,b,c,d};;LS5:={LS4,X};print(` A NotT0  wavelike topology embeds into LS5,
  a N=5, NOT T0, wave-like topology `) :;LAT5abcds(LS5,`N`,5);
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{b\}, \{a, b\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a\}, \{b\}, \{a, b\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

A NotT0 wavelike topology embeds into LS5, a N=5, NOT T0, wave-like topology

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{ }
{b}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{ }
{a, c}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c}
{a, d}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d}
{a, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{s}
{b, c}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c}
{b, d}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d}
{b, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{s}
{a, b, c}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{s}
{a, c, d}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d}
{a, c, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, s}
{a, d, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d, s}
{b, c, d}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d}
{b, c, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, s}
{b, d, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{c, d}
{a, b, c, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{d, s}
{a, c, d, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{c, d, s}	{a, b}	{c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{a,b,c},{a,b,c,d};;print(` A NotT0  wavelike topology embeds into LS5, a N=5, NOT T0,
  wave-like topology `) :;LAT5abcds(LS5,`N`,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{a, b, c\}, \{a, b, c, d\}$$

A NotT0 wavelike topology embeds into LS5, a N=5, NOT T0, wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{ }
{b}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{ }
{a, c}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c}
{a, d}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d}
{a, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{s}
{b, c}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c}
{b, d}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d}
{b, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, s}	{d}	{s}
{a, b, c}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{s}
{a, c, d}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d}
{a, c, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, s}
{a, d, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{d, s}
{b, c, d}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d}
{b, c, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, s}
{b, d, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{c, d}
{a, b, c, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{c, d, s}	{a, b}	{d, s}
{a, c, d, s}	{a}	{b}	{c, d, s}	{a, c, d, s}	{c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{b}	{a}	{c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{c, d, s}	{a, b}	{c, d, s}

Some singletons have the same closure and cannot be distinguished

(97)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a,b},{a,b,c},{a,b,c,d};;print(`A N=4, NOT T0, wave-like topology embeds into LS5, a N=5,
  NOT T0,wave-like topology `);LAT5abcds(LS5,`N `,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d\}$$

A N=4, NOT T0, wave-like topology embeds into LS5, a N=5, NOT T0,wave-like topology

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{ }
{*b*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{ }
{*c*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{ }
{*d*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*, *b*, *c*, *d*}	{*s*}	{*s*}	{ }	{*s*}	{ }
{*a*, *b*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{ }
{*a*, *c*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{*c*}
{*a*, *d*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{*d*}
{*a*, *s*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{*s*}
{*b*, *c*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{*c*}
{*b*, *d*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{*d*}
{*b*, *s*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{*s*}
{*c*, *d*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{ }	{*c*, *d*}
{*c*, *s*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*d*, *s*}	{*c*}	{*s*}
{*d*, *s*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*c*, *s*}	{*d*}	{*s*}
{*a*, *b*, *c*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{*c*}
{*a*, *b*, *d*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{*d*}
{*a*, *b*, *s*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{*s*}
{*a*, *c*, *d*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{*c*, *d*}
{*a*, *c*, *s*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{*c*, *s*}
{*a*, *d*, *s*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{*d*, *s*}
{*b*, *c*, *d*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{*c*, *d*}
{*b*, *c*, *s*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{*c*, *s*}
{*b*, *d*, *s*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{*d*, *s*}
{*c*, *d*, *s*}	{ }	{*a*, *b*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{*c*, *d*, *s*}	{ }	{*c*, *d*, *s*}
{*a*, *b*, *c*, *d*}	{*a*, *b*, *c*, *d*}	{ }	{*s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{*c*, *d*}
{*a*, *b*, *c*, *s*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{*c*, *s*}
{*a*, *b*, *d*, *s*}	{*a*, *b*}	{ }	{*c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{*d*, *s*}
{*a*, *c*, *d*, *s*}	{*a*}	{*b*}	{*c*, *d*, *s*}	{*a*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*}	{*c*, *d*, *s*}
{*b*, *c*, *d*, *s*}	{*b*}	{*a*}	{*c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{*c*, *d*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{*c*, *d*, *s*}

