

Pinning set data for all irreducible, indecomposable spherimultiloops
with any number of components components and at most 13 regions

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Contents

1	Introduction	2
2	References	2
3	Statistical overview	3
3.1	By number of regions - tabular data	3
3.2	By pinning number - tabular data	4
3.3	By number of regions - graphical data	5
3.4	By pinning number - graphical data	6
4	Spherimultiloops	7
4.1	4 regions	7
4.2	5 regions	8
4.3	6 regions	9
4.4	7 regions	11
4.5	8 regions	14
4.6	9 regions	23
4.7	10 regions	41
4.8	11 regions	103
4.9	12 regions	301

1 Introduction

This document presents exhaustive data about the pinning sets of certain unoriented multiloops in the unoriented sphere - pinning set data for all irreducible, indecomposable spherimultiloops with any number of components components and at most 13 regions. The reader should refer to the authors' forthcoming paper [SS24] for an explanation of the terminology used throughout this catalog, and for a detailed description and analysis of the algorithms used to compute all the information displayed here.

Section 3 presents statistics for the dataset at a glance. We focus in particular on computing statistics related to degrees of regions appearing in pinning sets. The data is presented in tabular form by number of regions and by pinning number in subsections 3.1 and 3.2, and in graphical form in subsections 3.3 and 3.4. Note that the number of multiloops by region matches [OEI24, A113201].

Section 4 contains detailed visualizations of the pinning sets of every multiloop in the database with at most 12 regions, and tables describing some of their individual statistics, with emphasis on degree. For each multiloop, optimal pinning sets are labelled with capital letters and colored using shades of red, and the other minimal pinning sets are labelled with lowercase letters and colored using shades of green. For better visibility, we do not plot the entire pinning semi-lattice; rather, the sub-semi-lattice generated by (taking unions of) minimal pinning sets, together with the set of all regions. The heights of vertices in the semi-lattice (and the labels therein) correspond to their cardinals. A lighter edge emphasises a greater difference between its endpoint's cardinals.

The multiloops in this catalog were generated with `plantri` [BM] and drawn with `SnapPy` [CDGW]. For each multiloop, we include its `plantri` code and planar diagram (PD) code in case the reader wishes to study it using either program.

2 References

- [BM] Gunnar Brinkmann and Brendan McKay. Plantri and fullgen, programs for generating planar graphs of specified types. Available at <https://users.cecs.anu.edu.au/~bdm/plantri/> (08/04/2024).
- [CDGW] Marc Culler, Nathan M. Dunfield, Matthias Goerner, and Jeffrey R. Weeks. SnapPy, a computer program for studying the geometry and topology of 3-manifolds. Available at <http://snappy.computop.org> (08/04/2024).
- [OEI24] OEIS Foundation Inc. The On-Line Encyclopedia of Integer Sequences, 2024. Published electronically at <http://oeis.org>.
- [SS24] Christopher-Lloyd Simon and Ben Stucky. Pin the loop taut : a one-player topologame, 2024. Submitted for publication, arxiv version.

3 Statistical overview

3.1 By number of regions - tabular data

Table 1: Statistical overview by number of regions (decimals shown to at most 6 significant figures).

Number of regions	Number of multiloops with this number of regions	Average pinning number	Average pinning number/number of regions	Average optimal pinning degree	Average minimal pinning degree	Average overall pinning set degree
4	1	4	1	2	2	2
5	1	3	0.6	2	2	2.225
6	2	4	0.666667	2.25	2.25	2.47381
7	3	4	0.571429	2.16667	2.16667	2.57606
8	9	4.22222	0.527778	2.31667	2.37315	2.73304
9	18	4.38889	0.487654	2.26065	2.29616	2.79458
10	62	4.56452	0.456452	2.26828	2.31136	2.87328
11	198	4.75758	0.432507	2.24113	2.28635	2.92834
12	803	5.03362	0.419469	2.24039	2.28062	2.97906
13	3378	5.30166	0.40782	2.22682	2.27049	3.02046

3.2 By pinning number - tabular data

Table 2: Statistical overview by pinning number (decimals shown to at most 6 significant figures).

Pinning number	Number of multiloops with this pinning number	Average number of regions	Average pinning number/number of regions	Average optimal pinning set degree	Average minimal pinning set degree	Average overall pinning set degree
3	21	11.381	0.279577	2.01587	2.02751	2.96574
4	827	12.3277	0.328091	2.2602	2.34749	3.05035
5	2171	12.6817	0.395443	2.25738	2.30065	3.02358
6	1158	12.8117	0.469083	2.19478	2.21511	2.96684
7	250	12.84	0.546044	2.11863	2.12835	2.89961
8	39	12.7692	0.628008	2.06143	2.06642	2.83445
9	7	12.7143	0.71029	2.03704	2.04339	2.78418
10	1	12	0.833333	2	2	2.69697
11	1	13	0.846154	2	2	2.72115

3.3 By number of regions - graphical data

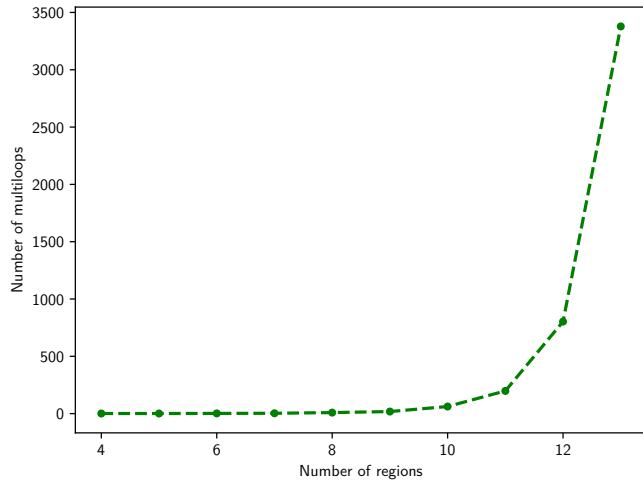


Figure 1: Number of multiloops by number of regions.

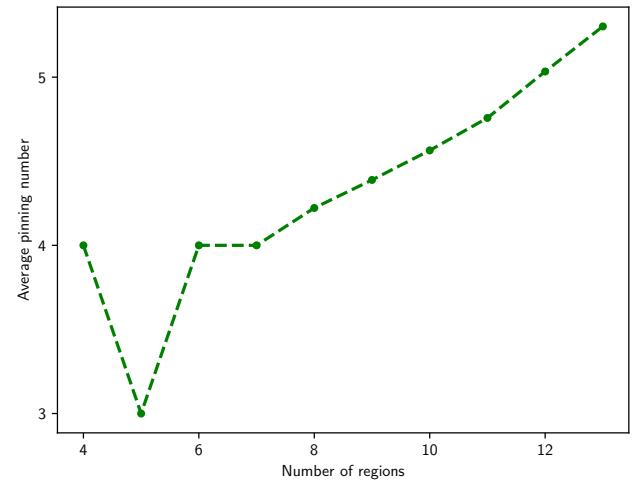


Figure 2: Average pinning number by number of regions.

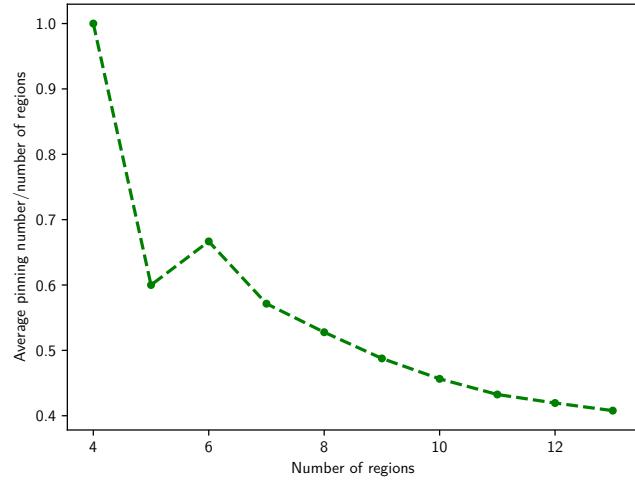


Figure 3: Average pinning number/number of regions by number of regions.

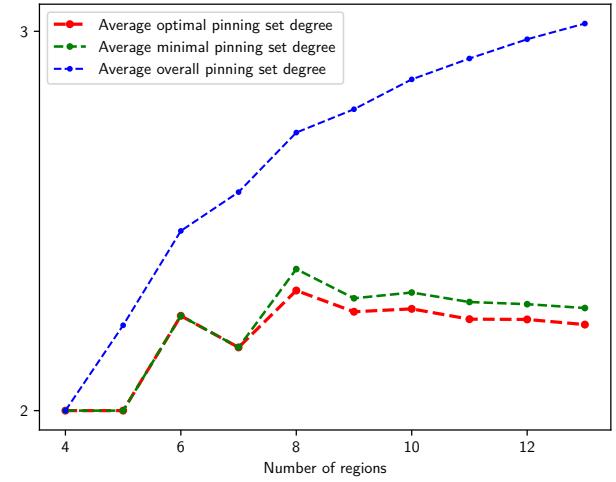


Figure 4: Average pinning set degree data by number of regions.

3.4 By pinning number - graphical data

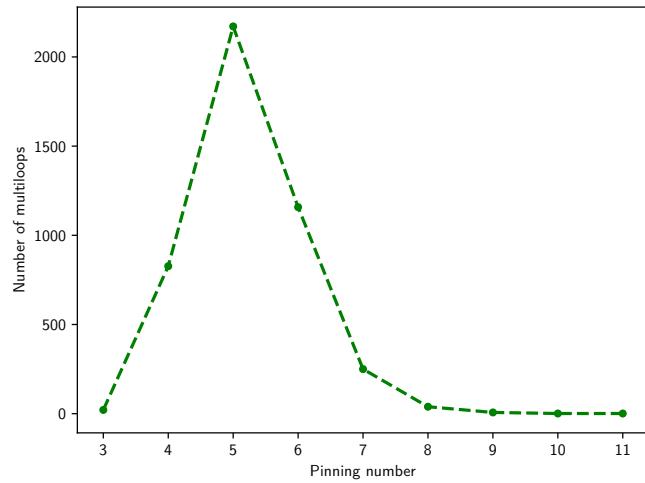


Figure 5: Number of multiloops by pinning number.

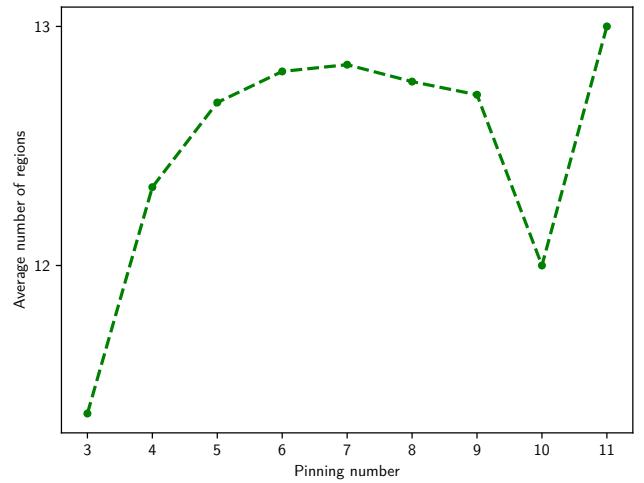


Figure 6: Average number of regions by pinning number.

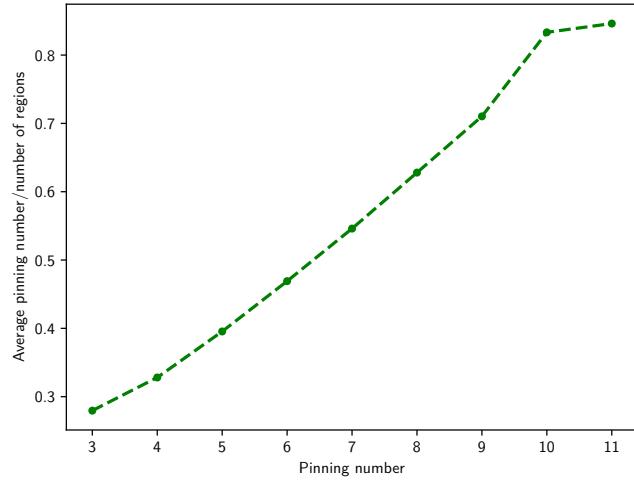


Figure 7: Average pinning number/number of regions by pinning number.

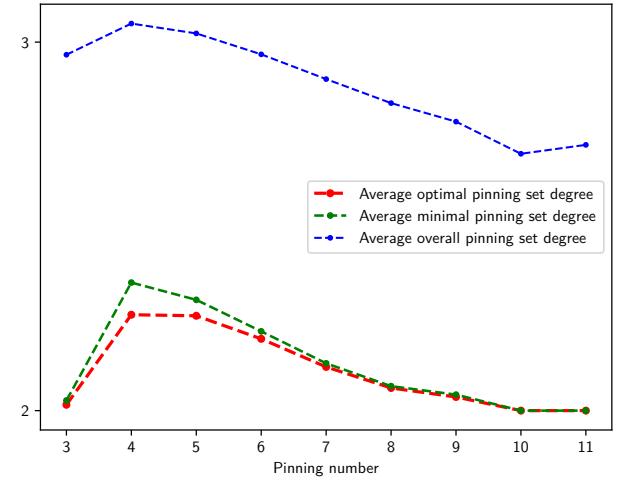


Figure 8: Average pinning set degree data by pinning number.

4 Spherimultiloops

4.1 4 regions

4.1.1 [[1, 4, 2, 3], [3, 2, 4, 1]]

PD code drawn by `SnapPy`: $[(4, 1, 3, 2), (2, 3, 1, 4)]$

Planar representation generated by `plantri`: $[[1, 1, 1, 1], [0, 0, 0, 0]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 1

Average overall degree: 2.0

Pinning number: 4

Table 3: Pinning sets/average degree by cardinal

Cardinal	4	Total
Optimal pinning sets	1	1
Minimal (suboptimal) pinning sets	0	0
Nonminimal pinning sets	0	0
Average degree	2.0	

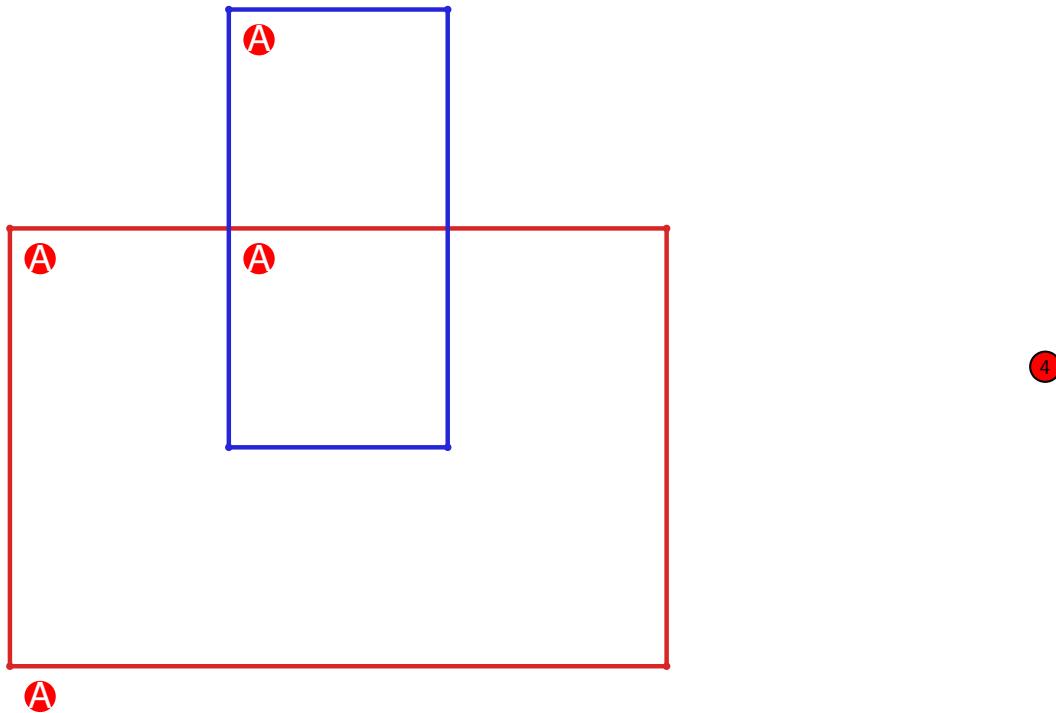


Figure 9: `SnapPy` multiloop plot.

Figure 10: Minimal join sub-semi-lattice of minimal pinning sets.

4.2 5 regions

4.2.1 $[[3, 6, 4, 1], [5, 2, 6, 3], [4, 2, 5, 1]]$

PD code drawn by SnapPy: $[(6, 3, 1, 4), (4, 1, 5, 2), (2, 5, 3, 6)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 2, 2, 0], [0, 1, 1, 0]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.23

Pinning number: 3

Table 4: Pinning sets/average degree by cardinal

Cardinal	3	4	5	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.25	2.4	

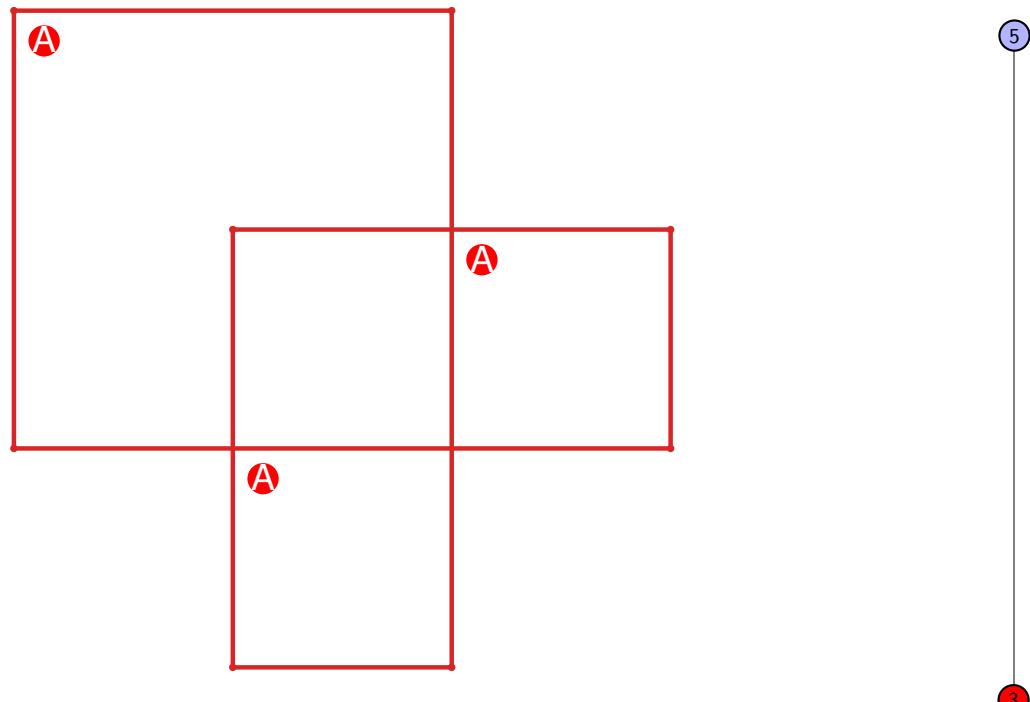


Figure 11: SnapPy multiloop plot.

Figure 12: Minimal join sub-semi-lattice of minimal pinning sets.

4.3 6 regions

4.3.1 $[[4, 8, 1, 5], [5, 3, 6, 4], [7, 1, 8, 2], [2, 6, 3, 7]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (7, 2, 8, 3), (1, 8, 2, 5), (3, 6, 4, 7)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 3, 3, 0], [1, 2, 2, 1]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.37

Pinning number: 4

Table 5: Pinning sets/average degree by cardinal

Cardinal	4	5	6	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.4	2.67	

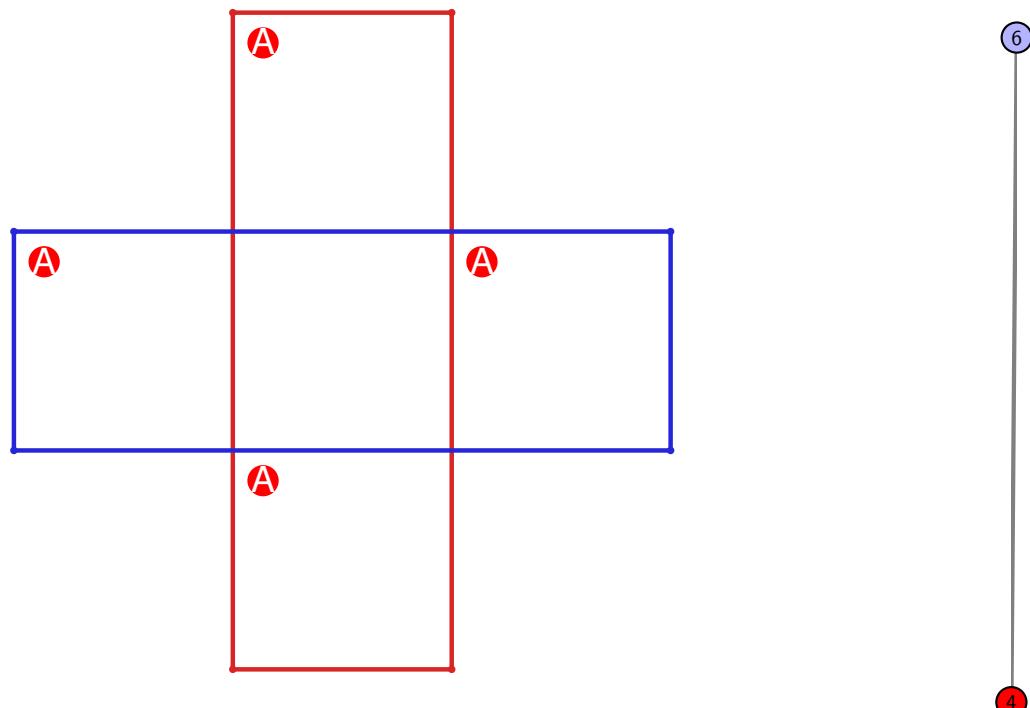


Figure 13: SnapPy multiloop plot.

Figure 14: Minimal join sub-semi-lattice of minimal pinning sets.

4.3.2 [[8, 3, 1, 4], [4, 7, 5, 8], [5, 2, 6, 3], [1, 6, 2, 7]]

PD code drawn by `SnapPy`: [(3, 8, 4, 1), (6, 1, 7, 2), (7, 4, 8, 5), (2, 5, 3, 6)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 3, 3], [0, 2, 2, 1]]

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 2

Average minimal degree: 2.5

Total pinning sets: 7

Average overall degree: 2.58

Pinning number: 4

Table 6: Pinning sets/average degree by cardinal

Cardinal	4	5	6	Total
Optimal pinning sets	2	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	4	1	5
Average degree	2.5	2.6	2.67	

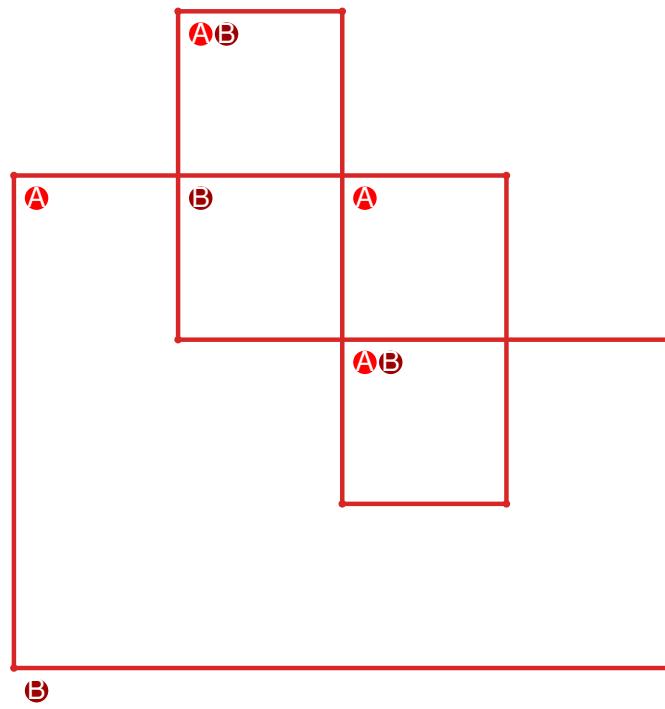


Figure 15: `SnapPy` multiloop plot.

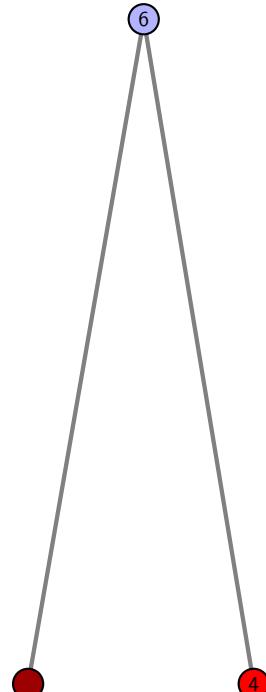


Figure 16: Minimal join sub-semi-lattice of minimal pinning sets.

4.4 7 regions

4.4.1 $[[5, 10, 6, 1], [9, 4, 10, 5], [6, 2, 7, 1], [3, 8, 4, 9], [2, 8, 3, 7]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (4, 9, 5, 10), (10, 5, 1, 6), (2, 7, 3, 8), (8, 3, 9, 4)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 4, 4, 1], [2, 3, 3, 2]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.46

Pinning number: 5

Table 7: Pinning sets/average degree by cardinal

Cardinal	5	6	7	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.5	2.86	

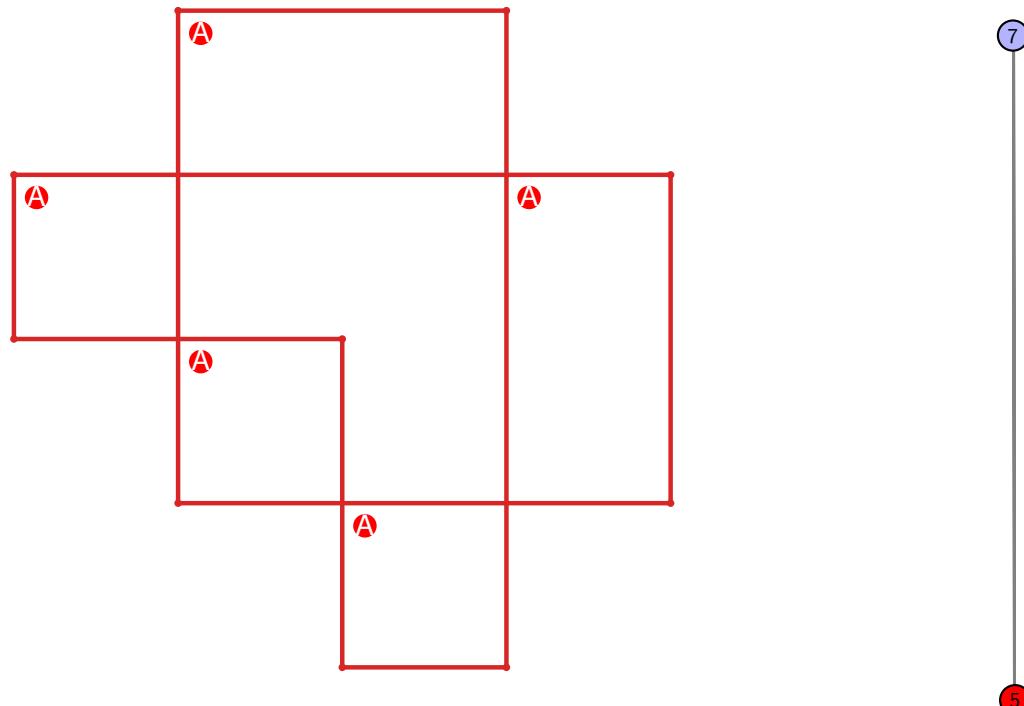


Figure 17: SnapPy multiloop plot.

Figure 18: Minimal join sub-semi-lattice of minimal pinning sets.

4.4.2 [[5, 10, 6, 1], [9, 4, 10, 5], [6, 4, 7, 3], [1, 8, 2, 9], [7, 2, 8, 3]]

PD code drawn by SnapPy: [(10, 3, 1, 4), (6, 1, 7, 2), (8, 5, 9, 6), (2, 7, 3, 8), (4, 9, 5, 10)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 4, 4, 1], [2, 3, 3, 2]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.56

Pinning number: 3

Table 8: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.38	2.6	2.75	2.86	

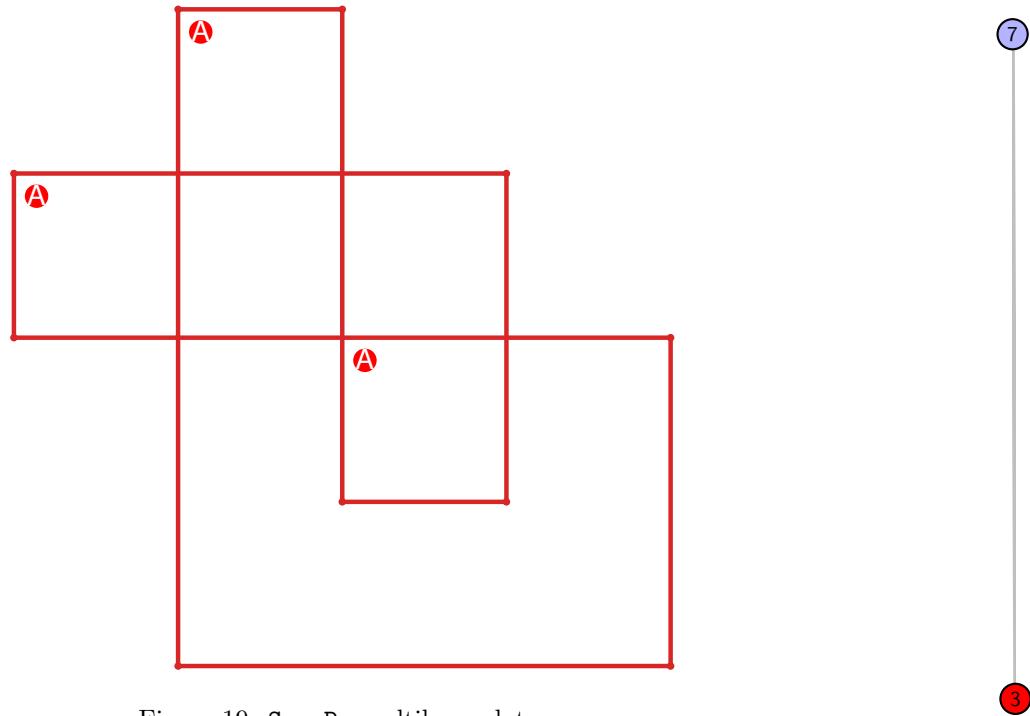


Figure 19: SnapPy multiloop plot.

Figure 20: Minimal join sub-semi-lattice of minimal pinning sets.

4.4.3 [[4, 10, 1, 5], [5, 3, 6, 4], [6, 9, 7, 10], [1, 7, 2, 8], [8, 2, 9, 3]]

PD code drawn by `SnapPy`: [(5, 4, 6, 1), (8, 3, 9, 4), (6, 9, 7, 10), (1, 10, 2, 5), (2, 7, 3, 8)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 4, 3], [0, 2, 4, 4], [1, 3, 3, 2]]

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 2

Average minimal degree: 2.5

Total pinning sets: 14

Average overall degree: 2.7

Pinning number: 4

Table 9: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	Total
Optimal pinning sets	2	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0
Nonminimal pinning sets	0	6	5	1	12
Average degree	2.5	2.67	2.8	2.86	

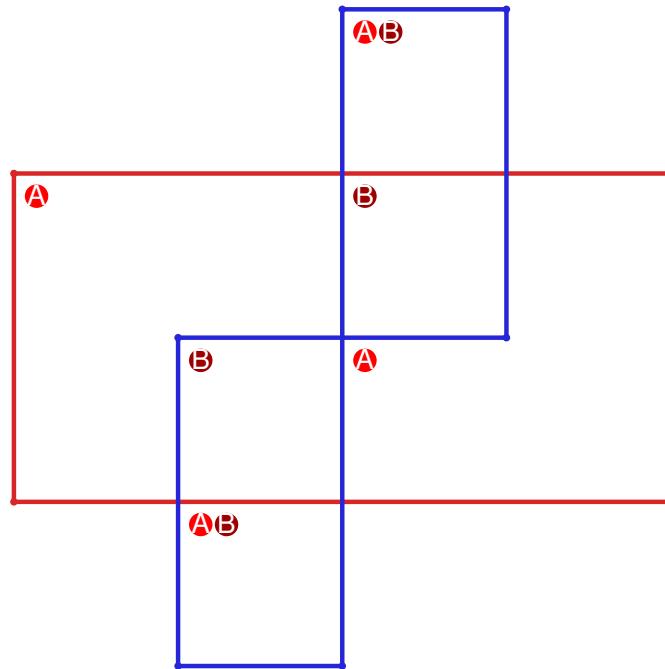


Figure 21: `SnapPy` multiloop plot.

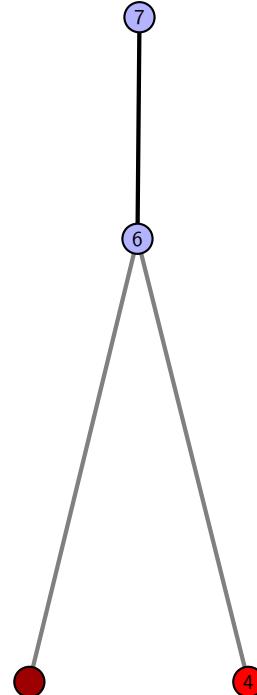


Figure 22: Minimal join sub-semi-lattice of minimal pinning sets.

4.5 8 regions

4.5.1 $[[6, 12, 1, 7], [7, 5, 8, 6], [11, 1, 12, 2], [4, 8, 5, 9], [2, 10, 3, 11], [9, 3, 10, 4]]$

PD code drawn by SnapPy: $[(12, 1, 7, 2), (10, 3, 11, 4), (8, 5, 9, 6), (6, 7, 1, 8), (4, 9, 5, 10), (2, 11, 3, 12)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 5, 5, 2], [3, 4, 4, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.54

Pinning number: 6

Table 10: Pinning sets/average degree by cardinal

Cardinal	6	7	8	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.57	3.0	

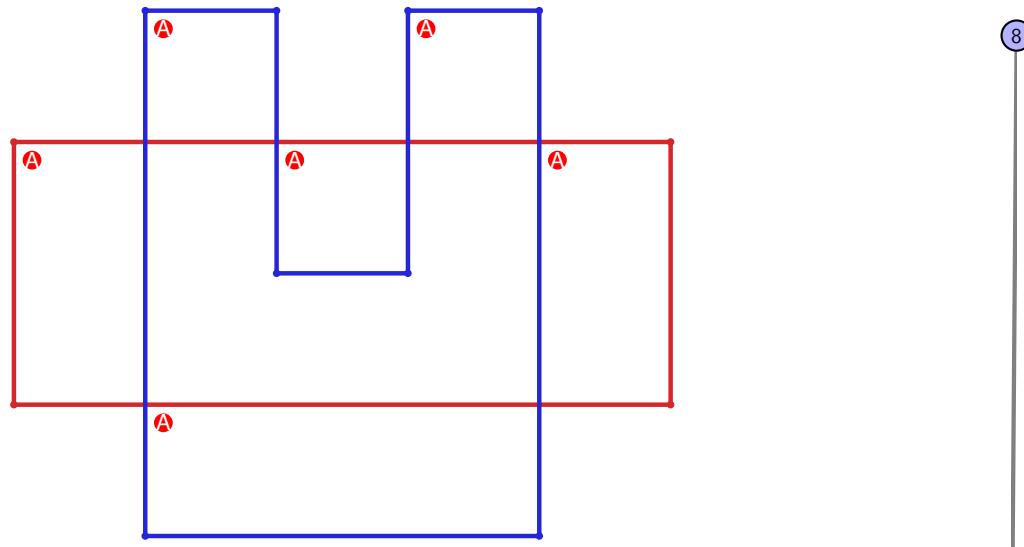


Figure 23: SnapPy multiloop plot.

Figure 24: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.2 [[12, 5, 1, 6], [6, 11, 7, 12], [7, 4, 8, 5], [1, 10, 2, 11], [3, 8, 4, 9], [9, 2, 10, 3]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (9, 2, 10, 3), (12, 5, 1, 6), (10, 7, 11, 8), (3, 8, 4, 9), (6, 11, 7, 12)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 5, 1], [2, 5, 5, 2], [3, 4, 4, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.63

Pinning number: 4

Table 11: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.4	2.67	2.86	3.0	

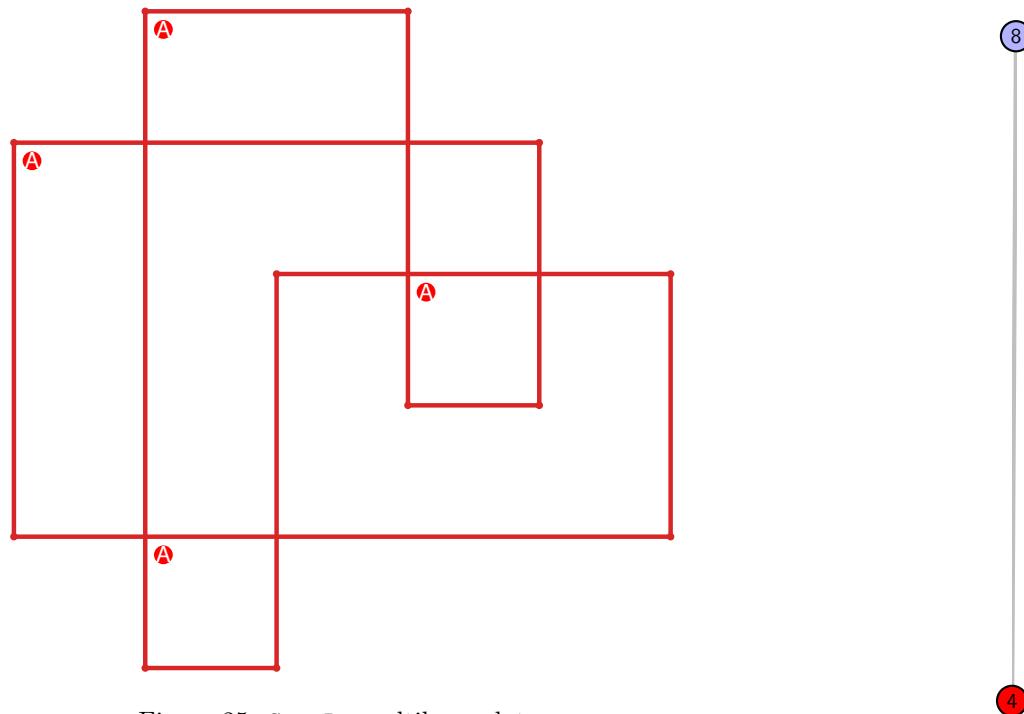


Figure 25: SnapPy multiloop plot.

Figure 26: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.3 [[6, 12, 1, 7], [7, 5, 8, 6], [11, 3, 12, 4], [1, 10, 2, 9], [4, 8, 5, 9], [2, 10, 3, 11]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (10, 3, 11, 4), (2, 11, 3, 12), (12, 5, 7, 6), (6, 7, 1, 8), (4, 9, 5, 10)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 5, 5, 4], [1, 3, 2, 1], [2, 3, 3, 2]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.63

Pinning number: 4

Table 12: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.4	2.67	2.86	3.0	

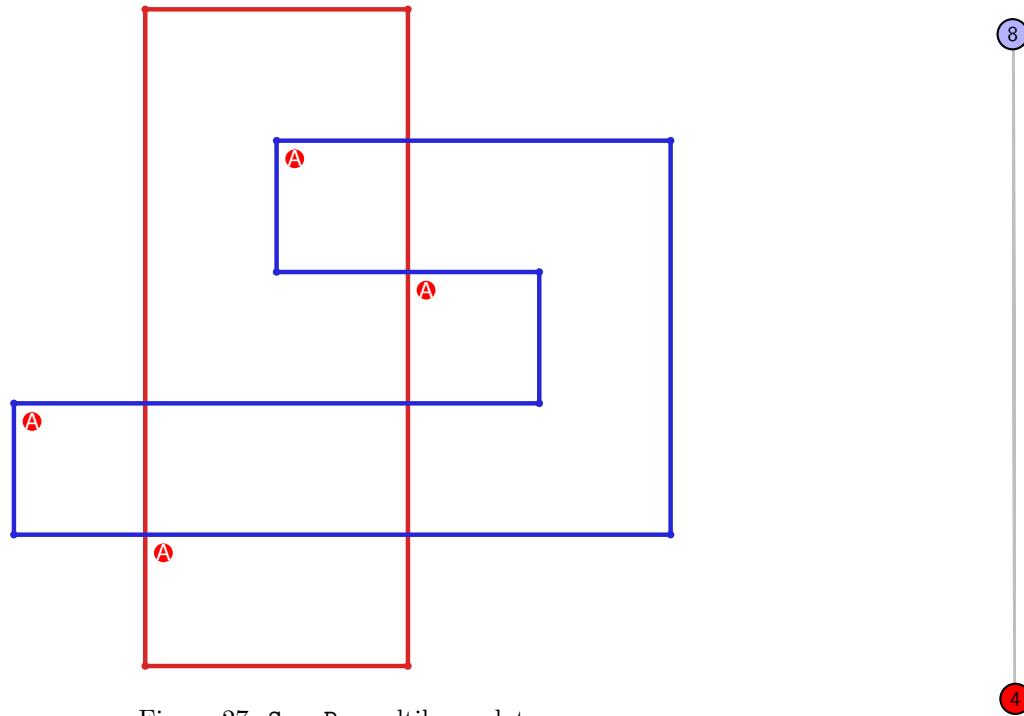


Figure 27: SnapPy multiloop plot.

Figure 28: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.4 [[6, 12, 1, 7], [7, 11, 8, 10], [5, 2, 6, 3], [11, 1, 12, 2], [8, 5, 9, 4], [9, 3, 10, 4]]

PD code drawn by SnapPy: [(7, 6, 8, 1), (1, 12, 2, 7), (9, 4, 10, 5), (2, 5, 3, 6), (8, 11, 9, 12), (3, 10, 4, 11)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 5, 5], [1, 4, 4, 2]]

Total optimal pinning sets: 5

Average optimal degree: 2.6

Total minimal pinning sets: 5

Average minimal degree: 2.6

Total pinning sets: 43

Average overall degree: 2.83

Pinning number: 4

Table 13: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	5	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	16	15	6	1	38
Average degree	2.6	2.8	2.89	2.95	3.0	

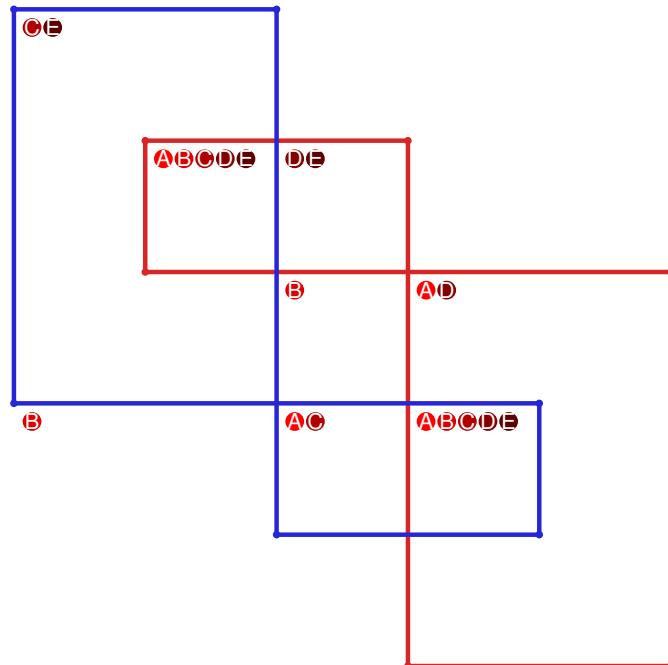


Figure 29: SnapPy multiloop plot.

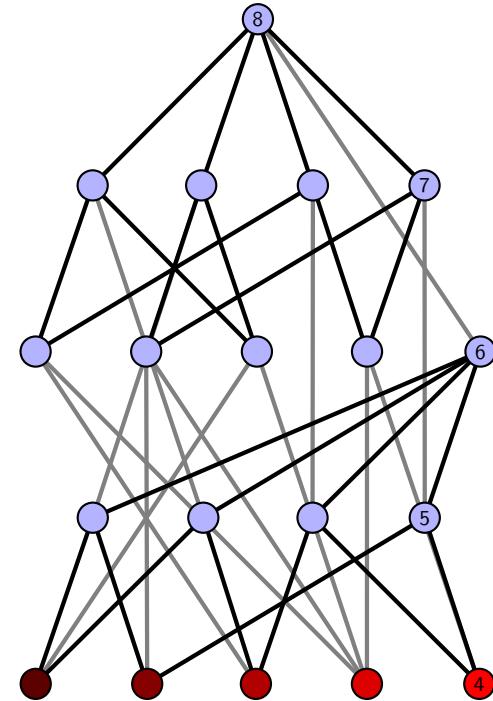


Figure 30: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.5 [[12, 7, 1, 8], [8, 4, 9, 3], [11, 2, 12, 3], [6, 1, 7, 2], [4, 10, 5, 9], [5, 10, 6, 11]]

PD code drawn by SnapPy: [(9, 12, 10, 1), (1, 6, 2, 7), (10, 5, 11, 6), (7, 2, 8, 3), (3, 8, 4, 9), (4, 11, 5, 12)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 3], [0, 2, 5, 0], [1, 5, 5, 1], [2, 4, 4, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 20

Average overall degree: 2.72

Pinning number: 4

Table 14: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	1
Nonminimal pinning sets	0	4	8	5	1	18
Average degree	2.25	2.52	2.75	2.91	3.0	

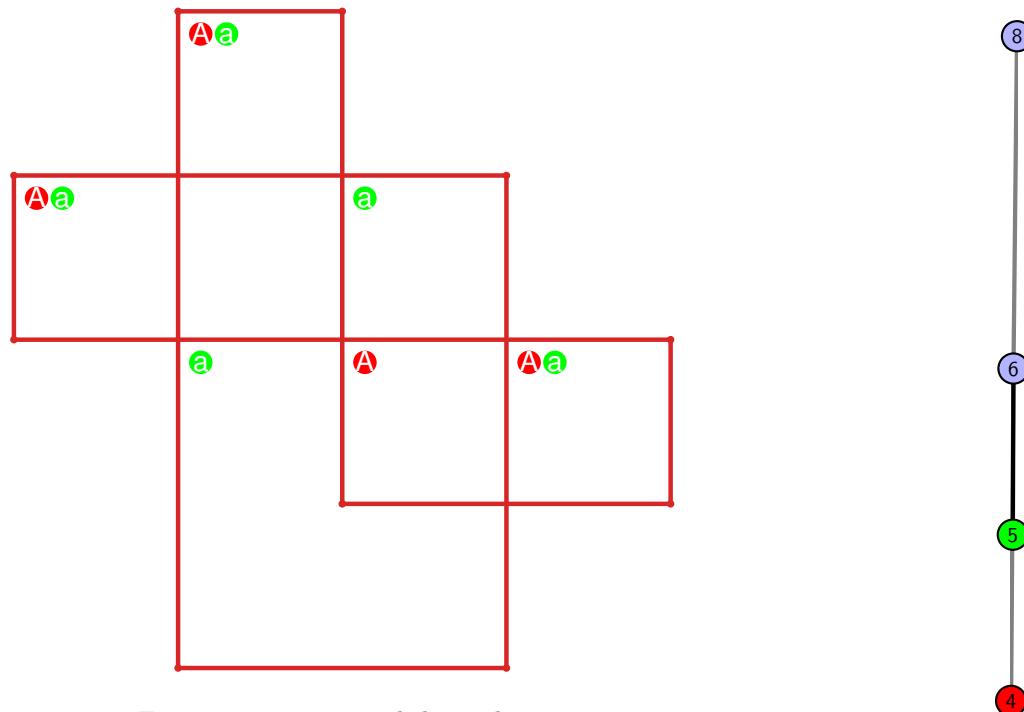


Figure 31: SnapPy multiloop plot.

Figure 32: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.6 $[[12, 3, 1, 4], [4, 10, 5, 9], [11, 8, 12, 9], [2, 7, 3, 8], [1, 7, 2, 6], [10, 6, 11, 5]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (3, 8, 4, 9), (4, 11, 5, 12), (12, 5, 1, 6), (9, 6, 10, 7), (7, 2, 8, 3)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 4, 4], [0, 3, 3, 5], [1, 4, 2, 1]]$

Total optimal pinning sets: 3

Average optimal degree: 2.5

Total minimal pinning sets: 3

Average minimal degree: 2.5

Total pinning sets: 32

Average overall degree: 2.8

Pinning number: 4

Table 15: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	3	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	10	12	6	1	29
Average degree	2.5	2.72	2.86	2.95	3.0	

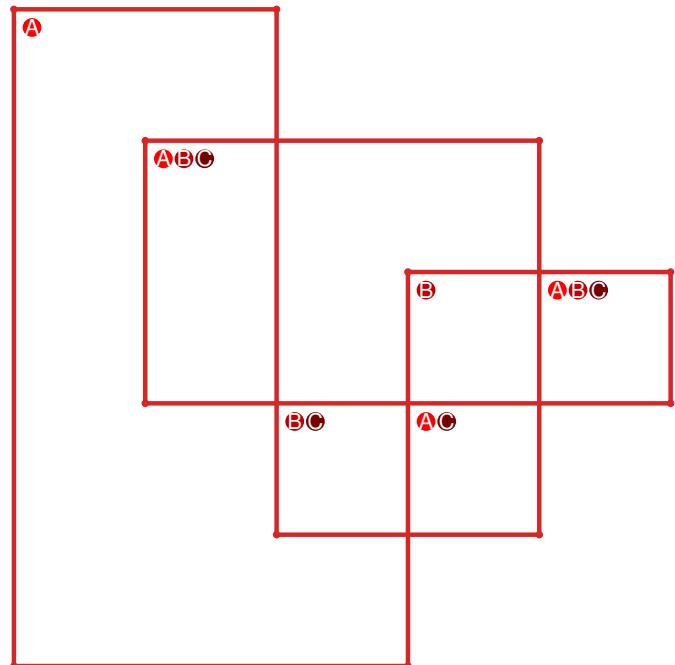


Figure 33: SnapPy multiloop plot.

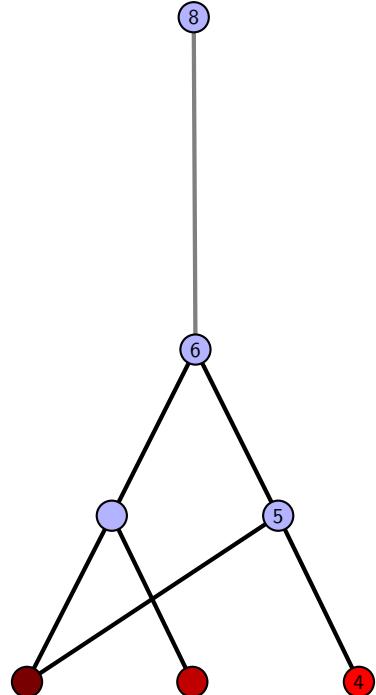


Figure 34: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.7 $[[8, 12, 1, 9], [9, 5, 10, 6], [7, 2, 8, 3], [11, 1, 12, 2], [4, 10, 5, 11], [6, 4, 7, 3]]$

PD code drawn by SnapPy: $[(8, 3, 1, 4), (9, 2, 10, 3), (11, 6, 12, 7), (4, 7, 5, 8), (1, 10, 2, 11), (5, 12, 6, 9)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 5, 3], [0, 2, 4, 0], [1, 3, 5, 1], [1, 4, 2, 2]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.43

Total pinning sets: 26

Average overall degree: 2.73

Pinning number: 4

Table 16: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	2	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	1	0	0	0	1
Nonminimal pinning sets	0	7	10	5	1	23
Average degree	2.25	2.6	2.8	2.91	3.0	

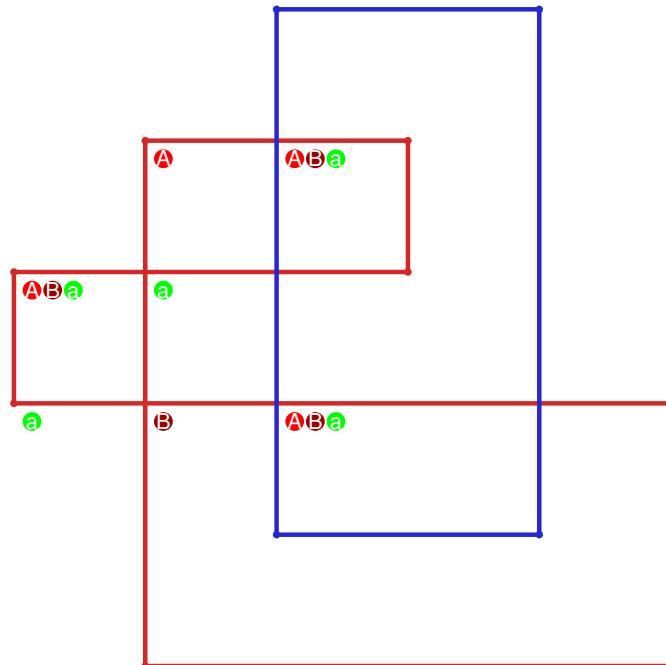


Figure 35: SnapPy multiloop plot.

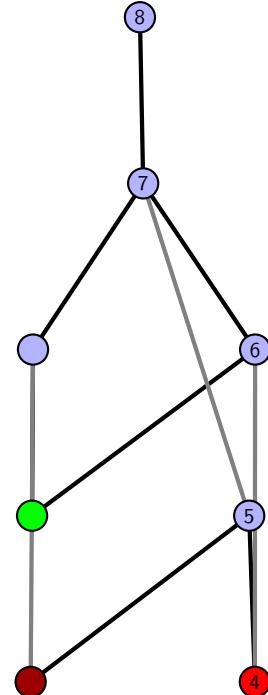


Figure 36: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.8 [[4, 8, 1, 5], [5, 9, 6, 12], [3, 11, 4, 12], [7, 1, 8, 2], [9, 7, 10, 6], [10, 2, 11, 3]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (8, 3, 5, 4), (12, 7, 9, 8), (1, 10, 2, 11), (4, 5, 1, 6), (6, 11, 7, 12)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 5, 4, 0], [1, 3, 5, 1], [2, 4, 3, 2]]

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.5

Total pinning sets: 25

Average overall degree: 2.72

Pinning number: 4

Table 17: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	2	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	1	0	0	1
Nonminimal pinning sets	0	7	9	5	1	22
Average degree	2.25	2.57	2.8	2.91	3.0	

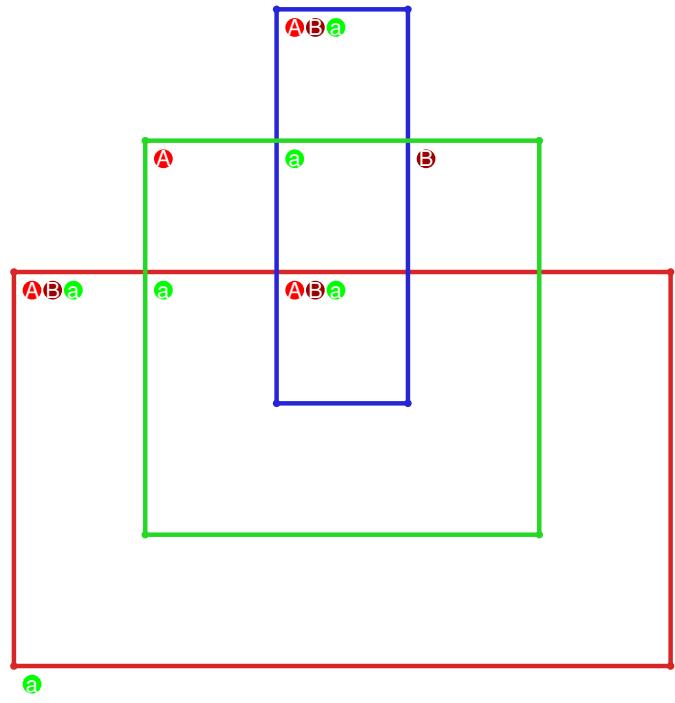


Figure 37: SnapPy multiloop plot.

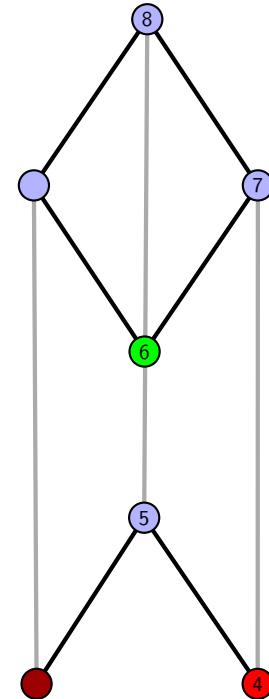


Figure 38: Minimal join sub-semi-lattice of minimal pinning sets.

4.5.9 [[4, 8, 1, 5], [5, 9, 6, 12], [3, 11, 4, 12], [7, 10, 8, 11], [1, 10, 2, 9], [6, 2, 7, 3]]

PD code drawn by SnapPy: [(12, 3, 9, 4), (1, 10, 2, 11), (9, 8, 10, 5), (4, 5, 1, 6), (6, 11, 7, 12), (7, 2, 8, 3)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 5, 4], [0, 3, 5, 1], [1, 4, 3, 2]]

Total optimal pinning sets: 2

Average optimal degree: 3.0

Total minimal pinning sets: 6

Average minimal degree: 3.0

Total pinning sets: 35

Average overall degree: 3.0

Pinning number: 4

Table 18: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	Total
Optimal pinning sets	2	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	4	0	0	4
Nonminimal pinning sets	0	8	12	8	1	29
Average degree	3.0	3.0	3.0	3.0	3.0	

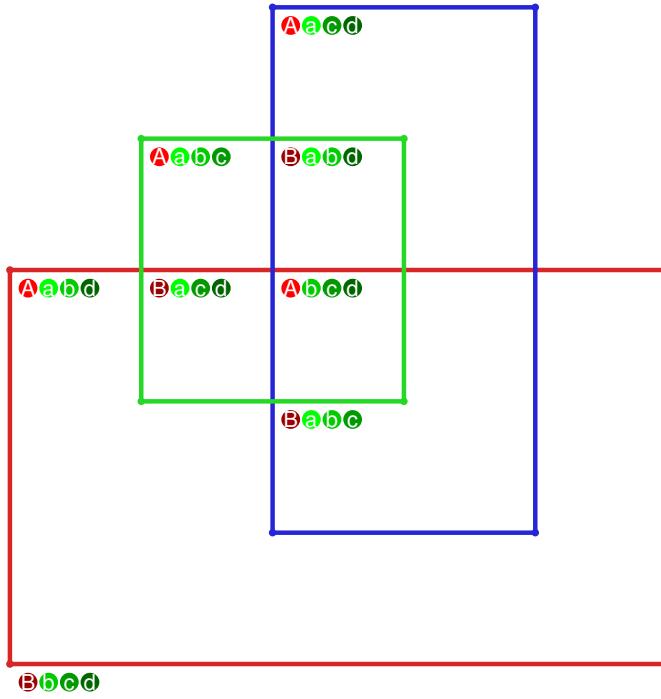


Figure 39: SnapPy multiloop plot.

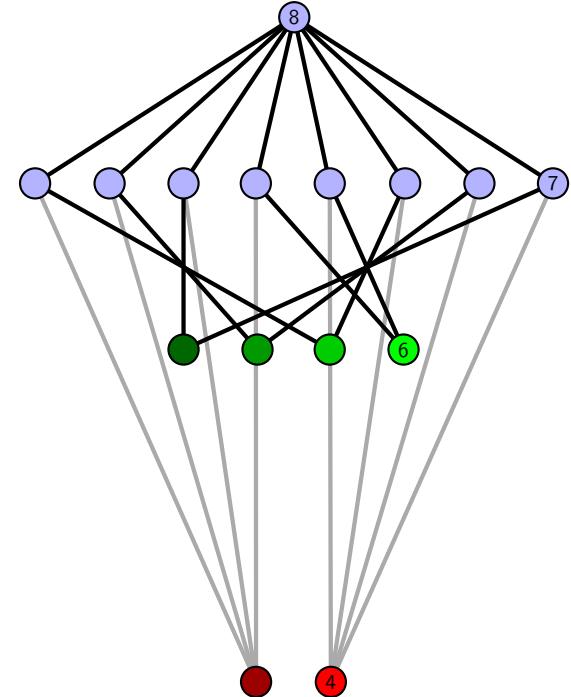


Figure 40: Minimal join sub-semi-lattice of minimal pinning sets.

4.6 9 regions

4.6.1 $[[7, 14, 8, 1], [13, 6, 14, 7], [8, 2, 9, 1], [5, 12, 6, 13], [2, 10, 3, 9], [11, 4, 12, 5], [10, 4, 11, 3]]$

PD code drawn by SnapPy: $[(14, 7, 1, 8), (8, 1, 9, 2), (10, 3, 11, 4), (6, 13, 7, 14), (2, 9, 3, 10), (4, 11, 5, 12), (12, 5, 13, 6)]$
 Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 6, 2], [3, 6, 6, 3], [4, 5, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.59

Pinning number: 7

Table 19: Pinning sets/average degree by cardinal

Cardinal	7	8	9	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.62	3.11	

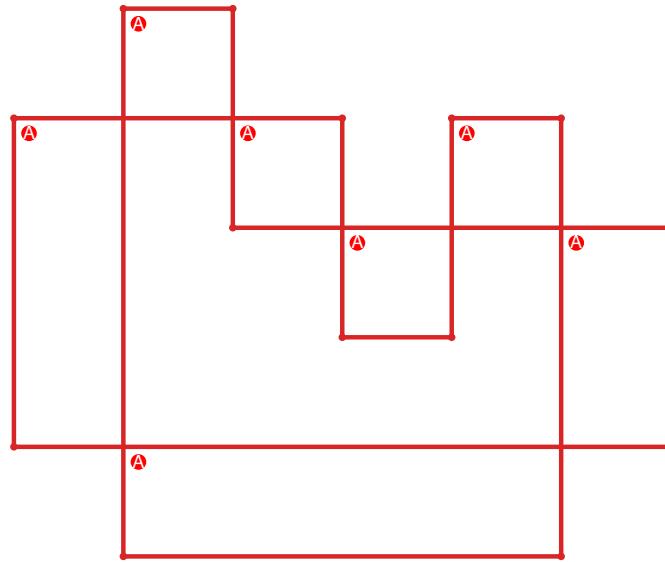


Figure 41: SnapPy multiloop plot.



Figure 42: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.2 [[7, 14, 8, 1], [13, 6, 14, 7], [8, 6, 9, 5], [1, 12, 2, 13], [9, 4, 10, 5], [11, 2, 12, 3], [3, 10, 4, 11]]

PD code drawn by SnapPy: [(9, 14, 10, 1), (7, 2, 8, 3), (3, 6, 4, 7), (11, 4, 12, 5), (1, 8, 2, 9), (13, 10, 14, 11), (5, 12, 6, 13)]
 Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 5, 1], [2, 6, 6, 2], [3, 6, 6, 3], [4, 5, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.68

Pinning number: 5

Table 20: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.42	2.71	2.94	3.11	

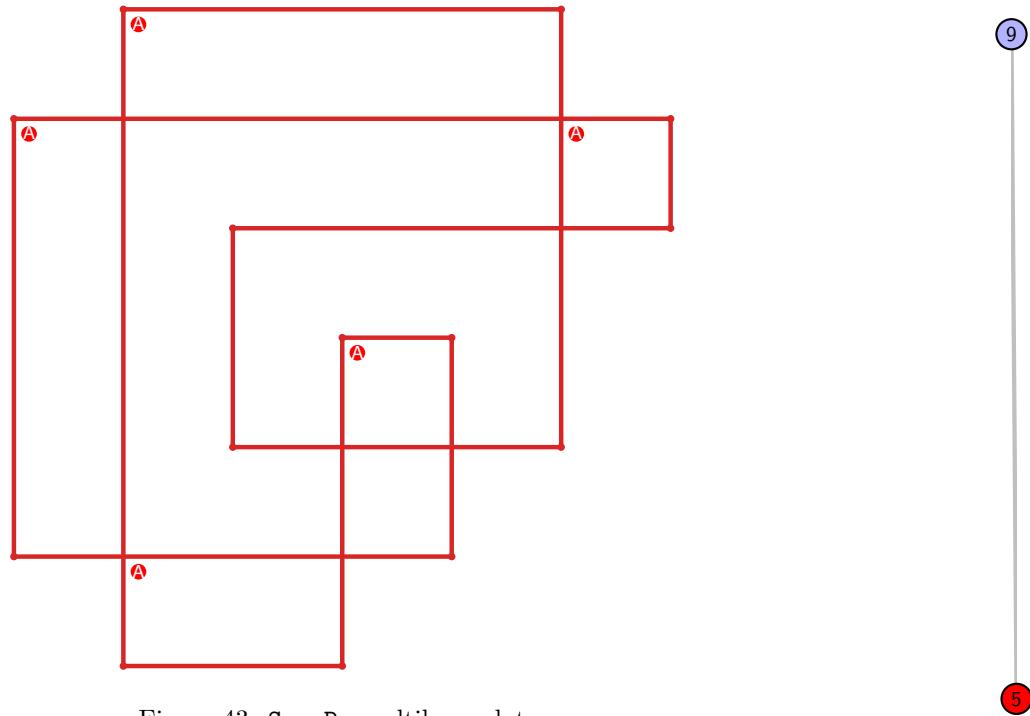


Figure 43: SnapPy multiloop plot.

Figure 44: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.3 [[7, 14, 8, 1], [13, 6, 14, 7], [8, 2, 9, 1], [5, 12, 6, 13], [2, 12, 3, 11], [9, 4, 10, 5], [3, 10, 4, 11]]

PD code drawn by SnapPy: [(5, 14, 6, 1), (9, 2, 10, 3), (13, 6, 14, 7), (7, 12, 8, 13), (1, 8, 2, 9), (3, 10, 4, 11), (11, 4, 12, 5)]
 Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 5, 4, 1], [2, 3, 6, 6], [2, 6, 6, 3], [4, 5, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.68

Pinning number: 5

Table 21: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.42	2.71	2.94	3.11	

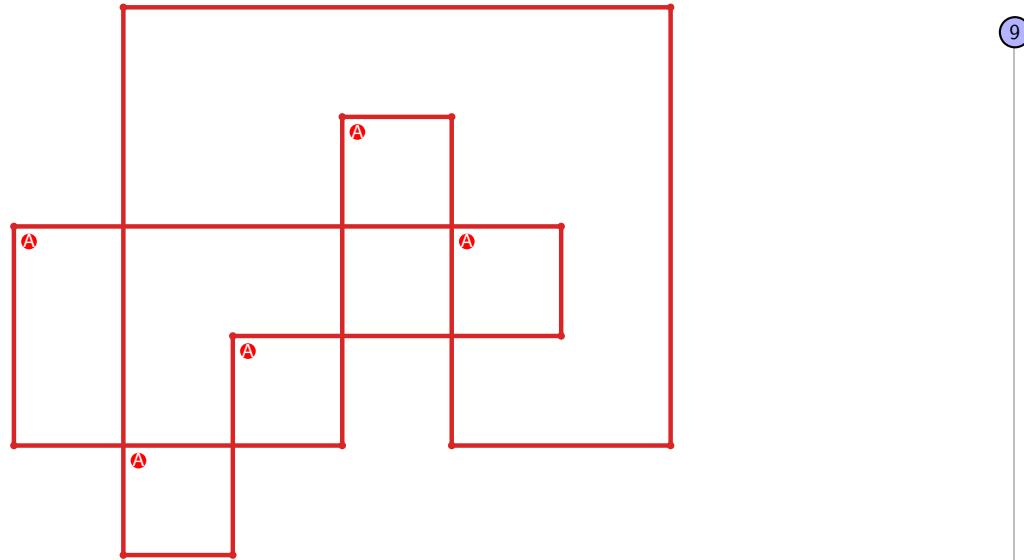


Figure 45: SnapPy multiloop plot.

Figure 46: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.4 [[7, 14, 8, 1], [9, 6, 10, 7], [13, 2, 14, 3], [8, 2, 9, 1], [5, 12, 6, 13], [10, 4, 11, 3], [11, 4, 12, 5]]

PD code drawn by SnapPy: [(14, 7, 1, 8), (8, 1, 9, 2), (6, 3, 7, 4), (2, 9, 3, 10), (4, 11, 5, 12), (12, 5, 13, 6), (10, 13, 11, 14)]
 Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 6], [1, 6, 6, 2], [4, 5, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.79

Pinning number: 3

Table 22: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.42	2.67	2.83	2.95	3.04	3.11	

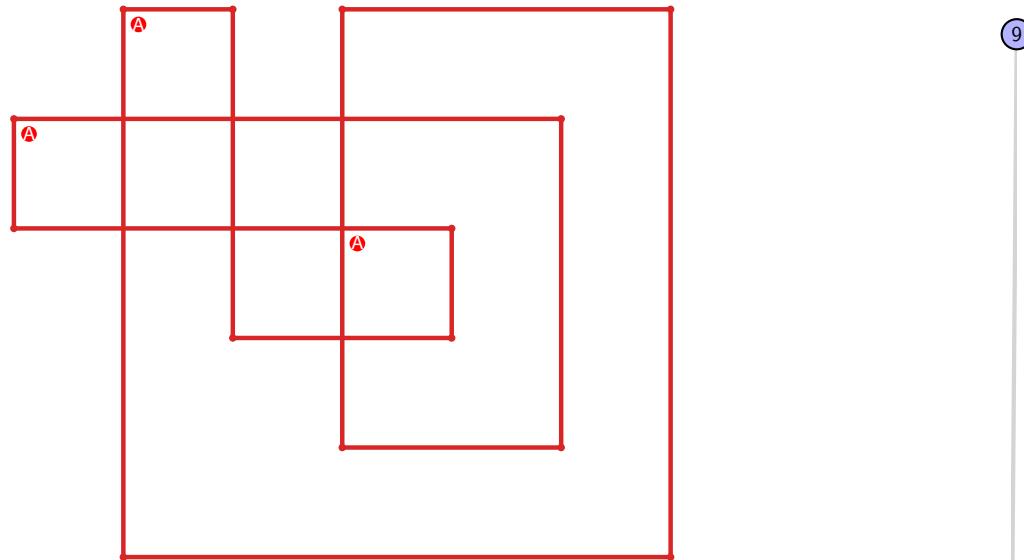


Figure 47: SnapPy multiloop plot.



Figure 48: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.5 [[14, 7, 1, 8], [8, 6, 9, 5], [13, 2, 14, 3], [6, 1, 7, 2], [9, 13, 10, 12], [4, 11, 5, 12], [3, 11, 4, 10]]

PD code drawn by SnapPy: [(2, 5, 3, 6), (11, 4, 12, 5), (7, 14, 8, 1), (1, 8, 2, 9), (9, 6, 10, 7), (3, 12, 4, 13), (10, 13, 11, 14)]
 Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 4, 3], [0, 2, 1, 0], [1, 2, 6, 5], [1, 4, 6, 6], [2, 5, 5, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.62

Total minimal pinning sets: 5

Average minimal degree: 2.61

Total pinning sets: 66

Average overall degree: 2.92

Pinning number: 4

Table 23: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	3
Nonminimal pinning sets	0	10	24	19	7	1	61
Average degree	2.62	2.75	2.91	3.01	3.07	3.11	

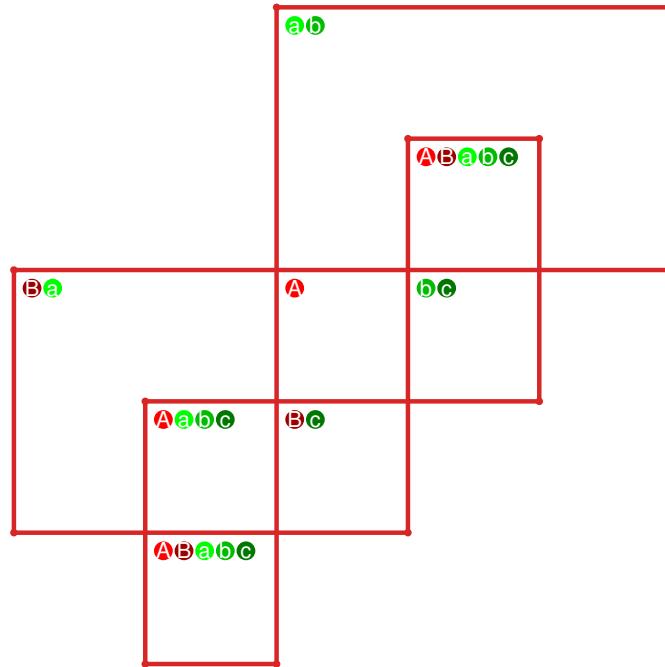


Figure 49: SnapPy multiloop plot.

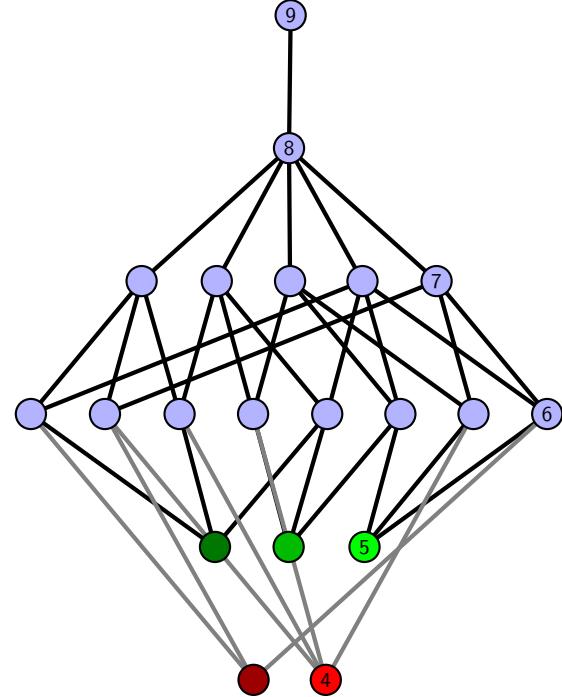


Figure 50: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.6 [[6, 14, 1, 7], [7, 13, 8, 12], [5, 2, 6, 3], [13, 1, 14, 2], [8, 11, 9, 12], [3, 9, 4, 10], [10, 4, 11, 5]]

PD code drawn by SnapPy: [(3, 6, 4, 1), (7, 2, 8, 3), (10, 5, 11, 6), (1, 14, 2, 7), (13, 8, 14, 9), (9, 12, 10, 13), (4, 11, 5, 12)]
 Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 6, 3], [0, 2, 1, 0], [1, 6, 5, 1], [2, 4, 6, 6], [2, 5, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.79

Pinning number: 3

Table 24: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.42	2.67	2.83	2.95	3.04	3.11	

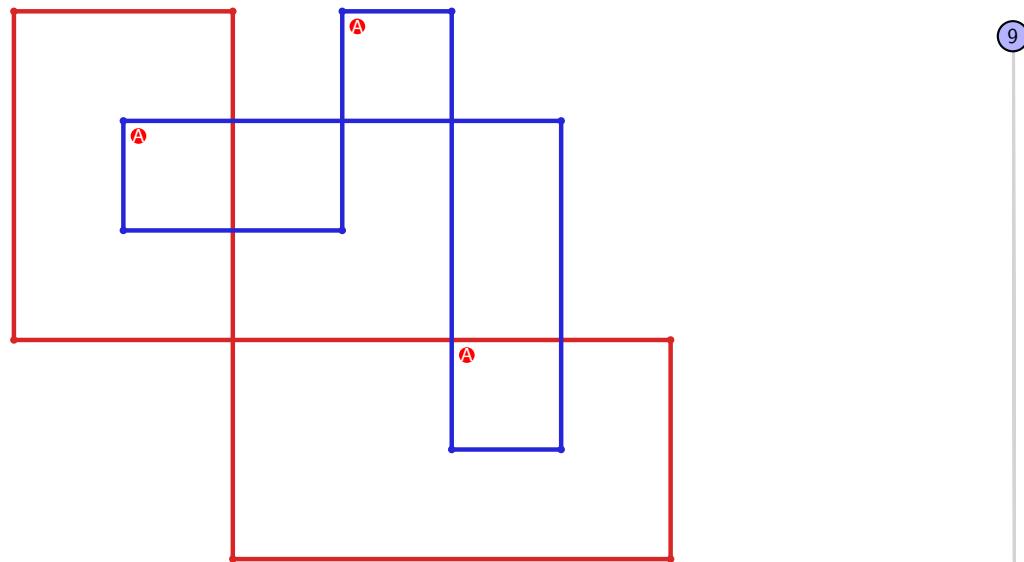


Figure 51: SnapPy multiloop plot.



Figure 52: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.7 [[4, 10, 1, 5], [5, 9, 6, 8], [3, 14, 4, 11], [9, 1, 10, 2], [6, 13, 7, 12], [7, 11, 8, 12], [13, 2, 14, 3]]

PD code drawn by SnapPy: [(5, 4, 6, 1), (14, 3, 9, 4), (13, 10, 14, 11), (2, 9, 3, 10), (1, 6, 2, 7), (12, 7, 13, 8), (8, 11, 5, 12)]
 Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 6, 6], [0, 6, 1, 0], [1, 6, 5, 5], [1, 4, 4, 2], [2, 4, 3, 2]]

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 5

Average minimal degree: 2.52

Total pinning sets: 56

Average overall degree: 2.84

Pinning number: 4

Table 25: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	3
Nonminimal pinning sets	0	9	20	15	6	1	51
Average degree	2.5	2.67	2.83	2.95	3.04	3.11	

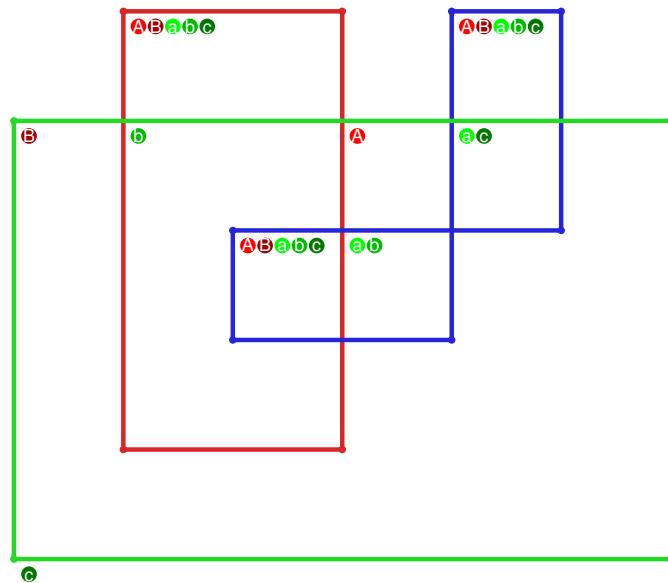


Figure 53: SnapPy multiloop plot.

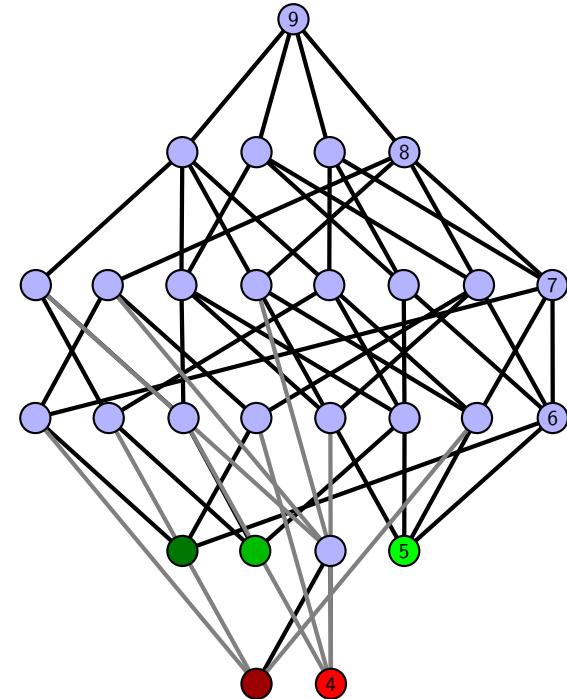


Figure 54: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.8 [[6, 14, 1, 7], [7, 5, 8, 6], [13, 1, 14, 2], [10, 4, 11, 5], [8, 11, 9, 12], [2, 12, 3, 13], [3, 9, 4, 10]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (13, 2, 14, 3), (11, 4, 12, 5), (6, 7, 1, 8), (14, 9, 7, 10), (5, 10, 6, 11), (3, 12, 4, 13)]
 Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 6, 4], [1, 3, 6, 5], [2, 4, 6, 2], [3, 5, 4, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 20

Average overall degree: 2.75

Pinning number: 5

Table 26: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	1
Nonminimal pinning sets	0	4	8	5	1	18
Average degree	2.2	2.5	2.79	3.0	3.11	

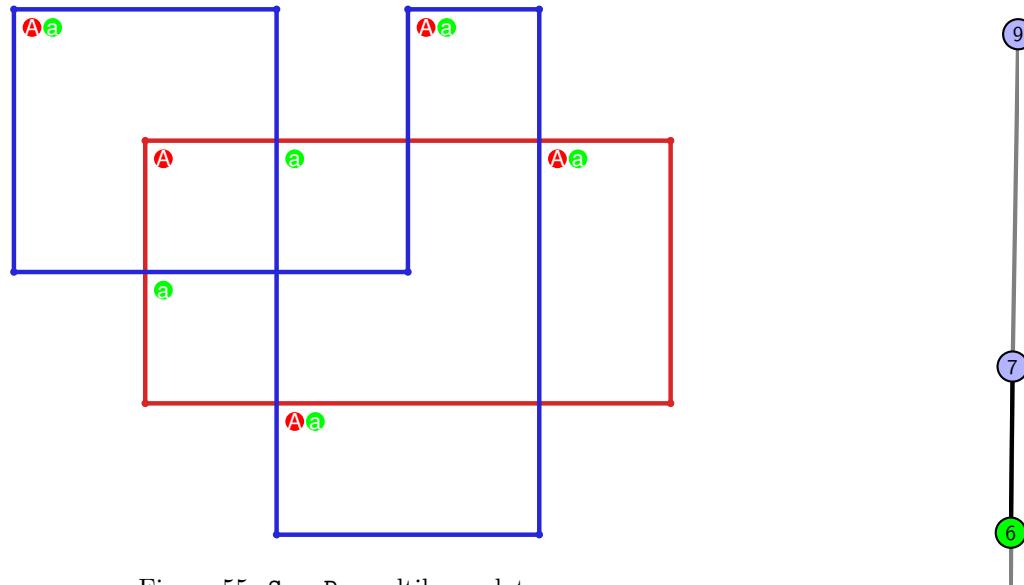


Figure 55: SnapPy multiloop plot.

Figure 56: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.9 [[14, 5, 1, 6], [6, 13, 7, 14], [4, 11, 5, 12], [1, 11, 2, 10], [12, 7, 13, 8], [8, 3, 9, 4], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(5, 14, 6, 1), (11, 2, 12, 3), (9, 4, 10, 5), (13, 6, 14, 7), (7, 12, 8, 13), (1, 8, 2, 9), (3, 10, 4, 11)]
 Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 3], [0, 2, 6, 6], [1, 5, 2, 1], [2, 4, 6, 6], [3, 5, 5, 3]]

Total optimal pinning sets: 4

Average optimal degree: 2.3

Total minimal pinning sets: 4

Average minimal degree: 2.3

Total pinning sets: 30

Average overall degree: 2.75

Pinning number: 5

Table 27: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	Total
Optimal pinning sets	4	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	10	10	5	1	26
Average degree	2.3	2.67	2.86	3.0	3.11	

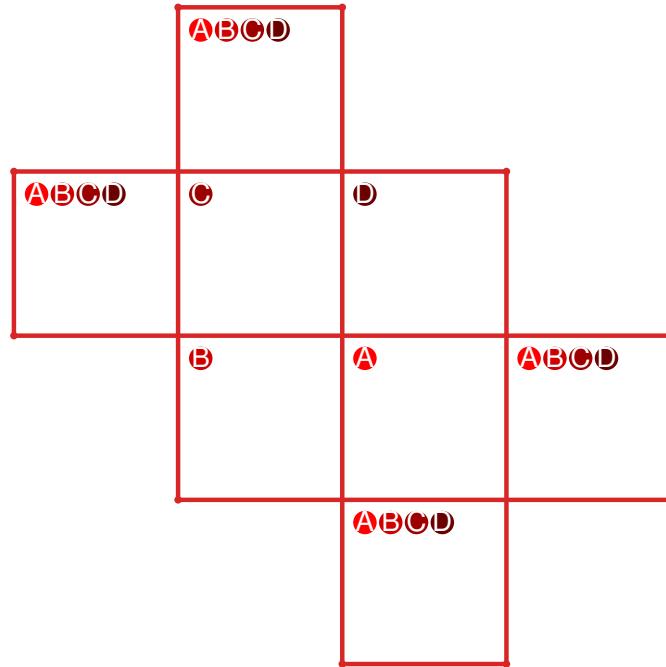


Figure 57: SnapPy multiloop plot.

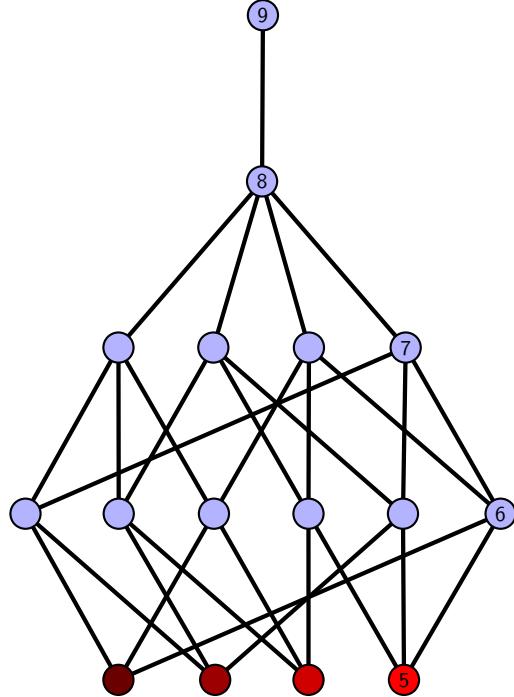


Figure 58: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.10 [[8, 14, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [13, 3, 14, 4], [1, 12, 2, 11], [6, 11, 7, 10], [2, 12, 3, 13]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (5, 2, 6, 3), (3, 12, 4, 13), (13, 4, 14, 5), (14, 7, 9, 8), (8, 9, 1, 10), (6, 11, 7, 12)]
 Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 6, 6, 5], [1, 4, 2, 1], [3, 4, 4, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 40

Average overall degree: 2.82

Pinning number: 4

Table 28: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	5	13	13	6	1	38
Average degree	2.25	2.53	2.76	2.92	3.04	3.11	

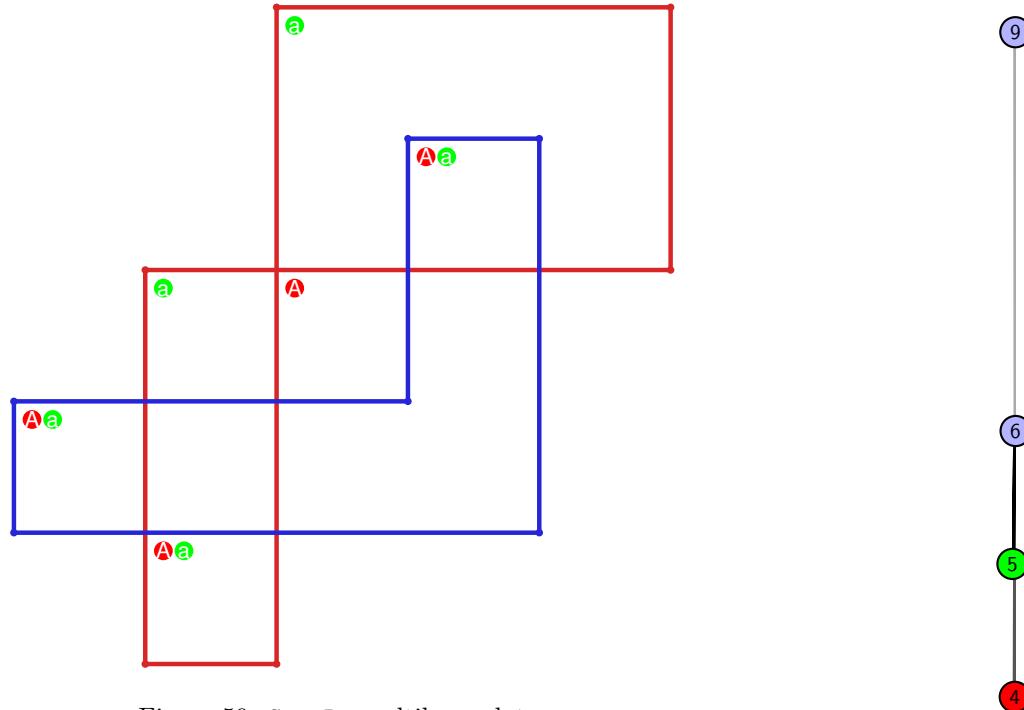


Figure 59: SnapPy multiloop plot.

Figure 60: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.11 [[7, 14, 8, 1], [6, 11, 7, 12], [13, 10, 14, 11], [8, 3, 9, 4], [1, 4, 2, 5], [12, 5, 13, 6], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (13, 2, 14, 3), (10, 3, 11, 4), (14, 7, 1, 8), (11, 8, 12, 9), (4, 9, 5, 10), (5, 12, 6, 13)]
 Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 6, 4], [0, 3, 6, 5], [1, 4, 2, 1], [2, 4, 3, 3]]

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 5

Average minimal degree: 2.68

Total pinning sets: 66

Average overall degree: 2.91

Pinning number: 4

Table 29: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	3
Nonminimal pinning sets	0	10	24	19	7	1	61
Average degree	2.5	2.74	2.9	3.01	3.07	3.11	

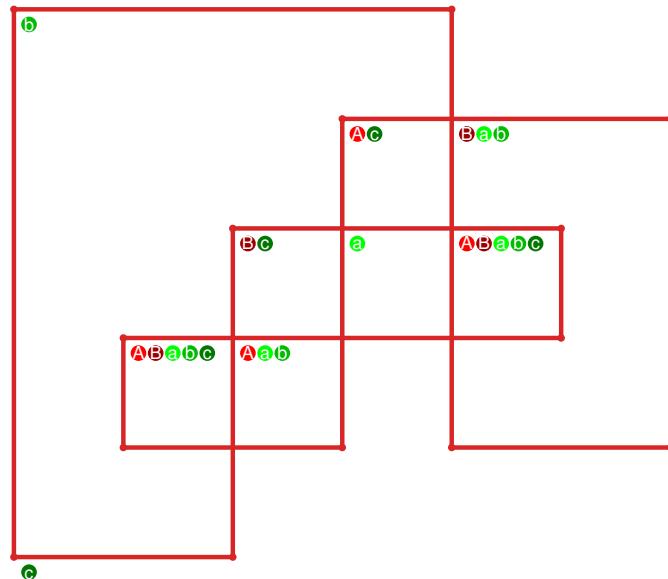


Figure 61: SnapPy multiloop plot.

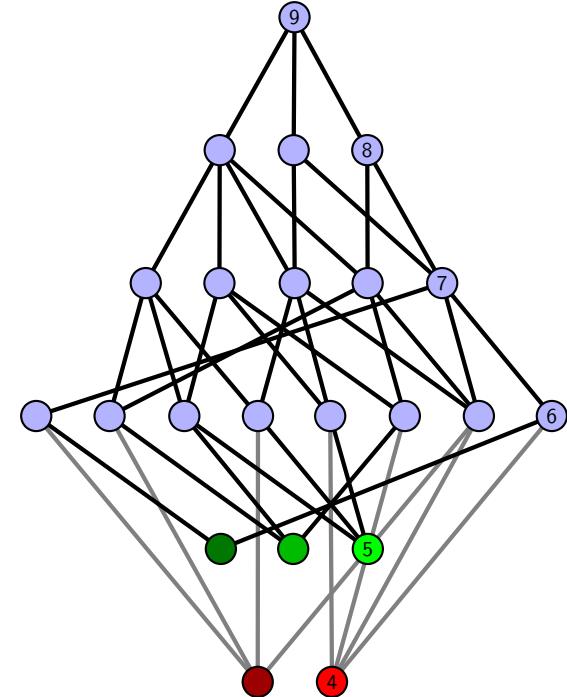


Figure 62: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.12 [[5, 14, 6, 1], [4, 11, 5, 12], [13, 10, 14, 11], [6, 10, 7, 9], [1, 9, 2, 8], [12, 3, 13, 4], [7, 3, 8, 2]]

PD code drawn by SnapPy: [(14, 5, 1, 6), (10, 1, 11, 2), (6, 13, 7, 14), (7, 4, 8, 5), (11, 8, 12, 9), (2, 9, 3, 10), (3, 12, 4, 13)]
 Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 4], [0, 3, 6, 6], [1, 6, 2, 1], [3, 5, 4, 4]]

Total optimal pinning sets: 6

Average optimal degree: 2.63

Total minimal pinning sets: 6

Average minimal degree: 2.63

Total pinning sets: 48

Average overall degree: 2.91

Pinning number: 5

Table 30: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	Total
Optimal pinning sets	6	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	17	17	7	1	42
Average degree	2.63	2.85	2.99	3.07	3.11	

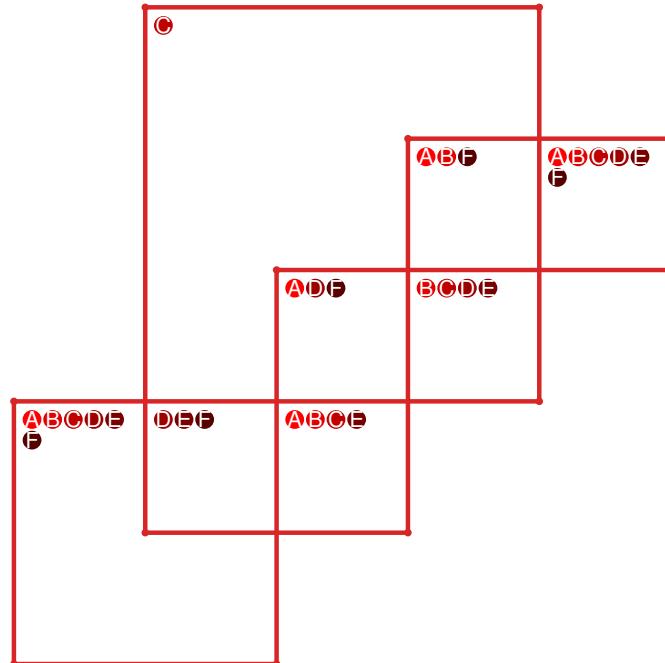


Figure 63: SnapPy multiloop plot.

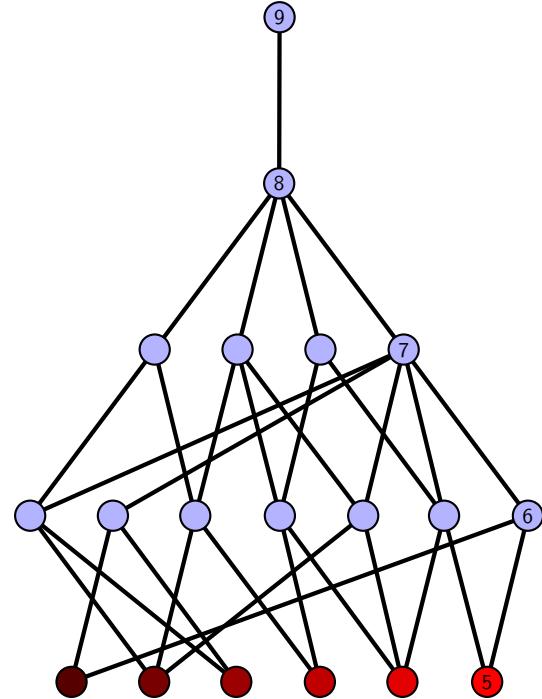


Figure 64: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.13 [[10, 5, 1, 6], [6, 3, 7, 4], [4, 9, 5, 10], [1, 11, 2, 14], [2, 13, 3, 14], [7, 13, 8, 12], [8, 11, 9, 12]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (8, 3, 9, 4), (2, 7, 3, 8), (14, 5, 11, 6), (10, 11, 1, 12), (12, 9, 13, 10), (6, 13, 7, 14)]
 Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 2], [0, 1, 6, 0], [0, 6, 4, 4], [1, 3, 3, 5], [1, 4, 6, 6], [2, 5, 5, 3]]

Total optimal pinning sets: 3

Average optimal degree: 2.42

Total minimal pinning sets: 4

Average minimal degree: 2.46

Total pinning sets: 58

Average overall degree: 2.83

Pinning number: 4

Table 31: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	12	20	15	6	1	54
Average degree	2.42	2.66	2.83	2.95	3.04	3.11	

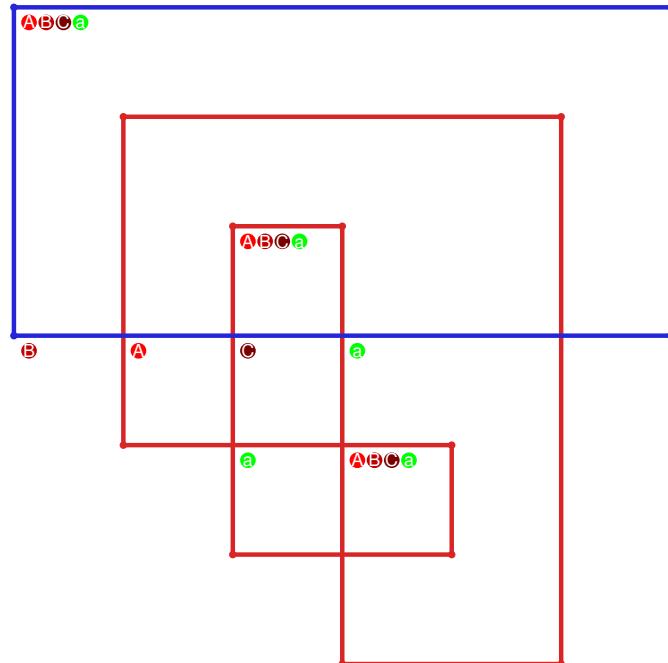


Figure 65: SnapPy multiloop plot.

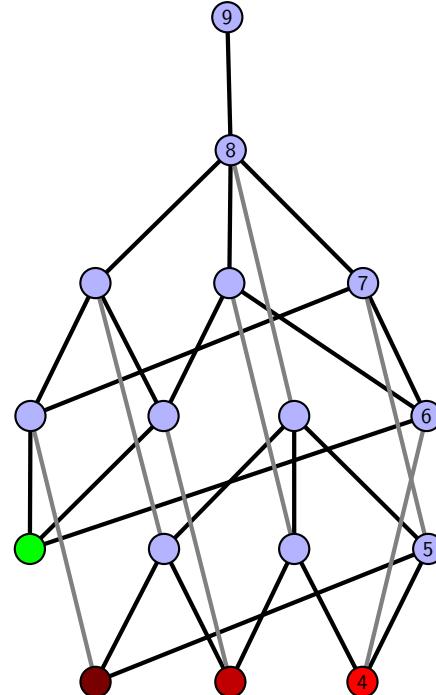


Figure 66: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.14 [[5, 14, 6, 1], [4, 7, 5, 8], [13, 6, 14, 7], [1, 10, 2, 11], [8, 3, 9, 4], [9, 12, 10, 13], [2, 12, 3, 11]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (11, 4, 12, 5), (2, 5, 3, 6), (13, 8, 14, 9), (9, 14, 10, 1), (7, 10, 8, 11), (3, 12, 4, 13)]
 Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 5, 6, 6], [1, 6, 5, 1], [2, 4, 6, 3], [3, 5, 4, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.42

Total pinning sets: 44

Average overall degree: 2.82

Pinning number: 4

Table 32: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	2
Nonminimal pinning sets	0	5	15	14	6	1	41
Average degree	2.25	2.54	2.78	2.94	3.04	3.11	

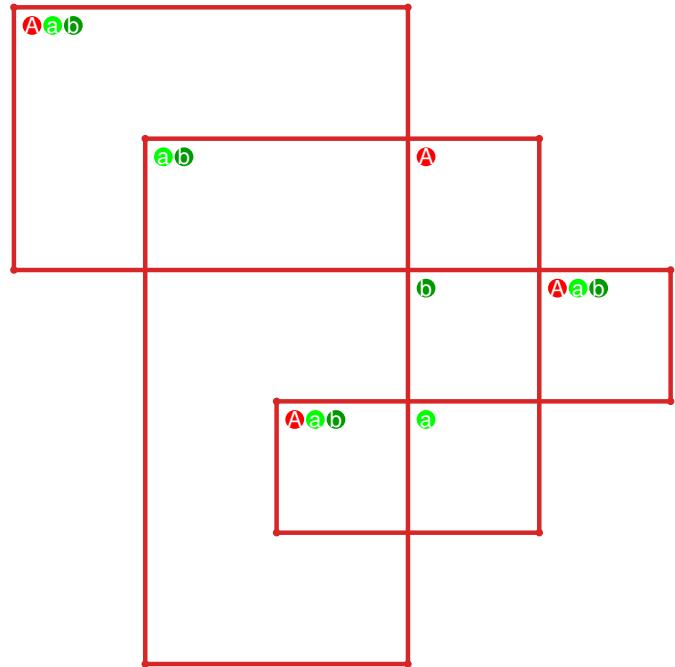


Figure 67: SnapPy multiloop plot.

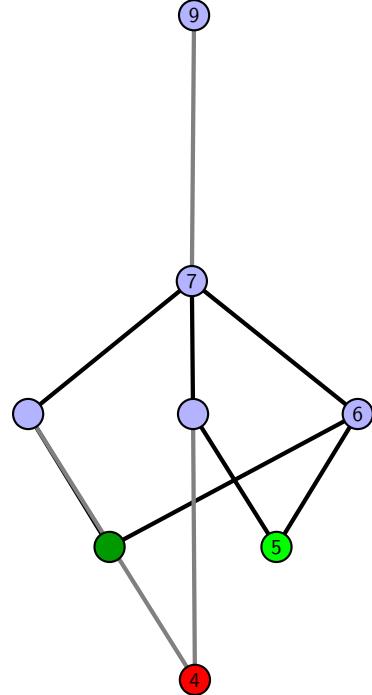


Figure 68: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.15 [[10, 14, 1, 11], [11, 6, 12, 5], [9, 2, 10, 3], [13, 1, 14, 2], [6, 13, 7, 12], [7, 4, 8, 5], [3, 8, 4, 9]]

PD code drawn by SnapPy: [(7, 10, 8, 1), (5, 2, 6, 3), (3, 14, 4, 11), (1, 6, 2, 7), (12, 9, 13, 10), (8, 13, 9, 14), (11, 4, 12, 5)]
 Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 4, 0], [1, 3, 5, 1], [1, 4, 6, 6], [2, 5, 5, 2]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.73

Pinning number: 4

Table 33: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	

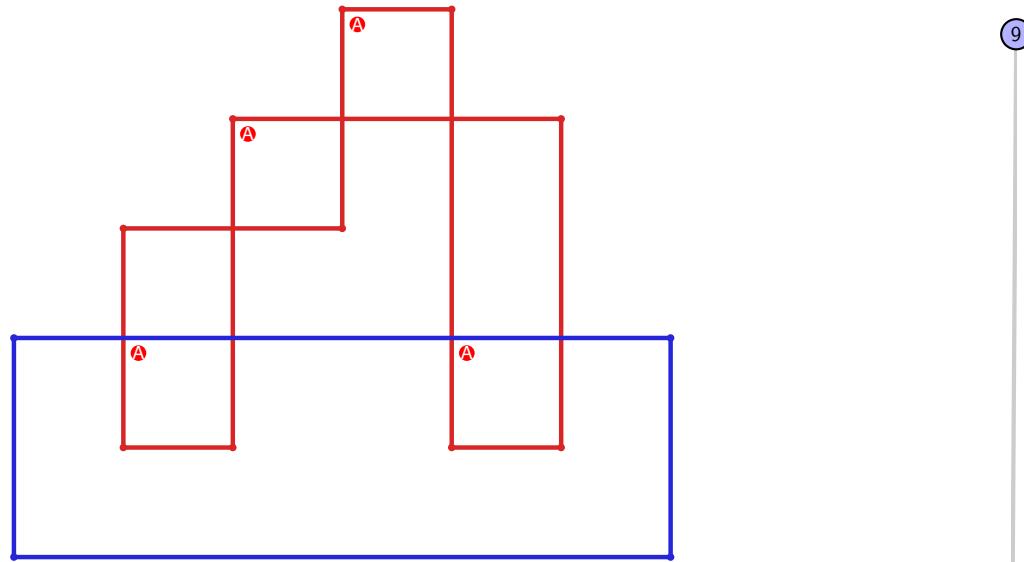


Figure 69: SnapPy multiloop plot.

Figure 70: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.16 [[5, 14, 6, 1], [11, 4, 12, 5], [13, 8, 14, 9], [6, 2, 7, 1], [3, 10, 4, 11], [12, 10, 13, 9], [7, 2, 8, 3]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (10, 5, 11, 6), (6, 9, 7, 10), (14, 7, 1, 8), (2, 11, 3, 12), (12, 3, 13, 4), (4, 13, 5, 14)]
 Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 5, 6], [0, 6, 6, 0], [1, 6, 5, 1], [1, 4, 2, 2], [2, 4, 3, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.73

Pinning number: 4

Table 34: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	

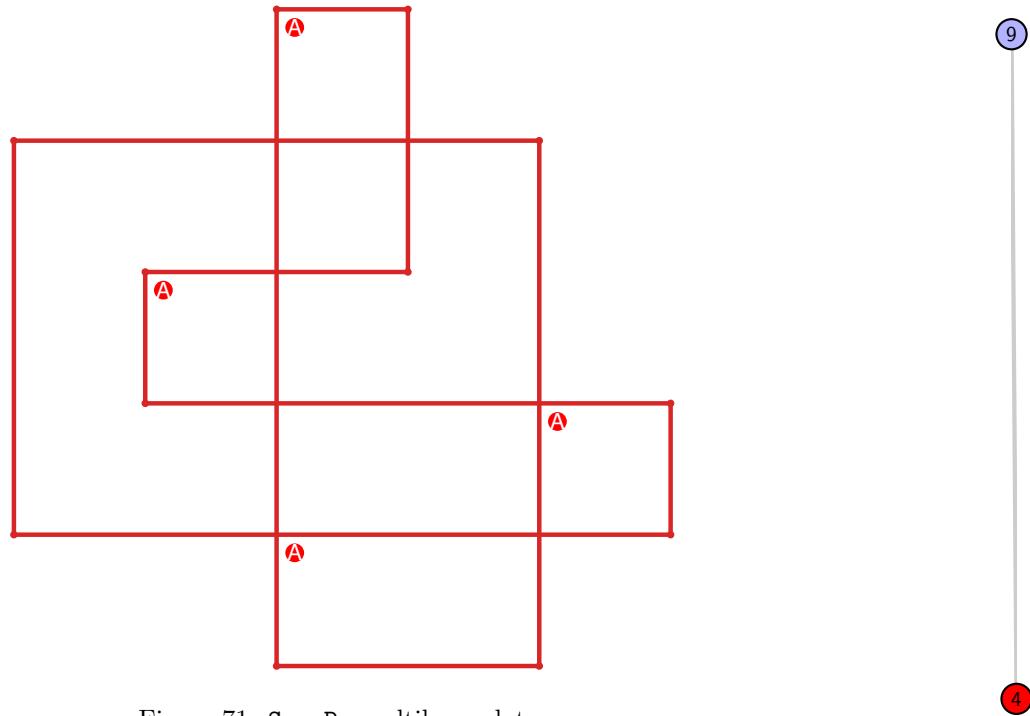


Figure 71: SnapPy multiloop plot.

Figure 72: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.17 [[10, 14, 1, 11], [11, 6, 12, 5], [9, 4, 10, 5], [13, 1, 14, 2], [6, 13, 7, 12], [3, 8, 4, 9], [2, 8, 3, 7]]

PD code drawn by SnapPy: [(7, 2, 8, 3), (3, 14, 4, 11), (5, 10, 6, 1), (1, 6, 2, 7), (12, 9, 13, 10), (11, 4, 12, 5), (8, 13, 9, 14)]
 Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 4, 0], [1, 3, 6, 1], [2, 6, 6, 2], [3, 5, 5, 4]]

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 28

Average overall degree: 2.76

Pinning number: 5

Table 35: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	Total
Optimal pinning sets	3	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	9	10	5	1	25
Average degree	2.27	2.63	2.86	3.0	3.11	

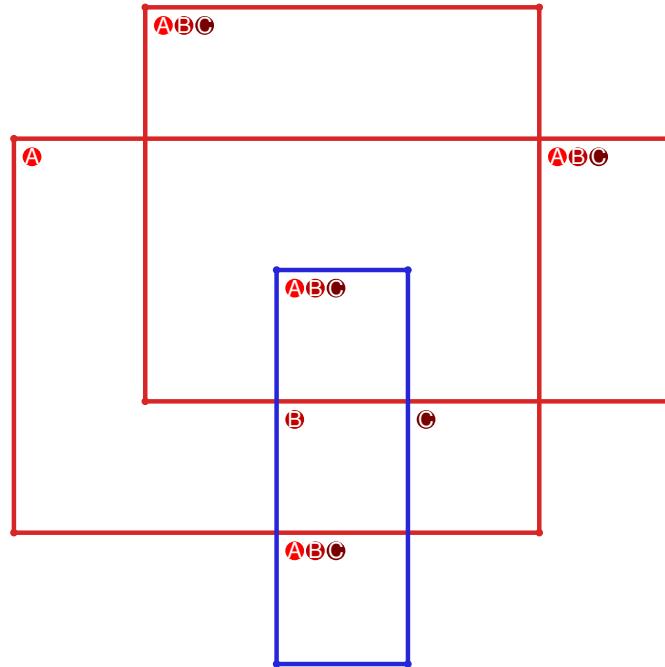


Figure 73: SnapPy multiloop plot.

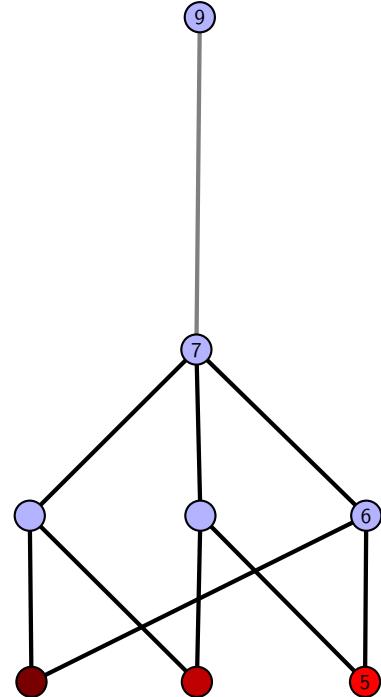


Figure 74: Minimal join sub-semi-lattice of minimal pinning sets.

4.6.18 [[4, 14, 1, 5], [5, 11, 6, 10], [3, 9, 4, 10], [13, 8, 14, 9], [1, 12, 2, 11], [6, 2, 7, 3], [7, 12, 8, 13]]

PD code drawn by SnapPy: [(5, 4, 6, 1), (12, 7, 13, 8), (1, 8, 2, 9), (9, 14, 10, 5), (10, 3, 11, 4), (6, 11, 7, 12), (2, 13, 3, 14)]
 Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 6, 5, 1], [1, 4, 6, 2], [3, 5, 4, 3]]

Total optimal pinning sets: 2

Average optimal degree: 2.75

Total minimal pinning sets: 6

Average minimal degree: 2.85

Total pinning sets: 72

Average overall degree: 3.0

Pinning number: 4

Table 36: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	4
Nonminimal pinning sets	0	9	26	22	8	1	66
Average degree	2.75	2.89	2.99	3.05	3.09	3.11	

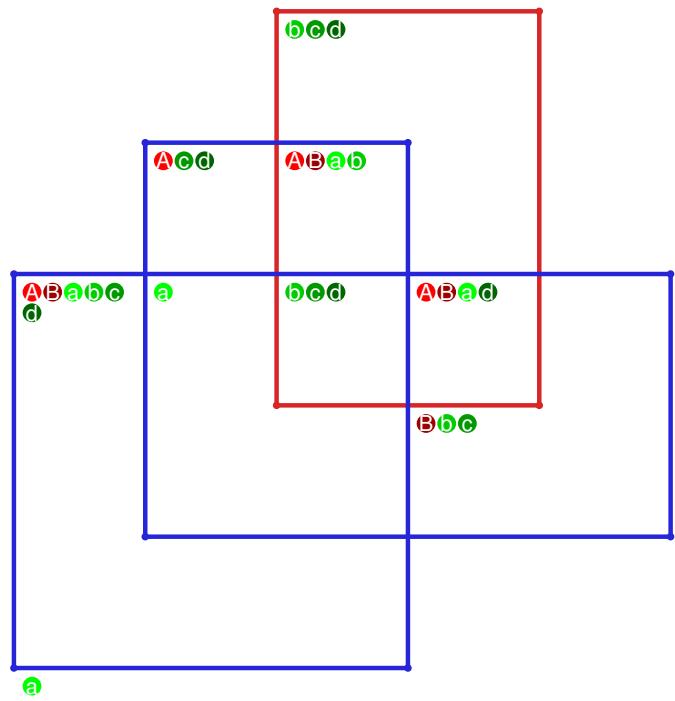


Figure 75: SnapPy multiloop plot.

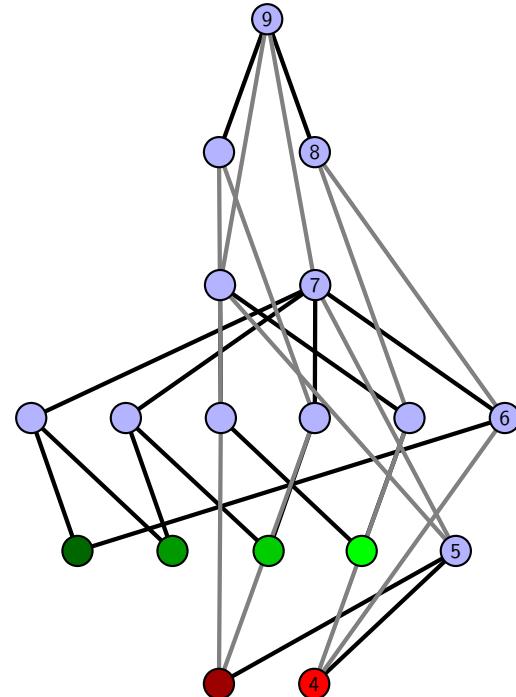


Figure 76: Minimal join sub-semi-lattice of minimal pinning sets.

4.7 10 regions

4.7.1 $[[8, 16, 1, 9], [9, 7, 10, 8], [15, 1, 16, 2], [6, 10, 7, 11], [2, 14, 3, 15], [11, 5, 12, 6], [13, 3, 14, 4], [4, 12, 5, 13]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (15, 2, 16, 3), (13, 4, 14, 5), (11, 6, 12, 7), (1, 16, 2, 9), (7, 10, 8, 11), (5, 12, 6, 13), (3, 14, 4, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 6, 2], [3, 7, 7, 3], [4, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.63

Pinning number: 8

Table 37: Pinning sets/average degree by cardinal

Cardinal	8	9	10	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.67	3.2	

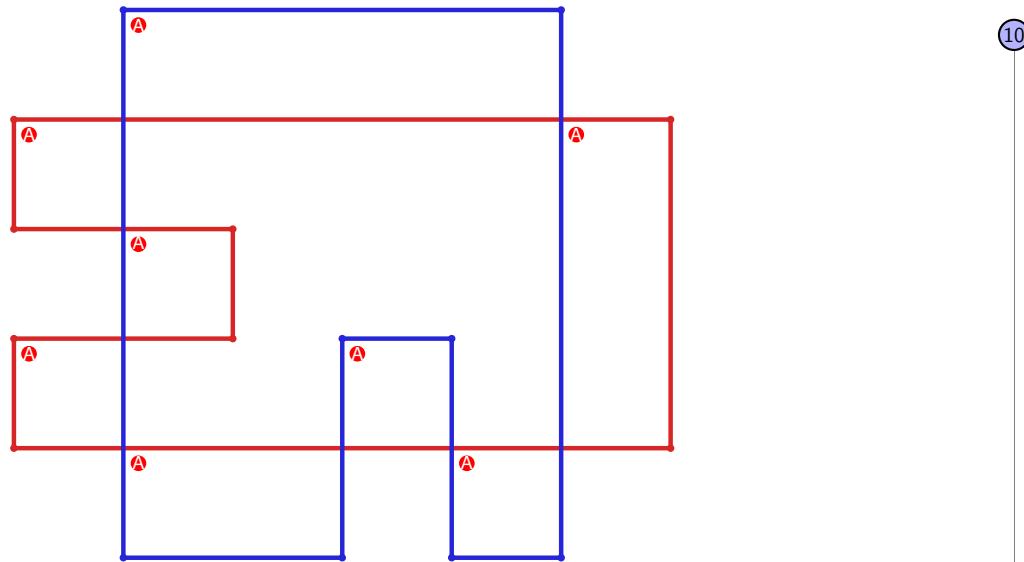


Figure 77: `SnapPy` multiloop plot.



Figure 78: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.2 [[16, 7, 1, 8], [8, 15, 9, 16], [9, 6, 10, 7], [1, 14, 2, 15], [5, 10, 6, 11], [13, 2, 14, 3], [11, 4, 12, 5], [3, 12, 4, 13]]

PD code drawn by `SnapPy`: [(11, 16, 12, 1), (9, 2, 10, 3), (7, 4, 8, 5), (14, 5, 15, 6), (3, 8, 4, 9), (1, 10, 2, 11), (15, 12, 16, 13), (6, 13, 7, 14)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 5, 1], [2, 6, 6, 2], [3, 7, 7, 3], [4, 7, 7, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.71

Pinning number: 6

Table 38: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.43	2.75	3.0	3.2	

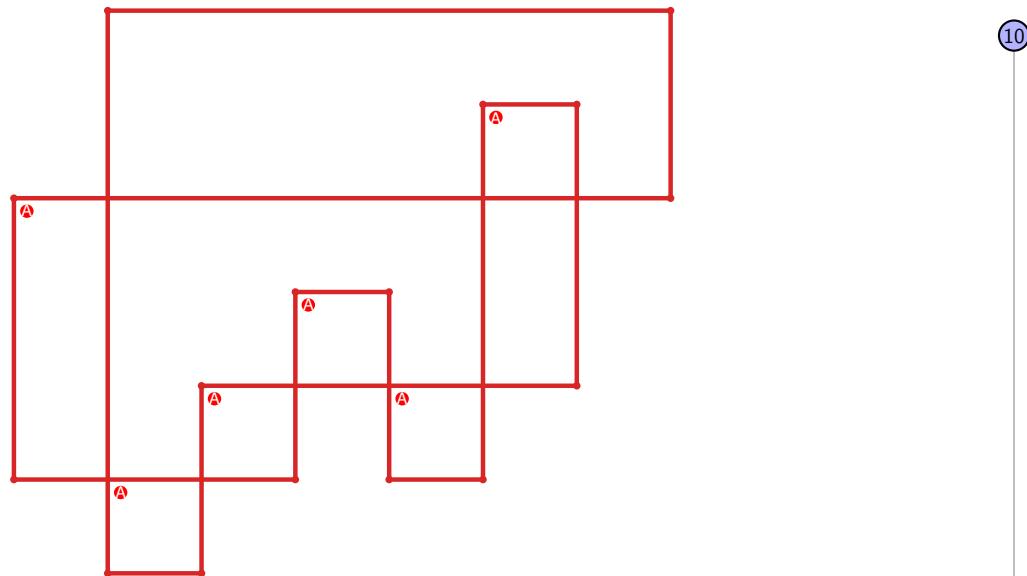


Figure 79: `SnapPy` multiloop plot.

Figure 80: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.3 `[[8, 16, 1, 9], [9, 7, 10, 8], [15, 1, 16, 2], [6, 10, 7, 11], [2, 14, 3, 15], [11, 3, 12, 4], [13, 5, 14, 6], [12, 5, 13, 4]]`

PD code drawn by `SnapPy`: `[(8, 9, 1, 10), (10, 1, 11, 2), (14, 3, 15, 4), (12, 5, 13, 6), (16, 7, 9, 8), (2, 15, 3, 16), (6, 11, 7, 12), (4, 13, 5, 14)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 5, 2], [3, 4, 7, 7], [3, 7, 7, 4], [5, 6, 6, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.71

Pinning number: 6

Table 39: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.43	2.75	3.0	3.2	

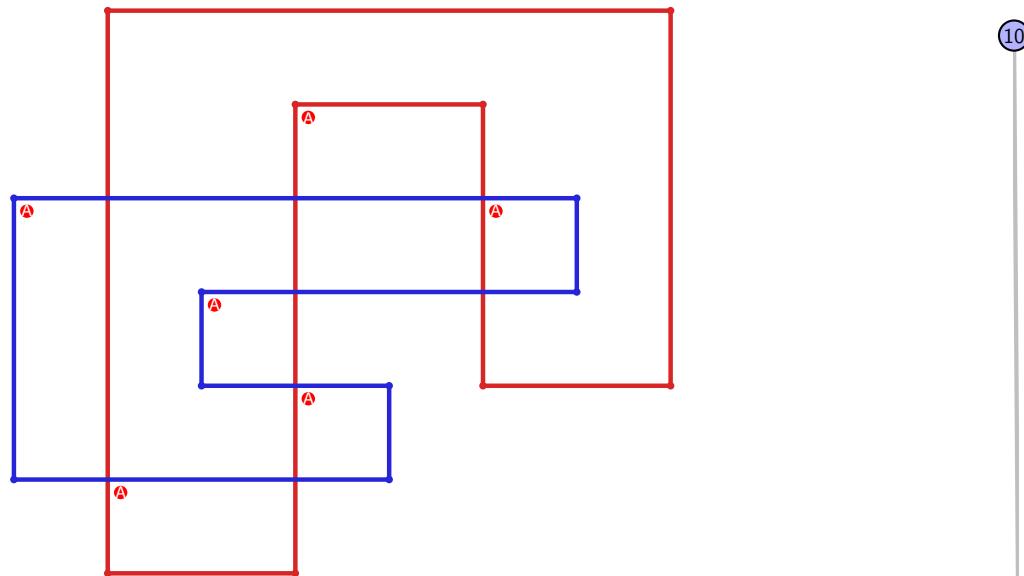


Figure 81: `SnapPy` multiloop plot.

6

Figure 82: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.4 [[16, 11, 1, 12], [12, 8, 13, 7], [15, 4, 16, 5], [10, 1, 11, 2], [8, 3, 9, 4], [13, 6, 14, 7], [5, 14, 6, 15], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (13, 2, 14, 3), (11, 4, 12, 5), (5, 10, 6, 11), (16, 7, 1, 8), (14, 9, 15, 10), (3, 12, 4, 13), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 4], [0, 7, 7, 0], [1, 7, 7, 2], [1, 6, 6, 1], [2, 5, 5, 2], [3, 4, 4, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.71

Pinning number: 6

Table 40: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.43	2.75	3.0	3.2	

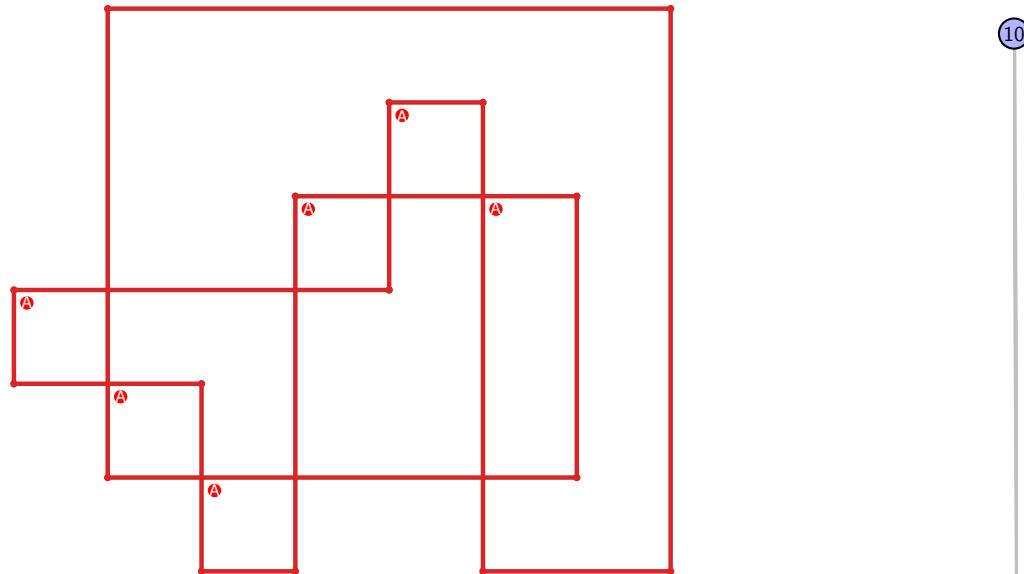


Figure 83: SnapPy multiloop plot.



Figure 84: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.5 $[[8, 16, 1, 9], [9, 15, 10, 14], [7, 2, 8, 3], [15, 1, 16, 2], [10, 7, 11, 6], [13, 3, 14, 4], [11, 5, 12, 6], [4, 12, 5, 13]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (15, 2, 16, 3), (3, 14, 4, 15), (11, 6, 12, 7), (4, 7, 5, 8), (1, 16, 2, 9), (10, 13, 11, 14), (5, 12, 6, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 6], [1, 7, 7, 2], [4, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1
Total pinning sets: 64
Pinning number: 4

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.82

Table 41: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

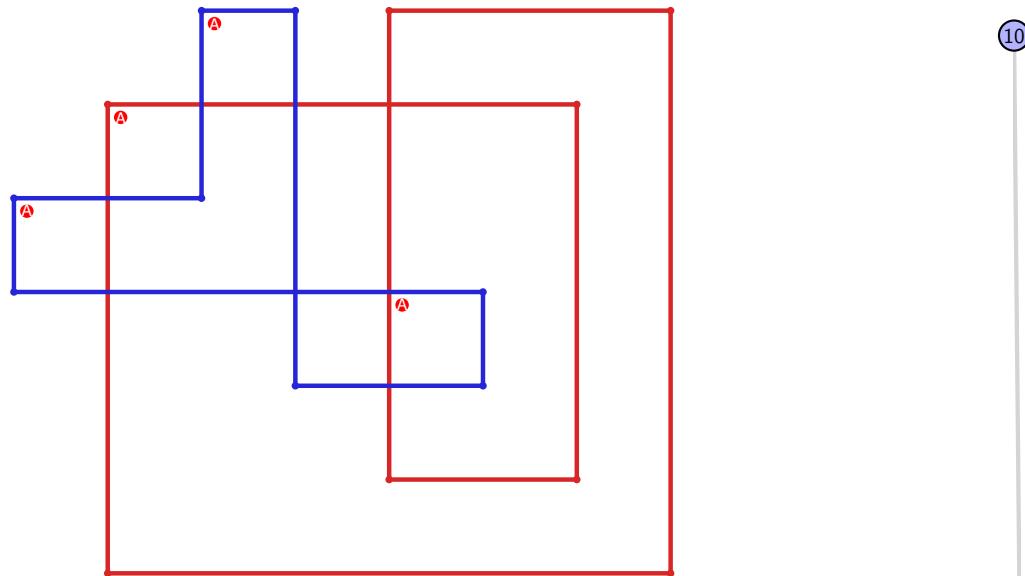


Figure 85: SnapPy multiloop plot.

4

Figure 86: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.6 [[16, 11, 1, 12], [12, 10, 13, 9], [15, 2, 16, 3], [10, 1, 11, 2], [13, 6, 14, 7], [8, 3, 9, 4], [5, 14, 6, 15], [7, 5, 8, 4]]

PD code drawn by SnapPy: [(13, 16, 14, 1), (6, 1, 7, 2), (2, 5, 3, 6), (11, 4, 12, 5), (7, 10, 8, 11), (14, 9, 15, 10), (3, 12, 4, 13), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 6, 3], [0, 2, 1, 0], [1, 6, 6, 7], [1, 7, 7, 2], [2, 7, 4, 4], [4, 6, 5, 5]]

Total optimal pinning sets: 2
Total minimal pinning sets: 6
Total pinning sets: 114
Pinning number: 4

Average optimal degree: 2.38
Average minimal degree: 2.52
Average overall degree: 2.92

Table 42: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	11	33	35	21	7	1	108
Average degree	2.38	2.64	2.85	2.98	3.07	3.14	3.2	

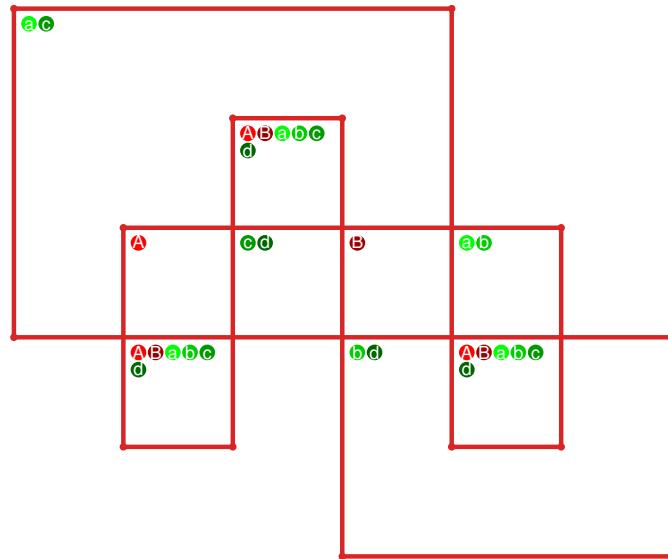


Figure 87: SnapPy multiloop plot.

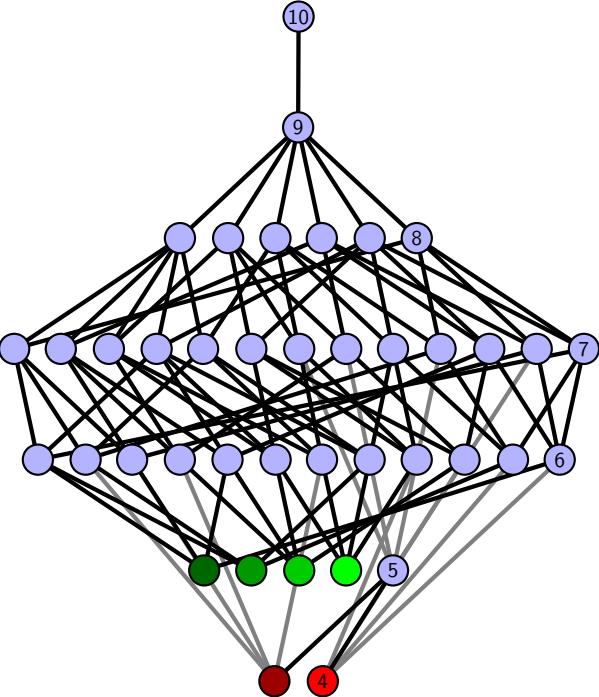


Figure 88: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.7 [[16, 9, 1, 10], [10, 8, 11, 7], [15, 2, 16, 3], [8, 1, 9, 2], [11, 4, 12, 5], [13, 6, 14, 7], [3, 14, 4, 15], [12, 6, 13, 5]]

PD code drawn by SnapPy: [(13, 16, 14, 1), (9, 2, 10, 3), (3, 10, 4, 11), (11, 4, 12, 5), (5, 8, 6, 9), (14, 7, 15, 8), (1, 12, 2, 13), (6, 15, 7, 16)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 3], [0, 2, 1, 0], [1, 6, 7, 7], [1, 7, 7, 6], [2, 5, 4, 2], [4, 5, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 43: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

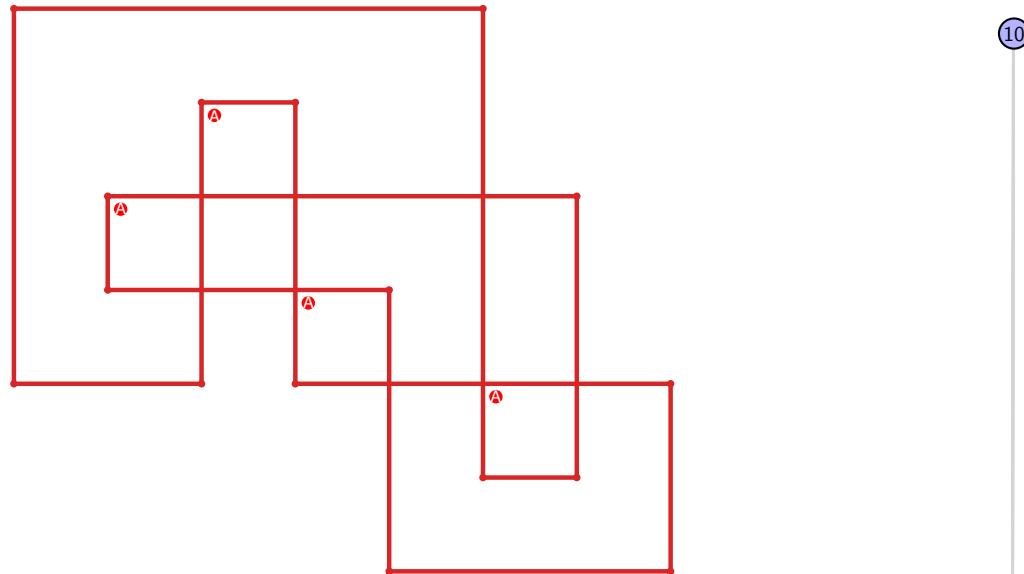


Figure 89: SnapPy multiloop plot.

Figure 90: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.8 [[16, 9, 1, 10], [10, 8, 11, 7], [15, 2, 16, 3], [8, 1, 9, 2], [11, 15, 12, 14], [6, 3, 7, 4], [12, 6, 13, 5], [13, 4, 14, 5]]

PD code drawn by SnapPy: [(9, 16, 10, 1), (1, 8, 2, 9), (3, 6, 4, 7), (12, 5, 13, 6), (10, 7, 11, 8), (4, 13, 5, 14), (11, 14, 12, 15), (2, 15, 3, 16)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 7], [1, 7, 6, 2], [4, 5, 7, 7], [4, 6, 6, 5]]

Total optimal pinning sets: 8
Total minimal pinning sets: 8
Total pinning sets: 207
Pinning number: 4

Average optimal degree: 2.75
Average minimal degree: 2.75
Average overall degree: 3.01

Table 44: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	8	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	40	66	56	28	8	1	199
Average degree	2.75	2.9	3.0	3.07	3.12	3.17	3.2	

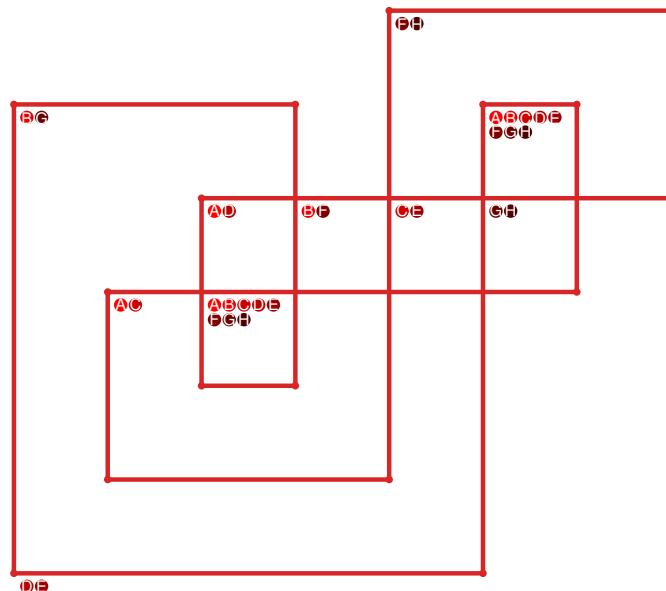


Figure 91: SnapPy multiloop plot.

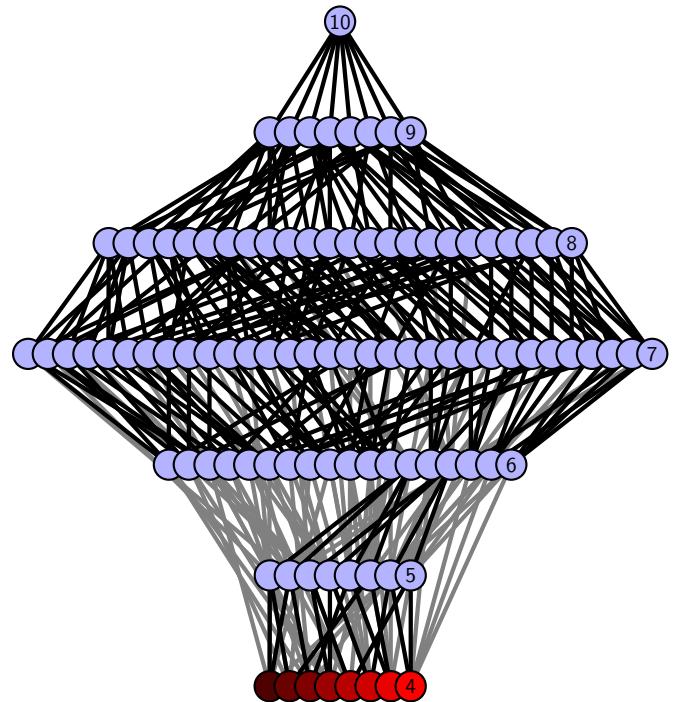


Figure 92: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.9 $[[12, 16, 1, 13], [13, 7, 14, 8], [11, 2, 12, 3], [15, 1, 16, 2], [6, 14, 7, 15], [8, 4, 9, 3], [5, 10, 6, 11], [4, 10, 5, 9]]$

PD code drawn by SnapPy: $[(9, 12, 10, 1), (1, 6, 2, 7), (16, 5, 13, 6), (7, 2, 8, 3), (3, 8, 4, 9), (14, 11, 15, 12), (4, 13, 5, 14), (10, 15, 11, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 4, 0], [1, 3, 6, 1], [1, 7, 7, 2], [2, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 45: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

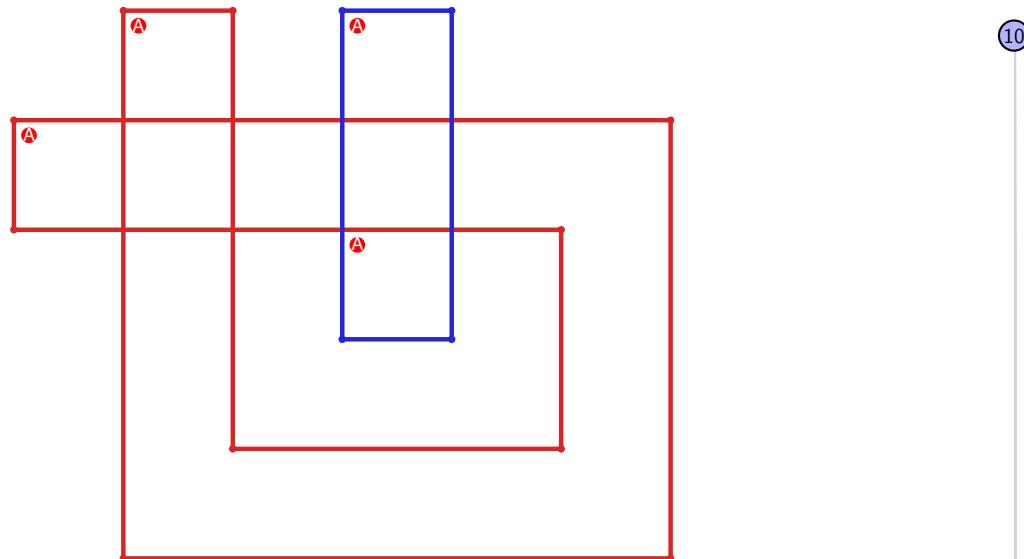


Figure 93: SnapPy multiloop plot.

4

Figure 94: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.10 $[[8, 16, 1, 9], [9, 3, 10, 4], [13, 7, 14, 8], [15, 5, 16, 6], [1, 12, 2, 11], [2, 10, 3, 11], [4, 12, 5, 13], [6, 14, 7, 15]]$

PD code drawn by `SnapPy`: $[(16, 1, 9, 2), (14, 3, 15, 4), (12, 5, 13, 6), (8, 9, 1, 10), (10, 7, 11, 8), (2, 11, 3, 12), (4, 13, 5, 14), (6, 15, 7, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 7, 7, 6], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 3, 2], [2, 3, 3, 2]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 46: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

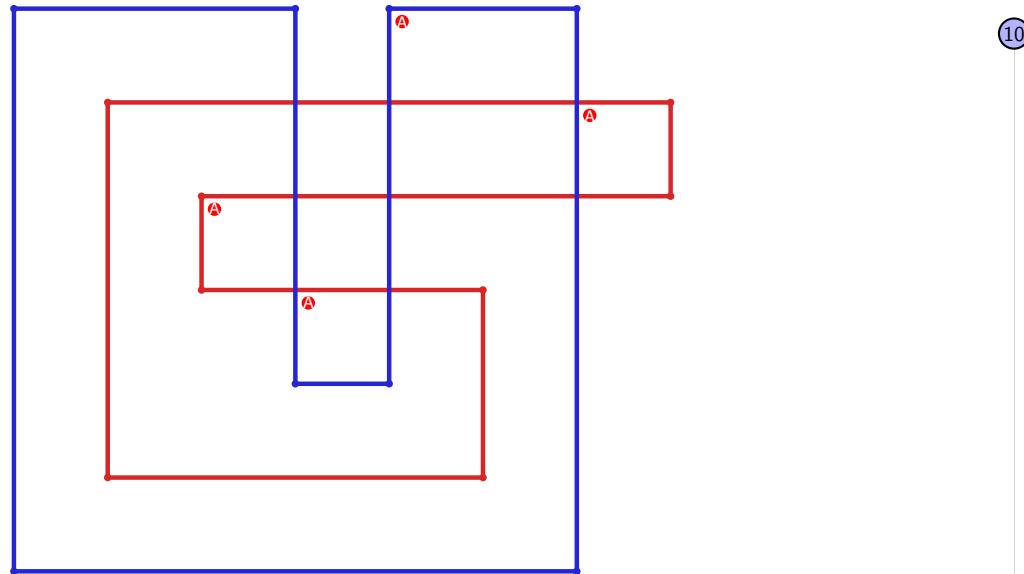


Figure 95: `SnapPy` multiloop plot.

4

Figure 96: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.11 [[16, 13, 1, 14], [14, 8, 15, 7], [15, 6, 16, 7], [12, 5, 13, 6], [1, 9, 2, 8], [2, 11, 3, 12], [4, 9, 5, 10], [10, 3, 11, 4]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (10, 3, 11, 4), (13, 4, 14, 5), (5, 12, 6, 13), (6, 15, 7, 16), (2, 7, 3, 8), (16, 9, 1, 10), (14, 11, 15, 12)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 2, 2], [0, 1, 1, 3], [0, 2, 5, 6], [0, 6, 5, 1], [3, 4, 7, 7], [3, 7, 7, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 80
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.33
 Average overall degree: 2.9

Table 47: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.25	2.54	2.76	2.93	3.05	3.14	3.2	

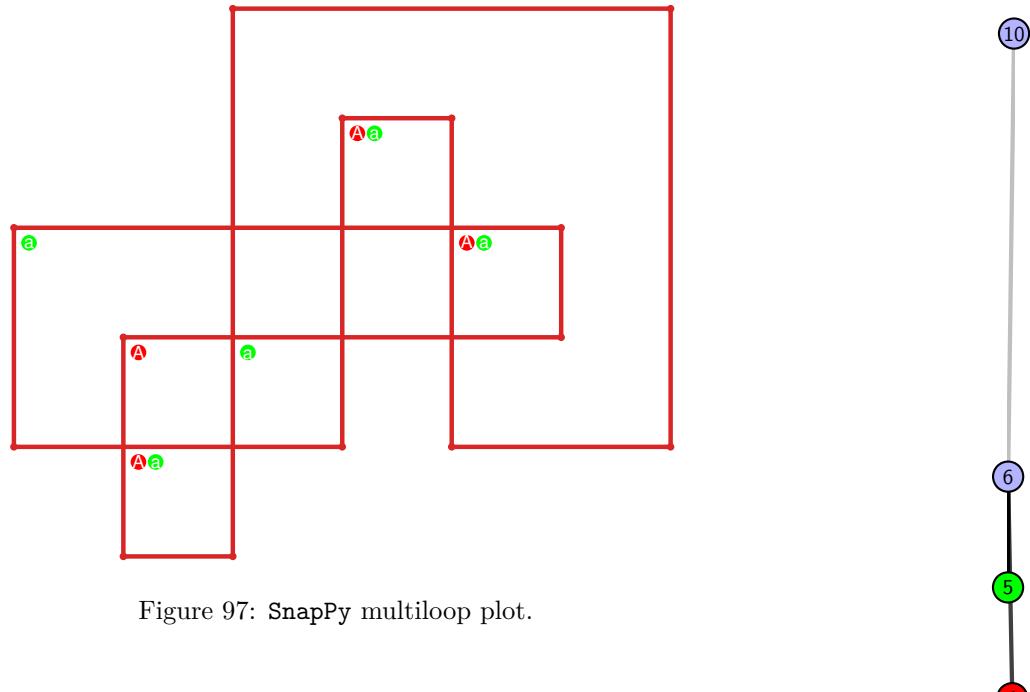


Figure 97: SnapPy multiloop plot.

Figure 98: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.12 [[8, 16, 1, 9], [9, 7, 10, 8], [10, 15, 11, 16], [1, 6, 2, 7], [4, 14, 5, 15], [11, 5, 12, 6], [2, 12, 3, 13], [13, 3, 14, 4]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (16, 3, 9, 4), (7, 4, 8, 5), (14, 5, 15, 6), (8, 9, 1, 10), (2, 11, 3, 12), (15, 12, 16, 13), (6, 13, 7, 14)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 7, 7, 5], [2, 4, 6, 3], [3, 5, 7, 7], [4, 6, 6, 4]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 5
 Total pinning sets: 98
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.47
 Average overall degree: 2.93

Table 48: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	1	0	0	0	0	4
Nonminimal pinning sets	0	6	25	33	21	7	1	93
Average degree	2.5	2.62	2.81	2.97	3.07	3.14	3.2	

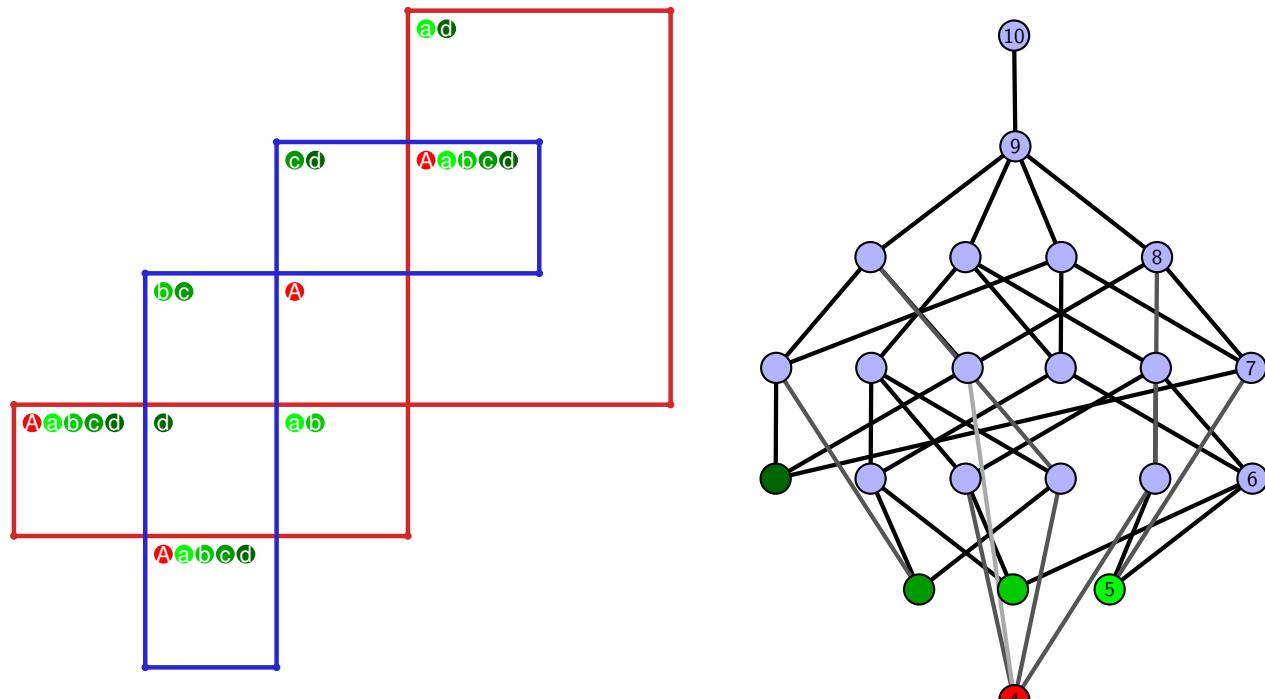


Figure 99: SnapPy multiloop plot.

Figure 100: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.13 $[[9, 16, 10, 1], [15, 8, 16, 9], [10, 8, 11, 7], [1, 14, 2, 15], [11, 5, 12, 4], [13, 6, 14, 7], [2, 6, 3, 5], [12, 3, 13, 4]]$

PD code drawn by `SnapPy`: $[(10, 1, 11, 2), (2, 9, 3, 10), (3, 16, 4, 1), (11, 4, 12, 5), (5, 8, 6, 9), (13, 6, 14, 7), (15, 12, 16, 13), (7, 14, 8, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 7], [2, 7, 6, 3], [3, 5, 7, 4], [4, 6, 5, 4]]$

Total optimal pinning sets: 4

Average optimal degree: 2.56

Total minimal pinning sets: 4

Average minimal degree: 2.56

Total pinning sets: 144

Average overall degree: 2.99

Pinning number: 4

Table 49: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.56	2.79	2.94	3.04	3.12	3.17	3.2	

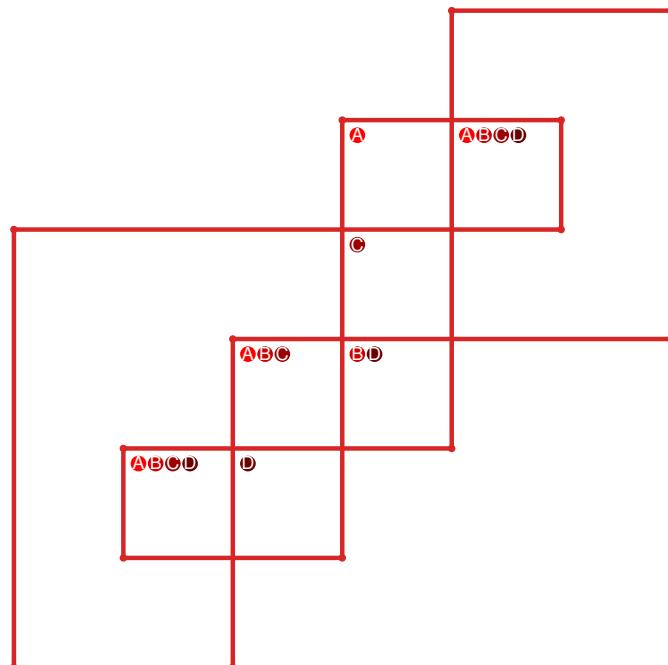


Figure 101: `SnapPy` multiloop plot.

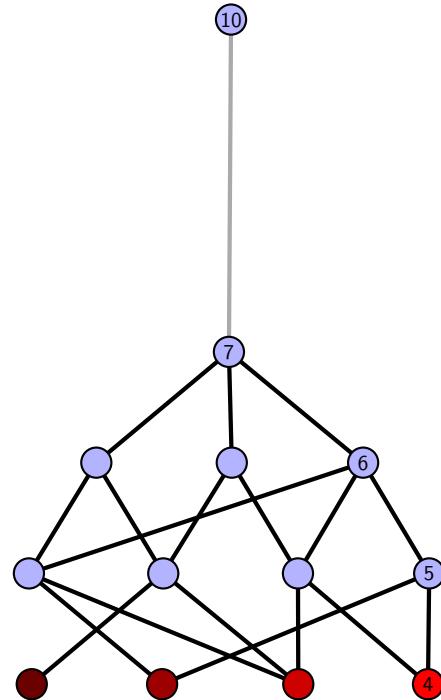


Figure 102: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.14 [[12, 5, 1, 6], [6, 11, 7, 12], [7, 4, 8, 5], [1, 10, 2, 11], [3, 16, 4, 13], [8, 16, 9, 15], [9, 14, 10, 15], [2, 14, 3, 13]]

PD code drawn by SnapPy: [(5, 2, 6, 3), (10, 3, 11, 4), (11, 8, 12, 9), (4, 9, 5, 10), (15, 6, 16, 7), (1, 16, 2, 13), (13, 12, 14, 1), (7, 14, 8, 15)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 7, 1], [2, 7, 7, 5], [2, 4, 6, 6], [3, 5, 5, 7], [3, 6, 4, 4]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 5
 Total pinning sets: 109
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.63
 Average overall degree: 2.92

Table 50: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	11	30	34	21	7	1	104
Average degree	2.25	2.65	2.84	2.97	3.07	3.14	3.2	

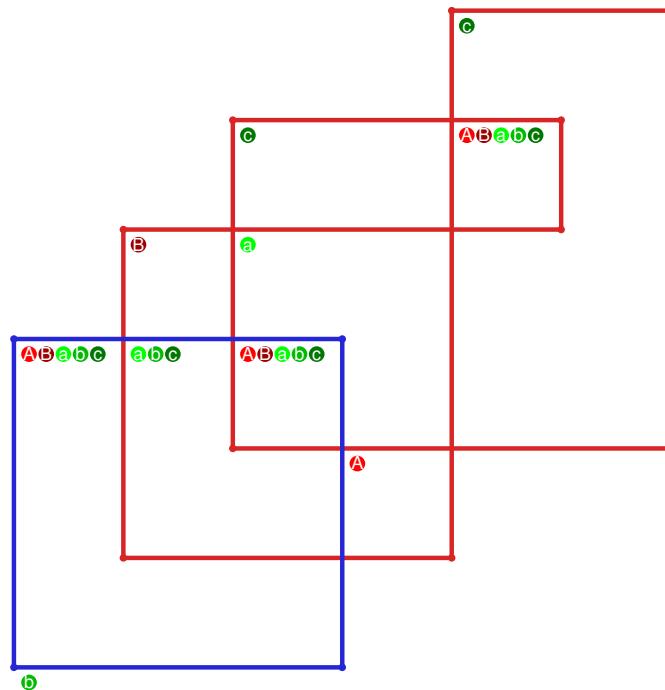


Figure 103: SnapPy multiloop plot.

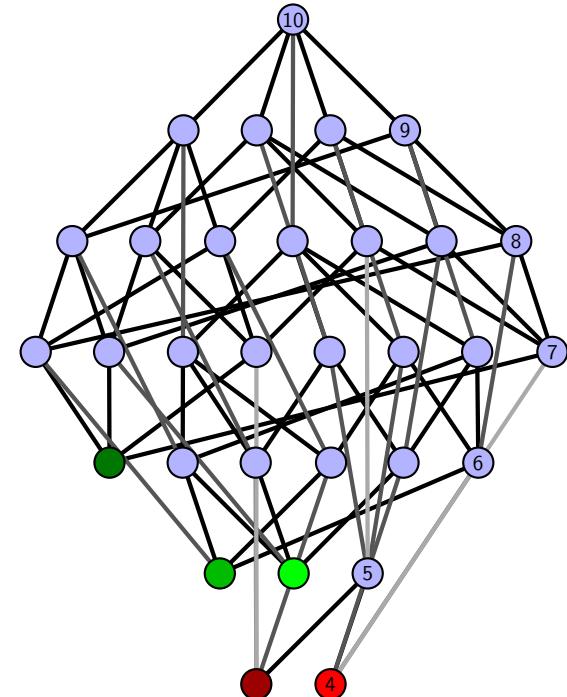


Figure 104: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.15 `[[7, 16, 8, 1], [15, 6, 16, 7], [8, 6, 9, 5], [1, 14, 2, 15], [9, 4, 10, 5], [10, 13, 11, 14], [2, 11, 3, 12], [12, 3, 13, 4]]`

PD code drawn by `SnapPy`: `[(10, 1, 11, 2), (7, 2, 8, 3), (3, 6, 4, 7), (13, 4, 14, 5), (16, 9, 1, 10), (8, 11, 9, 12), (15, 12, 16, 13), (5, 14, 6, 15)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 6, 1], [2, 7, 5, 2], [3, 4, 7, 6], [3, 5, 7, 7], [4, 6, 6, 5]]`

Total optimal pinning sets: 1
Total minimal pinning sets: 2
Total pinning sets: 80
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.33
Average overall degree: 2.9

Table 51: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.25	2.54	2.76	2.93	3.05	3.14	3.2	

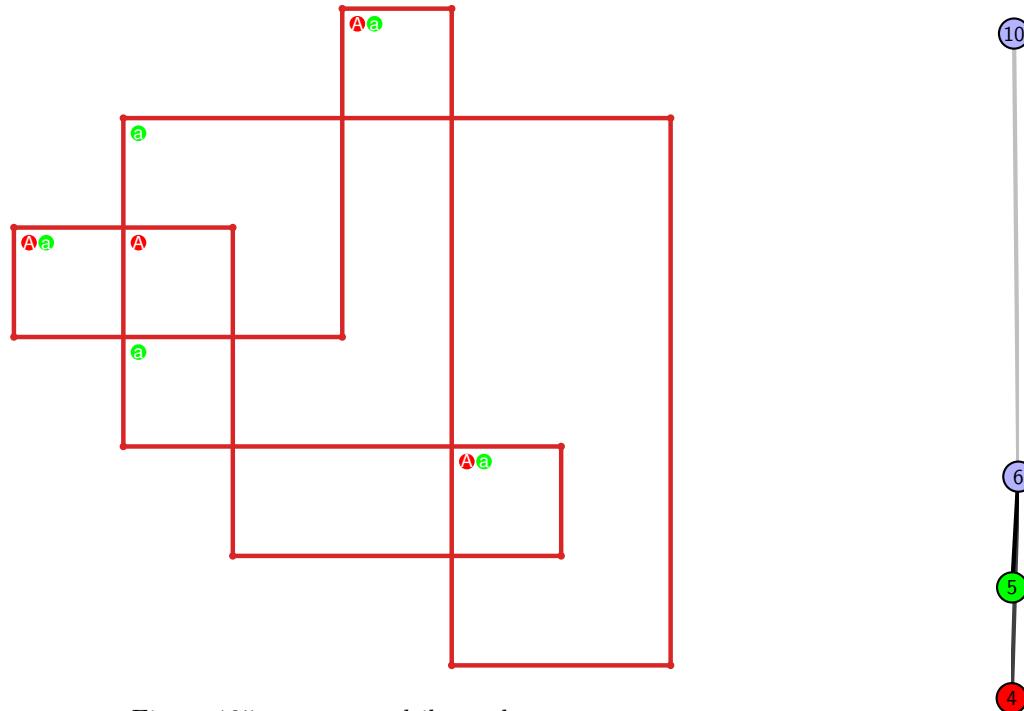


Figure 105: `SnapPy` multiloop plot.

Figure 106: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.16 [[6, 16, 1, 7], [7, 14, 8, 15], [15, 5, 16, 6], [1, 13, 2, 14], [8, 4, 9, 5], [9, 12, 10, 13], [2, 10, 3, 11], [11, 3, 12, 4]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (15, 2, 16, 3), (12, 3, 13, 4), (6, 7, 1, 8), (16, 9, 7, 10), (5, 10, 6, 11), (14, 11, 15, 12), (4, 13, 5, 14)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 5, 2], [3, 4, 7, 6], [3, 5, 7, 7], [4, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 4

Average minimal degree: 2.59

Total pinning sets: 100

Average overall degree: 2.98

Pinning number: 4

Table 52: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	6	23	34	24	8	1	96
Average degree	2.5	2.7	2.86	3.0	3.1	3.17	3.2	

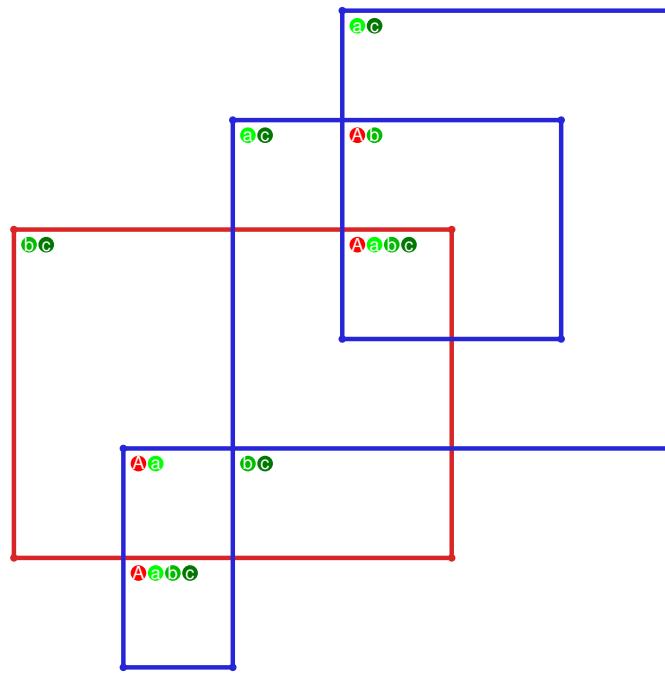


Figure 107: `SnapPy` multiloop plot.

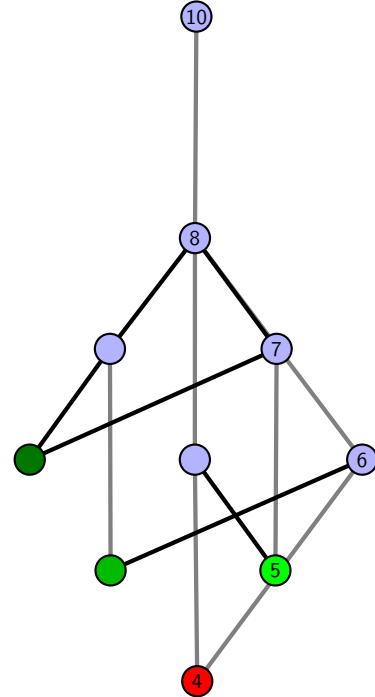


Figure 108: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.17 $[[8, 5, 1, 6], [6, 9, 7, 16], [7, 15, 8, 16], [4, 14, 5, 15], [1, 10, 2, 9], [3, 11, 4, 12], [13, 10, 14, 11], [2, 13, 3, 12]]$

PD code drawn by SnapPy: $[(6, 3, 7, 4), (9, 8, 10, 1), (2, 11, 3, 12), (5, 12, 6, 13), (13, 4, 14, 5), (14, 7, 15, 8), (10, 15, 11, 16), (1, 16, 2, 9)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 2, 2], [0, 1, 1, 3], [0, 2, 5, 6], [0, 6, 7, 1], [3, 7, 7, 6], [3, 5, 7, 4], [4, 6, 5, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 6
 Total pinning sets: 86
 Pinning number: 5

Average optimal degree: 2.67
 Average minimal degree: 2.67
 Average overall degree: 2.99

Table 53: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	3
Nonminimal pinning sets	0	15	32	24	8	1	80
Average degree	2.67	2.81	2.99	3.1	3.17	3.2	

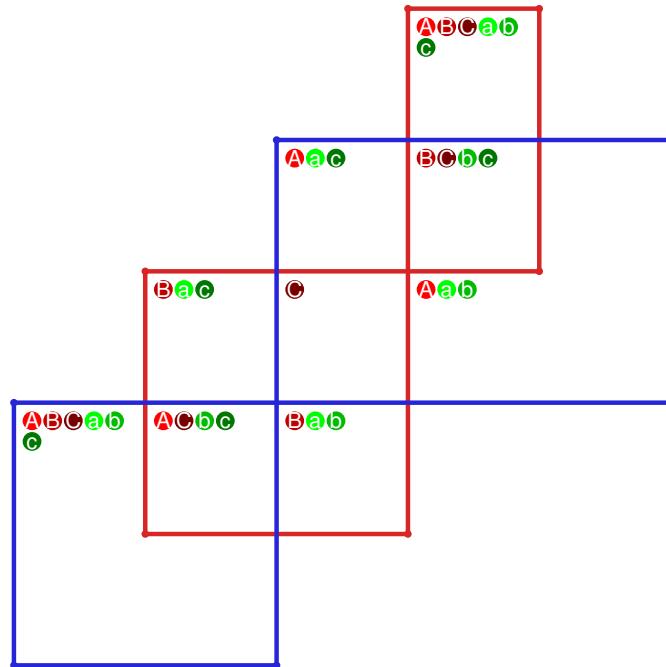


Figure 109: SnapPy multiloop plot.

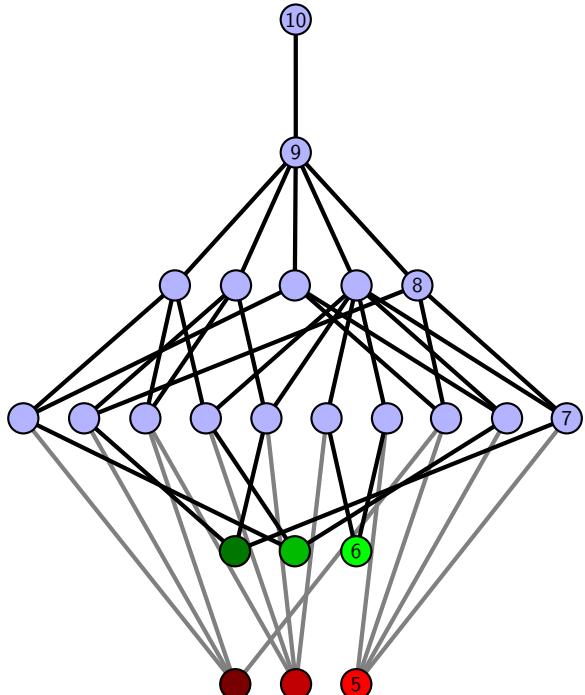


Figure 110: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.18 $[[10, 16, 1, 11], [11, 9, 12, 10], [12, 15, 13, 16], [1, 8, 2, 9], [4, 14, 5, 15], [13, 5, 14, 6], [7, 2, 8, 3], [3, 6, 4, 7]]$

PD code drawn by `SnapPy`: $[(5, 10, 6, 1), (16, 3, 11, 4), (1, 4, 2, 5), (9, 6, 10, 7), (14, 7, 15, 8), (2, 11, 3, 12), (15, 12, 16, 13), (8, 13, 9, 14)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 6, 1], [2, 7, 5, 5], [2, 4, 4, 7], [3, 7, 7, 3], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 54: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

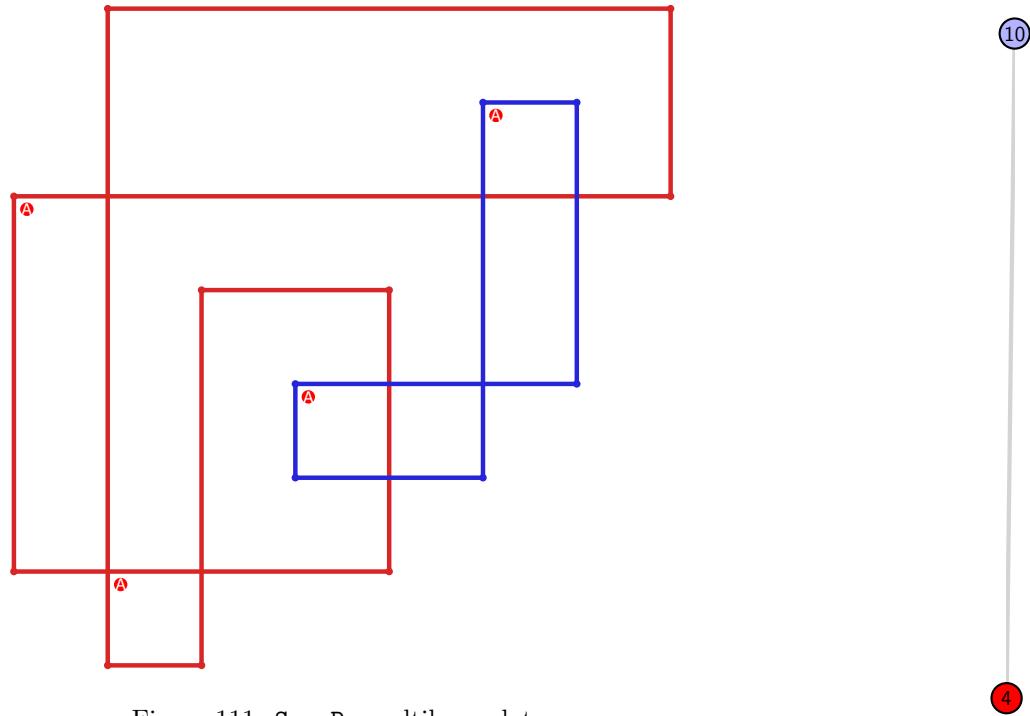


Figure 111: `SnapPy` multiloop plot.

Figure 112: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.19 $[[6, 12, 1, 7], [7, 5, 8, 6], [8, 11, 9, 12], [1, 4, 2, 5], [10, 16, 11, 13], [9, 16, 10, 15], [3, 14, 4, 15], [2, 14, 3, 13]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (12, 3, 13, 4), (13, 16, 14, 11), (4, 11, 5, 12), (7, 6, 8, 1), (1, 8, 2, 9), (9, 14, 10, 15), (15, 10, 16, 7)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 7, 1], [2, 7, 5, 5], [2, 4, 4, 6], [3, 5, 7, 7], [3, 6, 6, 4]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 5
 Total pinning sets: 122
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.48
 Average overall degree: 2.91

Table 55: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	18	35	35	21	7	1	117
Average degree	2.5	2.69	2.86	2.98	3.07	3.14	3.2	

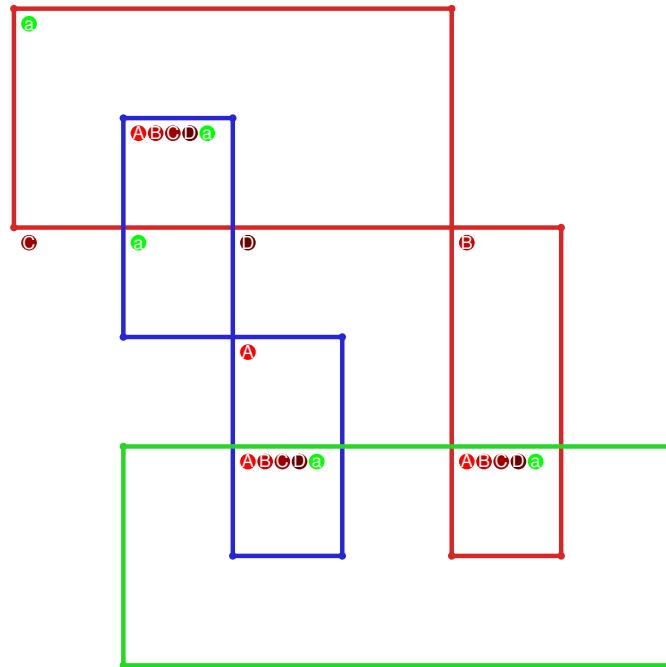


Figure 113: SnapPy multiloop plot.

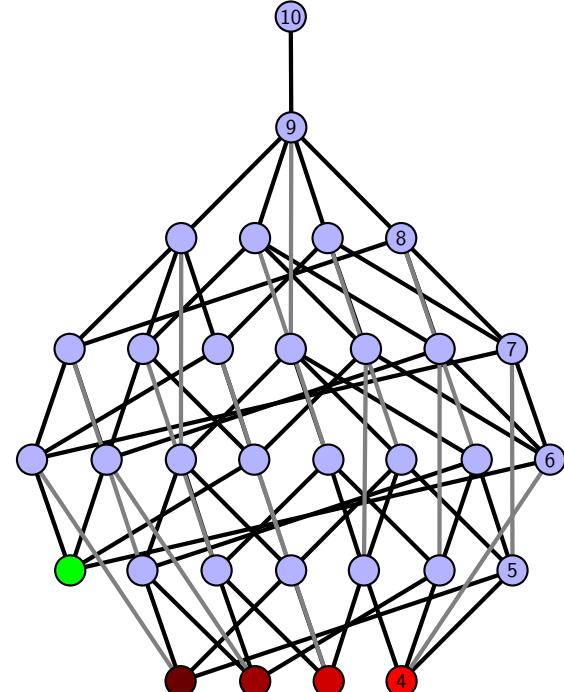


Figure 114: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.20 $[[8, 16, 1, 9], [9, 7, 10, 8], [10, 15, 11, 16], [1, 6, 2, 7], [14, 11, 15, 12], [5, 2, 6, 3], [12, 5, 13, 4], [13, 3, 14, 4]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (1, 16, 2, 9), (6, 3, 7, 4), (13, 4, 14, 5), (2, 7, 3, 8), (10, 15, 11, 16), (14, 11, 15, 12), (5, 12, 6, 13)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 5, 1], [2, 6, 7, 2], [3, 7, 6, 3], [4, 5, 7, 7], [4, 6, 6, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1
Total pinning sets: 64
Pinning number: 4

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.82

Table 56: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

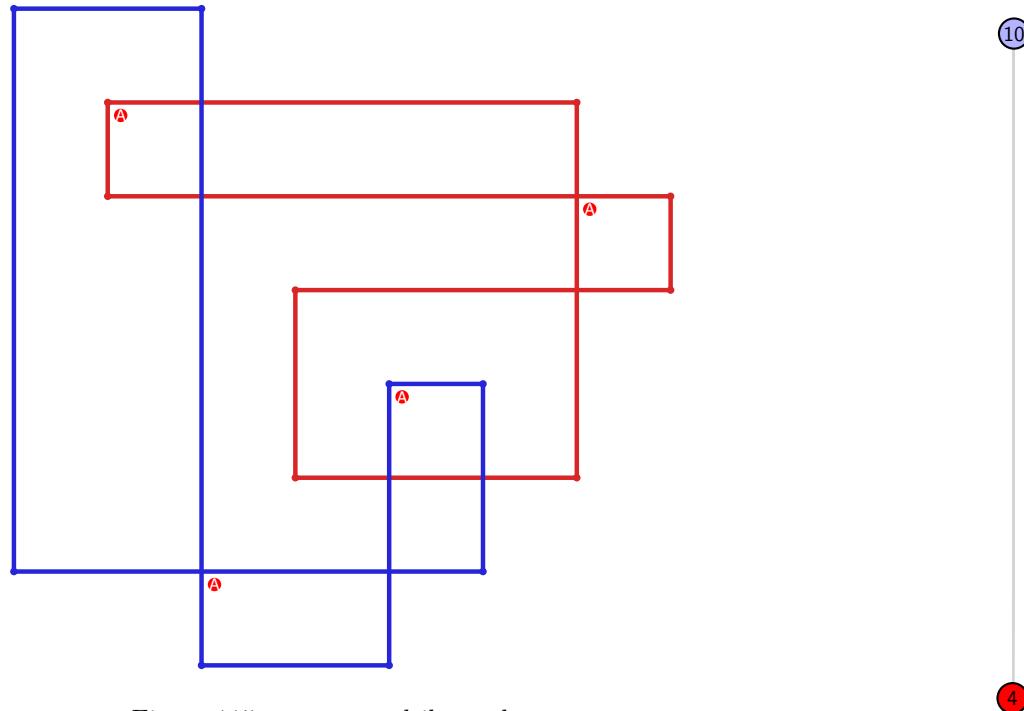


Figure 115: `SnapPy` multiloop plot.

Figure 116: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.21 $[[6, 16, 1, 7], [7, 5, 8, 6], [10, 15, 11, 16], [1, 4, 2, 5], [8, 13, 9, 14], [14, 9, 15, 10], [11, 3, 12, 4], [2, 12, 3, 13]]$

PD code drawn by SnapPy: $[(16, 1, 7, 2), (5, 2, 6, 3), (12, 3, 13, 4), (9, 14, 10, 15), (6, 7, 1, 8), (13, 8, 14, 9), (15, 10, 16, 11), (4, 11, 5, 12)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 5, 5, 6], [0, 6, 7, 1], [1, 7, 5, 5], [2, 4, 4, 2], [2, 7, 7, 3], [3, 6, 6, 4]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4
Total pinning sets: 60
Pinning number: 5

Average optimal degree: 2.3
Average minimal degree: 2.3
Average overall degree: 2.84

Table 57: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	4	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	14	20	15	6	1	56
Average degree	2.3	2.64	2.86	3.0	3.11	3.2	

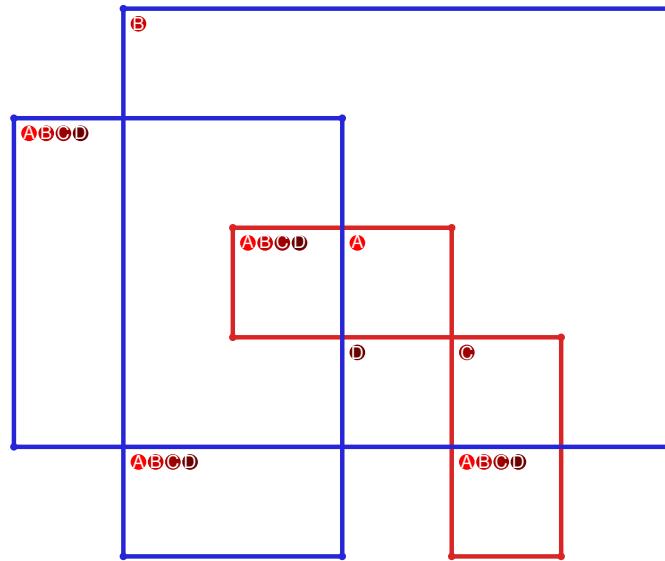


Figure 117: SnapPy multiloop plot.

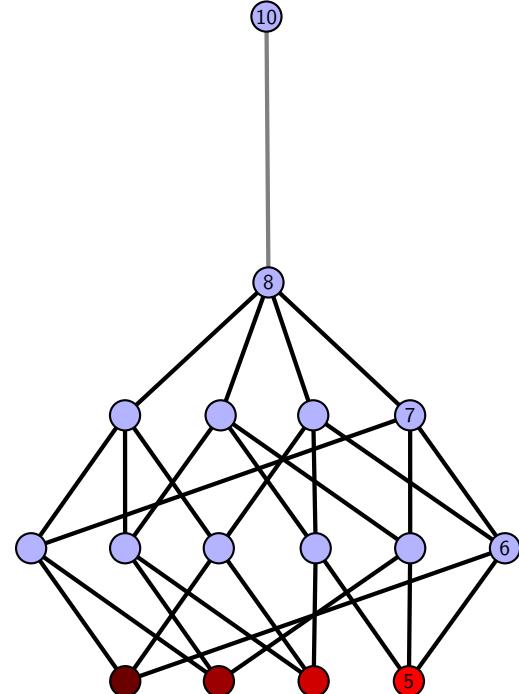


Figure 118: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.22 [[6, 16, 1, 7], [7, 5, 8, 6], [15, 12, 16, 13], [1, 4, 2, 5], [8, 14, 9, 13], [9, 14, 10, 15], [3, 11, 4, 12], [2, 11, 3, 10]]

PD code drawn by SnapPy: [(5, 2, 6, 3), (14, 3, 15, 4), (7, 6, 8, 1), (1, 8, 2, 9), (12, 9, 13, 10), (10, 15, 11, 16), (16, 11, 7, 12), (4, 13, 5, 14)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 5, 6], [0, 6, 7, 1], [1, 5, 5, 2], [2, 4, 4, 7], [2, 7, 7, 3], [3, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.89

Pinning number: 3

Table 58: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.43	2.69	2.86	2.98	3.07	3.14	3.2	

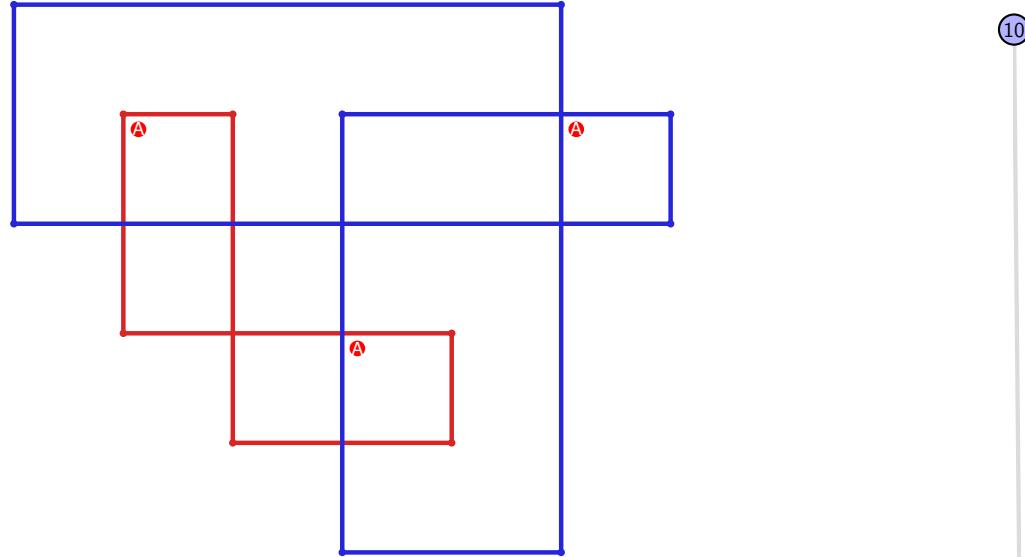


Figure 119: SnapPy multiloop plot.



Figure 120: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.23 $[[12, 16, 1, 13], [13, 11, 14, 12], [5, 15, 6, 16], [1, 10, 2, 11], [14, 4, 15, 5], [6, 9, 7, 10], [2, 7, 3, 8], [8, 3, 9, 4]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (13, 2, 14, 3), (12, 5, 1, 6), (4, 7, 5, 8), (11, 8, 12, 9), (16, 9, 13, 10), (3, 14, 4, 15), (10, 15, 11, 16)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 7, 6, 3], [3, 5, 7, 7], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 5

Average minimal degree: 2.53

Total pinning sets: 94

Average overall degree: 2.91

Pinning number: 4

Table 59: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	6	25	30	20	7	1	89
Average degree	2.25	2.58	2.8	2.95	3.06	3.14	3.2	

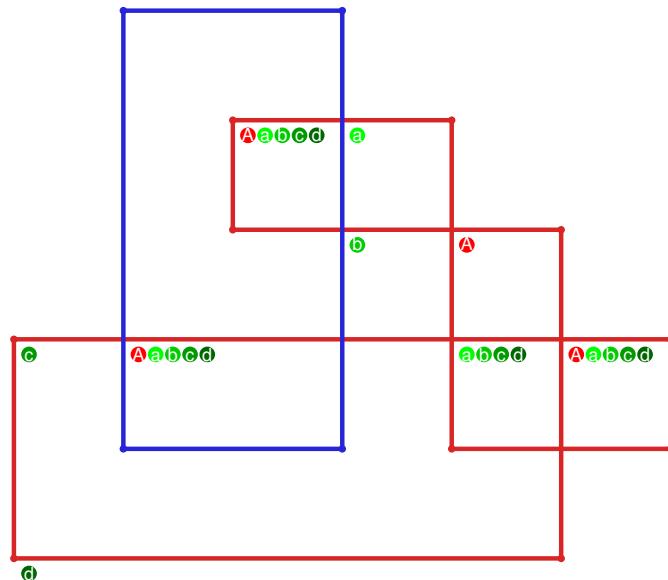


Figure 121: `SnapPy` multiloop plot.

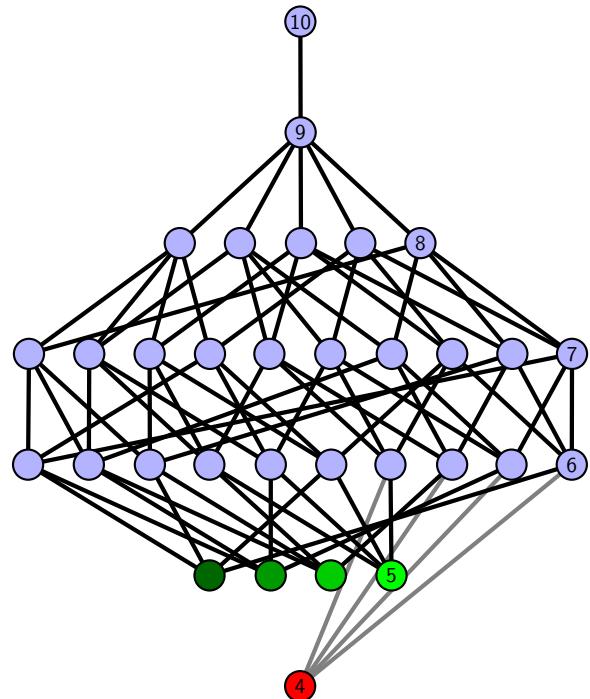


Figure 122: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.24 $[[4, 8, 1, 5], [5, 9, 6, 12], [3, 16, 4, 13], [7, 1, 8, 2], [9, 7, 10, 6], [11, 13, 12, 14], [15, 2, 16, 3], [10, 15, 11, 14]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (16, 3, 13, 4), (15, 12, 16, 9), (2, 13, 3, 14), (11, 14, 12, 15), (8, 9, 5, 10), (1, 6, 2, 7), (10, 7, 11, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 4, 0], [1, 3, 7, 1], [1, 7, 7, 2], [2, 7, 3, 2], [4, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 60: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

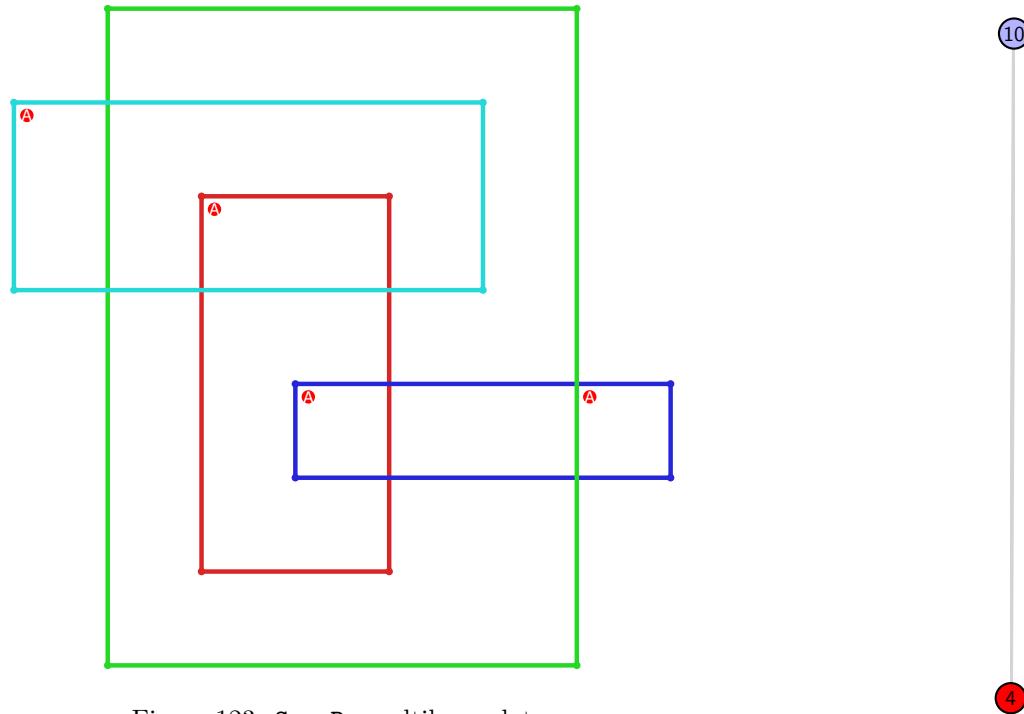


Figure 123: SnapPy multiloop plot.

Figure 124: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.25 $[[3, 8, 4, 1], [2, 12, 3, 9], [7, 4, 8, 5], [1, 10, 2, 9], [11, 16, 12, 13], [5, 16, 6, 15], [6, 14, 7, 15], [10, 14, 11, 13]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (1, 6, 2, 7), (8, 9, 1, 10), (10, 7, 11, 8), (4, 13, 5, 14), (14, 3, 15, 4), (12, 15, 9, 16), (16, 11, 13, 12)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 7, 1, 1], [1, 7, 7, 5], [2, 4, 6, 6], [2, 5, 5, 7], [3, 6, 4, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 61: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

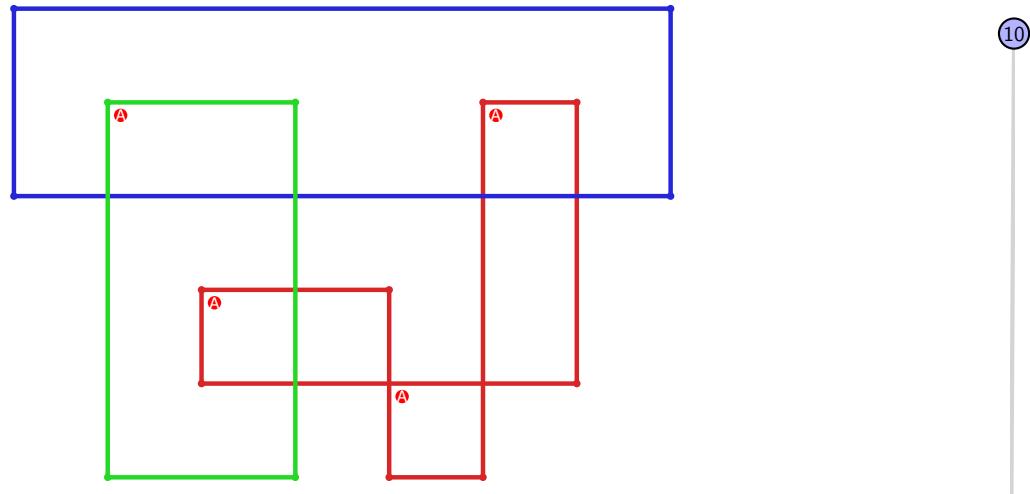


Figure 125: SnapPy multiloop plot.



Figure 126: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.26 $[[7, 16, 8, 1], [15, 6, 16, 7], [8, 2, 9, 1], [5, 14, 6, 15], [2, 10, 3, 9], [4, 11, 5, 12], [13, 10, 14, 11], [3, 13, 4, 12]]$

PD code drawn by `SnapPy`: $[(10, 1, 11, 2), (4, 13, 5, 14), (8, 5, 9, 6), (15, 6, 16, 7), (7, 14, 8, 15), (16, 9, 1, 10), (2, 11, 3, 12), (12, 3, 13, 4)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 7, 2], [3, 7, 7, 6], [3, 5, 7, 4], [4, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 20

Average overall degree: 2.78

Pinning number: 6

Table 62: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	1
Nonminimal pinning sets	0	4	8	5	1	18
Average degree	2.17	2.49	2.81	3.07	3.2	

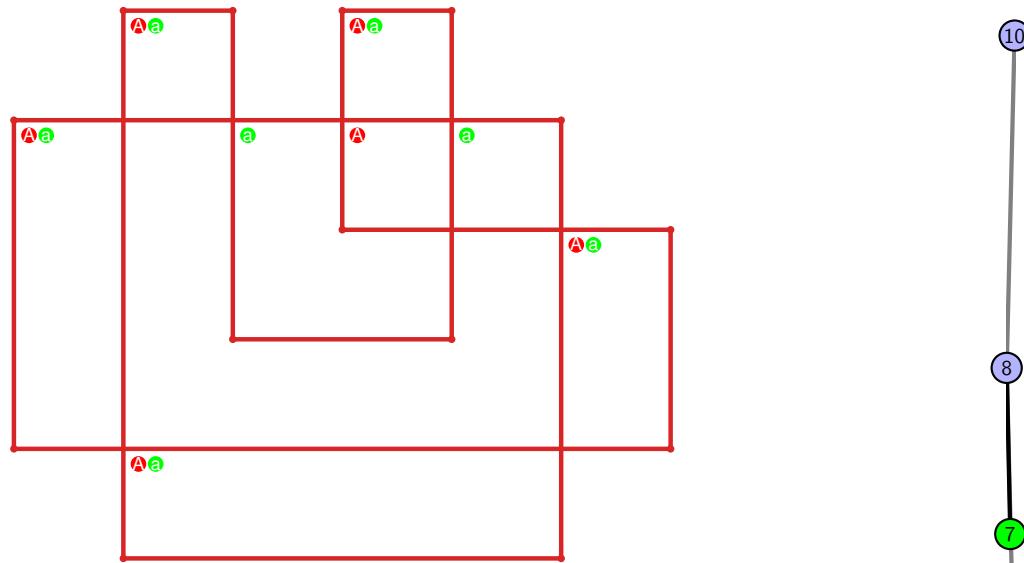


Figure 127: `SnapPy` multiloop plot.



Figure 128: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.27 $[[16, 9, 1, 10], [10, 15, 11, 16], [8, 1, 9, 2], [5, 14, 6, 15], [11, 6, 12, 7], [2, 7, 3, 8], [13, 4, 14, 5], [12, 4, 13, 3]]$

PD code drawn by `SnapPy`: $[(16, 9, 1, 10), (10, 1, 11, 2), (8, 3, 9, 4), (15, 4, 16, 5), (13, 6, 14, 7), (2, 11, 3, 12), (7, 12, 8, 13), (5, 14, 6, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 6, 4], [1, 3, 7, 5], [2, 4, 7, 2], [3, 7, 7, 3], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.76

Pinning number: 5

Table 63: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.69	2.9	3.07	3.2	

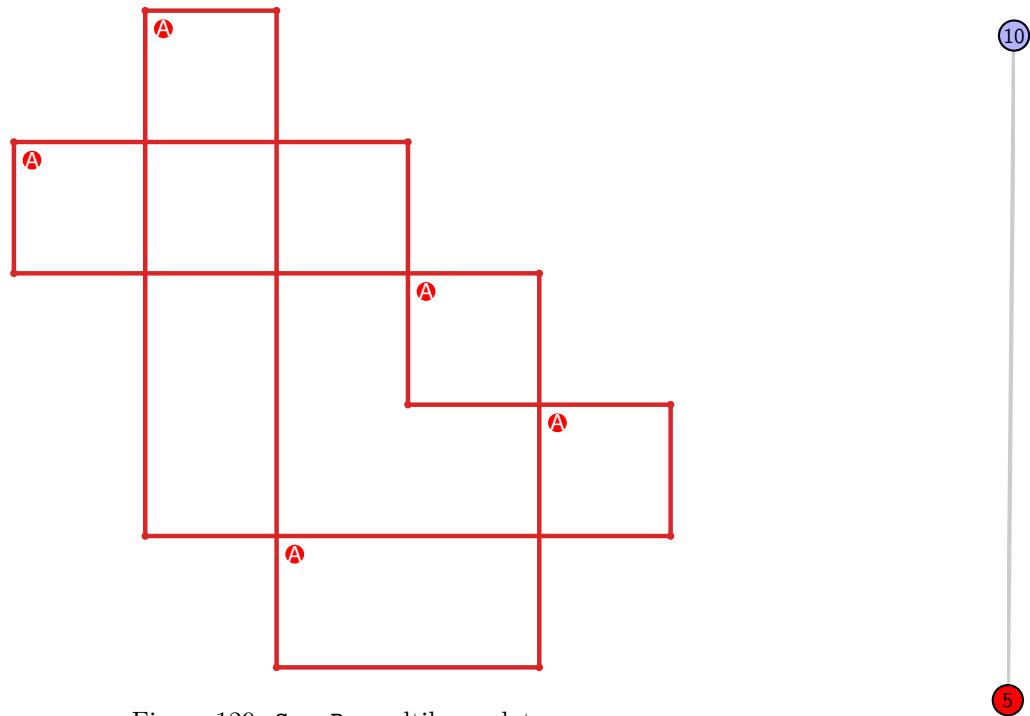


Figure 129: `SnapPy` multiloop plot.

Figure 130: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.28 [[16, 5, 1, 6], [6, 14, 7, 13], [15, 12, 16, 13], [4, 11, 5, 12], [1, 9, 2, 8], [14, 8, 15, 7], [10, 3, 11, 4], [9, 3, 10, 2]]

PD code drawn by SnapPy: [(16, 7, 1, 8), (8, 1, 9, 2), (14, 3, 15, 4), (5, 12, 6, 13), (6, 15, 7, 16), (2, 9, 3, 10), (13, 10, 14, 11), (11, 4, 12, 5)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 7, 5], [1, 4, 2, 1], [3, 7, 7, 3], [4, 6, 6, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 40

Average overall degree: 2.84

Pinning number: 5

Table 64: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	5	13	13	6	1	38
Average degree	2.2	2.5	2.76	2.96	3.11	3.2	

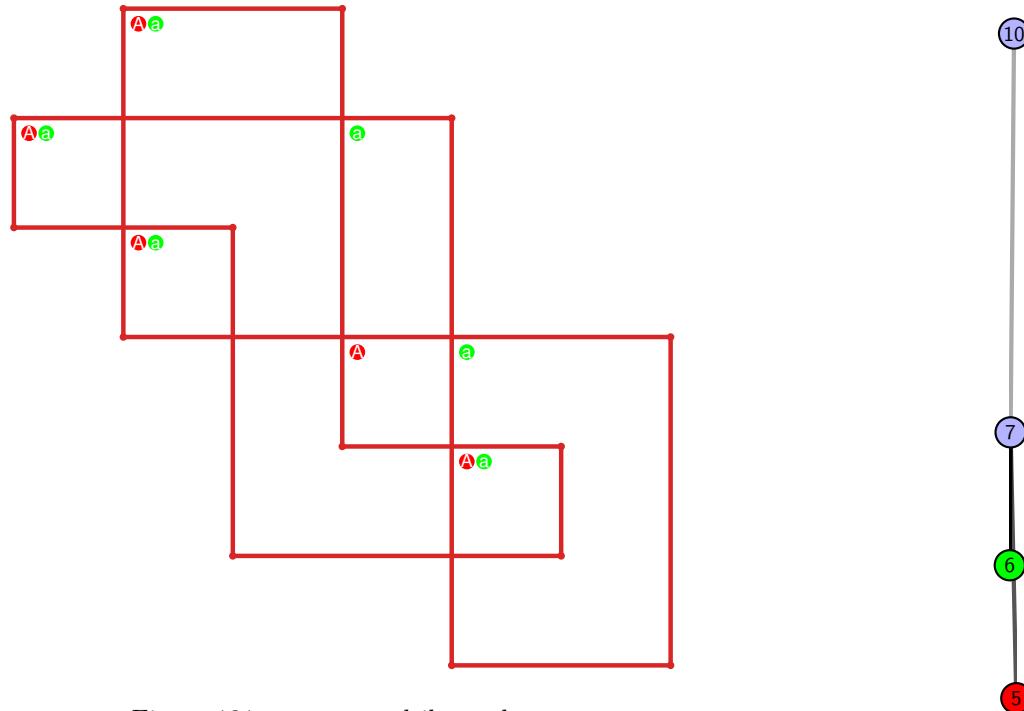


Figure 131: SnapPy multiloop plot.

Figure 132: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.29 $[[16, 11, 1, 12], [12, 6, 13, 5], [15, 4, 16, 5], [10, 3, 11, 4], [1, 9, 2, 8], [6, 14, 7, 13], [7, 14, 8, 15], [2, 9, 3, 10]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (13, 2, 14, 3), (3, 10, 4, 11), (6, 15, 7, 16), (16, 7, 1, 8), (14, 9, 15, 10), (11, 4, 12, 5), (5, 12, 6, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 7, 7], [0, 7, 7, 6], [1, 6, 6, 1], [2, 5, 5, 4], [3, 4, 4, 3]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 48

Average overall degree: 2.83

Pinning number: 5

Table 65: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.2	2.56	2.8	2.98	3.11	3.2	

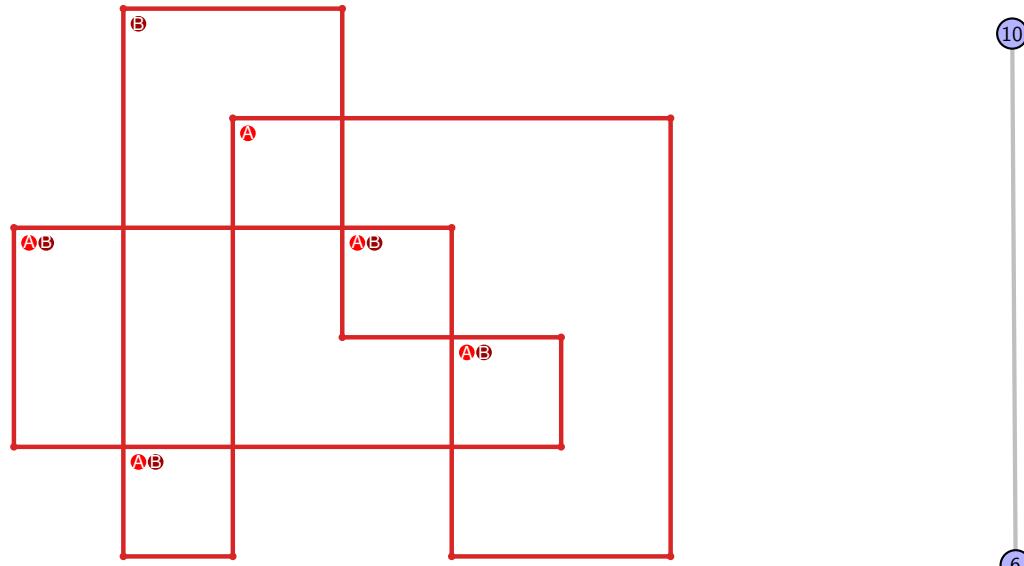


Figure 133: SnapPy multiloop plot.

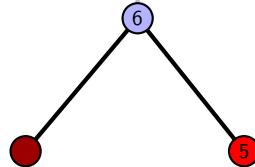


Figure 134: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.30 $[[16, 5, 1, 6], [6, 14, 7, 13], [15, 12, 16, 13], [4, 9, 5, 10], [1, 9, 2, 8], [14, 8, 15, 7], [2, 11, 3, 12], [10, 3, 11, 4]]$

PD code drawn by `SnapPy`: $[(7, 16, 8, 1), (13, 2, 14, 3), (4, 11, 5, 12), (5, 14, 6, 15), (1, 6, 2, 7), (15, 8, 16, 9), (12, 9, 13, 10), (10, 3, 11, 4)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 6, 5], [1, 4, 2, 1], [2, 4, 7, 7], [3, 6, 6, 3]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 4

Table 66: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.25	2.58	2.8	2.95	3.06	3.14	3.2	

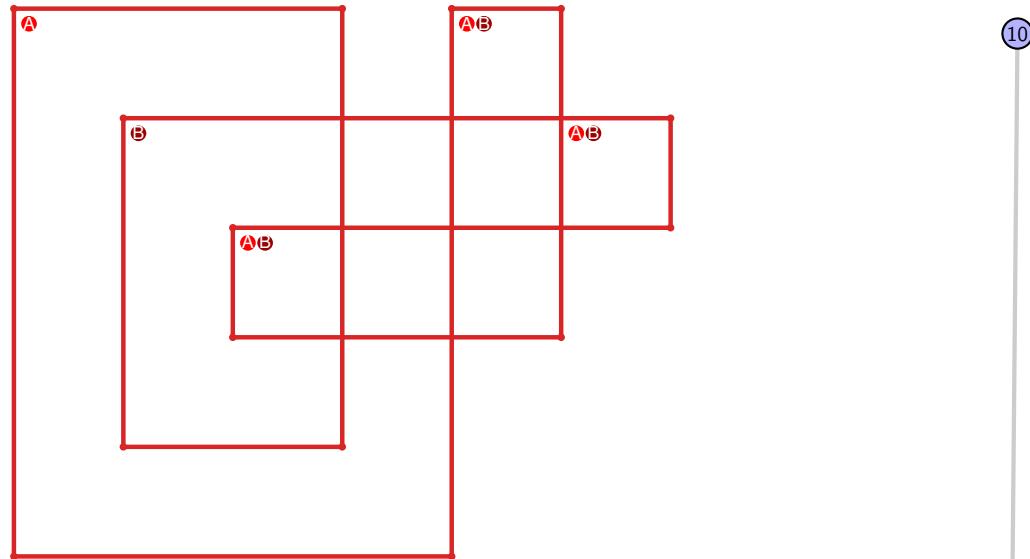


Figure 135: `SnapPy` multiloop plot.

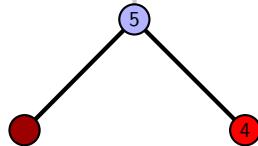


Figure 136: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.31 $[[10, 16, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [3, 15, 4, 16], [1, 14, 2, 13], [8, 13, 9, 12], [2, 5, 3, 6], [14, 4, 15, 5]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (10, 3, 1, 4), (7, 4, 8, 5), (5, 14, 6, 15), (1, 12, 2, 13), (8, 13, 9, 14), (15, 6, 16, 7), (16, 9, 11, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 7, 6, 5], [1, 4, 2, 1], [2, 4, 7, 3], [3, 6, 4, 3]]$

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 4

Average minimal degree: 2.65

Total pinning sets: 128

Average overall degree: 2.99

Pinning number: 4

Table 67: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	12	35	42	26	8	1	124
Average degree	2.5	2.74	2.91	3.03	3.12	3.17	3.2	

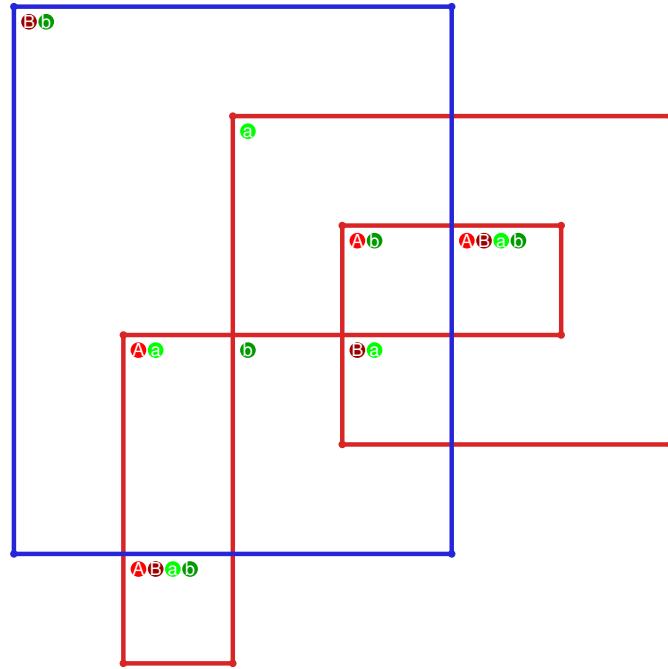


Figure 137: `SnapPy` multiloop plot.

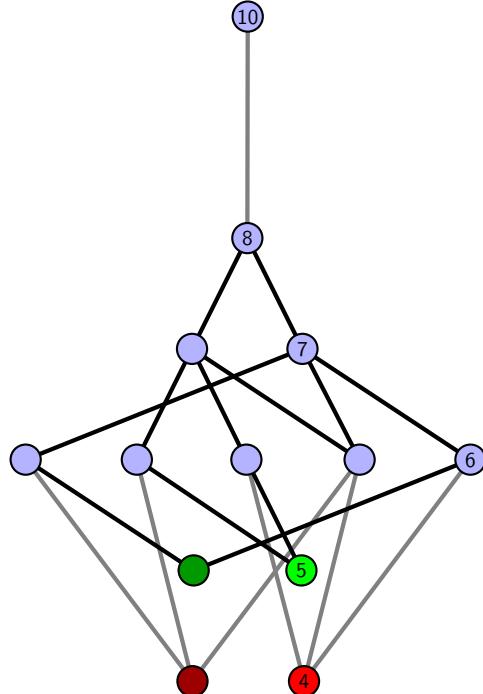


Figure 138: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.32 $[[8, 16, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [15, 12, 16, 13], [1, 12, 2, 11], [6, 11, 7, 10], [3, 13, 4, 14], [14, 2, 15, 3]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (5, 2, 6, 3), (3, 12, 4, 13), (13, 4, 14, 5), (14, 7, 15, 8), (10, 15, 11, 16), (1, 16, 2, 9), (6, 11, 7, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 4], [0, 3, 7, 5], [1, 4, 2, 1], [2, 7, 7, 3], [3, 6, 6, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 5

Average minimal degree: 2.67

Total pinning sets: 110

Average overall degree: 2.99

Pinning number: 4

Table 68: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	1	0	0	0	0	4
Nonminimal pinning sets	0	6	27	38	25	8	1	105
Average degree	2.5	2.71	2.88	3.02	3.11	3.17	3.2	

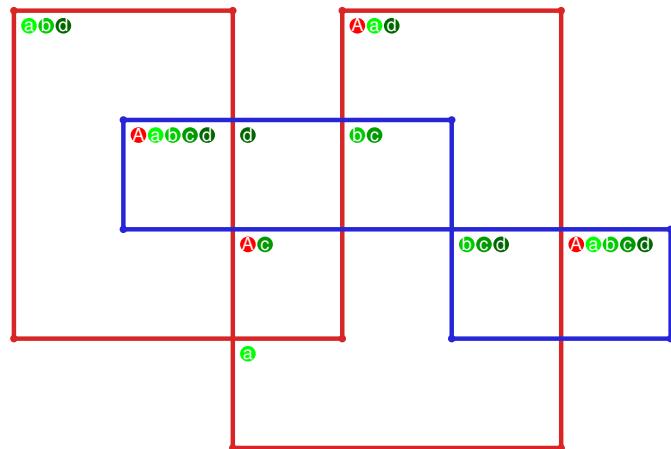


Figure 139: SnapPy multiloop plot.

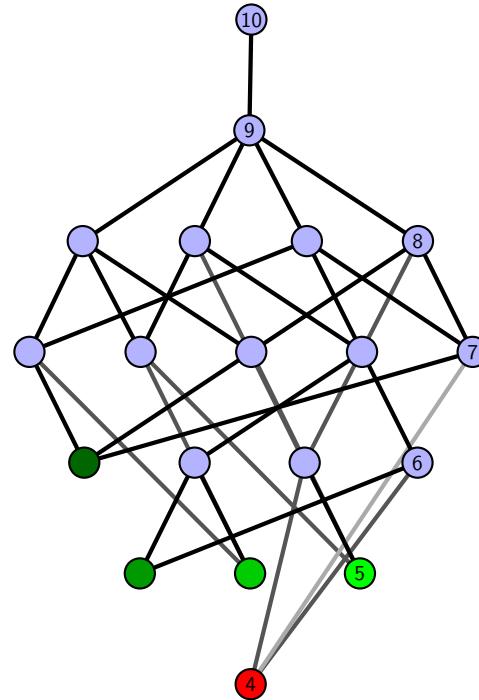


Figure 140: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.33 $[[7, 16, 8, 1], [13, 6, 14, 7], [15, 10, 16, 11], [8, 3, 9, 4], [1, 4, 2, 5], [5, 12, 6, 13], [14, 12, 15, 11], [2, 9, 3, 10]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (15, 2, 16, 3), (11, 4, 12, 5), (16, 7, 1, 8), (13, 8, 14, 9), (9, 12, 10, 13), (3, 10, 4, 11), (5, 14, 6, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 7], [0, 7, 7, 4], [0, 3, 7, 5], [1, 4, 6, 1], [1, 5, 2, 2], [2, 4, 3, 3]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 4

Table 69: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.25	2.58	2.8	2.95	3.06	3.14	3.2	

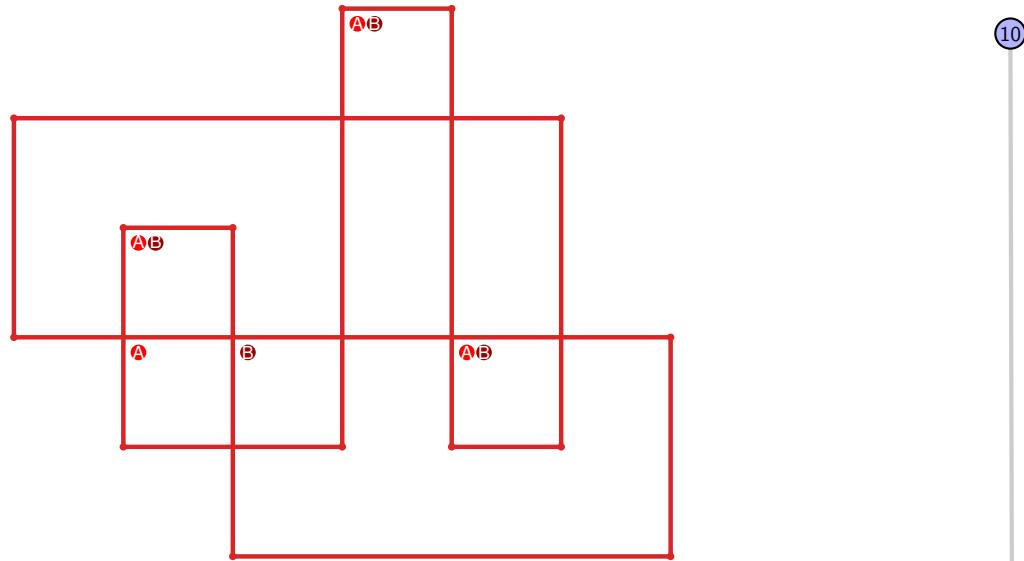


Figure 141: `SnapPy` multiloop plot.