Some singletons have the same closure and cannot be distinguished

11. Some Examples that correspond to problems in Text Books

```
> print(` `);X:={a,b,c,d,s};LS4:={},{s},{a,s},{c,d,s},{a,c,d,s},{b,c,d,s};LS5:={LS4,X};print(`LS5 is a Not-T0 wave-lke topology`);
  print(`Lipshitz, p 76 problem 14 and prob 30 p 79`);LAT5abcds(LS5,`Lipshitz, p 76 problem 14 and prob 30 p 79`,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{s\}, \{a, s\}, \{c, d, s\}, \{a, c, d, s\}, \{b, c, d, s\}$$

$$LS5 := \{\{\}, \{s\}, \{a, s\}, \{c, d, s\}, \{a, c, d, s\}, \{b, c, d, s\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-lke topology

Lipshitz, p 76 problem 14 and prob 30 p 79

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d, s}	{a}	{a}	{ }	{a}	{ }
{b}	{ }	{a, c, d, s}	{b}	{b}	{ }	{b}	{ }
{c}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c}	{d}	{ }
{s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{ }
{a, b}	{ }	{c, d, s}	{a, b}	{a, b}	{ }	{a, b}	{ }
{a, c}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{ }
{a, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c}	{a, d}	{ }
{a, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a}
{b, c}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, d}	{c}	{b}
{b, d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c}	{d}	{b}
{b, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b}
{c, d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{c, d}
{c, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{c}
{d, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{d}
{a, b, c}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{b}
{a, b, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c}	{a, d}	{b}
{a, b, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b}
{a, c, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{a, c, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, c}
{a, d, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, d}
{b, c, d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c, d}
{b, c, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b, c}
{b, d, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b, d}
{c, d, s}	{c, d, s}	{ }	{a, b}	{a, b, c, d, s}	{a, b, c, d}	{s}	{c, d}
{a, b, c, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, c, d}
{a, b, c, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b, c}
{a, b, d, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b, d}
{a, c, d, s}	{a, c, d, s}	{ }	{b}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, c, d}
{b, c, d, s}	{b, c, d, s}	{ }	{a}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b, c, d}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b, c, d}

Some singletons have the same closure and cannot be distinguished

(99)

```
> print(` `);X:={a,b,c,d,s};LS3:={},{a},{a,b},{a,b,c};LS5:={LS4,X};print(`LS5 is a Not-T0 wave-lke topology`);print(`Lipshitz,
  p 76 problem 14 and prob 30 p 79`);LAT5abcds(LS5,`Lipshitz, p 76 problem 14 and prob 30 p 79`,5):
```

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{a\}, \{a, b\}, \{a, b, c\}$$

$$LS5 := \{\{\}, \{s\}, \{a, s\}, \{c, d, s\}, \{a, c, d, s\}, \{b, c, d, s\}, \{a, b, c, d, s\}\}$$

LS5 is a Not-T0 wave-lke topology

Lipshitz, p 76 problem 14 and prob 30 p 79

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{b, c, d, s}	{a}	{a}	{ }	{a}	{ }
{b}	{ }	{a, c, d, s}	{b}	{b}	{ }	{b}	{ }
{c}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, d}	{c}	{ }
{d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c}	{d}	{ }
{s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{ }
{a, b}	{ }	{c, d, s}	{a, b}	{a, b}	{ }	{a, b}	{ }
{a, c}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{ }
{a, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c}	{a, d}	{ }
{a, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a}
{b, c}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, d}	{c}	{b}
{b, d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c}	{d}	{b}
{b, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b}
{c, d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{c, d}
{c, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{c}
{d, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{d}
{a, b, c}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, d}	{a, c}	{b}
{a, b, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c}	{a, d}	{b}
{a, b, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b}
{a, c, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{a, c, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, c}
{a, d, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, d}
{b, c, d}	{ }	{a, s}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c, d}
{b, c, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b, c}
{b, d, s}	{s}	{ }	{a, b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b, d}
{c, d, s}	{c, d, s}	{ }	{a, b}	{a, b, c, d, s}	{a, b, c, d}	{s}	{c, d}
{a, b, c, d}	{ }	{s}	{a, b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, c, d}
{a, b, c, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b, c}
{a, b, d, s}	{a, s}	{ }	{b, c, d}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b, d}
{a, c, d, s}	{a, c, d, s}	{ }	{b}	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, c, d}
{b, c, d, s}	{b, c, d, s}	{ }	{a}	{a, b, c, d, s}	{a, b, c, d}	{s}	{b, c, d}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d}	{s}	{a, b, c, d}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{a},{c,d},{a,c,d},{b,c,d,s};LS5:={LS4,X};print(`LS5 is a  NOT-T0 wave-like TOPOLOGY `)
  ;LAT5abcds(LS5,`Lipshitz, p 66 problem 14 and prob 30 p 79`,5):
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, s\}$$

$$LS5 := \{\{\}, \{a\}, \{c, d\}, \{a, c, d\}, \{b, c, d, s\}, \{a, b, c, d, s\}\}$$

LS5 is a NOT-T0 wave-like TOPOLOGY

Is LS5: a topology = true, connected = false, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{b, c, d, s}	{ }	{a}	{ }	{a}	{ }
{b}	{ }	{a, c, d}	{b, s}	{b, s}	{s}	{b}	{ }
{c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{ }
{d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, s}	{d}	{ }
{s}	{ }	{a, c, d}	{b, s}	{b, s}	{b}	{s}	{ }
{a, b}	{a}	{c, d}	{b, s}	{a, b, s}	{s}	{a, b}	{ }
{a, c}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{ }
{a, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, s}	{a, d}	{ }
{a, s}	{a}	{c, d}	{b, s}	{a, b, s}	{b}	{a, s}	{ }
{b, c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b}
{b, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, s}	{d}	{b}
{b, s}	{ }	{a, c, d}	{b, s}	{b, s}	{b, s}	{ }	{b, s}
{c, d}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, c, d, s}	{ }	{c, d}
{c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{s}
{d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, s}	{d}	{s}
{a, b, c}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b}
{a, b, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, s}	{a, d}	{b}
{a, b, s}	{a}	{c, d}	{b, s}	{a, b, s}	{b, s}	{a}	{b, s}
{a, c, d}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{s}
{a, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, s}	{a, d}	{s}
{b, c, d}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, c, d, s}	{ }	{b, c, d}
{b, c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, d, s}	{c}	{b, s}
{b, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{b, c, s}	{d}	{b, s}
{c, d, s}	{c, d}	{a}	{b, s}	{b, c, d, s}	{b, c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d}
{a, b, c, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, d, s}	{a, c}	{b, s}
{a, b, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, s}	{a, d}	{b, s}
{a, c, d, s}	{a, c, d}	{ }	{b, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{b, c, d, s}	{a}	{ }	{b, c, d, s}	{b, c, d, s}	{ }	{b, c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d};LS3:={},{},{},{},{a,b,d},{a,c,d};LS4:={LS3,X};print(`LS4 is NOT A TOPOLOGY !!! `);LAT4abcd
  (LS4,` Not T0 `,4):
```

` `

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{\}, \{\}, \{\}, \{a, b, d\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a, b, d\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS4 is NOT A TOPOLOGY !!!

` `

Is LS4: a topology = *false*, *connected* = *true*, *Kolmogorov.T0* = *false*, *Hausdorff.T2* = *false*

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{\}$	$\{a, c, d\}$	$\{b\}$	$\{b\}$	$\{\}$	$\{\}$	$\{\}$
$\{c\}$	$\{\}$	$\{a, b, d\}$	$\{c\}$	$\{c\}$	$\{\}$	$\{\}$	$\{\}$
$\{d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{\}$
$\{a, b\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{b\}$
$\{a, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{c\}$
$\{a, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, d\}$
$\{b, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, d\}$	$\{b, c\}$	$\{\}$
$\{b, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{b\}$
$\{c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{c\}$
$\{a, b, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, c\}$
$\{a, b, d\}$	$\{a, b, d\}$	$\{\}$	$\{c\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, d\}$
$\{a, c, d\}$	$\{a, c, d\}$	$\{\}$	$\{b\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, c, d\}$
$\{b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{b, c, d\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, c, d\}$

The Closed-Open subsets of LS are = $\{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is = $(\{a, b, c, d\}, \{b\}, \{c\}, \{a, b, c, d\})$ **(102)**

```
> print(` `);X:={a,b,c,d};LS3:={},{},{a,b},{},{a,b,d},{a,c,d};LS4:={LS3,X};print(`LS is NOT A TOPOLOGY, BUT satisfies
  Kolmogorov  T0 axioms !!! `);LAT4abcd(LS4,`Case 2 vol6  ..LS 2 is Not a topology, but is T0  `,4):
```