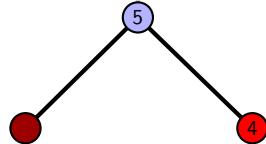


Figure 142: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.34 $[[7, 16, 8, 1], [11, 6, 12, 7], [15, 8, 16, 9], [1, 4, 2, 5], [5, 10, 6, 11], [12, 10, 13, 9], [3, 14, 4, 15], [2, 14, 3, 13]]$

PD code drawn by `SnapPy`: $[(15, 2, 16, 3), (9, 4, 10, 5), (13, 6, 14, 7), (7, 10, 8, 11), (3, 8, 4, 9), (11, 16, 12, 1), (1, 12, 2, 13), (5, 14, 6, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 6, 7, 4], [1, 3, 5, 1], [1, 4, 7, 2], [2, 7, 7, 3], [3, 6, 6, 5]]$

Total optimal pinning sets: 3

Average optimal degree: 2.33

Total minimal pinning sets: 3

Average minimal degree: 2.33

Total pinning sets: 112

Average overall degree: 2.91

Pinning number: 4

Table 70: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.33	2.64	2.84	2.97	3.07	3.14	3.2	

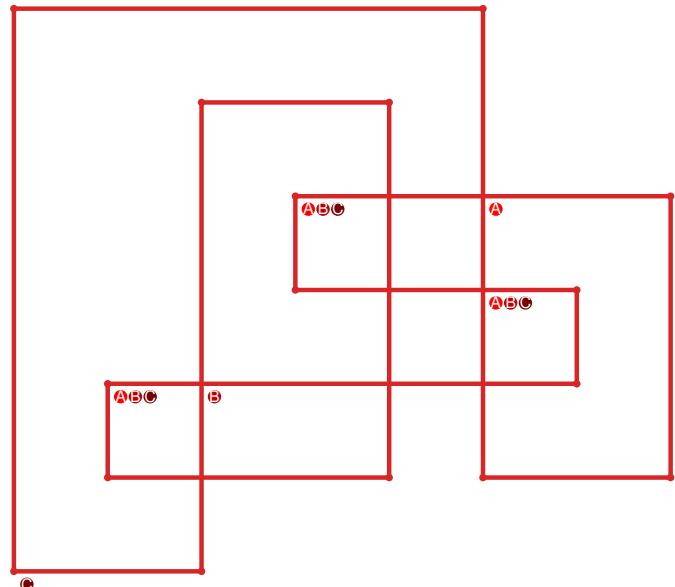


Figure 143: `SnapPy` multiloop plot.

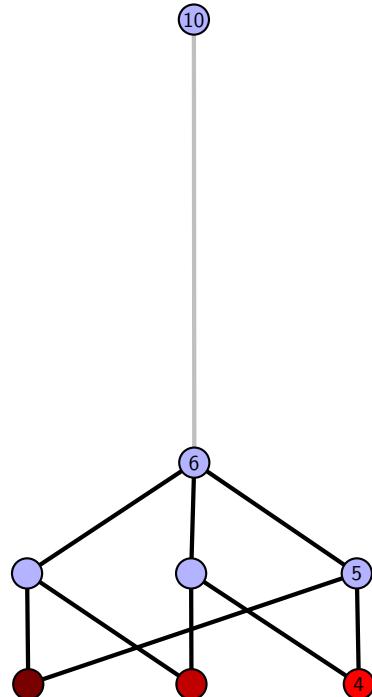


Figure 144: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.35 $[[7, 12, 8, 1], [6, 16, 7, 13], [11, 15, 12, 16], [8, 3, 9, 4], [1, 4, 2, 5], [13, 5, 14, 6], [14, 10, 15, 11], [2, 9, 3, 10]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (11, 2, 12, 3), (14, 3, 15, 4), (12, 7, 1, 8), (15, 8, 16, 9), (5, 10, 6, 11), (9, 16, 10, 13), (4, 13, 5, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 7, 4], [0, 3, 7, 5], [1, 4, 6, 1], [2, 5, 7, 2], [3, 6, 4, 3]]$

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 90
 Pinning number: 5

Average optimal degree: 2.55
 Average minimal degree: 2.55
 Average overall degree: 2.92

Table 71: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	8	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	30	20	7	1	82
Average degree	2.55	2.79	2.95	3.06	3.14	3.2	

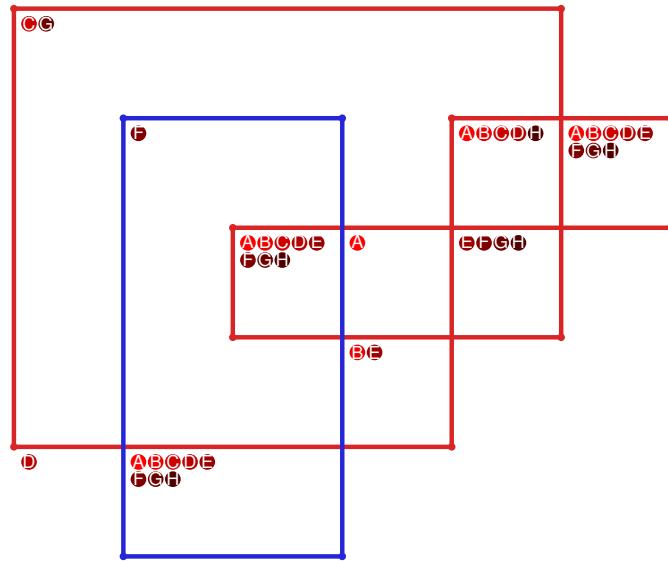


Figure 145: `SnapPy` multiloop plot.

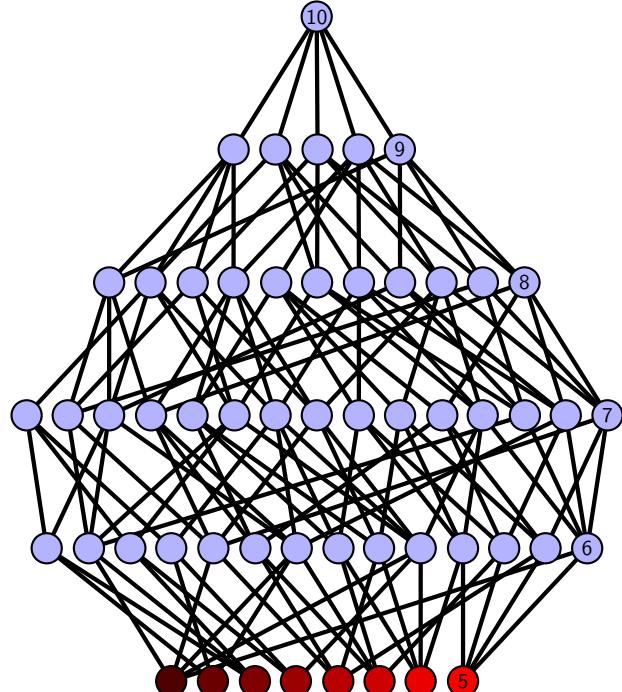


Figure 146: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.36 $[[8, 16, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [15, 1, 16, 2], [6, 11, 7, 10], [3, 13, 4, 14], [2, 13, 3, 12], [14, 11, 15, 12]]$

PD code drawn by `SnapPy`: $[(5, 2, 6, 3), (3, 14, 4, 15), (12, 7, 13, 8), (11, 16, 12, 9), (9, 8, 10, 1), (1, 10, 2, 11), (6, 13, 7, 14), (15, 4, 16, 5)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 7, 0], [1, 7, 2, 1], [2, 7, 6, 6], [3, 5, 5, 7], [3, 6, 5, 4]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 4
Total pinning sets: 68
Pinning number: 5

Average optimal degree: 2.4
Average minimal degree: 2.47
Average overall degree: 2.91

Table 72: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	13	24	19	7	1	64
Average degree	2.4	2.69	2.9	3.05	3.14	3.2	

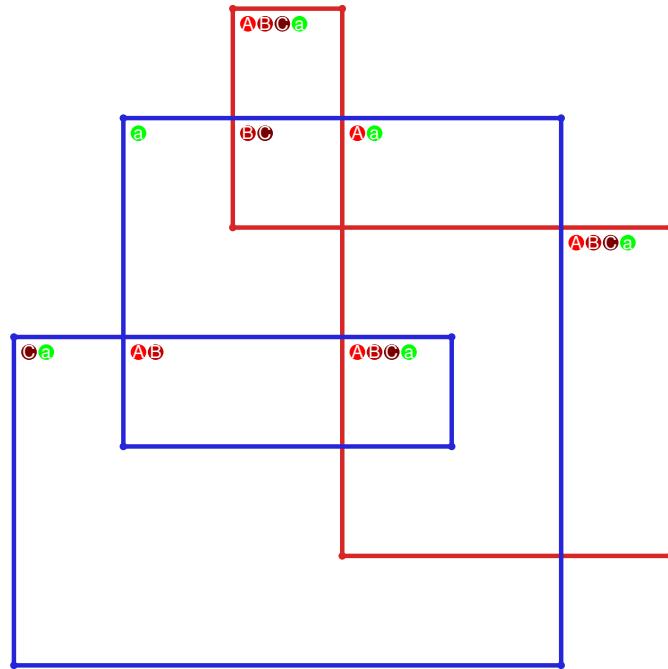


Figure 147: `SnapPy` multiloop plot.

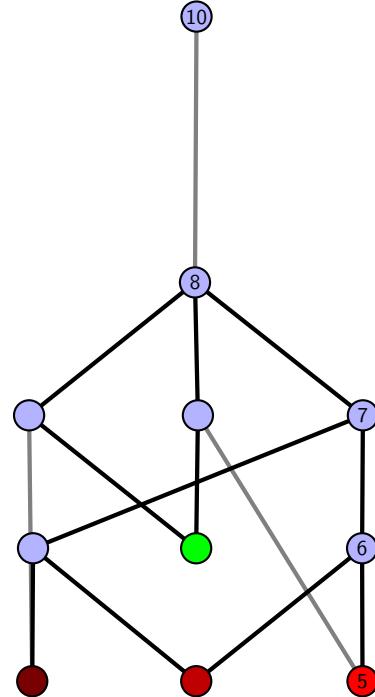


Figure 148: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.37 $[[16, 9, 1, 10], [10, 5, 11, 6], [6, 15, 7, 16], [8, 1, 9, 2], [13, 4, 14, 5], [11, 14, 12, 15], [7, 3, 8, 2], [3, 12, 4, 13]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (7, 2, 8, 3), (13, 6, 14, 7), (16, 9, 1, 10), (8, 11, 9, 12), (3, 12, 4, 13), (5, 14, 6, 15), (15, 4, 16, 5)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 0], [1, 7, 7, 5], [1, 4, 7, 2], [2, 7, 3, 3], [4, 6, 5, 4]]$

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 3

Average minimal degree: 2.4

Total pinning sets: 64

Average overall degree: 2.9

Pinning number: 5

Table 73: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	22	18	7	1	61
Average degree	2.4	2.69	2.9	3.04	3.14	3.2	

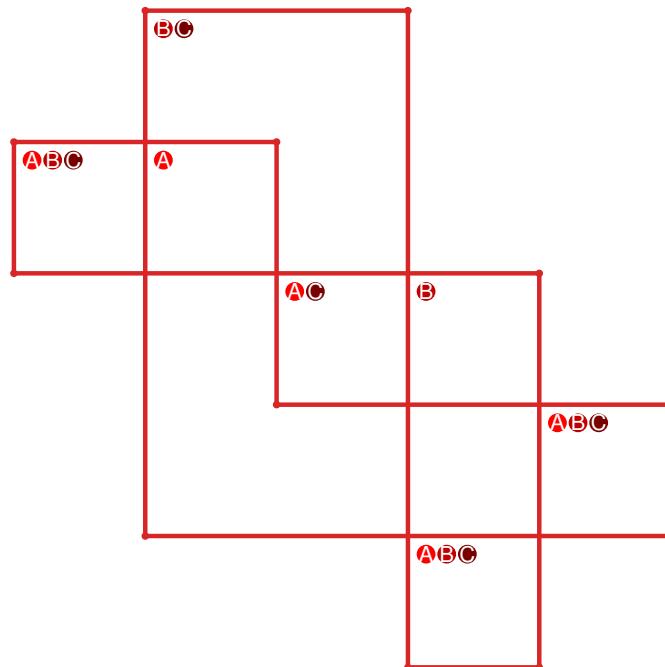


Figure 149: SnapPy multiloop plot.

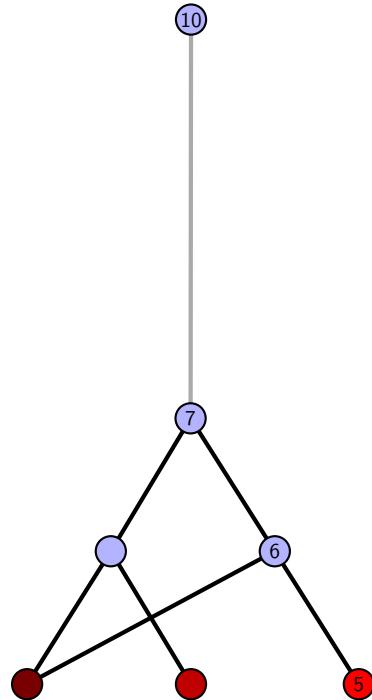


Figure 150: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.38 $[[6, 16, 1, 7], [7, 14, 8, 15], [15, 5, 16, 6], [1, 12, 2, 11], [3, 13, 4, 14], [8, 4, 9, 5], [12, 9, 13, 10], [2, 10, 3, 11]]$

PD code drawn by `SnapPy`: $[(15, 2, 16, 3), (12, 3, 13, 4), (8, 5, 9, 6), (1, 10, 2, 11), (14, 11, 15, 12), (4, 13, 5, 14), (9, 16, 10, 7), (6, 7, 1, 8)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 5, 2], [0, 1, 5, 0], [0, 6, 7, 7], [1, 7, 6, 5], [1, 4, 6, 2], [3, 5, 4, 7], [3, 6, 4, 3]]$

Total optimal pinning sets: 4

Average optimal degree: 2.6

Total minimal pinning sets: 5

Average minimal degree: 2.61

Total pinning sets: 84

Average overall degree: 2.98

Pinning number: 5

Table 74: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	4	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	17	30	23	8	1	79
Average degree	2.6	2.81	2.98	3.1	3.17	3.2	

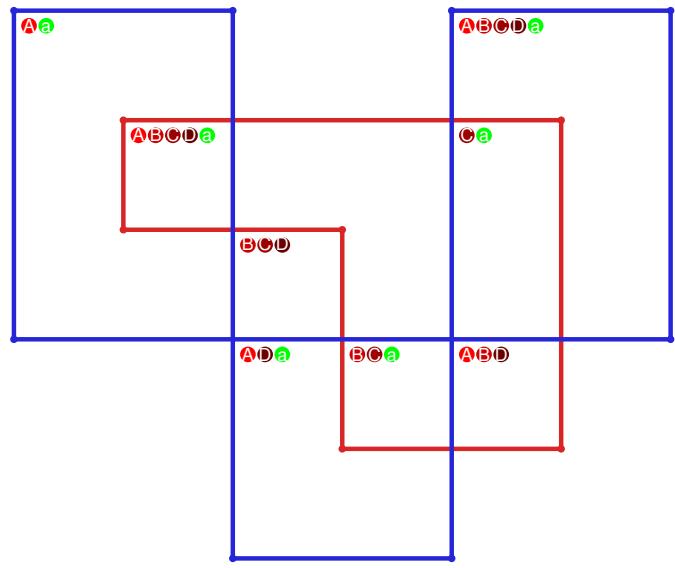


Figure 151: `SnapPy` multiloop plot.

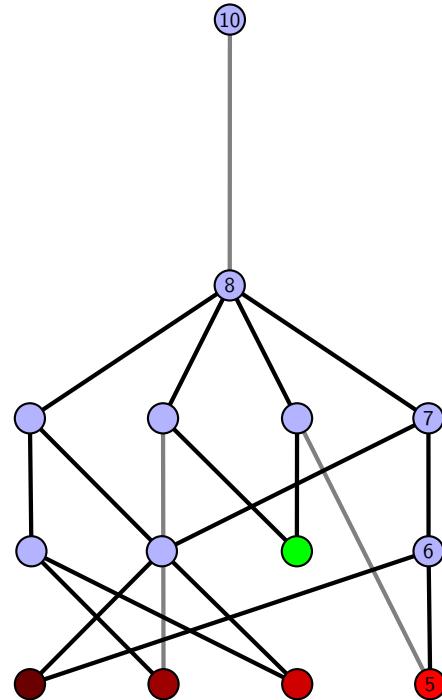


Figure 152: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.39 $[[7, 16, 8, 1], [15, 6, 16, 7], [8, 6, 9, 5], [1, 13, 2, 12], [3, 14, 4, 15], [9, 4, 10, 5], [13, 10, 14, 11], [2, 11, 3, 12]]$

PD code drawn by `SnapPy`: $[(7, 2, 8, 3), (3, 6, 4, 7), (13, 4, 14, 5), (11, 8, 12, 9), (16, 9, 1, 10), (10, 15, 11, 16), (1, 12, 2, 13), (5, 14, 6, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 7], [1, 7, 6, 5], [2, 4, 6, 2], [3, 5, 4, 7], [3, 6, 4, 3]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4

Total pinning sets: 72

Pinning number: 5

Average optimal degree: 2.45

Average minimal degree: 2.45

Average overall degree: 2.91

Table 75: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	4	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	25	19	7	1	68
Average degree	2.45	2.73	2.92	3.05	3.14	3.2	

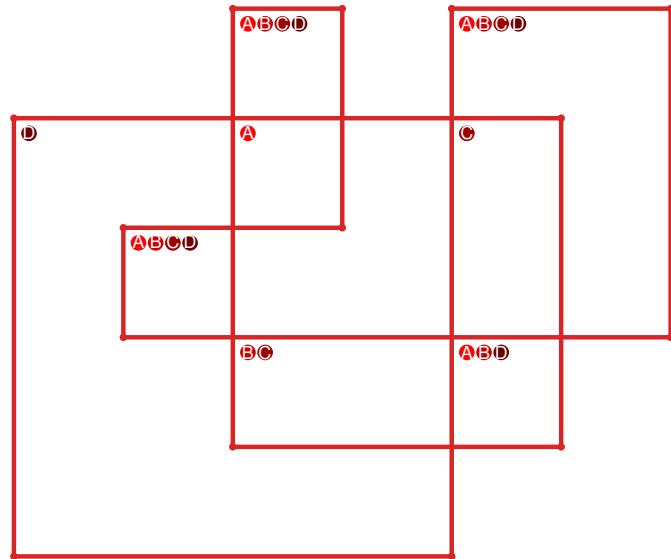


Figure 153: `SnapPy` multiloop plot.

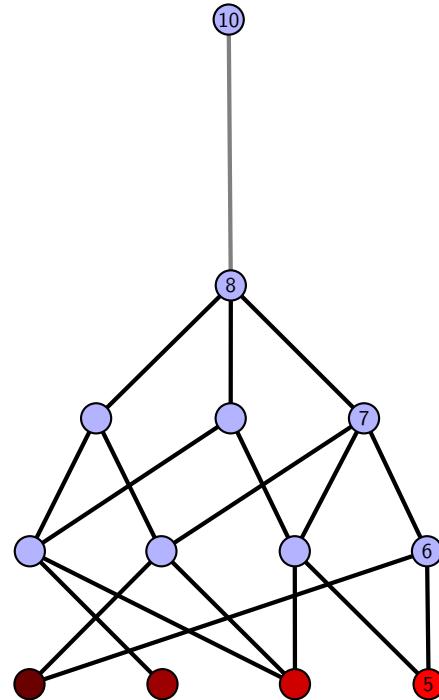


Figure 154: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.40 $[[6, 16, 1, 7], [7, 5, 8, 6], [8, 15, 9, 16], [1, 12, 2, 11], [14, 4, 15, 5], [9, 13, 10, 12], [2, 10, 3, 11], [3, 13, 4, 14]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (11, 2, 12, 3), (5, 14, 6, 15), (15, 4, 16, 5), (16, 13, 7, 14), (6, 7, 1, 8), (12, 9, 13, 10), (3, 10, 4, 11)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 4, 5], [0, 5, 6, 6], [1, 7, 7, 2], [2, 7, 6, 3], [3, 5, 7, 3], [4, 6, 5, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.53

Total pinning sets: 64

Average overall degree: 2.92

Pinning number: 5

Table 76: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	2
Nonminimal pinning sets	0	10	23	19	7	1	60
Average degree	2.4	2.67	2.89	3.05	3.14	3.2	

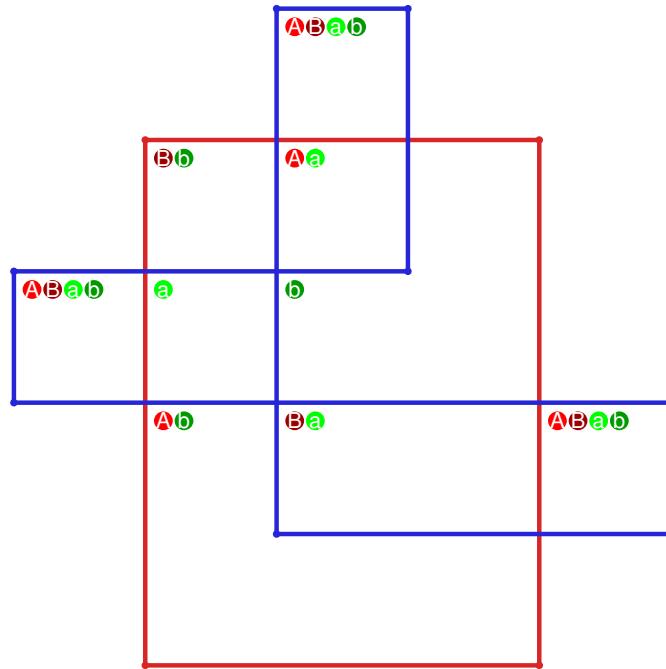


Figure 155: SnapPy multiloop plot.

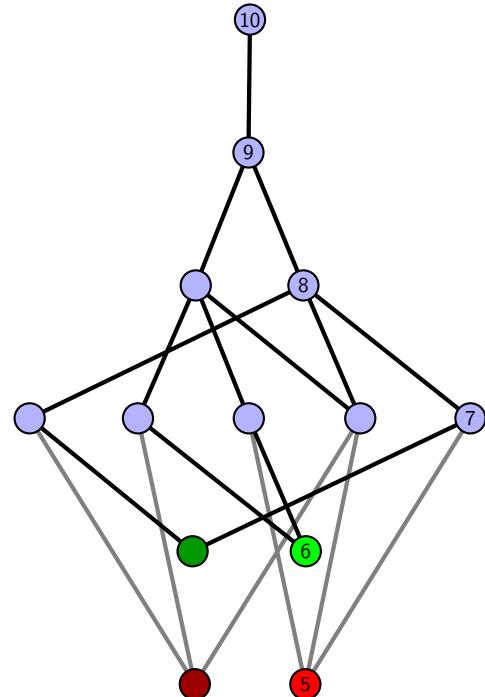


Figure 156: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.41 $[[5, 16, 6, 1], [9, 4, 10, 5], [10, 15, 11, 16], [6, 11, 7, 12], [1, 12, 2, 13], [13, 8, 14, 9], [14, 3, 15, 4], [7, 3, 8, 2]]$

PD code drawn by SnapPy: $[(16, 5, 1, 6), (12, 1, 13, 2), (7, 2, 8, 3), (11, 6, 12, 7), (4, 9, 5, 10), (15, 10, 16, 11), (8, 13, 9, 14), (3, 14, 4, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 4], [0, 3, 7, 5], [1, 4, 7, 6], [1, 5, 7, 2], [3, 6, 5, 4]]$

Total optimal pinning sets: 10
 Total minimal pinning sets: 10
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 3.04
 Average minimal degree: 3.04
 Average overall degree: 3.15

Table 77: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	10	0	0	0	0	0	10
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	42	60	37	10	1	150
Average degree	3.04	3.11	3.16	3.19	3.2	3.2	

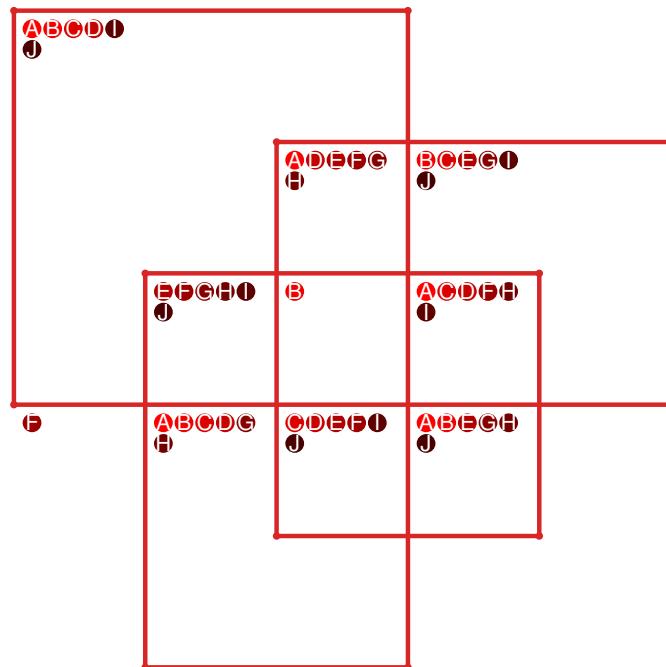


Figure 157: SnapPy multiloop plot.

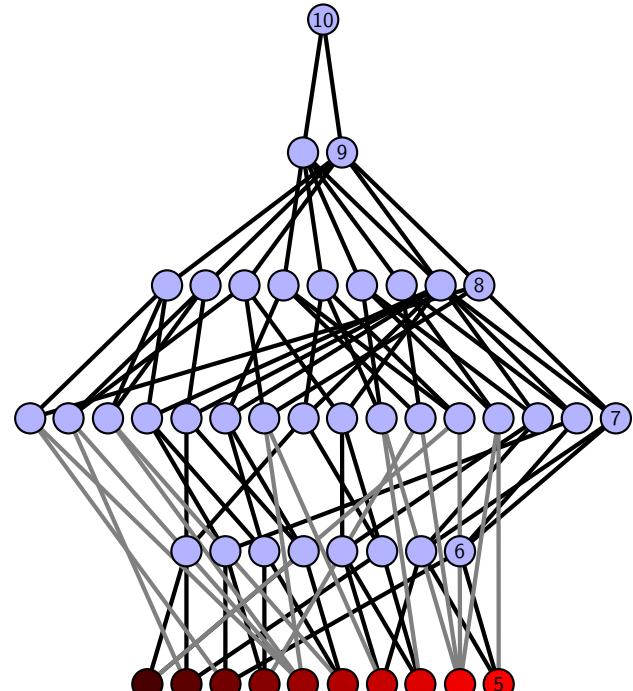


Figure 158: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.42 $[[16, 5, 1, 6], [6, 3, 7, 4], [4, 15, 5, 16], [1, 10, 2, 11], [11, 2, 12, 3], [7, 12, 8, 13], [9, 14, 10, 15], [8, 14, 9, 13]]$

PD code drawn by `SnapPy`: $[(9, 16, 10, 1), (4, 1, 5, 2), (14, 3, 15, 4), (15, 8, 16, 9), (5, 10, 6, 11), (11, 6, 12, 7), (7, 12, 8, 13), (2, 13, 3, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 5, 2], [0, 1, 6, 0], [0, 6, 4, 4], [1, 3, 3, 5], [1, 4, 7, 7], [2, 7, 7, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 78: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

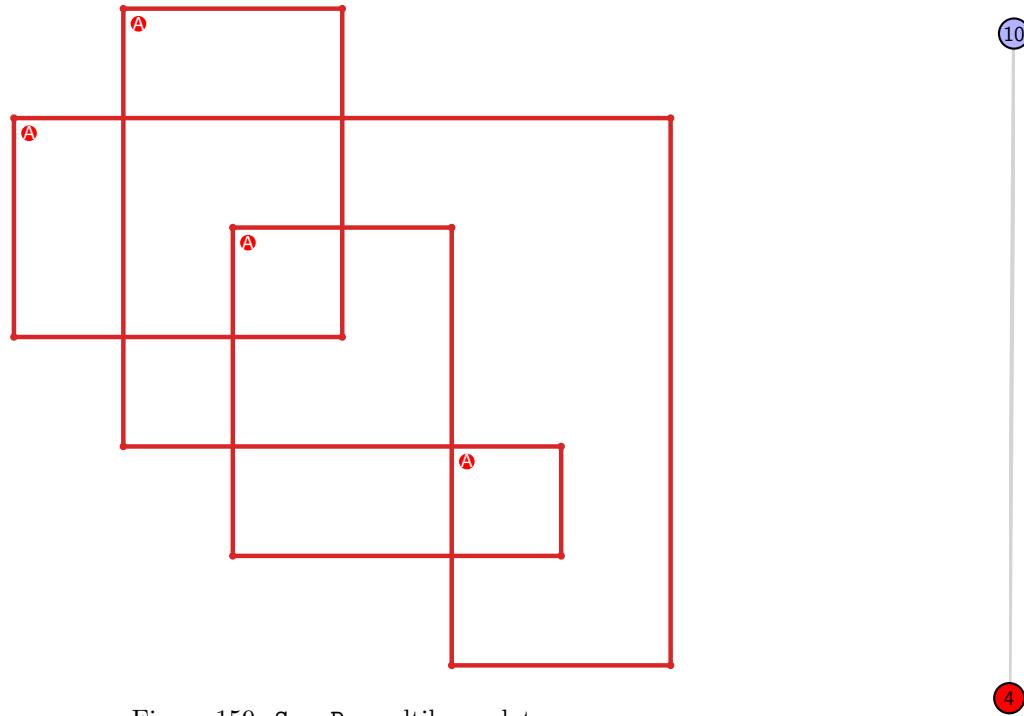


Figure 159: `SnapPy` multiloop plot.

Figure 160: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.43 $[[16, 5, 1, 6], [6, 3, 7, 4], [4, 15, 5, 16], [1, 13, 2, 12], [2, 11, 3, 12], [7, 11, 8, 10], [14, 9, 15, 10], [13, 9, 14, 8]]$

PD code drawn by `SnapPy`: $[(4, 1, 5, 2), (14, 3, 15, 4), (6, 11, 7, 12), (12, 7, 13, 8), (8, 5, 9, 6), (16, 9, 1, 10), (10, 15, 11, 16), (2, 13, 3, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 5, 2], [0, 1, 6, 0], [0, 7, 4, 4], [1, 3, 3, 5], [1, 4, 7, 6], [2, 5, 7, 7], [3, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 6

Average minimal degree: 2.48

Total pinning sets: 104

Average overall degree: 2.92

Pinning number: 4

Table 79: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	5
Nonminimal pinning sets	0	6	29	34	21	7	1	98
Average degree	2.5	2.62	2.83	2.97	3.07	3.14	3.2	

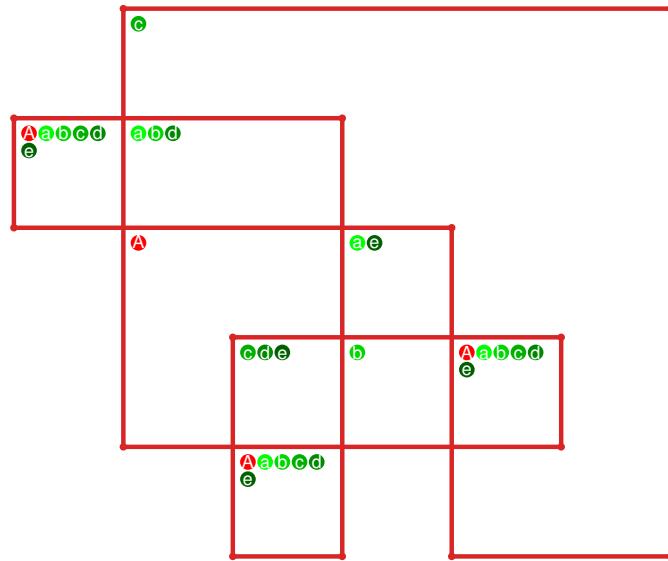


Figure 161: `SnapPy` multiloop plot.

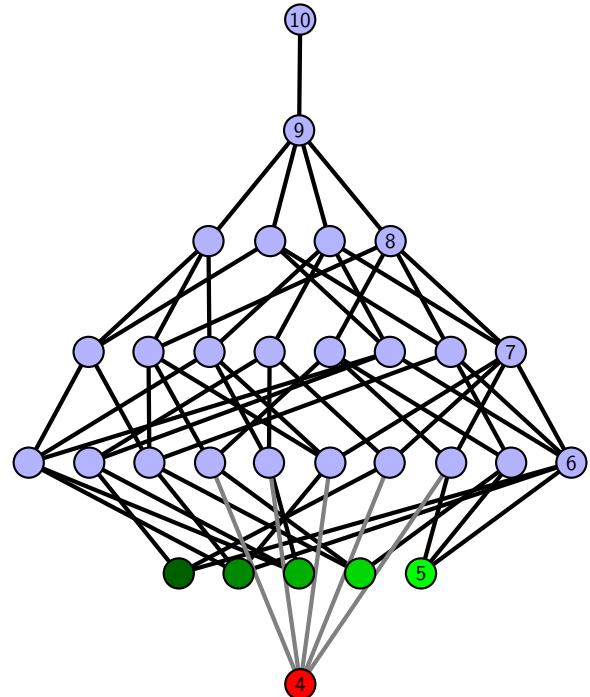


Figure 162: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.44 $[[6, 12, 1, 7], [7, 3, 8, 4], [11, 5, 12, 6], [1, 13, 2, 16], [2, 15, 3, 16], [8, 15, 9, 14], [4, 10, 5, 11], [13, 10, 14, 9]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (12, 3, 13, 4), (16, 9, 11, 10), (2, 11, 3, 12), (4, 13, 5, 14), (6, 7, 1, 8), (8, 5, 9, 6), (10, 15, 7, 16)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 6, 0], [0, 7, 4, 4], [1, 3, 3, 5], [1, 4, 7, 7], [1, 7, 2, 2], [3, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 80: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

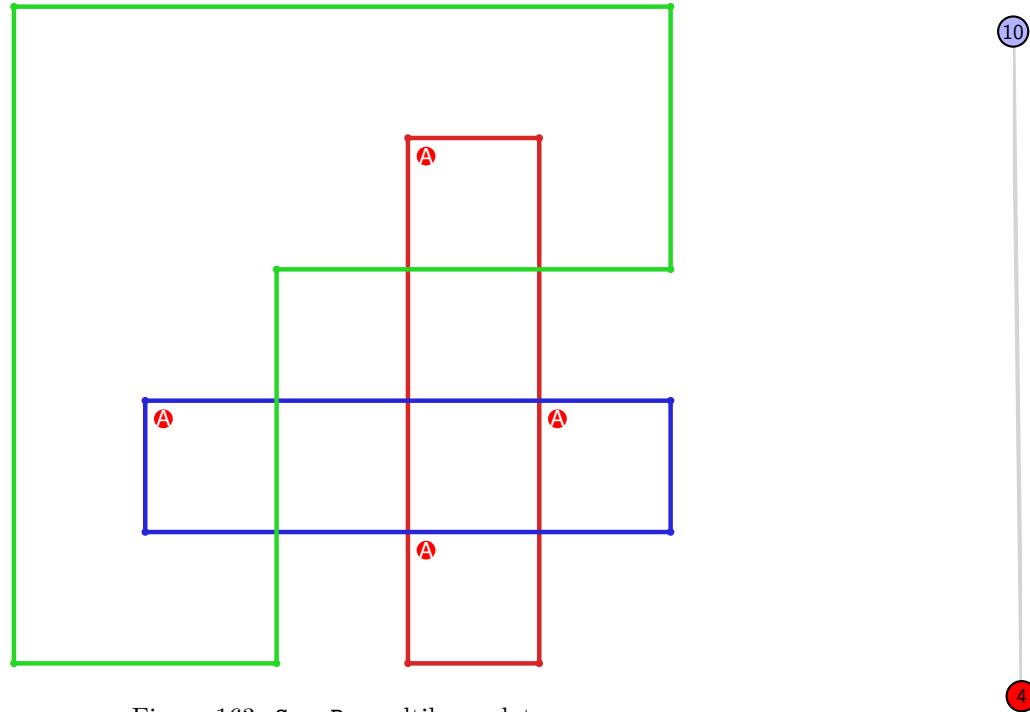


Figure 163: SnapPy multiloop plot.

Figure 164: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.45 $[[8, 12, 1, 9], [9, 3, 10, 4], [11, 7, 12, 8], [1, 13, 2, 16], [2, 15, 3, 16], [10, 5, 11, 4], [6, 13, 7, 14], [14, 5, 15, 6]]$

PD code drawn by SnapPy: $[(16, 1, 13, 2), (2, 13, 3, 14), (12, 3, 9, 4), (14, 5, 15, 6), (6, 15, 7, 16), (8, 9, 1, 10), (10, 7, 11, 8), (4, 11, 5, 12)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 5], [0, 5, 6, 0], [0, 6, 4, 4], [1, 3, 3, 7], [1, 7, 2, 1], [2, 7, 7, 3], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 81: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

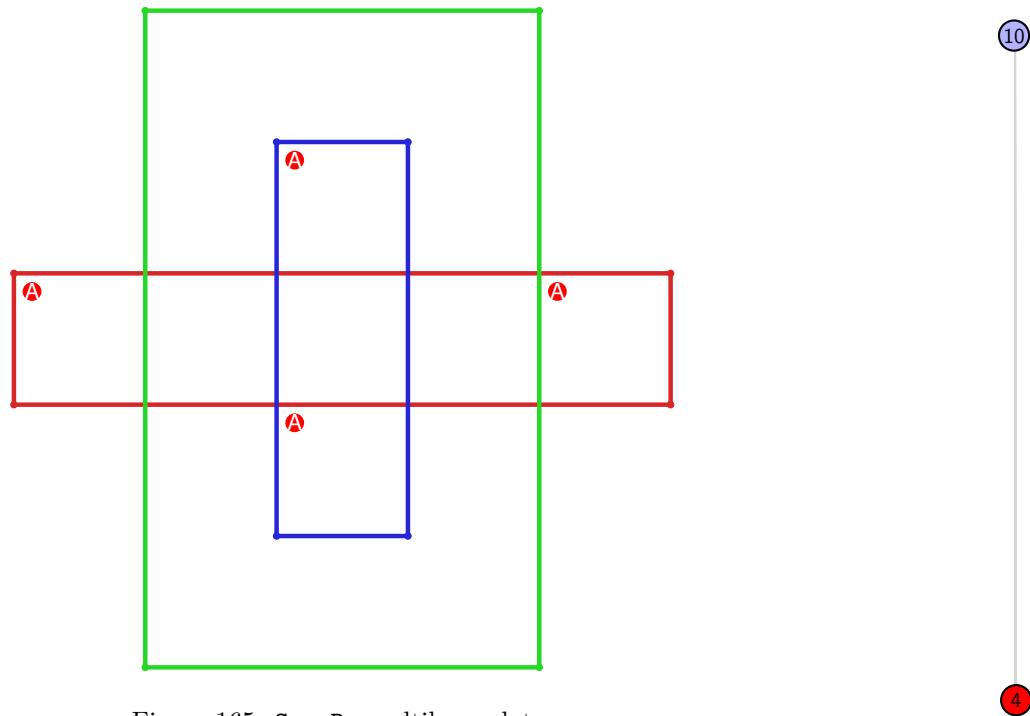


Figure 165: SnapPy multiloop plot.

Figure 166: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.46 $[[5, 12, 6, 1], [4, 7, 5, 8], [11, 6, 12, 7], [1, 13, 2, 16], [8, 3, 9, 4], [10, 13, 11, 14], [2, 15, 3, 16], [9, 15, 10, 14]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (9, 4, 10, 5), (2, 5, 3, 6), (3, 10, 4, 11), (16, 7, 13, 8), (12, 13, 1, 14), (14, 11, 15, 12), (8, 15, 9, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 5, 6, 6], [1, 6, 7, 1], [2, 7, 7, 3], [3, 7, 4, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.82

Pinning number: 4

Table 82: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	

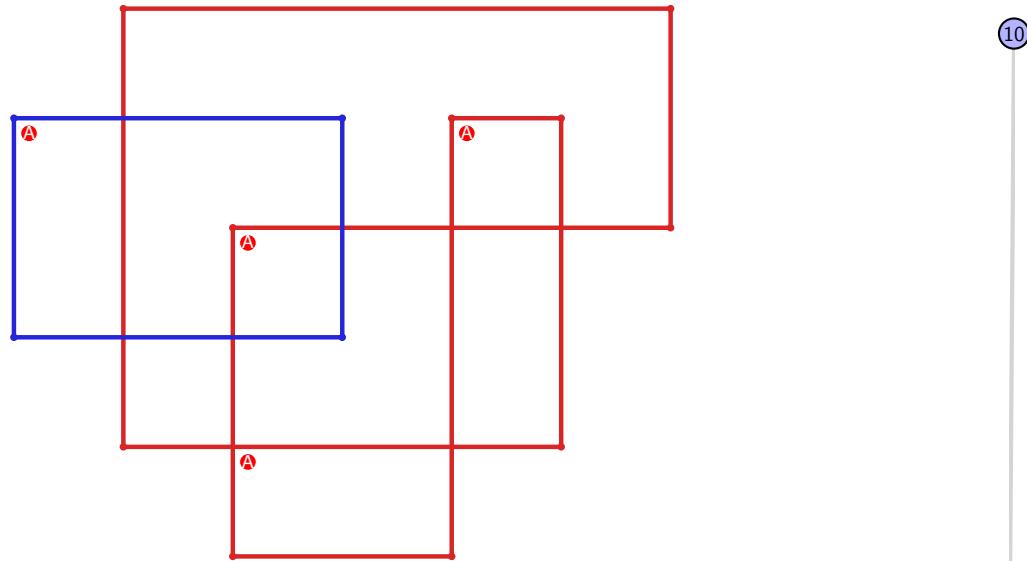


Figure 167: `SnapPy` multiloop plot.



Figure 168: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.47 $[[7, 16, 8, 1], [6, 13, 7, 14], [15, 12, 16, 13], [8, 2, 9, 1], [14, 5, 15, 6], [11, 2, 12, 3], [9, 4, 10, 5], [3, 10, 4, 11]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (11, 2, 12, 3), (16, 7, 1, 8), (12, 9, 13, 10), (3, 10, 4, 11), (4, 13, 5, 14), (14, 5, 15, 6), (8, 15, 9, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 5, 6, 0], [1, 6, 2, 1], [2, 7, 7, 3], [3, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 48

Average overall degree: 2.83

Pinning number: 5

Table 83: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.2	2.56	2.8	2.98	3.11	3.2	

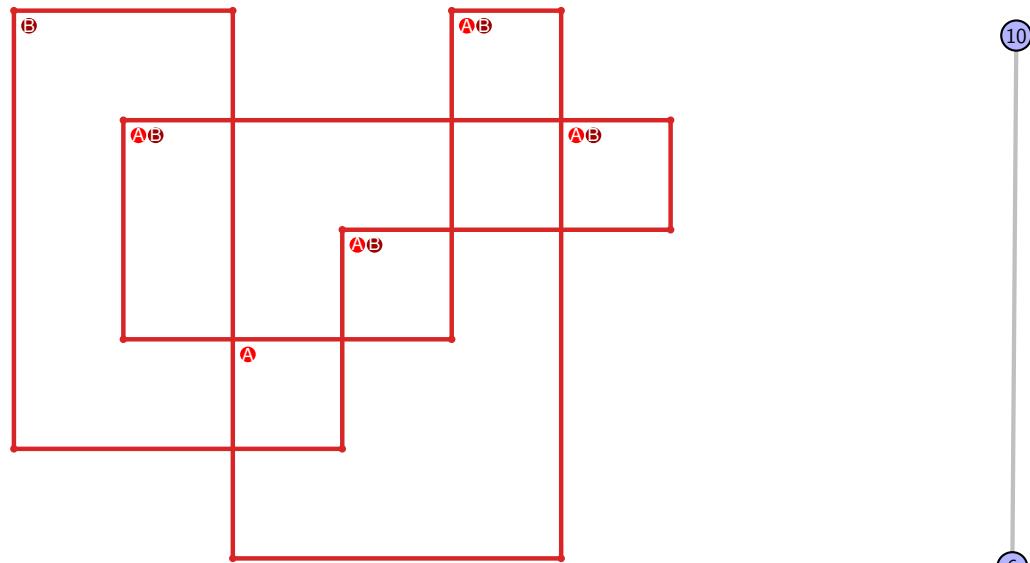


Figure 169: SnapPy multiloop plot.

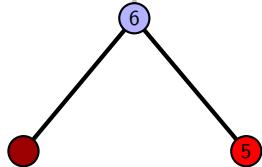


Figure 170: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.48 $[[10, 16, 1, 11], [11, 9, 12, 10], [15, 7, 16, 8], [1, 7, 2, 6], [8, 12, 9, 13], [4, 14, 5, 15], [2, 5, 3, 6], [13, 3, 14, 4]]$

PD code drawn by SnapPy: $[(11, 10, 12, 1), (9, 2, 10, 3), (3, 8, 4, 9), (13, 4, 14, 5), (15, 6, 16, 7), (1, 12, 2, 13), (7, 14, 8, 15), (5, 16, 6, 11)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 3], [0, 2, 6, 6], [1, 7, 2, 1], [2, 7, 7, 6], [3, 5, 7, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 56
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.84

Table 84: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	12	19	15	6	1	53
Average degree	2.27	2.61	2.84	3.0	3.11	3.2	

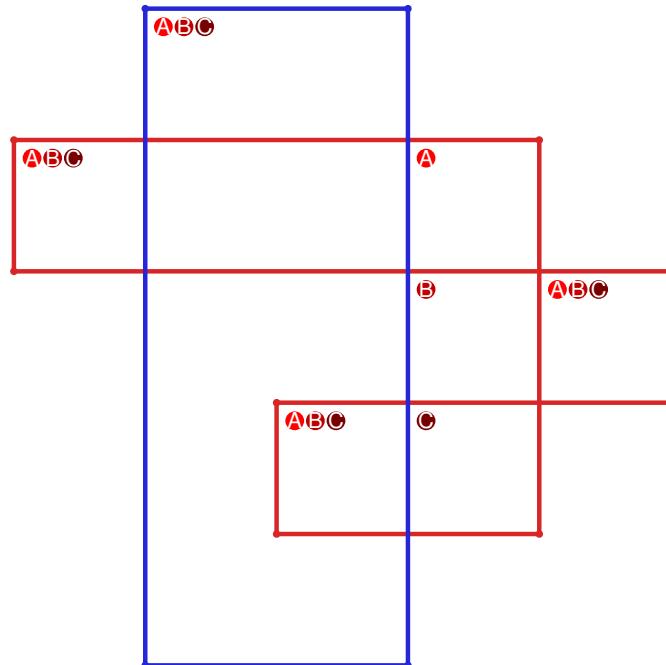


Figure 171: SnapPy multiloop plot.

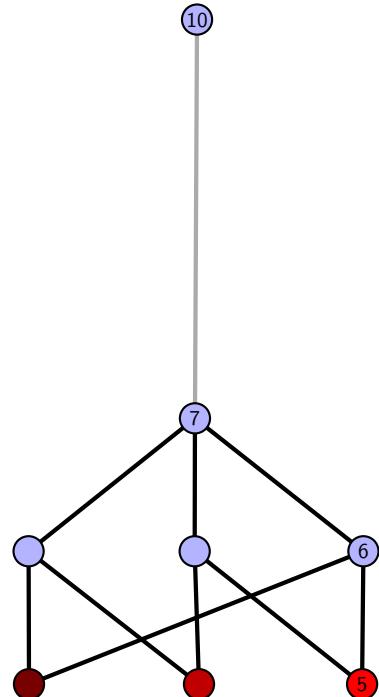


Figure 172: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.49 $[[16, 11, 1, 12], [12, 8, 13, 7], [15, 2, 16, 3], [10, 1, 11, 2], [8, 5, 9, 6], [13, 6, 14, 7], [3, 14, 4, 15], [4, 9, 5, 10]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (10, 3, 11, 4), (4, 9, 5, 10), (1, 6, 2, 7), (13, 8, 14, 9), (16, 11, 1, 12), (7, 14, 8, 15), (12, 15, 13, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 0], [1, 7, 7, 5], [1, 4, 6, 1], [2, 5, 7, 2], [3, 6, 4, 4]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 60
 Pinning number: 5

Average optimal degree: 2.3
 Average minimal degree: 2.3
 Average overall degree: 2.84

Table 85: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	4	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	14	20	15	6	1	56
Average degree	2.3	2.64	2.86	3.0	3.11	3.2	

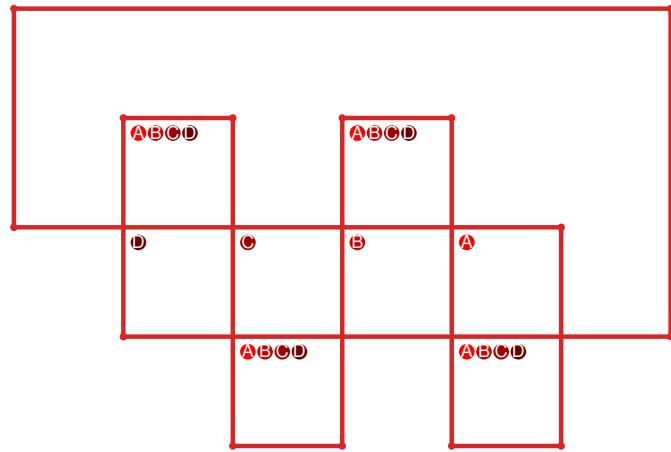


Figure 173: SnapPy multiloop plot.

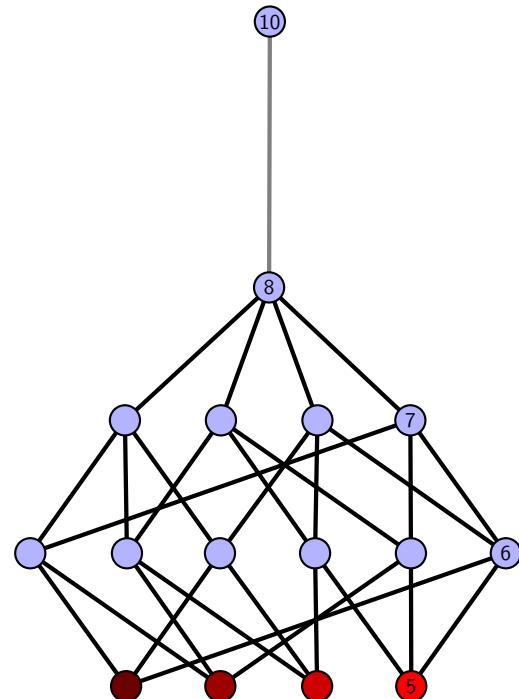


Figure 174: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.50 $[[5, 16, 6, 1], [4, 11, 5, 12], [15, 2, 16, 3], [6, 2, 7, 1], [12, 9, 13, 10], [10, 3, 11, 4], [14, 7, 15, 8], [8, 13, 9, 14]]$

PD code drawn by SnapPy: $[(10, 3, 11, 4), (8, 5, 9, 6), (16, 7, 1, 8), (4, 9, 5, 10), (1, 12, 2, 13), (13, 2, 14, 3), (11, 14, 12, 15), (6, 15, 7, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 5, 6, 3], [0, 2, 6, 0], [1, 7, 7, 5], [1, 4, 2, 1], [2, 7, 7, 3], [4, 6, 6, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 48

Average overall degree: 2.83

Pinning number: 5

Table 86: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.2	2.56	2.8	2.98	3.11	3.2	

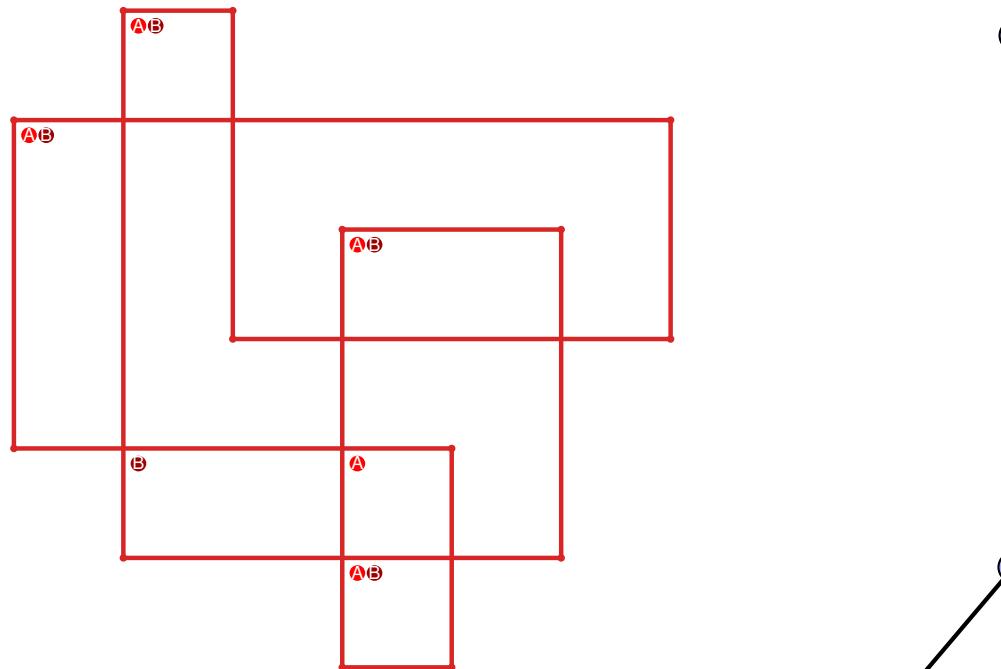


Figure 175: SnapPy multiloop plot.

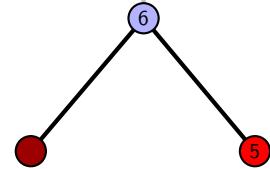


Figure 176: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.51 $[[12, 16, 1, 13], [13, 7, 14, 8], [11, 2, 12, 3], [15, 1, 16, 2], [6, 14, 7, 15], [8, 6, 9, 5], [3, 10, 4, 11], [9, 4, 10, 5]]$

PD code drawn by SnapPy: $[(12, 3, 1, 4), (13, 2, 14, 3), (10, 5, 11, 6), (15, 8, 16, 9), (6, 9, 7, 10), (4, 11, 5, 12), (7, 16, 8, 13), (1, 14, 2, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 4, 0], [1, 3, 5, 1], [1, 4, 7, 7], [2, 7, 7, 2], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.76

Pinning number: 5

Table 87: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.69	2.9	3.07	3.2	

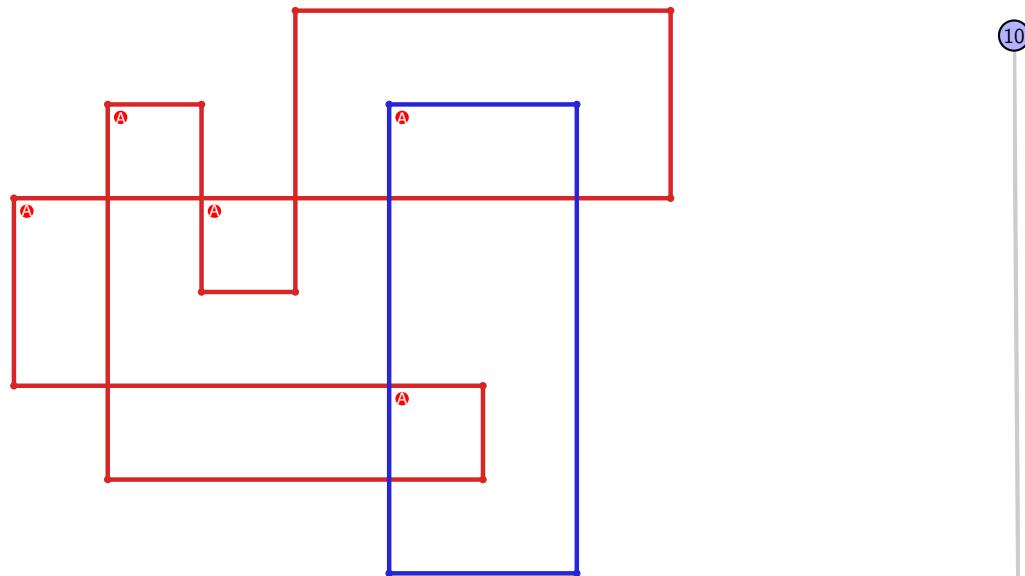


Figure 177: SnapPy multiloop plot.



Figure 178: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.52 $[[6, 16, 1, 7], [7, 5, 8, 6], [15, 1, 16, 2], [4, 10, 5, 11], [8, 13, 9, 14], [2, 14, 3, 15], [11, 3, 12, 4], [12, 9, 13, 10]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (15, 2, 16, 3), (11, 4, 12, 5), (5, 10, 6, 11), (8, 13, 9, 14), (3, 14, 4, 15), (1, 16, 2, 7), (12, 9, 13, 10)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 6, 7], [1, 7, 7, 5], [2, 4, 6, 2], [3, 5, 7, 3], [3, 6, 4, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.76

Pinning number: 5

Table 88: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.69	2.9	3.07	3.2	

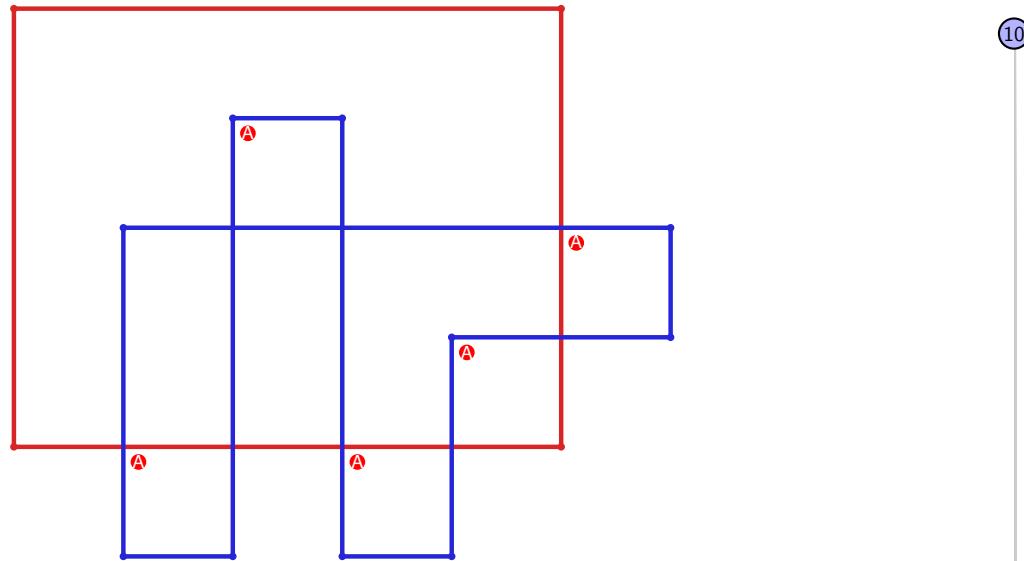


Figure 179: `SnapPy` multiloop plot.



Figure 180: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.53 $[[5, 16, 6, 1], [15, 4, 16, 5], [6, 14, 7, 13], [1, 11, 2, 10], [3, 14, 4, 15], [7, 12, 8, 13], [11, 8, 12, 9], [2, 9, 3, 10]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (9, 6, 10, 7), (16, 7, 1, 8), (8, 15, 9, 16), (5, 10, 6, 11), (11, 4, 12, 5), (1, 12, 2, 13), (3, 14, 4, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 6, 7, 7], [1, 7, 2, 1], [2, 6, 6, 2], [3, 5, 5, 7], [3, 6, 4, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.76

Pinning number: 5

Table 89: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.69	2.9	3.07	3.2	

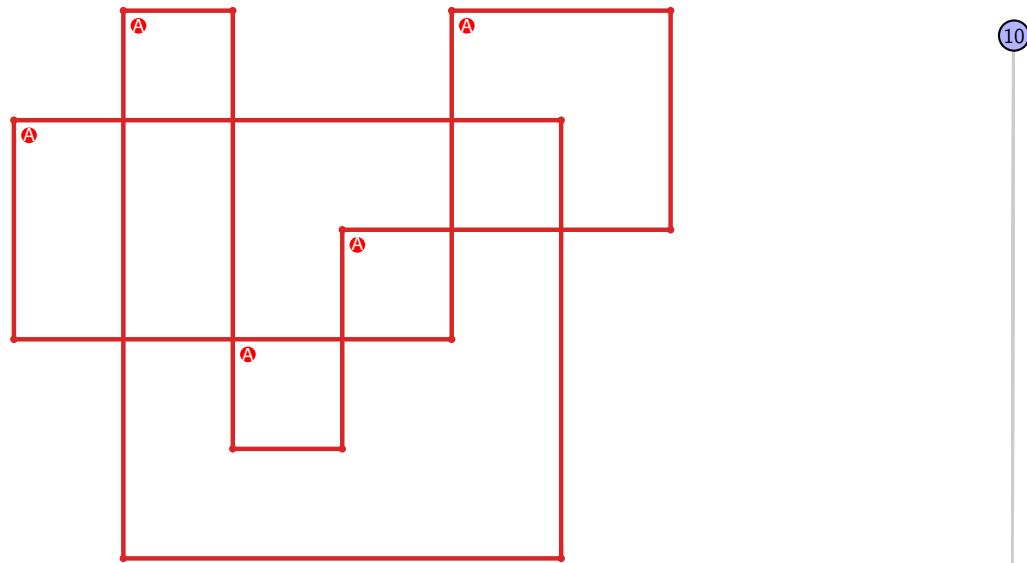


Figure 181: SnapPy multiloop plot.



Figure 182: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.54 $[[8, 16, 1, 9], [9, 7, 10, 8], [15, 5, 16, 6], [1, 14, 2, 13], [6, 10, 7, 11], [4, 14, 5, 15], [2, 12, 3, 13], [11, 3, 12, 4]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (13, 2, 14, 3), (15, 4, 16, 5), (7, 10, 8, 11), (11, 6, 12, 7), (1, 12, 2, 13), (5, 14, 6, 15), (3, 16, 4, 9)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 5, 6, 6], [1, 7, 2, 1], [2, 7, 3, 2], [3, 7, 7, 3], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.76

Pinning number: 5

Table 90: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.69	2.9	3.07	3.2	

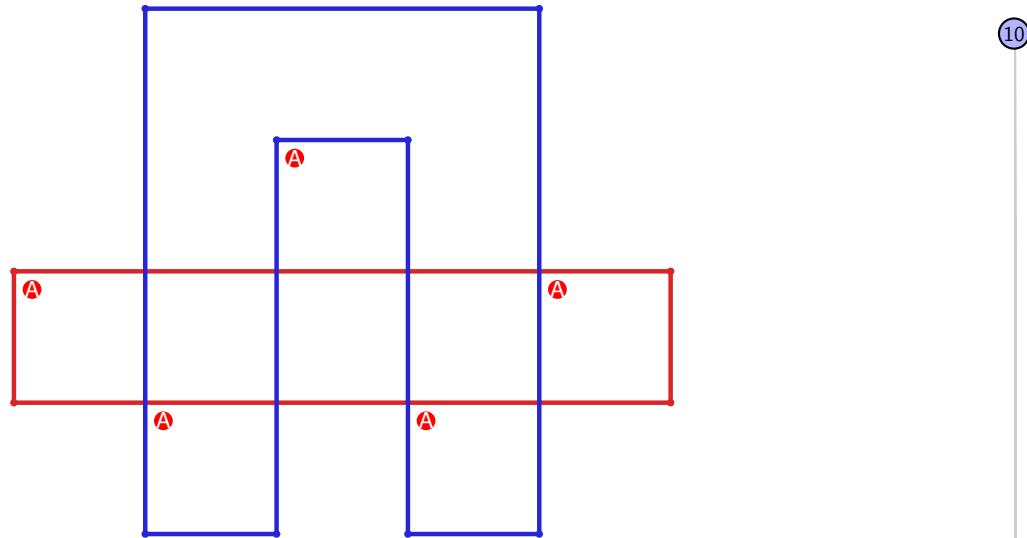


Figure 183: SnapPy multiloop plot.



Figure 184: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.55 $[[6, 10, 1, 7], [7, 11, 8, 16], [5, 15, 6, 16], [9, 1, 10, 2], [11, 9, 12, 8], [14, 4, 15, 5], [2, 13, 3, 12], [3, 13, 4, 14]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (13, 4, 14, 5), (16, 11, 13, 12), (3, 14, 4, 15), (12, 5, 7, 6), (6, 7, 1, 8), (2, 9, 3, 10), (10, 15, 11, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 4, 0], [1, 3, 6, 1], [2, 7, 7, 2], [3, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 3
Total pinning sets: 28
Pinning number: 6

Average optimal degree: 2.22
Average minimal degree: 2.22
Average overall degree: 2.78

Table 91: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	Total
Optimal pinning sets	3	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	9	10	5	1	25
Average degree	2.22	2.63	2.9	3.07	3.2	

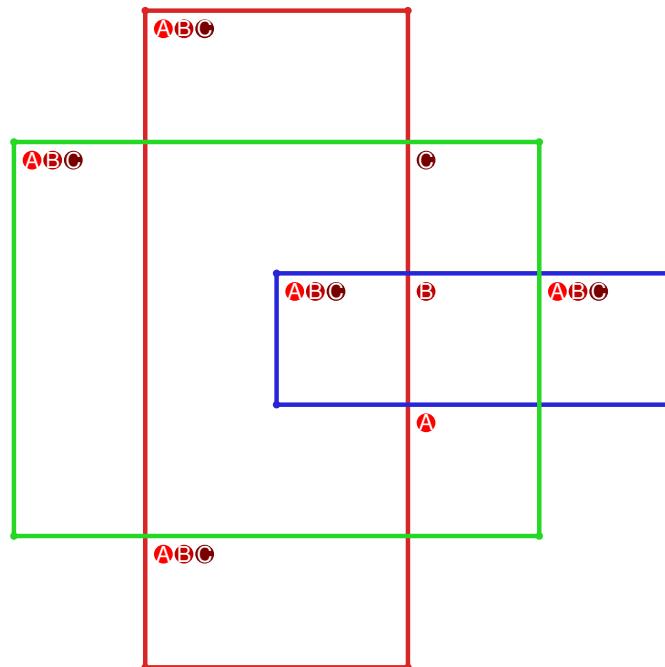


Figure 185: SnapPy multiloop plot.

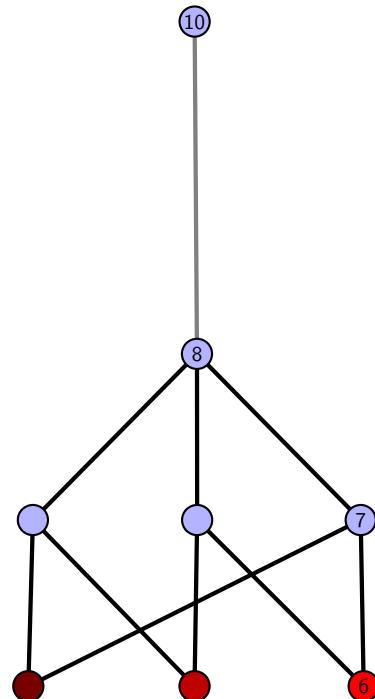


Figure 186: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.56 $[[5, 16, 6, 1], [4, 11, 5, 12], [15, 10, 16, 11], [6, 2, 7, 1], [12, 3, 13, 4], [9, 14, 10, 15], [2, 8, 3, 7], [13, 8, 14, 9]]$

PD code drawn by `SnapPy`: $[(10, 1, 11, 2), (5, 16, 6, 1), (11, 6, 12, 7), (13, 8, 14, 9), (2, 9, 3, 10), (7, 12, 8, 13), (3, 14, 4, 15), (15, 4, 16, 5)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 6, 0], [1, 6, 7, 1], [2, 7, 7, 2], [3, 7, 4, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.76

Pinning number: 5

Table 92: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.69	2.9	3.07	3.2	

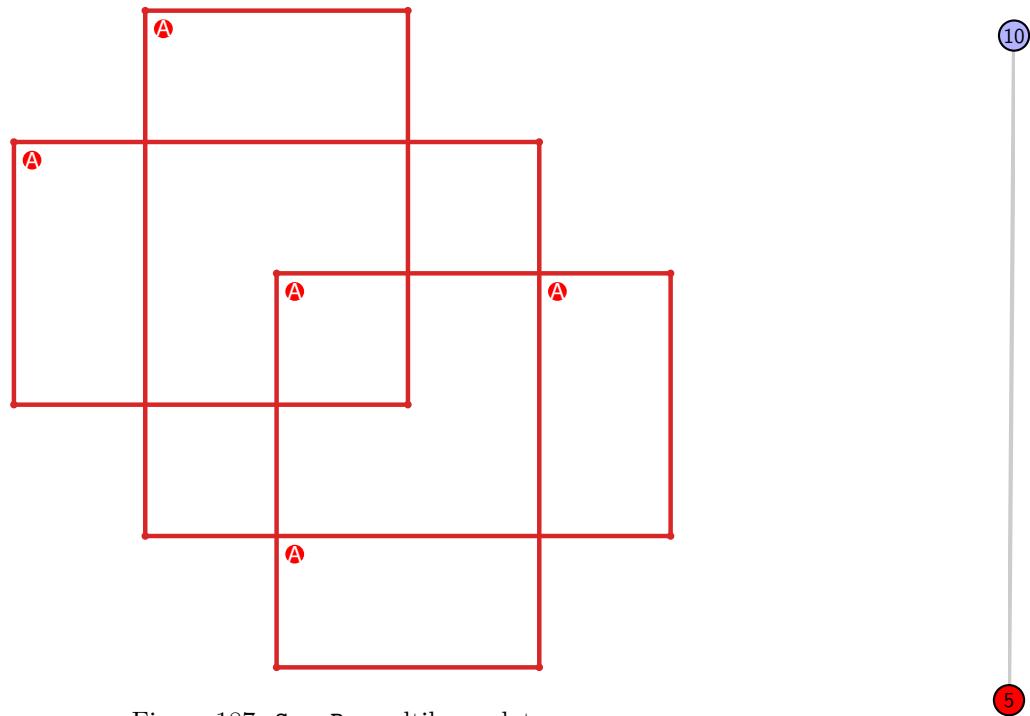


Figure 187: `SnapPy` multiloop plot.

Figure 188: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.57 $[[4, 10, 1, 5], [5, 11, 6, 16], [3, 15, 4, 16], [9, 14, 10, 15], [1, 12, 2, 11], [6, 2, 7, 3], [13, 8, 14, 9], [12, 8, 13, 7]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (6, 13, 7, 14), (14, 7, 15, 8), (2, 9, 3, 10), (8, 15, 9, 16), (1, 16, 2, 11), (11, 10, 12, 5), (12, 3, 13, 4)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 5, 1], [1, 4, 7, 2], [3, 7, 7, 3], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 4

Average minimal degree: 2.62

Total pinning sets: 84

Average overall degree: 2.98

Pinning number: 4

Table 93: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	3	0	0	0	0	3
Nonminimal pinning sets	0	6	15	28	22	8	1	80
Average degree	2.5	2.73	2.85	2.98	3.09	3.17	3.2	

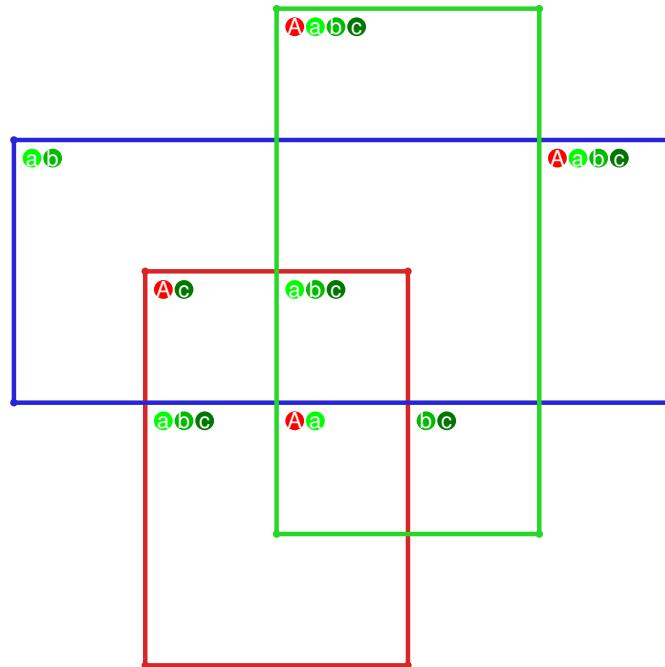


Figure 189: SnapPy multiloop plot.

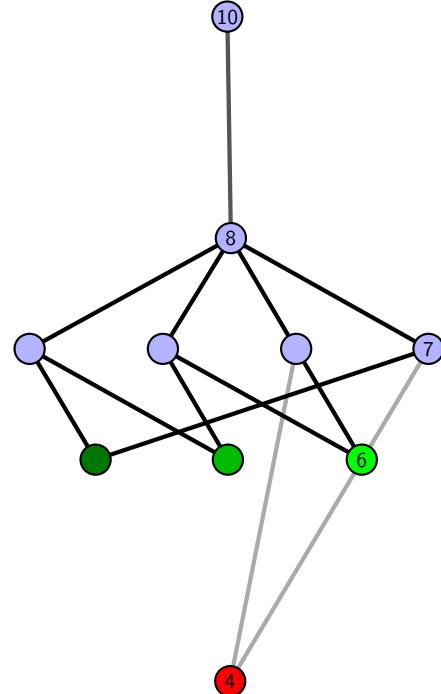


Figure 190: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.58 [[4, 16, 1, 5], [5, 12, 6, 13], [13, 3, 14, 4], [15, 8, 16, 9], [1, 11, 2, 12], [6, 2, 7, 3], [14, 10, 15, 9], [10, 7, 11, 8]]

PD code drawn by SnapPy: [(5, 4, 6, 1), (12, 1, 13, 2), (14, 7, 15, 8), (8, 13, 9, 14), (3, 10, 4, 11), (16, 11, 5, 12), (2, 15, 3, 16), (9, 6, 10, 7)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 5, 1], [1, 4, 7, 2], [2, 7, 3, 3], [3, 6, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.75

Total minimal pinning sets: 11

Average minimal degree: 2.98

Total pinning sets: 155

Average overall degree: 3.08

Pinning number: 4

Table 94: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	9	1	0	0	0	0	10
Nonminimal pinning sets	0	6	44	53	31	9	1	144
Average degree	2.75	2.96	3.04	3.11	3.15	3.19	3.2	

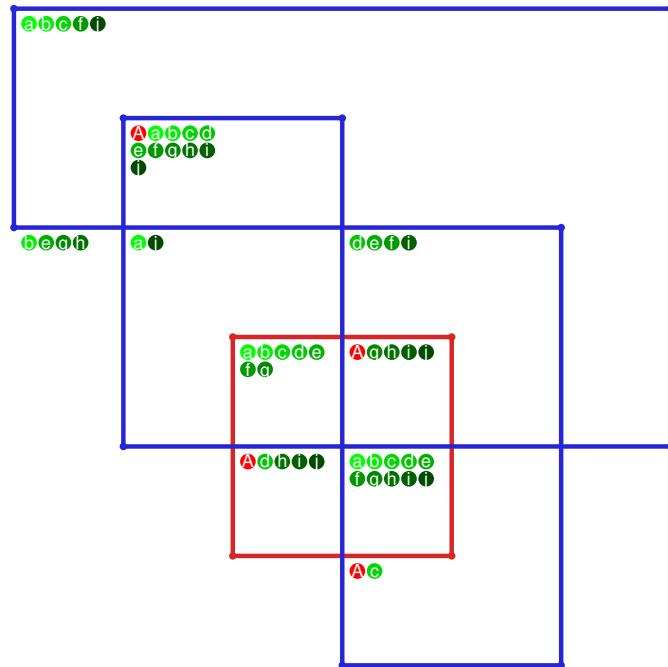


Figure 191: SnapPy multiloop plot.

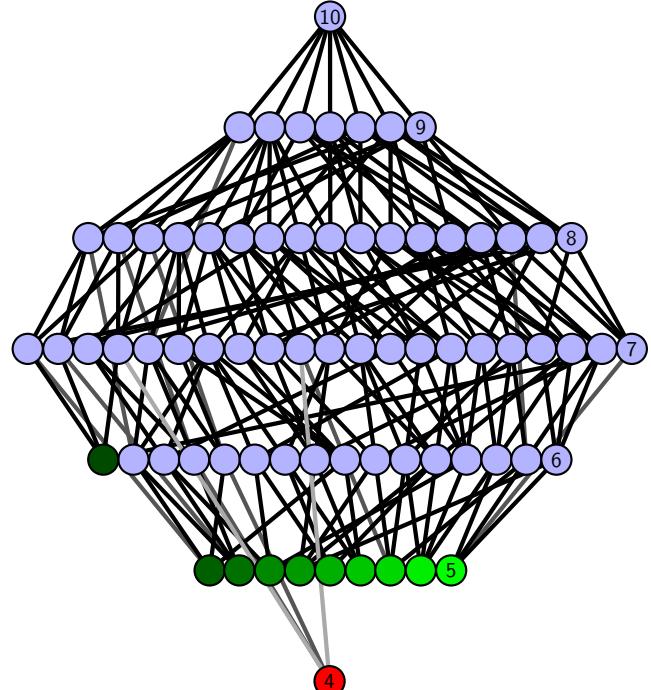


Figure 192: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.59 $[[16, 9, 1, 10], [10, 6, 11, 5], [15, 4, 16, 5], [8, 13, 9, 14], [1, 7, 2, 6], [11, 2, 12, 3], [3, 14, 4, 15], [12, 7, 13, 8]]$

PD code drawn by `SnapPy`: $[(9, 16, 10, 1), (13, 2, 14, 3), (3, 8, 4, 9), (4, 15, 5, 16), (10, 5, 11, 6), (14, 7, 15, 8), (6, 11, 7, 12), (1, 12, 2, 13)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 6, 6], [0, 6, 7, 7], [0, 7, 5, 1], [1, 4, 7, 6], [2, 5, 3, 2], [3, 5, 4, 3]]$

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 4

Average minimal degree: 2.65

Total pinning sets: 124

Average overall degree: 2.98

Pinning number: 4

Table 95: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	12	34	40	25	8	1	120
Average degree	2.5	2.74	2.91	3.03	3.11	3.17	3.2	

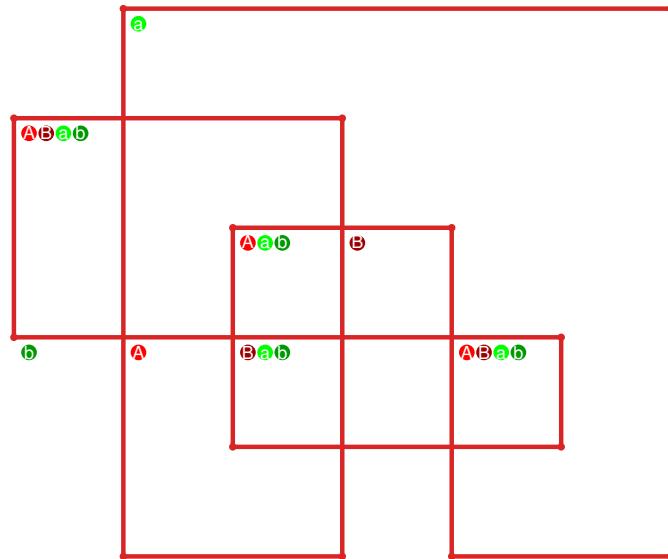


Figure 193: `SnapPy` multiloop plot.

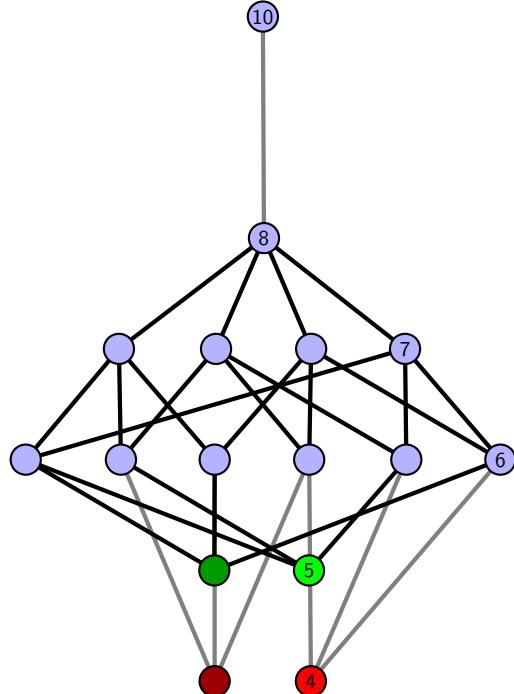


Figure 194: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.60 $[[16, 5, 1, 6], [6, 12, 7, 11], [4, 15, 5, 16], [1, 13, 2, 12], [7, 2, 8, 3], [3, 10, 4, 11], [14, 9, 15, 10], [13, 9, 14, 8]]$

PD code drawn by `SnapPy`: $[(5, 16, 6, 1), (14, 3, 15, 4), (6, 11, 7, 12), (12, 7, 13, 8), (1, 8, 2, 9), (9, 4, 10, 5), (10, 15, 11, 16), (2, 13, 3, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 7, 4, 1], [1, 3, 7, 5], [1, 4, 6, 2], [2, 5, 7, 7], [3, 6, 6, 4]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 5
Total pinning sets: 114
Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.74
Average overall degree: 3.0

Table 96: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	6	30	39	25	8	1	109
Average degree	2.5	2.76	2.91	3.03	3.11	3.17	3.2	

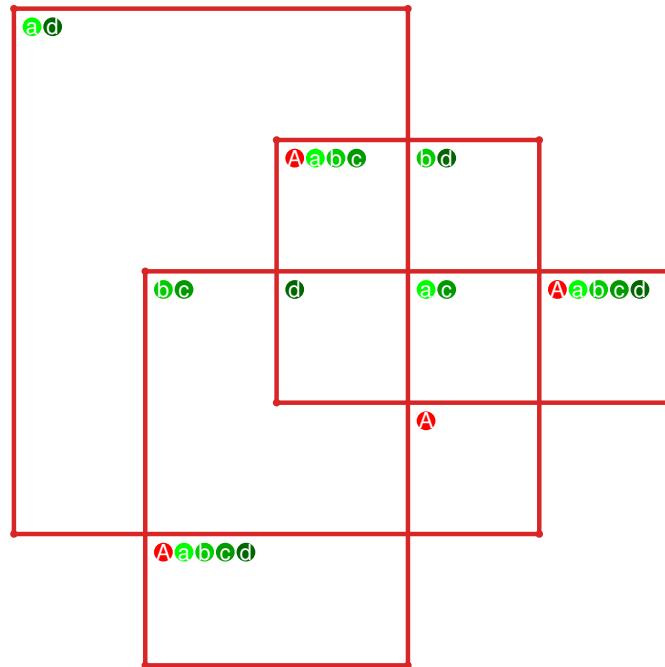


Figure 195: `SnapPy` multiloop plot.

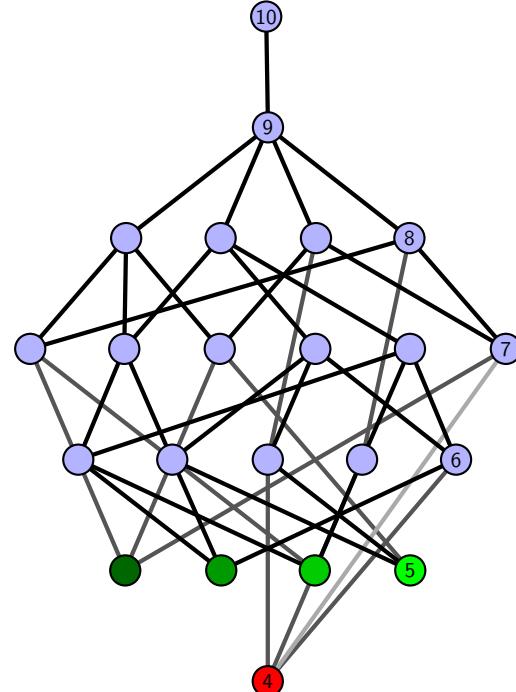


Figure 196: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.61 $[[4, 16, 1, 5], [5, 13, 6, 12], [7, 3, 8, 4], [8, 15, 9, 16], [1, 14, 2, 13], [6, 11, 7, 12], [2, 10, 3, 11], [14, 9, 15, 10]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (9, 16, 10, 5), (4, 5, 1, 6), (13, 6, 14, 7), (7, 12, 8, 13), (8, 3, 9, 4), (15, 10, 16, 11), (2, 11, 3, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 7, 6, 1], [1, 6, 2, 1], [2, 5, 4, 7], [3, 6, 4, 3]]$

Total optimal pinning sets: 16
 Total minimal pinning sets: 17
 Total pinning sets: 153
 Pinning number: 5

Average optimal degree: 2.8
 Average minimal degree: 2.83
 Average overall degree: 3.03

Table 97: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	Total
Optimal pinning sets	16	0	0	0	0	0	16
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	47	52	28	8	1	136
Average degree	2.8	2.97	3.07	3.12	3.17	3.2	

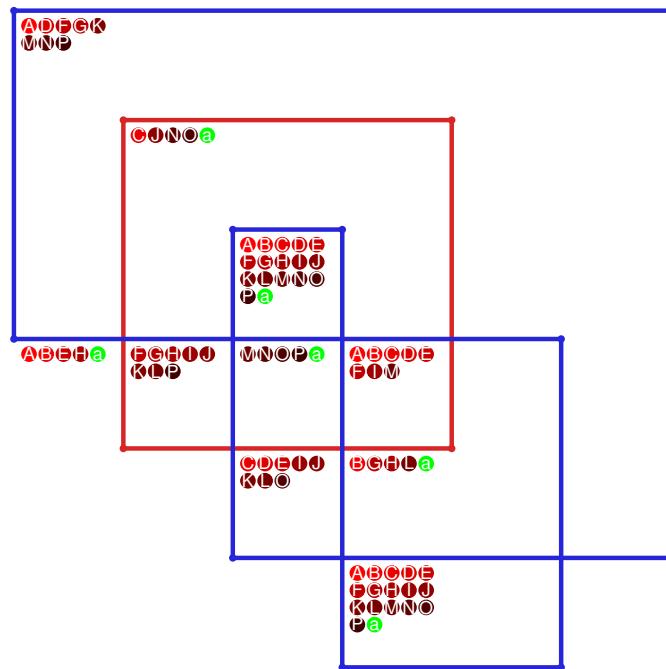


Figure 197: SnapPy multiloop plot.

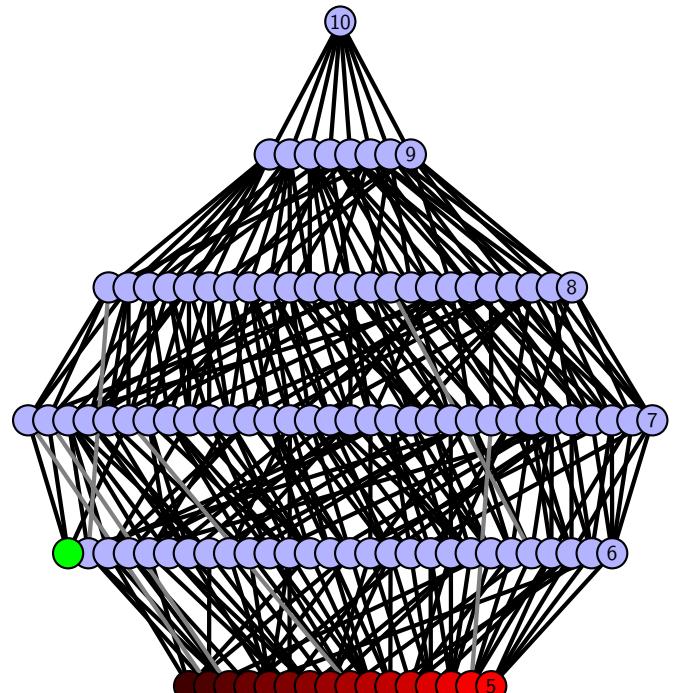


Figure 198: Minimal join sub-semi-lattice of minimal pinning sets.

4.7.62 $[[4, 10, 1, 5], [5, 11, 6, 16], [3, 15, 4, 16], [9, 14, 10, 15], [1, 8, 2, 7], [11, 7, 12, 6], [12, 2, 13, 3], [13, 8, 14, 9]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (13, 10, 14, 5), (14, 3, 15, 4), (6, 15, 7, 16), (2, 11, 3, 12), (16, 7, 11, 8), (1, 8, 2, 9), (9, 12, 10, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 7, 7], [0, 7, 6, 5], [1, 4, 6, 1], [2, 5, 4, 7], [3, 6, 4, 3]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 4
Total pinning sets: 120
Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.75
Average overall degree: 2.99

Table 98: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	2	0	0	0	0	2
Nonminimal pinning sets	0	12	29	40	26	8	1	116
Average degree	2.5	2.73	2.9	3.03	3.12	3.17	3.2	

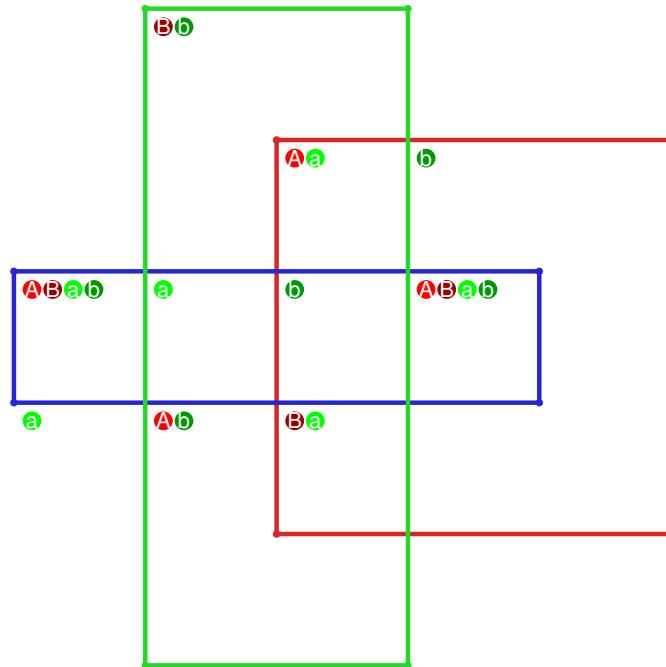


Figure 199: SnapPy multiloop plot.

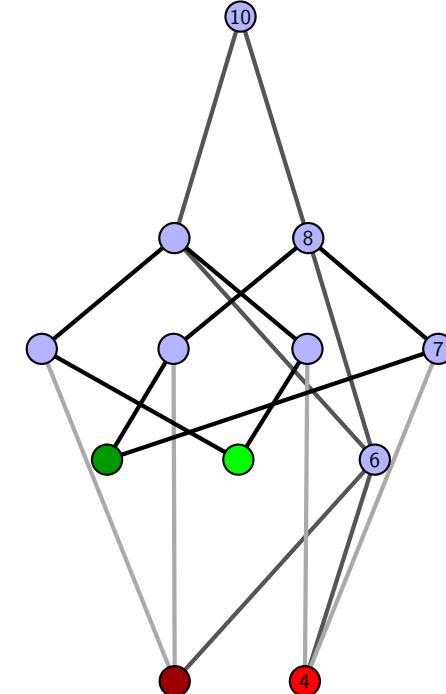


Figure 200: Minimal join sub-semi-lattice of minimal pinning sets.

4.8 11 regions

4.8.1 $[[9, 18, 10, 1], [17, 8, 18, 9], [10, 2, 11, 1], [7, 16, 8, 17], [2, 12, 3, 11], [15, 6, 16, 7], [12, 4, 13, 3], [5, 14, 6, 15], [4, 14, 5, 13]]$

PD code drawn by `SnapPy`: $[(1, 10, 2, 11), (13, 4, 14, 5), (15, 6, 16, 7), (9, 18, 10, 1), (11, 2, 12, 3), (3, 12, 4, 13), (5, 14, 6, 15), (7, 16, 8, 17), (17, 8, 18, 9)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 6, 2], [3, 7, 7, 3], [4, 8, 8, 4], [5, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.67

Pinning number: 9

Table 99: Pinning sets/average degree by cardinal

Cardinal	9	10	11	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.7	3.27	

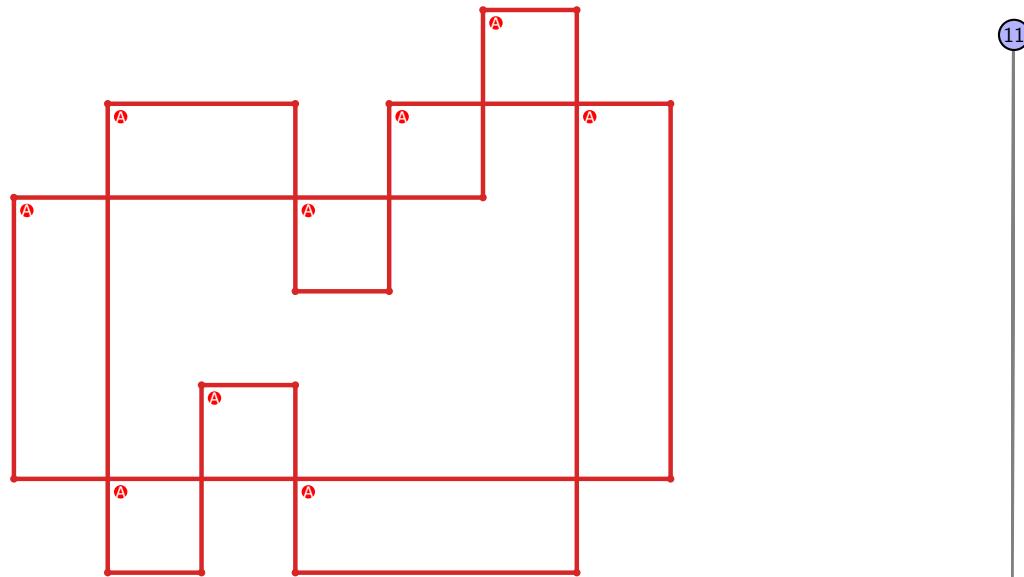


Figure 201: `SnapPy` multiloop plot.

Figure 202: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.2 [[9, 18, 10, 1], [17, 8, 18, 9], [10, 8, 11, 7], [1, 16, 2, 17], [11, 6, 12, 7], [15, 2, 16, 3], [5, 12, 6, 13], [3, 14, 4, 15], [13, 4, 14, 5]]

PD code drawn by `SnapPy`: [(13, 18, 14, 1), (11, 2, 12, 3), (9, 4, 10, 5), (5, 8, 6, 9), (15, 6, 16, 7), (3, 10, 4, 11), (1, 12, 2, 13), (17, 14, 18, 15), (7, 16, 8, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 5, 1], [2, 6, 6, 2], [3, 7, 7, 3], [4, 8, 8, 4], [5, 8, 8, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.74

Pinning number: 7

Table 100: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.44	2.78	3.05	3.27	

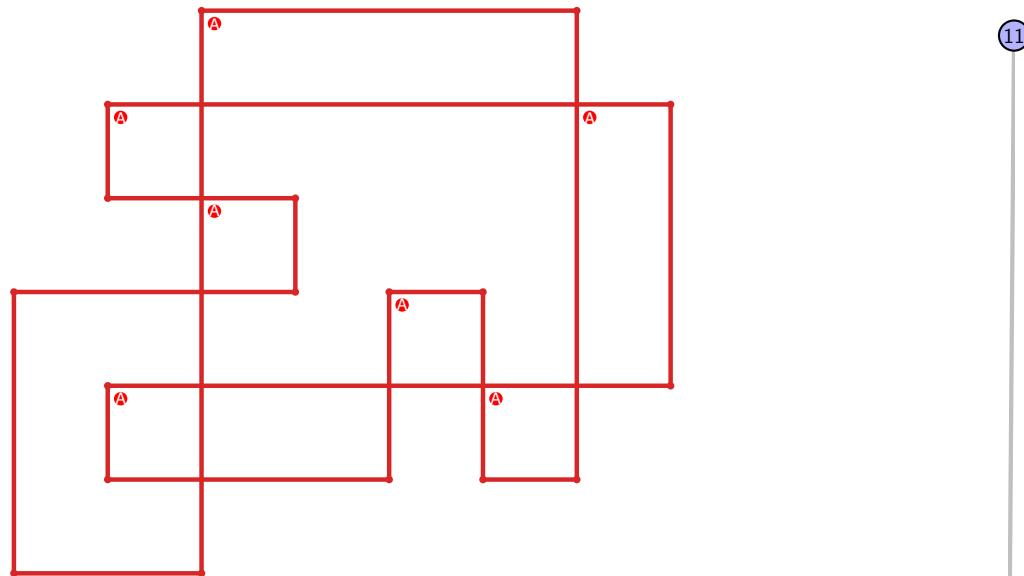


Figure 203: `SnapPy` multiloop plot.

7

Figure 204: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.3 $[[9, 18, 10, 1], [17, 8, 18, 9], [10, 2, 11, 1], [7, 16, 8, 17], [2, 12, 3, 11], [13, 6, 14, 7], [15, 4, 16, 5], [12, 4, 13, 3], [5, 14, 6, 15]]$

PD code drawn by SnapPy: $[(1, 10, 2, 11), (13, 2, 14, 3), (11, 4, 12, 5), (15, 6, 16, 7), (9, 18, 10, 1), (3, 12, 4, 13), (5, 14, 6, 15), (7, 16, 8, 17), (17, 8, 18, 9)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 7, 7, 2], [3, 7, 8, 8], [3, 8, 8, 7], [4, 6, 5, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 16
Pinning number: 7

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.74

Table 101: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.44	2.78	3.05	3.27	

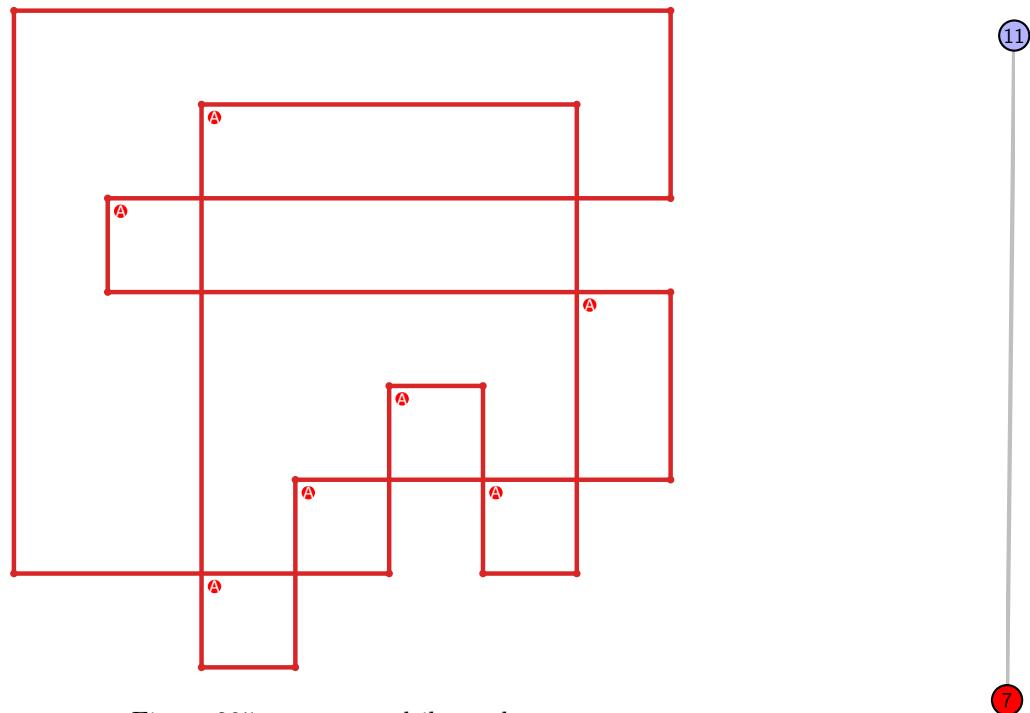


Figure 205: SnapPy multiloop plot.

Figure 206: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.4 $[[9, 18, 10, 1], [13, 8, 14, 9], [17, 4, 18, 5], [10, 2, 11, 1], [3, 12, 4, 13], [7, 14, 8, 15], [5, 16, 6, 17], [2, 12, 3, 11], [15, 6, 16, 7]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (12, 3, 13, 4), (10, 5, 11, 6), (8, 17, 9, 18), (18, 9, 1, 10), (4, 11, 5, 12), (2, 13, 3, 14), (6, 15, 7, 16), (16, 7, 17, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 4], [0, 7, 7, 0], [1, 7, 7, 2], [1, 8, 8, 1], [2, 8, 8, 2], [3, 4, 4, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.74

Pinning number: 7

Table 102: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.44	2.78	3.05	3.27	

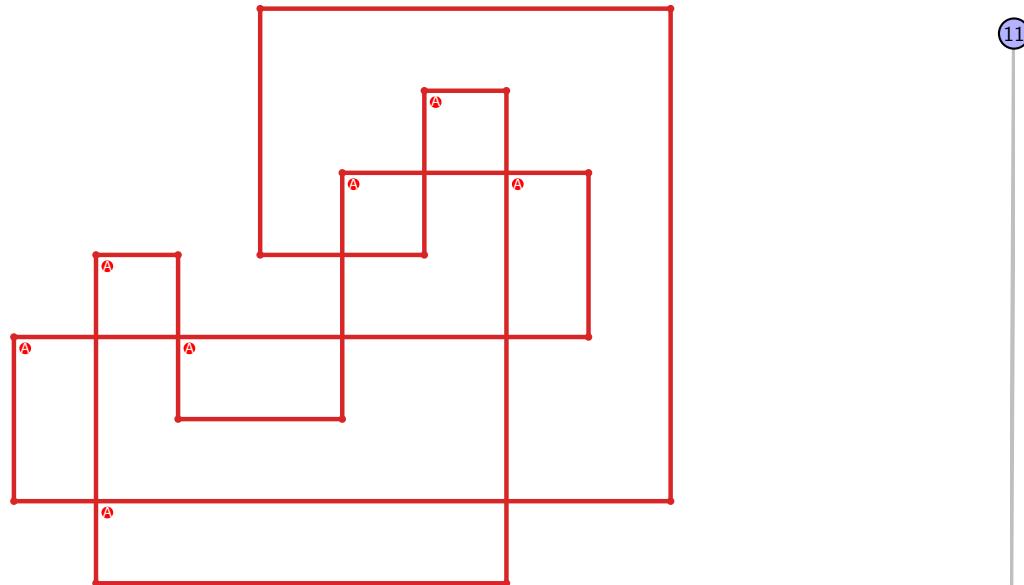


Figure 207: SnapPy multiloop plot.



Figure 208: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.5 $[[9, 18, 10, 1], [11, 8, 12, 9], [17, 2, 18, 3], [10, 2, 11, 1], [7, 16, 8, 17], [12, 4, 13, 3], [15, 6, 16, 7], [4, 14, 5, 13], [5, 14, 6, 15]]$

PD code drawn by `SnapPy`: $[(18, 9, 1, 10), (12, 3, 13, 4), (8, 5, 9, 6), (10, 1, 11, 2), (2, 11, 3, 12), (4, 13, 5, 14), (6, 15, 7, 16), (16, 7, 17, 8), (14, 17, 15, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 6], [1, 7, 7, 2], [4, 8, 8, 4], [5, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 103: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

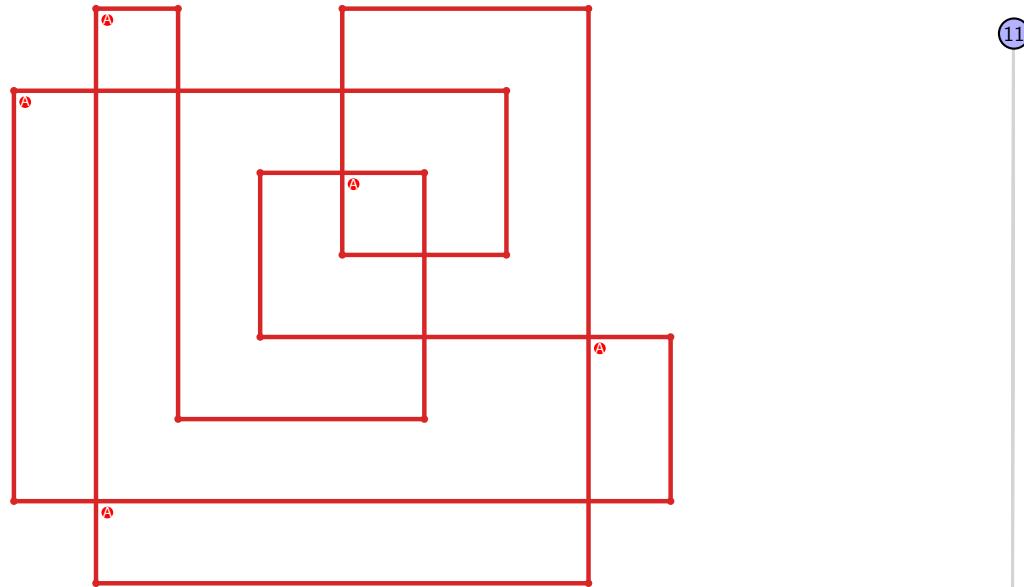


Figure 209: `SnapPy` multiloop plot.

Figure 210: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.6 [[10, 18, 1, 11], [11, 17, 12, 16], [9, 2, 10, 3], [17, 1, 18, 2], [12, 4, 13, 5], [7, 15, 8, 16], [3, 8, 4, 9], [13, 6, 14, 5], [14, 6, 15, 7]]

PD code drawn by `SnapPy`: [(7, 10, 8, 1), (11, 2, 12, 3), (3, 12, 4, 13), (13, 4, 14, 5), (1, 6, 2, 7), (16, 9, 17, 10), (5, 14, 6, 15), (15, 18, 16, 11), (8, 17, 9, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 3], [0, 2, 1, 0], [1, 6, 7, 7], [1, 8, 8, 6], [2, 5, 4, 2], [4, 8, 8, 4], [5, 7, 7, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 104: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

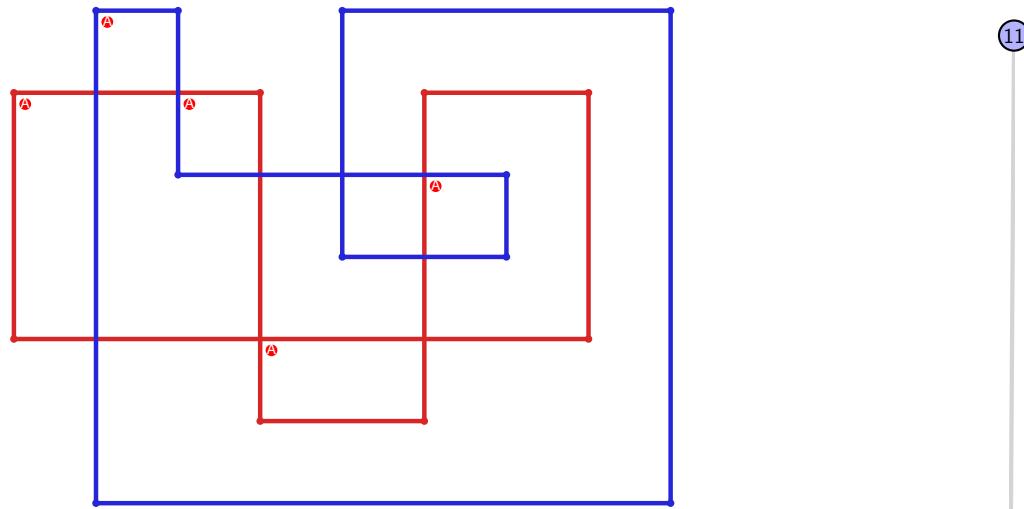


Figure 211: `SnapPy` multiloop plot.



Figure 212: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.7 $[[9, 18, 10, 1], [11, 8, 12, 9], [17, 2, 18, 3], [10, 2, 11, 1], [7, 14, 8, 15], [12, 4, 13, 3], [5, 16, 6, 17], [15, 6, 16, 7], [13, 4, 14, 5]]$

PD code drawn by SnapPy: $[(15, 18, 16, 1), (1, 10, 2, 11), (11, 2, 12, 3), (13, 4, 14, 5), (9, 6, 10, 7), (5, 12, 6, 13), (3, 14, 4, 15), (7, 16, 8, 17), (17, 8, 18, 9)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 6, 3], [0, 2, 1, 0], [1, 7, 7, 8], [1, 8, 8, 2], [2, 8, 7, 7], [4, 6, 6, 4], [4, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 105: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

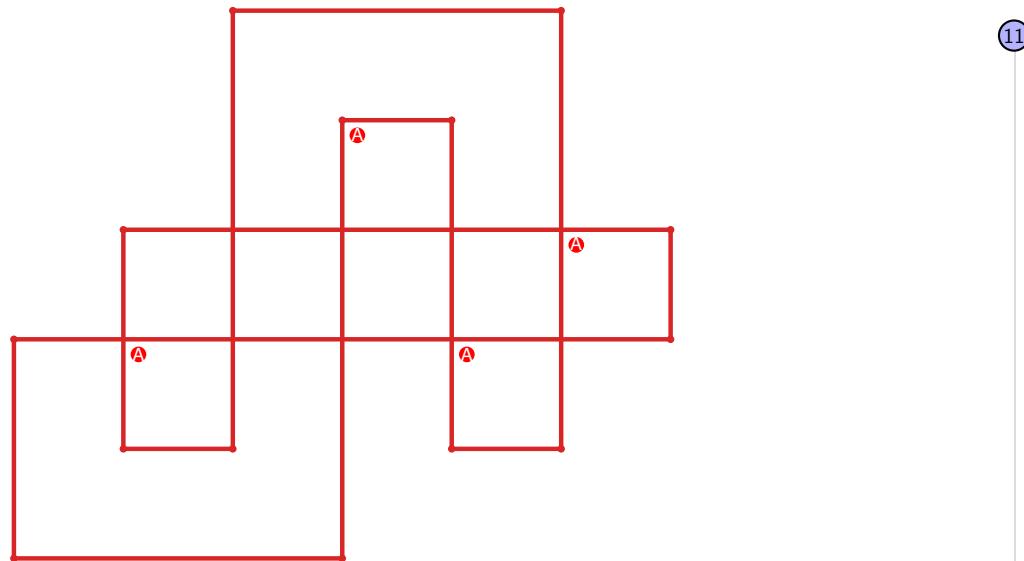


Figure 213: SnapPy multiloop plot.

4

Figure 214: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.8 [[14, 18, 1, 15], [15, 10, 16, 9], [13, 2, 14, 3], [17, 1, 18, 2], [10, 17, 11, 16], [8, 3, 9, 4], [5, 12, 6, 13], [11, 6, 12, 7], [4, 7, 5, 8]]

PD code drawn by `SnapPy`: [(7, 2, 8, 3), (14, 3, 1, 4), (5, 18, 6, 15), (1, 8, 2, 9), (16, 11, 17, 12), (9, 12, 10, 13), (4, 13, 5, 14), (15, 6, 16, 7), (10, 17, 11, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 4, 0], [1, 3, 7, 1], [1, 8, 8, 2], [2, 8, 7, 7], [4, 6, 6, 8], [5, 7, 6, 5]]

Total optimal pinning sets: 1
Total minimal pinning sets: 1
Total pinning sets: 128
Pinning number: 4

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.9

Table 106: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

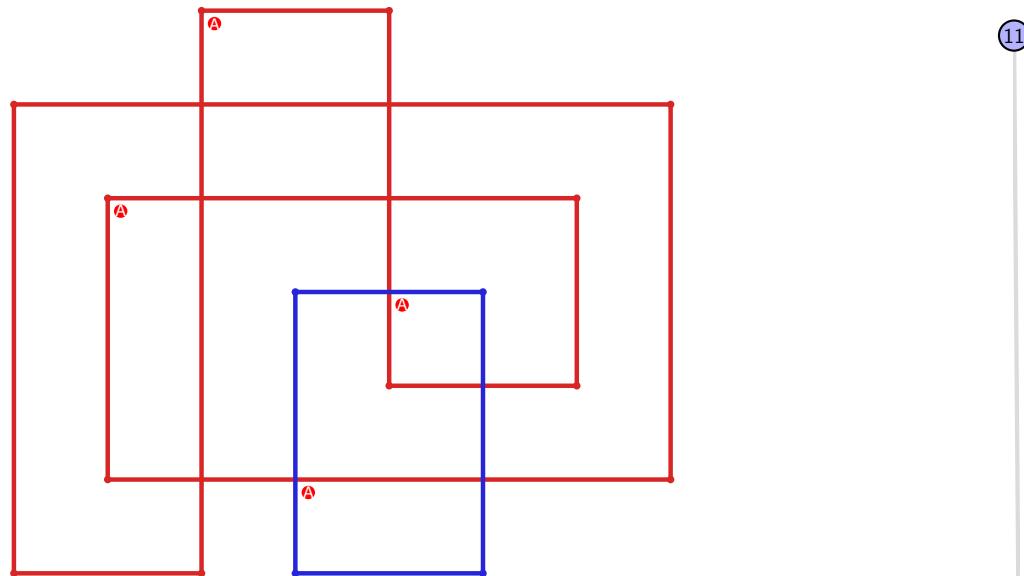


Figure 215: `SnapPy` multiloop plot.

4

Figure 216: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.9 $[[3, 12, 4, 1], [2, 7, 3, 8], [11, 18, 12, 13], [4, 15, 5, 16], [1, 9, 2, 8], [9, 6, 10, 7], [13, 10, 14, 11], [14, 17, 15, 18], [5, 17, 6, 16]]$

PD code drawn by `SnapPy`: $[(7, 4, 8, 5), (12, 5, 1, 6), (6, 11, 7, 12), (17, 8, 18, 9), (1, 10, 2, 11), (2, 13, 3, 14), (14, 3, 15, 4), (18, 15, 13, 16), (9, 16, 10, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 8], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 7, 2], [2, 6, 8, 3], [3, 7, 5, 3]]$

Total optimal pinning sets: 4

Average optimal degree: 2.38

Total minimal pinning sets: 4

Average minimal degree: 2.38

Total pinning sets: 240

Average overall degree: 2.98

Pinning number: 4

Table 107: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.38	2.67	2.87	3.0	3.09	3.17	3.23	3.27	

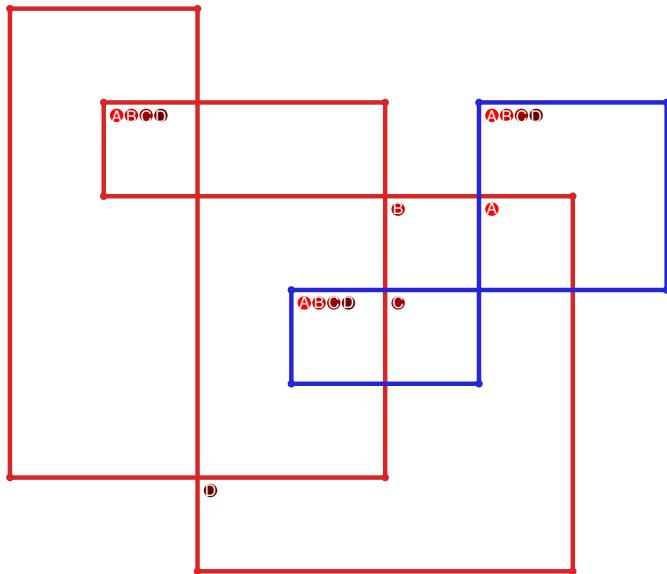


Figure 217: `SnapPy` multiloop plot.

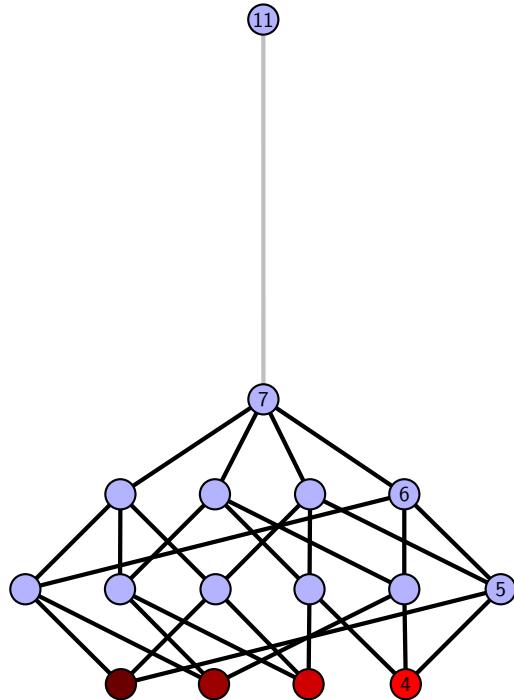


Figure 218: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.10 $[[3, 18, 4, 1], [9, 2, 10, 3], [17, 4, 18, 5], [1, 8, 2, 9], [10, 8, 11, 7], [5, 14, 6, 15], [16, 11, 17, 12], [13, 6, 14, 7], [15, 13, 16, 12]]$

PD code drawn by SnapPy: $[(7, 18, 8, 1), (15, 2, 16, 3), (11, 4, 12, 5), (5, 8, 6, 9), (17, 6, 18, 7), (14, 9, 15, 10), (10, 13, 11, 14), (3, 12, 4, 13), (1, 16, 2, 17)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 7, 7, 8], [2, 8, 8, 4], [4, 8, 5, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 108: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

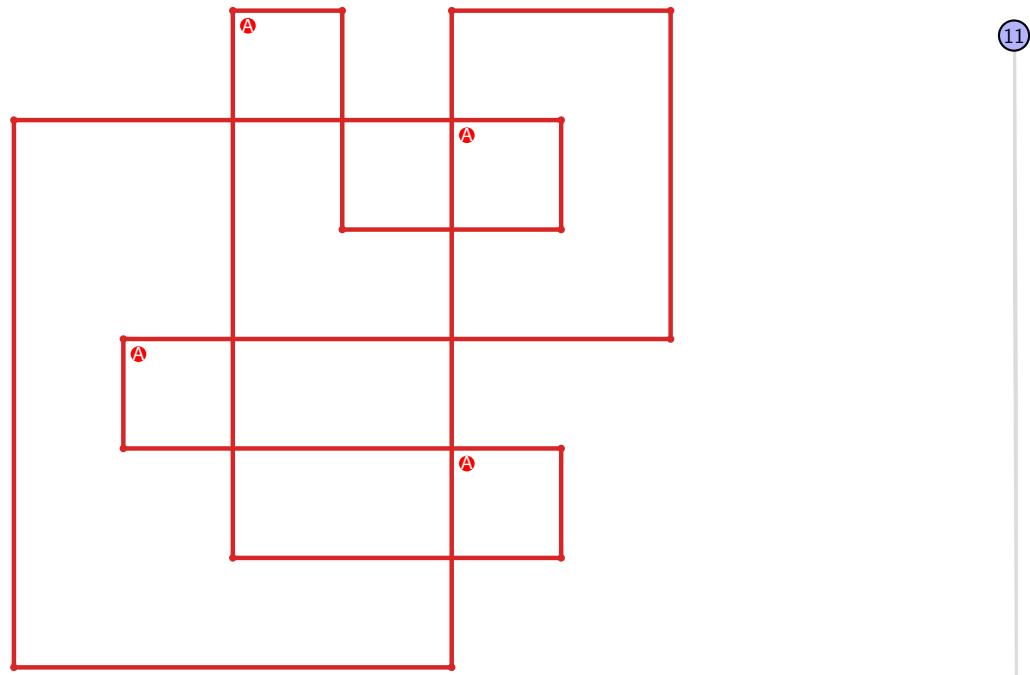


Figure 219: SnapPy multiloop plot.

Figure 220: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.11 $[[3, 18, 4, 1], [2, 13, 3, 14], [8, 17, 9, 18], [4, 11, 5, 12], [1, 15, 2, 14], [15, 12, 16, 13], [16, 7, 17, 8], [9, 7, 10, 6], [10, 5, 11, 6]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (3, 6, 4, 7), (13, 4, 14, 5), (1, 8, 2, 9), (12, 9, 13, 10), (17, 10, 18, 11), (11, 16, 12, 17), (5, 14, 6, 15), (18, 15, 1, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 8, 5], [0, 5, 1, 1], [1, 4, 3, 6], [2, 5, 7, 2], [2, 6, 8, 8], [3, 7, 7, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 109: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

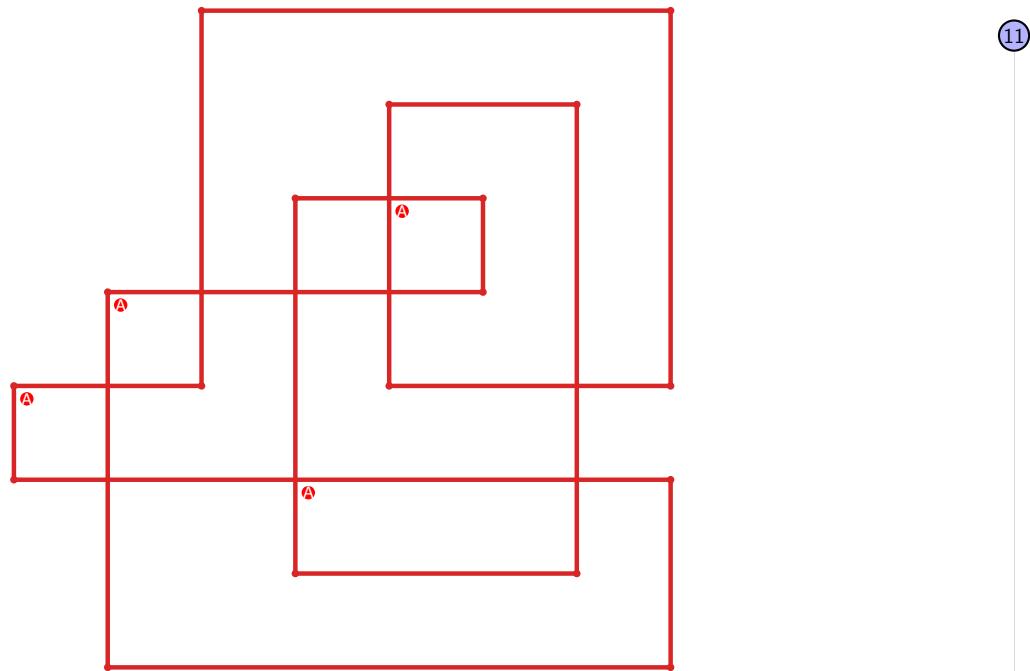


Figure 221: SnapPy multiloop plot.

Figure 222: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.12 $[[3, 18, 4, 1], [11, 2, 12, 3], [17, 6, 18, 7], [4, 16, 5, 15], [1, 10, 2, 11], [12, 10, 13, 9], [7, 14, 8, 15], [5, 16, 6, 17], [13, 8, 14, 9]]$

PD code drawn by SnapPy: $[(9, 18, 10, 1), (15, 4, 16, 5), (11, 6, 12, 7), (7, 10, 8, 11), (17, 8, 18, 9), (5, 12, 6, 13), (13, 2, 14, 3), (3, 14, 4, 15), (1, 16, 2, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 7, 6], [0, 5, 1, 1], [1, 4, 8, 8], [2, 8, 8, 3], [2, 3, 3, 2], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 110: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

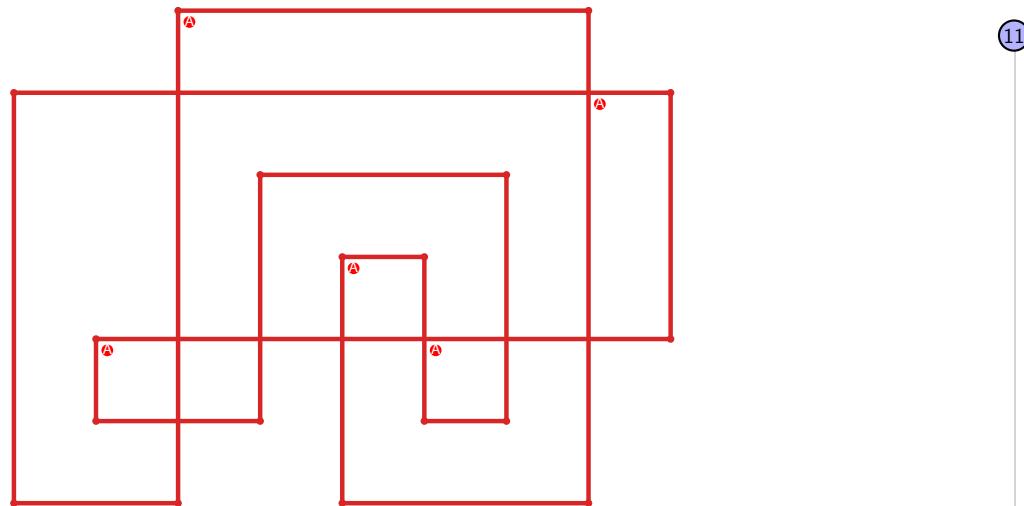


Figure 223: SnapPy multiloop plot.

5

Figure 224: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.13 [[3, 18, 4, 1], [11, 2, 12, 3], [17, 4, 18, 5], [1, 10, 2, 11], [12, 10, 13, 9], [5, 14, 6, 15], [7, 16, 8, 17], [13, 8, 14, 9], [6, 16, 7, 15]]

PD code drawn by SnapPy: [(9, 18, 10, 1), (15, 2, 16, 3), (11, 6, 12, 7), (7, 10, 8, 11), (17, 8, 18, 9), (3, 12, 4, 13), (13, 4, 14, 5), (5, 14, 6, 15), (1, 16, 2, 17)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 7, 8, 8], [2, 8, 8, 7], [4, 6, 5, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 111: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

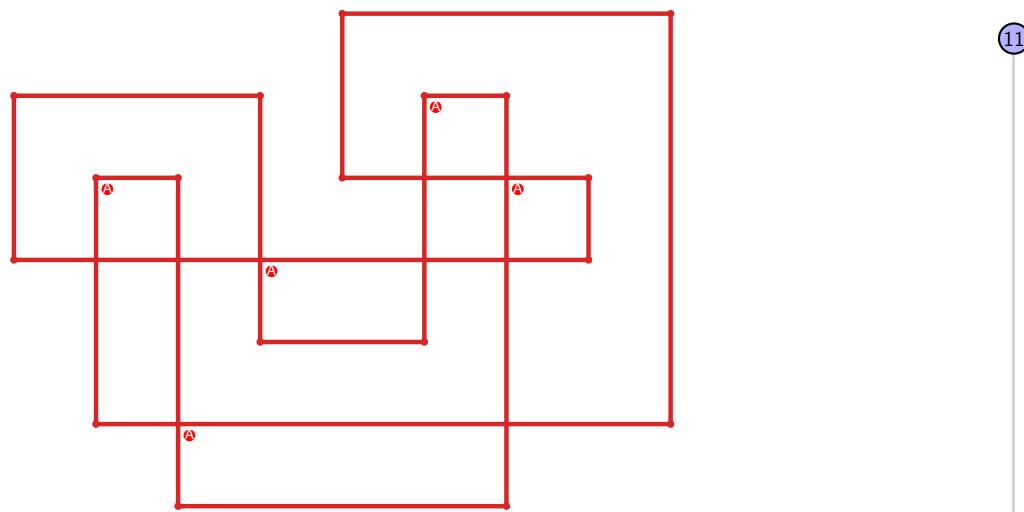


Figure 225: SnapPy multiloop plot.



Figure 226: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.14 $[[3, 18, 4, 1], [11, 2, 12, 3], [17, 8, 18, 9], [4, 14, 5, 13], [1, 10, 2, 11], [12, 10, 13, 9], [5, 16, 6, 17], [7, 14, 8, 15], [15, 6, 16, 7]]$

PD code drawn by SnapPy: $[(9, 18, 10, 1), (13, 4, 14, 5), (15, 6, 16, 7), (7, 10, 8, 11), (17, 8, 18, 9), (11, 2, 12, 3), (5, 12, 6, 13), (3, 14, 4, 15), (1, 16, 2, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 6, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 3, 8, 8], [2, 8, 8, 3], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 3

Table 112: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.44	2.7	2.87	3.0	3.09	3.17	3.22	3.27	

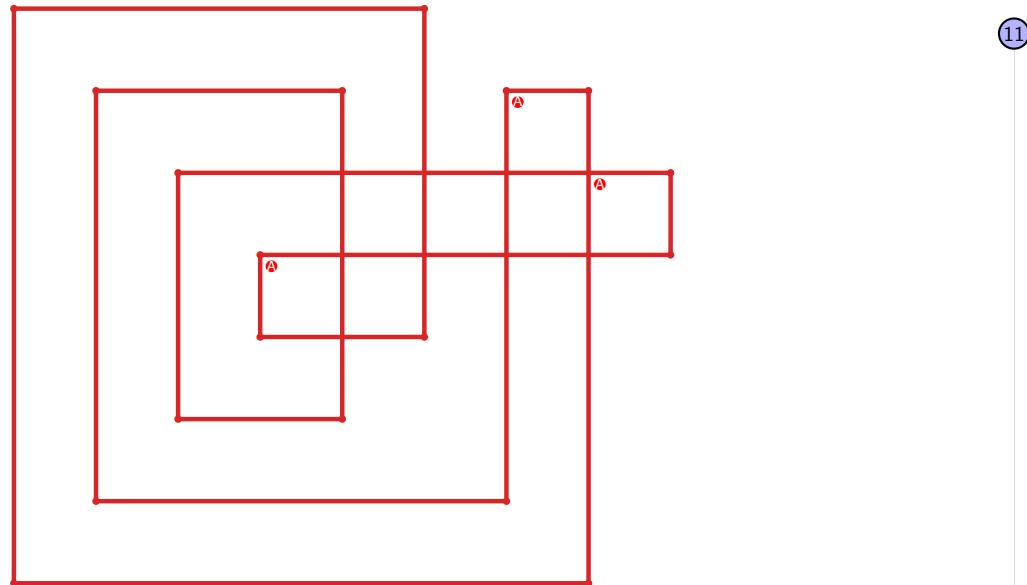


Figure 227: SnapPy multiloop plot.

3

Figure 228: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.15 $[[3, 8, 4, 1], [2, 18, 3, 9], [11, 7, 12, 8], [4, 16, 5, 17], [1, 10, 2, 9], [10, 17, 11, 18], [14, 6, 15, 7], [12, 15, 13, 16], [5, 13, 6, 14]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (12, 5, 13, 6), (1, 6, 2, 7), (3, 14, 4, 15), (13, 16, 14, 17), (2, 17, 3, 18), (11, 18, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 8, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 8, 8, 7], [2, 6, 8, 3], [3, 7, 6, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 6
 Total pinning sets: 292
 Pinning number: 4

Average optimal degree: 2.58
 Average minimal degree: 2.73
 Average overall degree: 3.06

Table 113: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	20	63	88	71	34	9	1	286
Average degree	2.58	2.81	2.96	3.07	3.15	3.2	3.24	3.27	

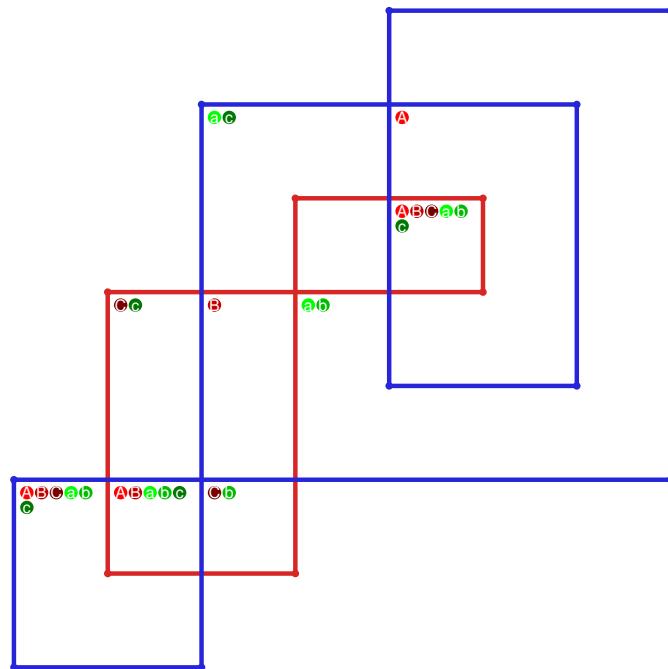


Figure 229: SnapPy multiloop plot.

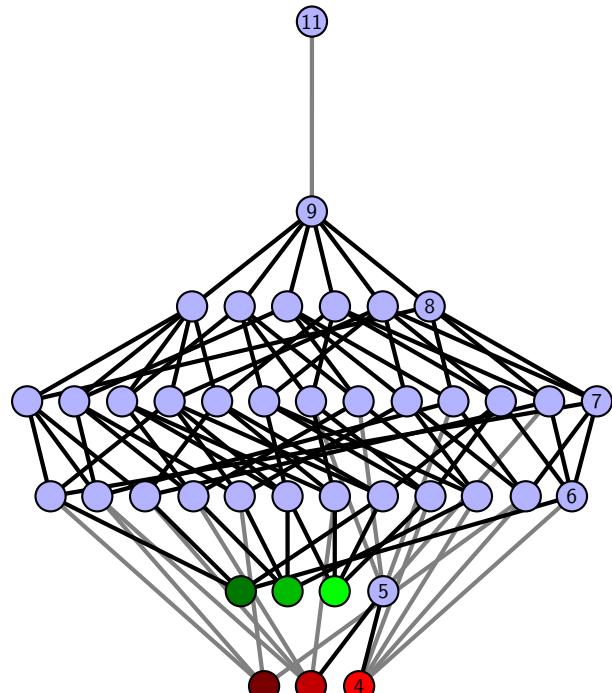


Figure 230: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.16 $[[3, 18, 4, 1], [2, 11, 3, 12], [14, 17, 15, 18], [4, 9, 5, 10], [1, 13, 2, 12], [13, 10, 14, 11], [16, 7, 17, 8], [15, 7, 16, 6], [8, 5, 9, 6]]$

PD code drawn by `SnapPy`: $[(6, 3, 7, 4), (4, 13, 5, 14), (14, 5, 15, 6), (2, 7, 3, 8), (11, 8, 12, 9), (18, 9, 1, 10), (10, 17, 11, 18), (12, 15, 13, 16), (1, 16, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 8, 8, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 8, 7, 7], [2, 6, 6, 8], [3, 7, 6, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 3

Table 114: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.44	2.7	2.88	3.0	3.09	3.17	3.23	3.27	

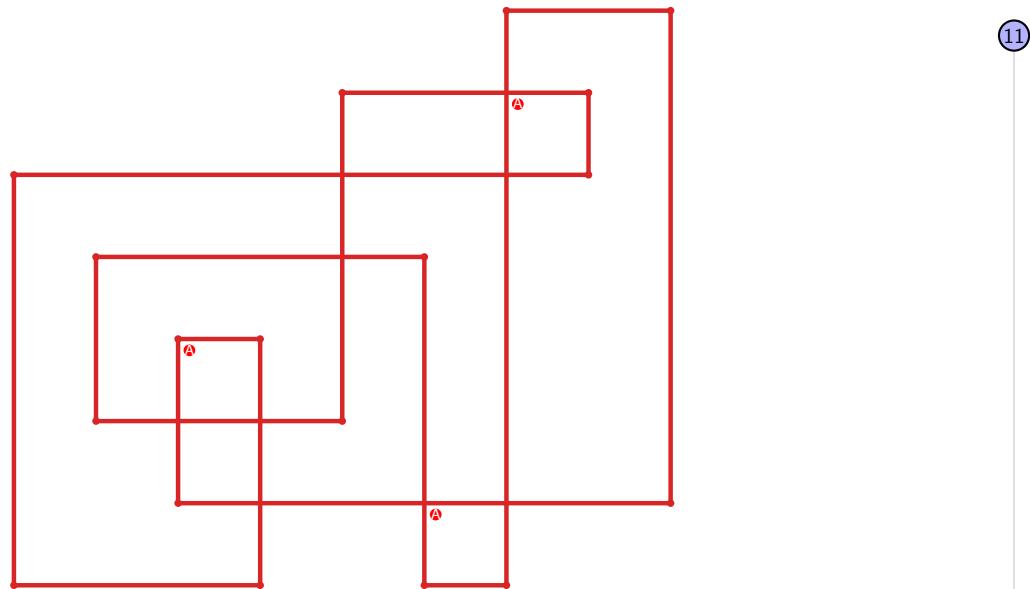


Figure 231: `SnapPy` multiloop plot.

Figure 232: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.17 $[[3, 14, 4, 1], [2, 9, 3, 10], [13, 18, 14, 15], [4, 7, 5, 8], [1, 11, 2, 10], [11, 8, 12, 9], [15, 12, 16, 13], [6, 17, 7, 18], [5, 17, 6, 16]]$

PD code drawn by SnapPy: $[(2, 5, 3, 6), (9, 6, 10, 7), (14, 7, 1, 8), (8, 13, 9, 14), (17, 10, 18, 11), (1, 12, 2, 13), (18, 3, 15, 4), (4, 15, 5, 16), (11, 16, 12, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 5], [0, 5, 1, 1], [1, 4, 3, 6], [2, 5, 8, 2], [2, 8, 8, 3], [3, 7, 7, 6]]$

Total optimal pinning sets: 5
Total minimal pinning sets: 6
Total pinning sets: 250
Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.48
Average overall degree: 2.98

Table 115: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	25	56	70	56	28	8	1	244
Average degree	2.5	2.71	2.88	3.0	3.09	3.17	3.23	3.27	

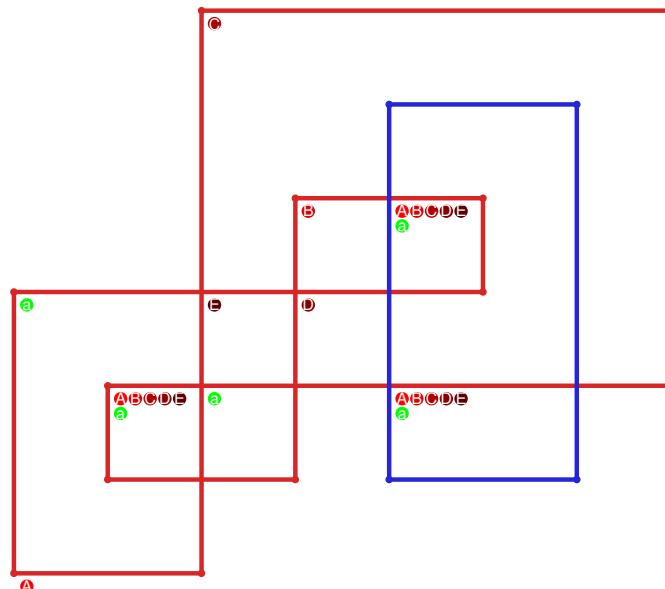


Figure 233: SnapPy multiloop plot.

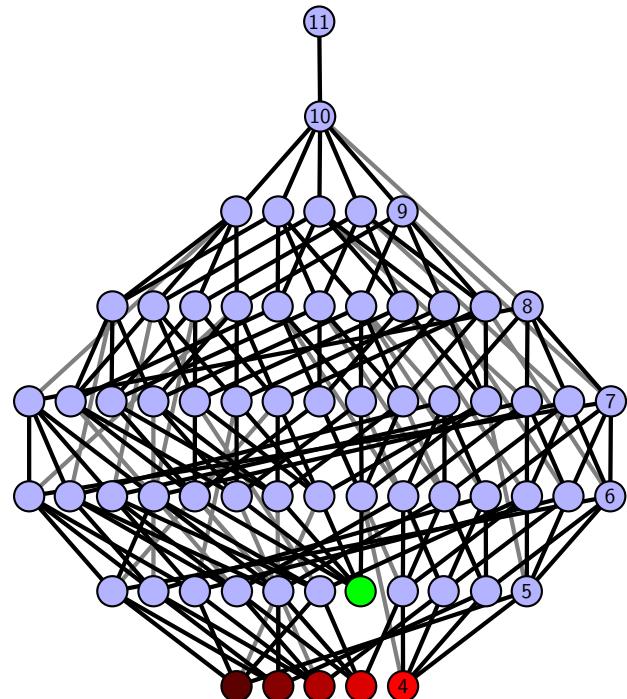


Figure 234: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.18 $[[5, 18, 6, 1], [13, 4, 14, 5], [17, 10, 18, 11], [6, 2, 7, 1], [3, 12, 4, 13], [14, 12, 15, 11], [9, 16, 10, 17], [2, 8, 3, 7], [15, 8, 16, 9]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (5, 18, 6, 1), (13, 6, 14, 7), (15, 8, 16, 9), (9, 12, 10, 13), (1, 10, 2, 11), (7, 14, 8, 15), (3, 16, 4, 17), (17, 4, 18, 5)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 6], [0, 7, 7, 0], [1, 7, 5, 1], [1, 4, 8, 2], [2, 8, 8, 2], [3, 8, 4, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 64
Pinning number: 5

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.84

Table 116: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

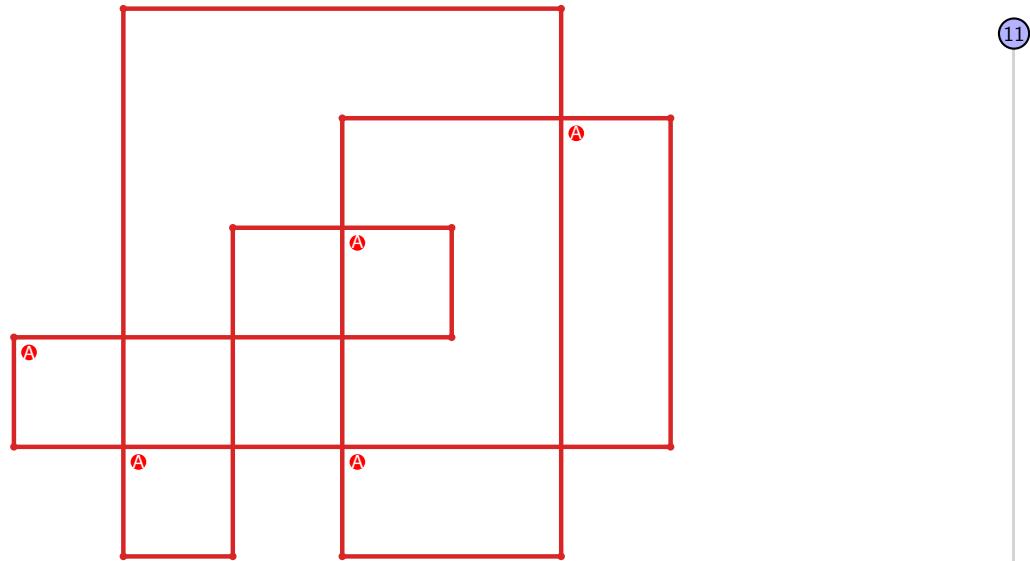


Figure 235: `SnapPy` multiloop plot.

11
5

Figure 236: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.19 $[[4, 10, 1, 5], [5, 3, 6, 4], [9, 18, 10, 11], [1, 15, 2, 16], [16, 2, 17, 3], [6, 14, 7, 13], [11, 8, 12, 9], [14, 17, 15, 18], [7, 12, 8, 13]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (14, 1, 15, 2), (8, 17, 9, 18), (2, 13, 3, 14), (10, 15, 11, 16), (3, 12, 4, 5), (11, 6, 12, 7), (18, 7, 13, 8), (16, 9, 17, 10)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 7, 4, 4], [1, 3, 3, 7], [1, 7, 8, 8], [2, 8, 8, 2], [2, 5, 4, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 117: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

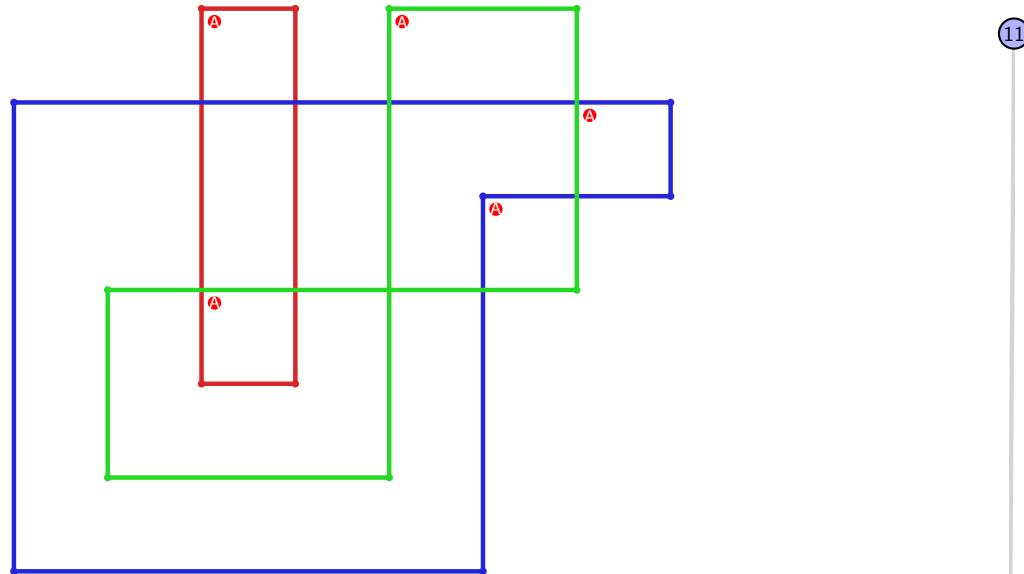


Figure 237: `SnapPy` multiloop plot.

11
5

Figure 238: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.20 $[[4, 18, 1, 5], [5, 3, 6, 4], [8, 17, 9, 18], [1, 11, 2, 12], [12, 2, 13, 3], [6, 15, 7, 16], [16, 7, 17, 8], [9, 15, 10, 14], [10, 13, 11, 14]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (12, 1, 13, 2), (9, 14, 10, 15), (3, 18, 4, 5), (17, 6, 18, 7), (7, 16, 8, 17), (13, 8, 14, 9), (15, 10, 16, 11), (2, 11, 3, 12)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 8, 4, 4], [1, 3, 3, 8], [1, 7, 6, 6], [2, 5, 5, 2], [2, 5, 8, 8], [3, 7, 7, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 118: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

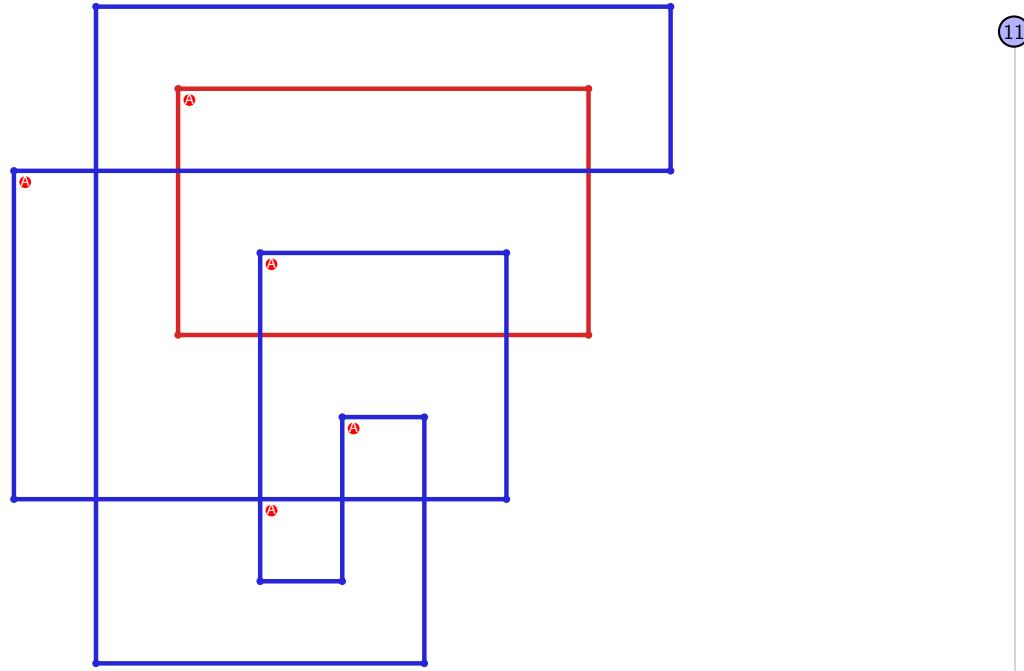


Figure 239: SnapPy multiloop plot.

Figure 240: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.21 $[[9, 18, 10, 1], [17, 8, 18, 9], [10, 2, 11, 1], [3, 16, 4, 17], [7, 12, 8, 13], [2, 12, 3, 11], [15, 6, 16, 7], [4, 14, 5, 13], [5, 14, 6, 15]]$

PD code drawn by `SnapPy`: $[(13, 4, 14, 5), (15, 6, 16, 7), (9, 18, 10, 1), (5, 10, 6, 11), (11, 2, 12, 3), (3, 12, 4, 13), (1, 14, 2, 15), (7, 16, 8, 17), (17, 8, 18, 9)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 5, 6, 7], [1, 7, 6, 5], [2, 4, 3, 2], [3, 4, 8, 8], [3, 8, 8, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 119: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

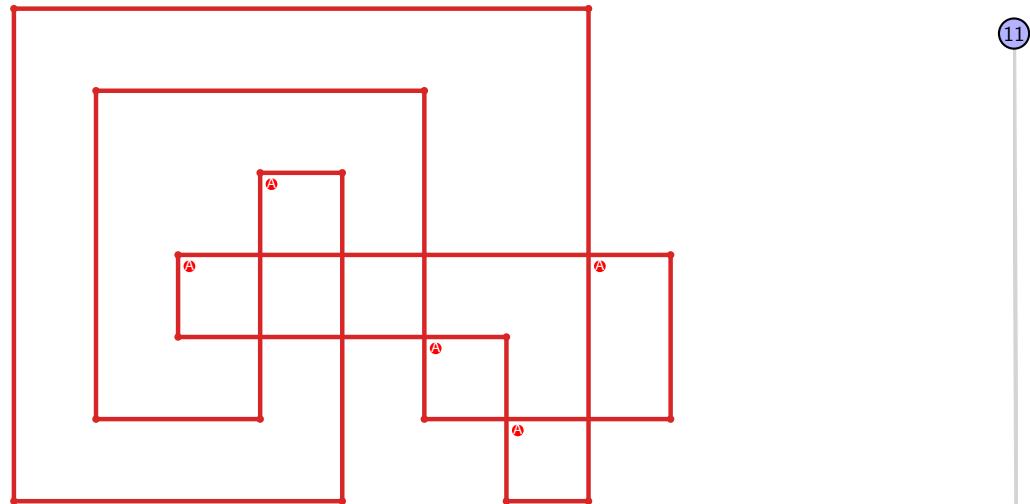


Figure 241: `SnapPy` multiloop plot.



Figure 242: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.22 [[18, 9, 1, 10], [10, 7, 11, 8], [8, 17, 9, 18], [1, 13, 2, 12], [6, 11, 7, 12], [16, 5, 17, 6], [13, 5, 14, 4], [2, 15, 3, 16], [14, 3, 15, 4]]

PD code drawn by SnapPy: [(18, 9, 1, 10), (12, 1, 13, 2), (6, 3, 7, 4), (14, 5, 15, 6), (2, 7, 3, 8), (8, 15, 9, 16), (16, 11, 17, 12), (4, 13, 5, 14), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 6, 7, 4], [1, 3, 5, 1], [2, 4, 7, 6], [3, 5, 8, 8], [3, 8, 8, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 120: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

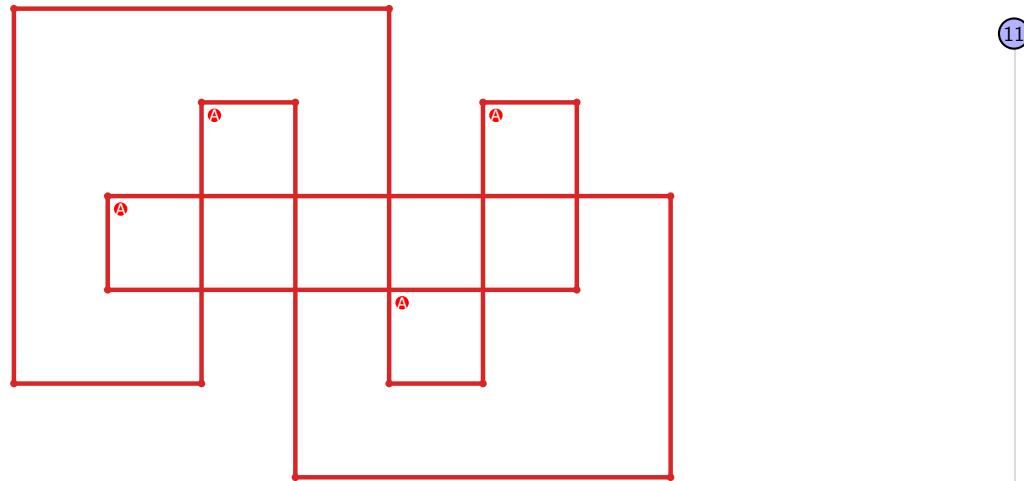


Figure 243: SnapPy multiloop plot.

4

Figure 244: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.23 `[[18, 7, 1, 8], [8, 17, 9, 18], [6, 15, 7, 16], [1, 11, 2, 10], [16, 9, 17, 10], [12, 5, 13, 6], [14, 3, 15, 4], [11, 3, 12, 2], [4, 13, 5, 14]]`

PD code drawn by `SnapPy`: `[(18, 9, 1, 10), (12, 1, 13, 2), (10, 3, 11, 4), (16, 5, 17, 6), (14, 7, 15, 8), (8, 17, 9, 18), (2, 11, 3, 12), (4, 13, 5, 14), (6, 15, 7, 16)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 6], [0, 7, 7, 4], [1, 3, 2, 1], [2, 7, 8, 8], [2, 8, 8, 7], [3, 6, 5, 3], [5, 6, 6, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 121: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

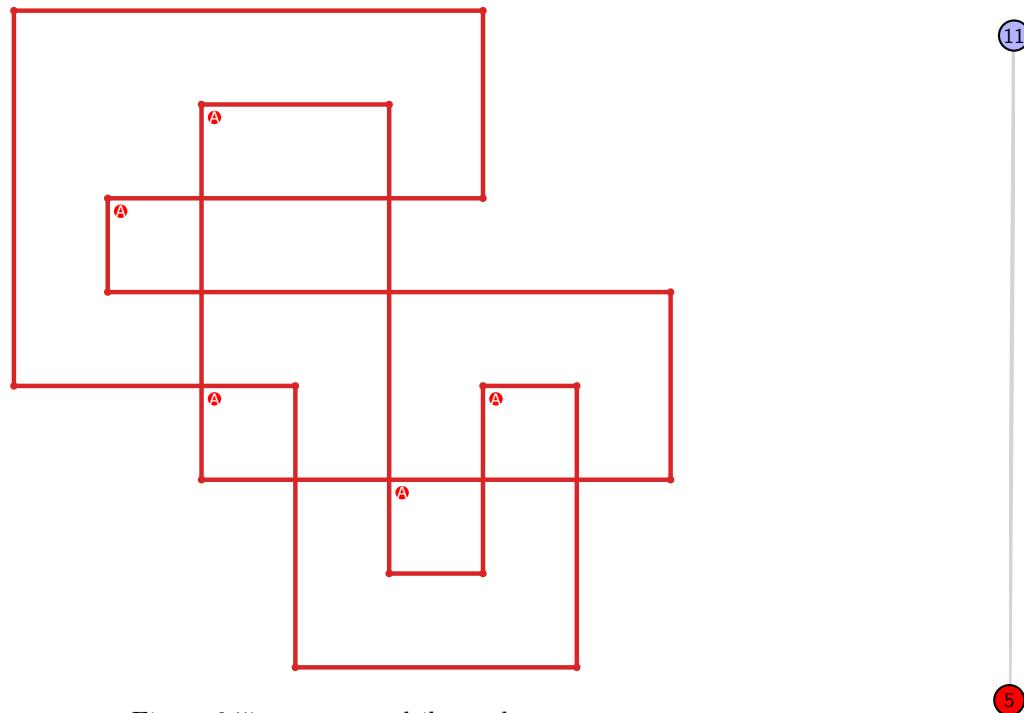


Figure 245: `SnapPy` multiloop plot.

Figure 246: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.24 $[[13, 18, 14, 1], [17, 12, 18, 13], [14, 6, 15, 5], [1, 10, 2, 11], [11, 16, 12, 17], [6, 16, 7, 15], [9, 4, 10, 5], [2, 8, 3, 7], [3, 8, 4, 9]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (2, 11, 3, 12), (4, 17, 5, 18), (18, 5, 1, 6), (16, 7, 17, 8), (14, 9, 15, 10), (12, 3, 13, 4), (8, 13, 9, 14), (10, 15, 11, 16)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 6], [0, 6, 7, 4], [1, 3, 5, 1], [2, 4, 7, 2], [2, 8, 8, 3], [3, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 122: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

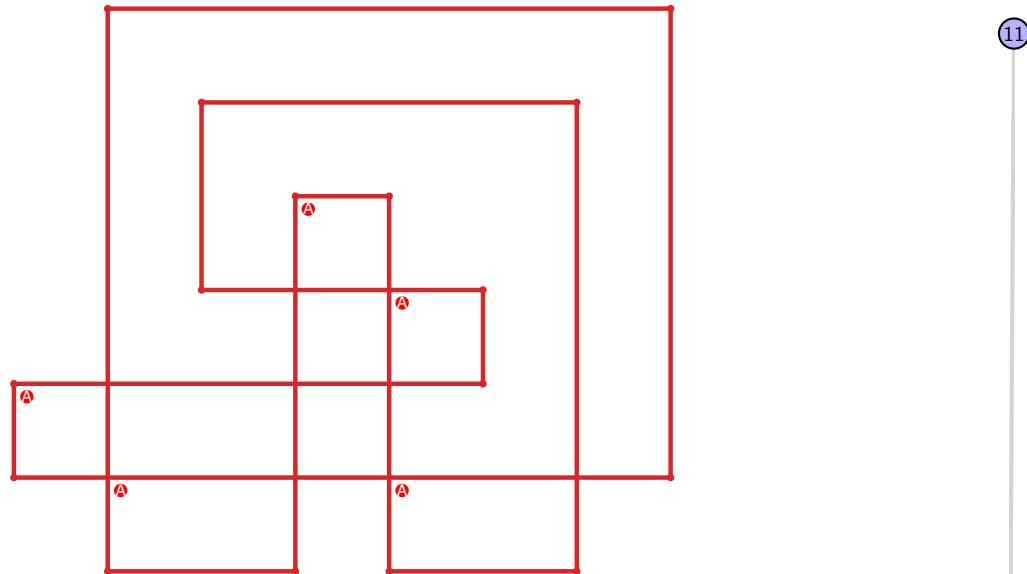


Figure 247: SnapPy multiloop plot.

11
5

Figure 248: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.25 $[[9, 18, 10, 1], [15, 8, 16, 9], [17, 6, 18, 7], [10, 6, 11, 5], [1, 14, 2, 15], [7, 16, 8, 17], [11, 2, 12, 3], [13, 4, 14, 5], [12, 4, 13, 3]]$

PD code drawn by SnapPy: $[(18, 9, 1, 10), (10, 1, 11, 2), (2, 7, 3, 8), (14, 3, 15, 4), (12, 5, 13, 6), (16, 11, 17, 12), (4, 13, 5, 14), (6, 15, 7, 16), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 5, 5, 3], [0, 2, 6, 7], [0, 7, 6, 1], [1, 2, 2, 1], [3, 4, 8, 8], [3, 8, 8, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4
Total pinning sets: 120
Pinning number: 5

Average optimal degree: 2.3
Average minimal degree: 2.3
Average overall degree: 2.91

Table 123: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	34	35	21	7	1	116
Average degree	2.3	2.63	2.85	3.0	3.11	3.2	3.27	

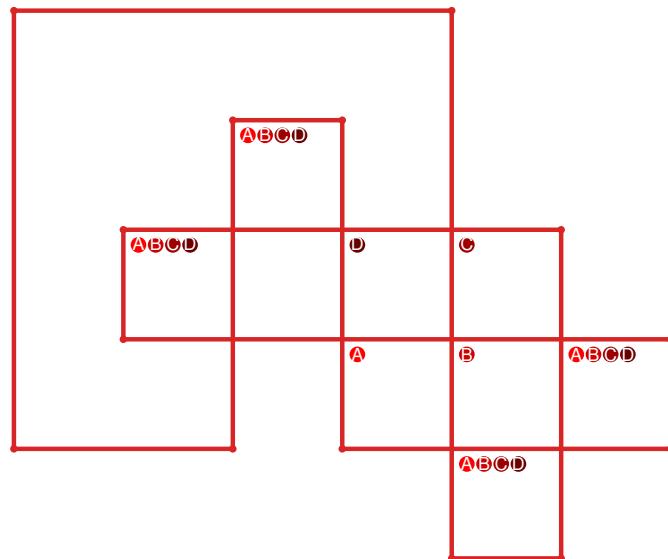


Figure 249: SnapPy multiloop plot.

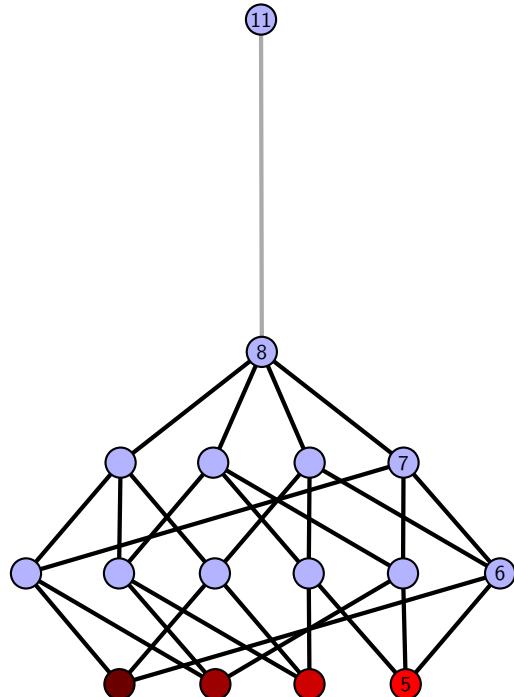


Figure 250: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.26 $[[18, 13, 1, 14], [14, 7, 15, 8], [12, 17, 13, 18], [1, 17, 2, 16], [6, 15, 7, 16], [8, 4, 9, 3], [11, 2, 12, 3], [5, 10, 6, 11], [4, 10, 5, 9]]$

PD code drawn by `SnapPy`: $[(10, 3, 11, 4), (5, 18, 6, 1), (1, 6, 2, 7), (14, 9, 15, 10), (2, 11, 3, 12), (12, 15, 13, 16), (8, 13, 9, 14), (7, 16, 8, 17), (17, 4, 18, 5)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 3, 0], [0, 2, 6, 4], [1, 3, 7, 1], [1, 8, 8, 6], [2, 5, 7, 3], [4, 6, 8, 8], [5, 7, 7, 5]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 96
Pinning number: 5

Average optimal degree: 2.2
Average minimal degree: 2.2
Average overall degree: 2.9

Table 124: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

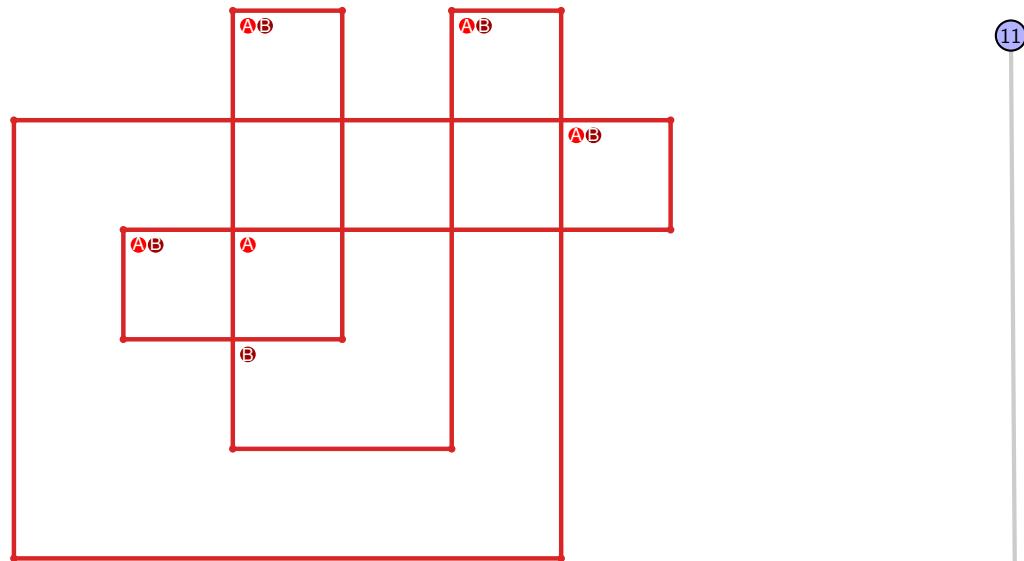


Figure 251: `SnapPy` multiloop plot.

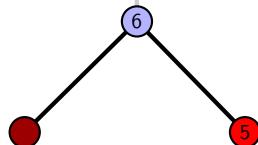


Figure 252: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.27 $[[13, 18, 14, 1], [12, 9, 13, 10], [4, 17, 5, 18], [14, 7, 15, 8], [1, 11, 2, 10], [2, 11, 3, 12], [3, 8, 4, 9], [16, 5, 17, 6], [6, 15, 7, 16]]$

PD code drawn by SnapPy: $[(11, 18, 12, 1), (9, 2, 10, 3), (16, 3, 17, 4), (7, 4, 8, 5), (5, 14, 6, 15), (15, 6, 16, 7), (1, 10, 2, 11), (17, 12, 18, 13), (8, 13, 9, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 8, 8, 6], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 3, 2], [2, 8, 8, 2], [3, 7, 7, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 5

Table 125: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.2	2.5	2.74	2.94	3.09	3.2	3.27	

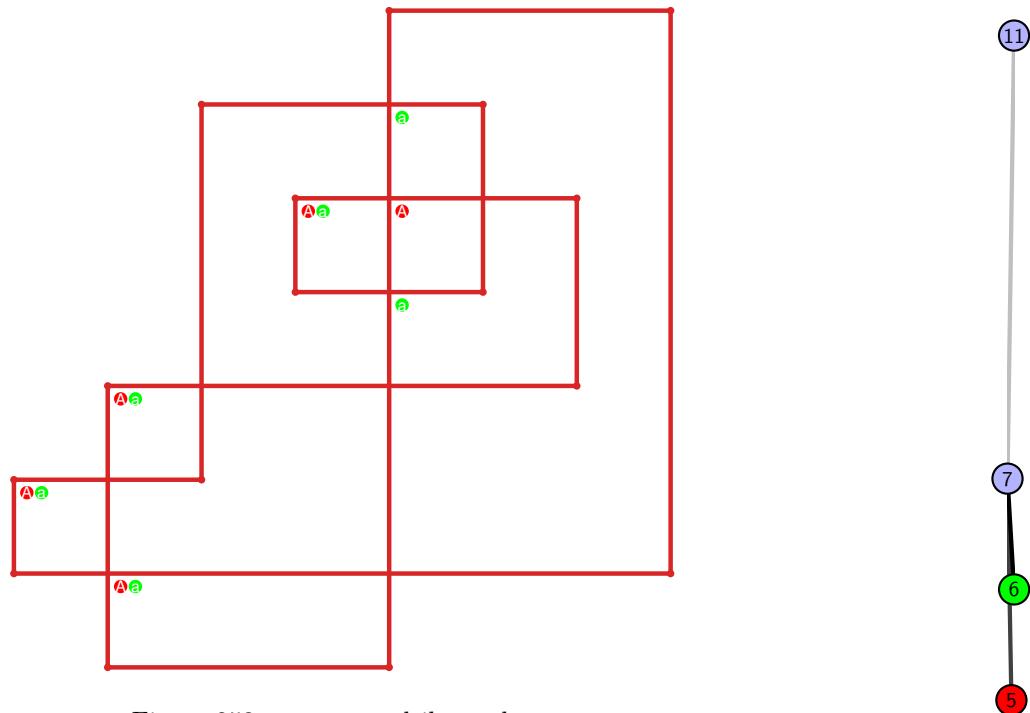


Figure 253: SnapPy multiloop plot.

Figure 254: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.28 $[[14, 7, 1, 8], [8, 15, 9, 18], [4, 13, 5, 14], [6, 11, 7, 12], [1, 16, 2, 15], [9, 17, 10, 18], [10, 3, 11, 4], [12, 5, 13, 6], [16, 3, 17, 2]]$

PD code drawn by `SnapPy`: $[(7, 14, 8, 1), (9, 2, 10, 3), (11, 4, 12, 5), (3, 8, 4, 9), (1, 10, 2, 11), (13, 18, 14, 15), (6, 15, 7, 16), (16, 5, 17, 6), (17, 12, 18, 13)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 7], [0, 7, 7, 6], [0, 8, 8, 1], [1, 8, 6, 1], [2, 5, 8, 3], [2, 3, 3, 2], [4, 6, 5, 4]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 112

Average overall degree: 2.91

Pinning number: 5

Table 126: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.27	2.6	2.83	2.99	3.11	3.2	3.27	

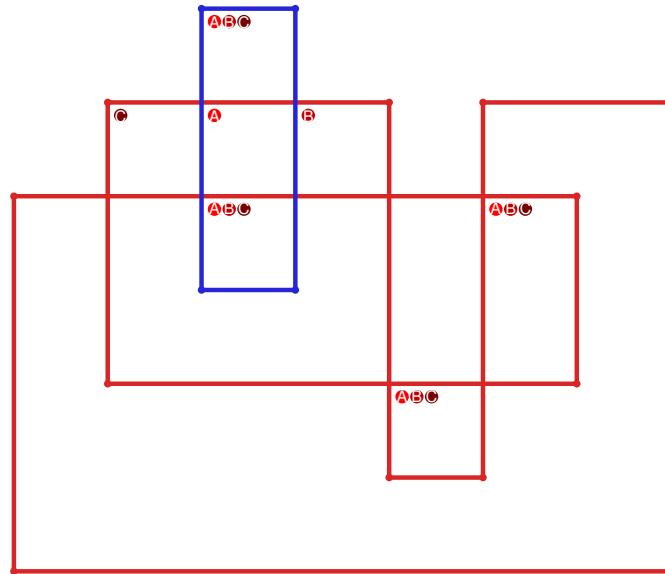


Figure 255: `SnapPy` multiloop plot.

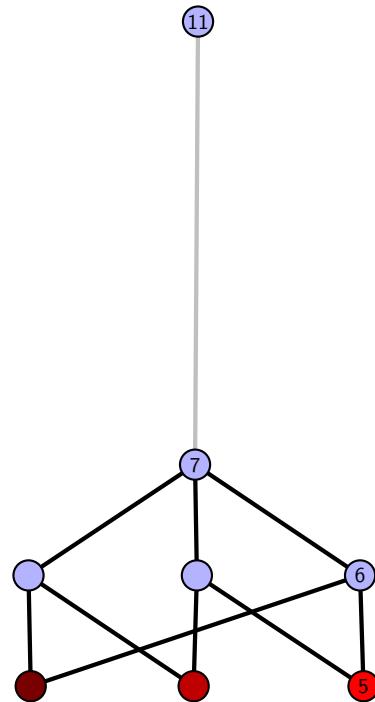


Figure 256: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.29 $[[8, 18, 1, 9], [9, 12, 10, 13], [17, 7, 18, 8], [1, 11, 2, 12], [10, 2, 11, 3], [13, 3, 14, 4], [4, 16, 5, 17], [6, 14, 7, 15], [15, 5, 16, 6]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (11, 2, 12, 3), (13, 4, 14, 5), (16, 7, 17, 8), (6, 17, 7, 18), (15, 18, 16, 9), (3, 10, 4, 11), (1, 12, 2, 13), (5, 14, 6, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 4, 4, 1], [1, 3, 3, 5], [1, 4, 7, 6], [2, 5, 8, 8], [2, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 5

Table 127: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.2	2.5	2.74	2.94	3.09	3.2	3.27	

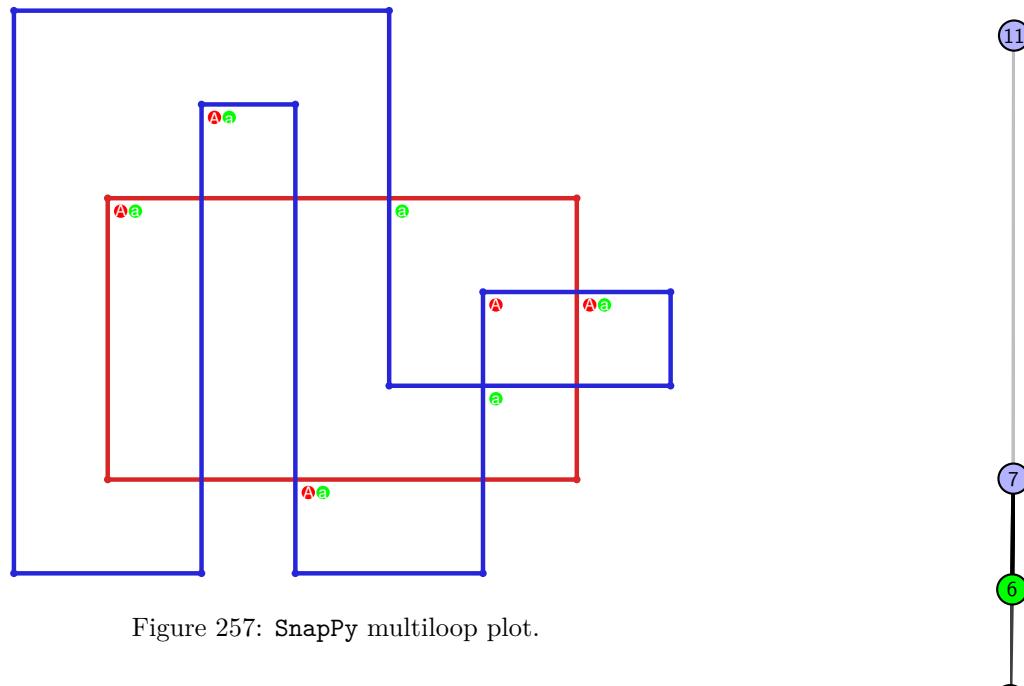


Figure 257: `SnapPy` multiloop plot.

Figure 258: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.30 $[[6, 18, 1, 7], [7, 10, 8, 11], [15, 5, 16, 6], [17, 12, 18, 13], [1, 9, 2, 10], [8, 2, 9, 3], [11, 3, 12, 4], [4, 14, 5, 15], [16, 14, 17, 13]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (10, 1, 11, 2), (14, 3, 15, 4), (5, 8, 6, 9), (18, 9, 7, 10), (16, 11, 17, 12), (12, 15, 13, 16), (2, 13, 3, 14), (4, 17, 5, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 8], [0, 8, 8, 6], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 3, 7], [2, 6, 8, 2], [2, 7, 3, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 4

Table 128: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

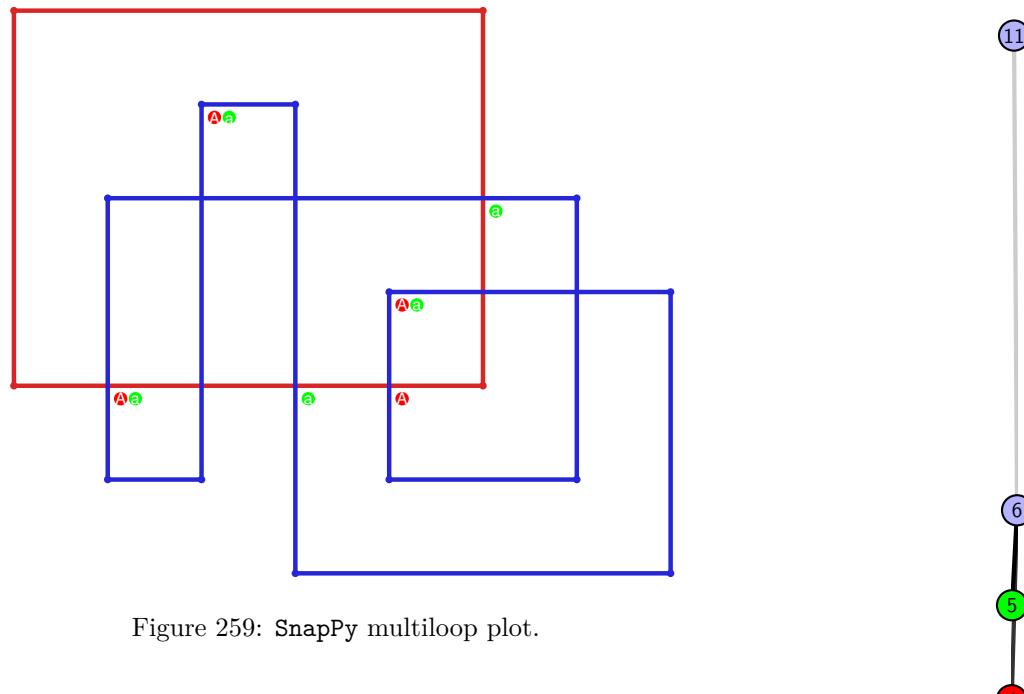


Figure 259: `SnapPy` multiloop plot.

Figure 260: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.31 $[[10, 18, 1, 11], [11, 14, 12, 15], [4, 9, 5, 10], [17, 7, 18, 8], [1, 13, 2, 14], [12, 2, 13, 3], [15, 3, 16, 4], [8, 5, 9, 6], [6, 16, 7, 17]]$

PD code drawn by `SnapPy`: $[(11, 10, 12, 1), (5, 2, 6, 3), (13, 4, 14, 5), (1, 6, 2, 7), (16, 9, 17, 10), (8, 17, 9, 18), (15, 18, 16, 11), (3, 12, 4, 13), (7, 14, 8, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 7, 8, 8], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 8, 2], [2, 8, 3, 2], [3, 7, 6, 3]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 6
Total pinning sets: 146
Pinning number: 5

Average optimal degree: 2.47
Average minimal degree: 2.59
Average overall degree: 2.99

Table 129: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	17	43	45	26	8	1	140
Average degree	2.47	2.72	2.92	3.06	3.15	3.23	3.27	

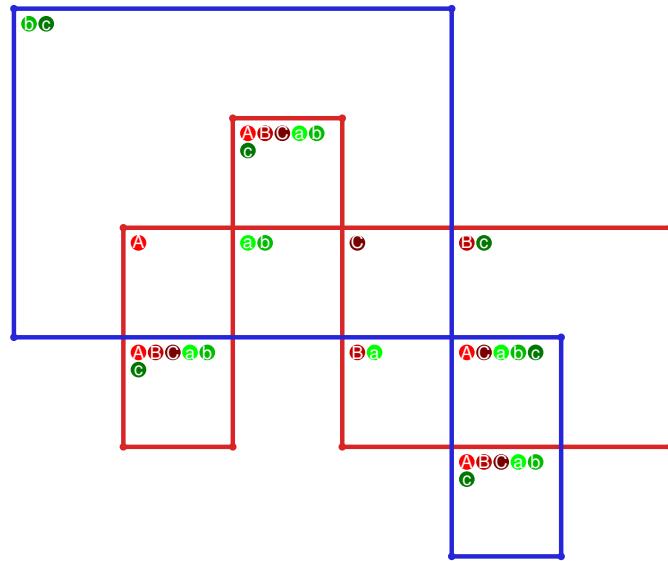


Figure 261: `SnapPy` multiloop plot.

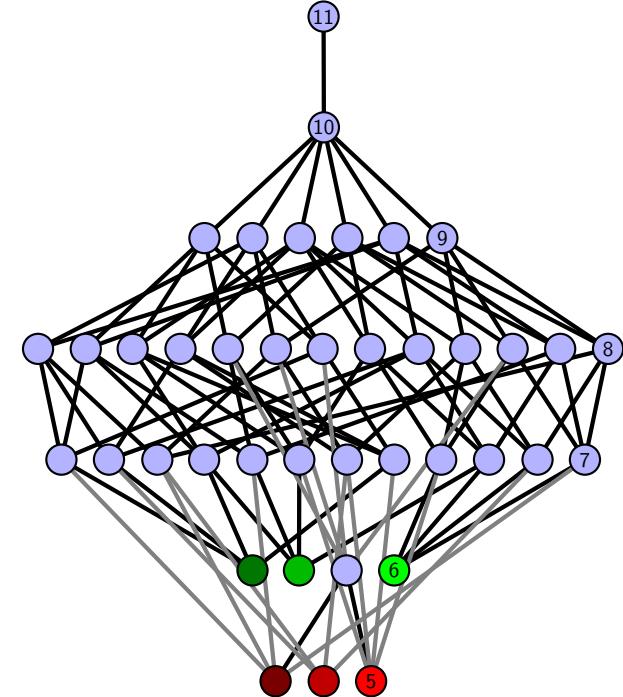


Figure 262: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.32 $[[3, 18, 4, 1], [2, 9, 3, 10], [12, 17, 13, 18], [4, 13, 5, 14], [1, 11, 2, 10], [11, 8, 12, 9], [16, 7, 17, 8], [5, 15, 6, 14], [6, 15, 7, 16]]$

PD code drawn by SnapPy: $[(14, 5, 15, 6), (9, 6, 10, 7), (18, 7, 1, 8), (8, 17, 9, 18), (2, 11, 3, 12), (12, 3, 13, 4), (4, 13, 5, 14), (10, 15, 11, 16), (1, 16, 2, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 6, 2], [2, 5, 8, 8], [3, 8, 8, 3], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.35

Total pinning sets: 100

Average overall degree: 2.93

Pinning number: 5

Table 130: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	6	27	33	21	7	1	95
Average degree	2.4	2.53	2.79	2.98	3.11	3.2	3.27	

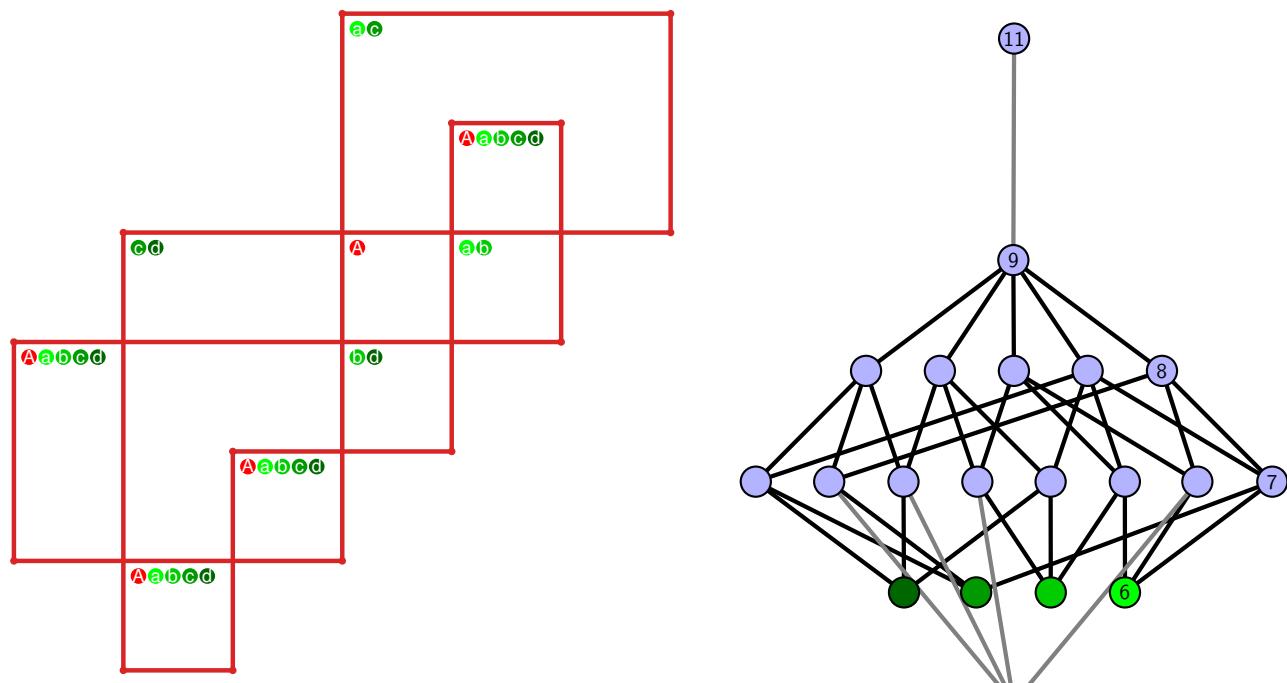


Figure 263: SnapPy multiloop plot.

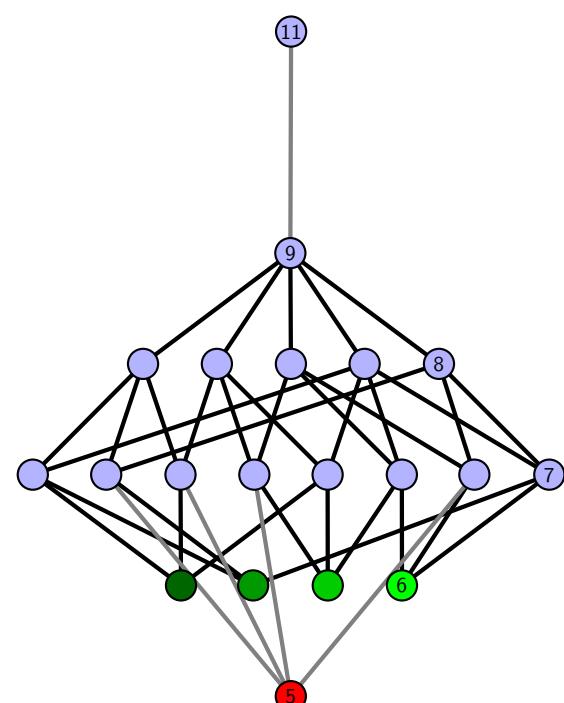


Figure 264: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.33 $[[3, 18, 4, 1], [11, 2, 12, 3], [17, 8, 18, 9], [4, 8, 5, 7], [1, 10, 2, 11], [12, 10, 13, 9], [13, 16, 14, 17], [5, 14, 6, 15], [15, 6, 16, 7]]$

PD code drawn by SnapPy: $[(9, 18, 10, 1), (13, 4, 14, 5), (5, 2, 6, 3), (15, 6, 16, 7), (7, 10, 8, 11), (17, 8, 18, 9), (3, 12, 4, 13), (11, 14, 12, 15), (1, 16, 2, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 6, 2], [2, 5, 8, 7], [3, 6, 8, 8], [3, 7, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.75

Total minimal pinning sets: 10

Average minimal degree: 2.75

Total pinning sets: 320

Average overall degree: 3.09

Pinning number: 4

Table 131: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	8	0	0	0	0	0	0	8
Nonminimal pinning sets	0	14	69	101	80	36	9	1	310
Average degree	2.75	2.85	2.99	3.09	3.16	3.21	3.24	3.27	

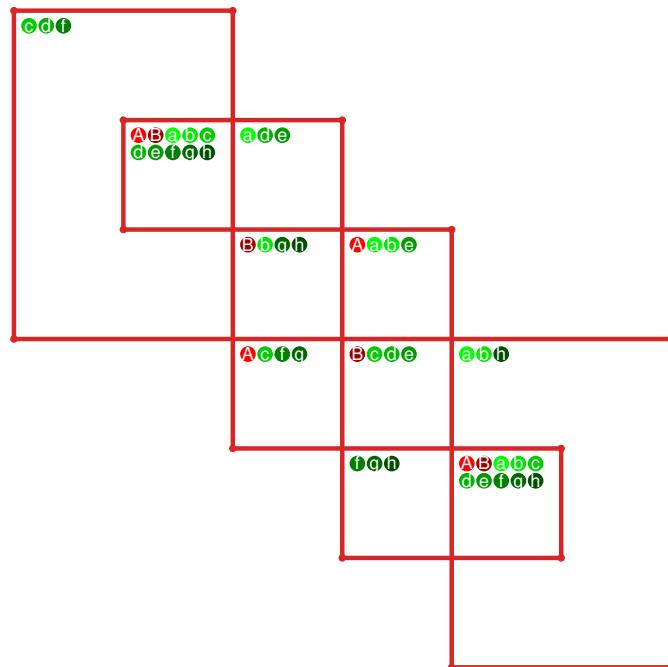


Figure 265: SnapPy multiloop plot.

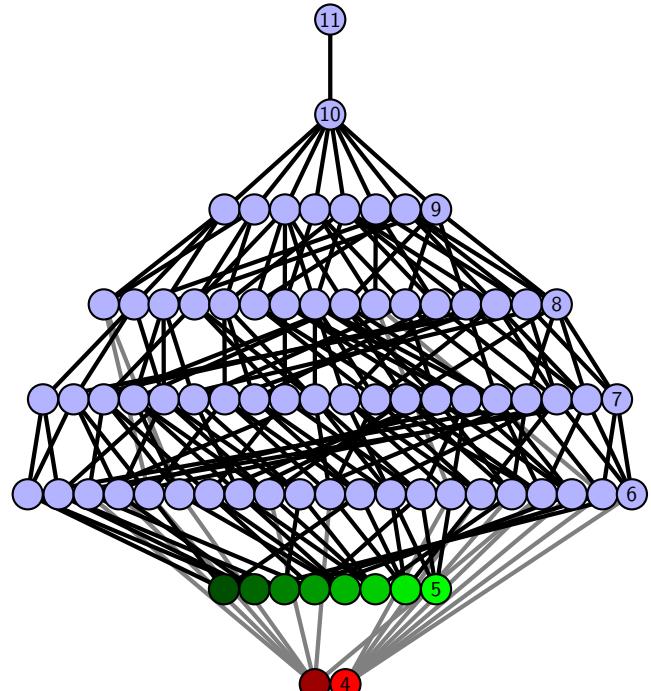


Figure 266: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.34 $[[3, 8, 4, 1], [2, 18, 3, 9], [7, 15, 8, 16], [4, 15, 5, 14], [1, 10, 2, 9], [10, 17, 11, 18], [16, 11, 17, 12], [12, 6, 13, 7], [5, 13, 6, 14]]$

PD code drawn by SnapPy: $[(13, 4, 14, 5), (1, 6, 2, 7), (17, 12, 18, 13), (3, 14, 4, 15), (15, 2, 16, 3), (5, 16, 6, 17), (11, 18, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 8, 8], [0, 5, 1, 1], [1, 4, 6, 6], [2, 5, 5, 7], [2, 6, 8, 8], [3, 7, 7, 3]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 124
 Pinning number: 5

Average optimal degree: 2.32
 Average minimal degree: 2.32
 Average overall degree: 2.91

Table 132: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	35	35	21	7	1	119
Average degree	2.32	2.65	2.86	3.0	3.11	3.2	3.27	

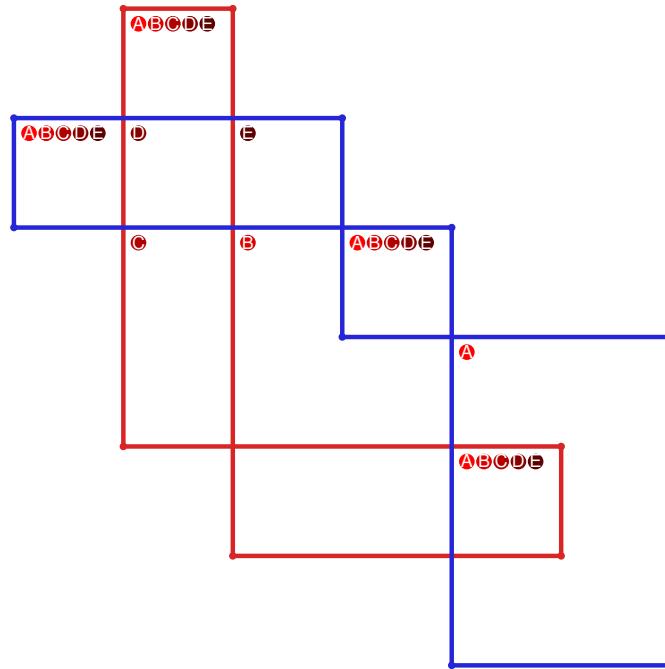


Figure 267: SnapPy multiloop plot.

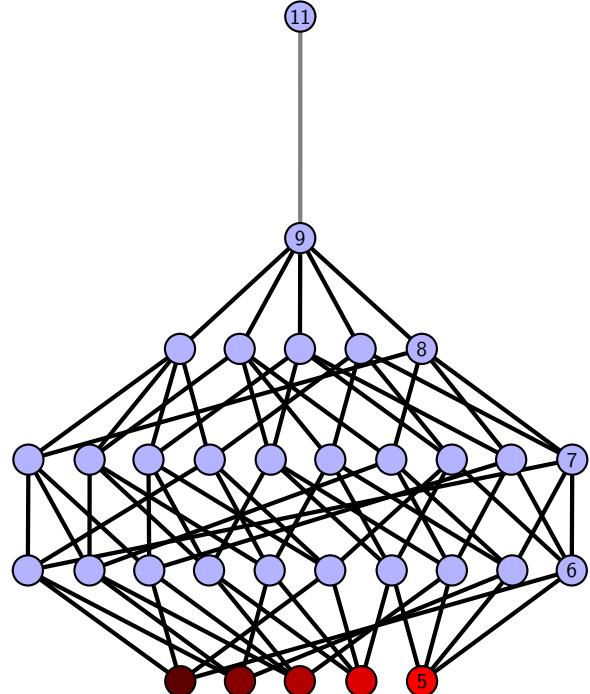


Figure 268: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.35 $[[3, 18, 4, 1], [2, 9, 3, 10], [17, 4, 18, 5], [1, 11, 2, 10], [11, 8, 12, 9], [5, 12, 6, 13], [13, 16, 14, 17], [14, 7, 15, 8], [6, 15, 7, 16]]$

PD code drawn by `SnapPy`: $[(15, 2, 16, 3), (12, 5, 13, 6), (9, 6, 10, 7), (18, 7, 1, 8), (8, 17, 9, 18), (3, 10, 4, 11), (4, 13, 5, 14), (11, 14, 12, 15), (1, 16, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 5], [2, 4, 8, 6], [2, 5, 8, 7], [4, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 2

Total pinning sets: 160

Pinning number: 4

Average optimal degree: 2.25

Average minimal degree: 2.33

Average overall degree: 2.97

Table 133: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

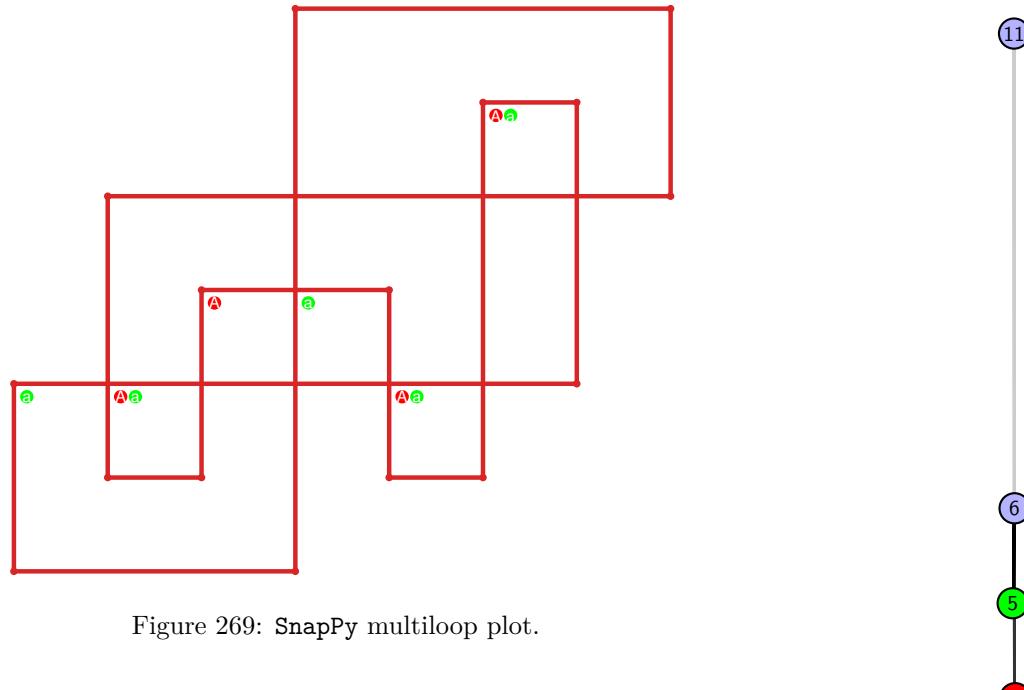


Figure 269: `SnapPy` multiloop plot.

Figure 270: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.36 `[[18, 9, 1, 10], [10, 13, 11, 14], [4, 17, 5, 18], [5, 8, 6, 9], [1, 12, 2, 13], [11, 2, 12, 3], [14, 3, 15, 4], [7, 16, 8, 17], [6, 16, 7, 15]]`

PD code drawn by `SnapPy`: `[(11, 18, 12, 1), (2, 5, 3, 6), (15, 6, 16, 7), (16, 9, 17, 10), (7, 10, 8, 11), (12, 3, 13, 4), (4, 13, 5, 14), (1, 14, 2, 15), (8, 17, 9, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 7, 8], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 8, 2], [2, 8, 8, 3], [3, 7, 7, 6]]`

Total optimal pinning sets: 5
 Total minimal pinning sets: 6
 Total pinning sets: 184
 Pinning number: 5

Average optimal degree: 2.64
 Average minimal degree: 2.64
 Average overall degree: 3.05

Table 134: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	25	54	57	32	9	1	178
Average degree	2.64	2.85	3.0	3.11	3.19	3.24	3.27	

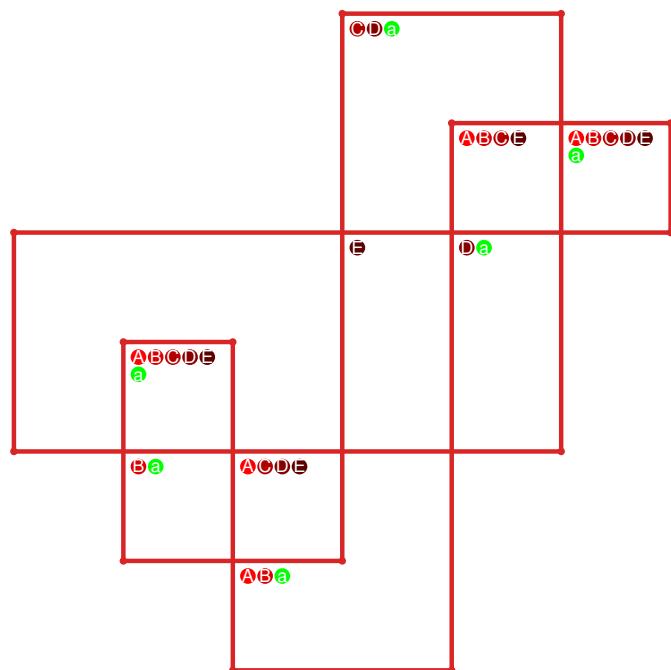


Figure 271: `SnapPy` multiloop plot.

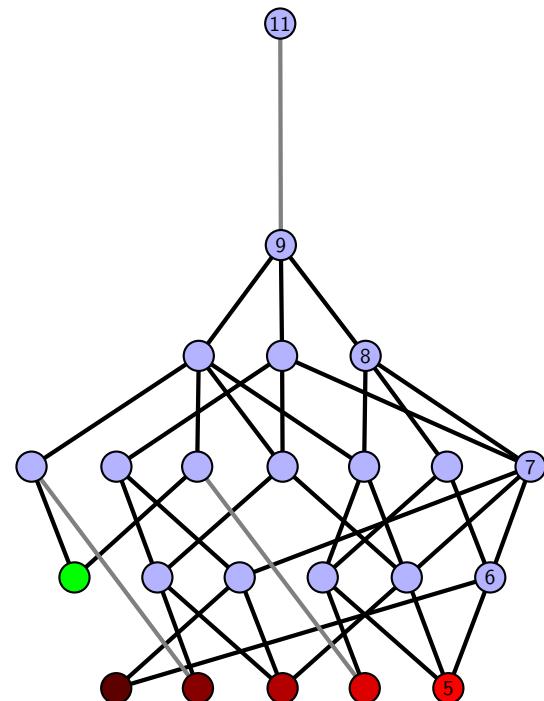


Figure 272: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.37 `[[18, 11, 1, 12], [12, 4, 13, 3], [6, 17, 7, 18], [7, 10, 8, 11], [1, 5, 2, 4], [13, 2, 14, 3], [14, 5, 15, 6], [9, 16, 10, 17], [8, 16, 9, 15]]`

PD code drawn by `SnapPy`: `[(11, 18, 12, 1), (1, 10, 2, 11), (2, 17, 3, 18), (12, 3, 13, 4), (5, 8, 6, 9), (16, 9, 17, 10), (13, 6, 14, 7), (7, 14, 8, 15), (4, 15, 5, 16)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 8], [0, 6, 5, 1], [1, 4, 6, 1], [2, 5, 4, 8], [2, 8, 8, 3], [3, 7, 7, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 4

Average minimal degree: 2.59

Total pinning sets: 200

Average overall degree: 3.04

Table 135: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	3
Nonminimal pinning sets	0	7	31	58	58	32	9	1	196
Average degree	2.5	2.71	2.88	3.01	3.12	3.19	3.24	3.27	

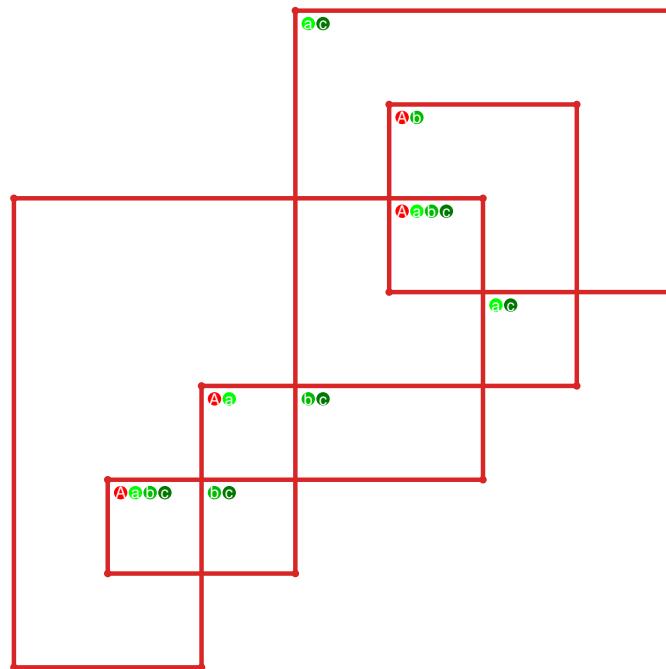


Figure 273: `SnapPy` multiloop plot.

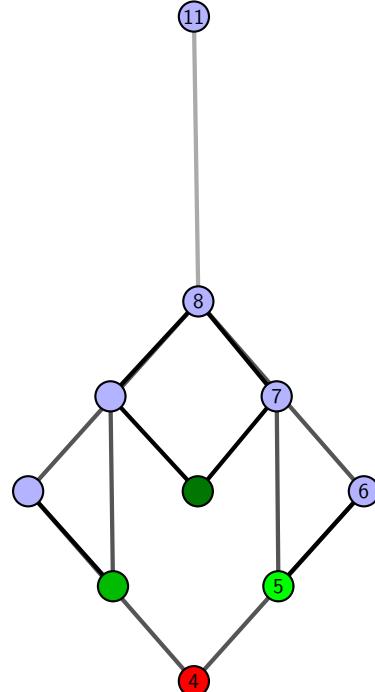


Figure 274: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.38 $[[8, 18, 1, 9], [9, 3, 10, 4], [13, 7, 14, 8], [14, 17, 15, 18], [1, 12, 2, 11], [2, 10, 3, 11], [4, 12, 5, 13], [16, 6, 17, 7], [15, 6, 16, 5]]$

PD code drawn by `SnapPy`: $[(18, 1, 9, 2), (3, 14, 4, 15), (15, 4, 16, 5), (12, 5, 13, 6), (8, 9, 1, 10), (10, 7, 11, 8), (2, 11, 3, 12), (13, 16, 14, 17), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 3], [0, 2, 7, 8], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 8, 2], [2, 8, 8, 3], [3, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 4

Table 136: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

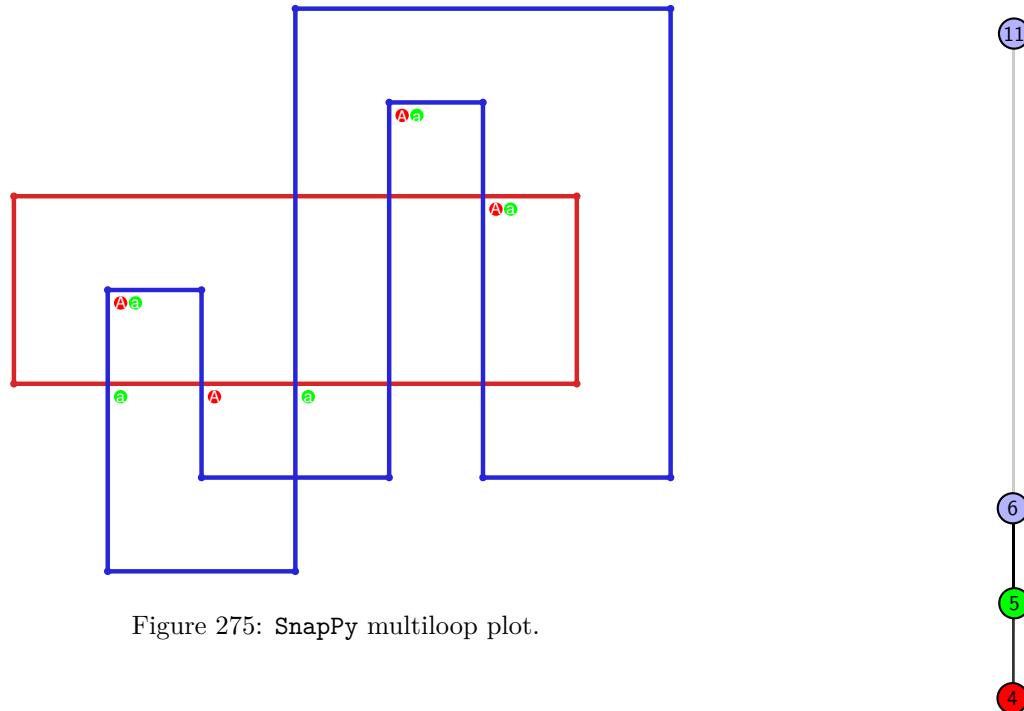


Figure 275: `SnapPy` multiloop plot.

Figure 276: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.39 $[[18, 9, 1, 10], [10, 17, 11, 18], [11, 8, 12, 9], [1, 16, 2, 17], [7, 12, 8, 13], [15, 6, 16, 7], [2, 6, 3, 5], [13, 5, 14, 4], [14, 3, 15, 4]]$

PD code drawn by SnapPy: $[(18, 9, 1, 10), (1, 16, 2, 17), (11, 2, 12, 3), (7, 4, 8, 5), (14, 5, 15, 6), (3, 8, 4, 9), (15, 12, 16, 13), (6, 13, 7, 14), (10, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 6, 1], [2, 7, 5, 2], [3, 4, 8, 6], [3, 5, 8, 7], [4, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 4

Table 137: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

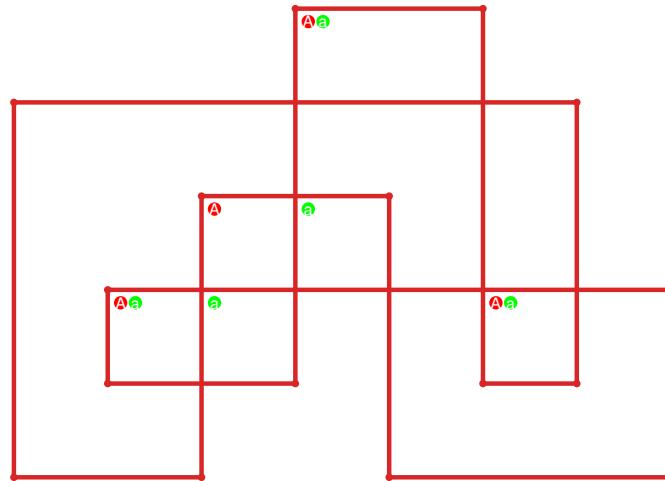


Figure 277: SnapPy multiloop plot.



Figure 278: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.40 $[[7, 14, 8, 1], [13, 6, 14, 7], [8, 6, 9, 5], [1, 12, 2, 13], [9, 15, 10, 18], [11, 4, 12, 5], [2, 16, 3, 15], [10, 17, 11, 18], [3, 16, 4, 17]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (2, 5, 3, 6), (10, 3, 11, 4), (12, 9, 13, 10), (4, 11, 5, 12), (7, 16, 8, 17), (17, 6, 18, 7), (18, 13, 15, 14), (14, 15, 1, 16)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 7], [2, 7, 8, 3], [3, 8, 8, 4], [4, 8, 5, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 5
Total minimal pinning sets: 6
Total pinning sets: 250
Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.48
Average overall degree: 2.98

Table 138: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	25	56	70	56	28	8	1	244
Average degree	2.5	2.71	2.88	3.0	3.09	3.17	3.23	3.27	

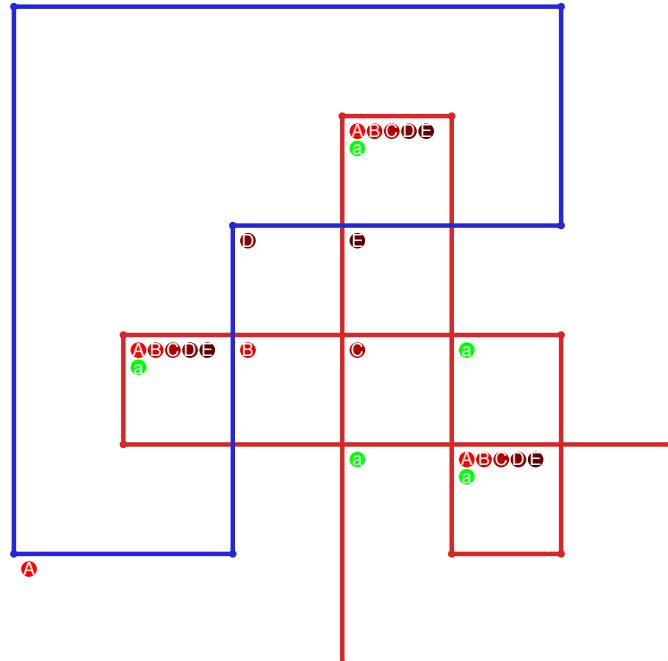


Figure 279: SnapPy multiloop plot.

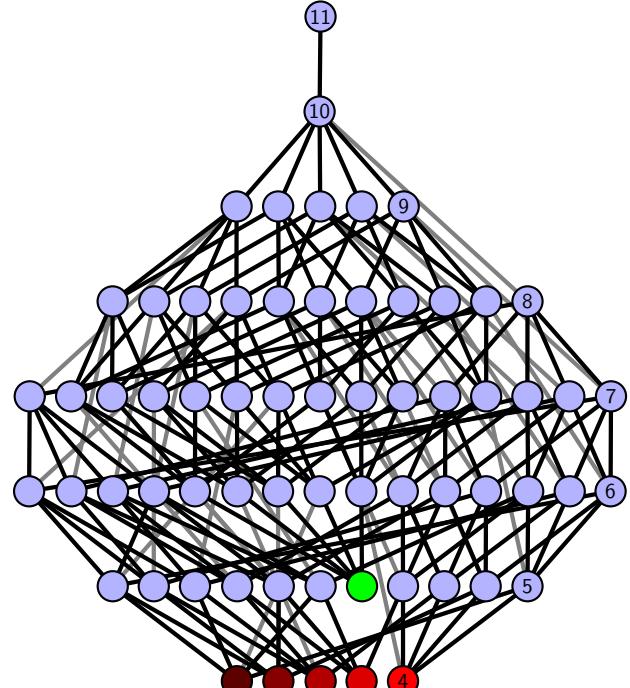


Figure 280: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.41 $[[18, 7, 1, 8], [8, 17, 9, 18], [9, 6, 10, 7], [1, 16, 2, 17], [12, 5, 13, 6], [10, 15, 11, 16], [2, 11, 3, 12], [4, 13, 5, 14], [14, 3, 15, 4]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (5, 2, 6, 3), (14, 3, 15, 4), (16, 7, 17, 8), (18, 9, 1, 10), (6, 11, 7, 12), (15, 12, 16, 13), (4, 13, 5, 14), (10, 17, 11, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 7], [2, 8, 6, 3], [3, 5, 8, 4], [4, 8, 8, 4], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.42

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 4

Table 139: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.25	2.56	2.78	2.95	3.07	3.16	3.23	3.27	

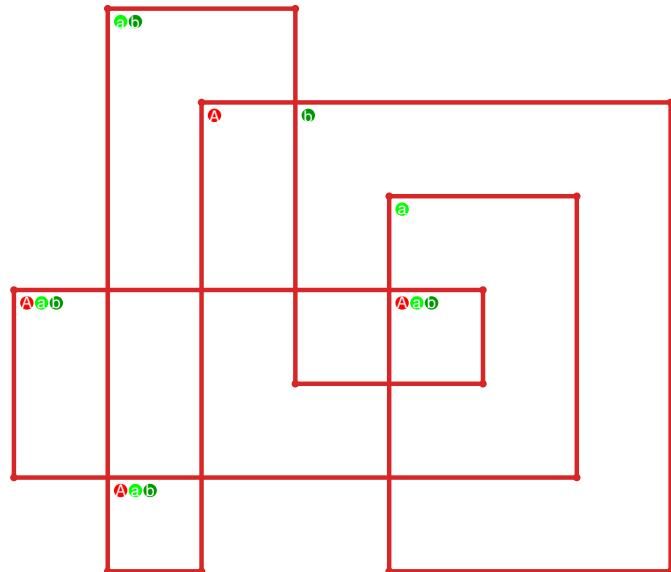


Figure 281: `SnapPy` multiloop plot.