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{\}, \{a, b\}, \{\}, \{a, b, d\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a, b\}, \{a, b, d\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS is NOT A TOPOLOGY, BUT satisfies Kolmogorov T0 axioms !!!

ls LS4: a topology = false, *connected = true*, *Kolmogorov.T0 = true*, *Hausdorff.T2 = false*

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{\}$	$\{a, c, d\}$	$\{b\}$	$\{b\}$	$\{\}$	$\{\}$	$\{\}$
$\{c\}$	$\{\}$	$\{a, b, d\}$	$\{c\}$	$\{c\}$	$\{\}$	$\{\}$	$\{\}$
$\{d\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c\}$	$\{d\}$	$\{\}$
$\{a, b\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{b\}$
$\{a, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{c\}$
$\{a, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{d\}$
$\{b, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, d\}$	$\{b, c\}$	$\{\}$
$\{b, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, c\}$	$\{b, d\}$	$\{\}$
$\{c, d\}$	$\{\}$	$\{a, b\}$	$\{c, d\}$	$\{c, d\}$	$\{c\}$	$\{\}$	$\{c\}$
$\{a, b, c\}$	$\{a, b\}$	$\{\}$	$\{c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, c\}$
$\{a, b, d\}$	$\{a, b, d\}$	$\{\}$	$\{c\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, d\}$
$\{a, c, d\}$	$\{a, c, d\}$	$\{\}$	$\{b\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{c, d\}$
$\{b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, c, d\}$	$\{b\}$	$\{c, d\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, c, d\}$

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{b\}, \{c\}, \{c, d\})$ **(103)**

```
> print(` `);X:={a,b,c,d};LS3:={},{a},{},{},{a,b,d},{a,c,d};LS4:={LS3,X};print(`LS is NOT A TOPOLOGY,  but satifies
  Kolmogorov T0 axioms!!! `);LAT4abcd(LS4,` Case3 vol6  ..LS 3 is Not topology, but is Not T0  `,4):
```

` `

$$X := \{a, b, c, d\}$$

$$LS3 := \{\}, \{a\}, \{\}, \{\}, \{a, b, d\}, \{a, c, d\}$$

$$LS4 := \{\{\}, \{a\}, \{a, b, d\}, \{a, c, d\}, \{a, b, c, d\}\}$$

LS is NOT A TOPOLOGY, but satifies Kolmogorov T0 axioms!!!

` `

ls LS4: a topology = false, connected = true, Kolmogorov.T0 = true, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{ }
{b}	{ }	{a, c, d}	{b}	{b}	{ }	{ }	{ }
{c}	{ }	{a, b, d}	{c}	{c}	{ }	{ }	{ }
{d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c}	{d}	{ }
{a, b}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b}
{a, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{d}
{b, c}	{ }	{a}	{b, c, d}	{b, c, d}	{d}	{b, c}	{ }
{b, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c}	{d}	{b}
{c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c}	{d}	{c}
{a, b, c}	{a}	{ }	{b, c, d}	{a, b, c, d}	{b, c, d}	{a}	{b, c}
{a, b, d}	{a, b, d}	{ }	{c}	{a, b, c, d}	{b, c, d}	{a}	{b, d}
{a, c, d}	{a, c, d}	{ }	{b}	{a, b, c, d}	{b, c, d}	{a}	{c, d}
{b, c, d}	{ }	{a}	{b, c, d}	{b, c, d}	{b, c, d}	{ }	{b, c, d}
{a, b, c, d}	{a, b, c, d}	{ }	{ }	{a, b, c, d}	{b, c, d}	{ }	{b, c, d}