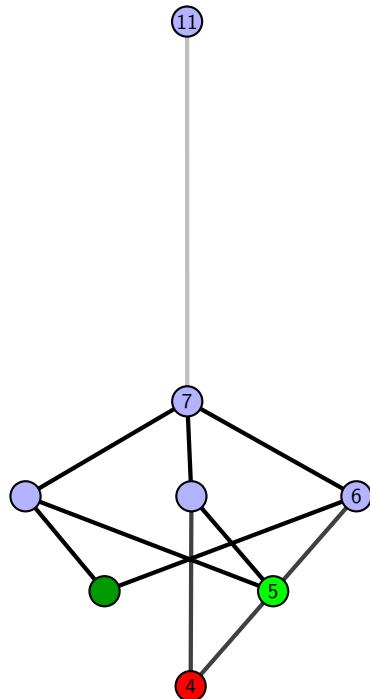


Figure 282: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.42 $[[14, 18, 1, 15], [15, 13, 16, 14], [17, 7, 18, 8], [1, 12, 2, 13], [16, 9, 17, 8], [11, 6, 12, 7], [2, 6, 3, 5], [9, 5, 10, 4], [10, 3, 11, 4]]$

PD code drawn by `SnapPy`: $[(14, 5, 1, 6), (1, 12, 2, 13), (7, 2, 8, 3), (16, 3, 17, 4), (4, 15, 5, 16), (11, 8, 12, 9), (18, 9, 15, 10), (6, 13, 7, 14), (10, 17, 11, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 8, 6, 3], [3, 5, 8, 7], [4, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 4

Table 140: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

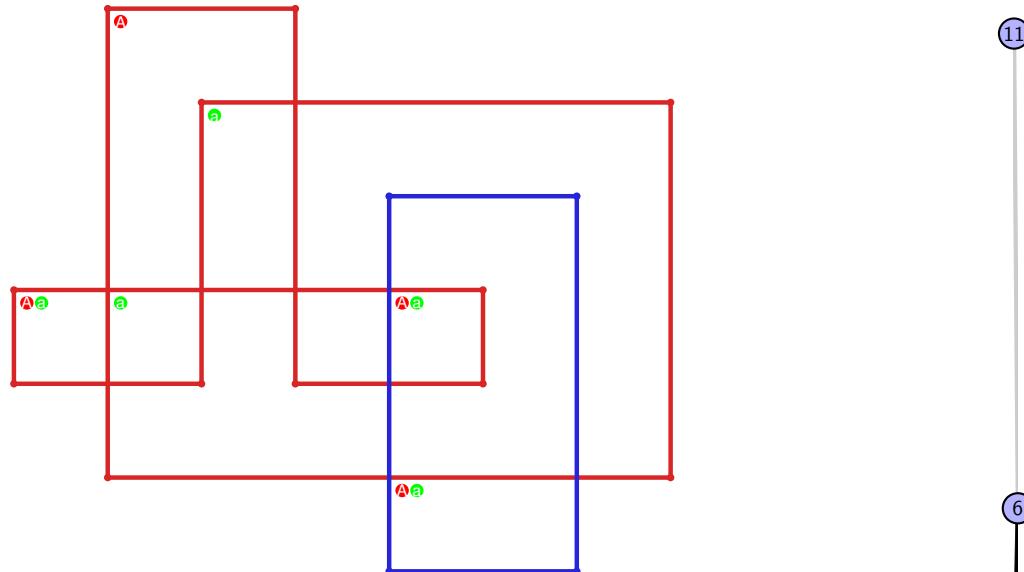


Figure 283: `SnapPy` multiloop plot.



Figure 284: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.43 $[[4, 18, 1, 5], [5, 3, 6, 4], [6, 17, 7, 18], [1, 14, 2, 13], [2, 12, 3, 13], [9, 16, 10, 17], [7, 15, 8, 14], [8, 11, 9, 12], [15, 10, 16, 11]]$

PD code drawn by `SnapPy`: $[(12, 1, 13, 2), (8, 17, 9, 18), (15, 18, 16, 5), (4, 5, 1, 6), (6, 3, 7, 4), (7, 14, 8, 15), (16, 9, 17, 10), (13, 10, 14, 11), (2, 11, 3, 12)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 4, 4], [1, 3, 3, 7], [2, 7, 8, 8], [2, 8, 7, 3], [4, 6, 8, 5], [5, 7, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 6

Average minimal degree: 2.54

Total pinning sets: 190

Average overall degree: 2.98

Pinning number: 4

Table 141: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	5
Nonminimal pinning sets	0	7	36	55	50	27	8	1	184
Average degree	2.25	2.58	2.81	2.96	3.08	3.16	3.23	3.27	

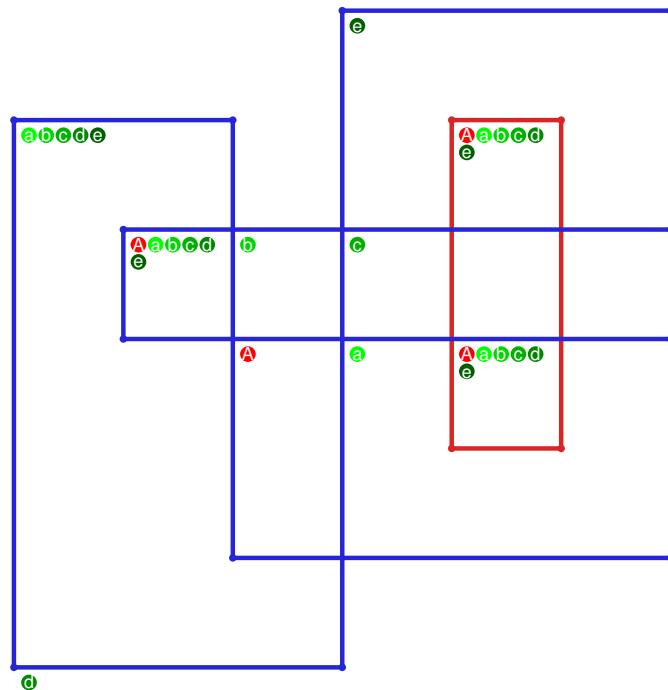


Figure 285: `SnapPy` multiloop plot.

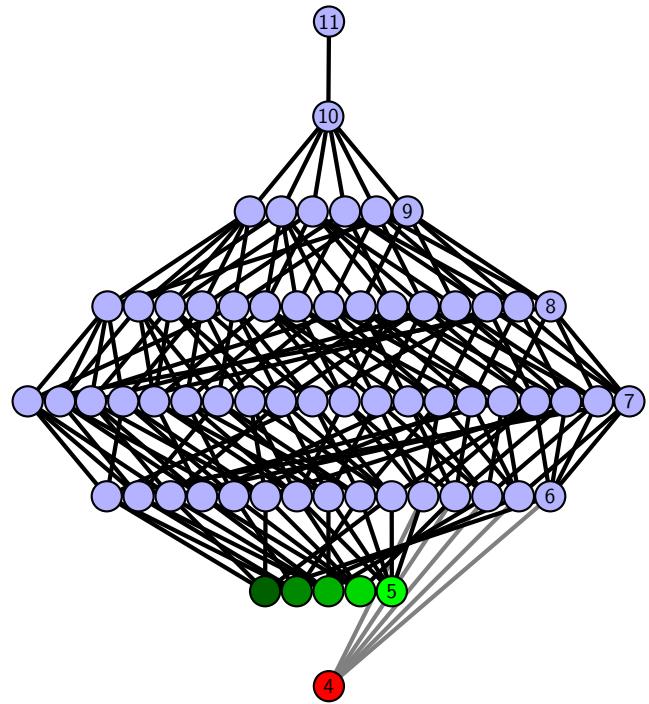


Figure 286: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.44 $[[3, 10, 4, 1], [2, 18, 3, 11], [13, 9, 14, 10], [4, 8, 5, 7], [1, 12, 2, 11], [12, 17, 13, 18], [8, 14, 9, 15], [5, 15, 6, 16], [16, 6, 17, 7]]$

PD code drawn by `SnapPy`: $[(17, 4, 18, 5), (5, 2, 6, 3), (14, 7, 15, 8), (1, 8, 2, 9), (6, 15, 7, 16), (3, 16, 4, 17), (13, 18, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 7, 3, 2], [3, 6, 8, 8], [3, 7, 7, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 4

Average minimal degree: 2.46

Total pinning sets: 184

Average overall degree: 2.98

Pinning number: 4

Table 142: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.25	2.56	2.79	2.96	3.08	3.16	3.23	3.27	

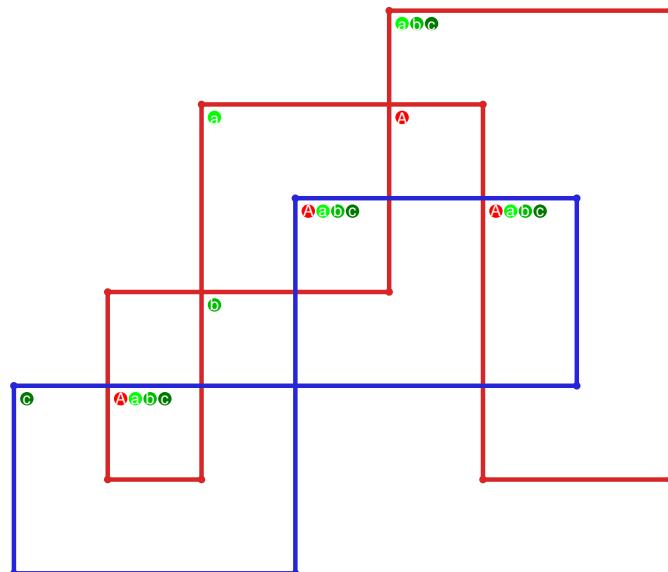


Figure 287: `SnapPy` multiloop plot.

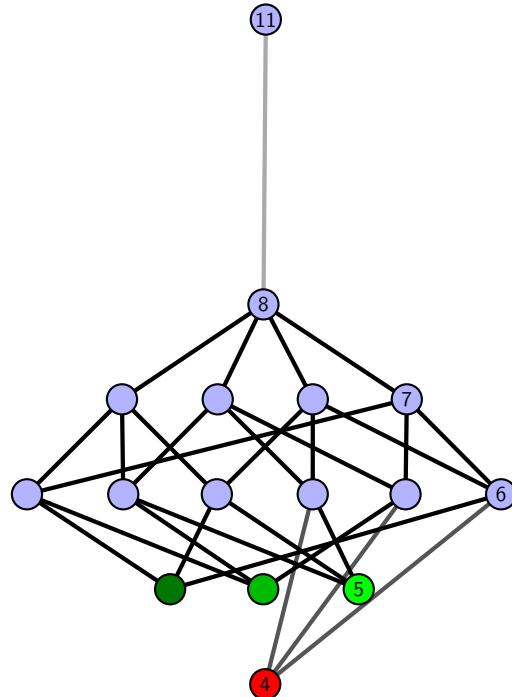


Figure 288: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.45 $[[3, 18, 4, 1], [2, 13, 3, 14], [17, 8, 18, 9], [4, 8, 5, 7], [1, 15, 2, 14], [15, 12, 16, 13], [9, 16, 10, 17], [5, 10, 6, 11], [11, 6, 12, 7]]$

PD code drawn by SnapPy: $[(9, 4, 10, 5), (5, 2, 6, 3), (15, 6, 16, 7), (3, 8, 4, 9), (13, 10, 14, 11), (18, 11, 1, 12), (12, 17, 13, 18), (7, 14, 8, 15), (1, 16, 2, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 7, 2], [3, 6, 8, 8], [3, 7, 7, 5]]$

Total optimal pinning sets: 5

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.4

Total pinning sets: 248

Average overall degree: 2.98

Pinning number: 4

Table 143: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	25	55	70	56	28	8	1	243
Average degree	2.4	2.69	2.87	3.0	3.09	3.17	3.23	3.27	

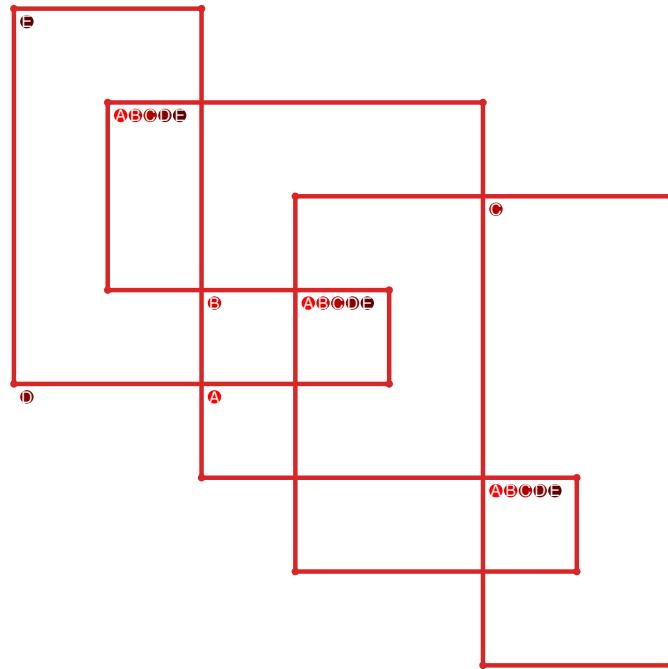


Figure 289: SnapPy multiloop plot.

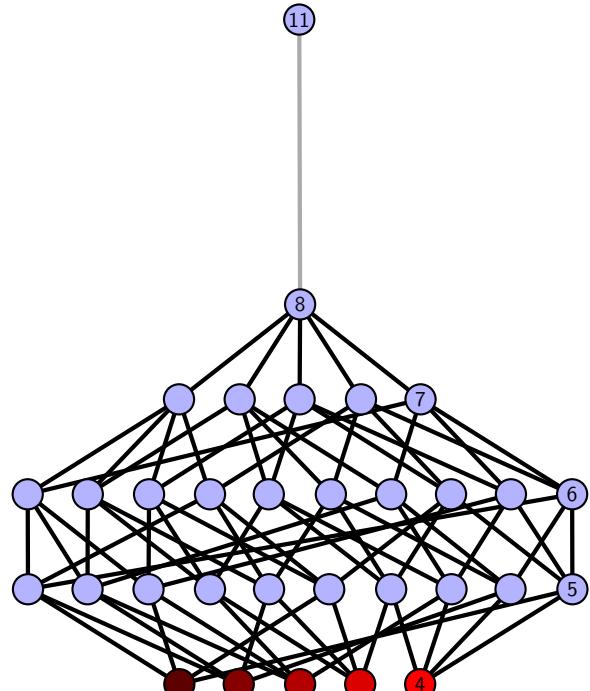


Figure 290: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.46 $[[3, 18, 4, 1], [13, 2, 14, 3], [17, 10, 18, 11], [4, 10, 5, 9], [1, 12, 2, 13], [14, 12, 15, 11], [7, 16, 8, 17], [5, 8, 6, 9], [15, 6, 16, 7]]$

PD code drawn by `SnapPy`: $[(11, 18, 12, 1), (13, 4, 14, 5), (3, 6, 4, 7), (7, 2, 8, 3), (15, 8, 16, 9), (9, 12, 10, 13), (17, 10, 18, 11), (5, 14, 6, 15), (1, 16, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 8, 7], [3, 6, 8, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 5

Average minimal degree: 2.53

Total pinning sets: 200

Average overall degree: 2.99

Pinning number: 4

Table 144: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	7	37	60	54	28	8	1	195
Average degree	2.25	2.58	2.82	2.98	3.09	3.17	3.23	3.27	

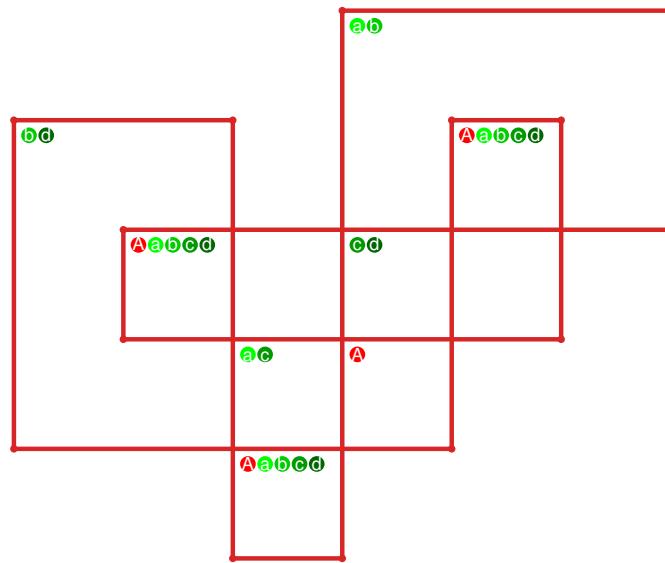


Figure 291: `SnapPy` multiloop plot.

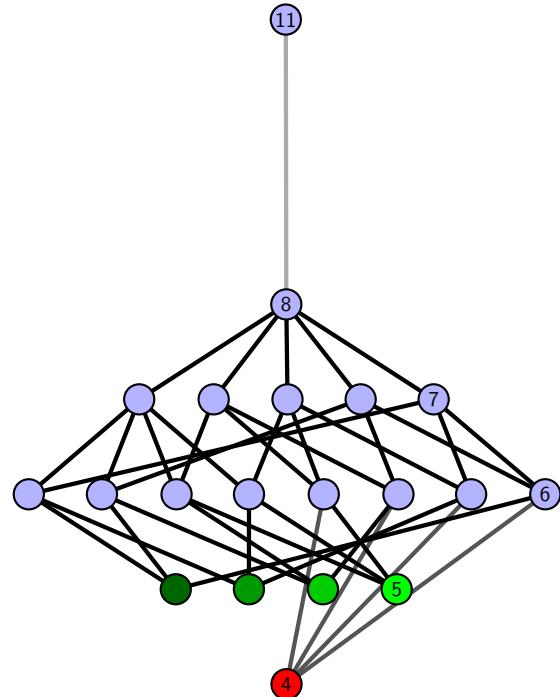


Figure 292: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.47 $[[3, 10, 4, 1], [2, 18, 3, 11], [13, 9, 14, 10], [4, 14, 5, 15], [1, 12, 2, 11], [12, 17, 13, 18], [8, 5, 9, 6], [15, 8, 16, 7], [16, 6, 17, 7]]$

PD code drawn by SnapPy: $[(6, 3, 7, 4), (17, 4, 18, 5), (5, 16, 6, 17), (14, 7, 15, 8), (1, 8, 2, 9), (2, 15, 3, 16), (13, 18, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 7, 3], [3, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 8
 Total minimal pinning sets: 10
 Total pinning sets: 222
 Pinning number: 5

Average optimal degree: 2.7
 Average minimal degree: 2.71
 Average overall degree: 3.06

Table 145: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	8	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	36	69	64	33	9	1	212
Average degree	2.7	2.89	3.04	3.13	3.2	3.24	3.27	

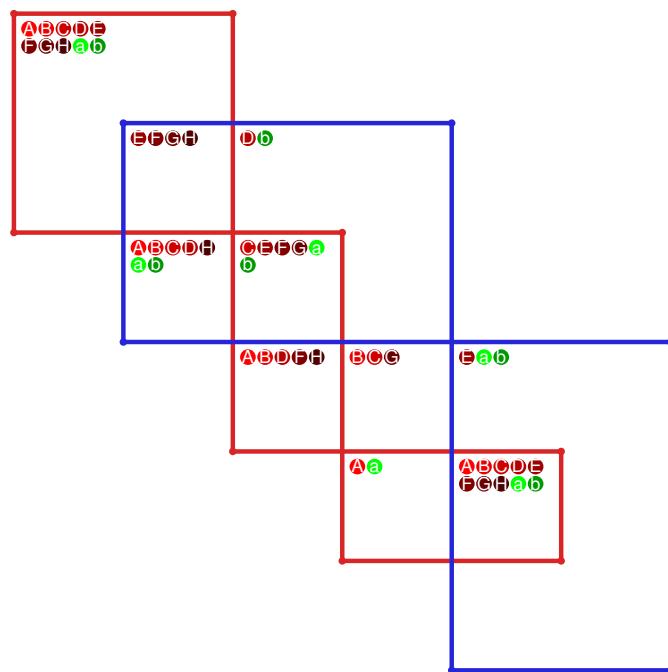


Figure 293: SnapPy multiloop plot.

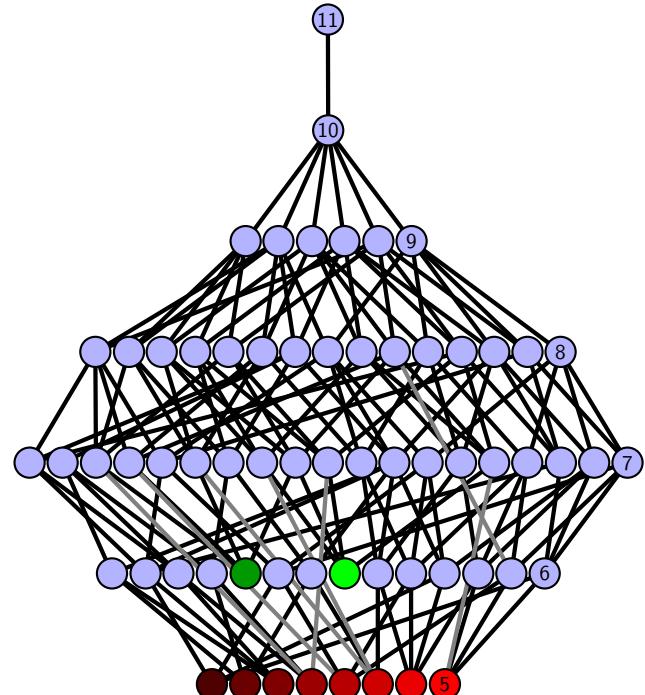


Figure 294: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.48 $[[3, 8, 4, 1], [2, 18, 3, 9], [11, 7, 12, 8], [4, 12, 5, 13], [1, 10, 2, 9], [10, 17, 11, 18], [14, 6, 15, 7], [5, 15, 6, 16], [13, 16, 14, 17]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (12, 5, 13, 6), (1, 6, 2, 7), (2, 13, 3, 14), (3, 16, 4, 17), (14, 17, 15, 18), (11, 18, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 7, 7], [3, 6, 6, 8], [3, 7, 6, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 9
 Total pinning sets: 320
 Pinning number: 4

Average optimal degree: 2.58
 Average minimal degree: 2.75
 Average overall degree: 3.07

Table 146: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	6
Nonminimal pinning sets	0	20	72	98	76	35	9	1	311
Average degree	2.58	2.82	2.97	3.08	3.15	3.21	3.24	3.27	

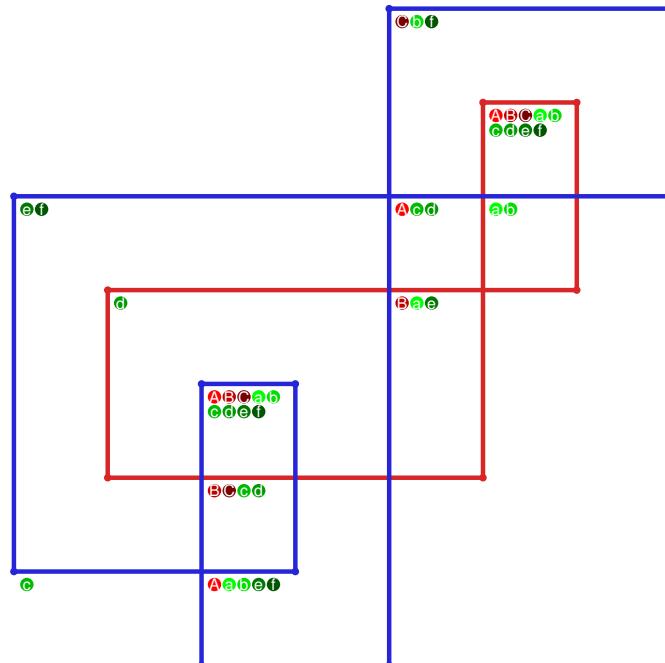


Figure 295: SnapPy multiloop plot.

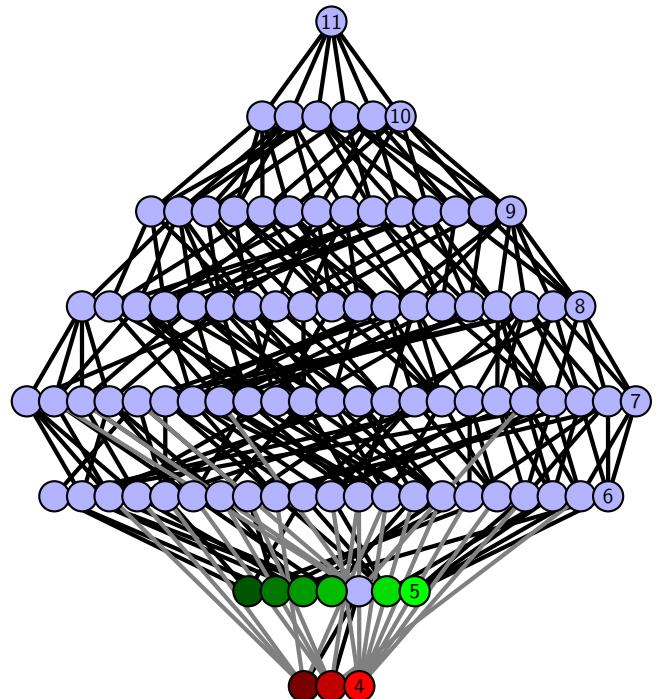


Figure 296: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.49 $[[3, 18, 4, 1], [2, 7, 3, 8], [12, 17, 13, 18], [4, 13, 5, 14], [1, 9, 2, 8], [9, 6, 10, 7], [16, 11, 17, 12], [5, 15, 6, 14], [10, 15, 11, 16]]$

PD code drawn by SnapPy: $[(6, 3, 7, 4), (17, 4, 18, 5), (5, 16, 6, 17), (13, 8, 14, 9), (1, 10, 2, 11), (11, 2, 12, 3), (7, 12, 8, 13), (9, 14, 10, 15), (18, 15, 1, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 7, 8], [2, 8, 8, 2], [3, 8, 5, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 147: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

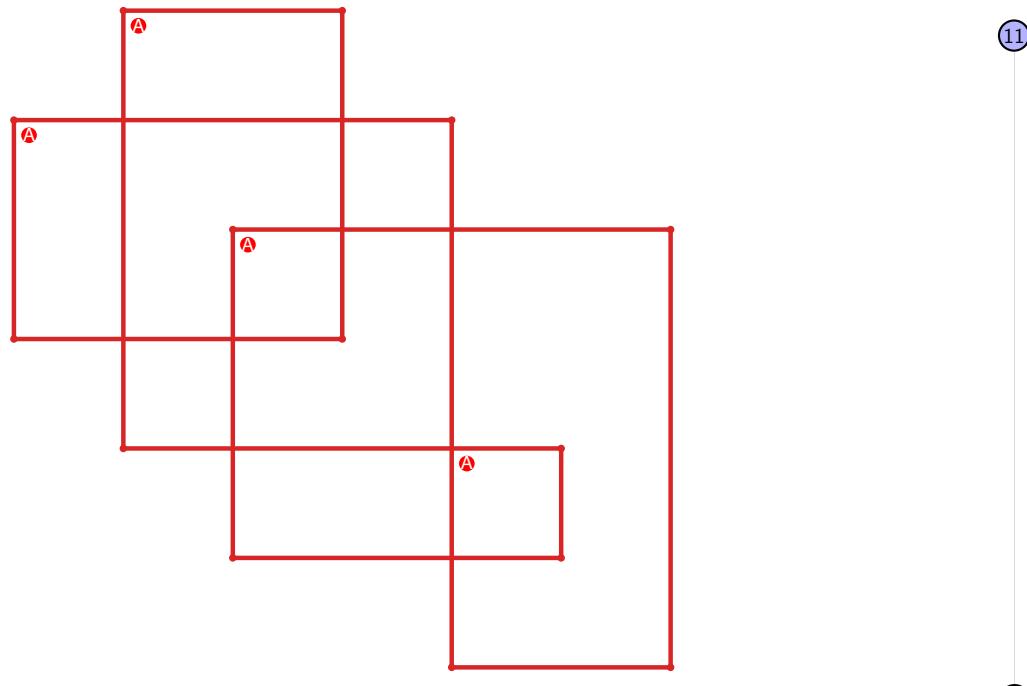


Figure 297: SnapPy multiloop plot.

Figure 298: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.50 $[[3, 14, 4, 1], [9, 2, 10, 3], [13, 4, 14, 5], [1, 8, 2, 9], [10, 8, 11, 7], [5, 15, 6, 18], [12, 17, 13, 18], [11, 17, 12, 16], [6, 15, 7, 16]]$

PD code drawn by SnapPy: $[(7, 14, 8, 1), (11, 2, 12, 3), (5, 8, 6, 9), (13, 6, 14, 7), (1, 12, 2, 13), (10, 17, 11, 18), (18, 3, 15, 4), (4, 15, 5, 16), (16, 9, 17, 10)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 8], [2, 8, 8, 6], [2, 5, 7, 7], [4, 6, 6, 8], [4, 7, 5, 5]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 112

Average overall degree: 2.91

Pinning number: 5

Table 148: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.27	2.6	2.83	2.99	3.11	3.2	3.27	

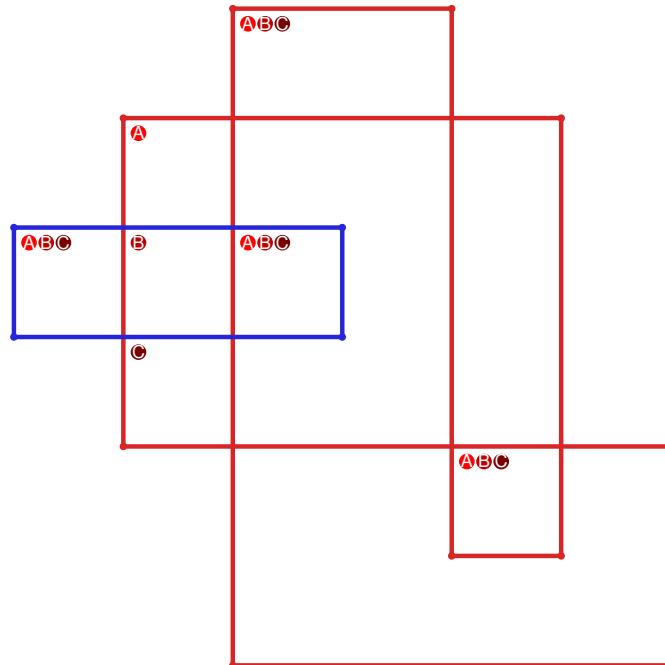


Figure 299: SnapPy multiloop plot.

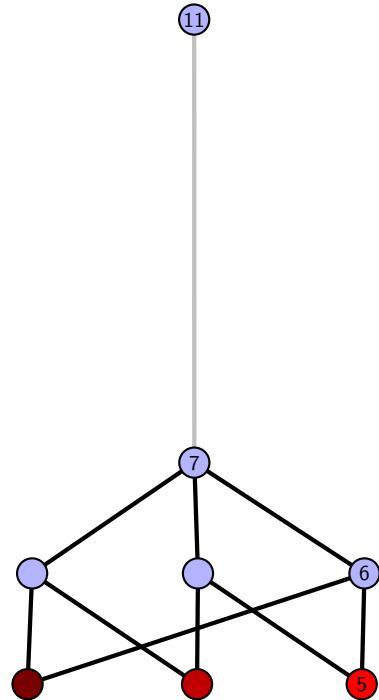


Figure 300: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.51 $[[3, 18, 4, 1], [2, 11, 3, 12], [17, 4, 18, 5], [1, 13, 2, 12], [13, 10, 14, 11], [5, 9, 6, 8], [16, 7, 17, 8], [9, 14, 10, 15], [6, 15, 7, 16]]$

PD code drawn by SnapPy: $[(15, 2, 16, 3), (14, 5, 15, 6), (6, 3, 7, 4), (11, 8, 12, 9), (18, 9, 1, 10), (10, 17, 11, 18), (7, 12, 8, 13), (4, 13, 5, 14), (1, 16, 2, 17)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 7, 8, 6], [2, 5, 8, 8], [4, 8, 5, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 80
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.91

Table 149: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.2	2.5	2.74	2.94	3.09	3.2	3.27	

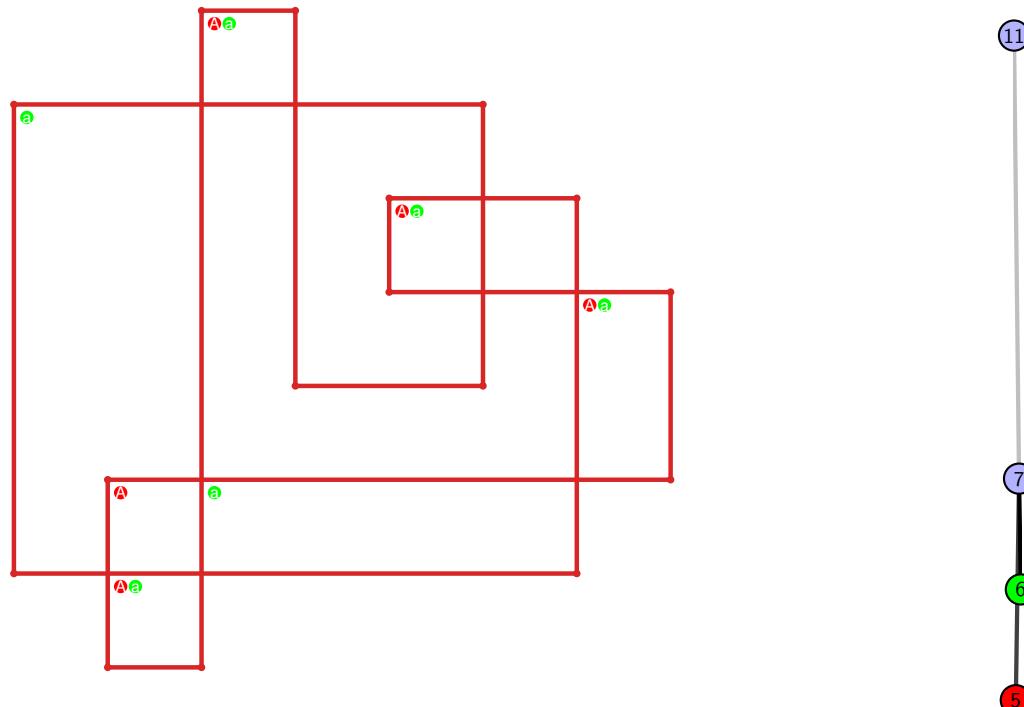


Figure 301: SnapPy multiloop plot.

Figure 302: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.52 $[[3, 18, 4, 1], [2, 9, 3, 10], [14, 17, 15, 18], [4, 15, 5, 16], [1, 11, 2, 10], [11, 8, 12, 9], [13, 6, 14, 7], [16, 5, 17, 6], [7, 12, 8, 13]]$

PD code drawn by `SnapPy`: $[(14, 3, 15, 4), (11, 4, 12, 5), (9, 6, 10, 7), (18, 7, 1, 8), (8, 17, 9, 18), (5, 10, 6, 11), (2, 13, 3, 14), (12, 15, 13, 16), (1, 16, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 8], [2, 8, 8, 7], [2, 6, 3, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 5

Table 150: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.2	2.5	2.74	2.94	3.09	3.2	3.27	

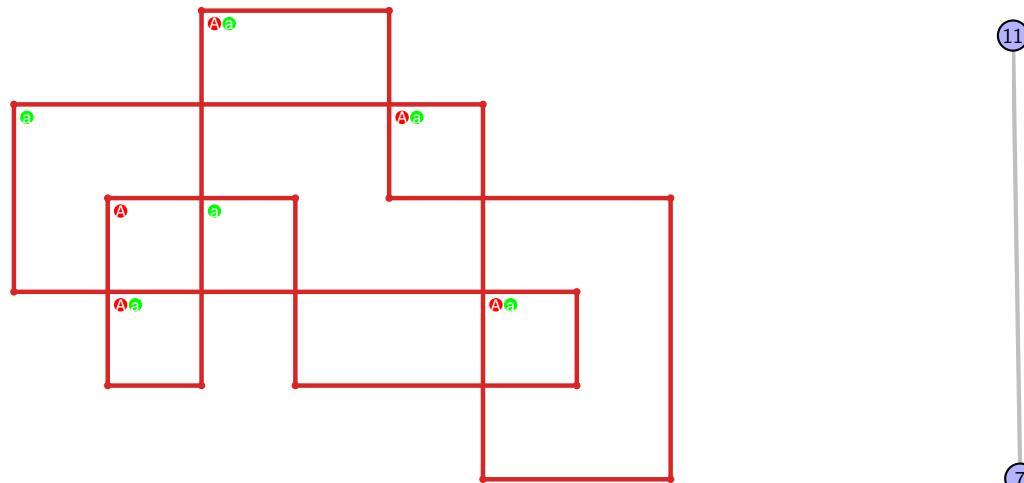


Figure 303: `SnapPy` multiloop plot.



Figure 304: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.53 $[[5, 18, 6, 1], [4, 11, 5, 12], [14, 17, 15, 18], [6, 15, 7, 16], [1, 13, 2, 12], [10, 3, 11, 4], [13, 8, 14, 9], [16, 7, 17, 8], [2, 9, 3, 10]]$

PD code drawn by `SnapPy`: $[(7, 18, 8, 1), (13, 4, 14, 5), (10, 5, 11, 6), (17, 6, 18, 7), (1, 8, 2, 9), (9, 16, 10, 17), (3, 12, 4, 13), (11, 14, 12, 15), (2, 15, 3, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 6, 8, 1], [1, 8, 8, 1], [2, 8, 4, 7], [2, 6, 3, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 2
Total pinning sets: 160
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.33
Average overall degree: 2.97

Table 151: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

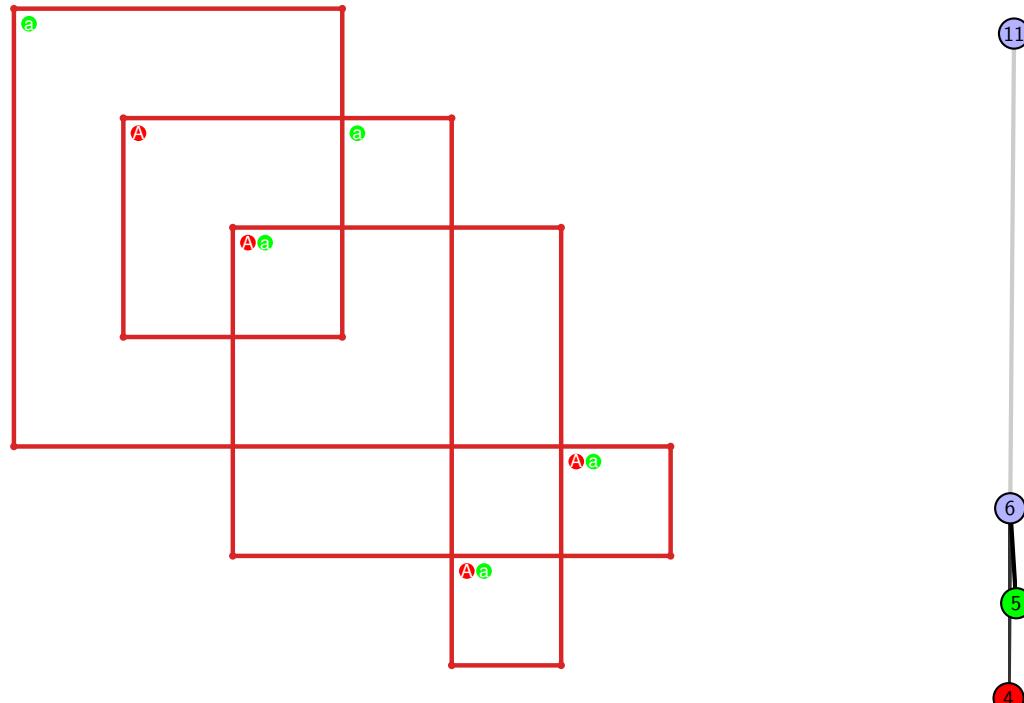


Figure 305: `SnapPy` multiloop plot.

Figure 306: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.54 [[8, 14, 1, 9], [9, 15, 10, 18], [4, 7, 5, 8], [5, 13, 6, 14], [1, 16, 2, 15], [10, 17, 11, 18], [11, 3, 12, 4], [12, 6, 13, 7], [16, 3, 17, 2]]

PD code drawn by SnapPy: [(8, 9, 1, 10), (18, 1, 13, 2), (13, 4, 14, 5), (2, 5, 3, 6), (3, 14, 4, 15), (6, 15, 7, 16), (17, 10, 18, 11), (11, 16, 12, 17), (12, 7, 9, 8)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 8, 8, 1], [1, 8, 6, 1], [2, 5, 8, 7], [2, 6, 3, 3], [4, 6, 5, 4]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 9
 Total pinning sets: 139
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.66
 Average overall degree: 2.99

Table 152: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	7
Nonminimal pinning sets	0	11	40	44	26	8	1	130
Average degree	2.4	2.7	2.91	3.05	3.15	3.23	3.27	

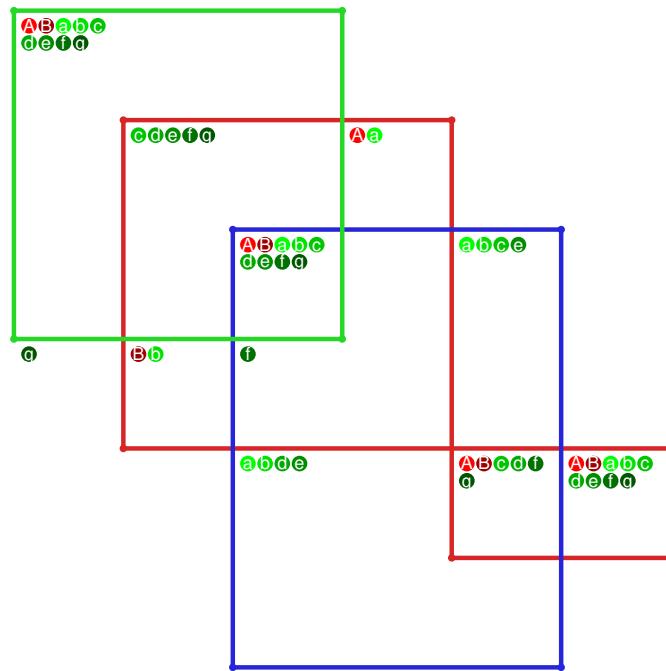


Figure 307: SnapPy multiloop plot.

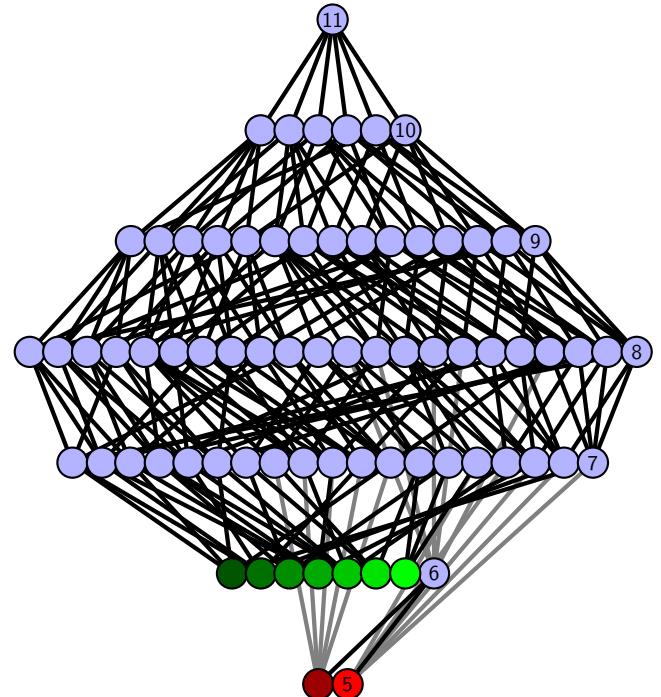


Figure 308: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.55 $[[18, 9, 1, 10], [10, 4, 11, 3], [14, 17, 15, 18], [15, 8, 16, 9], [1, 5, 2, 4], [11, 2, 12, 3], [6, 13, 7, 14], [7, 16, 8, 17], [5, 13, 6, 12]]$

PD code drawn by SnapPy: $[(18, 7, 1, 8), (1, 16, 2, 17), (12, 5, 13, 6), (15, 6, 16, 7), (9, 2, 10, 3), (3, 10, 4, 11), (4, 13, 5, 14), (11, 14, 12, 15), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 8, 5, 1], [1, 4, 8, 1], [2, 8, 8, 7], [2, 6, 3, 3], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.49

Total pinning sets: 100

Average overall degree: 2.98

Pinning number: 5

Table 153: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	6	23	34	24	8	1	96
Average degree	2.4	2.62	2.82	3.0	3.14	3.23	3.27	

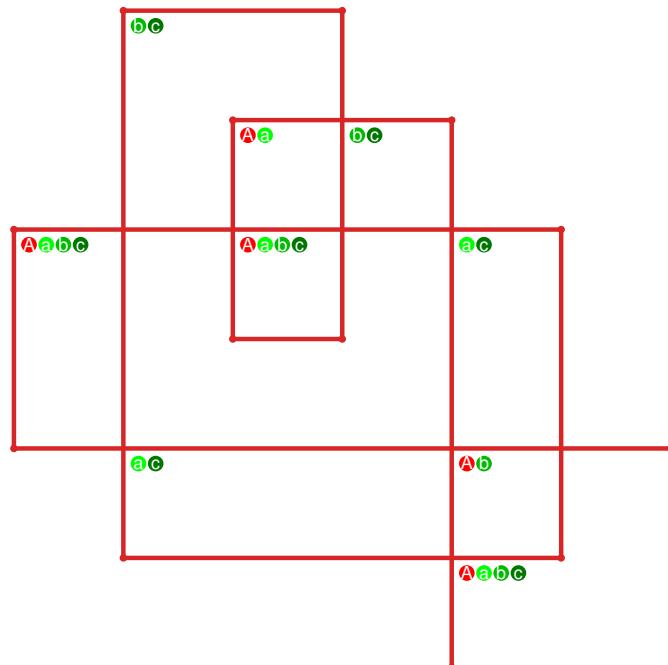


Figure 309: SnapPy multiloop plot.

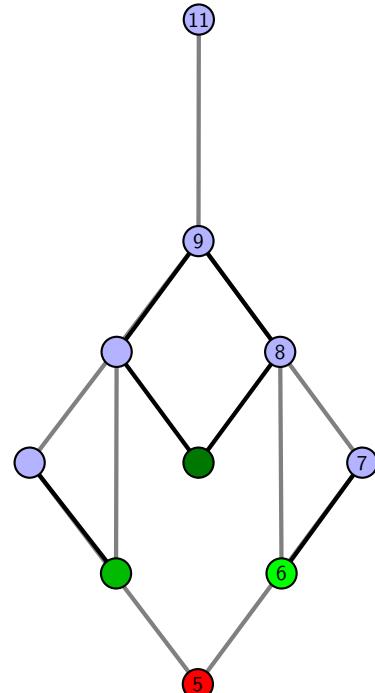


Figure 310: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.56 $[[5, 18, 6, 1], [4, 9, 5, 10], [14, 17, 15, 18], [6, 15, 7, 16], [1, 11, 2, 10], [12, 3, 13, 4], [13, 8, 14, 9], [16, 7, 17, 8], [11, 3, 12, 2]]$

PD code drawn by `SnapPy`: $[(9, 18, 10, 1), (13, 4, 14, 5), (10, 5, 11, 6), (1, 6, 2, 7), (7, 16, 8, 17), (3, 12, 4, 13), (11, 14, 12, 15), (2, 15, 3, 16), (17, 8, 18, 9)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 7, 7], [0, 8, 8, 1], [1, 8, 8, 6], [1, 5, 7, 2], [2, 6, 3, 3], [4, 5, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.6

Total minimal pinning sets: 8

Average minimal degree: 2.55

Total pinning sets: 128

Average overall degree: 3.0

Pinning number: 5

Table 154: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	7
Nonminimal pinning sets	0	6	36	43	26	8	1	120
Average degree	2.6	2.67	2.89	3.05	3.15	3.23	3.27	

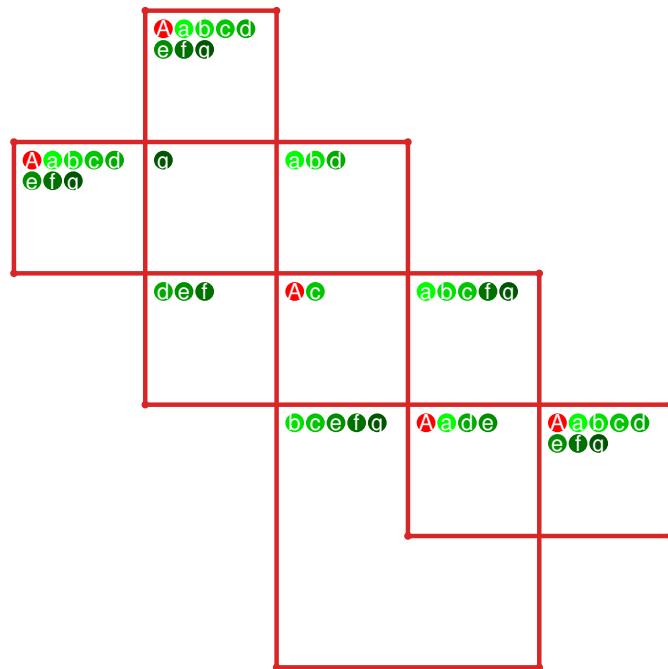


Figure 311: `SnapPy` multiloop plot.

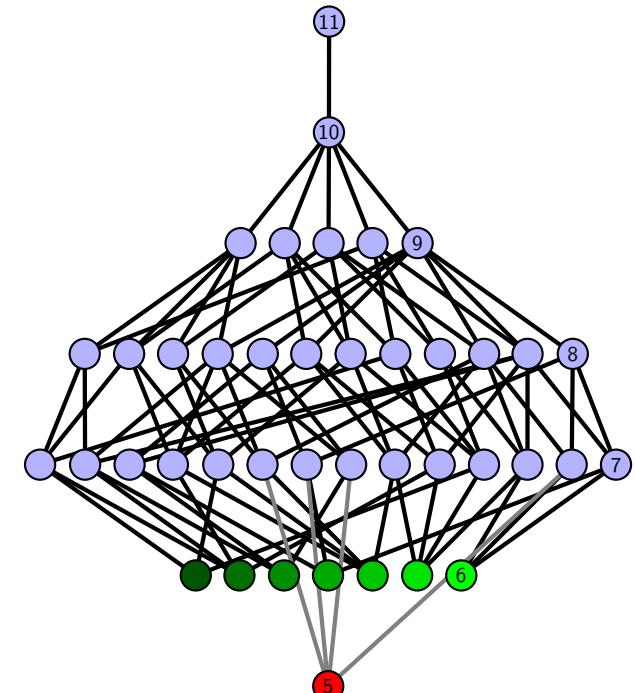


Figure 312: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.57 $[[7, 18, 8, 1], [6, 15, 7, 16], [17, 8, 18, 9], [1, 17, 2, 16], [14, 5, 15, 6], [9, 3, 10, 2], [10, 13, 11, 14], [11, 4, 12, 5], [3, 12, 4, 13]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (11, 2, 12, 3), (14, 5, 15, 6), (18, 9, 1, 10), (7, 10, 8, 11), (3, 12, 4, 13), (13, 16, 14, 17), (4, 15, 5, 16), (17, 6, 18, 7)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 4], [0, 5, 3, 0], [0, 2, 5, 1], [1, 6, 7, 1], [2, 8, 6, 3], [4, 5, 8, 7], [4, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.49

Total pinning sets: 100

Average overall degree: 2.98

Pinning number: 5

Table 155: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	6	23	34	24	8	1	96
Average degree	2.4	2.62	2.82	3.0	3.14	3.23	3.27	

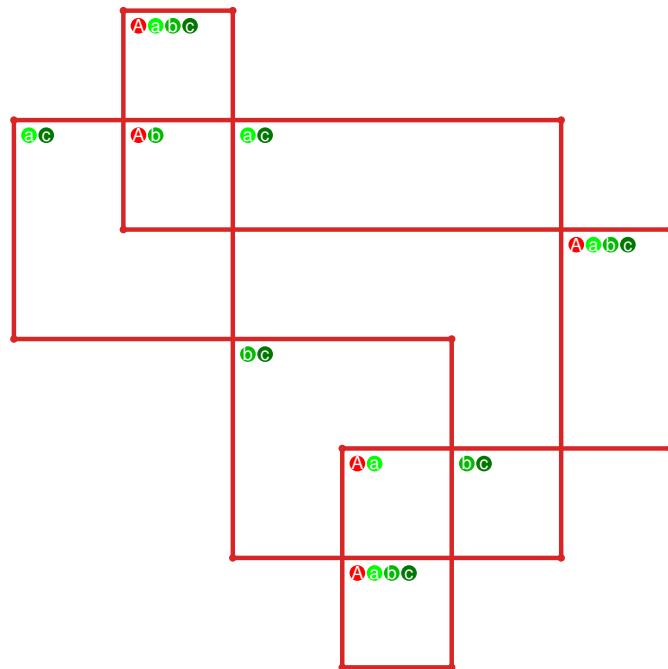


Figure 313: SnapPy multiloop plot.

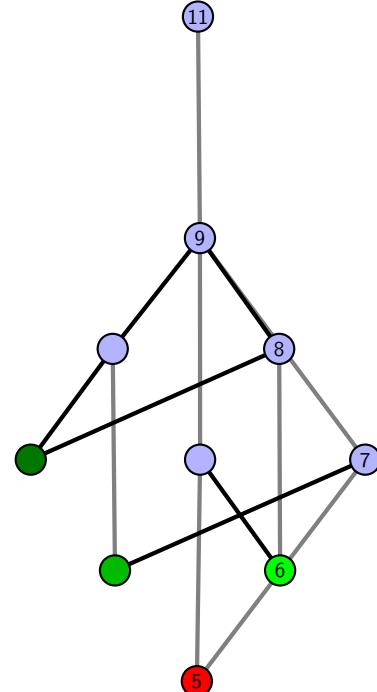


Figure 314: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.58 $[[6, 18, 1, 7], [7, 17, 8, 16], [5, 2, 6, 3], [17, 1, 18, 2], [8, 15, 9, 16], [3, 11, 4, 12], [12, 4, 13, 5], [14, 9, 15, 10], [10, 13, 11, 14]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (13, 4, 14, 5), (2, 5, 3, 6), (10, 17, 11, 18), (6, 7, 1, 8), (18, 9, 7, 10), (16, 11, 17, 12), (12, 15, 13, 16), (3, 14, 4, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 6, 3], [0, 2, 1, 0], [1, 7, 7, 1], [2, 8, 6, 6], [2, 5, 5, 8], [4, 8, 8, 4], [5, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 64
Pinning number: 5

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.84

Table 156: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

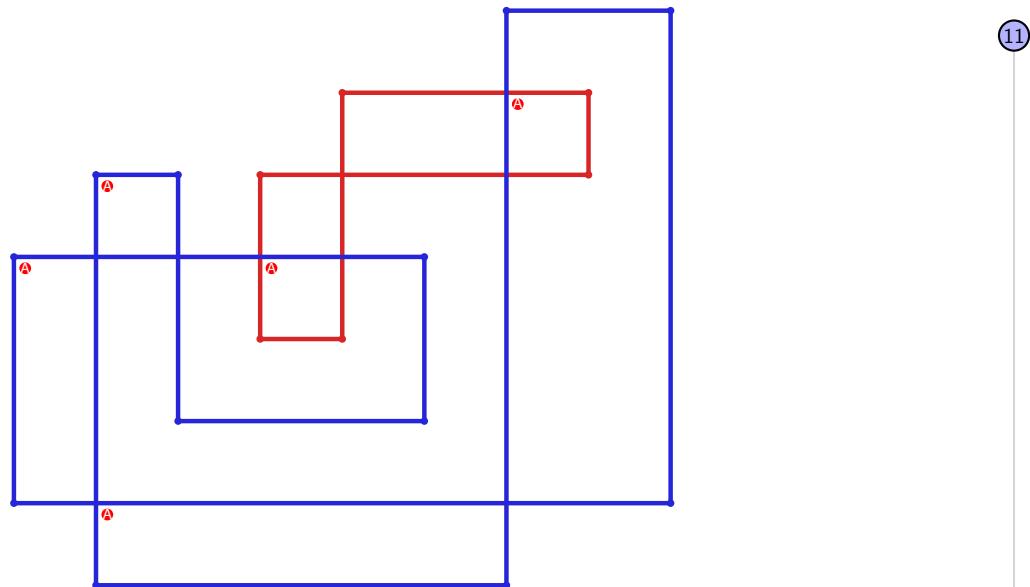


Figure 315: SnapPy multiloop plot.

Figure 316: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.59 $[[3, 6, 4, 1], [2, 12, 3, 7], [5, 18, 6, 13], [4, 18, 5, 17], [1, 8, 2, 7], [8, 11, 9, 12], [13, 16, 14, 17], [14, 10, 15, 11], [9, 15, 10, 16]]$

PD code drawn by SnapPy: $[(1, 4, 2, 5), (16, 11, 17, 12), (9, 12, 10, 7), (6, 7, 1, 8), (8, 5, 9, 6), (10, 17, 11, 18), (15, 18, 16, 13), (13, 2, 14, 3), (3, 14, 4, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 3, 3], [0, 2, 2, 6], [0, 5, 1, 1], [1, 4, 7, 8], [2, 8, 7, 3], [5, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 3

Table 157: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.44	2.7	2.88	3.0	3.09	3.17	3.23	3.27	

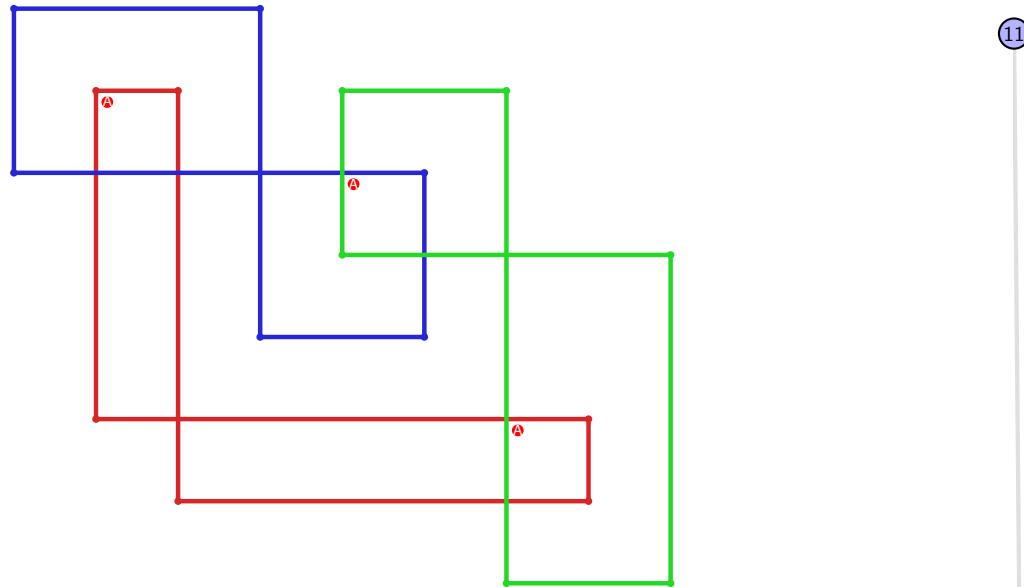


Figure 317: SnapPy multiloop plot.



Figure 318: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.60 $[[3, 10, 4, 1], [2, 18, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [12, 17, 13, 18], [5, 8, 6, 9], [16, 13, 17, 14], [7, 15, 8, 16], [6, 15, 7, 14]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (6, 3, 7, 4), (2, 7, 3, 8), (12, 17, 13, 18), (18, 9, 11, 10), (10, 11, 1, 12), (16, 13, 17, 14), (5, 14, 6, 15), (15, 4, 16, 5)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 4, 1, 1], [1, 3, 6, 6], [2, 7, 8, 2], [4, 8, 7, 4], [5, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 158: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

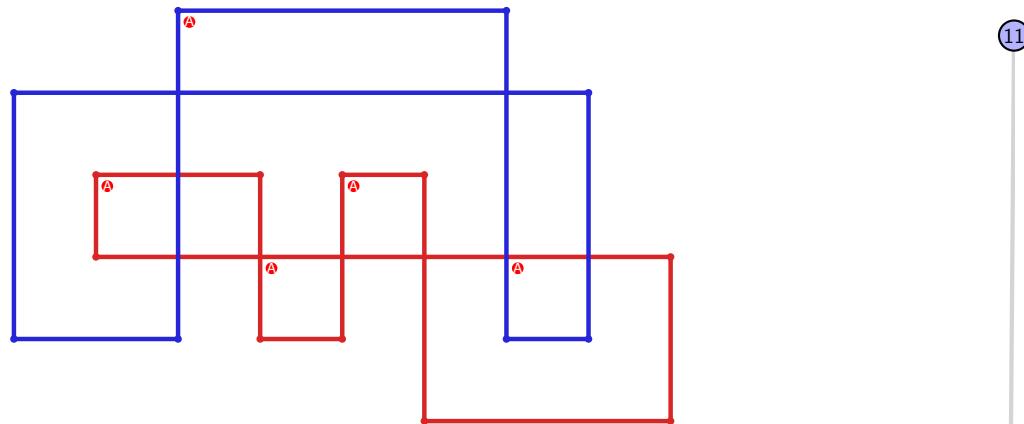


Figure 319: `SnapPy` multiloop plot.

5

Figure 320: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.61 $[[3, 12, 4, 1], [2, 18, 3, 13], [11, 6, 12, 7], [4, 10, 5, 9], [1, 14, 2, 13], [14, 17, 15, 18], [7, 15, 8, 16], [5, 10, 6, 11], [16, 8, 17, 9]]$

PD code drawn by `SnapPy`: $[(9, 4, 10, 5), (17, 6, 18, 7), (7, 2, 8, 3), (3, 8, 4, 9), (1, 10, 2, 11), (15, 18, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12), (5, 16, 6, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 7, 8], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 8, 8], [2, 3, 3, 2], [3, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 159: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

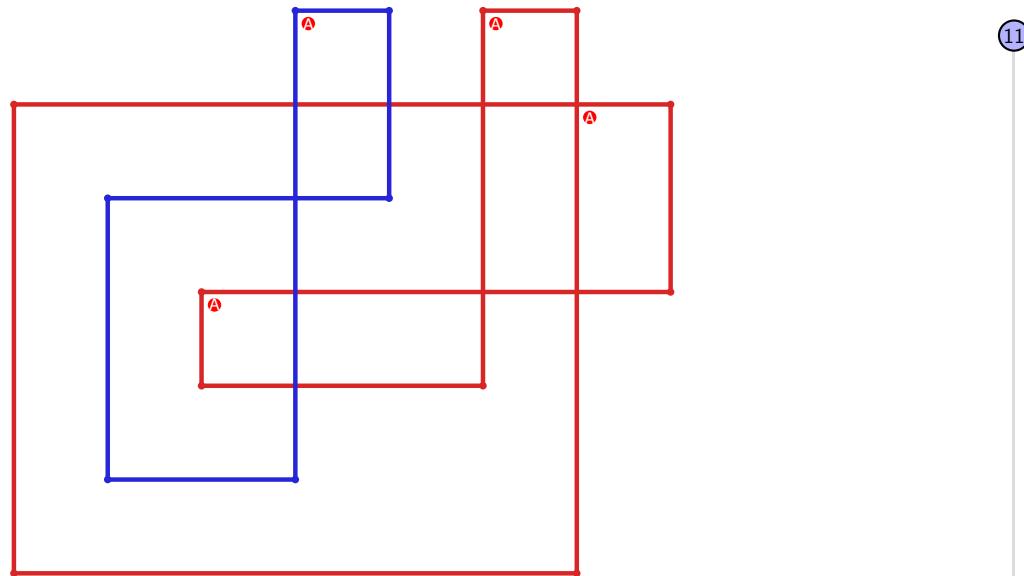


Figure 321: `SnapPy` multiloop plot.

4

Figure 322: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.62 $[[3, 12, 4, 1], [2, 18, 3, 13], [6, 11, 7, 12], [4, 7, 5, 8], [1, 14, 2, 13], [14, 17, 15, 18], [10, 5, 11, 6], [8, 16, 9, 17], [15, 9, 16, 10]]$

PD code drawn by SnapPy: $[(8, 3, 9, 4), (2, 5, 3, 6), (16, 7, 17, 8), (4, 9, 5, 10), (1, 10, 2, 11), (6, 17, 7, 18), (15, 18, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 7, 8], [2, 8, 3, 2], [3, 8, 8, 5], [5, 7, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 4

Table 160: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.25	2.58	2.81	2.96	3.08	3.16	3.23	3.27	

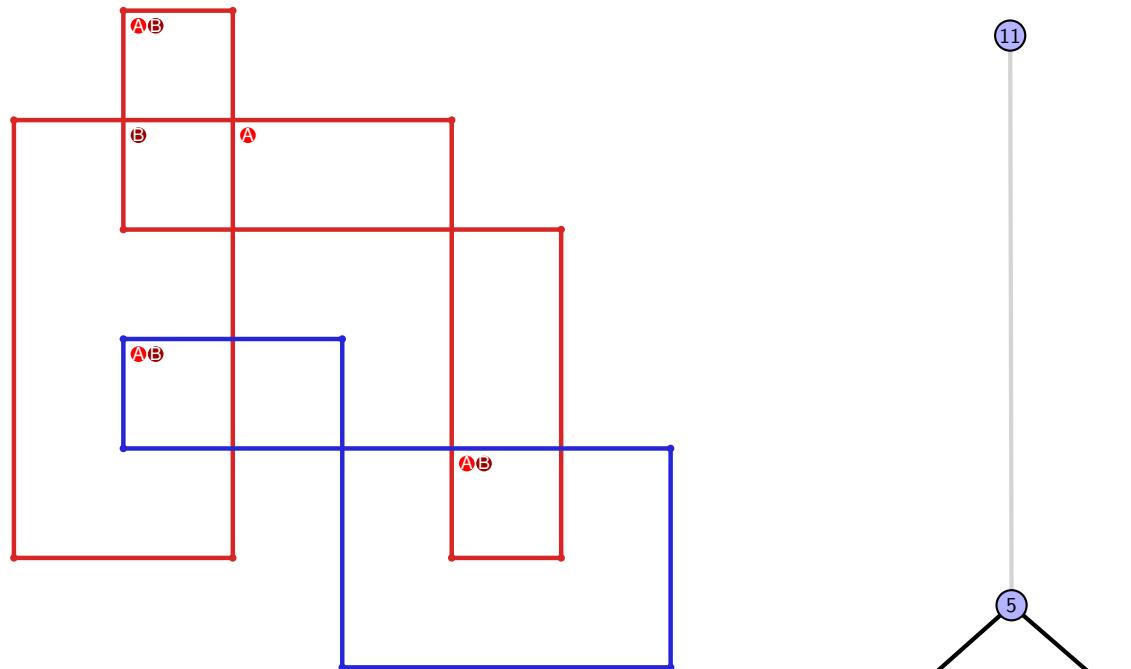


Figure 323: SnapPy multiloop plot.

Figure 324: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.63 $[[3, 8, 4, 1], [2, 14, 3, 9], [7, 4, 8, 5], [1, 10, 2, 9], [10, 13, 11, 14], [5, 15, 6, 18], [6, 17, 7, 18], [12, 16, 13, 17], [11, 16, 12, 15]]$

PD code drawn by `SnapPy`: $[(5, 2, 6, 3), (1, 6, 2, 7), (11, 14, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8), (17, 12, 18, 13), (13, 18, 14, 15), (4, 15, 5, 16), (16, 3, 17, 4)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 8], [2, 8, 6, 6], [2, 5, 5, 7], [4, 6, 8, 8], [4, 7, 7, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.9

Table 161: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

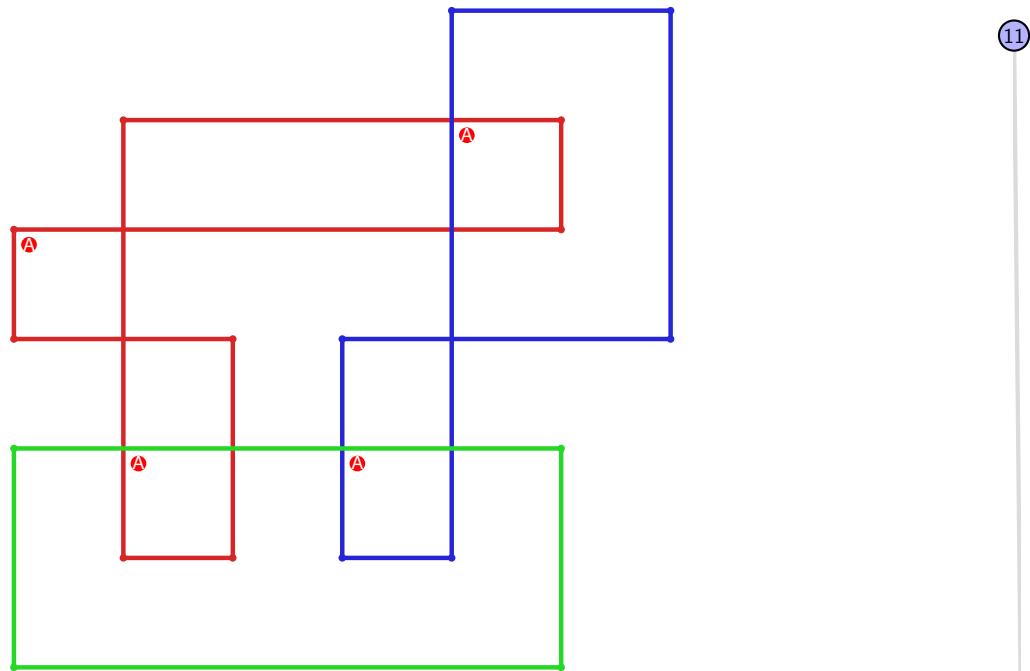


Figure 325: `SnapPy` multiloop plot.

4

11

Figure 326: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.64 $[[4, 8, 1, 5], [5, 9, 6, 14], [3, 18, 4, 15], [7, 1, 8, 2], [9, 7, 10, 6], [10, 13, 11, 14], [15, 11, 16, 12], [17, 2, 18, 3], [12, 16, 13, 17]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (18, 3, 15, 4), (2, 15, 3, 16), (17, 12, 18, 13), (13, 10, 14, 11), (11, 16, 12, 17), (7, 14, 8, 9), (9, 8, 10, 5), (1, 6, 2, 7)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 4, 0], [1, 3, 5, 1], [1, 4, 8, 6], [2, 5, 8, 8], [2, 8, 3, 2], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 162: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

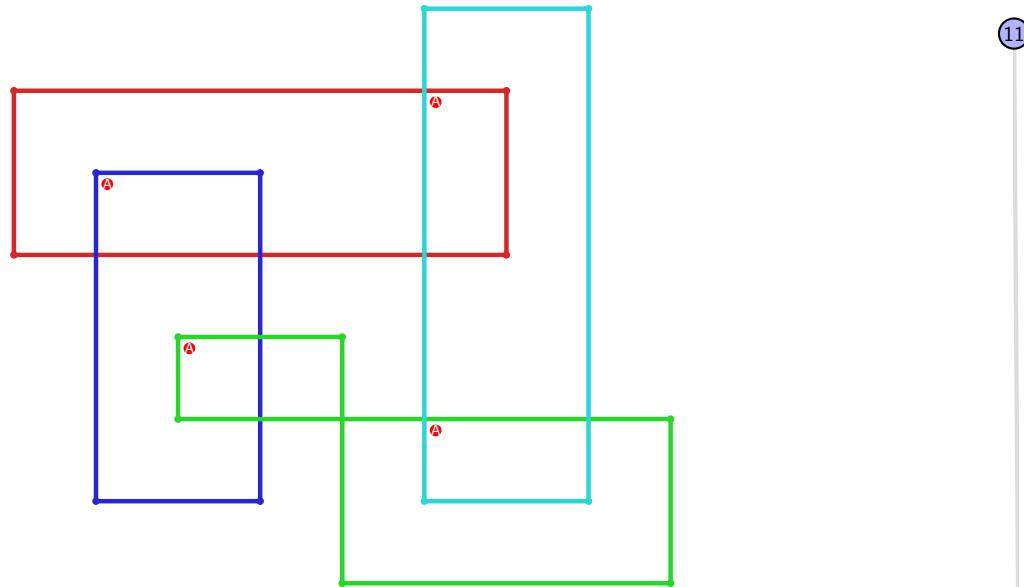


Figure 327: `SnapPy` multiloop plot.

4

Figure 328: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.65 $[[11, 14, 12, 1], [3, 10, 4, 11], [13, 18, 14, 15], [12, 18, 13, 17], [1, 8, 2, 9], [9, 2, 10, 3], [4, 8, 5, 7], [15, 7, 16, 6], [16, 5, 17, 6]]$

PD code drawn by `SnapPy`: $[(7, 14, 8, 1), (16, 3, 17, 4), (4, 15, 5, 16), (5, 2, 6, 3), (13, 6, 14, 7), (1, 8, 2, 9), (9, 12, 10, 13), (17, 10, 18, 11), (11, 18, 12, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 3, 3], [0, 2, 2, 8], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 8, 7], [2, 6, 8, 8], [3, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 163: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

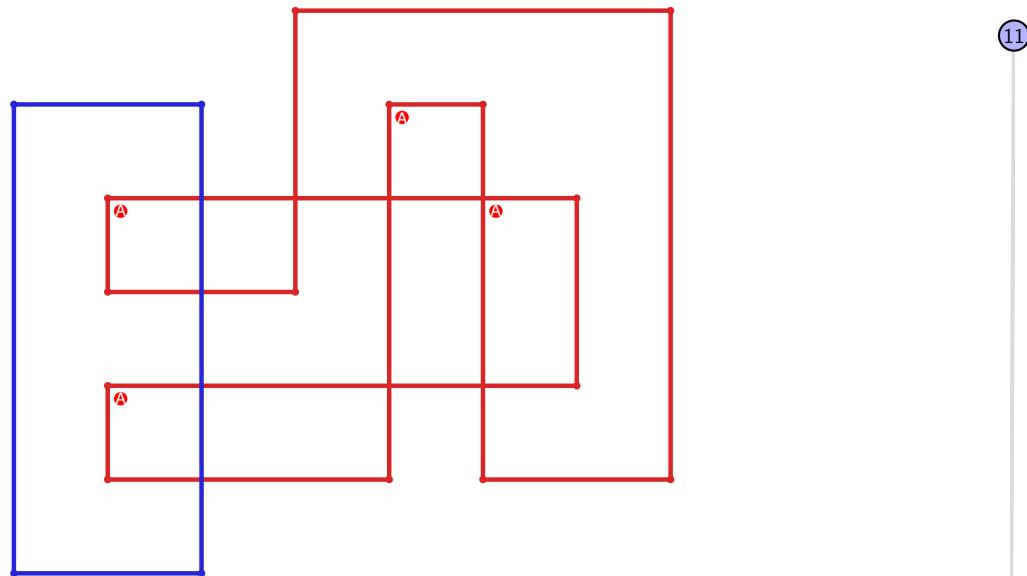


Figure 329: `SnapPy` multiloop plot.

11
4

Figure 330: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.66 [[14, 11, 1, 12], [12, 5, 13, 6], [6, 13, 7, 14], [7, 10, 8, 11], [1, 4, 2, 5], [9, 18, 10, 15], [8, 18, 9, 17], [3, 16, 4, 17], [2, 16, 3, 15]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (9, 2, 10, 3), (4, 7, 5, 8), (11, 8, 12, 9), (3, 10, 4, 11), (18, 13, 15, 14), (14, 15, 1, 16), (16, 5, 17, 6), (6, 17, 7, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 2, 2], [0, 1, 1, 3], [0, 2, 5, 6], [0, 7, 8, 1], [3, 8, 6, 6], [3, 5, 5, 7], [4, 6, 8, 8], [4, 7, 7, 5]]

Total optimal pinning sets: 7
 Total minimal pinning sets: 7
 Total pinning sets: 158
 Pinning number: 5

Average optimal degree: 2.54
 Average minimal degree: 2.54
 Average overall degree: 2.98

Table 164: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	7	0	0	0	0	0	0	7
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	26	45	45	26	8	1	151
Average degree	2.54	2.77	2.93	3.06	3.15	3.23	3.27	

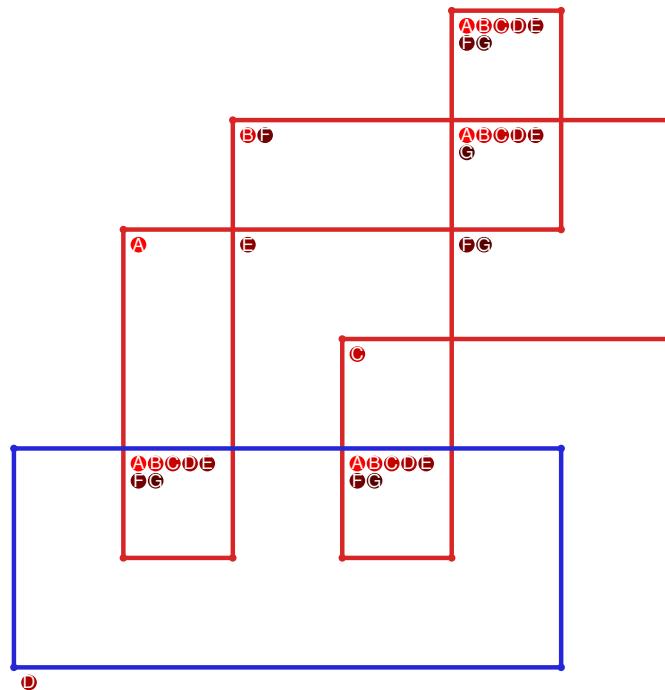


Figure 331: SnapPy multiloop plot.

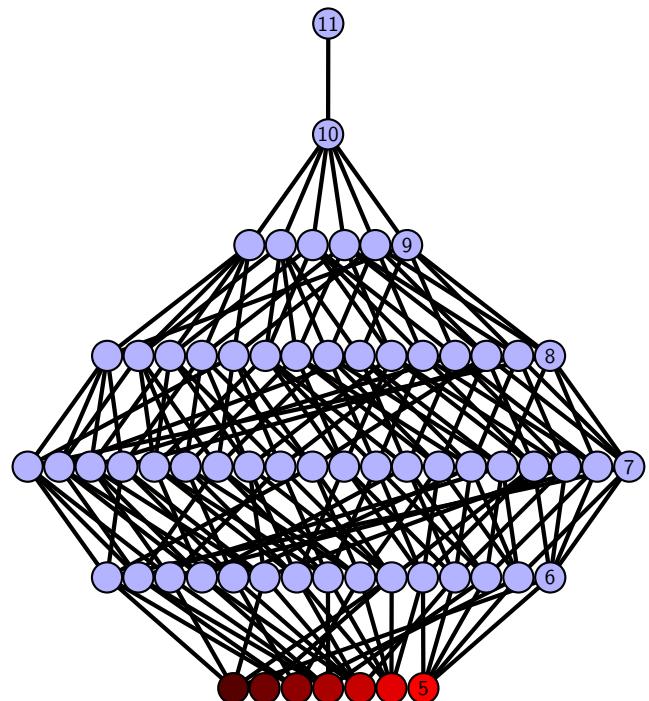


Figure 332: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.67 $[[6, 12, 1, 7], [7, 5, 8, 6], [11, 18, 12, 13], [1, 4, 2, 5], [8, 16, 9, 15], [13, 10, 14, 11], [3, 17, 4, 18], [2, 17, 3, 16], [9, 14, 10, 15]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (14, 3, 15, 4), (10, 17, 11, 18), (4, 13, 5, 14), (12, 15, 7, 16), (7, 6, 8, 1), (1, 8, 2, 9), (18, 9, 13, 10), (16, 11, 17, 12)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 5, 5, 6], [0, 6, 7, 1], [1, 7, 8, 8], [2, 8, 8, 2], [2, 7, 7, 3], [3, 6, 6, 4], [4, 5, 5, 4]]$

Total optimal pinning sets: 4

Average optimal degree: 2.25

Total minimal pinning sets: 4

Average minimal degree: 2.25

Total pinning sets: 60

Average overall degree: 2.85

Pinning number: 6

Table 165: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	14	20	15	6	1	56
Average degree	2.25	2.63	2.88	3.04	3.17	3.27	

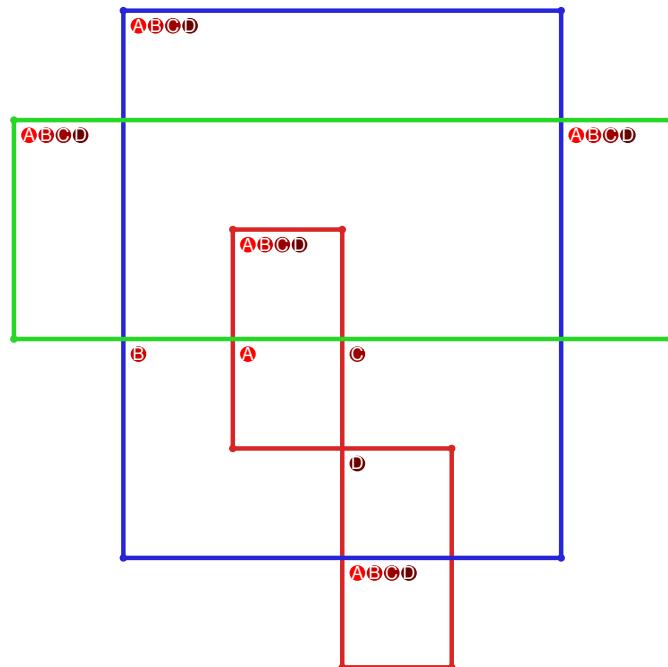


Figure 333: SnapPy multiloop plot.

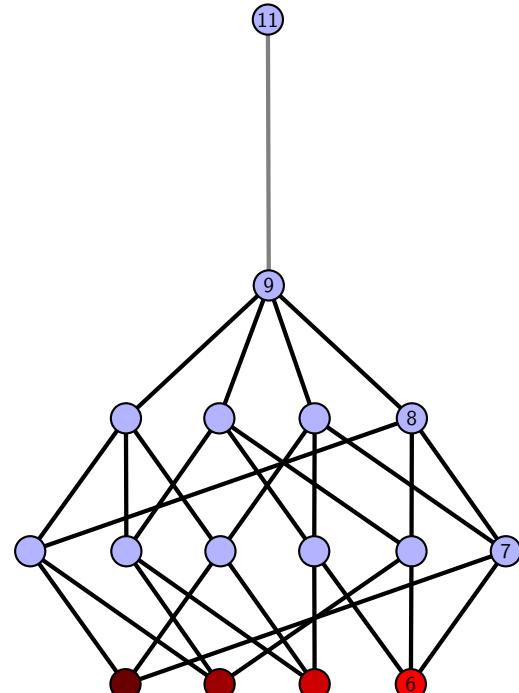


Figure 334: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.68 $[[6, 12, 1, 7], [7, 5, 8, 6], [11, 18, 12, 13], [1, 4, 2, 5], [8, 14, 9, 13], [15, 10, 16, 11], [3, 17, 4, 18], [2, 17, 3, 16], [14, 10, 15, 9]]$

PD code drawn by `SnapPy`: $[(5, 2, 6, 3), (14, 3, 15, 4), (12, 17, 7, 18), (4, 13, 5, 14), (16, 11, 17, 12), (7, 6, 8, 1), (1, 8, 2, 9), (18, 9, 13, 10), (10, 15, 11, 16)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 5, 6], [0, 6, 7, 1], [1, 8, 8, 2], [2, 8, 8, 7], [2, 7, 7, 3], [3, 6, 6, 5], [4, 5, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 166: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

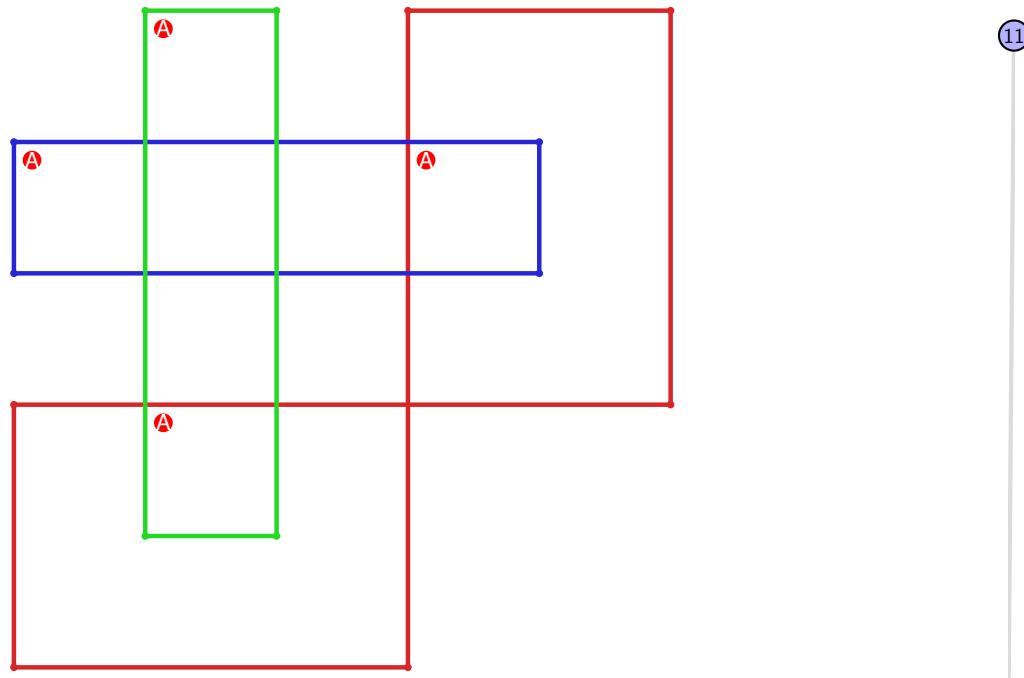


Figure 335: `SnapPy` multiloop plot.

Figure 336: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.69 $[[7, 18, 8, 1], [17, 6, 18, 7], [8, 11, 9, 12], [1, 4, 2, 5], [5, 16, 6, 17], [10, 15, 11, 16], [9, 15, 10, 14], [12, 3, 13, 4], [2, 13, 3, 14]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (17, 2, 18, 3), (15, 4, 16, 5), (6, 9, 7, 10), (18, 11, 1, 12), (12, 7, 13, 8), (8, 13, 9, 14), (3, 14, 4, 15), (5, 16, 6, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 7], [0, 7, 8, 4], [1, 3, 5, 1], [2, 4, 6, 6], [2, 5, 5, 8], [2, 8, 8, 3], [3, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 167: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

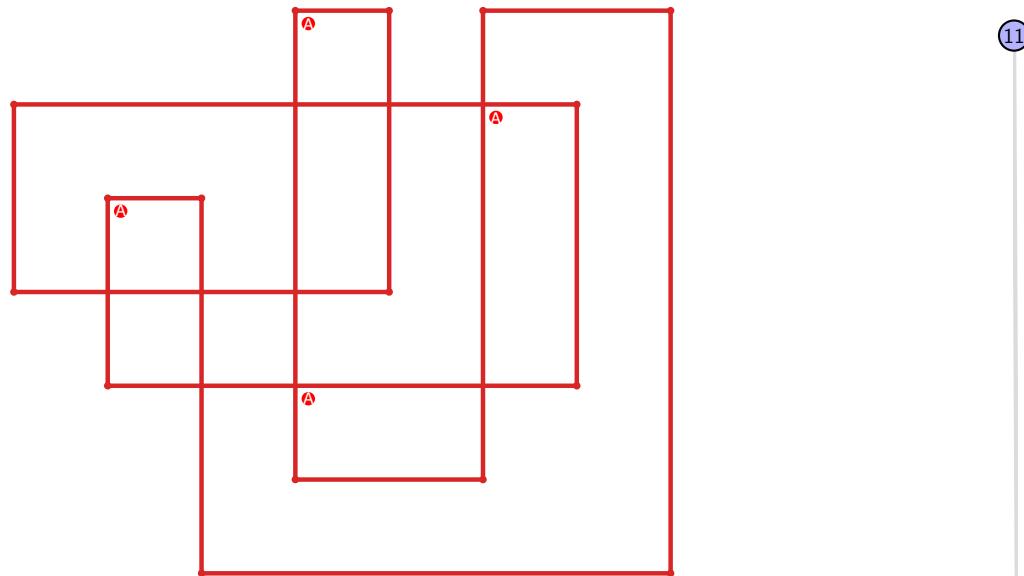


Figure 337: SnapPy multiloop plot.



Figure 338: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.70 [[12, 18, 1, 13], [13, 17, 14, 16], [11, 4, 12, 5], [17, 1, 18, 2], [14, 8, 15, 9], [9, 15, 10, 16], [5, 10, 6, 11], [6, 3, 7, 4], [2, 7, 3, 8]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (9, 2, 10, 3), (12, 5, 1, 6), (13, 6, 14, 7), (3, 8, 4, 9), (16, 11, 17, 12), (7, 14, 8, 15), (15, 18, 16, 13), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 8, 1, 0], [1, 8, 5, 5], [1, 4, 4, 6], [2, 5, 7, 2], [2, 6, 8, 8], [3, 7, 7, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 168: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

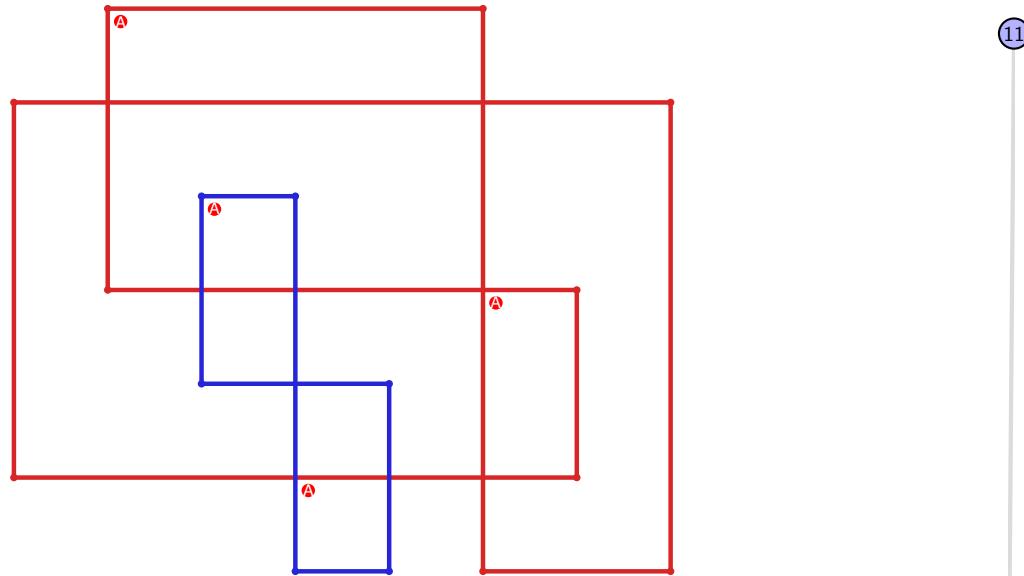


Figure 339: SnapPy multiloop plot.



Figure 340: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.71 $[[8, 14, 1, 9], [9, 13, 10, 12], [7, 18, 8, 15], [13, 1, 14, 2], [10, 4, 11, 5], [5, 11, 6, 12], [15, 6, 16, 7], [17, 2, 18, 3], [3, 16, 4, 17]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (13, 2, 14, 3), (11, 4, 12, 5), (16, 7, 17, 8), (3, 14, 4, 15), (15, 18, 16, 13), (6, 17, 7, 18), (5, 10, 6, 11), (1, 12, 2, 9)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 7, 1, 0], [1, 8, 5, 5], [1, 4, 4, 6], [2, 5, 8, 2], [2, 8, 8, 3], [4, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.9

Table 169: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

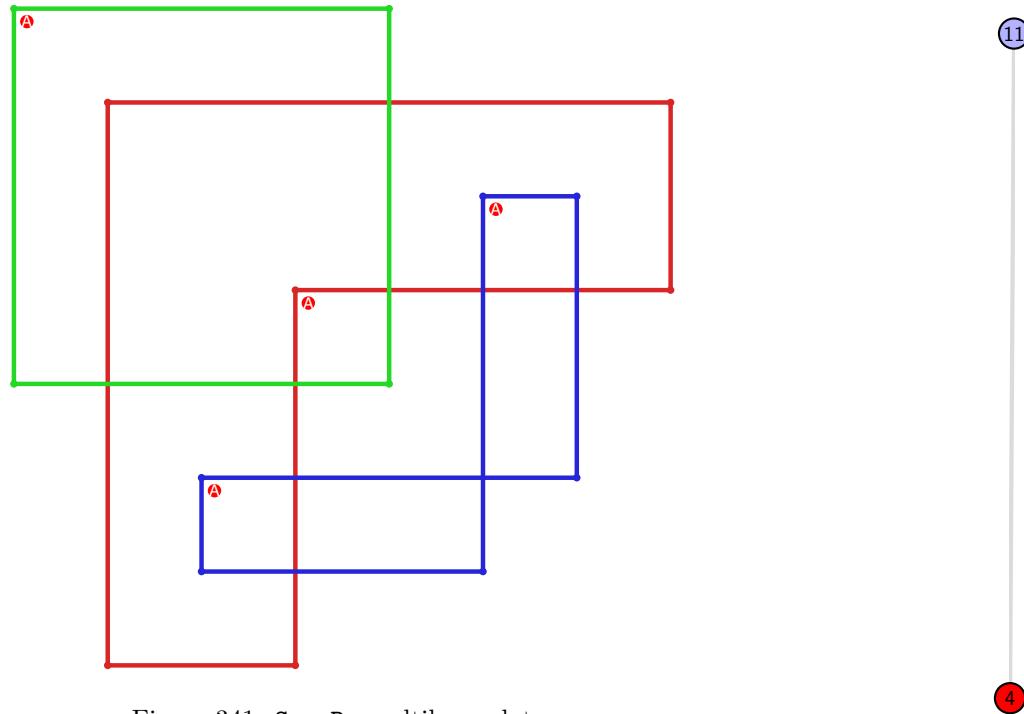


Figure 341: `SnapPy` multiloop plot.

Figure 342: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.72 [[10, 18, 1, 11], [11, 17, 12, 16], [4, 9, 5, 10], [17, 1, 18, 2], [12, 15, 13, 16], [8, 3, 9, 4], [5, 3, 6, 2], [6, 14, 7, 15], [13, 7, 14, 8]]

PD code drawn by SnapPy: [(10, 3, 1, 4), (6, 1, 7, 2), (18, 5, 11, 6), (2, 7, 3, 8), (14, 9, 15, 10), (4, 11, 5, 12), (17, 12, 18, 13), (13, 16, 14, 17), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 5, 6], [0, 6, 1, 0], [1, 7, 8, 1], [2, 8, 6, 2], [2, 5, 7, 3], [4, 6, 8, 8], [4, 7, 7, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 170: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

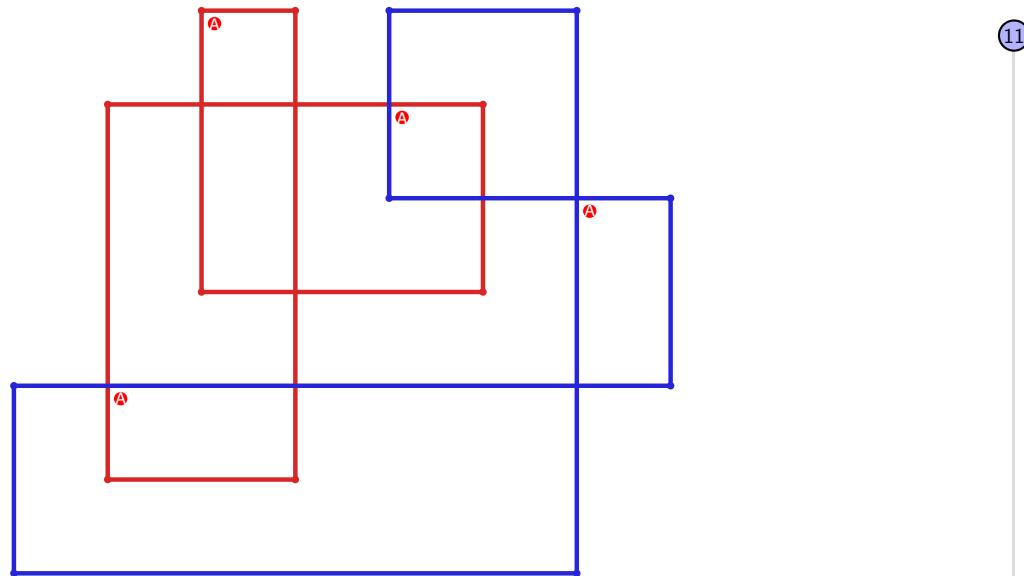


Figure 343: SnapPy multiloop plot.

4

Figure 344: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.73 $[[18, 5, 1, 6], [6, 16, 7, 15], [4, 17, 5, 18], [1, 17, 2, 16], [7, 11, 8, 10], [14, 9, 15, 10], [3, 12, 4, 13], [2, 12, 3, 11], [8, 13, 9, 14]]$

PD code drawn by SnapPy: $[(15, 2, 16, 3), (11, 6, 12, 7), (7, 4, 8, 5), (8, 17, 9, 18), (18, 9, 1, 10), (5, 10, 6, 11), (12, 3, 13, 4), (13, 16, 14, 17), (1, 14, 2, 15)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 7, 1], [1, 7, 8, 5], [1, 4, 8, 8], [2, 8, 7, 7], [3, 6, 6, 4], [4, 6, 5, 5]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4

Total pinning sets: 144

Pinning number: 5

Average optimal degree: 2.4

Average minimal degree: 2.4

Average overall degree: 2.97

Table 171: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.4	2.7	2.91	3.05	3.15	3.23	3.27	

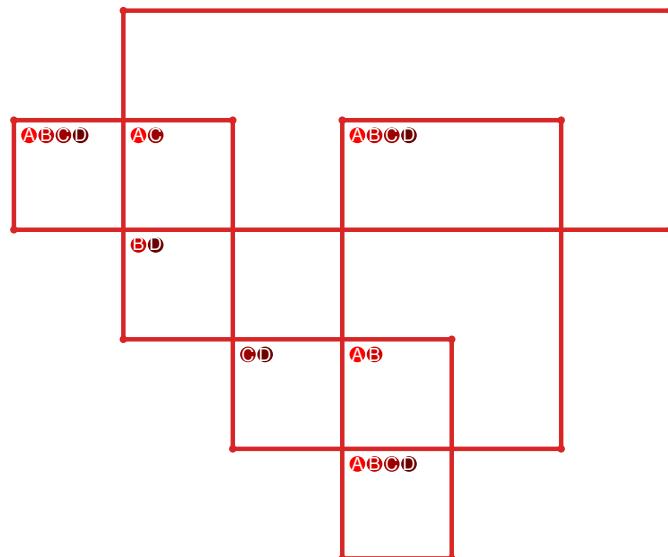


Figure 345: SnapPy multiloop plot.

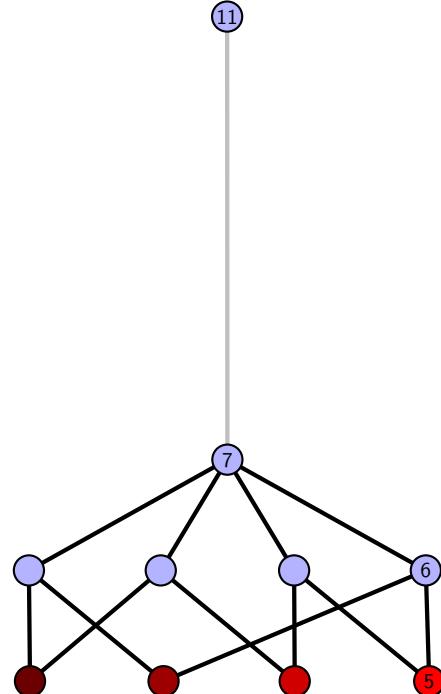


Figure 346: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.74 $[[18, 3, 1, 4], [4, 14, 5, 13], [17, 10, 18, 11], [2, 15, 3, 16], [1, 15, 2, 14], [5, 9, 6, 8], [12, 7, 13, 8], [11, 7, 12, 6], [9, 16, 10, 17]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (4, 9, 5, 10), (10, 5, 11, 6), (6, 3, 7, 4), (15, 8, 16, 9), (11, 2, 12, 3), (12, 17, 13, 18), (18, 13, 1, 14), (7, 14, 8, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 8, 8], [0, 8, 4, 4], [0, 3, 3, 1], [1, 8, 7, 6], [1, 5, 7, 7], [2, 6, 6, 5], [2, 5, 3, 2]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4

Total pinning sets: 144

Pinning number: 5

Average optimal degree: 2.4

Average minimal degree: 2.4

Average overall degree: 2.97

Table 172: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.4	2.7	2.91	3.05	3.15	3.23	3.27	

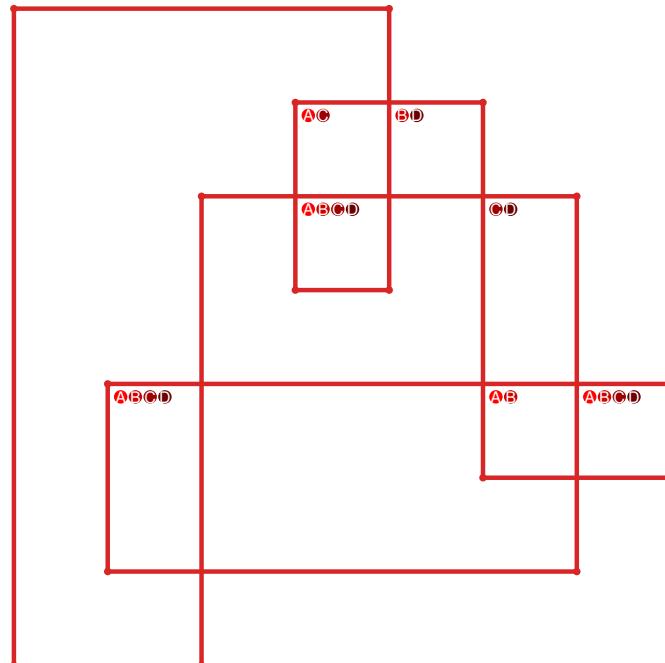


Figure 347: SnapPy multiloop plot.

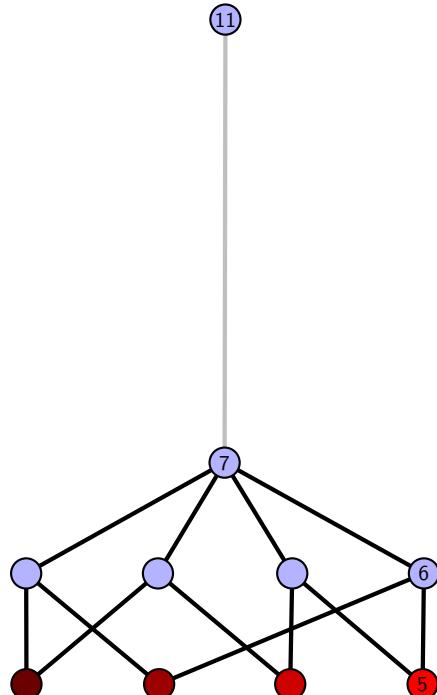


Figure 348: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.75 $[[4, 18, 1, 5], [5, 17, 6, 16], [9, 3, 10, 4], [17, 1, 18, 2], [6, 15, 7, 16], [13, 8, 14, 9], [2, 10, 3, 11], [11, 14, 12, 15], [7, 12, 8, 13]]$

PD code drawn by `SnapPy`: $[(18, 1, 5, 2), (12, 3, 13, 4), (8, 17, 9, 18), (4, 5, 1, 6), (16, 7, 17, 8), (6, 9, 7, 10), (15, 10, 16, 11), (11, 14, 12, 15), (2, 13, 3, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 6, 6], [0, 6, 1, 0], [1, 7, 8, 1], [2, 8, 8, 7], [2, 7, 3, 2], [4, 6, 5, 8], [4, 7, 5, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 173: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

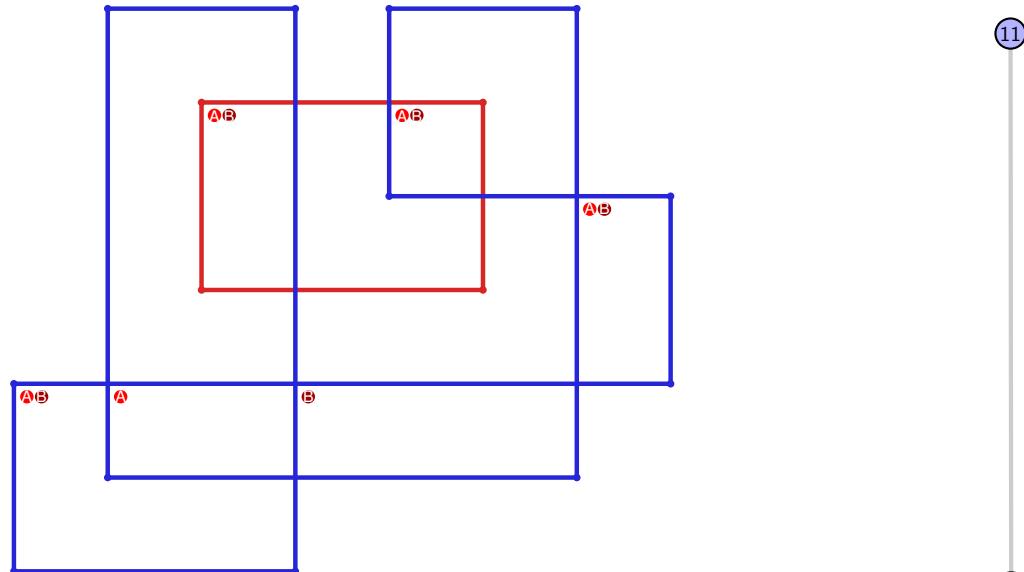


Figure 349: `SnapPy` multiloop plot.