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{b\}, \{c\}, \{b, c, d\})$

(104)

```
> print(` `);X:={a,b,c,d,s};LS4:={},{b,c,d,s},{a,c,d,s},{c,d,s},{a,s},{s};LS5:={LS4,X};print(`LS5 is a N=5  Not-T0 wavelike
  TOPOLOGY`);print(`  See Kiehn Vol 1 page 446 or Kiehn Vol 6  page 214`);LAT5abcds(LS5,` `,5);
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{b, c, d, s\}, \{a, c, d, s\}, \{c, d, s\}, \{a, s\}, \{s\}$$

$$LS5 := \{\{\ \}, \{s\}, \{a, s\}, \{c, d, s\}, \{a, c, d, s\}, \{b, c, d, s\}, \{a, b, c, d, s\}\}$$

LS5 is a N=5 Not-T0 wavelike TOPOLOGY

See Kiehn Vol 1 page 446 or Kiehn Vol 6 page 214

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\ \}$	$\{b, c, d, s\}$	$\{a\}$	$\{a\}$	$\{\ \}$	$\{a\}$	$\{\ \}$
$\{b\}$	$\{\ \}$	$\{a, c, d, s\}$	$\{b\}$	$\{b\}$	$\{\ \}$	$\{b\}$	$\{\ \}$
$\{c\}$	$\{\ \}$	$\{a, s\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{b, d\}$	$\{c\}$	$\{\ \}$
$\{d\}$	$\{\ \}$	$\{a, s\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{b, c\}$	$\{d\}$	$\{\ \}$
$\{s\}$	$\{s\}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{\ \}$
$\{a, b\}$	$\{\ \}$	$\{c, d, s\}$	$\{a, b\}$	$\{a, b\}$	$\{\ \}$	$\{a, b\}$	$\{\ \}$
$\{a, c\}$	$\{\ \}$	$\{s\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, d\}$	$\{a, c\}$	$\{\ \}$
$\{a, d\}$	$\{\ \}$	$\{s\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c\}$	$\{a, d\}$	$\{\ \}$
$\{a, s\}$	$\{a, s\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a\}$
$\{b, c\}$	$\{\ \}$	$\{a, s\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{b, d\}$	$\{c\}$	$\{b\}$
$\{b, d\}$	$\{\ \}$	$\{a, s\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{b, c\}$	$\{d\}$	$\{b\}$
$\{b, s\}$	$\{s\}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{b\}$
$\{c, d\}$	$\{\ \}$	$\{a, s\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{\ \}$	$\{c, d\}$
$\{c, s\}$	$\{s\}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{c\}$
$\{d, s\}$	$\{s\}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{d\}$
$\{a, b, c\}$	$\{\ \}$	$\{s\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, d\}$	$\{a, c\}$	$\{b\}$
$\{a, b, d\}$	$\{\ \}$	$\{s\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c\}$	$\{a, d\}$	$\{b\}$
$\{a, b, s\}$	$\{a, s\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a, b\}$
$\{a, c, d\}$	$\{\ \}$	$\{s\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{c, d\}$
$\{a, c, s\}$	$\{a, s\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a, c\}$
$\{a, d, s\}$	$\{a, s\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a, d\}$
$\{b, c, d\}$	$\{\ \}$	$\{a, s\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{b, c, d\}$	$\{\ \}$	$\{b, c, d\}$
$\{b, c, s\}$	$\{s\}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{b, c\}$
$\{b, d, s\}$	$\{s\}$	$\{\ \}$	$\{a, b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{b, d\}$
$\{c, d, s\}$	$\{c, d, s\}$	$\{\ \}$	$\{a, b\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{c, d\}$
$\{a, b, c, d\}$	$\{\ \}$	$\{s\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{b, c, d\}$
$\{a, b, c, s\}$	$\{a, s\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a, b, c\}$
$\{a, b, d, s\}$	$\{a, s\}$	$\{\ \}$	$\{b, c, d\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a, b, d\}$
$\{a, c, d, s\}$	$\{a, c, d, s\}$	$\{\ \}$	$\{b\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a, c, d\}$
$\{b, c, d, s\}$	$\{b, c, d, s\}$	$\{\ \}$	$\{a\}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{b, c, d\}$
$\{a, b, c, d, s\}$	$\{a, b, c, d, s\}$	$\{\ \}$	$\{\ \}$	$\{a, b, c, d, s\}$	$\{a, b, c, d\}$	$\{s\}$	$\{a, b, c, d\}$

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS3:={},{a,b,c},{a,b},{a};LS5:={LS3,X};print(`LS5 is a N=5  Not-T0 wave-like topology !!! `);
  LAT5abcds(LS5 ,`Topology 2, p 440, vol 1`,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS3 := \{\}, \{a, b, c\}, \{a, b\}, \{a\}$$

$$LS5 := \{\{\}, \{a\}, \{a, b\}, \{a, b, c\}, \{a, b, c, d, s\}\}$$

LS5 is a N=5 Not-T0 wave-like topology !!!

` `

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{ }
{c}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{ }
{d}	{ }	{a, b, c}	{d, s}	{d, s}	{s}	{d}	{ }
{s}	{ }	{a, b, c}	{d, s}	{d, s}	{d}	{s}	{ }
{a, b}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b}
{a, c}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c}
{a, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d}
{a, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c}
{b, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d}
{b, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{s}
{c, d}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d}
{c, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{s}
{d, s}	{ }	{a, b, c}	{d, s}	{d, s}	{d, s}	{ }	{d, s}
{a, b, c}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c}
{a, b, d}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d}
{a, b, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, s}
{a, c, d}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d}
{a, c, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, s}
{a, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{d, s}
{b, c, d}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d}
{b, c, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, s}
{b, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{d, s}
{c, d, s}	{ }	{a, b}	{c, d, s}	{c, d, s}	{d, s}	{c}	{d, s}
{a, b, c, d}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d}
{a, b, c, s}	{a, b, c}	{ }	{d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, s}
{a, b, d, s}	{a, b}	{ }	{c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, d, s}
{a, c, d, s}	{a}	{ }	{b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{c, d, s}
{b, c, d, s}	{ }	{a}	{b, c, d, s}	{b, c, d, s}	{c, d, s}	{b}	{c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{b, c, d, s}	{a}	{b, c, d, s}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{b,c,d,s},{a};LS5:={LS4,X};print(`LS5 is a  N=5  Not-T0 wave=like topology  `);LAT5abcds
  (LS5,`Topology 3, X:={a,b,c,d,s};`,5):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\ \}, \{b, c, d, s\}, \{a\}$$

$$LS5 := \{\{\ \}, \{a\}, \{b, c, d, s\}, \{a, b, c, d, s\}\}$$

LS5 is a N=5 Not-T0 wave=like topology

` `

Is LS5: a topology = true, connected = false, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
{*a*}	{*a*}	{*b*, *c*, *d*, *s*}	{ }	{*a*}	{ }	{*a*}	{ }
{*b*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*b*}	{ }
{*c*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *d*, *s*}	{*c*}	{ }
{*d*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *s*}	{*d*}	{ }
{*s*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{*s*}	{ }
{*a*, *b*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*c*, *d*, *s*}	{*a*, *b*}	{ }
{*a*, *c*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *d*, *s*}	{*a*, *c*}	{ }
{*a*, *d*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *s*}	{*a*, *d*}	{ }
{*a*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*}	{*a*, *s*}	{ }
{*b*, *c*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*b*, *c*}
{*b*, *d*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*b*, *d*}
{*b*, *s*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*b*, *s*}
{*c*, *d*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*c*, *d*}
{*c*, *s*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*c*, *s*}
{*d*, *s*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*d*, *s*}
{*a*, *b*, *c*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*b*, *c*}
{*a*, *b*, *d*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*b*, *d*}
{*a*, *b*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*b*, *s*}
{*a*, *c*, *d*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*c*, *d*}
{*a*, *c*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*c*, *s*}
{*a*, *d*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*d*, *s*}
{*b*, *c*, *d*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*b*, *c*, *d*}
{*b*, *c*, *s*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*b*, *c*, *s*}
{*b*, *d*, *s*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*b*, *d*, *s*}
{*c*, *d*, *s*}	{ }	{*a*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*c*, *d*, *s*}
{*a*, *b*, *c*, *d*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*b*, *c*, *d*}
{*a*, *b*, *c*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*b*, *c*, *s*}
{*a*, *b*, *d*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*b*, *d*, *s*}
{*a*, *c*, *d*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*c*, *d*, *s*}
{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{ }	{*b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{ }	{*b*, *c*, *d*, *s*}
{*a*, *b*, *c*, *d*, *s*}	{*a*, *b*, *c*, *d*, *s*}	{ }	{ }	{*a*, *b*, *c*, *d*, *s*}	{*b*, *c*, *d*, *s*}	{*a*}	{*b*, *c*, *d*, *s*}

Some singletons have the same closure and cannot be distinguished