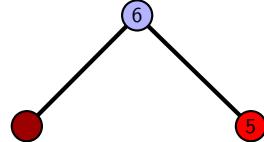


Figure 350: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.76 $[[9, 18, 10, 1], [17, 8, 18, 9], [10, 5, 11, 6], [1, 16, 2, 17], [4, 7, 5, 8], [11, 7, 12, 6], [12, 15, 13, 16], [2, 13, 3, 14], [14, 3, 15, 4]]$

PD code drawn by `SnapPy`: $[(12, 1, 13, 2), (8, 3, 9, 4), (4, 9, 5, 10), (2, 5, 3, 6), (15, 6, 16, 7), (18, 11, 1, 12), (10, 13, 11, 14), (17, 14, 18, 15), (7, 16, 8, 17)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 5, 5], [0, 6, 7, 1], [1, 8, 5, 2], [2, 4, 6, 2], [3, 5, 8, 7], [3, 6, 8, 8], [4, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.42

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 4

Table 174: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.25	2.56	2.78	2.95	3.07	3.16	3.23	3.27	

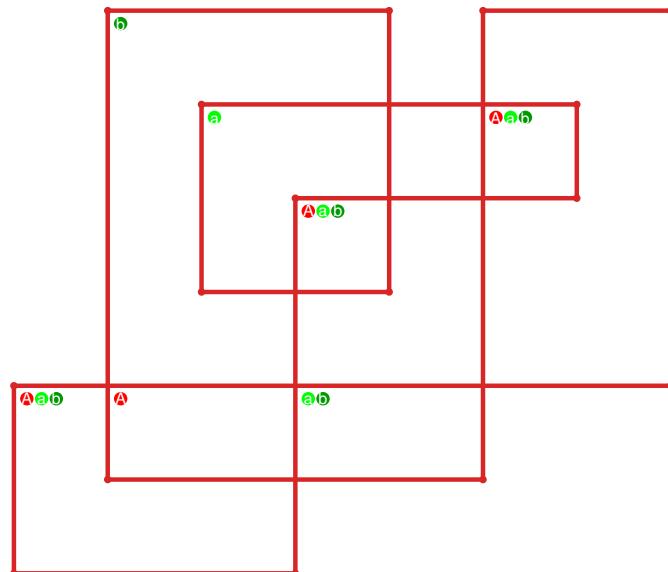


Figure 351: `SnapPy` multiloop plot.

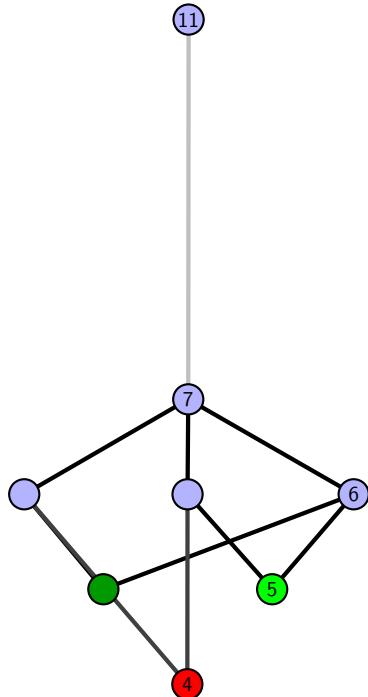


Figure 352: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.77 $[[7, 18, 8, 1], [17, 6, 18, 7], [8, 11, 9, 12], [1, 16, 2, 17], [10, 5, 11, 6], [9, 5, 10, 4], [12, 15, 13, 16], [2, 13, 3, 14], [14, 3, 15, 4]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (2, 7, 3, 8), (8, 3, 9, 4), (15, 4, 16, 5), (6, 9, 7, 10), (18, 11, 1, 12), (10, 13, 11, 14), (17, 14, 18, 15), (5, 16, 6, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 5, 6], [0, 6, 7, 1], [1, 5, 5, 2], [2, 4, 4, 8], [2, 8, 7, 3], [3, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.42

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 4

Table 175: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.25	2.56	2.78	2.95	3.07	3.16	3.23	3.27	

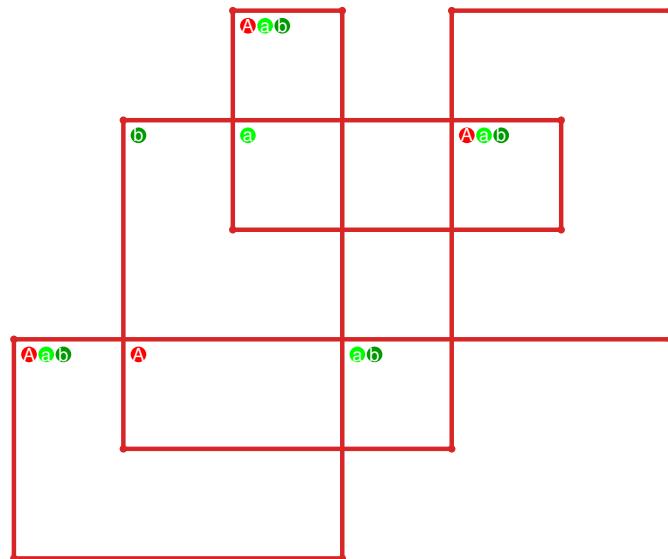


Figure 353: SnapPy multiloop plot.

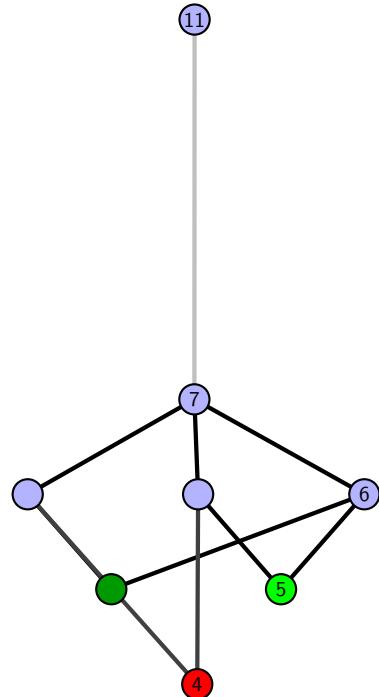


Figure 354: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.78 $[[18, 7, 1, 8], [8, 17, 9, 18], [11, 6, 12, 7], [1, 16, 2, 17], [9, 4, 10, 5], [5, 10, 6, 11], [12, 15, 13, 16], [2, 13, 3, 14], [14, 3, 15, 4]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (7, 2, 8, 3), (9, 4, 10, 5), (16, 5, 17, 6), (3, 8, 4, 9), (18, 11, 1, 12), (10, 13, 11, 14), (17, 14, 18, 15), (6, 15, 7, 16)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 5, 5, 6], [0, 6, 7, 1], [1, 8, 5, 5], [2, 4, 4, 2], [2, 8, 7, 3], [3, 6, 8, 8], [4, 7, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 176: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

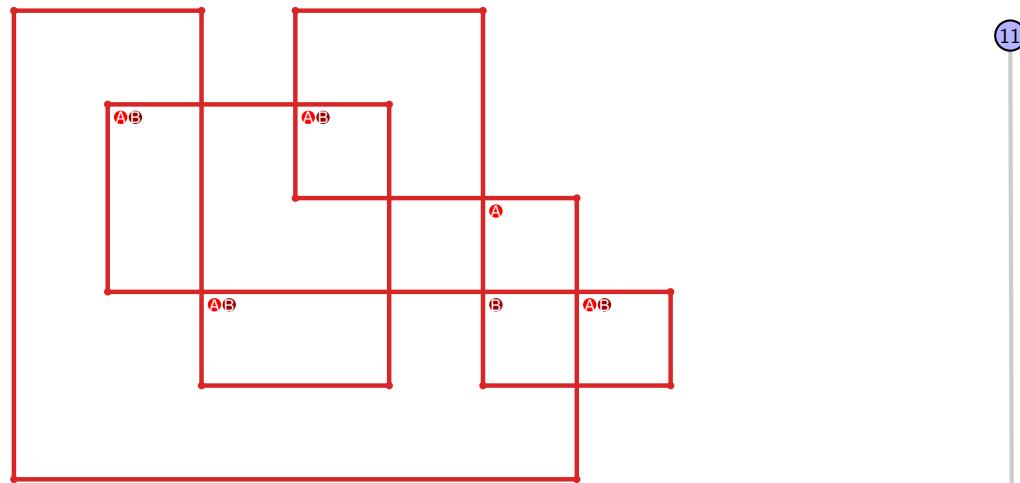


Figure 355: SnapPy multiloop plot.

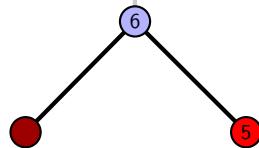


Figure 356: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.79 $[[10, 14, 1, 11], [11, 9, 12, 10], [5, 13, 6, 14], [1, 8, 2, 9], [12, 4, 13, 5], [6, 15, 7, 18], [7, 17, 8, 18], [2, 17, 3, 16], [3, 15, 4, 16]]$

PD code drawn by SnapPy: $[(15, 2, 16, 3), (9, 6, 10, 7), (18, 7, 15, 8), (3, 16, 4, 17), (8, 17, 9, 18), (11, 10, 12, 1), (5, 12, 6, 13), (13, 4, 14, 5), (1, 14, 2, 11)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 6, 7, 1], [1, 8, 2, 2], [2, 8, 6, 6], [3, 5, 5, 7], [3, 6, 8, 8], [4, 7, 7, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 177: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

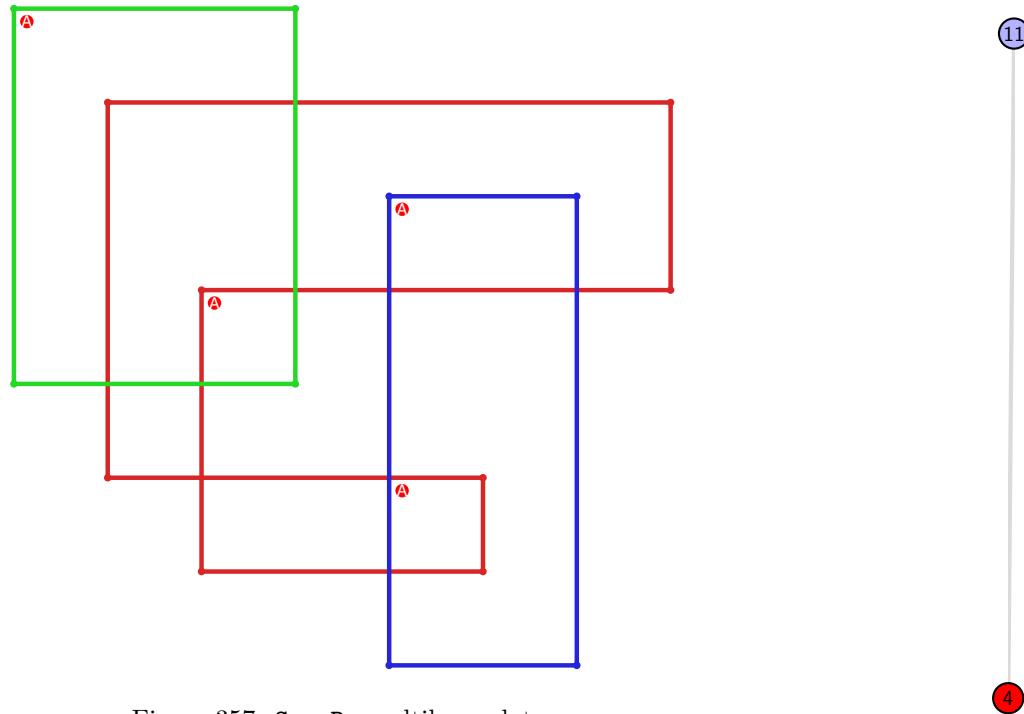


Figure 357: SnapPy multiloop plot.

Figure 358: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.80 [[8, 12, 1, 9], [9, 7, 10, 8], [11, 18, 12, 13], [1, 6, 2, 7], [10, 14, 11, 13], [5, 17, 6, 18], [2, 17, 3, 16], [14, 4, 15, 5], [3, 15, 4, 16]]

PD code drawn by SnapPy: [(13, 2, 14, 3), (7, 4, 8, 5), (16, 5, 17, 6), (6, 15, 7, 16), (1, 14, 2, 9), (9, 8, 10, 1), (3, 10, 4, 11), (18, 11, 15, 12), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 7, 6, 3], [3, 5, 8, 8], [4, 8, 8, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 178: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

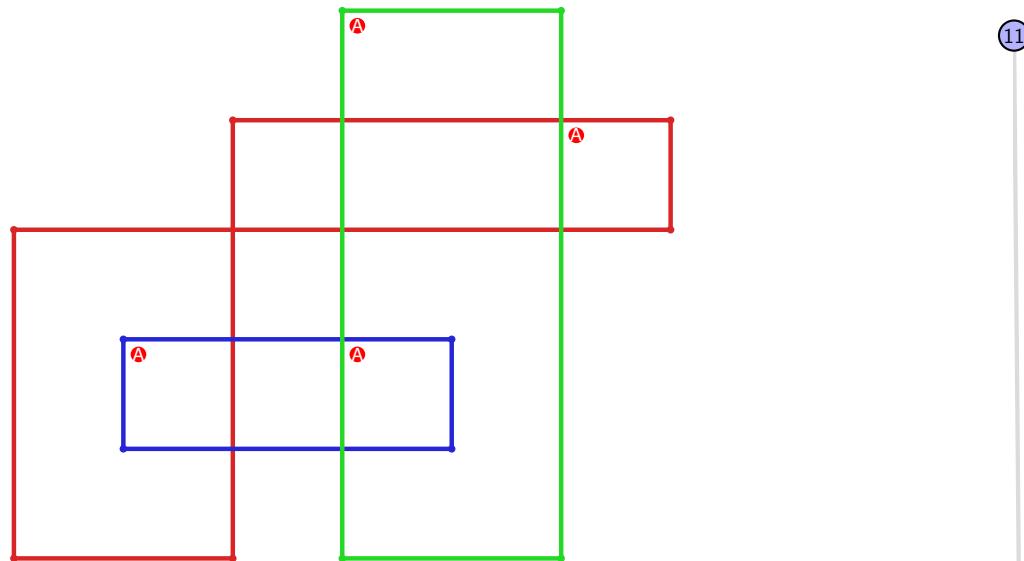


Figure 359: SnapPy multiloop plot.



Figure 360: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.81 $[[4, 14, 1, 5], [5, 11, 6, 10], [3, 18, 4, 15], [13, 1, 14, 2], [11, 7, 12, 6], [9, 15, 10, 16], [17, 2, 18, 3], [12, 7, 13, 8], [16, 8, 17, 9]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (18, 3, 9, 4), (11, 16, 12, 17), (17, 12, 18, 13), (8, 13, 5, 14), (15, 10, 16, 11), (2, 9, 3, 10), (1, 6, 2, 7), (14, 7, 15, 8)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 0], [1, 7, 7, 1], [1, 8, 8, 2], [2, 8, 3, 2], [3, 8, 4, 4], [5, 7, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 179: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

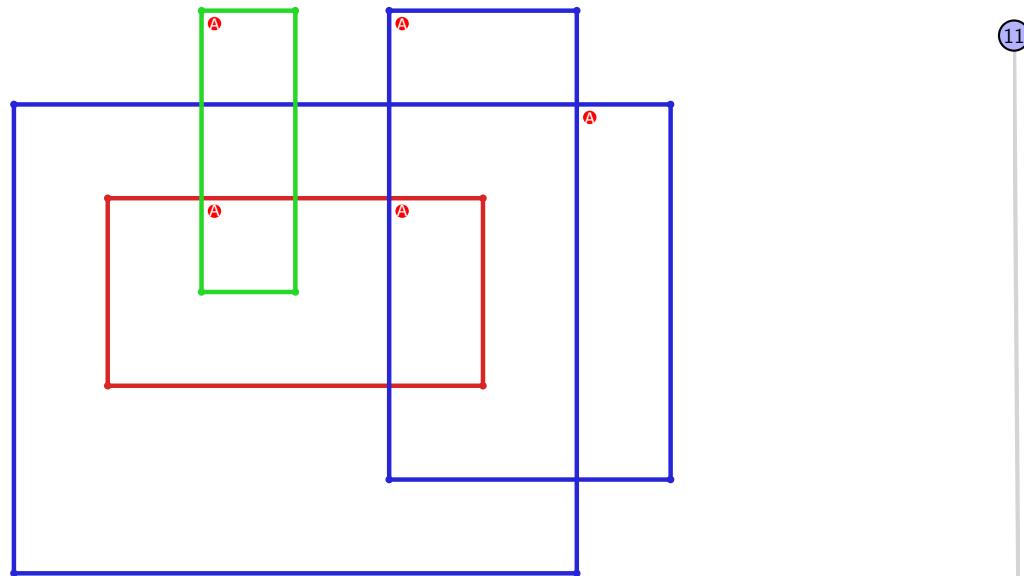


Figure 361: `SnapPy` multiloop plot.

5

Figure 362: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.82 $[[10, 3, 1, 4], [4, 11, 5, 14], [9, 18, 10, 15], [2, 7, 3, 8], [1, 7, 2, 6], [11, 6, 12, 5], [13, 15, 14, 16], [17, 8, 18, 9], [12, 17, 13, 16]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (3, 12, 4, 13), (4, 9, 5, 10), (10, 5, 1, 6), (15, 6, 16, 7), (11, 2, 12, 3), (18, 13, 15, 14), (7, 16, 8, 17), (14, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 7, 4, 4], [0, 3, 3, 5], [1, 4, 8, 1], [1, 8, 8, 2], [2, 8, 3, 2], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 180: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

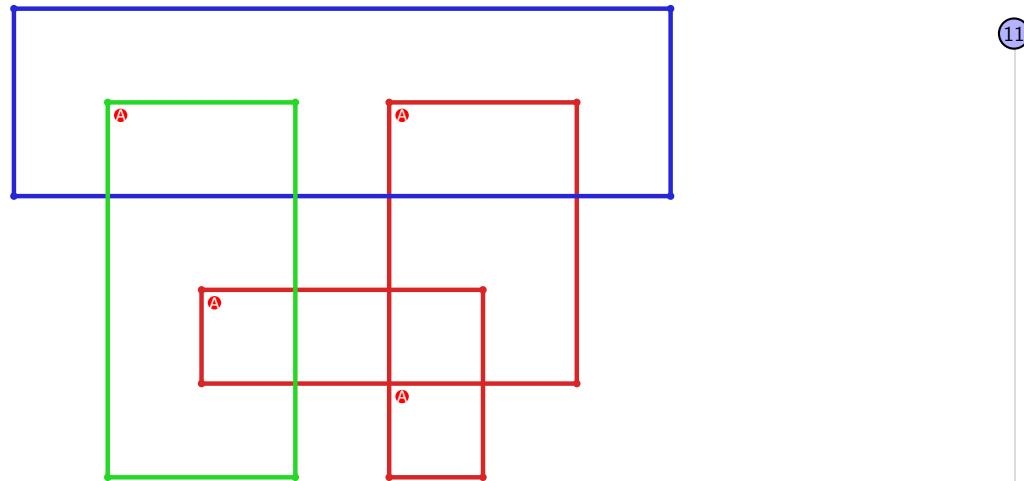


Figure 363: SnapPy multiloop plot.

4

Figure 364: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.83 $[[3, 10, 4, 1], [2, 14, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [13, 18, 14, 15], [5, 8, 6, 9], [12, 16, 13, 15], [7, 17, 8, 18], [6, 17, 7, 16]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (3, 6, 4, 7), (1, 8, 2, 9), (10, 11, 1, 12), (12, 9, 13, 10), (15, 4, 16, 5), (5, 16, 6, 17), (14, 17, 11, 18), (18, 13, 15, 14)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 6, 1, 1], [1, 6, 6, 7], [2, 7, 8, 2], [3, 8, 4, 4], [4, 8, 8, 5], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 181: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

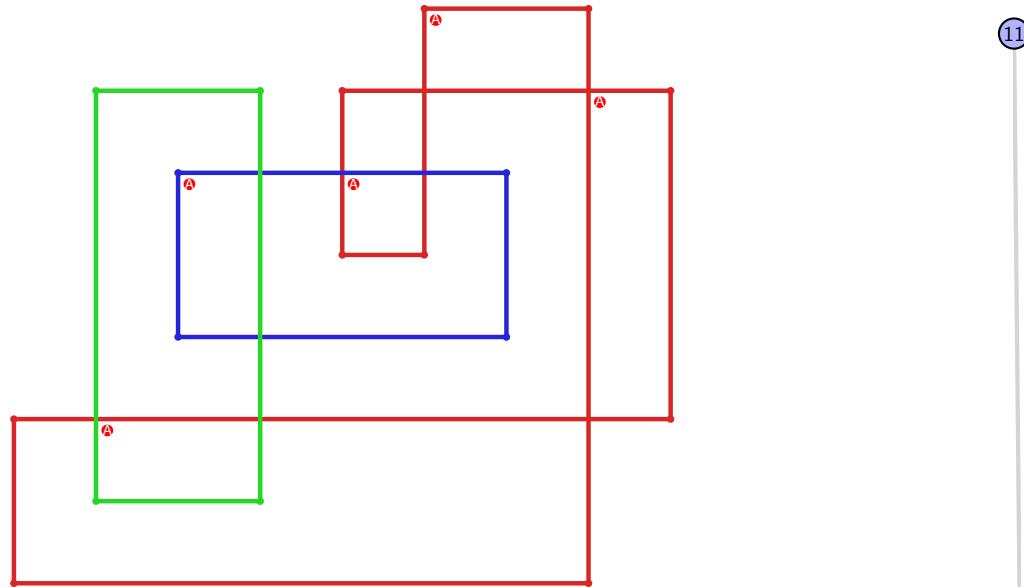


Figure 365: SnapPy multiloop plot.

Figure 366: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.84 [[3, 8, 4, 1], [2, 18, 3, 9], [7, 4, 8, 5], [1, 10, 2, 9], [12, 17, 13, 18], [5, 13, 6, 14], [14, 6, 15, 7], [10, 15, 11, 16], [16, 11, 17, 12]]

PD code drawn by SnapPy: [(5, 2, 6, 3), (15, 4, 16, 5), (1, 6, 2, 7), (17, 12, 18, 13), (3, 14, 4, 15), (11, 16, 12, 17), (13, 18, 14, 9), (8, 9, 1, 10), (10, 7, 11, 8)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 7, 1, 1], [1, 8, 8, 5], [2, 4, 6, 6], [2, 5, 5, 7], [3, 6, 8, 8], [4, 7, 7, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 182: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

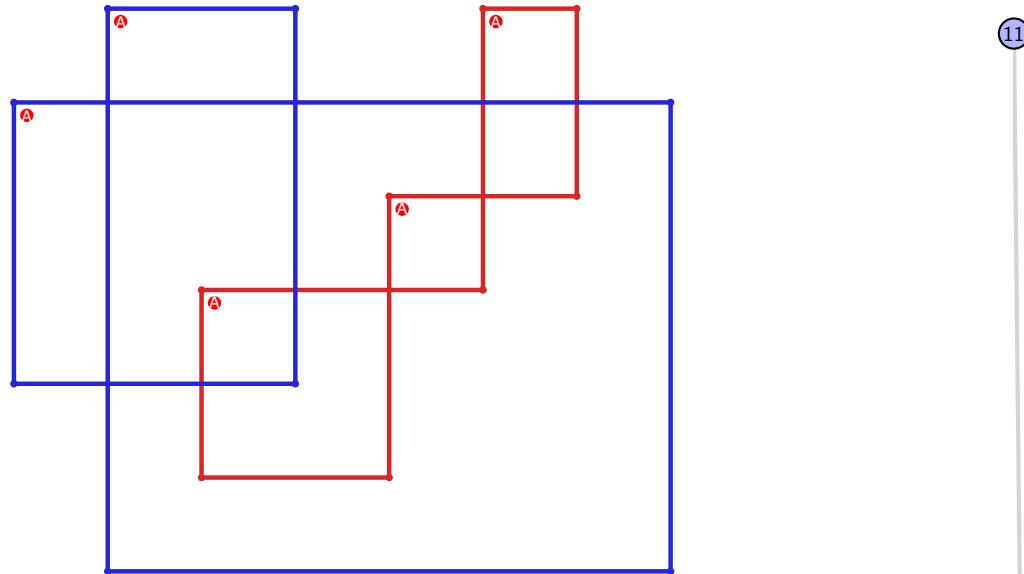


Figure 367: SnapPy multiloop plot.



Figure 368: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.85 $[[8, 18, 1, 9], [9, 7, 10, 8], [17, 1, 18, 2], [6, 10, 7, 11], [2, 16, 3, 17], [11, 5, 12, 6], [12, 15, 13, 16], [3, 13, 4, 14], [14, 4, 15, 5]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (17, 2, 18, 3), (15, 4, 16, 5), (13, 6, 14, 7), (3, 16, 4, 17), (8, 9, 1, 10), (18, 11, 9, 12), (7, 12, 8, 13), (5, 14, 6, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 7, 2], [3, 8, 6, 3], [4, 5, 8, 7], [4, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.14

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 20

Average overall degree: 2.8

Pinning number: 7

Table 183: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	1
Nonminimal pinning sets	0	4	8	5	1	18
Average degree	2.14	2.48	2.83	3.12	3.27	

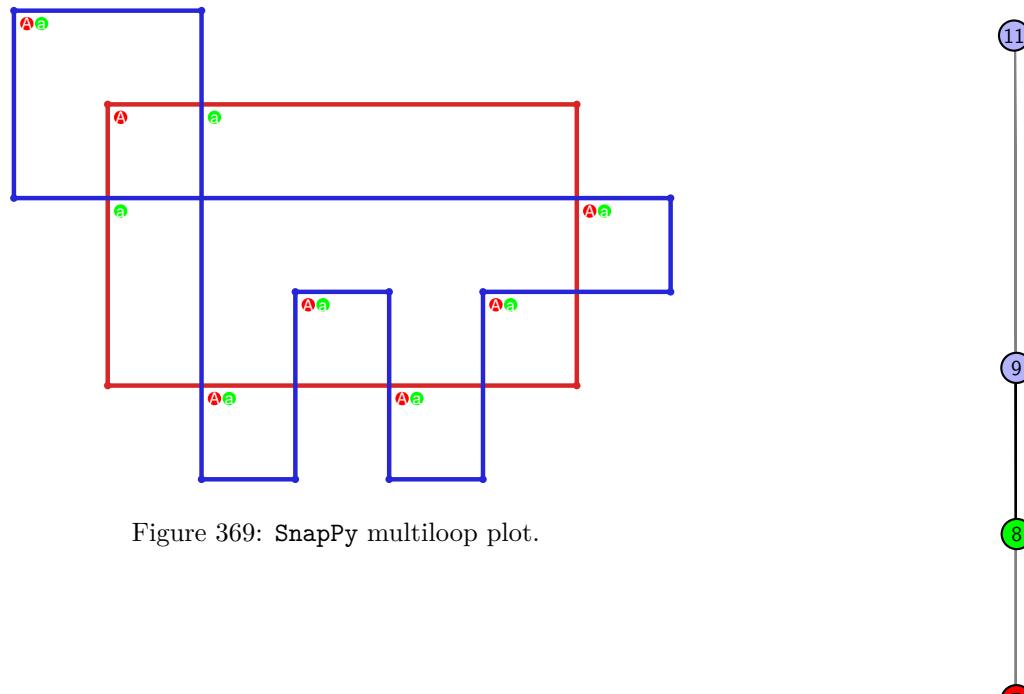


Figure 369: SnapPy multiloop plot.

Figure 370: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.86 [[18, 9, 1, 10], [10, 17, 11, 18], [8, 1, 9, 2], [16, 11, 17, 12], [2, 7, 3, 8], [12, 5, 13, 6], [6, 15, 7, 16], [3, 15, 4, 14], [4, 13, 5, 14]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (17, 4, 18, 5), (15, 6, 16, 7), (13, 8, 14, 9), (1, 10, 2, 11), (11, 18, 12, 1), (3, 12, 4, 13), (7, 14, 8, 15), (5, 16, 6, 17)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 7, 2], [3, 8, 8, 6], [3, 5, 7, 4], [4, 6, 8, 8], [5, 7, 7, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 184: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

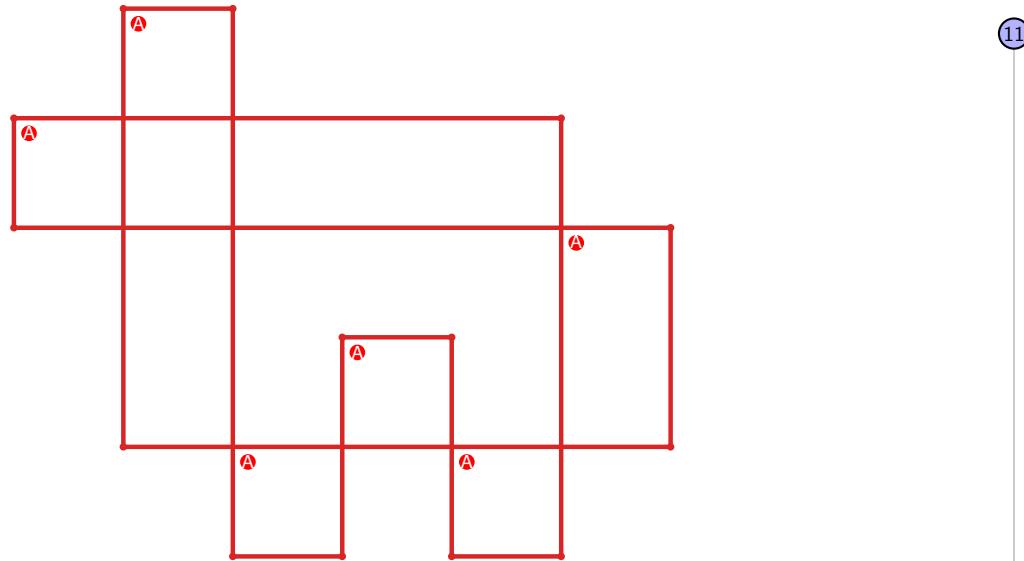


Figure 371: SnapPy multiloop plot.



Figure 372: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.87 $[[8, 18, 1, 9], [9, 7, 10, 8], [12, 17, 13, 18], [1, 13, 2, 14], [6, 10, 7, 11], [11, 5, 12, 6], [16, 4, 17, 5], [2, 15, 3, 14], [3, 15, 4, 16]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (16, 3, 17, 4), (14, 5, 15, 6), (4, 15, 5, 16), (7, 18, 8, 9), (9, 8, 10, 1), (1, 10, 2, 11), (17, 12, 18, 13), (6, 13, 7, 14)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 7], [1, 5, 5, 1], [2, 4, 4, 6], [2, 5, 8, 8], [3, 8, 8, 3], [6, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 32
Pinning number: 6

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.79

Table 185: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

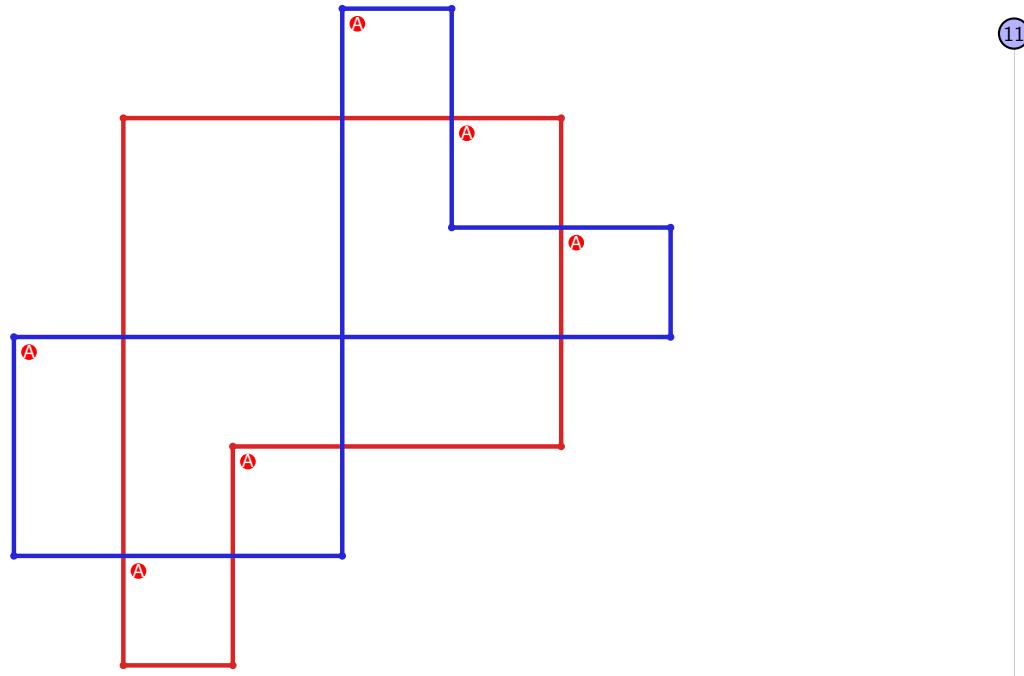


Figure 373: `SnapPy` multiloop plot.

Figure 374: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.88 [[10, 18, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [17, 5, 18, 6], [1, 14, 2, 13], [8, 13, 9, 12], [4, 16, 5, 17], [14, 3, 15, 2], [15, 3, 16, 4]]

PD code drawn by SnapPy: [(10, 11, 1, 12), (12, 1, 13, 2), (14, 3, 15, 4), (7, 4, 8, 5), (5, 16, 6, 17), (17, 6, 18, 7), (18, 9, 11, 10), (2, 13, 3, 14), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 7, 5], [1, 4, 2, 1], [3, 8, 8, 3], [4, 8, 8, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 40

Average overall degree: 2.85

Pinning number: 6

Table 186: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	5	13	13	6	1	38
Average degree	2.17	2.48	2.76	2.99	3.17	3.27	

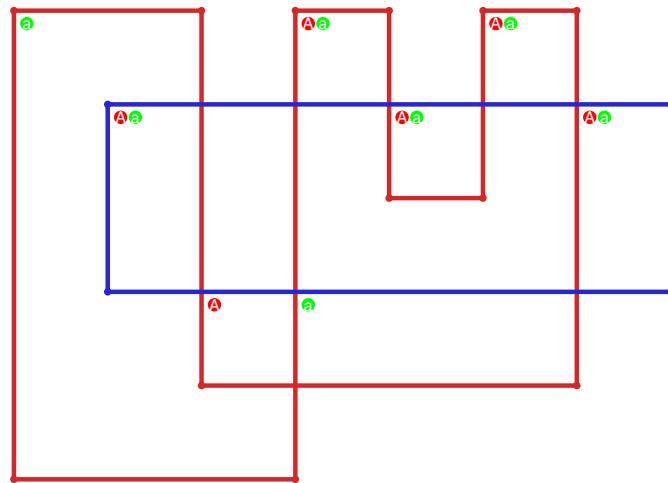


Figure 375: SnapPy multiloop plot.



Figure 376: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.89 $[[8, 18, 1, 9], [9, 5, 10, 6], [17, 7, 18, 8], [1, 11, 2, 12], [14, 4, 15, 5], [10, 15, 11, 16], [6, 16, 7, 17], [2, 13, 3, 12], [3, 13, 4, 14]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (15, 2, 16, 3), (13, 4, 14, 5), (18, 7, 9, 8), (8, 9, 1, 10), (16, 11, 17, 12), (3, 12, 4, 13), (5, 14, 6, 15), (6, 17, 7, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 6, 0], [0, 5, 7, 7], [1, 8, 8, 5], [1, 4, 3, 6], [1, 5, 2, 2], [3, 8, 8, 3], [4, 7, 7, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 48

Average overall degree: 2.85

Pinning number: 6

Table 187: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.17	2.54	2.81	3.02	3.17	3.27	

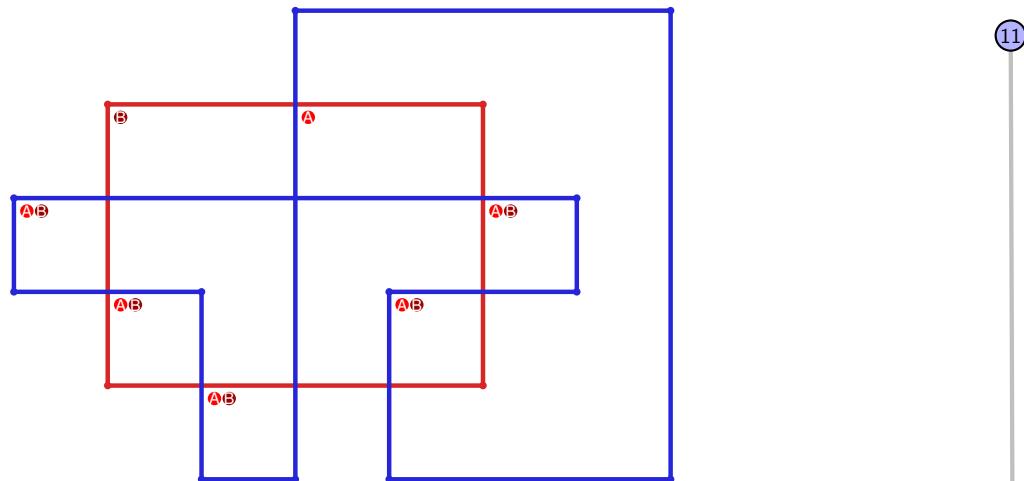


Figure 377: SnapPy multiloop plot.

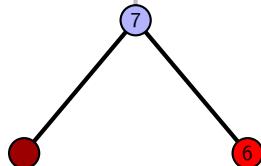


Figure 378: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.90 $[[10, 5, 1, 6], [6, 11, 7, 18], [9, 17, 10, 18], [4, 14, 5, 15], [1, 14, 2, 13], [11, 8, 12, 7], [12, 8, 13, 9], [2, 16, 3, 17], [15, 3, 16, 4]]$

PD code drawn by SnapPy: $[(11, 10, 12, 1), (7, 2, 8, 3), (4, 15, 5, 16), (16, 5, 17, 6), (17, 8, 18, 9), (1, 18, 2, 11), (9, 12, 10, 13), (6, 13, 7, 14), (14, 3, 15, 4)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 8, 8, 4], [0, 3, 7, 6], [1, 6, 6, 1], [2, 5, 5, 4], [2, 4, 8, 8], [3, 7, 7, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 188: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

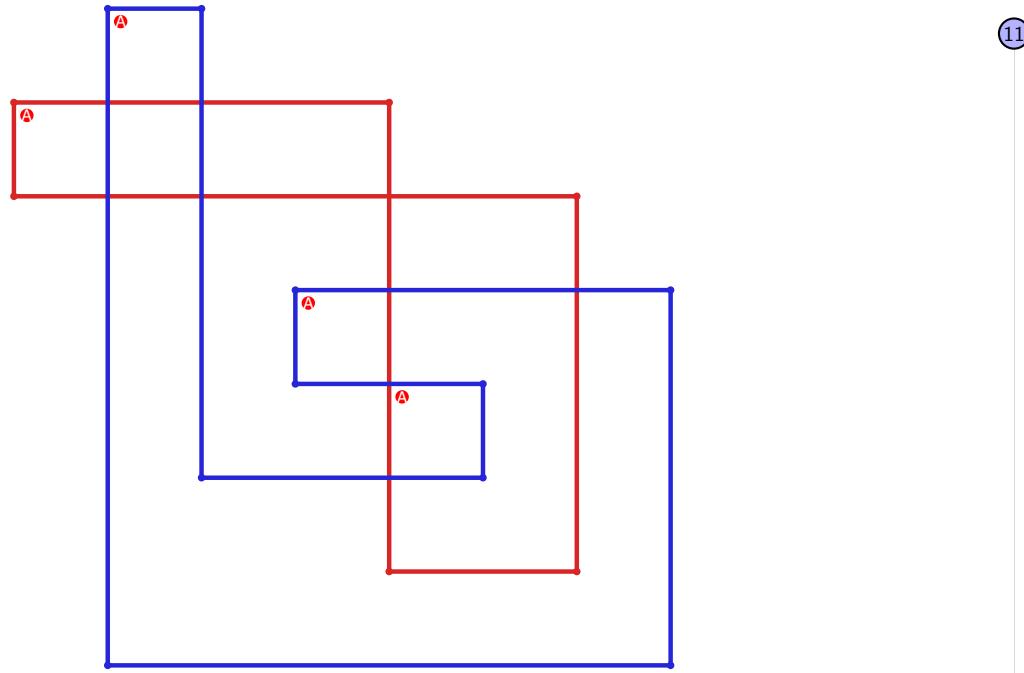


Figure 379: SnapPy multiloop plot.

Figure 380: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.91 [[18, 9, 1, 10], [10, 17, 11, 18], [11, 8, 12, 9], [1, 7, 2, 6], [16, 5, 17, 6], [7, 12, 8, 13], [2, 15, 3, 16], [4, 13, 5, 14], [14, 3, 15, 4]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (14, 3, 15, 4), (4, 17, 5, 18), (9, 6, 10, 7), (16, 7, 17, 8), (5, 10, 6, 11), (2, 11, 3, 12), (18, 13, 1, 14), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 6, 7], [2, 7, 3, 2], [3, 8, 8, 4], [4, 8, 8, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 189: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

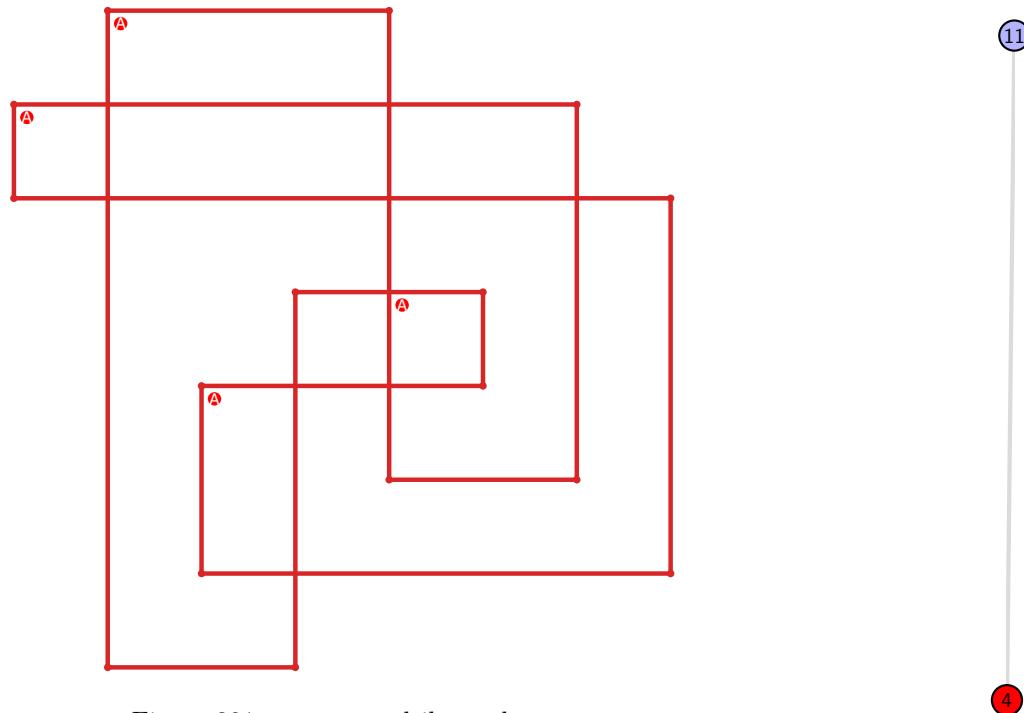


Figure 381: SnapPy multiloop plot.

Figure 382: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.92 [[18, 7, 1, 8], [8, 17, 9, 18], [9, 6, 10, 7], [1, 10, 2, 11], [11, 16, 12, 17], [12, 5, 13, 6], [2, 15, 3, 16], [4, 13, 5, 14], [14, 3, 15, 4]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (5, 2, 6, 3), (14, 3, 15, 4), (15, 6, 16, 7), (18, 9, 1, 10), (16, 11, 17, 12), (7, 12, 8, 13), (4, 13, 5, 14), (10, 17, 11, 18)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 5], [2, 4, 7, 7], [3, 8, 8, 4], [5, 8, 8, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 190: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

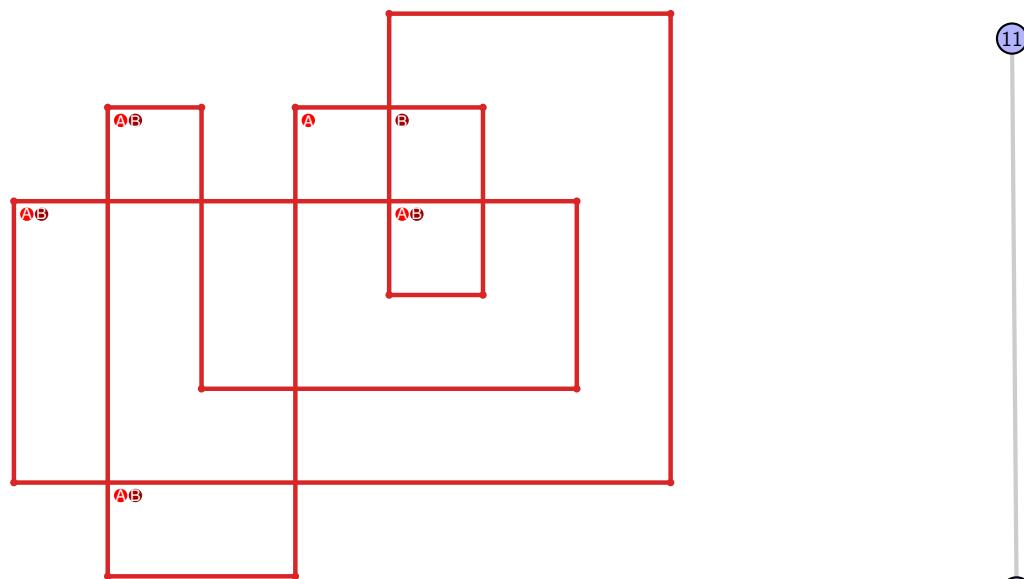


Figure 383: `SnapPy` multiloop plot.

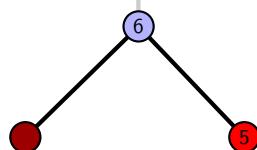


Figure 384: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.93 $[[14, 18, 1, 15], [15, 13, 16, 14], [17, 7, 18, 8], [1, 7, 2, 6], [12, 5, 13, 6], [16, 9, 17, 8], [2, 11, 3, 12], [4, 9, 5, 10], [10, 3, 11, 4]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (10, 3, 11, 4), (4, 13, 5, 14), (16, 5, 17, 6), (6, 15, 7, 16), (2, 7, 3, 8), (14, 9, 1, 10), (18, 11, 15, 12), (12, 17, 13, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [1, 7, 2, 2], [3, 8, 8, 4], [4, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 191: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

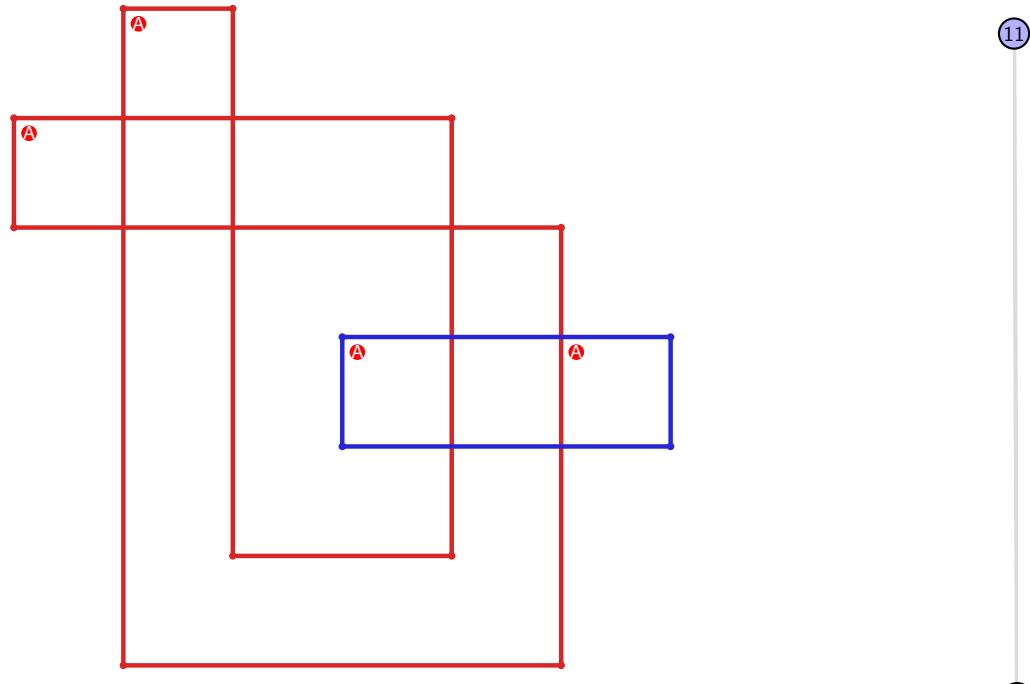


Figure 385: SnapPy multiloop plot.

Figure 386: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.94 $[[18, 11, 1, 12], [12, 17, 13, 18], [13, 10, 14, 11], [1, 14, 2, 15], [16, 5, 17, 6], [9, 4, 10, 5], [2, 8, 3, 7], [15, 7, 16, 6], [3, 8, 4, 9]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (13, 2, 14, 3), (3, 12, 4, 13), (4, 17, 5, 18), (18, 5, 1, 6), (10, 7, 11, 8), (15, 8, 16, 9), (16, 11, 17, 12), (9, 14, 10, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 5], [2, 4, 8, 8], [3, 8, 8, 7], [3, 6, 4, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 96
Pinning number: 5

Average optimal degree: 2.2
Average minimal degree: 2.2
Average overall degree: 2.9

Table 192: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

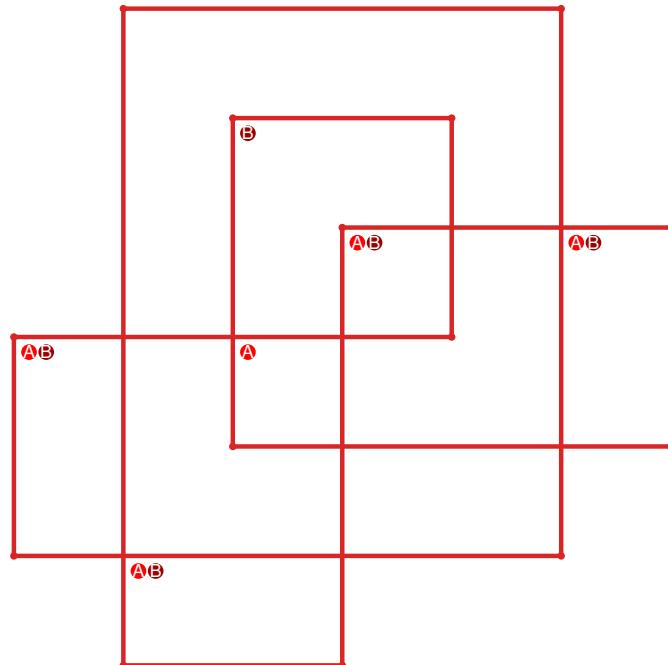


Figure 387: SnapPy multiloop plot.

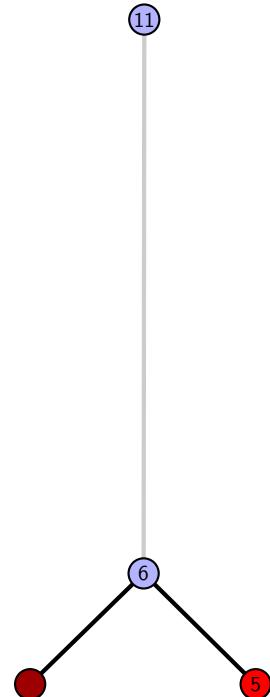


Figure 388: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.95 $[[5, 18, 6, 1], [4, 9, 5, 10], [17, 8, 18, 9], [6, 16, 7, 15], [1, 12, 2, 13], [10, 3, 11, 4], [7, 16, 8, 17], [11, 14, 12, 15], [2, 14, 3, 13]]$

PD code drawn by SnapPy: $[(13, 4, 14, 5), (18, 5, 1, 6), (15, 8, 16, 9), (9, 16, 10, 17), (7, 10, 8, 11), (11, 2, 12, 3), (3, 12, 4, 13), (1, 14, 2, 15), (6, 17, 7, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 6, 6, 7], [0, 7, 8, 8], [1, 8, 7, 1], [2, 3, 3, 2], [3, 5, 8, 4], [4, 7, 5, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 193: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

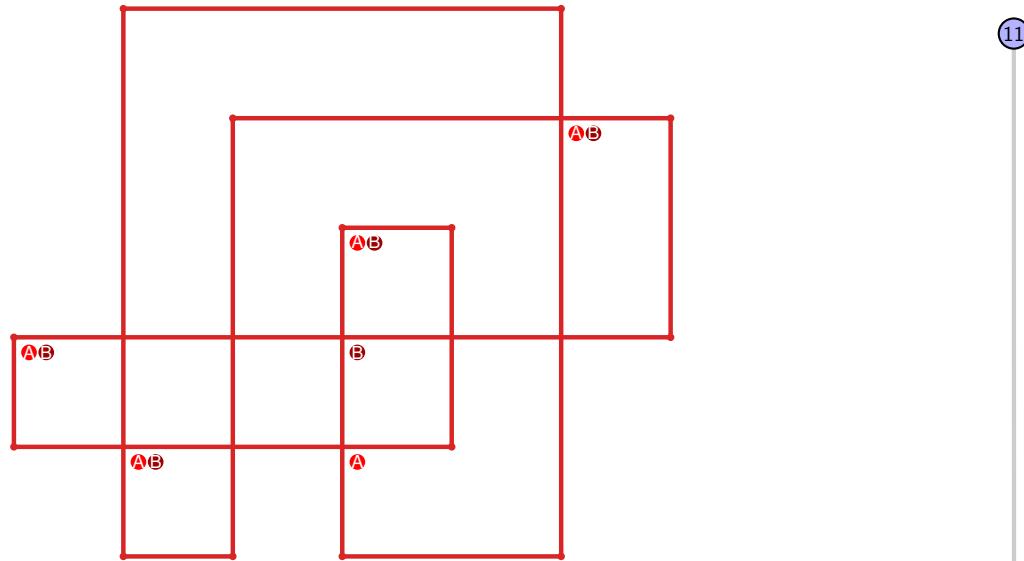


Figure 389: SnapPy multiloop plot.

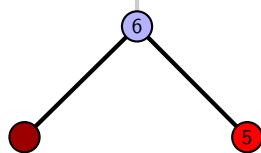


Figure 390: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.96 [[9, 18, 10, 1], [8, 15, 9, 16], [17, 14, 18, 15], [10, 3, 11, 4], [1, 6, 2, 7], [16, 7, 17, 8], [2, 13, 3, 14], [11, 5, 12, 4], [12, 5, 13, 6]]

PD code drawn by `SnapPy`: [(18, 7, 1, 8), (8, 1, 9, 2), (15, 2, 16, 3), (12, 3, 13, 4), (16, 9, 17, 10), (13, 10, 14, 11), (4, 11, 5, 12), (5, 14, 6, 15), (6, 17, 7, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 8, 3], [3, 8, 8, 3], [4, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.42

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 4

Table 194: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.25	2.56	2.78	2.95	3.07	3.16	3.23	3.27	

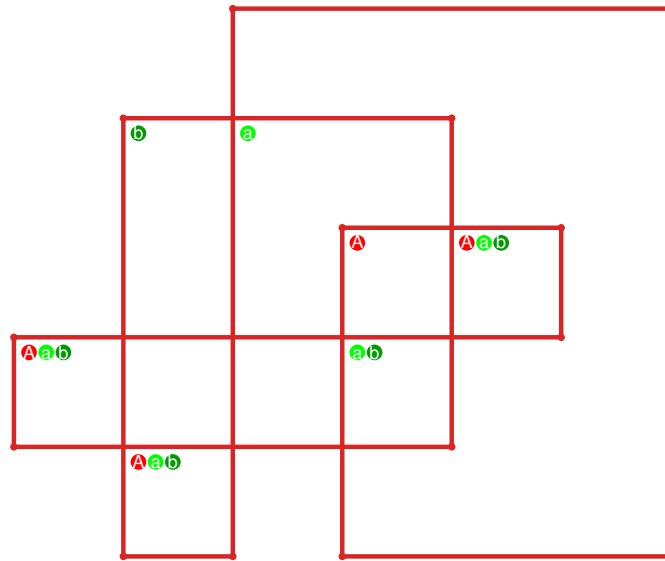


Figure 391: `SnapPy` multiloop plot.

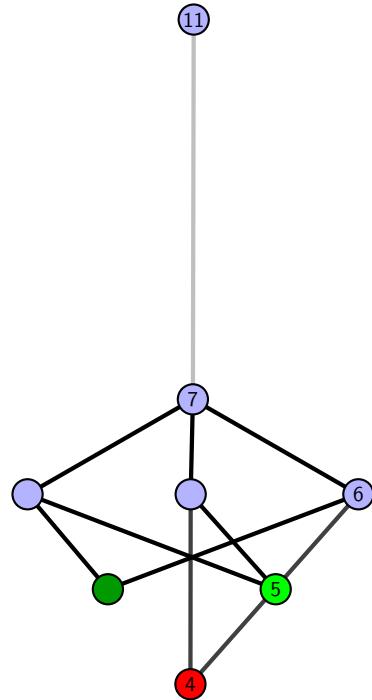


Figure 392: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.97 $[[18, 7, 1, 8], [8, 16, 9, 15], [17, 14, 18, 15], [3, 6, 4, 7], [1, 11, 2, 10], [16, 10, 17, 9], [2, 13, 3, 14], [5, 12, 6, 13], [4, 12, 5, 11]]$

PD code drawn by SnapPy: $[(18, 3, 1, 4), (15, 4, 16, 5), (6, 13, 7, 14), (7, 16, 8, 17), (8, 1, 9, 2), (2, 9, 3, 10), (17, 10, 18, 11), (14, 11, 15, 12), (12, 5, 13, 6)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 7, 3], [3, 6, 8, 8], [3, 7, 7, 4]]$

Total optimal pinning sets: 3

Average optimal degree: 2.5

Total minimal pinning sets: 4

Average minimal degree: 2.58

Total pinning sets: 272

Average overall degree: 3.05

Pinning number: 4

Table 195: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.5	2.76	2.93	3.05	3.14	3.2	3.24	3.27	

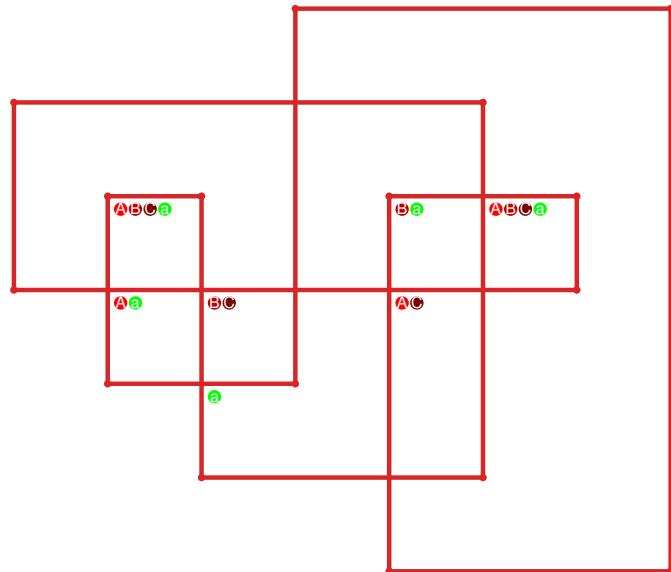


Figure 393: SnapPy multiloop plot.

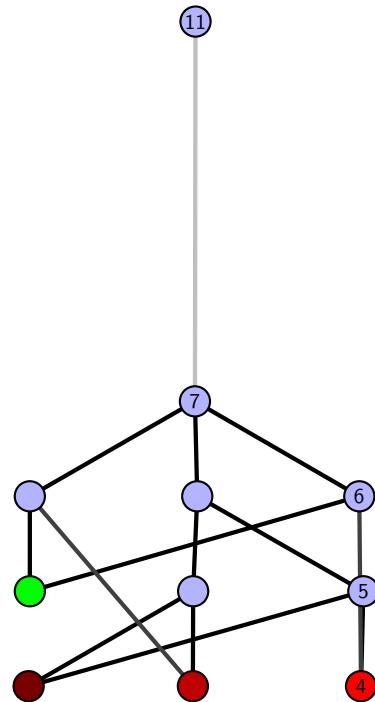


Figure 394: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.98 $[[18, 5, 1, 6], [6, 16, 7, 15], [17, 14, 18, 15], [11, 4, 12, 5], [1, 9, 2, 8], [16, 8, 17, 7], [2, 13, 3, 14], [3, 10, 4, 11], [12, 10, 13, 9]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (15, 2, 16, 3), (4, 13, 5, 14), (5, 16, 6, 17), (6, 9, 7, 10), (18, 7, 1, 8), (17, 10, 18, 11), (14, 11, 15, 12), (12, 3, 13, 4)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 8, 7], [3, 6, 8, 3], [3, 7, 6, 4]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 5
Total pinning sets: 224
Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.62
Average overall degree: 3.05

Table 196: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	7	39	67	63	33	9	1	219
Average degree	2.5	2.71	2.89	3.03	3.13	3.2	3.24	3.27	

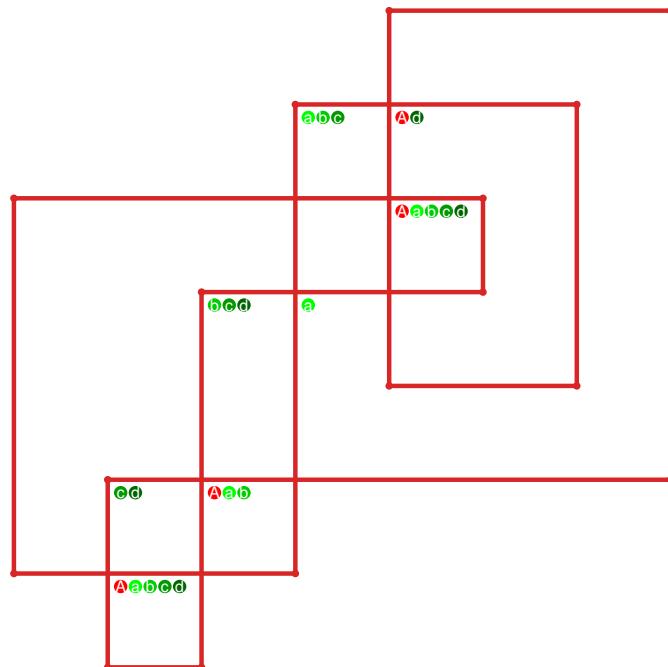


Figure 395: SnapPy multiloop plot.

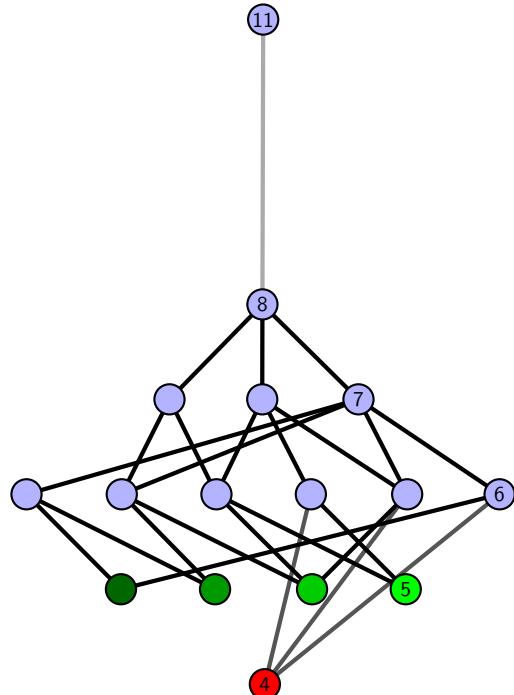


Figure 396: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.99 $[[7, 18, 8, 1], [6, 15, 7, 16], [17, 14, 18, 15], [8, 2, 9, 1], [16, 5, 17, 6], [10, 13, 11, 14], [2, 11, 3, 12], [9, 4, 10, 5], [12, 3, 13, 4]]$

PD code drawn by SnapPy: $[(5, 18, 6, 1), (12, 1, 13, 2), (16, 7, 17, 8), (6, 9, 7, 10), (13, 10, 14, 11), (2, 11, 3, 12), (3, 14, 4, 15), (15, 4, 16, 5), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 7, 0], [1, 7, 2, 1], [2, 7, 8, 6], [3, 5, 8, 8], [3, 8, 5, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 136
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 2.98

Table 197: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	16	38	43	26	8	1	132
Average degree	2.4	2.69	2.89	3.05	3.15	3.23	3.27	

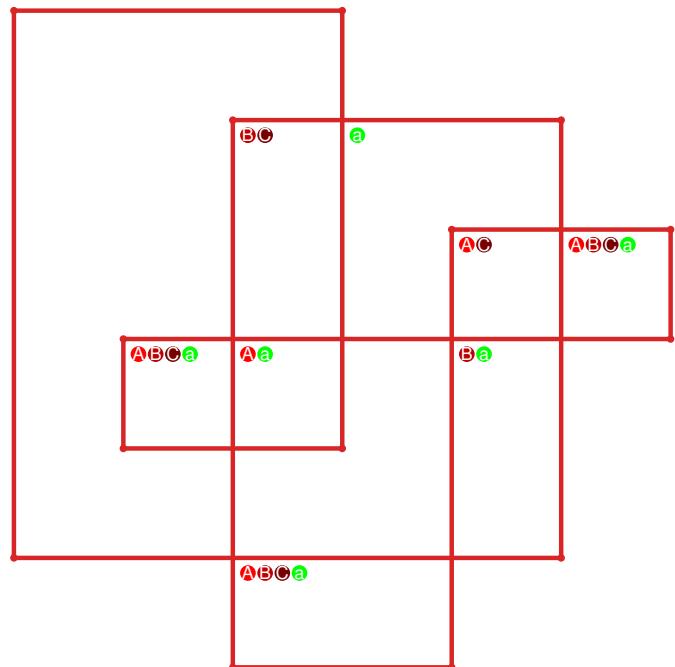


Figure 397: SnapPy multiloop plot.

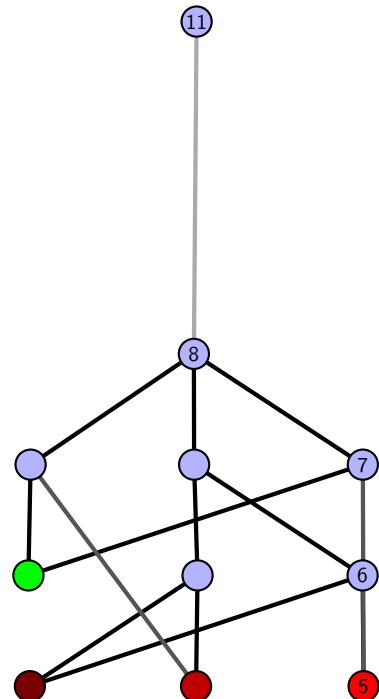


Figure 398: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.100 `[[5, 18, 6, 1], [4, 15, 5, 16], [17, 14, 18, 15], [6, 11, 7, 12], [1, 8, 2, 9], [16, 3, 17, 4], [10, 13, 11, 14], [7, 13, 8, 12], [2, 10, 3, 9]]`

PD code drawn by `SnapPy`: `[(14, 1, 15, 2), (17, 6, 18, 7), (7, 18, 8, 1), (4, 9, 5, 10), (10, 5, 11, 6), (8, 11, 9, 12), (15, 12, 16, 13), (2, 13, 3, 14), (3, 16, 4, 17)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 7, 8, 8], [1, 8, 2, 1], [2, 8, 7, 3], [3, 6, 4, 3], [4, 6, 5, 4]]`

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.42
 Average overall degree: 2.98

Table 198: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.25	2.56	2.78	2.95	3.07	3.16	3.23	3.27	

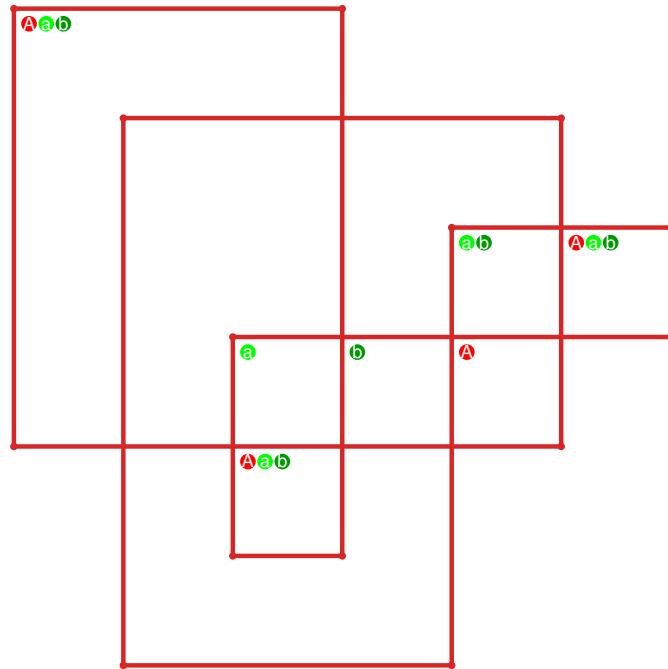


Figure 399: `SnapPy` multiloop plot.

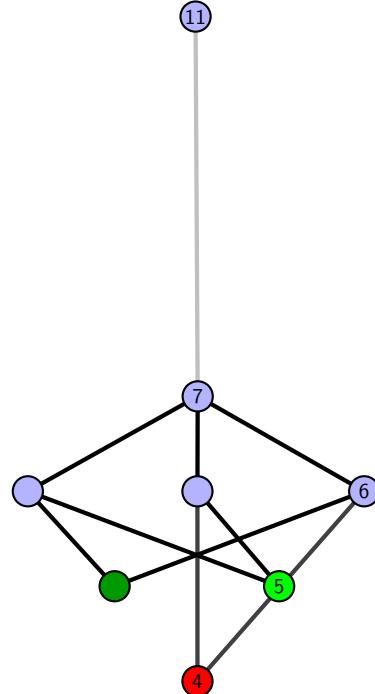


Figure 400: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.101 $[[6, 18, 1, 7], [7, 3, 8, 4], [15, 5, 16, 6], [17, 12, 18, 13], [1, 9, 2, 10], [10, 2, 11, 3], [8, 11, 9, 12], [4, 14, 5, 15], [16, 14, 17, 13]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (15, 4, 16, 5), (12, 5, 13, 6), (3, 14, 4, 15), (13, 16, 14, 17), (10, 17, 11, 18), (18, 9, 7, 10), (6, 7, 1, 8), (2, 11, 3, 12)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 8], [0, 8, 8, 6], [0, 6, 5, 5], [1, 4, 4, 6], [1, 5, 4, 3], [1, 8, 2, 2], [2, 7, 3, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 4

Average minimal degree: 2.46

Total pinning sets: 184

Average overall degree: 2.98

Pinning number: 4

Table 199: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.25	2.56	2.79	2.96	3.08	3.16	3.23	3.27	

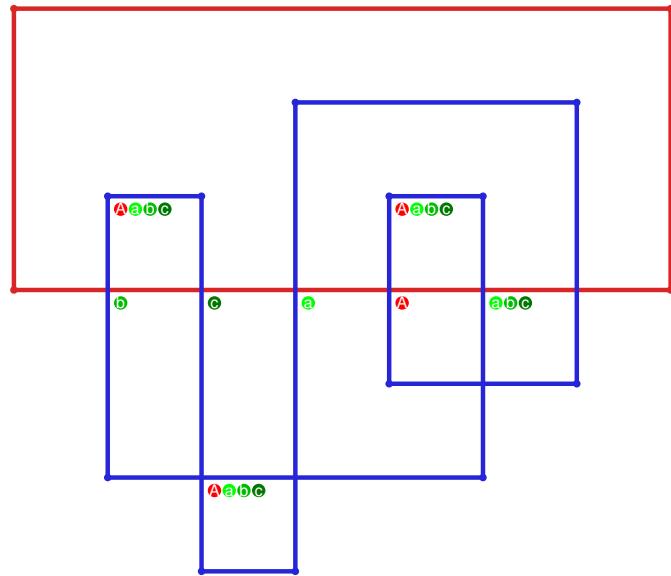


Figure 401: `SnapPy` multiloop plot.

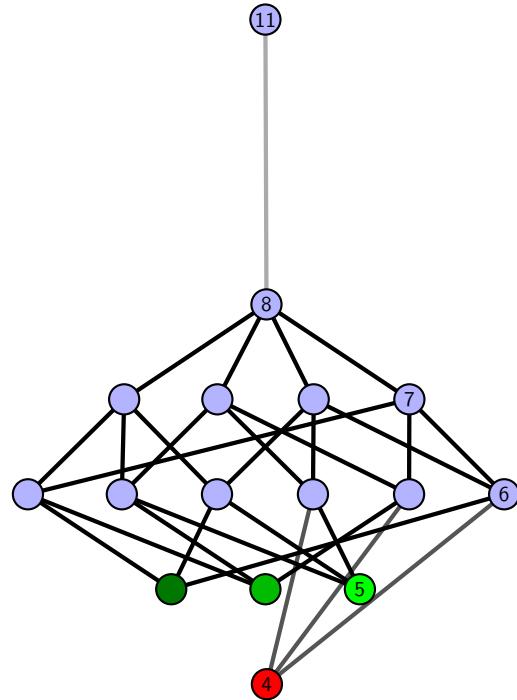


Figure 402: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.102 $[[6, 14, 1, 7], [7, 3, 8, 4], [5, 18, 6, 15], [13, 17, 14, 18], [1, 9, 2, 10], [10, 2, 11, 3], [8, 11, 9, 12], [4, 16, 5, 15], [16, 12, 17, 13]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (12, 1, 13, 2), (5, 14, 6, 7), (13, 8, 14, 9), (16, 9, 17, 10), (4, 11, 5, 12), (10, 17, 11, 18), (3, 18, 4, 15), (15, 2, 16, 3)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 8, 8], [0, 6, 5, 5], [1, 4, 4, 6], [1, 5, 4, 8], [1, 8, 2, 2], [3, 7, 6, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 6

Average minimal degree: 2.65

Total pinning sets: 183

Average overall degree: 2.98

Pinning number: 4

Table 200: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	3	0	0	0	0	0	5
Nonminimal pinning sets	0	7	30	54	50	27	8	1	177
Average degree	2.25	2.56	2.79	2.96	3.08	3.16	3.23	3.27	

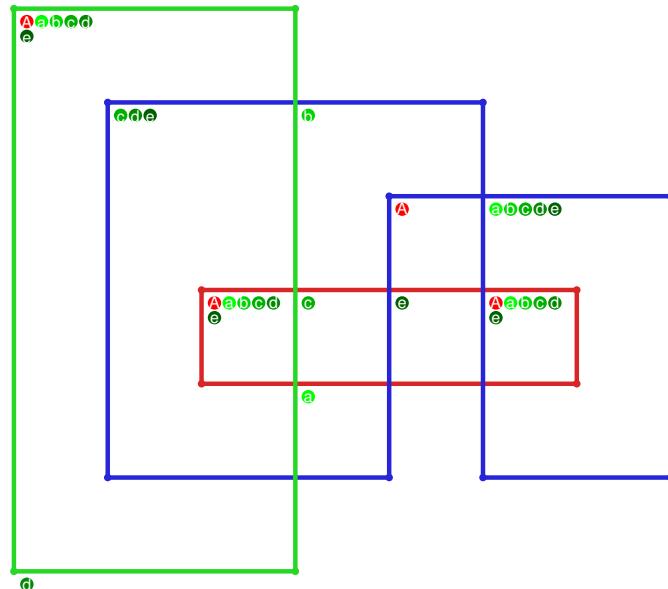


Figure 403: SnapPy multiloop plot.

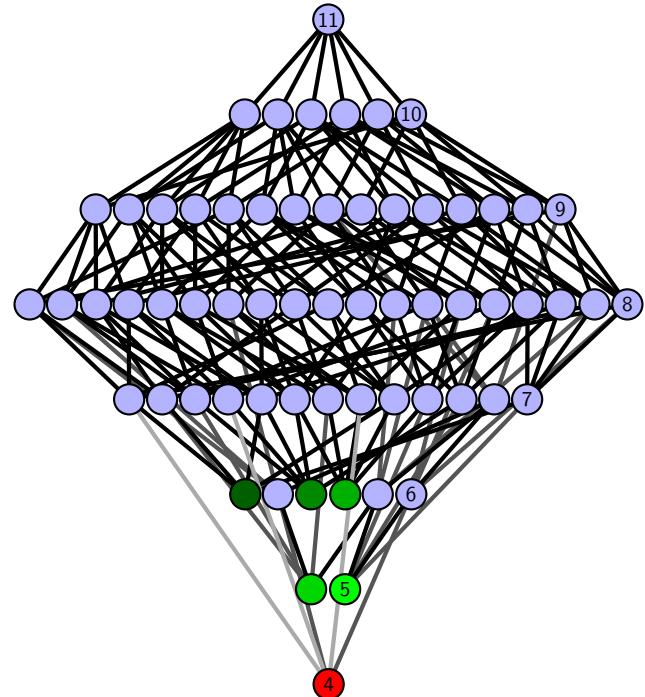


Figure 404: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.103 [[18, 9, 1, 10], [10, 3, 11, 4], [8, 17, 9, 18], [1, 12, 2, 13], [13, 2, 14, 3], [11, 14, 12, 15], [4, 7, 5, 8], [5, 16, 6, 17], [15, 6, 16, 7]]

PD code drawn by `SnapPy`: [(11, 18, 12, 1), (8, 1, 9, 2), (13, 4, 14, 5), (2, 5, 3, 6), (16, 7, 17, 8), (17, 10, 18, 11), (9, 12, 10, 13), (3, 14, 4, 15), (6, 15, 7, 16)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 7, 0], [0, 5, 4, 4], [1, 3, 3, 5], [1, 4, 3, 8], [1, 8, 7, 2], [2, 6, 8, 8], [5, 7, 7, 6]]

Total optimal pinning sets: 3
Total minimal pinning sets: 4

Total pinning sets: 136

Pinning number: 5

Average optimal degree: 2.4

Average minimal degree: 2.47

Average overall degree: 2.98

Table 201: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	16	38	43	26	8	1	132
Average degree	2.4	2.69	2.89	3.05	3.15	3.23	3.27	

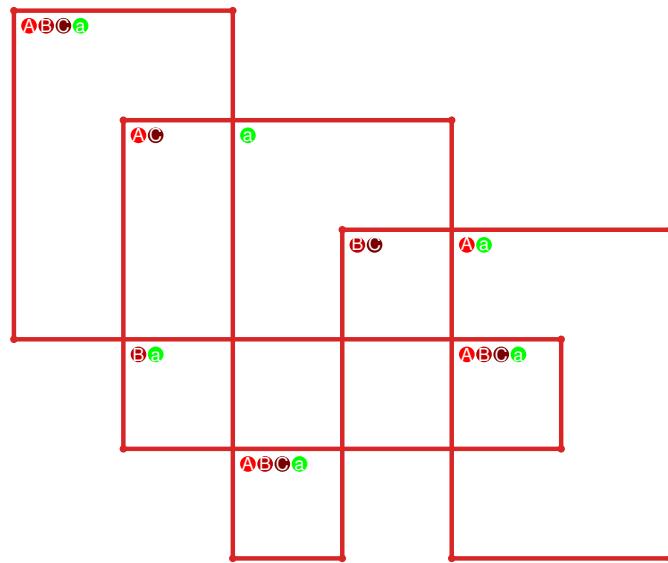


Figure 405: `SnapPy` multiloop plot.

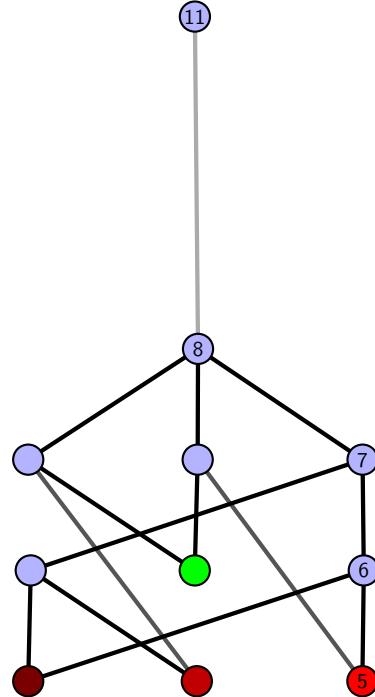


Figure 406: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.104 [[5, 18, 6, 1], [13, 4, 14, 5], [14, 17, 15, 18], [6, 15, 7, 16], [1, 11, 2, 10], [12, 9, 13, 10], [3, 8, 4, 9], [16, 7, 17, 8], [11, 3, 12, 2]]

PD code drawn by SnapPy: [(18, 9, 1, 10), (11, 2, 12, 3), (14, 5, 15, 6), (1, 6, 2, 7), (10, 7, 11, 8), (8, 17, 9, 18), (4, 13, 5, 14), (12, 15, 13, 16), (3, 16, 4, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 3], [0, 2, 7, 7], [0, 8, 8, 5], [1, 4, 8, 6], [1, 5, 8, 7], [2, 6, 3, 3], [4, 6, 5, 4]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 9
 Total pinning sets: 168
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.76
 Average overall degree: 3.06

Table 202: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	7
Nonminimal pinning sets	0	12	49	56	32	9	1	159
Average degree	2.6	2.81	2.99	3.11	3.19	3.24	3.27	

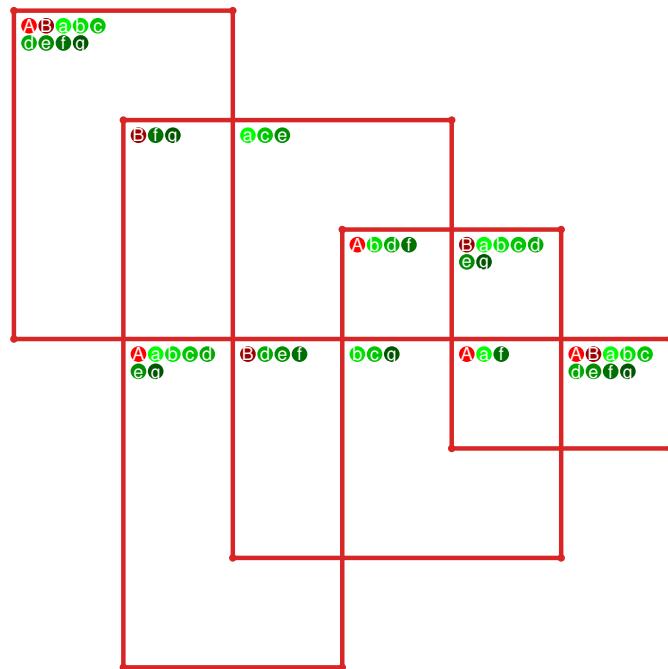


Figure 407: SnapPy multiloop plot.

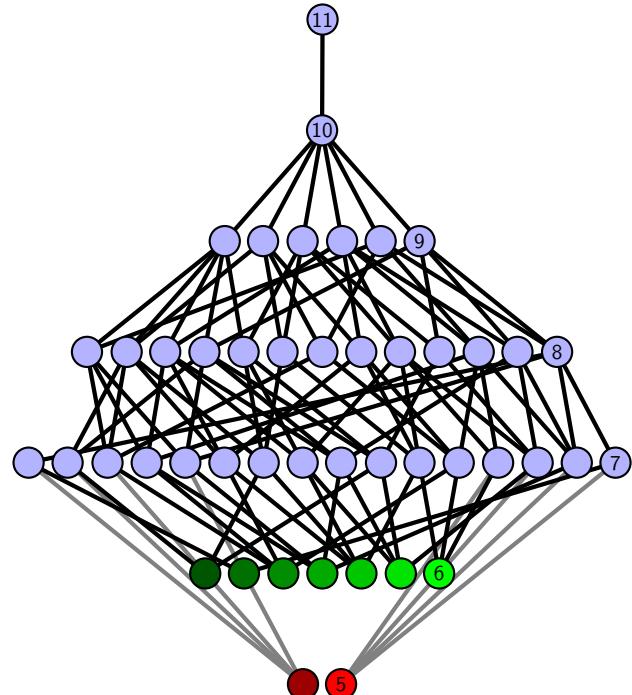


Figure 408: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.105 $[[18, 7, 1, 8], [8, 13, 9, 14], [14, 17, 15, 18], [15, 6, 16, 7], [1, 10, 2, 11], [3, 12, 4, 13], [9, 4, 10, 5], [5, 16, 6, 17], [2, 12, 3, 11]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (12, 3, 13, 4), (15, 4, 16, 5), (16, 7, 17, 8), (8, 17, 9, 18), (18, 9, 1, 10), (5, 10, 6, 11), (2, 13, 3, 14), (11, 14, 12, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 3], [0, 2, 7, 7], [0, 6, 8, 8], [1, 8, 8, 6], [1, 5, 4, 7], [2, 6, 3, 3], [4, 5, 5, 4]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4
Total pinning sets: 144
Pinning number: 5

Average optimal degree: 2.45
Average minimal degree: 2.45
Average overall degree: 2.98

Table 203: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.45	2.72	2.92	3.05	3.15	3.23	3.27	

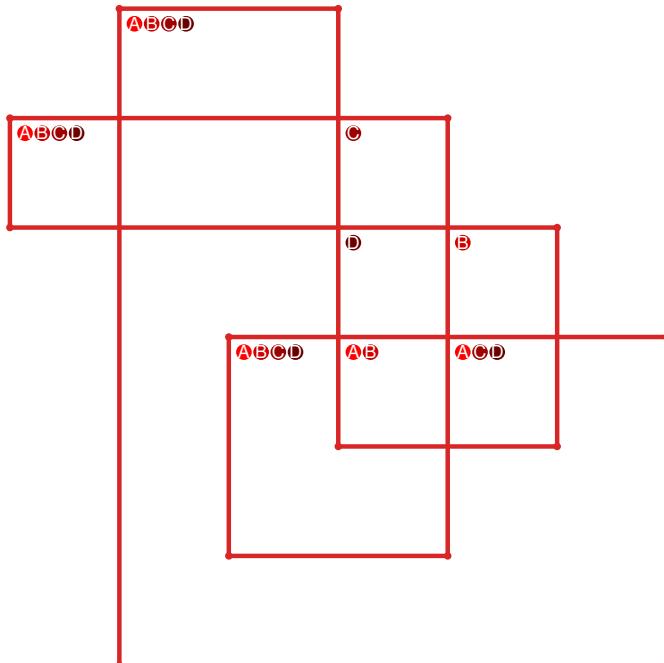


Figure 409: SnapPy multiloop plot.

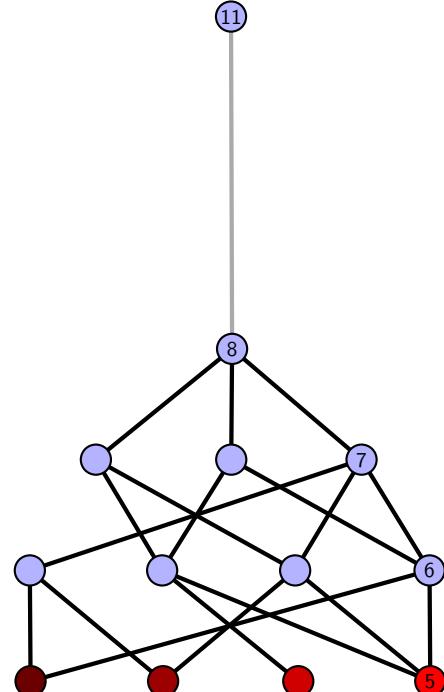


Figure 410: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.106 $[[8, 18, 1, 9], [9, 7, 10, 8], [10, 17, 11, 18], [1, 16, 2, 15], [6, 14, 7, 15], [16, 11, 17, 12], [2, 5, 3, 6], [3, 13, 4, 14], [12, 4, 13, 5]]$

PD code drawn by `SnapPy`: $[(9, 2, 10, 3), (8, 3, 1, 4), (16, 5, 17, 6), (13, 18, 14, 9), (1, 10, 2, 11), (4, 11, 5, 12), (12, 7, 13, 8), (17, 14, 18, 15), (6, 15, 7, 16)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 6, 7], [2, 8, 3, 2], [3, 8, 7, 4], [4, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 152
 Pinning number: 5

Average optimal degree: 2.48
 Average minimal degree: 2.48
 Average overall degree: 2.98

Table 204: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	23	44	45	26	8	1	147
Average degree	2.48	2.75	2.93	3.06	3.15	3.23	3.27	

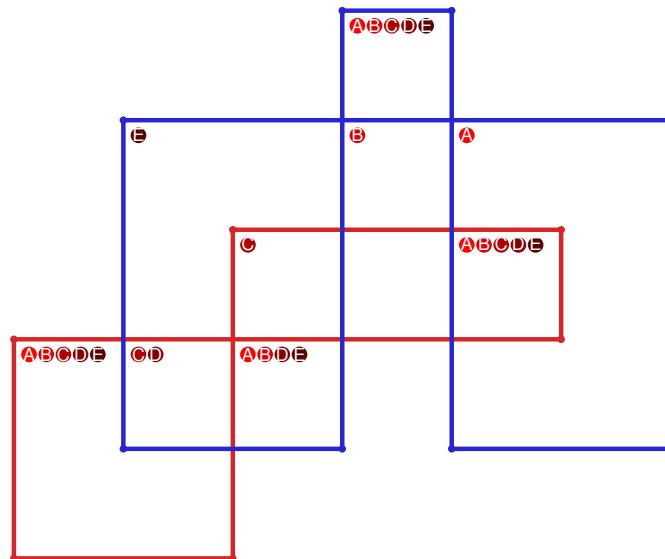


Figure 411: `SnapPy` multiloop plot.

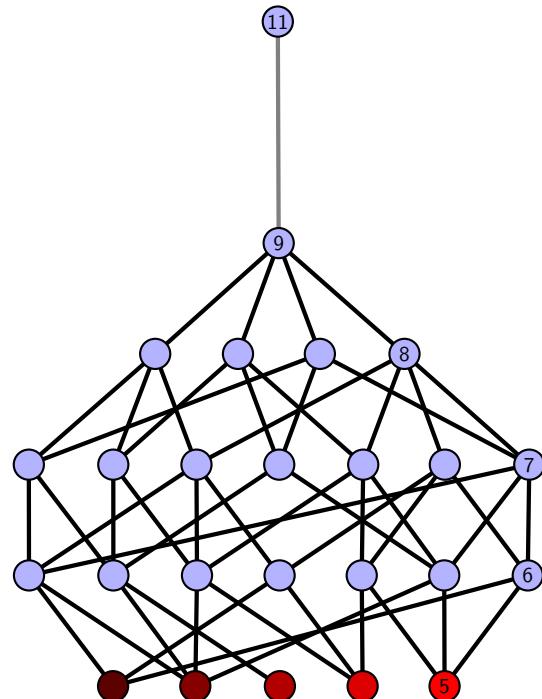


Figure 412: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.107 `[[9, 18, 10, 1], [17, 8, 18, 9], [10, 8, 11, 7], [1, 7, 2, 6], [16, 5, 17, 6], [11, 14, 12, 15], [2, 15, 3, 16], [13, 4, 14, 5], [12, 4, 13, 3]]`

PD code drawn by `SnapPy`: `[(18, 9, 1, 10), (10, 1, 11, 2), (13, 2, 14, 3), (3, 16, 4, 17), (4, 7, 5, 8), (14, 5, 15, 6), (8, 11, 9, 12), (17, 12, 18, 13), (6, 15, 7, 16)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [2, 7, 8, 6], [3, 5, 8, 4], [4, 8, 8, 5], [5, 7, 7, 6]]`

Total optimal pinning sets: 1
Total minimal pinning sets: 8

Total pinning sets: 256

Pinning number: 4

Average optimal degree: 2.5

Average minimal degree: 2.71

Average overall degree: 3.06

Table 205: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	7	49	79	69	34	9	1	248
Average degree	2.5	2.74	2.93	3.05	3.14	3.2	3.24	3.27	

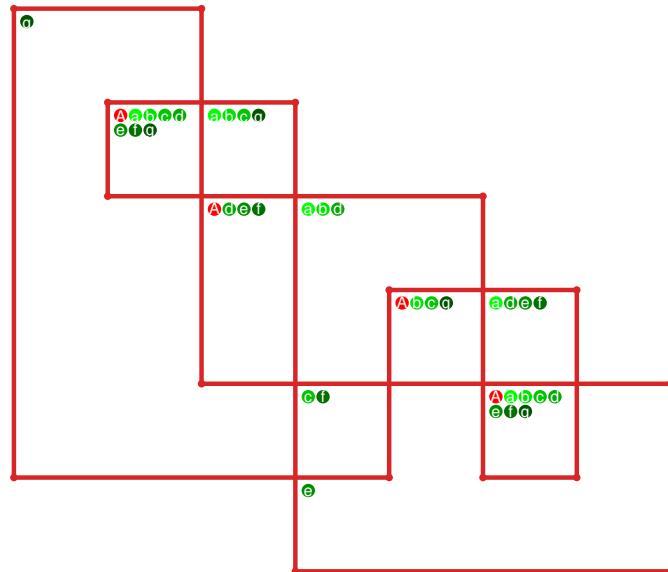


Figure 413: `SnapPy` multiloop plot.

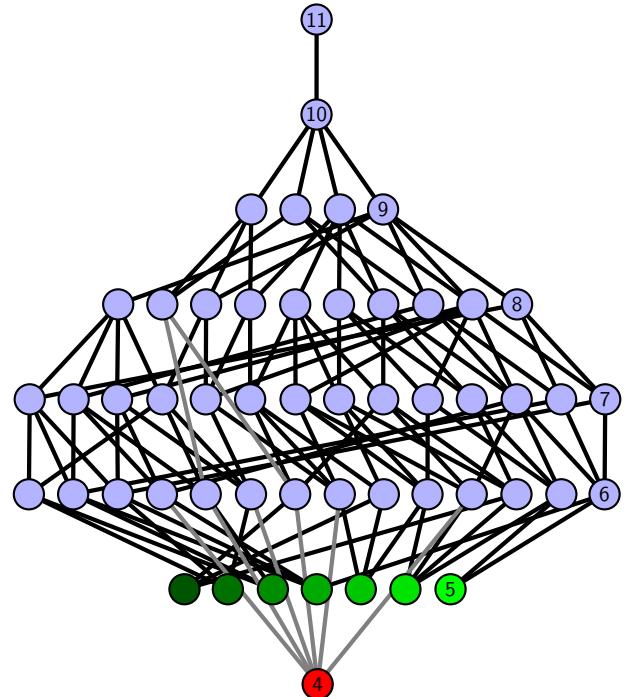


Figure 414: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.108 [[11, 18, 12, 1], [17, 10, 18, 11], [12, 10, 13, 9], [1, 9, 2, 8], [16, 7, 17, 8], [13, 4, 14, 5], [2, 15, 3, 16], [3, 6, 4, 7], [14, 6, 15, 5]]

PD code drawn by `SnapPy`: [(11, 2, 12, 3), (3, 12, 4, 13), (1, 4, 2, 5), (14, 5, 15, 6), (6, 17, 7, 18), (7, 10, 8, 11), (15, 8, 16, 9), (18, 13, 1, 14), (9, 16, 10, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [2, 7, 8, 8], [3, 8, 7, 4], [4, 6, 8, 5], [5, 7, 6, 5]]

Total optimal pinning sets: 6
Total minimal pinning sets: 6
Total pinning sets: 192
Pinning number: 5

Average optimal degree: 2.6
Average minimal degree: 2.6
Average overall degree: 3.04

Table 206: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	29	57	58	32	9	1	186
Average degree	2.6	2.84	3.0	3.12	3.19	3.24	3.27	

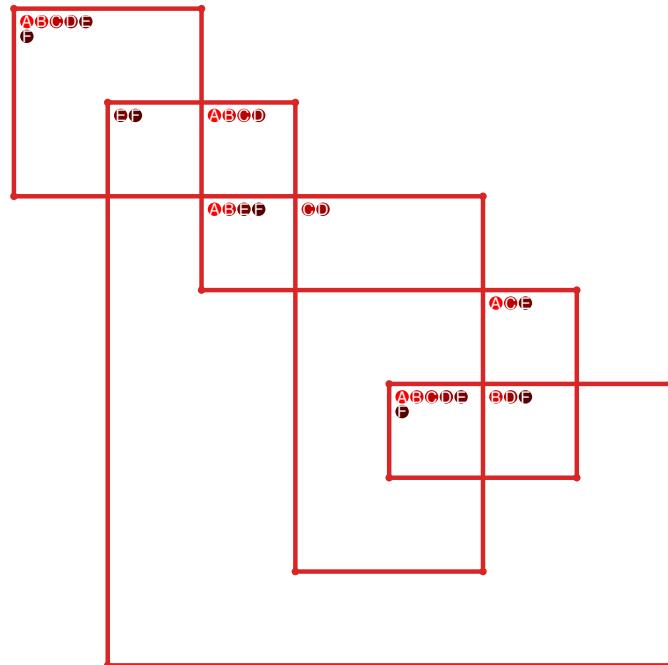


Figure 415: `SnapPy` multiloop plot.

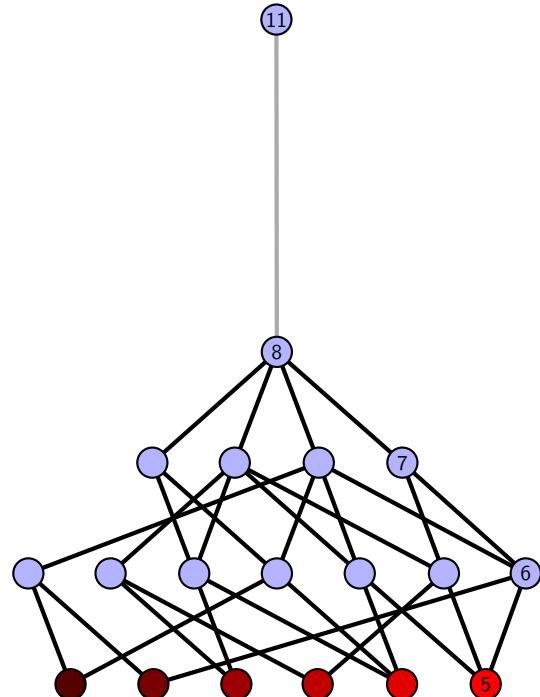


Figure 416: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.109 $[[8, 12, 1, 9], [9, 7, 10, 8], [11, 18, 12, 13], [1, 18, 2, 17], [6, 16, 7, 17], [10, 14, 11, 13], [2, 5, 3, 6], [3, 15, 4, 16], [14, 4, 15, 5]]$

PD code drawn by `SnapPy`: $[(9, 2, 10, 3), (8, 3, 1, 4), (16, 5, 17, 6), (6, 15, 7, 16), (1, 10, 2, 11), (4, 11, 5, 12), (12, 7, 13, 8), (18, 13, 15, 14), (14, 17, 9, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [1, 8, 2, 2], [3, 8, 7, 4], [4, 6, 8, 8], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 4

Table 207: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

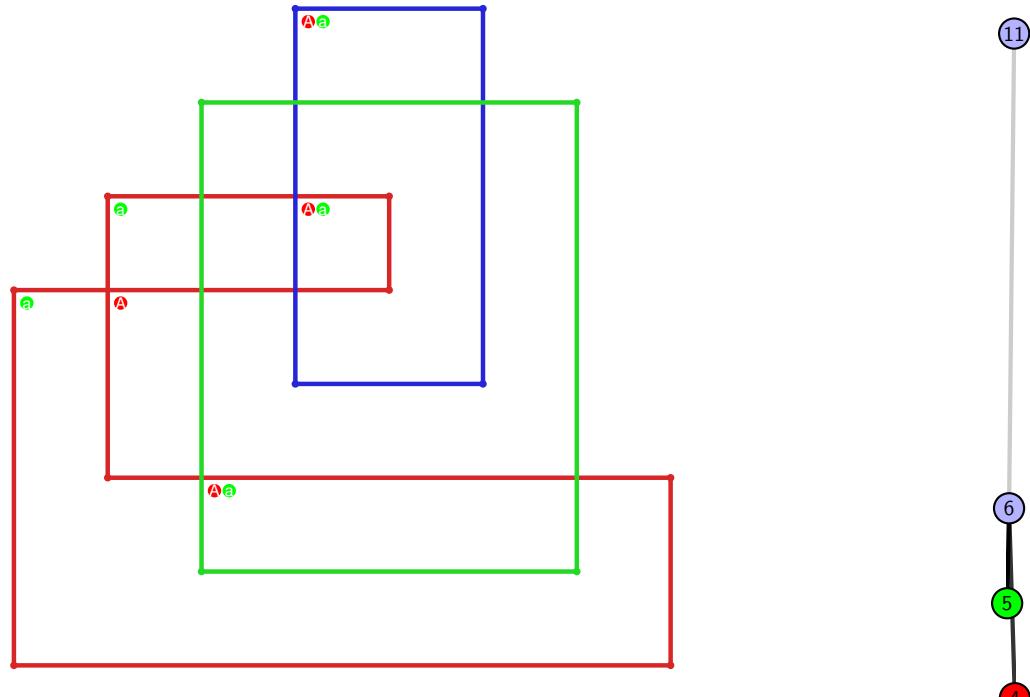


Figure 417: `SnapPy` multiloop plot.

Figure 418: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.110 $[[18, 11, 1, 12], [12, 17, 13, 18], [13, 10, 14, 11], [1, 14, 2, 15], [7, 16, 8, 17], [4, 9, 5, 10], [2, 5, 3, 6], [15, 6, 16, 7], [8, 3, 9, 4]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (18, 3, 1, 4), (13, 4, 14, 5), (2, 7, 3, 8), (11, 8, 12, 9), (16, 9, 17, 10), (17, 12, 18, 13), (5, 14, 6, 15), (10, 15, 11, 16)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 8], [2, 8, 8, 6], [3, 5, 8, 7], [3, 6, 4, 4], [4, 6, 5, 5]]$

Total optimal pinning sets: 6
Total minimal pinning sets: 6
Total pinning sets: 168
Pinning number: 5

Average optimal degree: 2.5
Average minimal degree: 2.5
Average overall degree: 2.99

Table 208: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	27	50	49	27	8	1	162
Average degree	2.5	2.77	2.95	3.07	3.16	3.23	3.27	

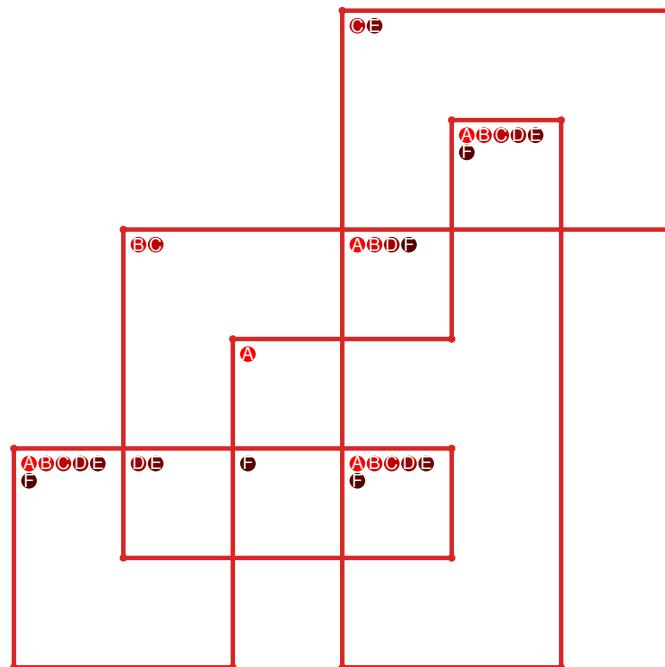


Figure 419: SnapPy multiloop plot.

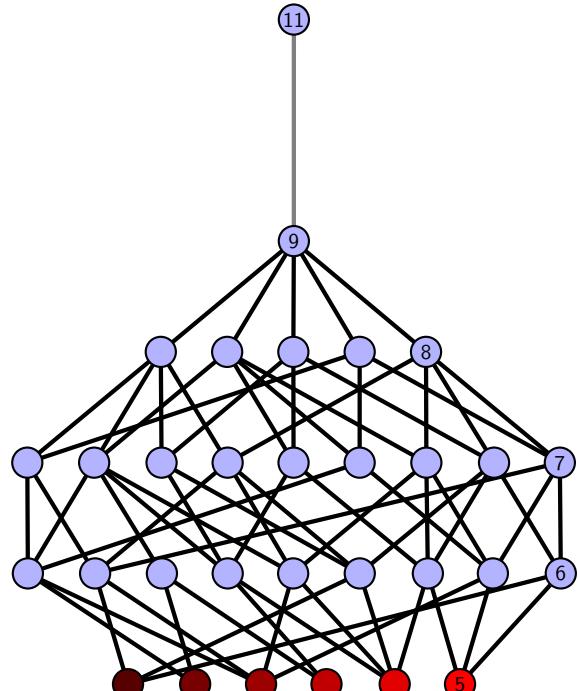


Figure 420: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.111 `[[5, 18, 6, 1], [13, 4, 14, 5], [14, 17, 15, 18], [6, 15, 7, 16], [1, 11, 2, 10], [3, 12, 4, 13], [16, 7, 17, 8], [11, 8, 12, 9], [2, 9, 3, 10]]`

PD code drawn by `SnapPy`: `[(11, 2, 12, 3), (14, 5, 15, 6), (9, 6, 10, 7), (18, 7, 1, 8), (8, 17, 9, 18), (1, 10, 2, 11), (4, 13, 5, 14), (12, 15, 13, 16), (3, 16, 4, 17)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 6, 6], [0, 7, 8, 8], [1, 8, 7, 1], [2, 7, 3, 3], [4, 6, 5, 8], [4, 7, 5, 4]]`

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 120

Average overall degree: 2.97

Pinning number: 5

Table 209: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	11	32	39	25	8	1	116
Average degree	2.4	2.65	2.87	3.03	3.15	3.23	3.27	

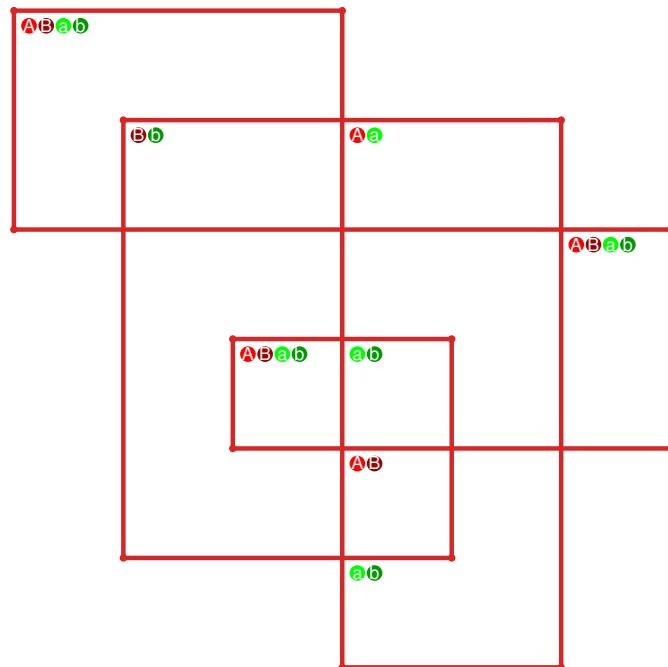


Figure 421: `SnapPy` multiloop plot.