```
> print(` `);X:={a,b,c,d,s};LS4:={},{},{},{},{},{},{},{},{a,b,c,d};;LS5:={LS4,X};print(`LS4 embeds as a NOT-T0 topology in N=5,
  Ex #2 page 207 vol 6`);LAT5abcds(LS5,`Topology 3, X:={a,b,c,d,s};`,5);
```

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{\}, \{\}, \{\}, \{\}, \{\}, \{\}, \{\}, \{a, b, c, d\}$$

$$LS5 := \{\{\}, \{a, b, c, d\}, \{a, b, c, d, s\}\}$$

LS4 embeds as a NOT-T0 topology in N=5, Ex #2 page 207 vol 6

Is LS5: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

Subset S	Int(S)	Ext(S)	Bnd(S)	Clo(S)	Lim(S)	IsoClo(S)	IsoCar(S)
{a}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{ }
{b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{ }
{c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{ }
{d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{ }
{s}	{ }	{a, b, c, d}	{s}	{s}	{ }	{s}	{ }
{a, b}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b}
{a, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c}
{a, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, d}
{a, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{b, c, d, s}	{a}	{s}
{b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c}
{b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, d}
{b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, c, d, s}	{b}	{s}
{c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{c, d}
{c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, d, s}	{c}	{s}
{d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, s}	{d}	{s}
{a, b, c}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c}
{a, b, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d}
{a, b, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, s}
{a, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d}
{a, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, s}
{a, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, d, s}
{b, c, d}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d}
{b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, s}
{b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, d, s}
{c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{c, d, s}
{a, b, c, d}	{a, b, c, d}	{ }	{s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d}
{a, b, c, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, s}
{a, b, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, d, s}
{a, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, c, d, s}
{b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{b, c, d, s}
{a, b, c, d, s}	{a, b, c, d, s}	{ }	{ }	{a, b, c, d, s}	{a, b, c, d, s}	{ }	{a, b, c, d, s}

Some singletons have the same closure and cannot be distinguished **(108)**