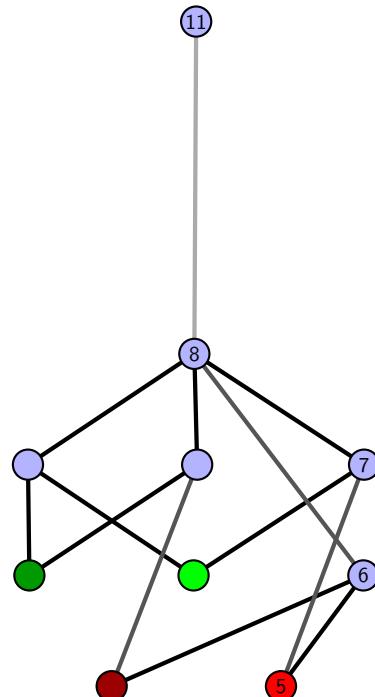


Figure 422: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.112 $[[9, 18, 10, 1], [8, 15, 9, 16], [17, 14, 18, 15], [10, 5, 11, 6], [1, 6, 2, 7], [16, 7, 17, 8], [4, 13, 5, 14], [11, 3, 12, 2], [12, 3, 13, 4]]$

PD code drawn by `SnapPy`: $[(18, 9, 1, 10), (10, 1, 11, 2), (8, 3, 9, 4), (17, 4, 18, 5), (14, 5, 15, 6), (2, 11, 3, 12), (15, 12, 16, 13), (6, 13, 7, 14), (7, 16, 8, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 4], [0, 3, 7, 5], [1, 4, 2, 1], [2, 8, 8, 3], [3, 8, 8, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 5
 Total pinning sets: 140
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.51
 Average overall degree: 2.98

Table 210: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	16	40	44	26	8	1	135
Average degree	2.4	2.69	2.9	3.05	3.15	3.23	3.27	

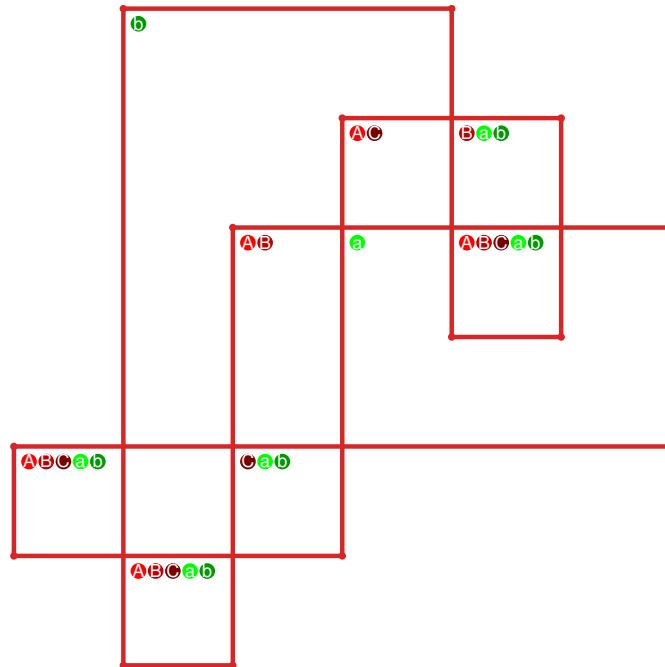


Figure 423: `SnapPy` multiloop plot.

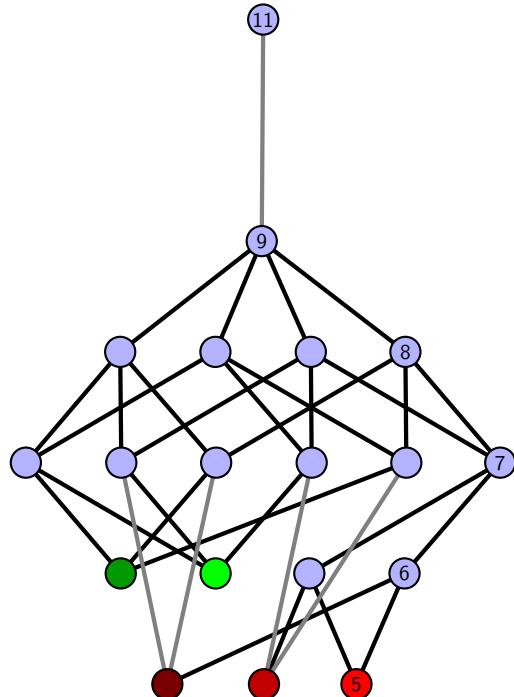


Figure 424: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.113 $[[8, 18, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [17, 12, 18, 13], [1, 12, 2, 11], [6, 11, 7, 10], [15, 3, 16, 4], [13, 16, 14, 17], [2, 14, 3, 15]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (5, 2, 6, 3), (3, 14, 4, 15), (15, 4, 16, 5), (16, 7, 17, 8), (12, 17, 13, 18), (8, 9, 1, 10), (18, 11, 9, 12), (6, 13, 7, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 8, 5], [1, 4, 2, 1], [2, 8, 8, 7], [3, 6, 8, 3], [4, 7, 6, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 7
 Total pinning sets: 166
 Pinning number: 5

Average optimal degree: 2.44
 Average minimal degree: 2.58
 Average overall degree: 2.99

Table 211: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	24	50	49	27	8	1	159
Average degree	2.44	2.74	2.94	3.07	3.16	3.23	3.27	

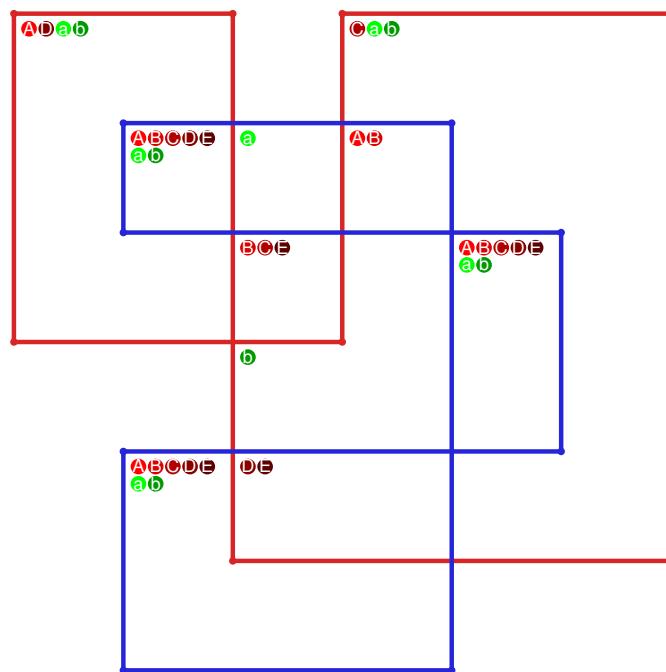


Figure 425: SnapPy multiloop plot.

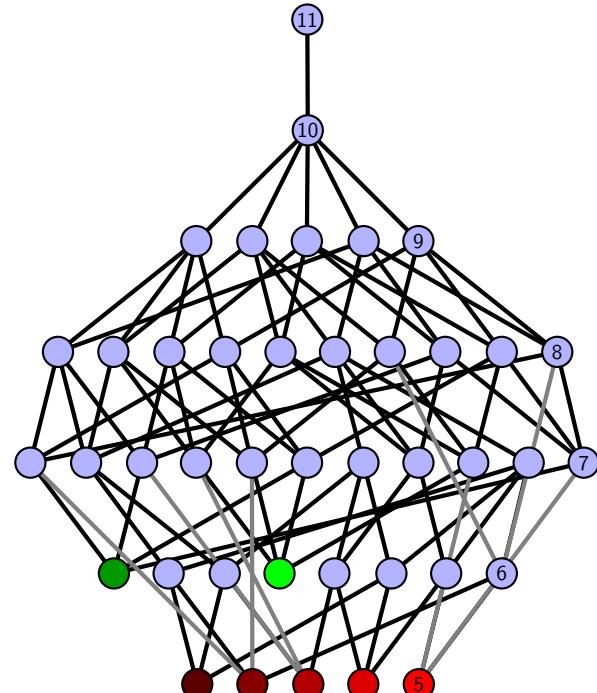


Figure 426: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.114 [[9, 18, 10, 1], [15, 8, 16, 9], [17, 12, 18, 13], [10, 4, 11, 3], [1, 6, 2, 7], [7, 14, 8, 15], [16, 14, 17, 13], [11, 4, 12, 5], [5, 2, 6, 3]]

PD code drawn by SnapPy: [(3, 18, 4, 1), (1, 8, 2, 9), (9, 2, 10, 3), (17, 4, 18, 5), (13, 6, 14, 7), (15, 10, 16, 11), (11, 14, 12, 15), (5, 12, 6, 13), (7, 16, 8, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 7], [0, 7, 7, 8], [0, 8, 8, 5], [1, 4, 6, 1], [1, 5, 2, 2], [2, 8, 3, 3], [3, 7, 4, 4]]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 212: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

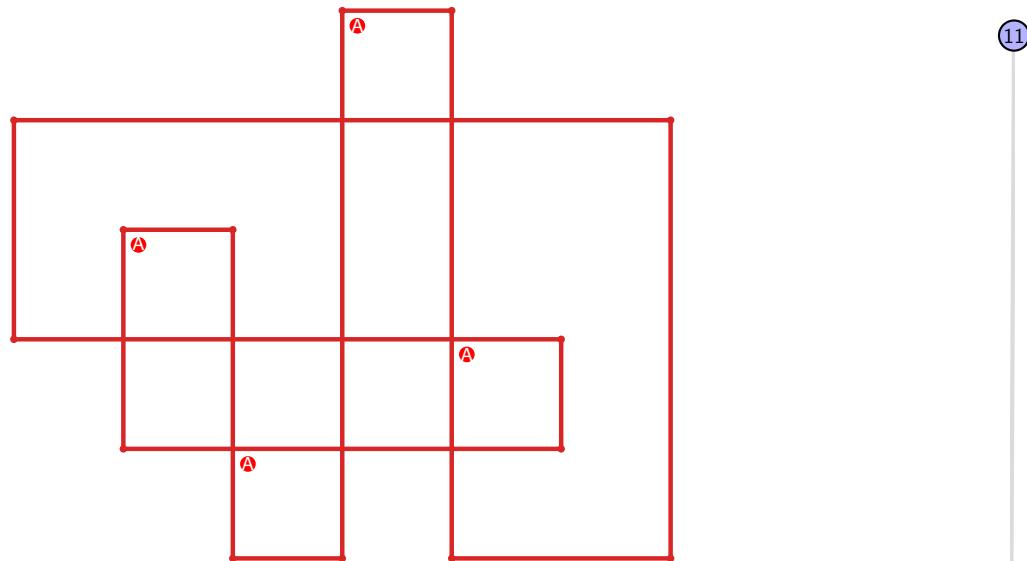


Figure 427: SnapPy multiloop plot.



Figure 428: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.115 [[10, 18, 1, 11], [11, 7, 12, 8], [15, 9, 16, 10], [3, 17, 4, 18], [1, 4, 2, 5], [6, 12, 7, 13], [8, 14, 9, 15], [16, 2, 17, 3], [5, 14, 6, 13]]

PD code drawn by `SnapPy`: [(11, 10, 12, 1), (9, 2, 10, 3), (14, 5, 15, 6), (18, 7, 11, 8), (16, 3, 17, 4), (6, 17, 7, 18), (1, 12, 2, 13), (8, 13, 9, 14), (4, 15, 5, 16)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 7], [0, 7, 7, 4], [0, 3, 7, 8], [1, 8, 8, 1], [1, 8, 2, 2], [2, 4, 3, 3], [4, 6, 5, 5]]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 213: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

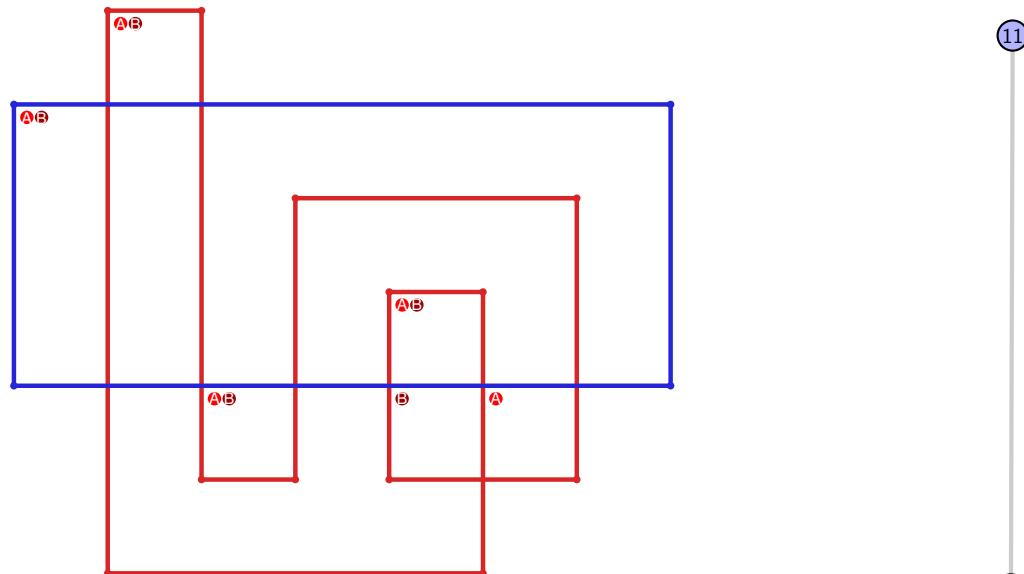


Figure 429: `SnapPy` multiloop plot.

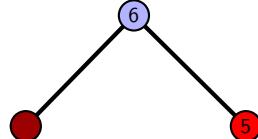


Figure 430: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.116 `[[12, 18, 1, 13], [13, 11, 14, 12], [14, 17, 15, 18], [1, 6, 2, 7], [7, 10, 8, 11], [4, 16, 5, 17], [15, 5, 16, 6], [2, 9, 3, 10], [8, 3, 9, 4]]`

PD code drawn by `SnapPy`: `[(6, 1, 7, 2), (18, 3, 13, 4), (11, 4, 12, 5), (12, 7, 1, 8), (5, 8, 6, 9), (16, 9, 17, 10), (2, 13, 3, 14), (17, 14, 18, 15), (10, 15, 11, 16)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 7, 4], [1, 3, 7, 8], [2, 8, 6, 6], [2, 5, 5, 3], [3, 8, 8, 4], [4, 7, 7, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 5

Average minimal degree: 2.49

Total pinning sets: 188

Average overall degree: 2.98

Pinning number: 4

Table 214: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	7	35	55	50	27	8	1	183
Average degree	2.25	2.56	2.8	2.96	3.08	3.16	3.23	3.27	

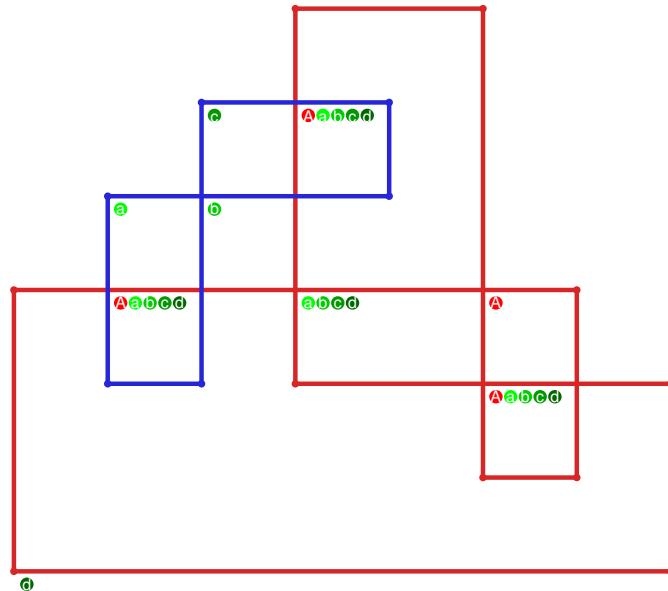


Figure 431: `SnapPy` multiloop plot.

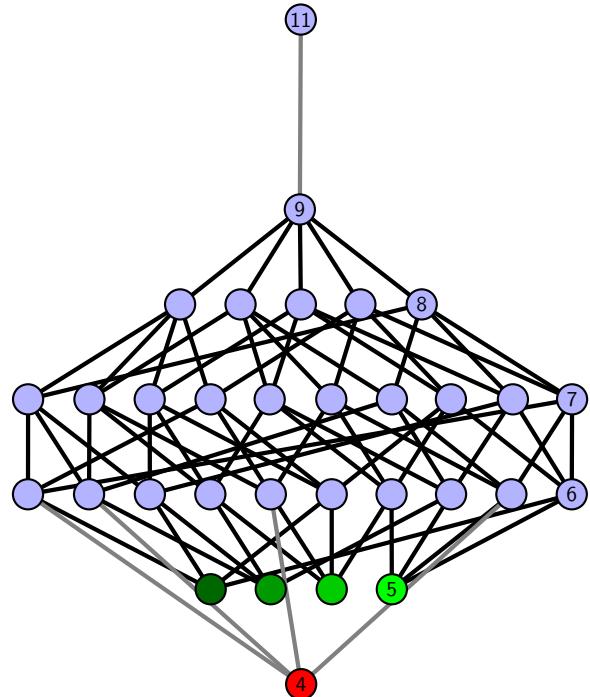


Figure 432: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.117 `[[7, 14, 8, 1], [13, 6, 14, 7], [8, 6, 9, 5], [1, 10, 2, 11], [12, 18, 13, 15], [9, 4, 10, 5], [2, 17, 3, 16], [11, 16, 12, 15], [3, 17, 4, 18]]`

PD code drawn by `SnapPy`: `[(7, 2, 8, 3), (3, 6, 4, 7), (11, 4, 12, 5), (13, 8, 14, 9), (5, 12, 6, 13), (10, 17, 11, 18), (18, 9, 15, 10), (15, 14, 16, 1), (1, 16, 2, 17)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 7], [1, 7, 7, 8], [2, 8, 3, 2], [3, 8, 8, 7], [3, 6, 4, 4], [4, 6, 6, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 215: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

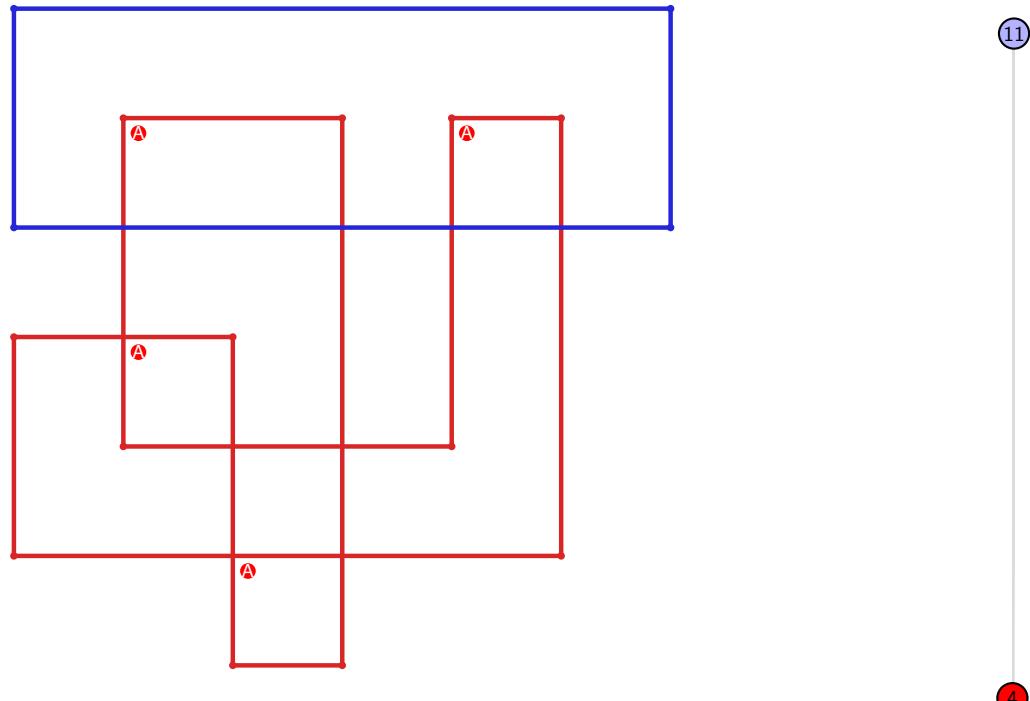


Figure 433: `SnapPy` multiloop plot.

Figure 434: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.118 $[[5, 8, 6, 1], [4, 18, 5, 9], [7, 17, 8, 18], [6, 17, 7, 16], [1, 14, 2, 13], [9, 3, 10, 4], [10, 15, 11, 16], [14, 11, 15, 12], [2, 12, 3, 13]]$

PD code drawn by `SnapPy`: $[(16, 1, 17, 2), (3, 6, 4, 7), (10, 7, 11, 8), (17, 12, 18, 13), (13, 4, 14, 5), (5, 14, 6, 15), (2, 15, 3, 16), (11, 18, 12, 9), (8, 9, 1, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 3, 3], [0, 2, 2, 6], [0, 7, 8, 8], [1, 8, 6, 1], [3, 5, 7, 7], [4, 6, 6, 8], [4, 7, 5, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 216: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

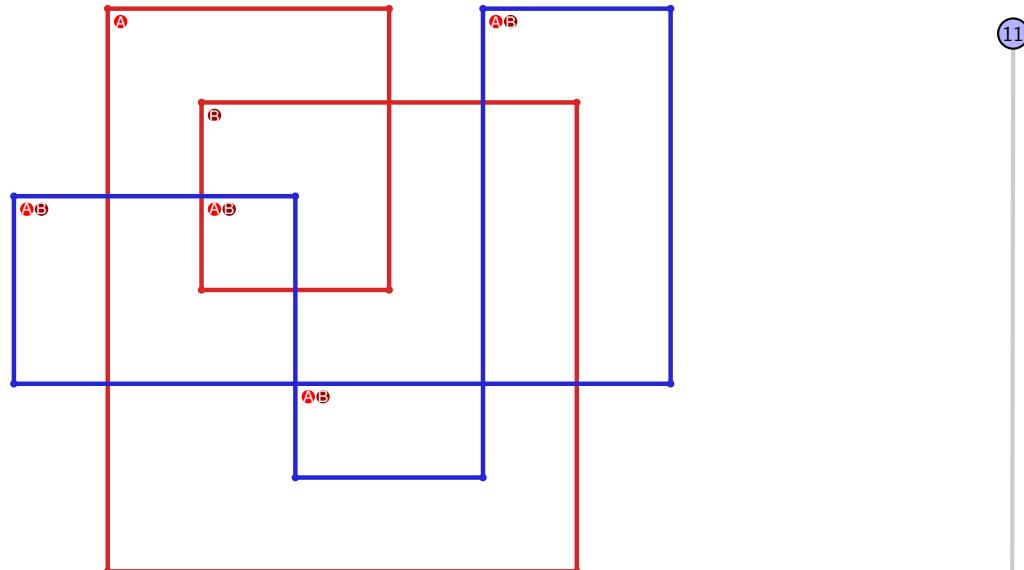


Figure 435: `SnapPy` multiloop plot.

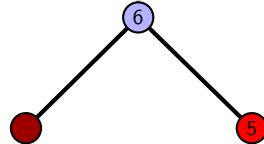


Figure 436: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.119 $[[7, 18, 8, 1], [6, 13, 7, 14], [17, 10, 18, 11], [8, 3, 9, 4], [1, 4, 2, 5], [14, 5, 15, 6], [15, 12, 16, 13], [11, 16, 12, 17], [2, 9, 3, 10]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (17, 2, 18, 3), (12, 3, 13, 4), (18, 7, 1, 8), (15, 8, 16, 9), (13, 10, 14, 11), (4, 11, 5, 12), (9, 14, 10, 15), (5, 16, 6, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 8], [0, 8, 8, 4], [0, 3, 8, 5], [1, 4, 6, 1], [1, 5, 7, 7], [2, 6, 6, 2], [2, 4, 3, 3]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 217: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

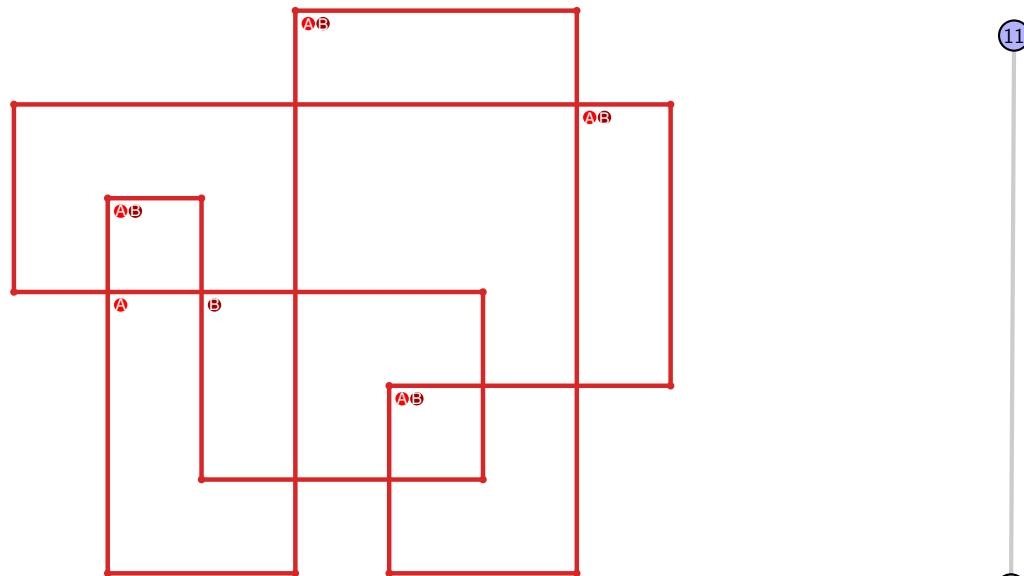


Figure 437: SnapPy multiloop plot.

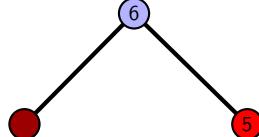


Figure 438: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.120 $[[7, 18, 8, 1], [6, 13, 7, 14], [17, 8, 18, 9], [1, 4, 2, 5], [14, 5, 15, 6], [15, 12, 16, 13], [9, 16, 10, 17], [10, 3, 11, 4], [2, 11, 3, 12]]$

PD code drawn by SnapPy: $[(7, 18, 8, 1), (16, 1, 17, 2), (11, 2, 12, 3), (14, 5, 15, 6), (17, 8, 18, 9), (12, 9, 13, 10), (3, 10, 4, 11), (6, 13, 7, 14), (4, 15, 5, 16)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 6, 0], [0, 7, 8, 4], [1, 3, 5, 1], [1, 4, 8, 6], [2, 5, 7, 2], [3, 6, 8, 8], [3, 7, 7, 5]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 112

Average overall degree: 2.91

Pinning number: 5

Table 218: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.27	2.6	2.83	2.99	3.11	3.2	3.27	

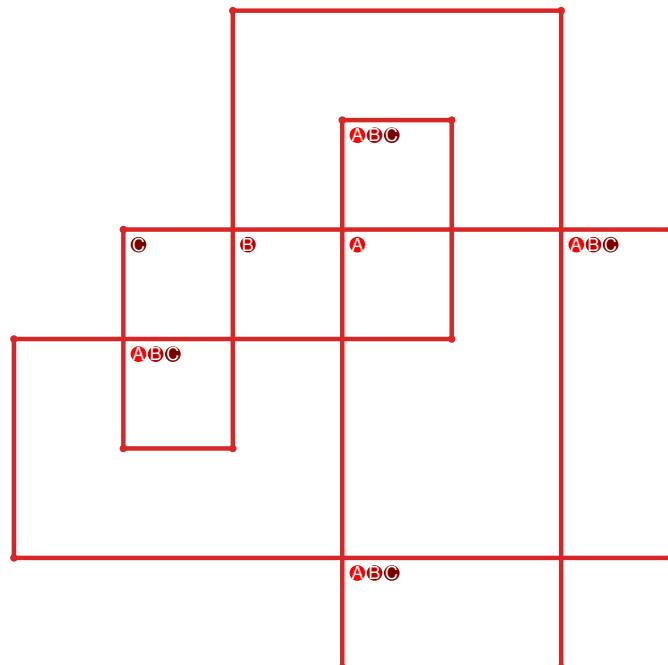


Figure 439: SnapPy multiloop plot.

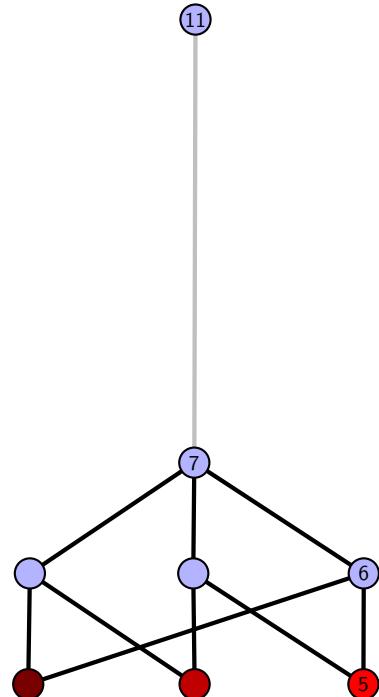


Figure 440: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.121 $[[7, 10, 8, 1], [6, 18, 7, 11], [13, 9, 14, 10], [8, 14, 9, 15], [1, 4, 2, 5], [11, 5, 12, 6], [12, 17, 13, 18], [15, 3, 16, 4], [2, 16, 3, 17]]$

PD code drawn by `SnapPy`: $[(18, 1, 11, 2), (9, 2, 10, 3), (14, 3, 15, 4), (16, 7, 17, 8), (5, 8, 6, 9), (6, 17, 7, 18), (10, 11, 1, 12), (15, 12, 16, 13), (4, 13, 5, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 7, 8, 5], [1, 4, 6, 1], [1, 5, 8, 2], [3, 8, 8, 4], [4, 7, 7, 6]]$

Total optimal pinning sets: 6

Average optimal degree: 2.5

Total minimal pinning sets: 7

Average minimal degree: 2.57

Total pinning sets: 180

Average overall degree: 3.0

Pinning number: 5

Table 219: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	28	55	53	28	8	1	173
Average degree	2.5	2.78	2.96	3.08	3.17	3.23	3.27	

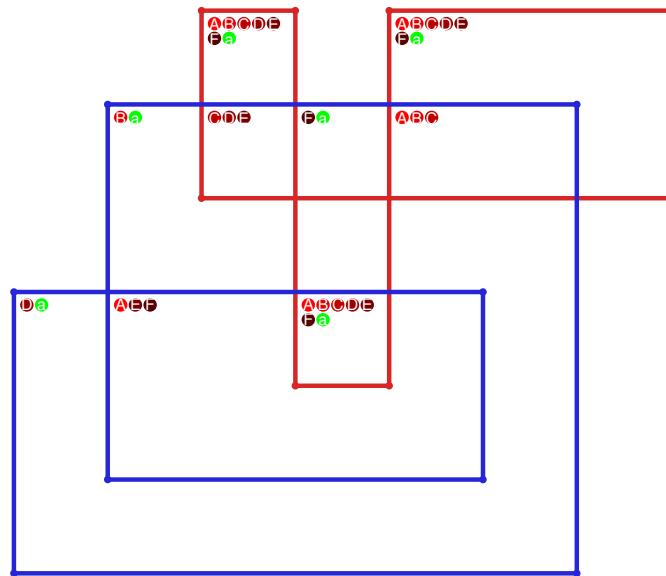


Figure 441: `SnapPy` multiloop plot.

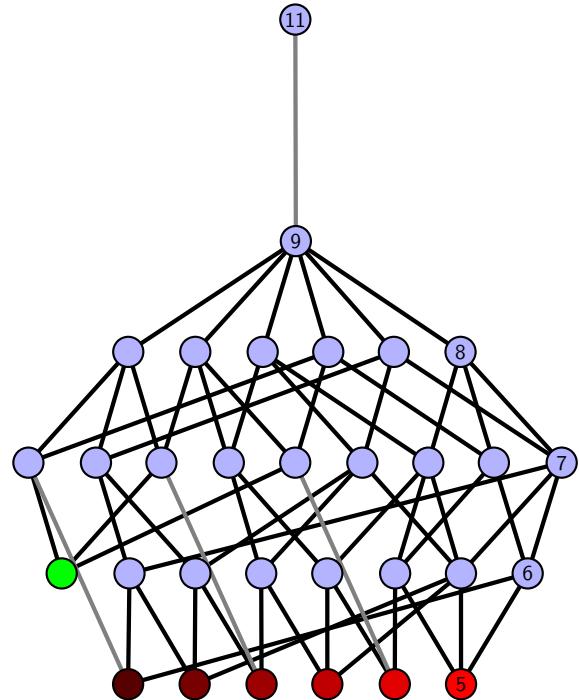


Figure 442: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.122 `[[5, 14, 6, 1], [9, 4, 10, 5], [13, 6, 14, 7], [1, 15, 2, 18], [3, 8, 4, 9], [10, 8, 11, 7], [12, 15, 13, 16], [2, 17, 3, 18], [11, 17, 12, 16]]`

PD code drawn by `SnapPy`: `[(6, 1, 7, 2), (10, 3, 11, 4), (4, 7, 5, 8), (14, 5, 1, 6), (2, 11, 3, 12), (15, 8, 16, 9), (13, 16, 14, 17), (17, 12, 18, 13), (9, 18, 10, 15)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 6, 7, 7], [1, 7, 5, 1], [1, 4, 8, 2], [2, 8, 8, 3], [3, 8, 4, 3], [5, 7, 6, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 220: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

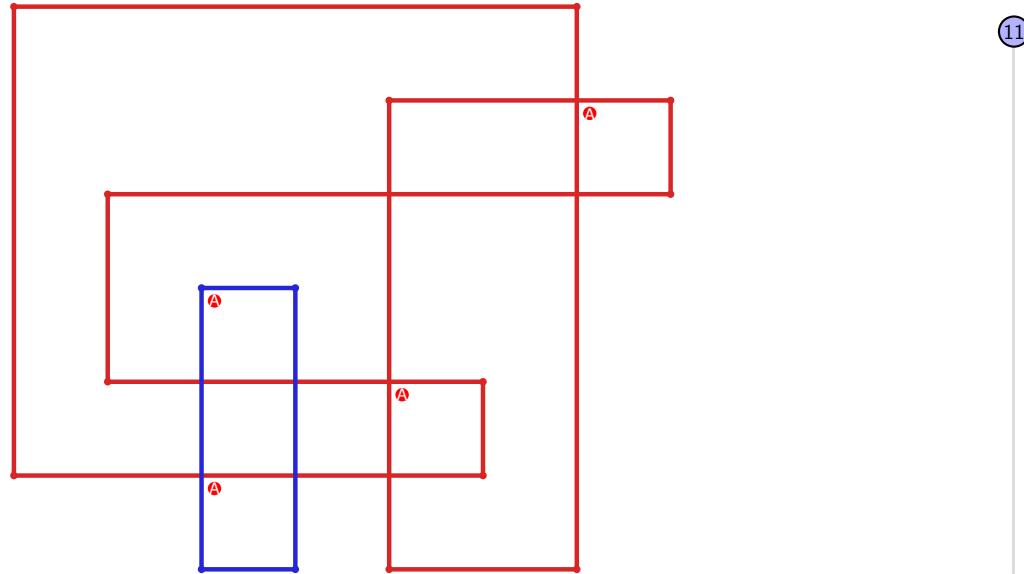


Figure 443: `SnapPy` multiloop plot.

Figure 444: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.123 [[12, 18, 1, 13], [13, 3, 14, 4], [15, 11, 16, 12], [17, 9, 18, 10], [1, 6, 2, 7], [7, 2, 8, 3], [14, 5, 15, 4], [10, 16, 11, 17], [5, 8, 6, 9]]

PD code drawn by SnapPy: [(5, 12, 6, 1), (18, 1, 13, 2), (2, 13, 3, 14), (11, 4, 12, 5), (3, 6, 4, 7), (16, 7, 17, 8), (14, 9, 15, 10), (8, 15, 9, 16), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 7, 7], [0, 7, 7, 8], [0, 8, 5, 5], [1, 4, 4, 8], [1, 8, 2, 1], [2, 3, 3, 2], [3, 6, 5, 4]]

Total optimal pinning sets: 1
Total minimal pinning sets: 1
Total pinning sets: 128
Pinning number: 4

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.9

Table 221: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

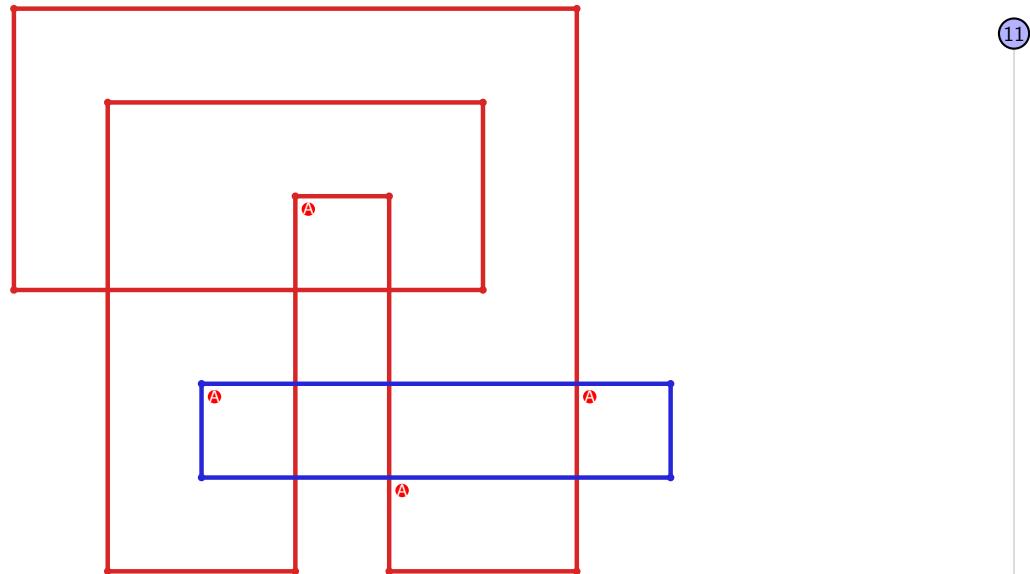


Figure 445: SnapPy multiloop plot.

4

Figure 446: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.124 [[13, 18, 14, 1], [3, 12, 4, 13], [17, 14, 18, 15], [1, 6, 2, 7], [7, 2, 8, 3], [11, 4, 12, 5], [15, 11, 16, 10], [16, 9, 17, 10], [5, 8, 6, 9]]

PD code drawn by SnapPy: [(5, 18, 6, 1), (9, 2, 10, 3), (17, 4, 18, 5), (3, 6, 4, 7), (14, 7, 15, 8), (8, 13, 9, 14), (1, 10, 2, 11), (15, 12, 16, 13), (11, 16, 12, 17)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 7, 0], [0, 8, 4, 4], [1, 3, 3, 8], [1, 8, 6, 1], [2, 5, 7, 7], [2, 6, 6, 8], [3, 7, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 222: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

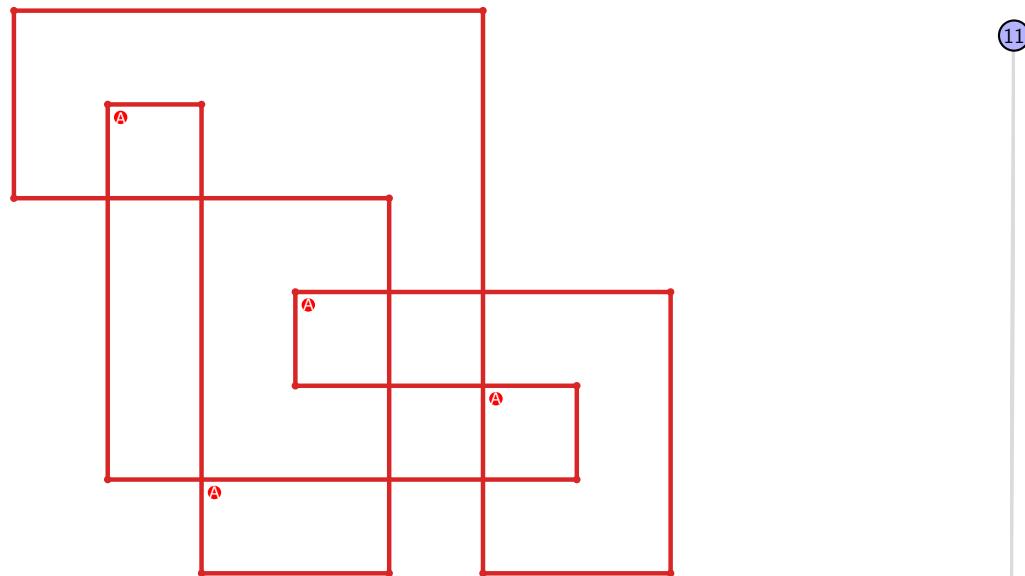


Figure 447: SnapPy multiloop plot.



Figure 448: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.125 `[[15, 18, 16, 1], [14, 5, 15, 6], [17, 12, 18, 13], [16, 12, 17, 11], [1, 8, 2, 9], [6, 9, 7, 10], [4, 13, 5, 14], [10, 3, 11, 4], [7, 2, 8, 3]]`

PD code drawn by `SnapPy`: `[(7, 18, 8, 1), (11, 2, 12, 3), (16, 5, 17, 6), (3, 6, 4, 7), (8, 13, 9, 14), (14, 9, 15, 10), (1, 10, 2, 11), (12, 15, 13, 16), (4, 17, 5, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 8, 8, 5], [1, 4, 8, 7], [1, 7, 2, 1], [3, 6, 5, 8], [4, 7, 5, 4]]`

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 4

Table 223: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.25	2.58	2.81	2.96	3.08	3.16	3.22	3.27	

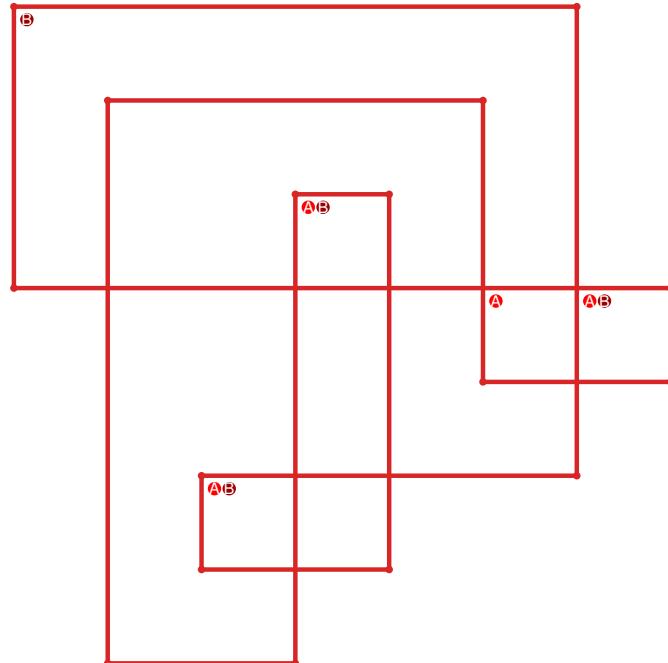


Figure 449: `SnapPy` multiloop plot.

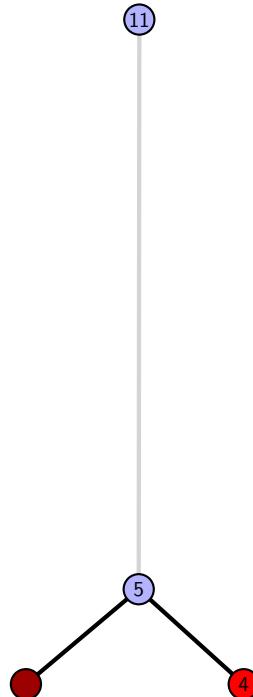


Figure 450: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.126 [[7, 18, 8, 1], [17, 6, 18, 7], [8, 11, 9, 12], [1, 12, 2, 13], [13, 16, 14, 17], [10, 5, 11, 6], [9, 5, 10, 4], [2, 15, 3, 16], [14, 3, 15, 4]]

PD code drawn by `SnapPy`: [(12, 1, 13, 2), (2, 7, 3, 8), (8, 3, 9, 4), (15, 4, 16, 5), (6, 9, 7, 10), (17, 10, 18, 11), (18, 13, 1, 14), (11, 14, 12, 15), (5, 16, 6, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 3], [0, 2, 7, 4], [1, 3, 7, 8], [1, 6, 6, 2], [2, 5, 5, 8], [3, 8, 8, 4], [4, 7, 7, 6]]

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 4

Average optimal degree: 2.25

Average minimal degree: 2.25

Average overall degree: 2.97

Table 224: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.25	2.58	2.81	2.96	3.08	3.16	3.23	3.27	

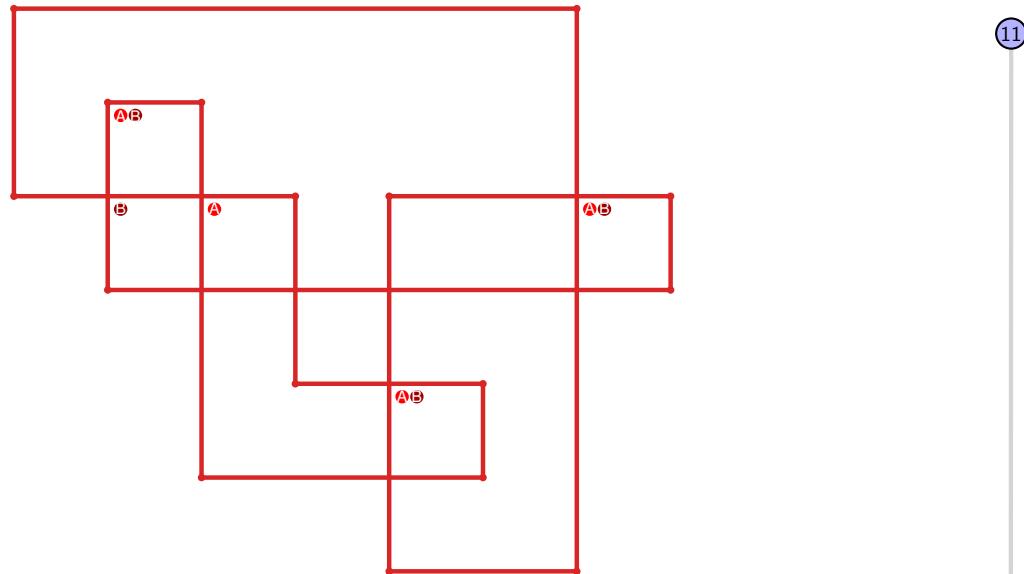


Figure 451: `SnapPy` multiloop plot.

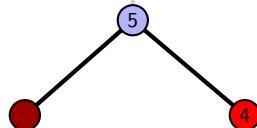


Figure 452: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.127 [[10, 14, 1, 11], [11, 9, 12, 10], [5, 13, 6, 14], [1, 6, 2, 7], [8, 18, 9, 15], [12, 4, 13, 5], [2, 17, 3, 16], [7, 16, 8, 15], [3, 17, 4, 18]]

PD code drawn by `SnapPy`: [(15, 2, 16, 3), (9, 4, 10, 5), (18, 7, 15, 8), (3, 16, 4, 17), (8, 17, 9, 18), (1, 12, 2, 13), (6, 13, 7, 14), (14, 5, 11, 6), (11, 10, 12, 1)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 7], [1, 7, 7, 8], [1, 8, 2, 2], [3, 8, 8, 7], [3, 6, 4, 4], [4, 6, 6, 5]]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.9

Pinning number: 4

Table 225: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	

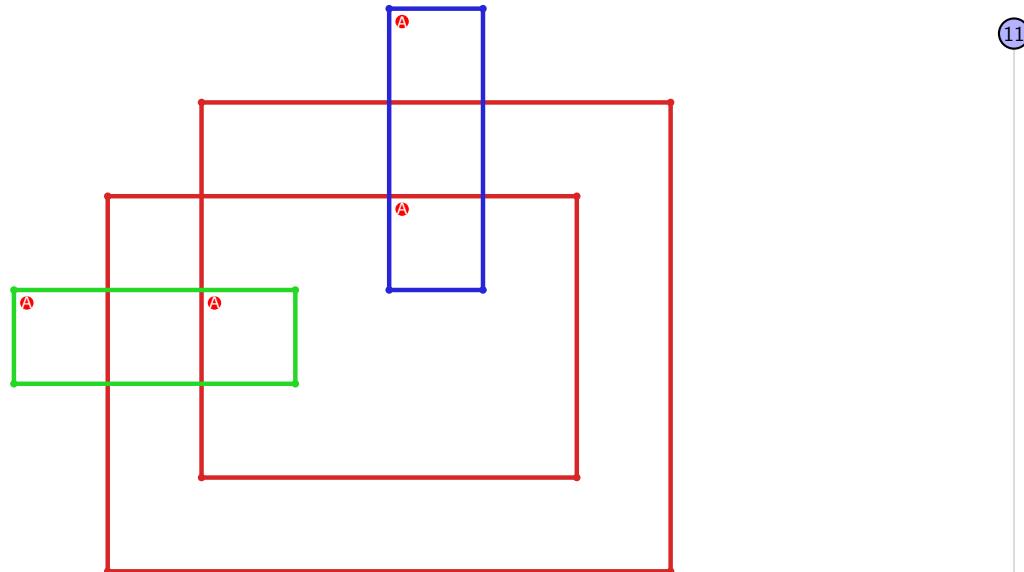


Figure 453: `SnapPy` multiloop plot.

4

Figure 454: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.128 [[15, 18, 16, 1], [3, 14, 4, 15], [4, 17, 5, 18], [16, 5, 17, 6], [1, 11, 2, 10], [2, 9, 3, 10], [13, 8, 14, 9], [6, 12, 7, 11], [7, 12, 8, 13]]

PD code drawn by SnapPy: [(14, 3, 15, 4), (11, 6, 12, 7), (18, 7, 1, 8), (8, 17, 9, 18), (9, 4, 10, 5), (5, 10, 6, 11), (1, 12, 2, 13), (2, 15, 3, 16), (13, 16, 14, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 3, 3], [0, 2, 2, 7], [0, 7, 5, 5], [1, 4, 4, 6], [1, 5, 8, 8], [3, 8, 8, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 96

Average overall degree: 2.9

Pinning number: 5

Table 226: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	

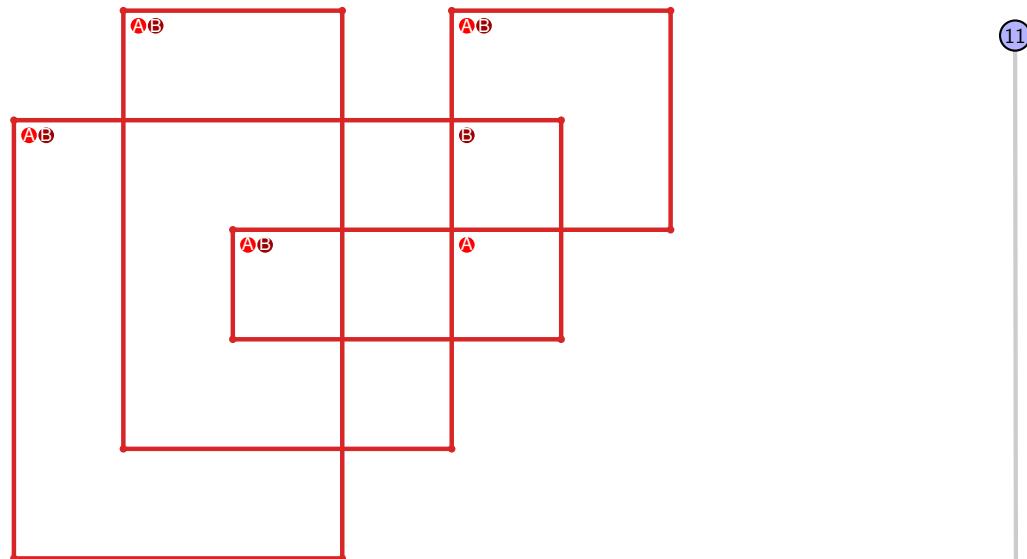


Figure 455: SnapPy multiloop plot.

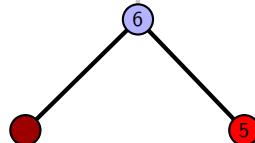


Figure 456: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.129 $[[5, 8, 6, 1], [4, 14, 5, 9], [7, 13, 8, 14], [6, 13, 7, 12], [1, 15, 2, 18], [9, 3, 10, 4], [11, 15, 12, 16], [2, 17, 3, 18], [10, 17, 11, 16]]$

PD code drawn by `SnapPy`: $[(14, 1, 15, 2), (3, 6, 4, 7), (17, 4, 18, 5), (5, 18, 6, 13), (2, 13, 3, 14), (12, 15, 9, 16), (8, 9, 1, 10), (10, 7, 11, 8), (16, 11, 17, 12)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 3, 3], [0, 2, 2, 6], [0, 6, 7, 7], [1, 7, 8, 1], [3, 8, 8, 4], [4, 8, 5, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 4

Average minimal degree: 2.38

Total pinning sets: 92

Average overall degree: 2.91

Pinning number: 5

Table 227: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	6	24	30	20	7	1	88
Average degree	2.2	2.5	2.77	2.97	3.1	3.2	3.27	

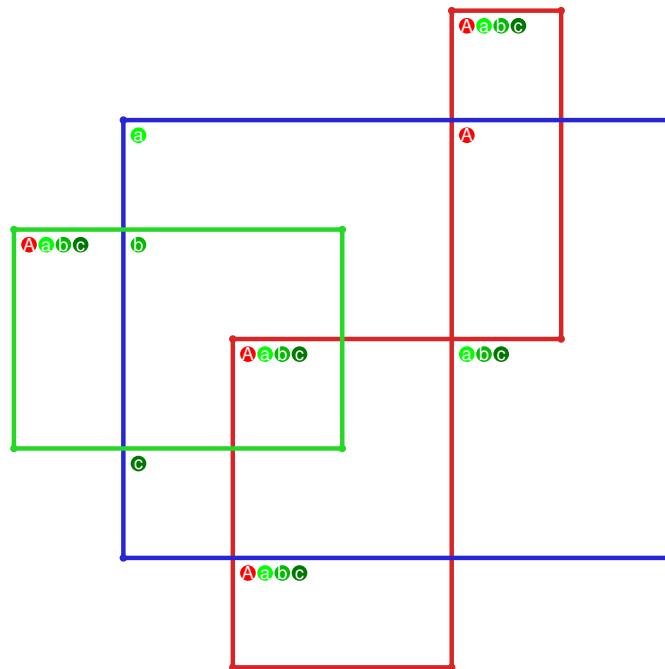


Figure 457: `SnapPy` multiloop plot.

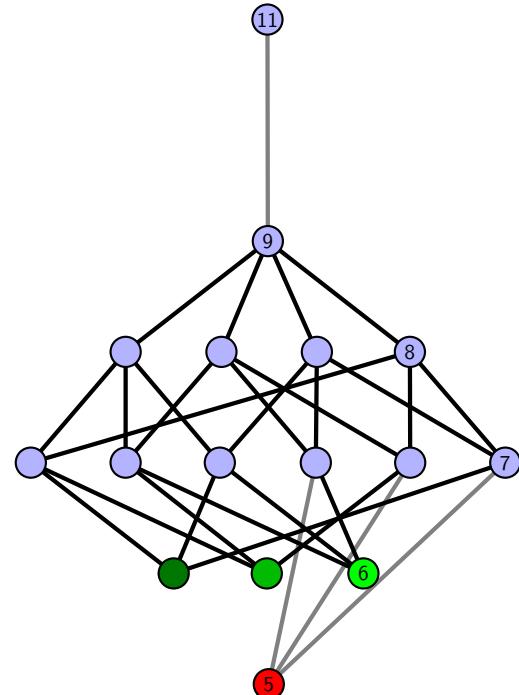


Figure 458: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.130 $[[9, 18, 10, 1], [8, 15, 9, 16], [17, 14, 18, 15], [10, 2, 11, 1], [16, 7, 17, 8], [4, 13, 5, 14], [2, 12, 3, 11], [3, 6, 4, 7], [12, 5, 13, 6]]$

PD code drawn by `SnapPy`: $[(10, 3, 11, 4), (1, 4, 2, 5), (14, 5, 15, 6), (9, 18, 10, 1), (2, 11, 3, 12), (15, 12, 16, 13), (6, 13, 7, 14), (7, 16, 8, 17), (17, 8, 18, 9)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 7, 8, 8], [3, 8, 7, 3], [4, 6, 8, 5], [5, 7, 6, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 68
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.39
 Average overall degree: 2.92

Table 228: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	13	24	19	7	1	64
Average degree	2.33	2.65	2.91	3.09	3.2	3.27	

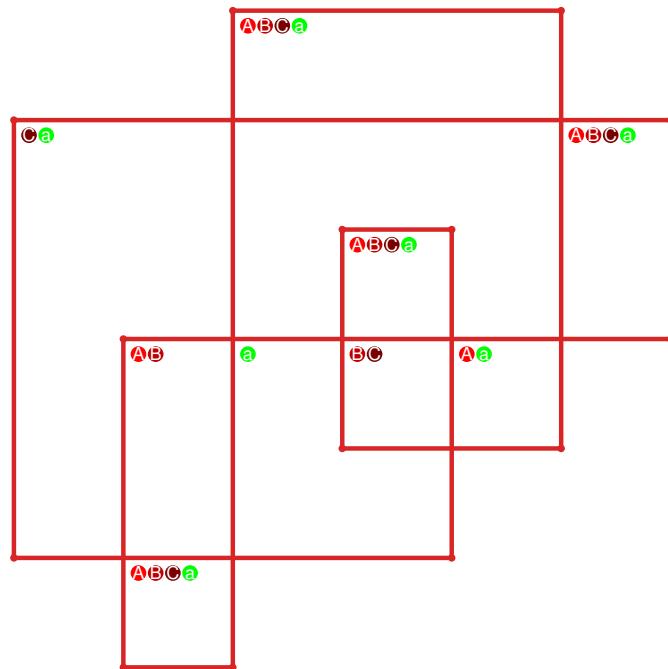


Figure 459: `SnapPy` multiloop plot.

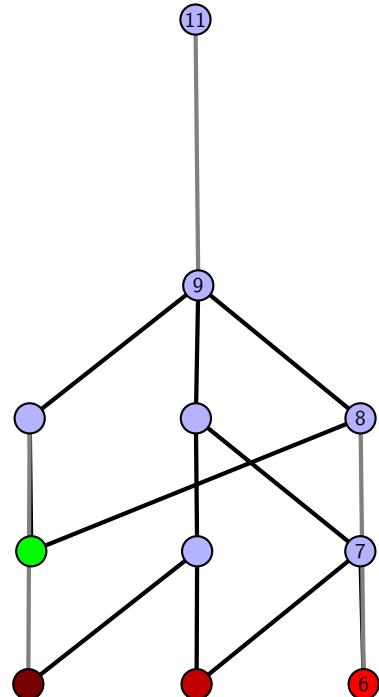


Figure 460: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.131 [[8, 18, 1, 9], [9, 14, 10, 15], [15, 7, 16, 8], [17, 1, 18, 2], [5, 13, 6, 14], [10, 6, 11, 7], [16, 3, 17, 2], [12, 4, 13, 5], [11, 4, 12, 3]]

PD code drawn by SnapPy: [(16, 1, 17, 2), (11, 2, 12, 3), (13, 4, 14, 5), (5, 12, 6, 13), (6, 17, 7, 18), (18, 7, 9, 8), (8, 9, 1, 10), (15, 10, 16, 11), (3, 14, 4, 15)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 0], [1, 7, 7, 5], [1, 4, 8, 2], [2, 8, 3, 3], [4, 8, 8, 4], [5, 7, 7, 6]]

Total optimal pinning sets: 1
Total minimal pinning sets: 2
Total pinning sets: 80
Pinning number: 5

Average optimal degree: 2.2
Average minimal degree: 2.27
Average overall degree: 2.91

Table 229: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.2	2.5	2.74	2.94	3.09	3.2	3.27	

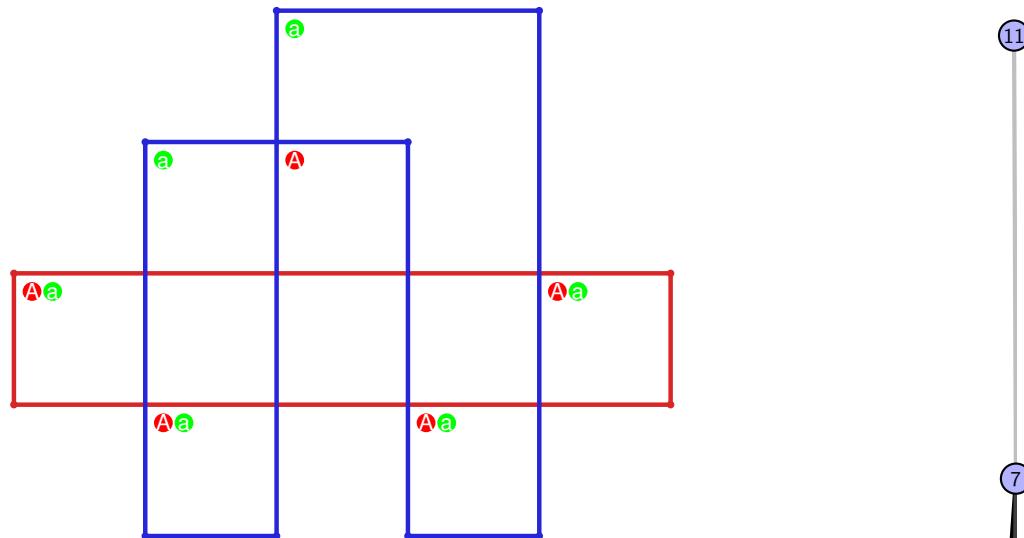


Figure 461: SnapPy multiloop plot.



Figure 462: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.132 [[18, 9, 1, 10], [10, 17, 11, 18], [11, 8, 12, 9], [1, 12, 2, 13], [16, 3, 17, 4], [7, 2, 8, 3], [13, 7, 14, 6], [4, 15, 5, 16], [14, 5, 15, 6]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (2, 9, 3, 10), (7, 4, 8, 5), (14, 5, 15, 6), (15, 8, 16, 9), (18, 11, 1, 12), (6, 13, 7, 14), (3, 16, 4, 17), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 5, 6], [1, 7, 7, 5], [2, 4, 6, 3], [3, 5, 8, 8], [4, 8, 8, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 64

Pinning number: 6

Average optimal degree: 2.33

Average minimal degree: 2.33

Average overall degree: 2.91

Table 230: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	22	18	7	1	61
Average degree	2.33	2.66	2.9	3.07	3.2	3.27	

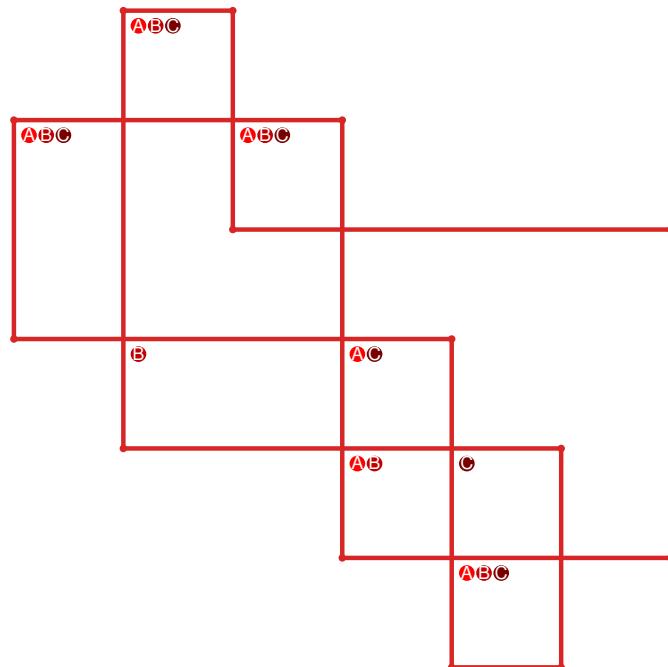


Figure 463: SnapPy multiloop plot.

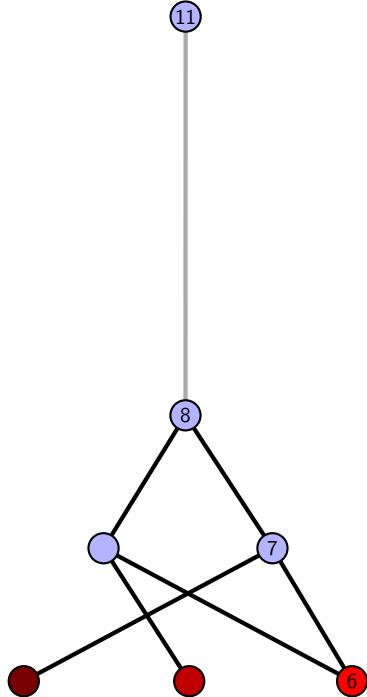


Figure 464: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.133 [[18, 7, 1, 8], [8, 15, 9, 16], [6, 17, 7, 18], [1, 13, 2, 12], [3, 14, 4, 15], [9, 4, 10, 5], [16, 5, 17, 6], [13, 10, 14, 11], [2, 11, 3, 12]]

PD code drawn by SnapPy: [(7, 2, 8, 3), (14, 3, 15, 4), (16, 5, 17, 6), (11, 8, 12, 9), (18, 9, 1, 10), (10, 17, 11, 18), (1, 12, 2, 13), (6, 13, 7, 14), (4, 15, 5, 16)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 6, 0], [0, 7, 8, 8], [1, 8, 7, 5], [1, 4, 7, 6], [1, 5, 2, 2], [3, 5, 4, 8], [3, 7, 4, 3]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 104
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.48
 Average overall degree: 2.97

Table 231: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	6	26	35	24	8	1	100
Average degree	2.4	2.61	2.84	3.01	3.14	3.23	3.27	

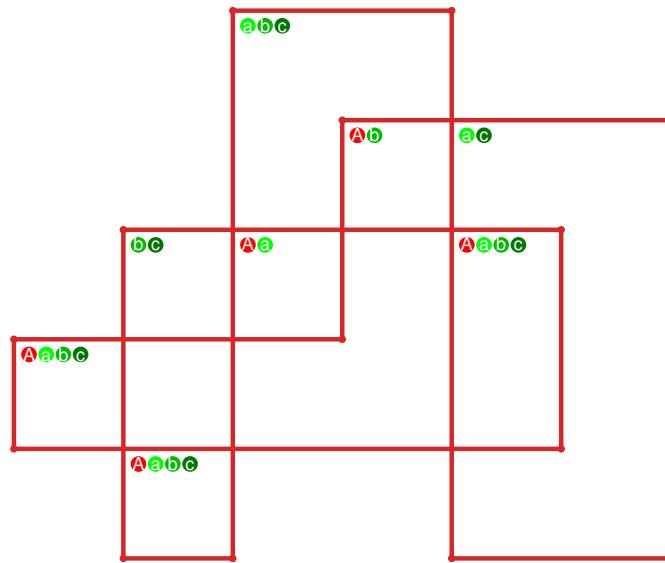


Figure 465: SnapPy multiloop plot.

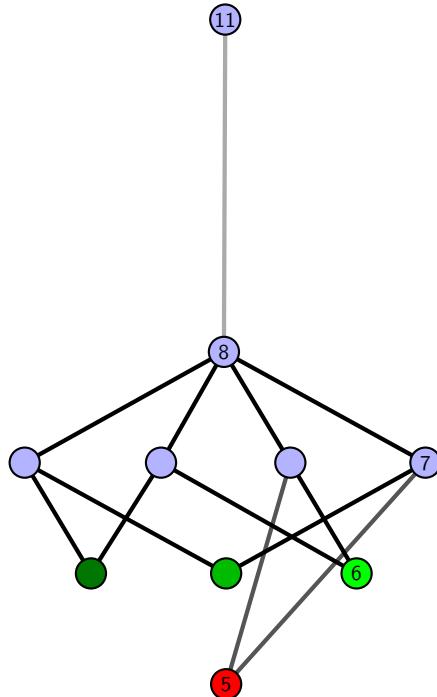


Figure 466: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.134 [[11, 18, 12, 1], [10, 3, 11, 4], [17, 2, 18, 3], [12, 2, 13, 1], [4, 15, 5, 16], [16, 9, 17, 10], [13, 6, 14, 7], [7, 14, 8, 15], [5, 8, 6, 9]]

PD code drawn by SnapPy: [(15, 18, 16, 1), (8, 1, 9, 2), (11, 4, 12, 5), (3, 6, 4, 7), (14, 7, 15, 8), (5, 12, 6, 13), (2, 13, 3, 14), (9, 16, 10, 17), (17, 10, 18, 11)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 0], [1, 7, 8, 5], [1, 4, 8, 2], [3, 8, 7, 7], [4, 6, 6, 8], [4, 7, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.6

Total minimal pinning sets: 7

Average minimal degree: 2.66

Total pinning sets: 136

Average overall degree: 3.04

Pinning number: 5

Table 232: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	6
Nonminimal pinning sets	0	6	36	47	30	9	1	129
Average degree	2.6	2.74	2.93	3.08	3.19	3.24	3.27	

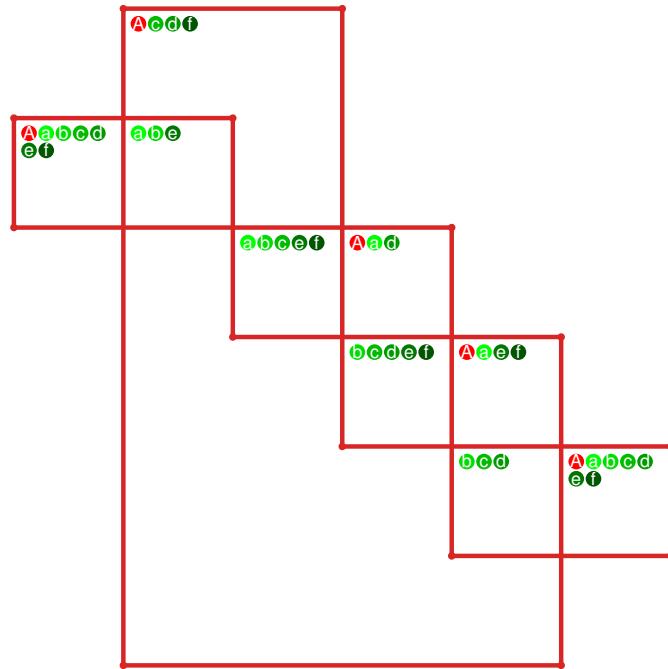


Figure 467: SnapPy multiloop plot.

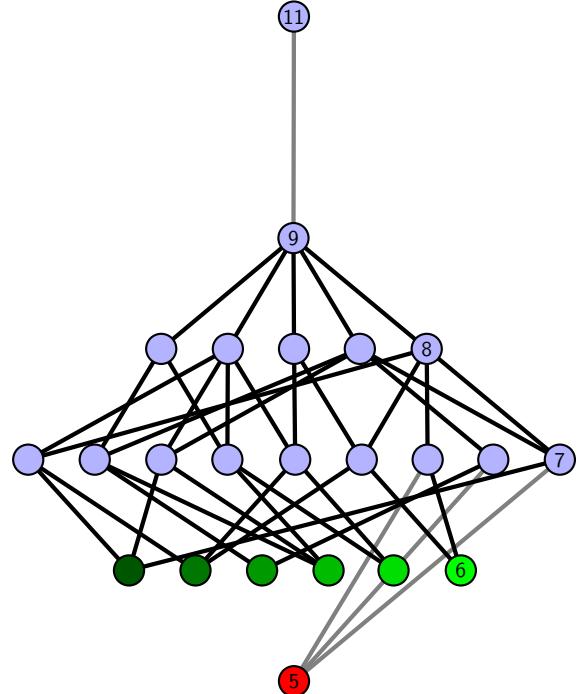


Figure 468: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.135 $[[6, 18, 1, 7], [7, 16, 8, 17], [17, 5, 18, 6], [1, 11, 2, 12], [15, 8, 16, 9], [4, 14, 5, 15], [10, 13, 11, 14], [2, 13, 3, 12], [9, 3, 10, 4]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (15, 2, 16, 3), (4, 9, 5, 10), (10, 5, 11, 6), (8, 11, 9, 12), (1, 12, 2, 13), (17, 14, 18, 15), (3, 16, 4, 17), (13, 18, 14, 7)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 6, 7, 7], [1, 8, 5, 1], [2, 4, 8, 6], [3, 5, 8, 7], [3, 6, 8, 3], [4, 7, 6, 5]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 6
 Total pinning sets: 116
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.54
 Average overall degree: 2.98

Table 233: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	5
Nonminimal pinning sets	0	6	31	39	25	8	1	110
Average degree	2.4	2.62	2.86	3.03	3.15	3.22	3.27	

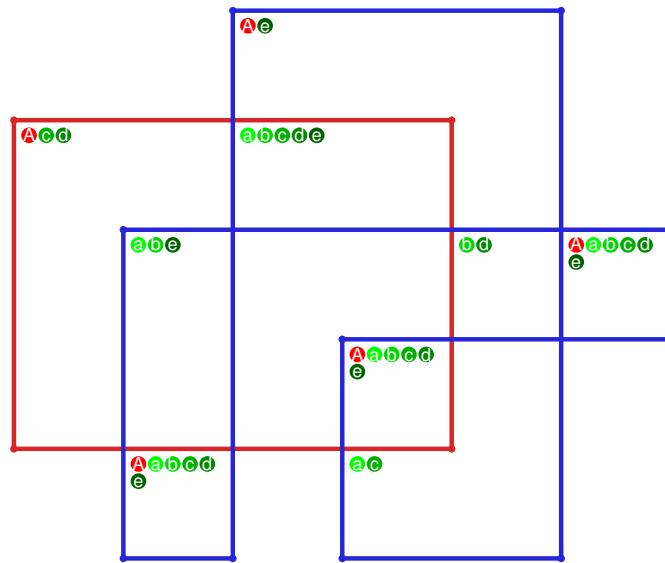


Figure 469: SnapPy multiloop plot.

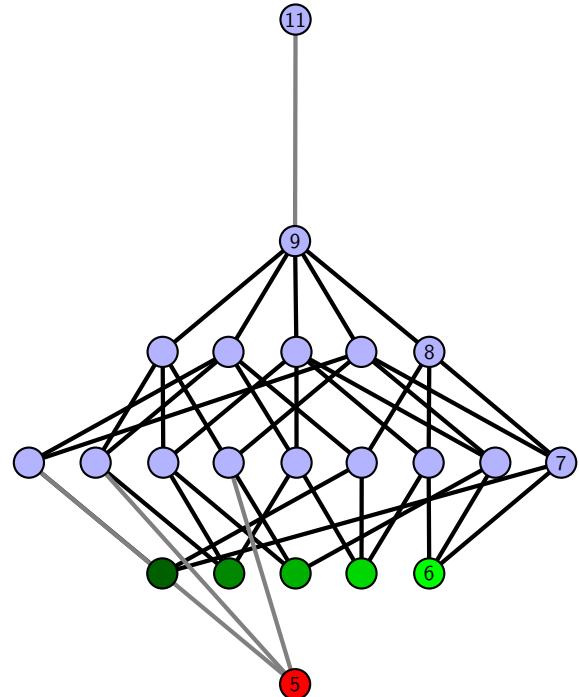


Figure 470: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.136 $[[18, 3, 1, 4], [4, 15, 5, 16], [10, 17, 11, 18], [11, 2, 12, 3], [1, 12, 2, 13], [7, 14, 8, 15], [5, 8, 6, 9], [16, 9, 17, 10], [13, 6, 14, 7]]$

PD code drawn by `SnapPy`: $[(9, 18, 10, 1), (16, 1, 17, 2), (11, 4, 12, 5), (3, 6, 4, 7), (14, 7, 15, 8), (17, 10, 18, 11), (5, 12, 6, 13), (2, 13, 3, 14), (8, 15, 9, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 4, 4], [0, 3, 3, 8], [1, 8, 8, 6], [1, 5, 8, 7], [1, 6, 2, 2], [4, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.51

Total pinning sets: 112

Average overall degree: 2.98

Pinning number: 5

Table 234: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	6	29	38	25	8	1	107
Average degree	2.4	2.62	2.85	3.02	3.15	3.23	3.27	

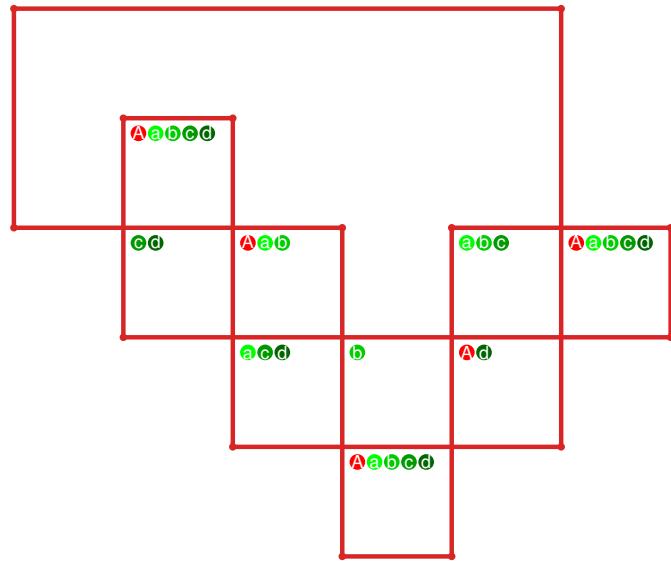


Figure 471: `SnapPy` multiloop plot.

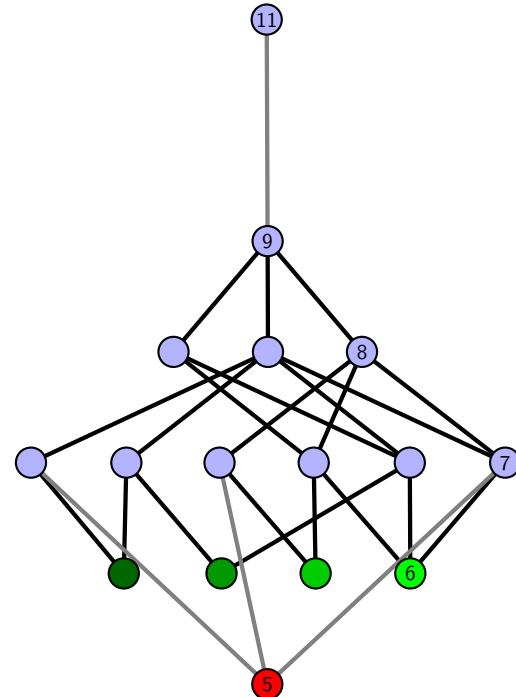


Figure 472: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.137 [[18, 9, 1, 10], [10, 15, 11, 16], [17, 2, 18, 3], [8, 1, 9, 2], [14, 5, 15, 6], [11, 5, 12, 4], [16, 4, 17, 3], [12, 7, 13, 8], [6, 13, 7, 14]]

PD code drawn by `SnapPy`: [(15, 18, 16, 1), (1, 14, 2, 15), (2, 9, 3, 10), (12, 3, 13, 4), (10, 5, 11, 6), (16, 7, 17, 8), (4, 11, 5, 12), (8, 13, 9, 14), (6, 17, 7, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 6, 6, 3], [0, 2, 7, 0], [1, 8, 8, 5], [1, 4, 7, 6], [1, 5, 2, 2], [3, 5, 8, 8], [4, 7, 7, 4]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 88
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.91

Table 235: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	6	22	29	20	7	1	85
Average degree	2.2	2.5	2.76	2.96	3.1	3.2	3.27	

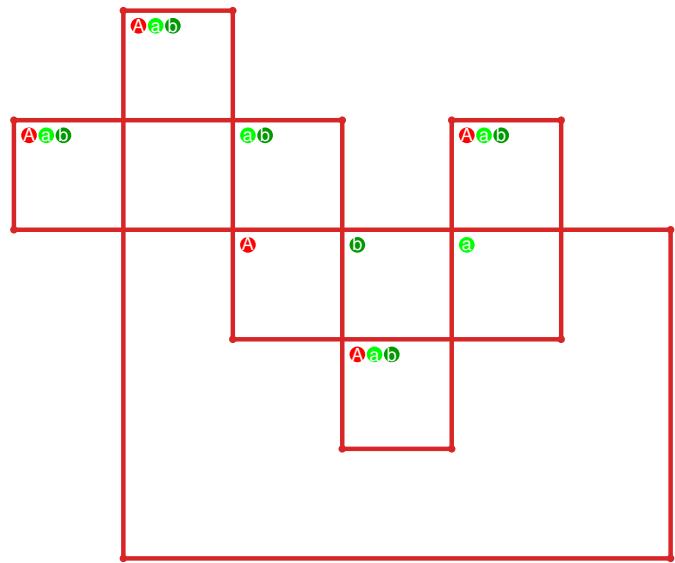


Figure 473: `SnapPy` multiloop plot.

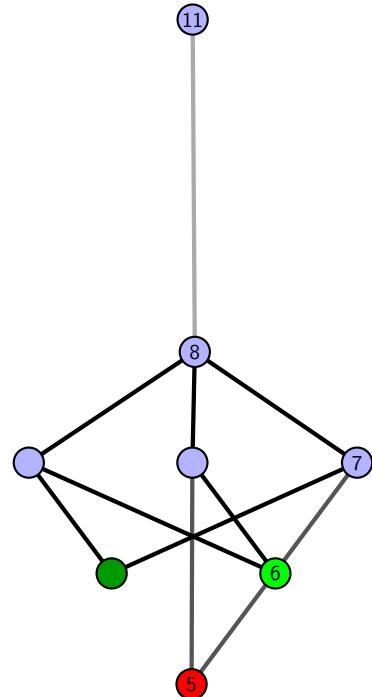


Figure 474: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.138 [[11, 18, 12, 1], [17, 10, 18, 11], [12, 10, 13, 9], [1, 14, 2, 15], [5, 16, 6, 17], [13, 8, 14, 9], [2, 8, 3, 7], [15, 4, 16, 5], [6, 4, 7, 3]]

PD code drawn by SnapPy: [(18, 3, 1, 4), (12, 1, 13, 2), (4, 17, 5, 18), (10, 5, 11, 6), (6, 9, 7, 10), (14, 7, 15, 8), (16, 11, 17, 12), (2, 13, 3, 14), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 7], [1, 7, 7, 8], [2, 6, 3, 2], [3, 5, 8, 8], [3, 8, 4, 4], [4, 7, 6, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 5
 Total pinning sets: 100
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.44
 Average overall degree: 2.92

Table 236: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	6	27	33	21	7	1	95
Average degree	2.2	2.52	2.79	2.98	3.11	3.2	3.27	

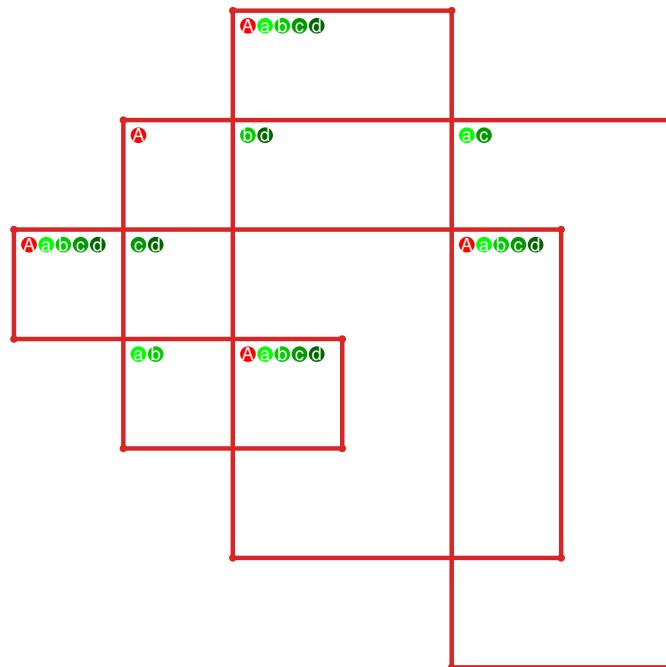


Figure 475: SnapPy multiloop plot.

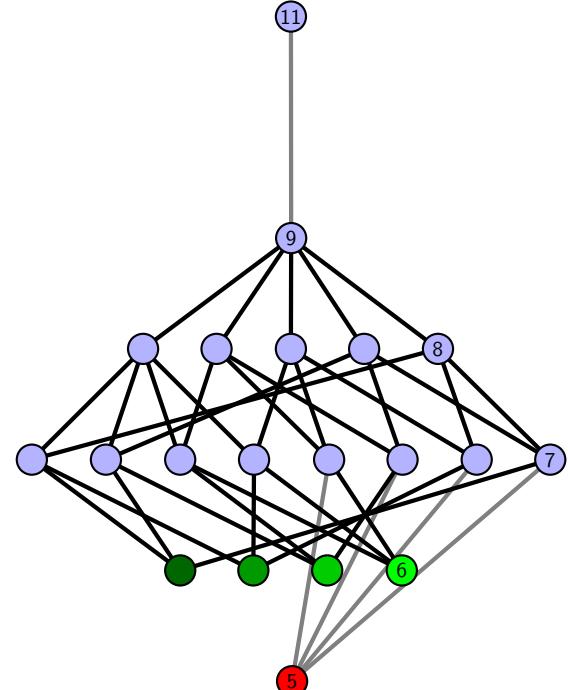


Figure 476: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.139 `[[8, 18, 1, 9], [9, 7, 10, 8], [10, 17, 11, 18], [1, 11, 2, 12], [14, 6, 15, 7], [16, 2, 17, 3], [12, 4, 13, 5], [5, 13, 6, 14], [15, 4, 16, 3]]`

PD code drawn by `SnapPy`: `[(9, 8, 10, 1), (1, 18, 2, 9), (15, 2, 16, 3), (17, 4, 18, 5), (12, 5, 13, 6), (3, 16, 4, 17), (13, 10, 14, 11), (6, 11, 7, 12), (7, 14, 8, 15)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 5, 6], [1, 7, 7, 8], [2, 8, 8, 3], [3, 8, 7, 7], [4, 6, 6, 4], [4, 6, 5, 5]]`

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 80
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.91

Table 237: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.2	2.5	2.74	2.94	3.09	3.2	3.27	

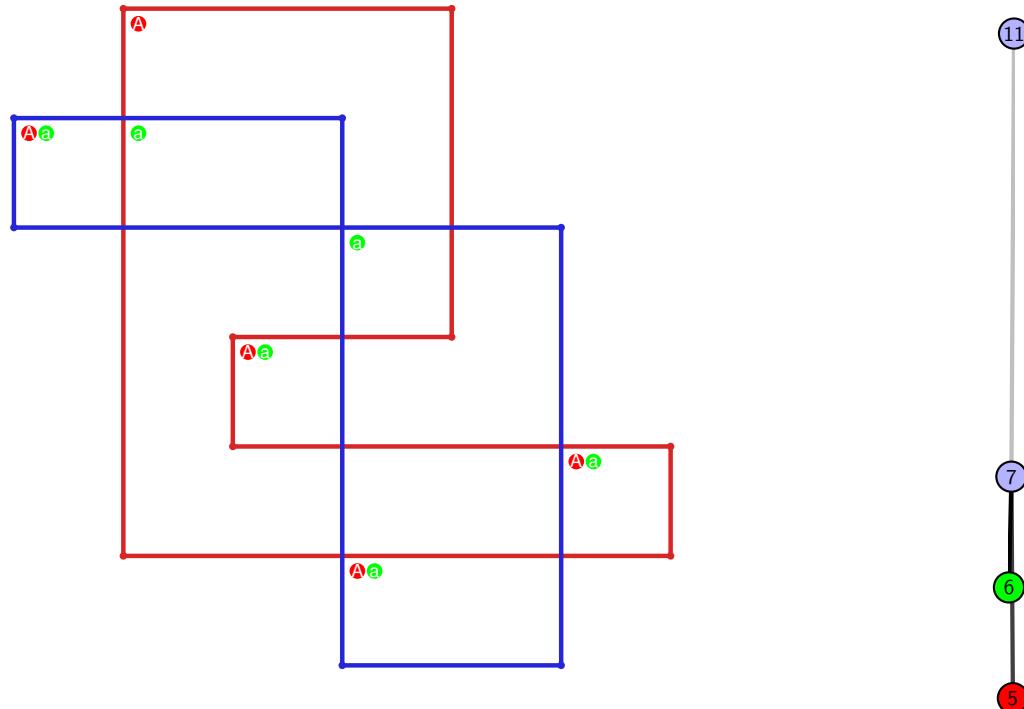


Figure 477: `SnapPy` multiloop plot.

Figure 478: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.140 $[[6, 18, 1, 7], [7, 5, 8, 6], [8, 17, 9, 18], [1, 13, 2, 14], [4, 10, 5, 11], [16, 9, 17, 10], [12, 15, 13, 16], [2, 15, 3, 14], [11, 3, 12, 4]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (15, 2, 16, 3), (12, 17, 13, 18), (1, 18, 2, 7), (4, 9, 5, 10), (10, 5, 11, 6), (8, 11, 9, 12), (16, 13, 17, 14), (3, 14, 4, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 7], [1, 8, 8, 5], [2, 4, 6, 2], [3, 5, 8, 7], [3, 6, 8, 3], [4, 7, 6, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 4

Average minimal degree: 2.38

Total pinning sets: 92

Average overall degree: 2.91

Pinning number: 5

Table 238: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	6	24	30	20	7	1	88
Average degree	2.2	2.5	2.77	2.97	3.1	3.2	3.27	

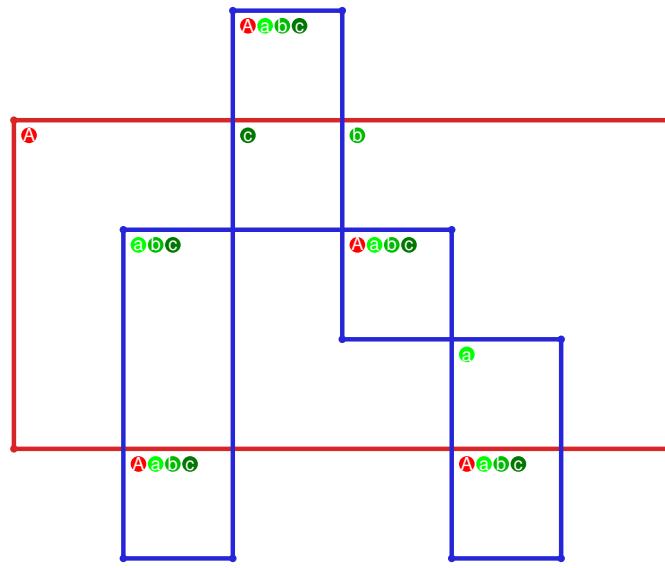


Figure 479: `SnapPy` multiloop plot.

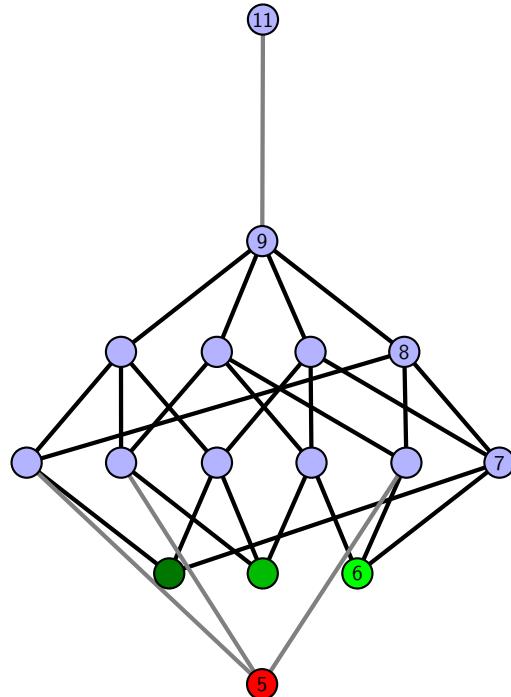


Figure 480: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.141 [[5, 18, 6, 1], [4, 15, 5, 16], [17, 14, 18, 15], [6, 14, 7, 13], [1, 11, 2, 10], [16, 3, 17, 4], [7, 12, 8, 13], [11, 8, 12, 9], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(13, 18, 14, 1), (8, 5, 9, 6), (17, 6, 18, 7), (7, 16, 8, 17), (4, 9, 5, 10), (10, 3, 11, 4), (14, 11, 15, 12), (1, 12, 2, 13), (2, 15, 3, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 8, 8], [1, 8, 2, 1], [3, 7, 7, 3], [4, 6, 6, 8], [4, 7, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 5

Table 239: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.2	2.5	2.74	2.94	3.09	3.2	3.27	

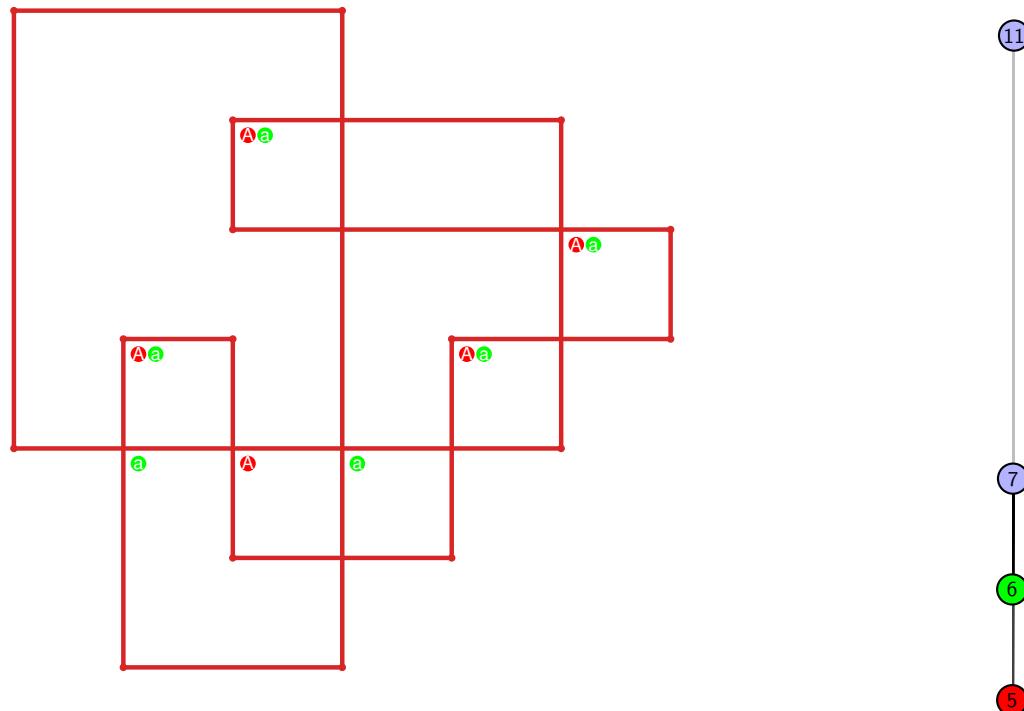


Figure 481: SnapPy multiloop plot.

Figure 482: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.142 $[[18, 9, 1, 10], [10, 4, 11, 3], [17, 2, 18, 3], [8, 1, 9, 2], [4, 12, 5, 11], [13, 16, 14, 17], [14, 7, 15, 8], [12, 6, 13, 5], [6, 15, 7, 16]]$

PD code drawn by `SnapPy`: $[(15, 18, 16, 1), (1, 8, 2, 9), (3, 10, 4, 11), (12, 5, 13, 6), (16, 7, 17, 8), (9, 2, 10, 3), (4, 13, 5, 14), (11, 14, 12, 15), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 3], [0, 2, 6, 0], [1, 7, 7, 1], [2, 7, 8, 6], [3, 5, 8, 8], [4, 8, 5, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 4

Total pinning sets: 68
Pinning number: 6

Average optimal degree: 2.33
Average minimal degree: 2.39
Average overall degree: 2.92

Table 240: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	13	24	19	7	1	64
Average degree	2.33	2.65	2.91	3.09	3.2	3.27	

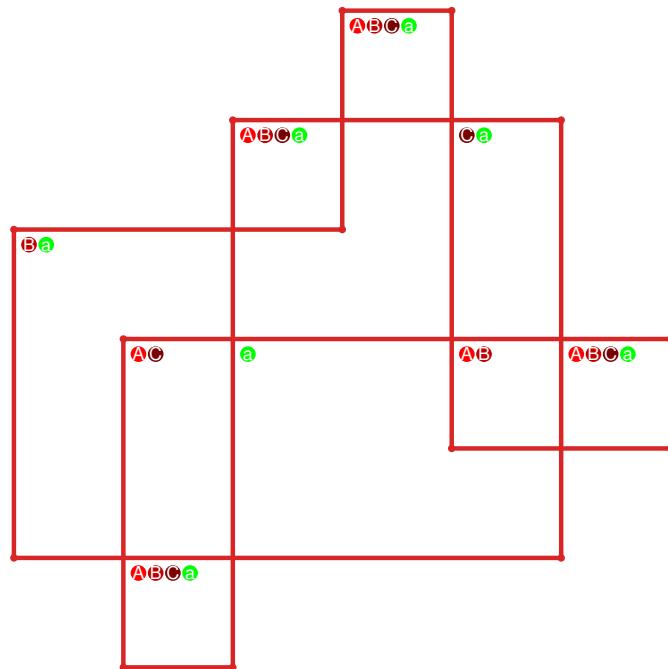


Figure 483: `SnapPy` multiloop plot.

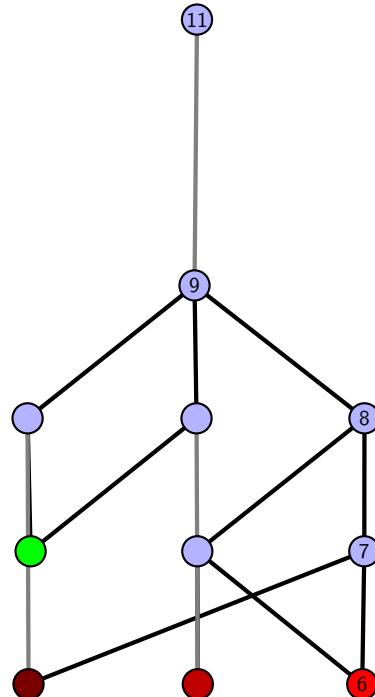


Figure 484: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.143 $[[7, 18, 8, 1], [6, 11, 7, 12], [17, 10, 18, 11], [8, 2, 9, 1], [12, 5, 13, 6], [13, 16, 14, 17], [9, 2, 10, 3], [15, 4, 16, 5], [14, 4, 15, 3]]$

PD code drawn by SnapPy: $[(18, 11, 1, 12), (12, 1, 13, 2), (9, 2, 10, 3), (14, 7, 15, 8), (3, 8, 4, 9), (10, 13, 11, 14), (4, 15, 5, 16), (16, 5, 17, 6), (6, 17, 7, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 6, 6, 0], [1, 7, 5, 1], [2, 4, 7, 8], [2, 8, 3, 3], [4, 8, 8, 5], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 3

Average minimal degree: 2.34

Total pinning sets: 88

Average overall degree: 2.91

Pinning number: 5

Table 241: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	6	22	29	20	7	1	85
Average degree	2.2	2.5	2.76	2.96	3.1	3.2	3.27	

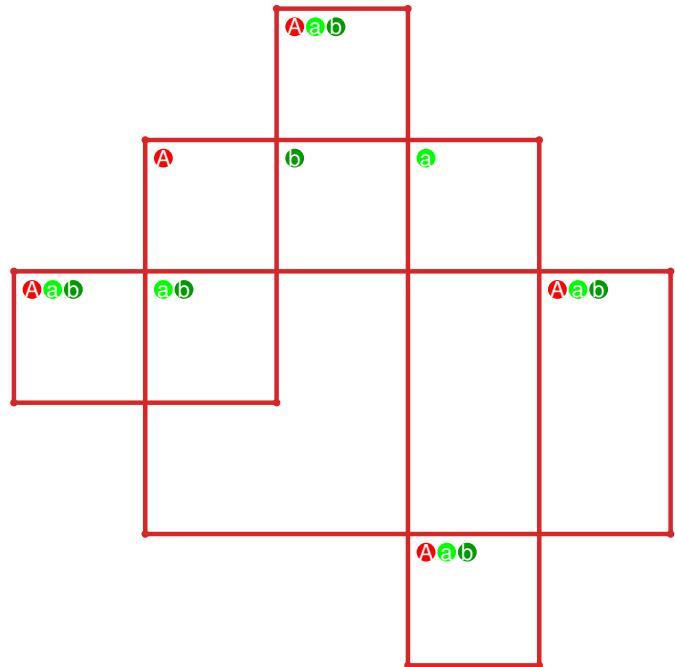


Figure 485: SnapPy multiloop plot.

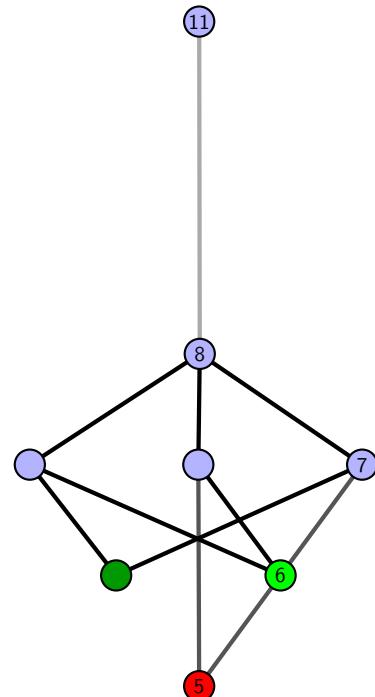


Figure 486: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.144 [[5, 12, 6, 1], [4, 18, 5, 13], [11, 17, 12, 18], [6, 17, 7, 16], [1, 8, 2, 9], [13, 9, 14, 10], [10, 3, 11, 4], [7, 15, 8, 16], [2, 15, 3, 14]]

PD code drawn by SnapPy: [(7, 12, 8, 1), (10, 5, 11, 6), (17, 6, 18, 7), (2, 9, 3, 10), (18, 11, 13, 12), (4, 13, 5, 14), (14, 3, 15, 4), (8, 15, 9, 16), (1, 16, 2, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 7], [0, 7, 8, 5], [1, 4, 8, 6], [1, 5, 8, 2], [3, 8, 4, 3], [4, 7, 6, 5]]

Total optimal pinning sets: 7
 Total minimal pinning sets: 9
 Total pinning sets: 244
 Pinning number: 5

Average optimal degree: 2.83
 Average minimal degree: 2.87
 Average overall degree: 3.13

Table 242: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	7	0	0	0	0	0	0	7
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	35	75	75	39	10	1	235
Average degree	2.83	2.98	3.1	3.18	3.23	3.26	3.27	

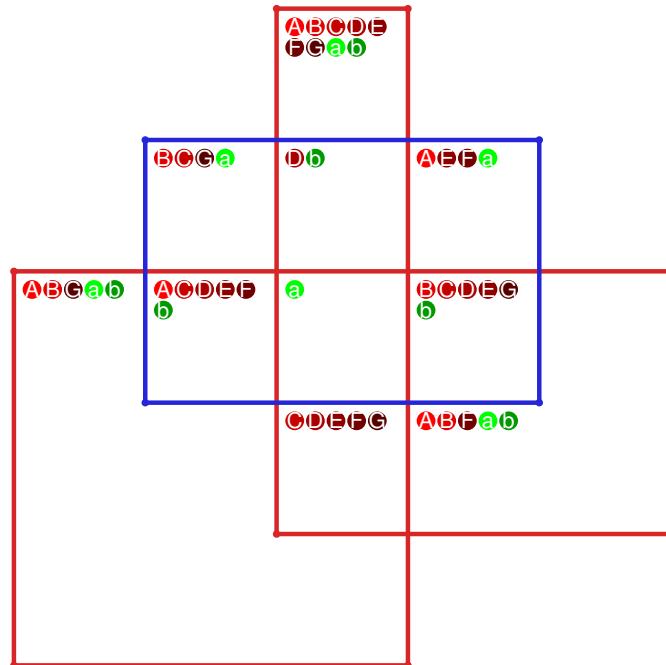


Figure 487: SnapPy multiloop plot.