```
> print(` `);X:={a,b,c,d,s};LS4:={},{b},{d},{a,b},{b,d},{c,d},{a,b,d},{b,c,d};print(` Let LSd be the dual of the preceeding
  example  X = {a,b,c,d}   poset 3 `);LSd:=CLO({a,b,c,d},LS);print(`This dual Lattice Structure represents the marriage
  between Cartan's Closure of Exterior Differential Systems \n and the Kuratowski Closure based upon a limit point operator
  equivalent to the exterior differential, d`) :LAT4abcd(LSd,`LSd =  poset 3, LSDual = poset 3, DISconnected T0 topologies
  EXCUSION DOWN   INCLUSION UP`,4):
```

` `

$$X := \{a, b, c, d, s\}$$

$$LS4 := \{\}, \{b\}, \{d\}, \{a, b\}, \{b, d\}, \{c, d\}, \{a, b, d\}, \{b, c, d\}$$

Let LSd be the dual of the preceeding example X = {a,b,c,d}   poset 3

$$LSd := \{\{\}, \{a, b, c, d\}\}$$

This dual Lattice Structure represents the marriage between Cartan's Closure of Exterior Differential Systems and the Kuratowski Closure based upon a limit point operator equivalent to the exterior differential, d

` `

Is LS4: a topology = true, connected = true, Kolmogorov.T0 = false, Hausdorff.T2 = false

` `

Subset S	*Int(S)*	*Ext(S)*	*Bnd(S)*	*Clo(S)*	*Lim(S)*	*IsoClo(S)*	*IsoCar(S)*
$\{a\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{b, c, d\}$	$\{a\}$	$\{\}$
$\{b\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, c, d\}$	$\{b\}$	$\{\}$
$\{c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, d\}$	$\{c\}$	$\{\}$
$\{d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c\}$	$\{d\}$	$\{\}$
$\{a, b\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b\}$
$\{a, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, c\}$
$\{a, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, d\}$
$\{b, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{b, c\}$
$\{b, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{b, d\}$
$\{c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{c, d\}$
$\{a, b, c\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, c\}$
$\{a, b, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, d\}$
$\{a, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, c, d\}$
$\{b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{b, c, d\}$
$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{\}$	$\{a, b, c, d\}$	$\{a, b, c, d\}$	$\{\}$	$\{a, b, c, d\}$

The Closed-Open subsets of LS are $= \{\{\}, \{a, b, c, d\}\}$

Some singletons have the same closure and cannot be distinguished

The {1,2,3,4} array of CLOSURE elements is $= (\{a, b, c, d\}, \{a, b, c, d\}, \{a, b, c, d\}, \{a, b, c, d\})$ **(109)**