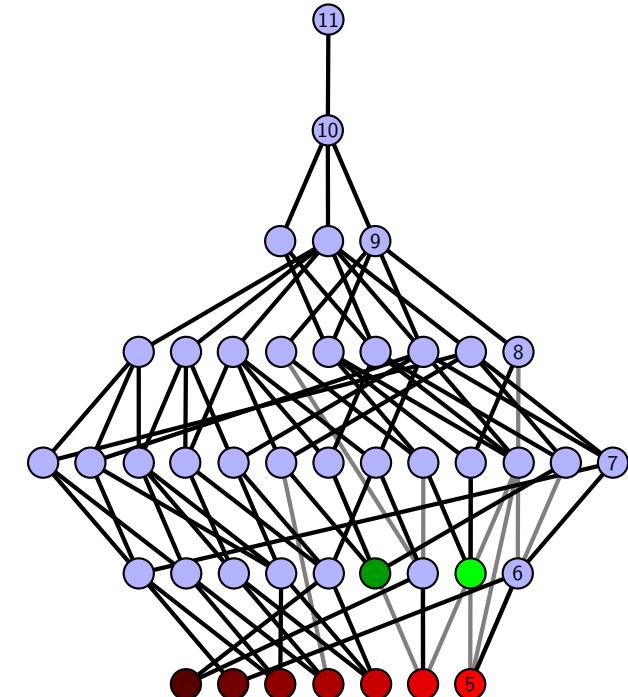


Figure 488: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.145 $[[5, 18, 6, 1], [4, 13, 5, 14], [17, 6, 18, 7], [1, 11, 2, 10], [14, 10, 15, 9], [3, 8, 4, 9], [12, 7, 13, 8], [16, 11, 17, 12], [2, 16, 3, 15]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (10, 5, 11, 6), (1, 6, 2, 7), (7, 12, 8, 13), (8, 17, 9, 18), (14, 9, 15, 10), (2, 11, 3, 12), (13, 18, 14, 1), (3, 16, 4, 17)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 7, 0], [0, 7, 8, 4], [1, 3, 8, 5], [1, 4, 8, 6], [1, 5, 7, 2], [2, 6, 8, 3], [3, 7, 5, 4]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 13
 Total pinning sets: 326
 Pinning number: 4

Average optimal degree: 3.0
 Average minimal degree: 2.95
 Average overall degree: 3.15

Table 243: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	8	4	0	0	0	0	0	12
Nonminimal pinning sets	0	7	59	106	89	41	10	1	313
Average degree	3.0	2.97	3.06	3.14	3.2	3.24	3.26	3.27	

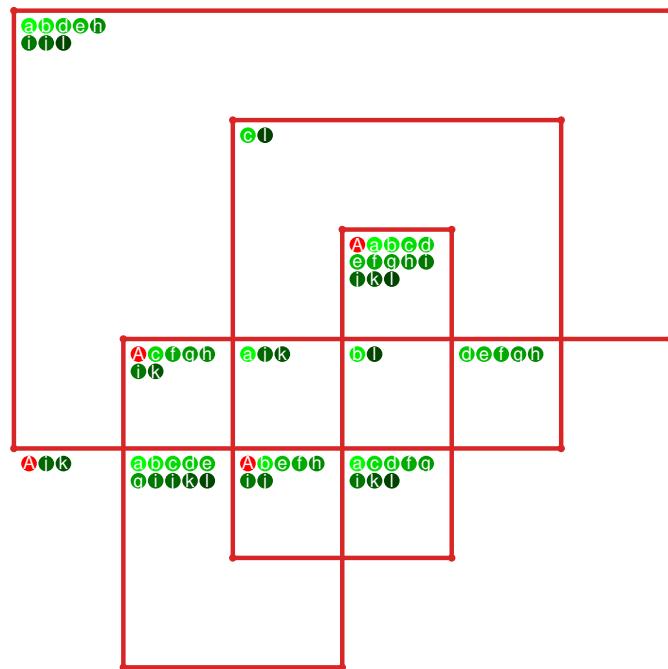


Figure 489: SnapPy multiloop plot.

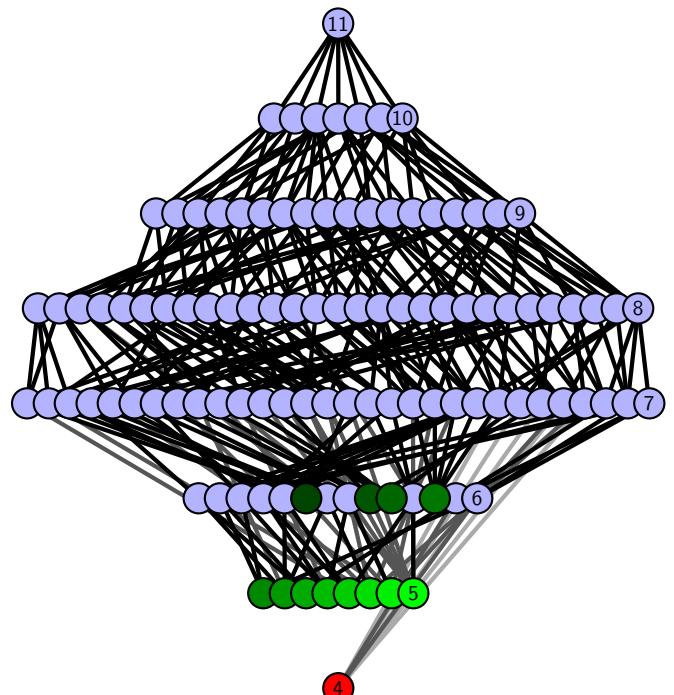


Figure 490: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.146 [[10, 18, 1, 11], [11, 9, 12, 10], [17, 5, 18, 6], [1, 5, 2, 4], [8, 12, 9, 13], [6, 16, 7, 17], [2, 15, 3, 14], [3, 13, 4, 14], [15, 7, 16, 8]]

PD code drawn by `SnapPy`: [(2, 9, 3, 10), (14, 3, 15, 4), (12, 5, 13, 6), (16, 7, 17, 8), (6, 17, 7, 18), (1, 18, 2, 11), (11, 10, 12, 1), (4, 13, 5, 14), (8, 15, 9, 16)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 3], [0, 2, 6, 7], [1, 7, 8, 1], [2, 8, 8, 2], [3, 8, 7, 7], [3, 6, 6, 4], [4, 6, 5, 5]]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 244: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

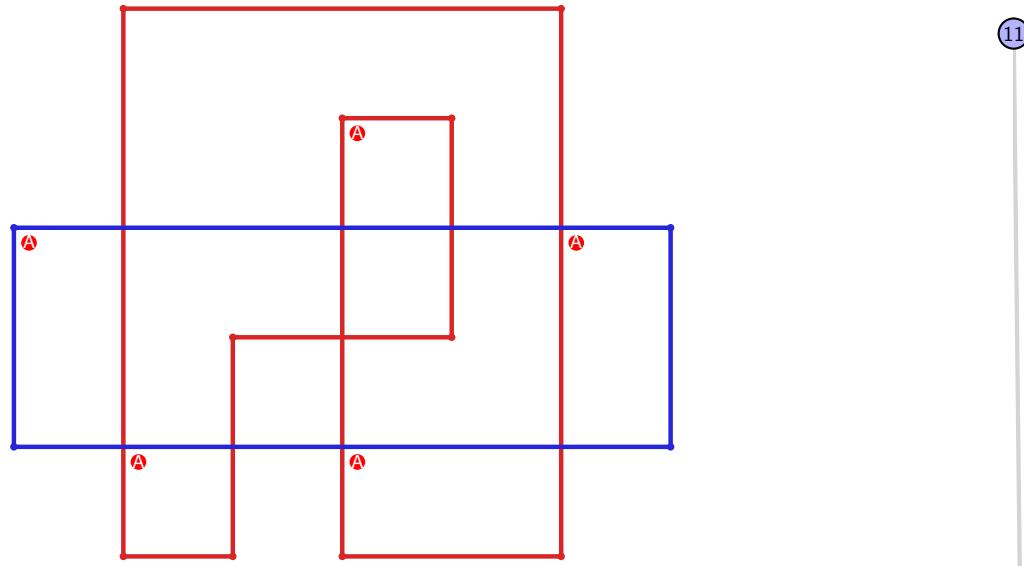


Figure 491: `SnapPy` multiloop plot.



Figure 492: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.147 [[6, 18, 1, 7], [7, 14, 8, 15], [9, 5, 10, 6], [17, 1, 18, 2], [13, 16, 14, 17], [8, 16, 9, 15], [4, 10, 5, 11], [2, 12, 3, 13], [11, 3, 12, 4]]

PD code drawn by SnapPy: [(18, 1, 7, 2), (16, 3, 17, 4), (12, 5, 13, 6), (2, 17, 3, 18), (6, 7, 1, 8), (14, 9, 15, 10), (10, 15, 11, 16), (8, 11, 9, 12), (4, 13, 5, 14)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 5, 6, 6], [0, 7, 4, 0], [1, 3, 7, 5], [1, 4, 2, 1], [2, 8, 8, 2], [3, 8, 8, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 245: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

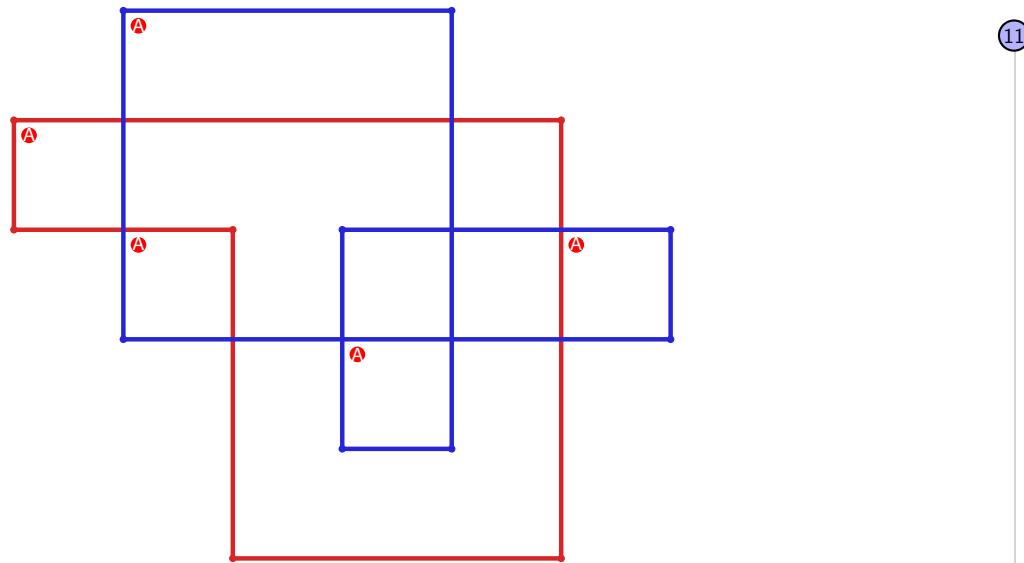


Figure 493: SnapPy multiloop plot.



Figure 494: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.148 [[12, 18, 1, 13], [13, 7, 14, 8], [8, 11, 9, 12], [17, 3, 18, 4], [1, 16, 2, 15], [6, 14, 7, 15], [10, 5, 11, 6], [9, 5, 10, 4], [2, 16, 3, 17]]

PD code drawn by SnapPy: [(14, 1, 15, 2), (2, 7, 3, 8), (8, 3, 9, 4), (16, 5, 17, 6), (6, 9, 7, 10), (4, 17, 5, 18), (18, 11, 13, 12), (12, 13, 1, 14), (10, 15, 11, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 8, 8], [0, 8, 8, 5], [1, 4, 6, 1], [2, 5, 7, 7], [2, 6, 6, 3], [3, 4, 4, 3]]

Total optimal pinning sets: 4
Total minimal pinning sets: 4

Total pinning sets: 120

Pinning number: 5

Average optimal degree: 2.3

Average minimal degree: 2.3

Average overall degree: 2.91

Table 246: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	34	35	21	7	1	116
Average degree	2.3	2.63	2.85	3.0	3.11	3.2	3.27	

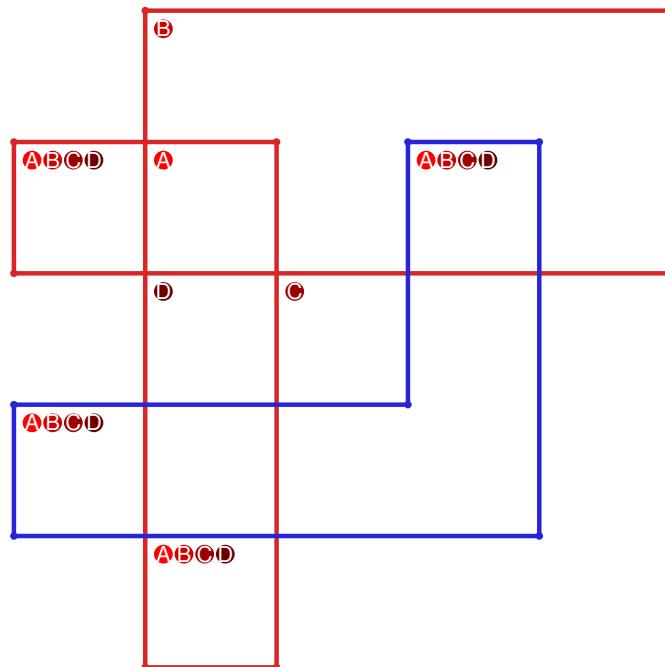


Figure 495: SnapPy multiloop plot.

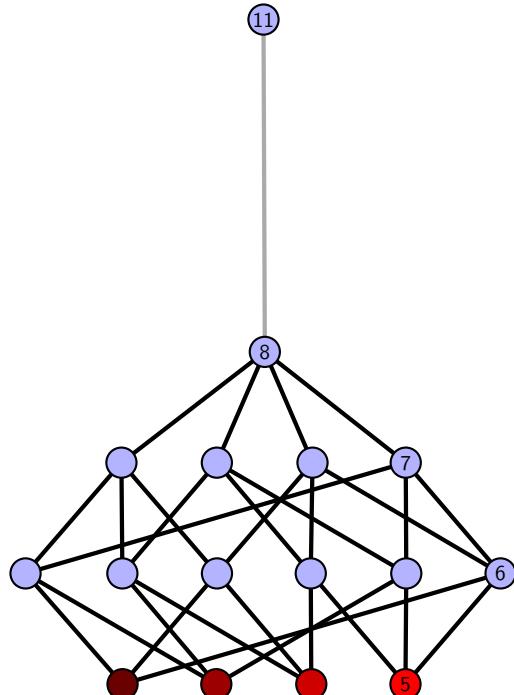


Figure 496: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.149 $[[18, 3, 1, 4], [4, 13, 5, 14], [14, 17, 15, 18], [9, 2, 10, 3], [1, 10, 2, 11], [12, 5, 13, 6], [7, 16, 8, 17], [15, 8, 16, 9], [11, 7, 12, 6]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (2, 7, 3, 8), (11, 4, 12, 5), (15, 6, 16, 7), (18, 9, 1, 10), (3, 12, 4, 13), (10, 13, 11, 14), (5, 16, 6, 17), (14, 17, 15, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 4, 4], [0, 3, 3, 8], [1, 8, 8, 1], [2, 8, 7, 7], [2, 6, 6, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 112

Average overall degree: 2.91

Pinning number: 5

Table 247: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.27	2.6	2.83	2.99	3.11	3.2	3.27	

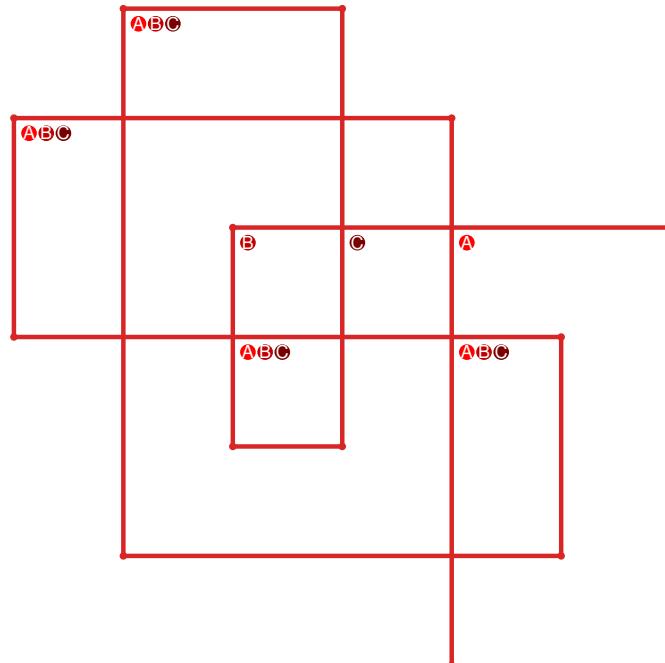


Figure 497: `SnapPy` multiloop plot.

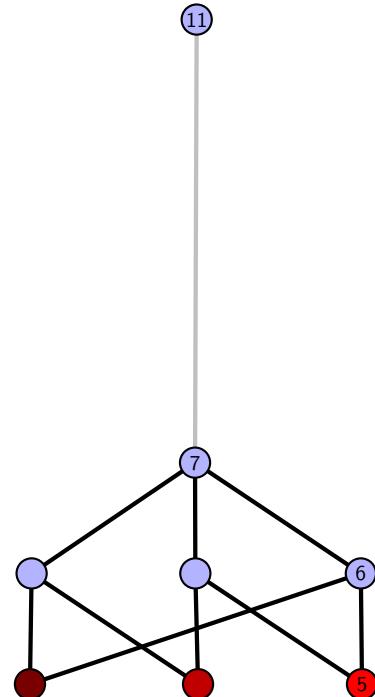


Figure 498: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.150 $[[18, 13, 1, 14], [14, 10, 15, 9], [4, 17, 5, 18], [12, 1, 13, 2], [10, 7, 11, 8], [15, 8, 16, 9], [16, 3, 17, 4], [5, 3, 6, 2], [6, 11, 7, 12]]$

PD code drawn by SnapPy: $[(13, 18, 14, 1), (7, 4, 8, 5), (12, 5, 13, 6), (6, 11, 7, 12), (3, 8, 4, 9), (15, 10, 16, 11), (1, 14, 2, 15), (9, 16, 10, 17), (17, 2, 18, 3)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 7], [0, 7, 8, 0], [1, 8, 8, 5], [1, 4, 6, 1], [2, 5, 7, 2], [2, 6, 8, 3], [3, 7, 4, 4]]$

Total optimal pinning sets: 5
Total minimal pinning sets: 5
Total pinning sets: 124
Pinning number: 5

Average optimal degree: 2.32
Average minimal degree: 2.32
Average overall degree: 2.91

Table 248: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	35	35	21	7	1	119
Average degree	2.32	2.65	2.86	3.0	3.11	3.2	3.27	

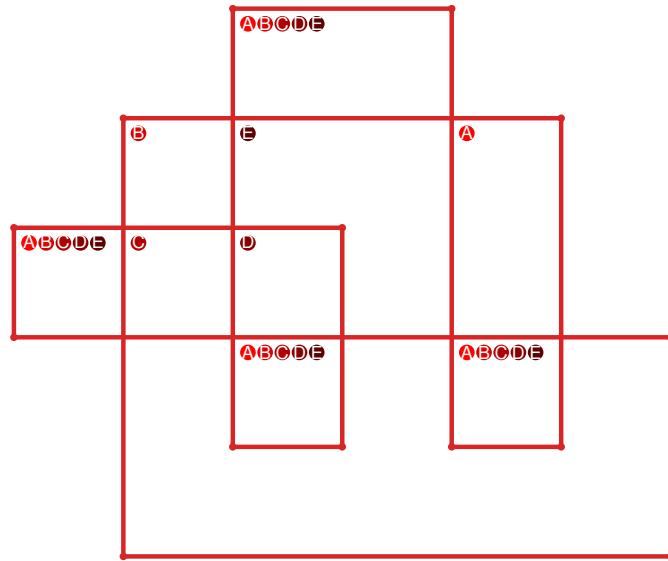


Figure 499: SnapPy multiloop plot.

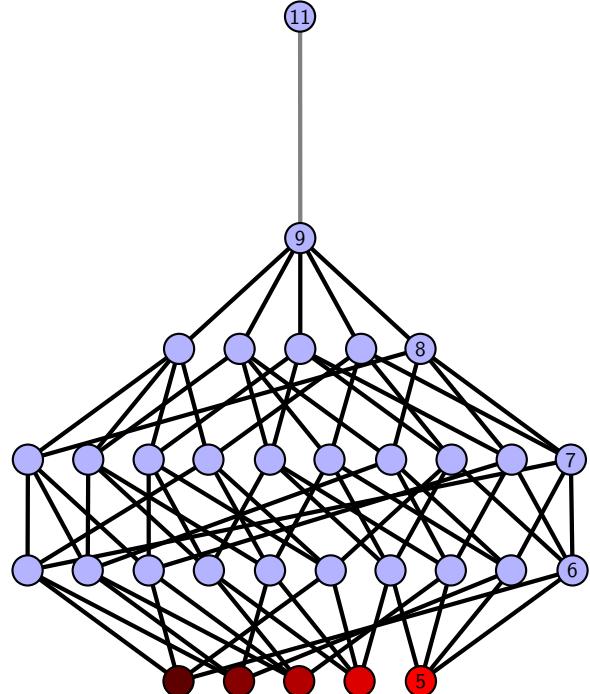


Figure 500: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.151 $[[12, 3, 1, 4], [4, 7, 5, 8], [8, 11, 9, 12], [2, 18, 3, 13], [1, 18, 2, 17], [6, 16, 7, 17], [5, 16, 6, 15], [10, 14, 11, 15], [9, 14, 10, 13]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (2, 5, 3, 6), (6, 9, 7, 10), (8, 15, 9, 16), (16, 3, 17, 4), (4, 17, 5, 18), (18, 11, 13, 12), (12, 13, 1, 14), (14, 7, 15, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 8], [0, 8, 4, 4], [0, 3, 3, 5], [1, 4, 6, 6], [1, 5, 5, 7], [2, 6, 8, 8], [2, 7, 7, 3]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 8
 Total pinning sets: 168
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.6
 Average overall degree: 3.01

Table 249: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	5
Nonminimal pinning sets	0	18	52	53	28	8	1	160
Average degree	2.6	2.76	2.95	3.08	3.17	3.23	3.27	

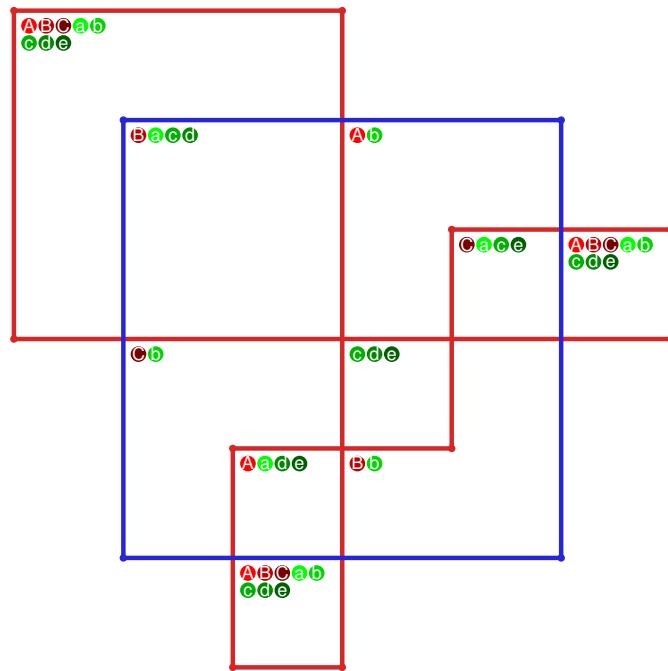


Figure 501: SnapPy multiloop plot.

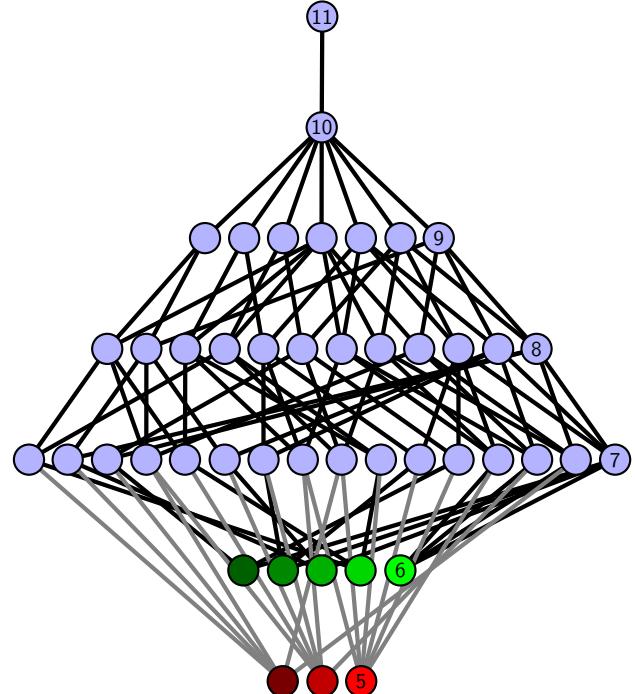


Figure 502: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.152 [[14, 18, 1, 15], [15, 13, 16, 14], [17, 7, 18, 8], [1, 7, 2, 6], [12, 5, 13, 6], [16, 9, 17, 8], [2, 9, 3, 10], [4, 11, 5, 12], [3, 11, 4, 10]]

PD code drawn by SnapPy: [(10, 3, 11, 4), (4, 13, 5, 14), (16, 5, 17, 6), (6, 15, 7, 16), (14, 7, 1, 8), (8, 1, 9, 2), (2, 9, 3, 10), (18, 11, 15, 12), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 7, 7], [1, 6, 2, 2], [3, 5, 8, 8], [4, 8, 8, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 250: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

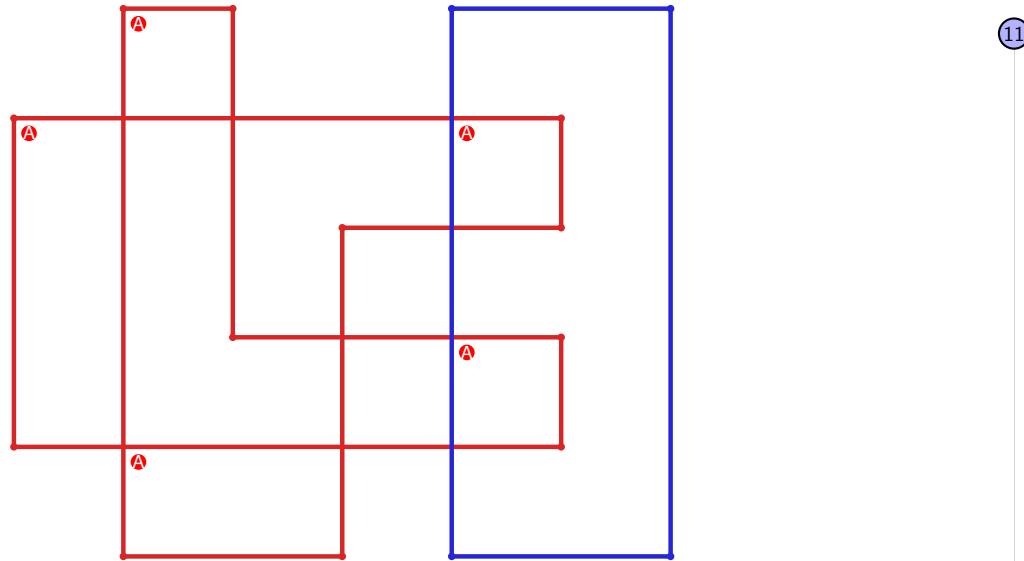


Figure 503: SnapPy multiloop plot.

11

Figure 504: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.153 $[[6, 18, 1, 7], [7, 5, 8, 6], [10, 17, 11, 18], [1, 11, 2, 12], [12, 4, 13, 5], [8, 15, 9, 16], [16, 9, 17, 10], [2, 15, 3, 14], [3, 13, 4, 14]]$

PD code drawn by `SnapPy`: $[(18, 1, 7, 2), (13, 2, 14, 3), (10, 15, 11, 16), (4, 17, 5, 18), (6, 7, 1, 8), (8, 5, 9, 6), (14, 9, 15, 10), (16, 11, 17, 12), (3, 12, 4, 13)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 3], [0, 2, 7, 4], [1, 3, 8, 8], [1, 7, 6, 6], [2, 5, 5, 2], [3, 5, 8, 8], [4, 7, 7, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 251: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

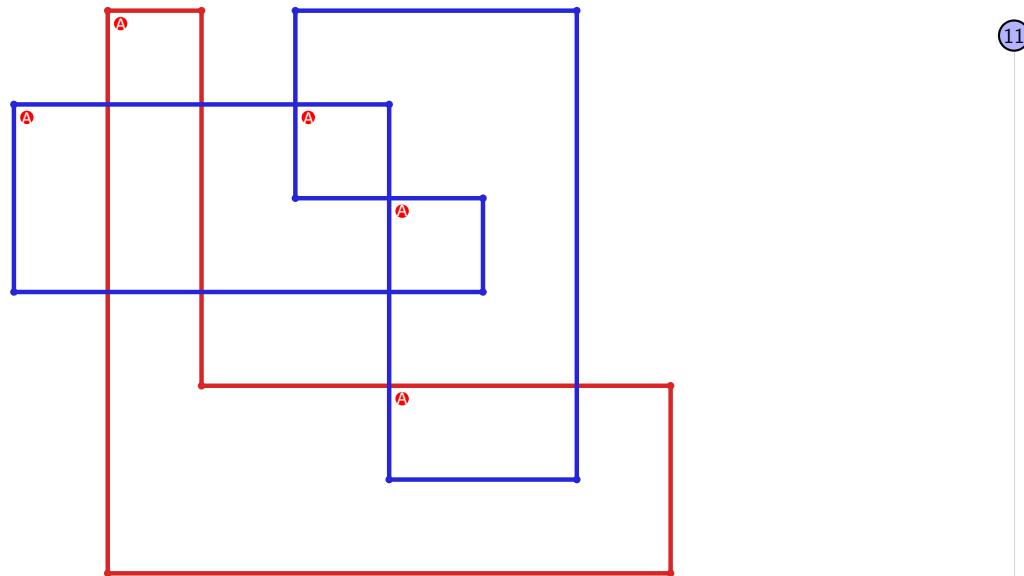


Figure 505: `SnapPy` multiloop plot.

11

Figure 506: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.154 [[14, 18, 1, 15], [15, 13, 16, 14], [7, 17, 8, 18], [1, 8, 2, 9], [3, 12, 4, 13], [16, 6, 17, 7], [2, 10, 3, 9], [11, 4, 12, 5], [5, 10, 6, 11]]

PD code drawn by SnapPy: [(7, 14, 8, 1), (15, 2, 16, 3), (11, 4, 12, 5), (5, 12, 6, 13), (1, 6, 2, 7), (13, 8, 14, 9), (18, 9, 15, 10), (3, 16, 4, 17), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 6], [1, 6, 7, 7], [1, 8, 2, 2], [3, 8, 4, 3], [4, 8, 8, 4], [5, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 252: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

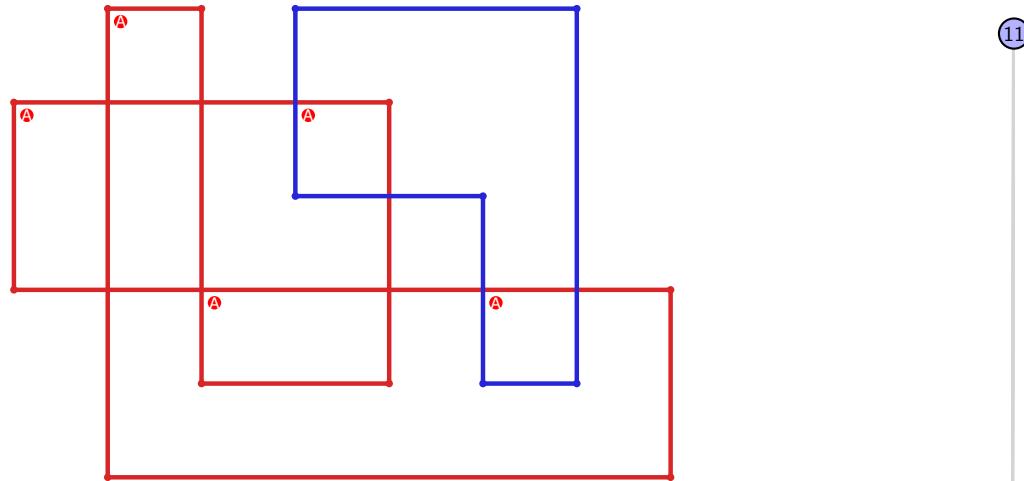


Figure 507: SnapPy multiloop plot.



Figure 508: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.155 $[[14, 18, 1, 15], [15, 13, 16, 14], [17, 9, 18, 10], [1, 7, 2, 6], [12, 5, 13, 6], [16, 11, 17, 10], [8, 3, 9, 4], [7, 3, 8, 2], [4, 11, 5, 12]]$

PD code drawn by SnapPy: $[(14, 5, 1, 6), (6, 1, 7, 2), (10, 3, 11, 4), (4, 13, 5, 14), (16, 7, 17, 8), (8, 15, 9, 16), (2, 9, 3, 10), (18, 11, 15, 12), (12, 17, 13, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 7, 7, 4], [1, 3, 8, 8], [1, 8, 2, 2], [2, 8, 7, 7], [3, 6, 6, 3], [4, 6, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 253: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

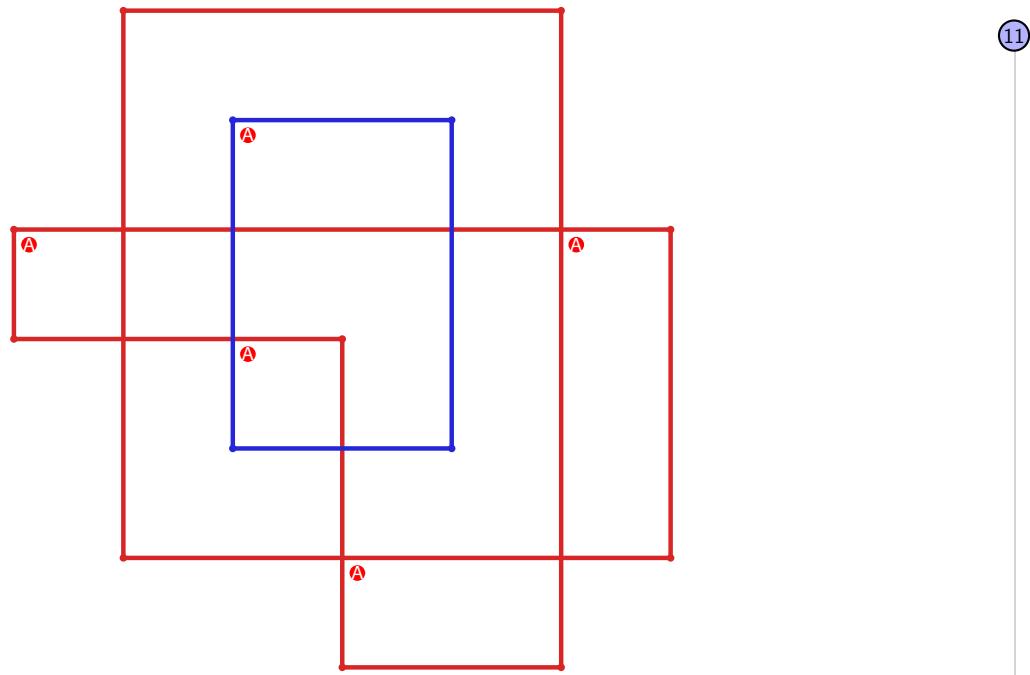


Figure 509: SnapPy multiloop plot.

Figure 510: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.156 [[14, 3, 1, 4], [4, 13, 5, 14], [2, 9, 3, 10], [1, 9, 2, 8], [12, 5, 13, 6], [10, 15, 11, 18], [7, 17, 8, 18], [6, 17, 7, 16], [11, 15, 12, 16]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (10, 3, 11, 4), (6, 13, 7, 14), (14, 7, 1, 8), (2, 11, 3, 12), (5, 16, 6, 17), (17, 8, 18, 9), (9, 18, 10, 15), (15, 4, 16, 5)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 3, 3], [0, 2, 2, 6], [1, 7, 8, 1], [2, 8, 8, 6], [3, 5, 7, 7], [4, 6, 6, 8], [4, 7, 5, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 254: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

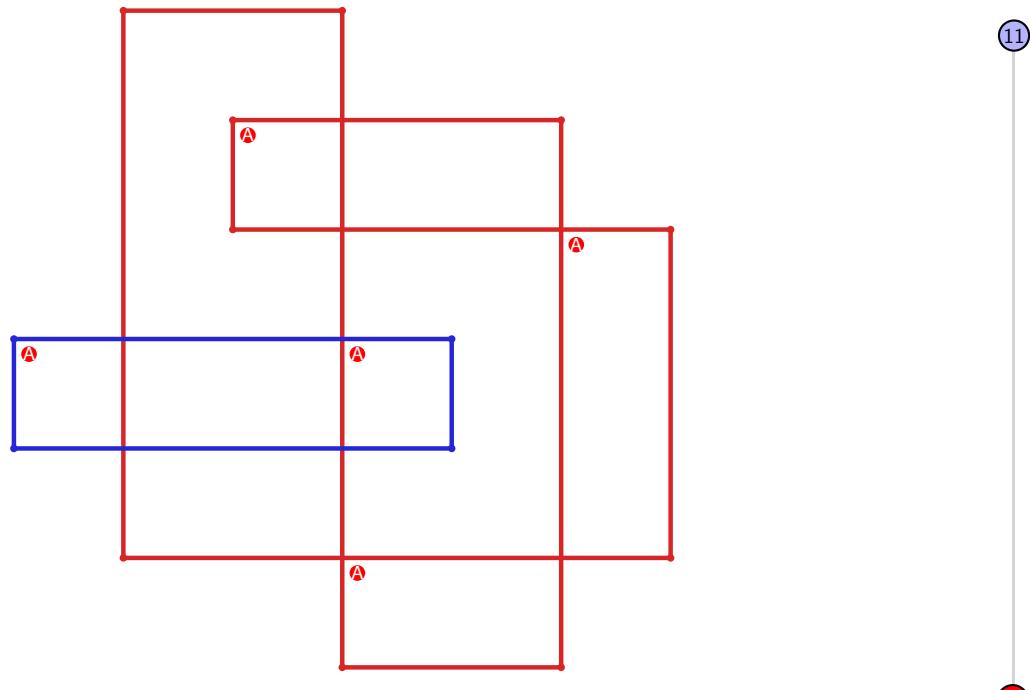


Figure 511: SnapPy multiloop plot.

Figure 512: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.157 [[11, 18, 12, 1], [17, 10, 18, 11], [12, 8, 13, 7], [1, 7, 2, 6], [3, 16, 4, 17], [9, 14, 10, 15], [8, 14, 9, 13], [2, 5, 3, 6], [15, 4, 16, 5]]

PD code drawn by `SnapPy`: [(13, 2, 14, 3), (18, 3, 1, 4), (4, 17, 5, 18), (5, 10, 6, 11), (15, 8, 16, 9), (11, 6, 12, 7), (7, 12, 8, 13), (1, 14, 2, 15), (9, 16, 10, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 3], [0, 2, 7, 7], [1, 7, 8, 8], [1, 8, 6, 6], [2, 5, 5, 2], [3, 8, 4, 3], [4, 7, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 255: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

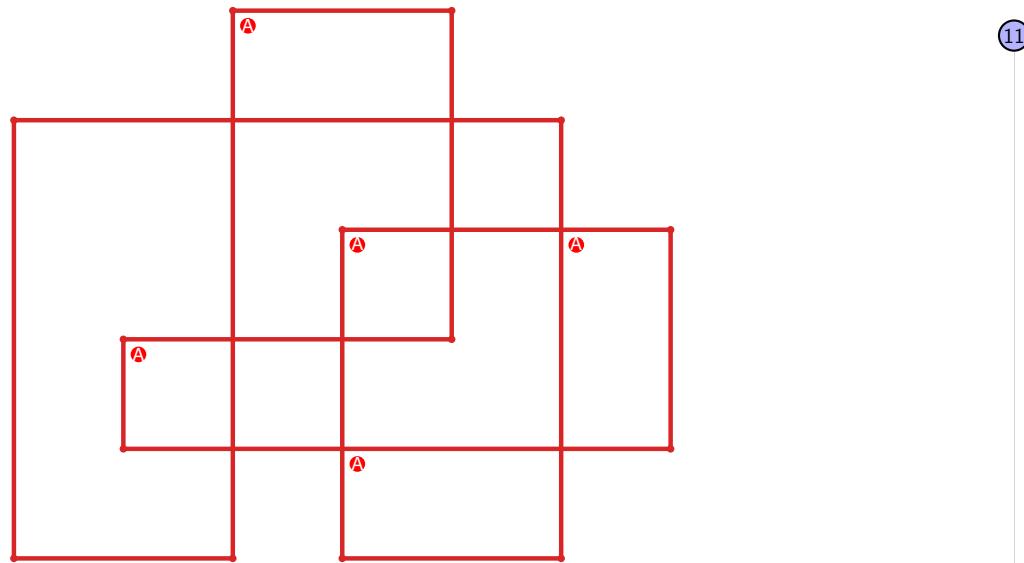


Figure 513: `SnapPy` multiloop plot.

5

Figure 514: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.158 `[[18, 7, 1, 8], [8, 16, 9, 15], [17, 14, 18, 15], [6, 1, 7, 2], [16, 10, 17, 9], [13, 2, 14, 3], [5, 10, 6, 11], [3, 12, 4, 13], [11, 4, 12, 5]]`

PD code drawn by `SnapPy`: `[(8, 1, 9, 2), (15, 4, 16, 5), (6, 13, 7, 14), (2, 7, 3, 8), (18, 9, 1, 10), (14, 11, 15, 12), (12, 5, 13, 6), (3, 16, 4, 17), (10, 17, 11, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 5, 6, 0], [1, 6, 2, 1], [2, 7, 7, 3], [3, 8, 8, 4], [5, 8, 8, 5], [6, 7, 7, 6]]`

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 48

Average overall degree: 2.85

Pinning number: 6

Table 256: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.17	2.54	2.81	3.02	3.17	3.27	

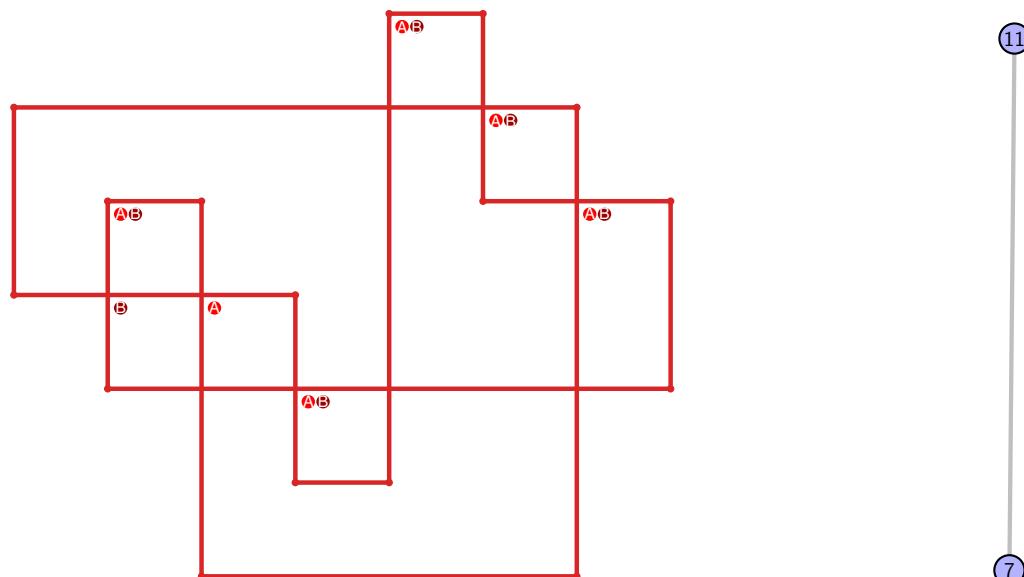


Figure 515: `SnapPy` multiloop plot.

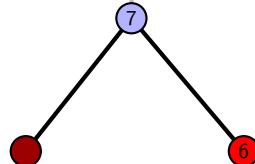


Figure 516: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.159 $[[18, 13, 1, 14], [14, 7, 15, 8], [8, 17, 9, 18], [12, 1, 13, 2], [6, 15, 7, 16], [16, 5, 17, 6], [9, 3, 10, 2], [4, 11, 5, 12], [3, 11, 4, 10]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (11, 4, 12, 5), (7, 18, 8, 1), (1, 8, 2, 9), (15, 10, 16, 11), (3, 12, 4, 13), (5, 14, 6, 15), (9, 16, 10, 17), (17, 6, 18, 7)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 6, 7, 0], [1, 5, 5, 1], [2, 4, 4, 7], [2, 8, 8, 3], [3, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 257: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

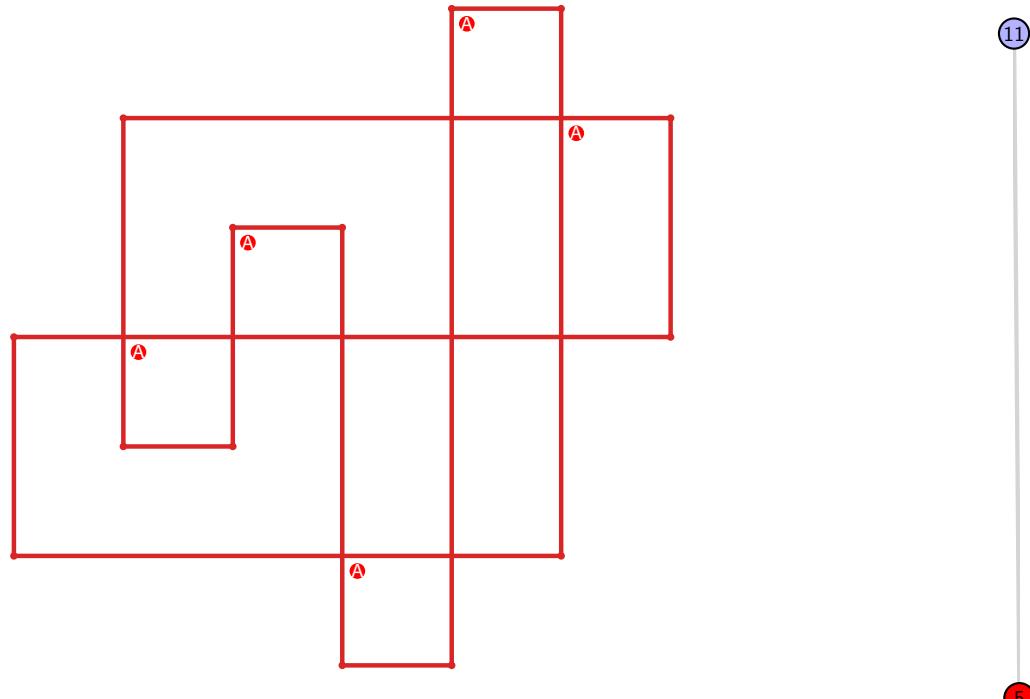


Figure 517: SnapPy multiloop plot.

5

11

Figure 518: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.160 [[10, 18, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [17, 1, 18, 2], [8, 13, 9, 12], [15, 5, 16, 6], [2, 16, 3, 17], [13, 3, 14, 4], [4, 14, 5, 15]]

PD code drawn by `SnapPy`: [(16, 1, 17, 2), (18, 3, 11, 4), (7, 4, 8, 5), (5, 14, 6, 15), (12, 9, 13, 10), (15, 6, 16, 7), (2, 17, 3, 18), (10, 11, 1, 12), (8, 13, 9, 14)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 8, 8, 6], [3, 5, 7, 3], [4, 6, 8, 8], [5, 7, 7, 5]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 48

Average overall degree: 2.85

Pinning number: 6

Table 258: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.17	2.54	2.81	3.02	3.17	3.27	

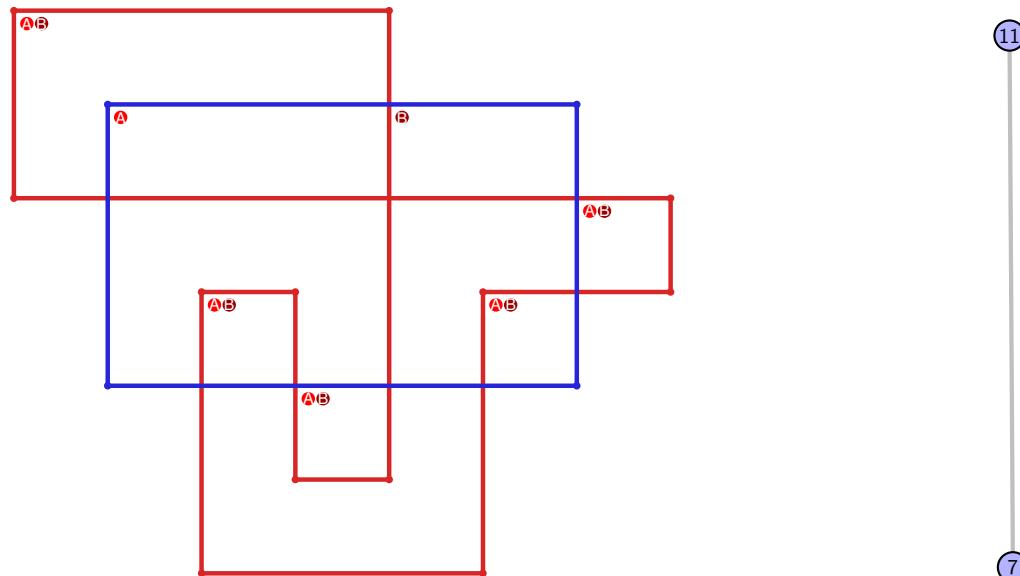


Figure 519: `SnapPy` multiloop plot.

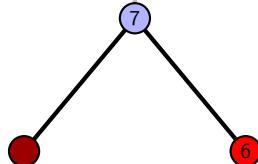


Figure 520: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.161 [[11, 18, 12, 1], [17, 10, 18, 11], [12, 8, 13, 7], [1, 7, 2, 6], [9, 16, 10, 17], [8, 16, 9, 15], [13, 4, 14, 5], [2, 5, 3, 6], [3, 14, 4, 15]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (17, 2, 18, 3), (3, 16, 4, 17), (4, 9, 5, 10), (14, 7, 15, 8), (18, 11, 1, 12), (12, 5, 13, 6), (6, 13, 7, 14), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 7], [1, 5, 5, 1], [2, 4, 4, 8], [2, 8, 8, 7], [3, 6, 8, 3], [5, 7, 6, 6]]

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 56
Pinning number: 6

Average optimal degree: 2.22
Average minimal degree: 2.22

Average overall degree: 2.86

Table 259: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	12	19	15	6	1	53
Average degree	2.22	2.6	2.86	3.04	3.17	3.27	

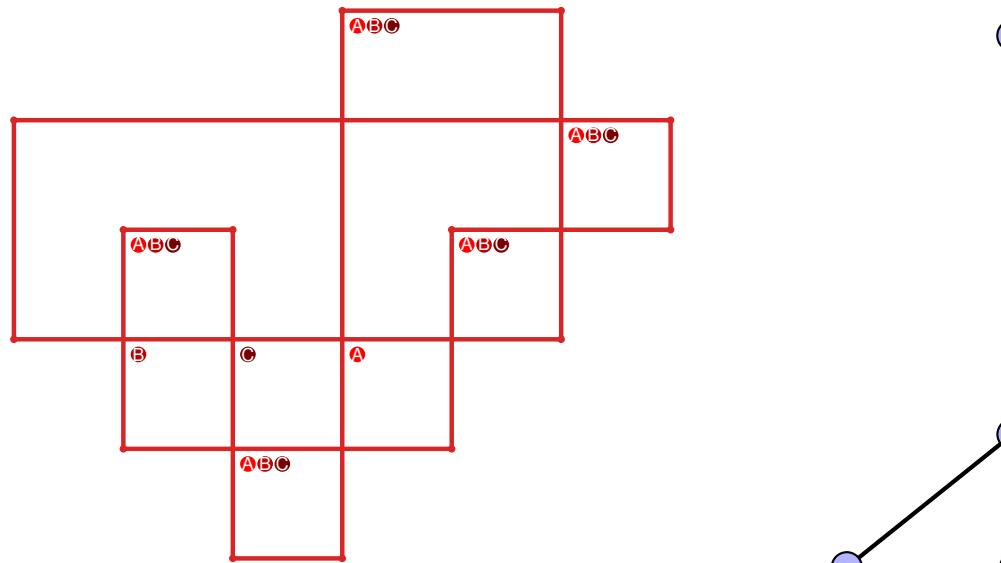


Figure 521: SnapPy multiloop plot.

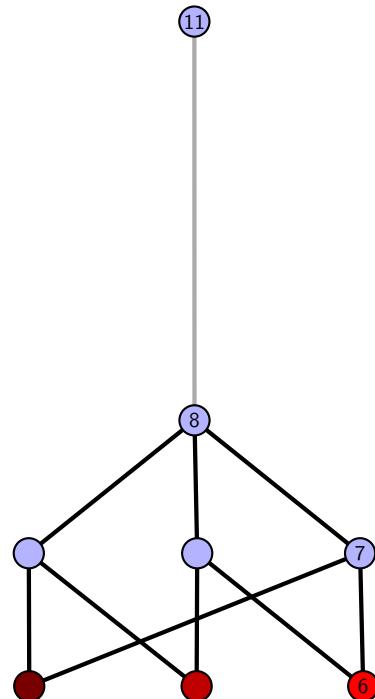


Figure 522: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.162 [[12, 18, 1, 13], [13, 8, 14, 7], [15, 11, 16, 12], [17, 1, 18, 2], [8, 5, 9, 6], [14, 6, 15, 7], [10, 3, 11, 4], [16, 3, 17, 2], [4, 9, 5, 10]]

PD code drawn by `SnapPy`: [(3, 12, 4, 1), (14, 1, 15, 2), (2, 13, 3, 14), (11, 4, 12, 5), (15, 6, 16, 7), (17, 8, 18, 9), (9, 16, 10, 17), (5, 10, 6, 11), (7, 18, 8, 13)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 5, 6, 7], [0, 7, 7, 0], [1, 8, 8, 5], [1, 4, 2, 1], [2, 8, 8, 7], [2, 6, 3, 3], [4, 6, 6, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 260: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

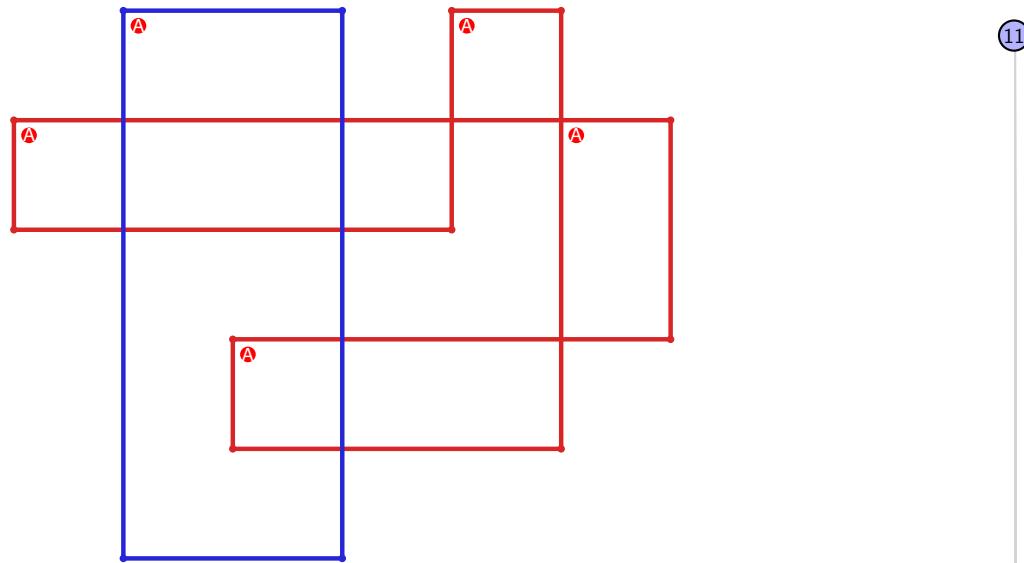


Figure 523: `SnapPy` multiloop plot.



Figure 524: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.163 [[11, 18, 12, 1], [17, 10, 18, 11], [12, 10, 13, 9], [1, 7, 2, 6], [3, 16, 4, 17], [13, 8, 14, 9], [7, 14, 8, 15], [2, 5, 3, 6], [15, 4, 16, 5]]

PD code drawn by `SnapPy`: [(13, 2, 14, 3), (18, 3, 1, 4), (4, 17, 5, 18), (11, 6, 12, 7), (7, 10, 8, 11), (15, 8, 16, 9), (5, 12, 6, 13), (1, 14, 2, 15), (9, 16, 10, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 7], [1, 7, 8, 8], [2, 6, 6, 2], [3, 5, 5, 8], [3, 8, 4, 3], [4, 7, 6, 4]]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 261: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

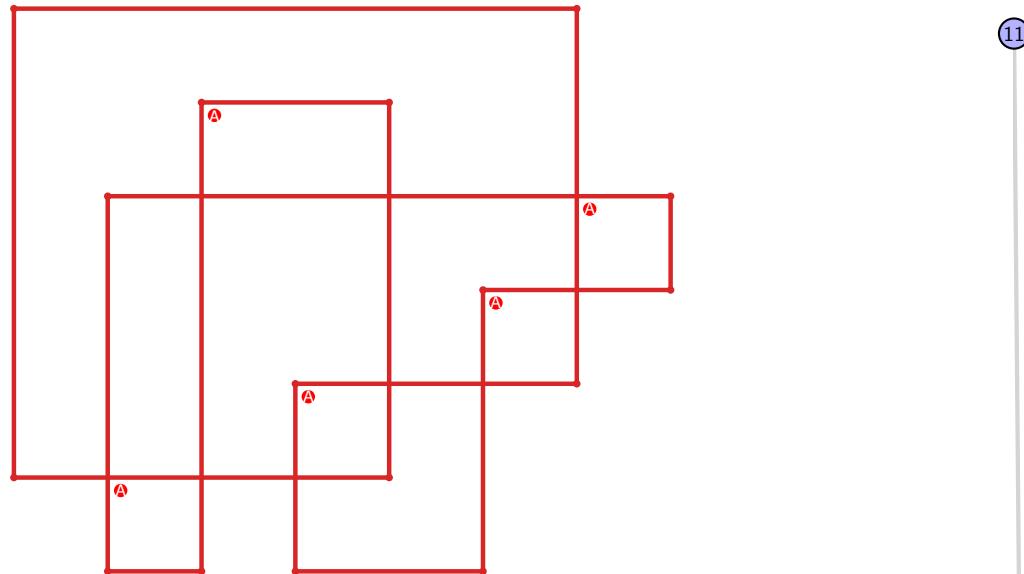


Figure 525: `SnapPy` multiloop plot.

5

Figure 526: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.164 [[18, 9, 1, 10], [10, 7, 11, 8], [8, 17, 9, 18], [1, 15, 2, 14], [6, 11, 7, 12], [16, 5, 17, 6], [15, 5, 16, 4], [2, 13, 3, 14], [12, 3, 13, 4]]

PD code drawn by SnapPy: [(9, 18, 10, 1), (1, 12, 2, 13), (13, 2, 14, 3), (7, 4, 8, 5), (15, 6, 16, 7), (3, 8, 4, 9), (17, 10, 18, 11), (11, 16, 12, 17), (5, 14, 6, 15)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 6, 7, 7], [1, 8, 5, 1], [2, 4, 6, 6], [3, 5, 5, 8], [3, 8, 8, 3], [4, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.84

Pinning number: 5

Table 262: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.39	2.67	2.88	3.04	3.17	3.27	

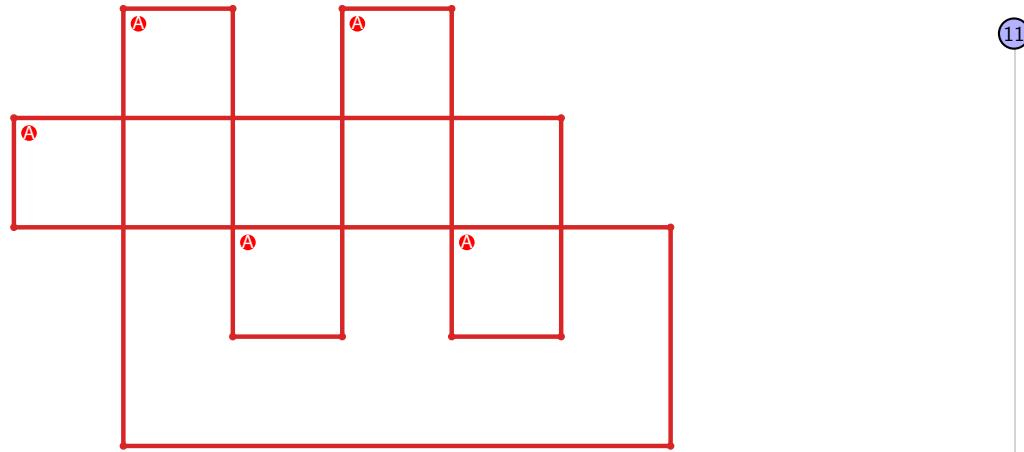


Figure 527: SnapPy multiloop plot.

5

Figure 528: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.165 [[13, 18, 14, 1], [17, 12, 18, 13], [14, 12, 15, 11], [1, 11, 2, 10], [5, 16, 6, 17], [15, 6, 16, 7], [2, 9, 3, 10], [4, 7, 5, 8], [8, 3, 9, 4]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (17, 2, 18, 3), (15, 4, 16, 5), (5, 14, 6, 15), (6, 9, 7, 10), (12, 7, 13, 8), (18, 11, 1, 12), (8, 13, 9, 14), (3, 16, 4, 17)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 6], [1, 7, 5, 5], [2, 4, 4, 7], [3, 8, 8, 3], [4, 8, 8, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 48

Average overall degree: 2.85

Pinning number: 6

Table 263: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.17	2.54	2.81	3.02	3.17	3.27	

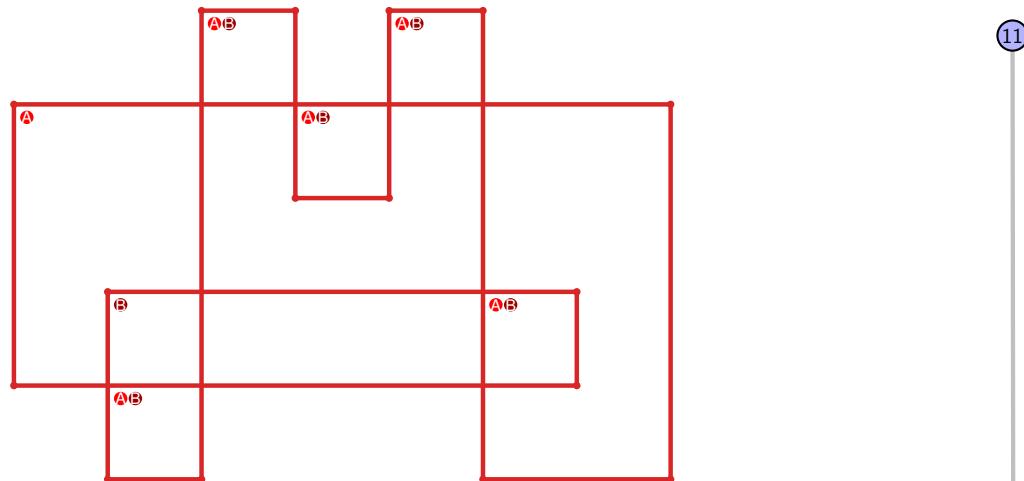


Figure 529: SnapPy multiloop plot.

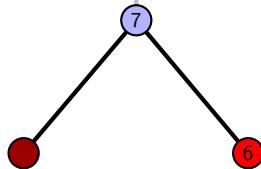


Figure 530: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.166 [[14, 18, 1, 15], [15, 8, 16, 7], [13, 2, 14, 3], [17, 1, 18, 2], [8, 17, 9, 16], [9, 6, 10, 7], [3, 12, 4, 13], [5, 10, 6, 11], [11, 4, 12, 5]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (6, 3, 7, 4), (4, 15, 5, 16), (2, 7, 3, 8), (14, 9, 1, 10), (17, 12, 18, 13), (10, 13, 11, 14), (16, 5, 17, 6), (11, 18, 12, 15)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 4, 0], [1, 3, 5, 1], [1, 4, 7, 7], [2, 8, 8, 2], [5, 8, 8, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 264: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

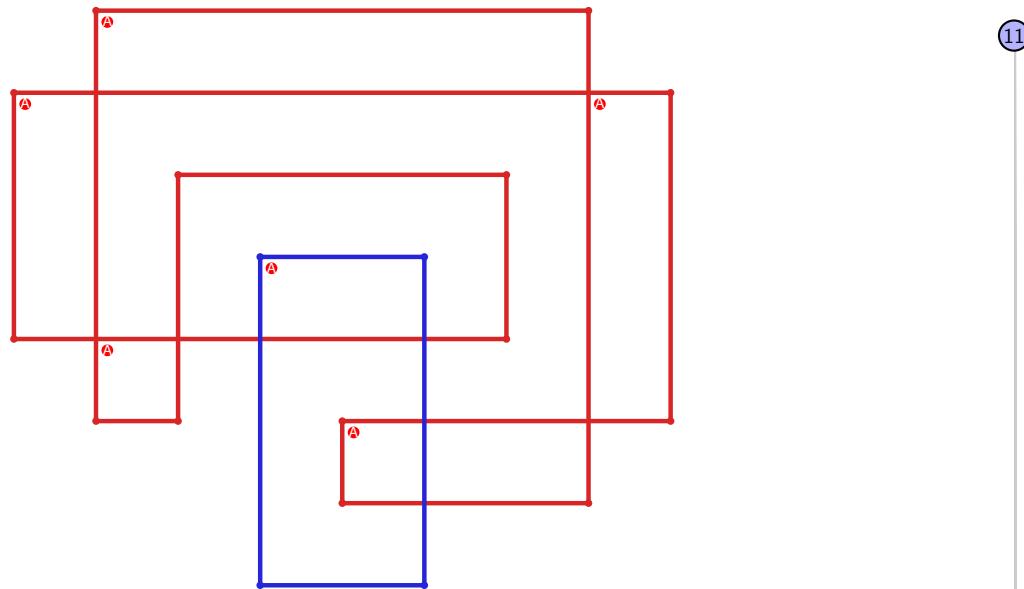


Figure 531: SnapPy multiloop plot.

Figure 532: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.167 $[[7, 18, 8, 1], [17, 6, 18, 7], [8, 2, 9, 1], [5, 16, 6, 17], [2, 10, 3, 9], [13, 4, 14, 5], [15, 10, 16, 11], [3, 12, 4, 13], [14, 12, 15, 11]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (15, 4, 16, 5), (7, 18, 8, 1), (13, 8, 14, 9), (9, 12, 10, 13), (1, 10, 2, 11), (3, 14, 4, 15), (5, 16, 6, 17), (17, 6, 18, 7)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 7, 2], [3, 7, 7, 8], [3, 8, 8, 4], [4, 8, 5, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 265: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

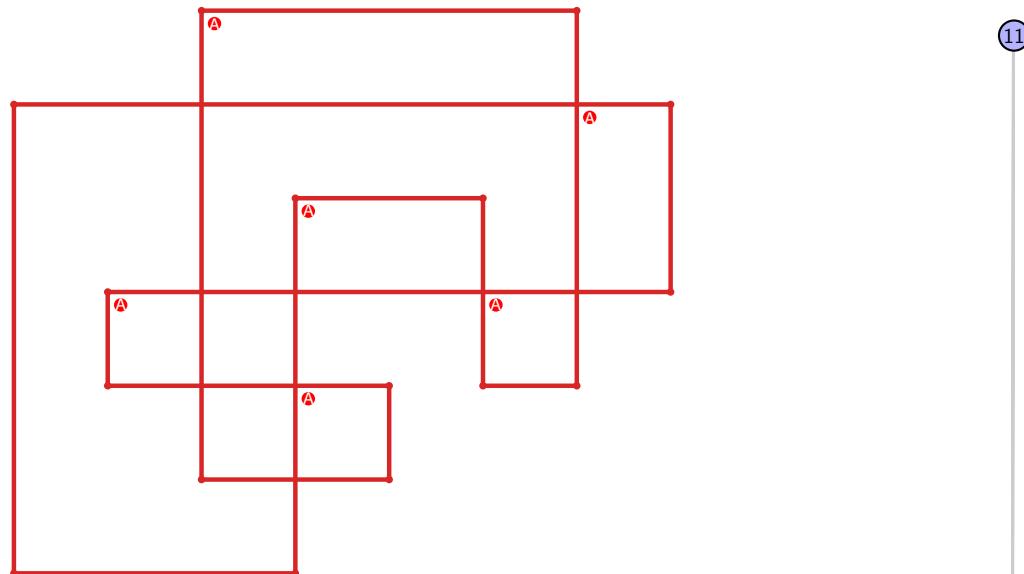


Figure 533: `SnapPy` multiloop plot.



Figure 534: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.168 `[[5, 18, 6, 1], [17, 4, 18, 5], [6, 16, 7, 15], [1, 10, 2, 11], [3, 16, 4, 17], [7, 14, 8, 15], [9, 12, 10, 13], [2, 12, 3, 11], [13, 8, 14, 9]]`

PD code drawn by `SnapPy`: `[(14, 1, 15, 2), (10, 5, 11, 6), (16, 7, 17, 8), (8, 17, 9, 18), (6, 9, 7, 10), (4, 11, 5, 12), (12, 3, 13, 4), (18, 13, 1, 14), (2, 15, 3, 16)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 6, 7, 7], [1, 7, 2, 1], [2, 8, 8, 2], [3, 8, 8, 7], [3, 6, 4, 3], [5, 6, 6, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 266: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

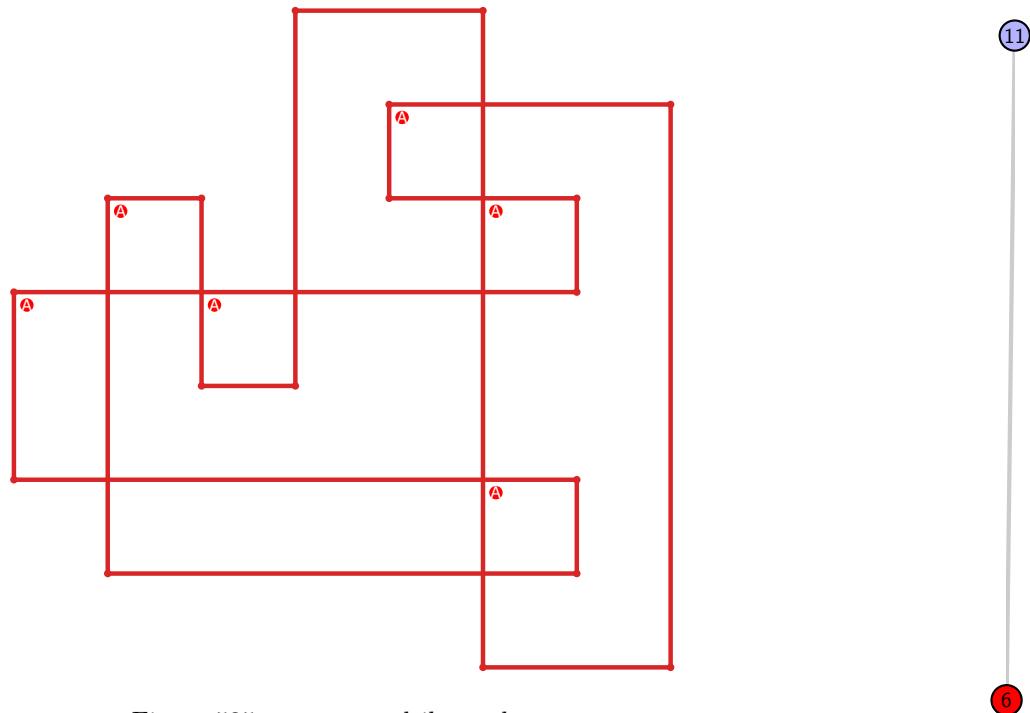


Figure 535: `SnapPy` multiloop plot.

Figure 536: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.169 $[[6, 18, 1, 7], [7, 5, 8, 6], [10, 17, 11, 18], [1, 13, 2, 14], [4, 8, 5, 9], [9, 3, 10, 4], [16, 11, 17, 12], [12, 15, 13, 16], [2, 15, 3, 14]]$

PD code drawn by `SnapPy`: $[(14, 1, 15, 2), (12, 3, 13, 4), (9, 16, 10, 17), (5, 18, 6, 7), (7, 6, 8, 1), (17, 8, 18, 9), (15, 10, 16, 11), (4, 11, 5, 12), (2, 13, 3, 14)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 6], [0, 7, 8, 8], [1, 5, 5, 1], [2, 4, 4, 8], [2, 7, 7, 2], [3, 6, 6, 8], [3, 7, 5, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 267: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

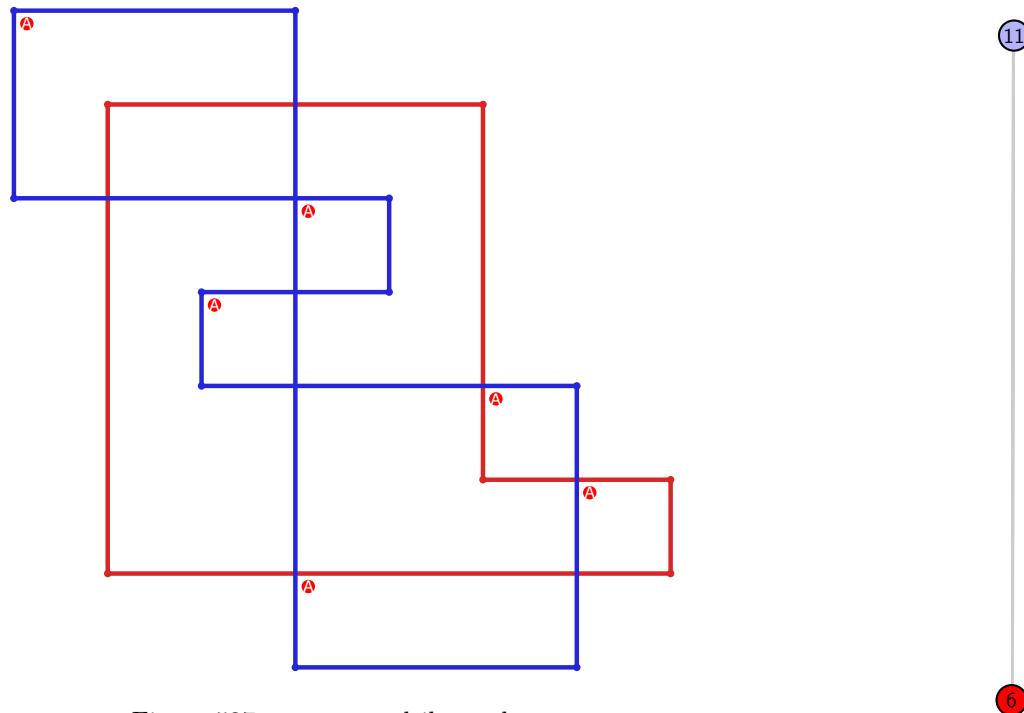


Figure 537: `SnapPy` multiloop plot.

Figure 538: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.170 `[[18, 11, 1, 12], [12, 5, 13, 6], [8, 17, 9, 18], [10, 1, 11, 2], [4, 13, 5, 14], [6, 15, 7, 16], [16, 7, 17, 8], [9, 3, 10, 2], [14, 3, 15, 4]]`

PD code drawn by `SnapPy`: `[(7, 18, 8, 1), (11, 2, 12, 3), (13, 6, 14, 7), (17, 8, 18, 9), (1, 10, 2, 11), (3, 12, 4, 13), (5, 14, 6, 15), (15, 4, 16, 5), (9, 16, 10, 17)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 7, 0], [1, 8, 8, 1], [1, 8, 6, 6], [2, 5, 5, 2], [2, 8, 3, 3], [4, 7, 5, 4]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 268: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

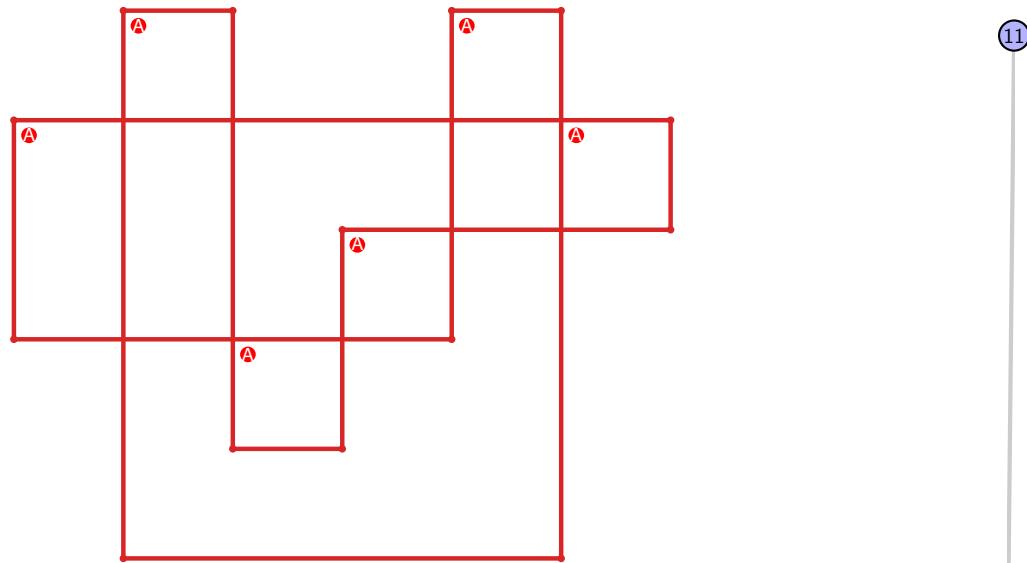


Figure 539: `SnapPy` multiloop plot.

11
6

Figure 540: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.171 $[[9, 18, 10, 1], [17, 8, 18, 9], [10, 2, 11, 1], [5, 16, 6, 17], [7, 12, 8, 13], [2, 12, 3, 11], [15, 4, 16, 5], [6, 14, 7, 13], [3, 14, 4, 15]]$

PD code drawn by `SnapPy`: $[(12, 1, 13, 2), (14, 5, 15, 6), (8, 17, 9, 18), (4, 9, 5, 10), (10, 3, 11, 4), (18, 11, 1, 12), (2, 13, 3, 14), (6, 15, 7, 16), (16, 7, 17, 8)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 6, 7], [1, 7, 7, 5], [2, 4, 8, 2], [3, 8, 8, 3], [3, 8, 4, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 269: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

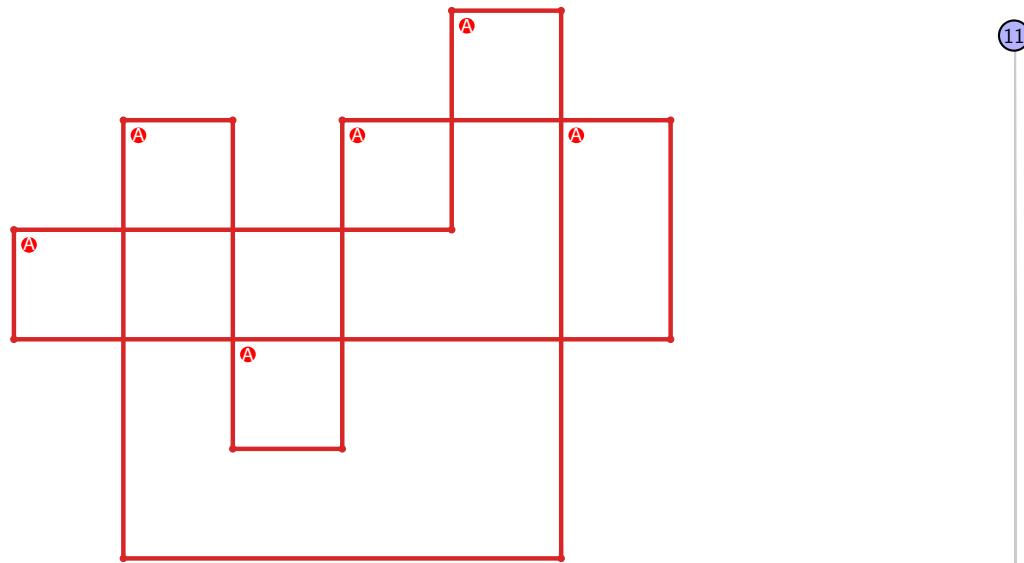


Figure 541: `SnapPy` multiloop plot.

6

Figure 542: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.172 $[[14, 18, 1, 15], [15, 8, 16, 7], [13, 6, 14, 7], [17, 1, 18, 2], [8, 17, 9, 16], [5, 12, 6, 13], [2, 10, 3, 9], [11, 4, 12, 5], [10, 4, 11, 3]]$

PD code drawn by SnapPy: $[(14, 7, 1, 8), (8, 1, 9, 2), (10, 3, 11, 4), (4, 15, 5, 16), (6, 13, 7, 14), (2, 9, 3, 10), (17, 12, 18, 13), (16, 5, 17, 6), (11, 18, 12, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 4, 0], [1, 3, 6, 1], [2, 7, 7, 2], [3, 8, 8, 4], [5, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 28

Pinning number: 7

Average optimal degree: 2.19

Average minimal degree: 2.19

Average overall degree: 2.8

Table 270: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	9	10	5	1	25
Average degree	2.19	2.64	2.93	3.12	3.27	

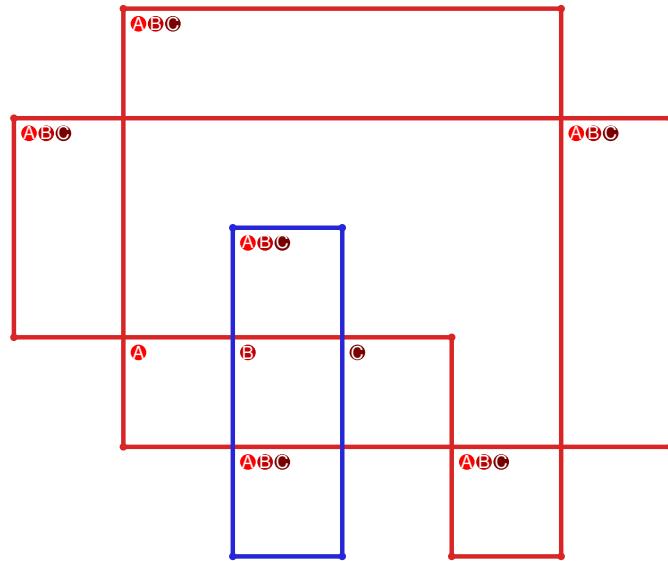


Figure 543: SnapPy multiloop plot.

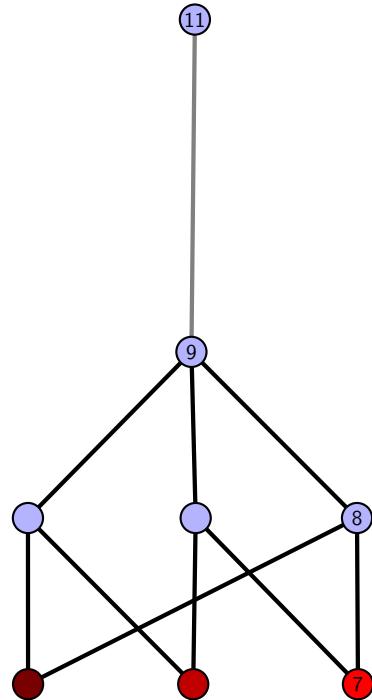


Figure 544: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.173 [[12, 18, 1, 13], [13, 11, 14, 12], [17, 1, 18, 2], [10, 14, 11, 15], [2, 8, 3, 7], [16, 6, 17, 7], [15, 6, 16, 5], [9, 4, 10, 5], [8, 4, 9, 3]]

PD code drawn by SnapPy: [(1, 6, 2, 7), (7, 2, 8, 3), (3, 18, 4, 13), (13, 4, 14, 5), (5, 12, 6, 1), (16, 9, 17, 10), (14, 11, 15, 12), (8, 17, 9, 18), (10, 15, 11, 16)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 6, 7, 1], [2, 8, 8, 5], [2, 4, 6, 6], [3, 5, 5, 7], [3, 6, 8, 8], [4, 7, 7, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 271: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

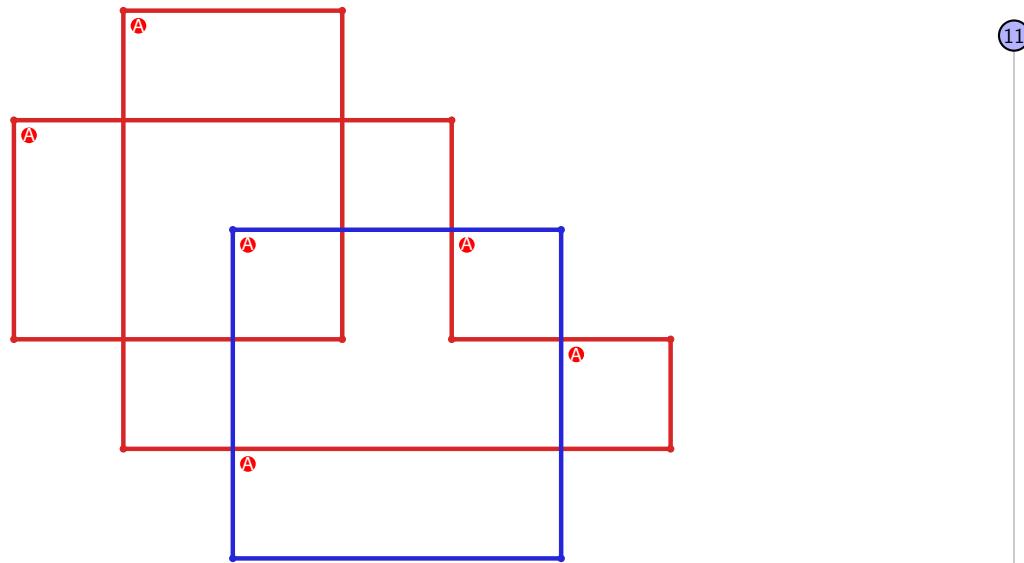


Figure 545: SnapPy multiloop plot.

6

Figure 546: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.174 [[18, 11, 1, 12], [12, 5, 13, 6], [6, 17, 7, 18], [10, 1, 11, 2], [4, 13, 5, 14], [16, 7, 17, 8], [2, 9, 3, 10], [14, 3, 15, 4], [8, 15, 9, 16]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (10, 3, 11, 4), (14, 5, 15, 6), (18, 7, 1, 8), (16, 9, 17, 10), (2, 11, 3, 12), (6, 13, 7, 14), (4, 15, 5, 16), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 6, 0], [1, 7, 7, 1], [2, 8, 8, 2], [3, 8, 7, 3], [4, 6, 8, 4], [5, 7, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.79

Pinning number: 6

Table 272: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.7	2.93	3.12	3.27	

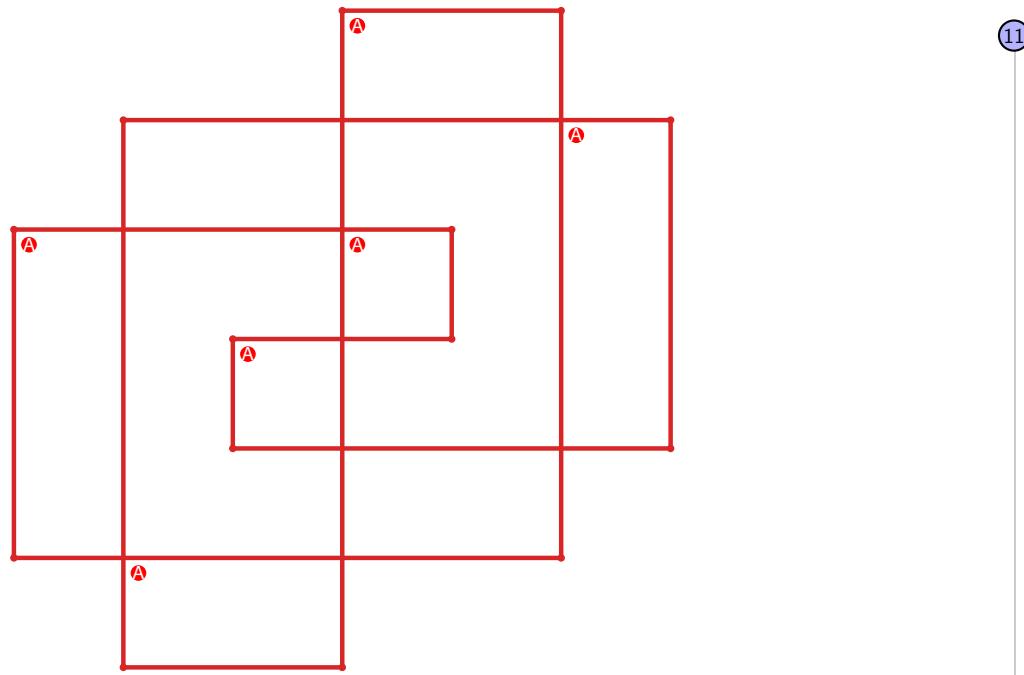


Figure 547: SnapPy multiloop plot.

Figure 548: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.175 $[[4, 18, 1, 5], [5, 13, 6, 12], [3, 11, 4, 12], [17, 10, 18, 11], [1, 14, 2, 13], [6, 2, 7, 3], [9, 16, 10, 17], [14, 8, 15, 7], [15, 8, 16, 9]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (6, 13, 7, 14), (14, 7, 15, 8), (16, 9, 17, 10), (1, 10, 2, 11), (11, 18, 12, 5), (12, 3, 13, 4), (8, 15, 9, 16), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 5, 1], [1, 4, 7, 2], [3, 8, 8, 3], [4, 8, 8, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.53

Total pinning sets: 84

Average overall degree: 2.98

Pinning number: 5

Table 273: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	3	0	0	0	0	3
Nonminimal pinning sets	0	6	15	28	22	8	1	80
Average degree	2.4	2.67	2.81	2.97	3.12	3.23	3.27	

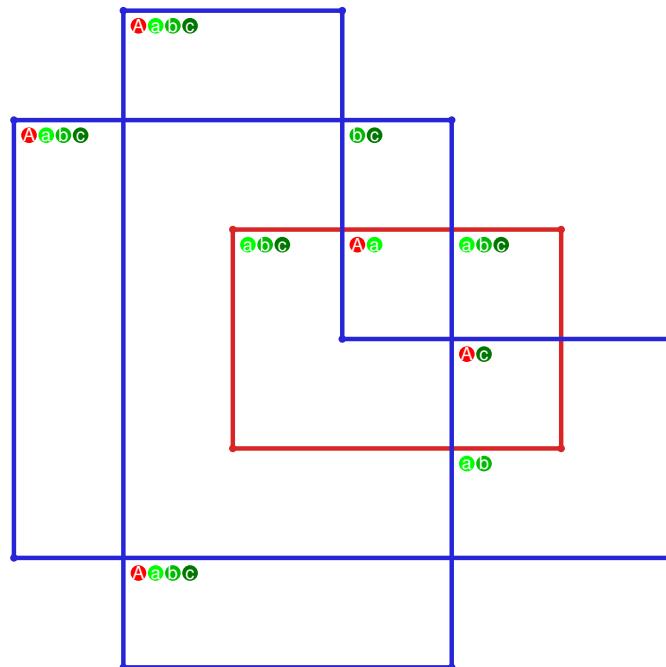


Figure 549: SnapPy multiloop plot.

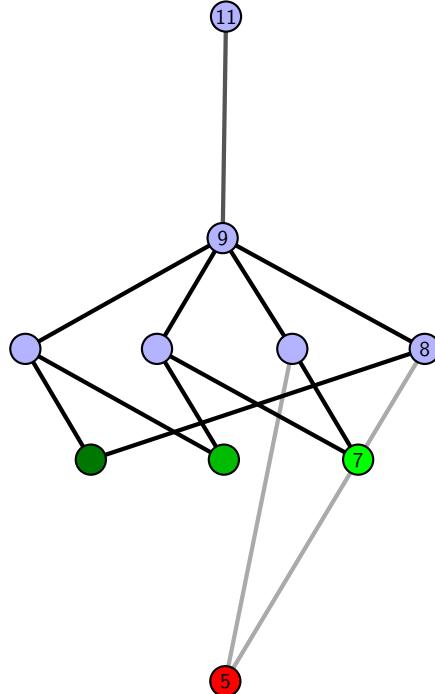


Figure 550: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.176 $[[4, 18, 1, 5], [5, 12, 6, 13], [13, 3, 14, 4], [14, 17, 15, 18], [1, 11, 2, 12], [6, 2, 7, 3], [16, 9, 17, 10], [15, 9, 16, 8], [10, 7, 11, 8]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (12, 1, 13, 2), (7, 14, 8, 15), (15, 8, 16, 9), (3, 10, 4, 11), (18, 11, 5, 12), (13, 16, 14, 17), (2, 17, 3, 18), (9, 6, 10, 7)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 8, 5, 1], [1, 4, 8, 2], [3, 8, 7, 7], [3, 6, 6, 8], [4, 7, 6, 5]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 8
 Total pinning sets: 324
 Pinning number: 4

Average optimal degree: 3.0
 Average minimal degree: 2.9
 Average overall degree: 3.14

Table 274: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	22	68	96	80	39	10	1	316
Average degree	3.0	3.02	3.07	3.13	3.19	3.23	3.26	3.27	

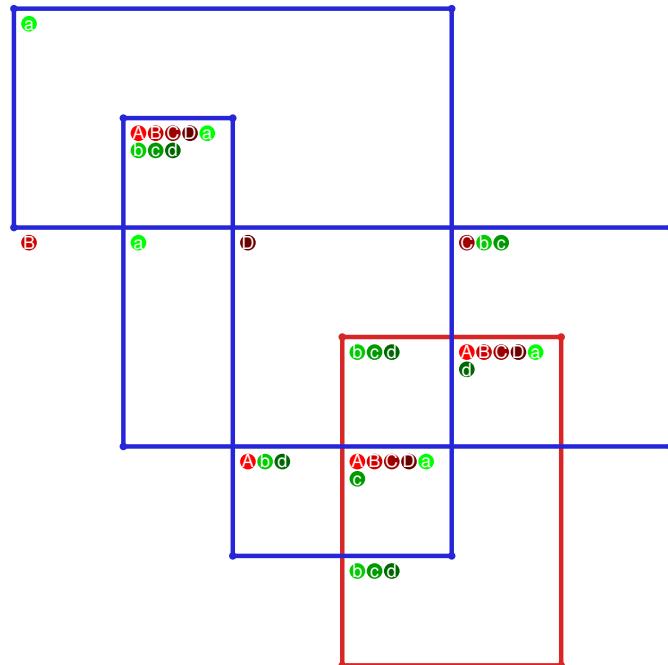


Figure 551: `SnapPy` multiloop plot.

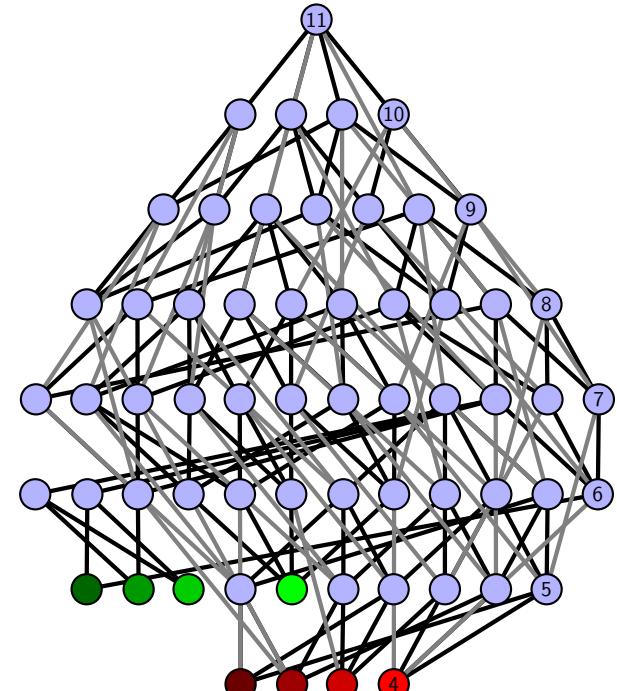


Figure 552: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.177 `[[4, 18, 1, 5], [5, 13, 6, 12], [3, 11, 4, 12], [17, 8, 18, 9], [1, 14, 2, 13], [6, 2, 7, 3], [15, 10, 16, 11], [9, 16, 10, 17], [7, 14, 8, 15]]`

PD code drawn by `SnapPy`: `[(5, 4, 6, 1), (14, 9, 15, 10), (1, 10, 2, 11), (11, 18, 12, 5), (12, 3, 13, 4), (6, 13, 7, 14), (8, 15, 9, 16), (2, 17, 3, 18), (16, 7, 17, 8)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 8, 5, 1], [1, 4, 8, 2], [2, 8, 7, 7], [3, 6, 6, 3], [3, 6, 5, 4]]`

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 3

Average minimal degree: 2.57

Total pinning sets: 192

Average overall degree: 3.04

Pinning number: 4

Table 275: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	31	55	55	31	9	1	189
Average degree	2.5	2.71	2.88	3.01	3.11	3.19	3.24	3.27	

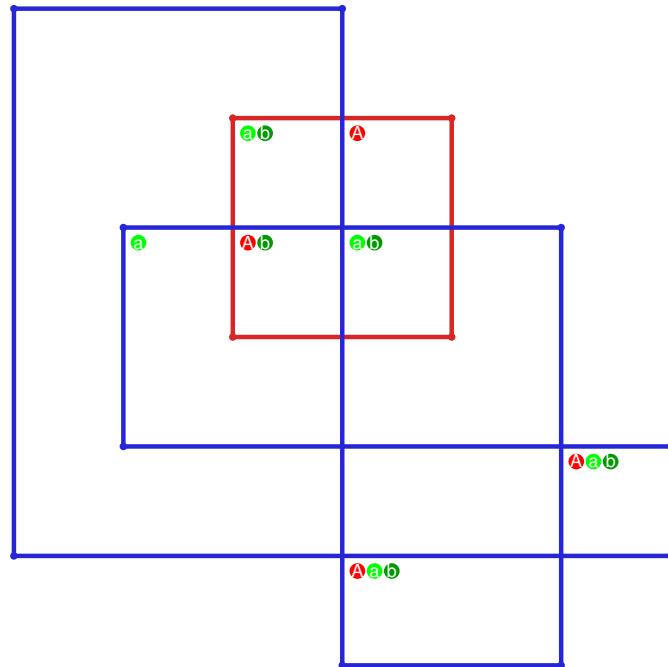


Figure 553: `SnapPy` multiloop plot.

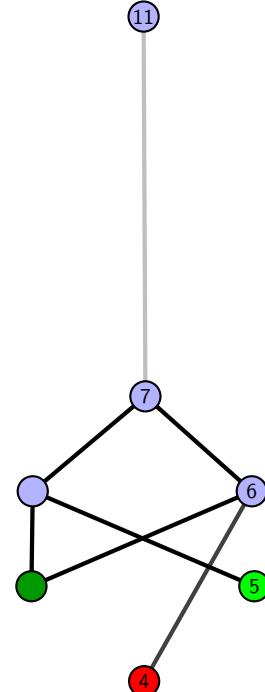


Figure 554: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.178 [[4, 10, 1, 5], [5, 11, 6, 18], [3, 17, 4, 18], [14, 9, 15, 10], [1, 12, 2, 11], [6, 2, 7, 3], [13, 16, 14, 17], [8, 15, 9, 16], [12, 8, 13, 7]]

PD code drawn by SnapPy: [(5, 4, 6, 1), (6, 13, 7, 14), (15, 8, 16, 9), (2, 9, 3, 10), (7, 16, 8, 17), (14, 17, 15, 18), (1, 18, 2, 11), (11, 10, 12, 5), (12, 3, 13, 4)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 5, 1], [1, 4, 8, 2], [2, 8, 7, 3], [3, 6, 8, 3], [4, 7, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.75

Total minimal pinning sets: 13

Average minimal degree: 2.95

Total pinning sets: 257

Average overall degree: 3.13

Pinning number: 4

Table 276: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	10	0	0	0	0	0	12
Nonminimal pinning sets	0	7	32	79	76	39	10	1	244
Average degree	2.75	2.91	3.01	3.11	3.18	3.23	3.26	3.27	

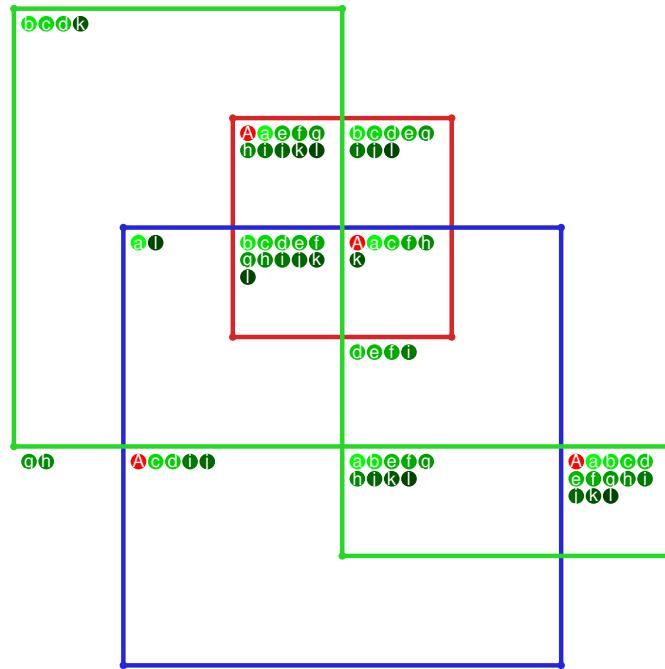


Figure 555: SnapPy multiloop plot.

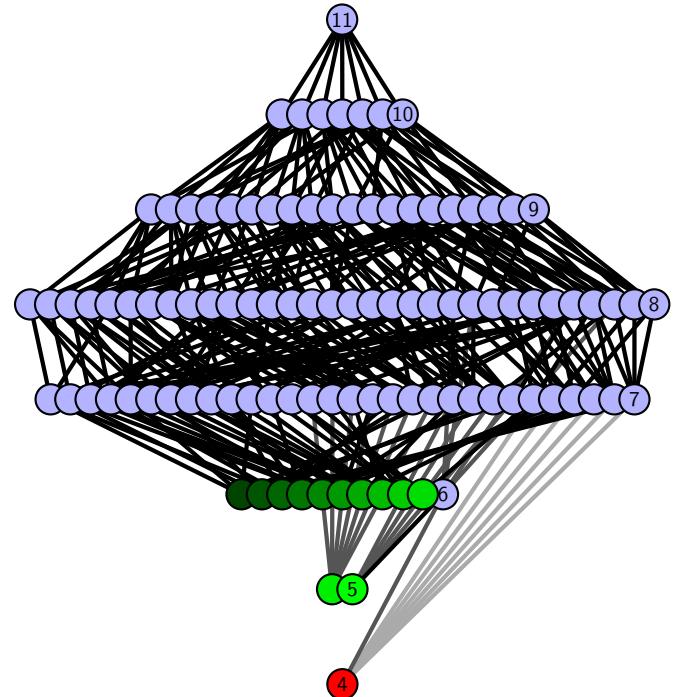


Figure 556: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.179 $[[18, 5, 1, 6], [6, 13, 7, 14], [4, 17, 5, 18], [1, 12, 2, 13], [7, 2, 8, 3], [14, 3, 15, 4], [16, 9, 17, 10], [11, 8, 12, 9], [15, 11, 16, 10]]$

PD code drawn by `SnapPy`: $[(5, 18, 6, 1), (12, 1, 13, 2), (16, 3, 17, 4), (9, 6, 10, 7), (14, 7, 15, 8), (8, 13, 9, 14), (17, 10, 18, 11), (4, 11, 5, 12), (2, 15, 3, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 7, 4, 1], [1, 3, 7, 5], [1, 4, 8, 2], [2, 8, 8, 7], [3, 6, 8, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.58
 Average minimal degree: 2.59
 Average overall degree: 3.06

Table 277: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	18	51	75	65	33	9	1	252
Average degree	2.58	2.8	2.95	3.06	3.14	3.2	3.24	3.27	

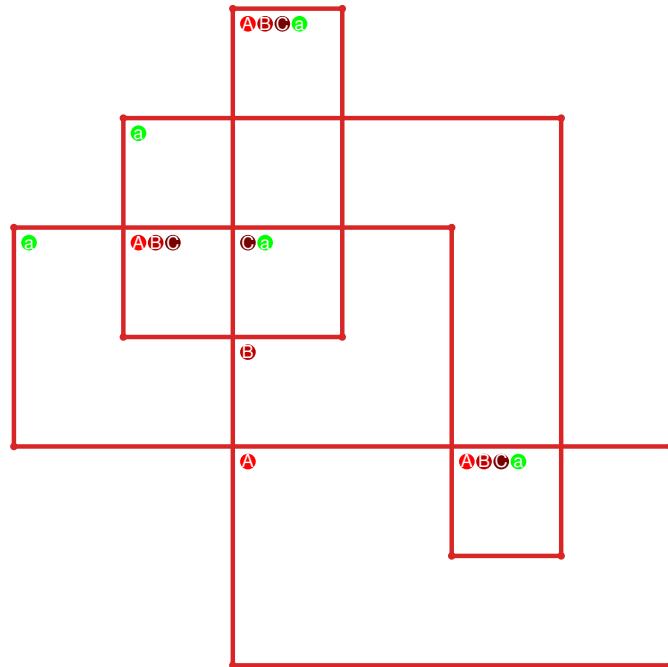


Figure 557: `SnapPy` multiloop plot.

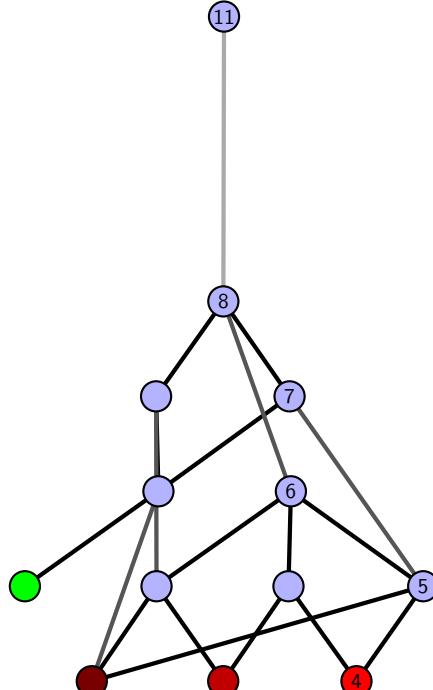


Figure 558: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.180 `[[4, 18, 1, 5], [5, 14, 6, 15], [15, 3, 16, 4], [10, 17, 11, 18], [1, 13, 2, 14], [6, 2, 7, 3], [16, 9, 17, 10], [11, 9, 12, 8], [12, 7, 13, 8]]`

PD code drawn by `SnapPy`: `[(5, 4, 6, 1), (14, 1, 15, 2), (7, 10, 8, 11), (15, 8, 16, 9), (3, 12, 4, 13), (18, 13, 5, 14), (9, 16, 10, 17), (2, 17, 3, 18), (11, 6, 12, 7)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 8, 5, 1], [1, 4, 8, 2], [2, 7, 3, 3], [3, 6, 8, 8], [4, 7, 7, 5]]`

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 192
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.57
 Average overall degree: 3.04

Table 278: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	31	55	55	31	9	1	189
Average degree	2.5	2.71	2.88	3.01	3.11	3.19	3.24	3.27	

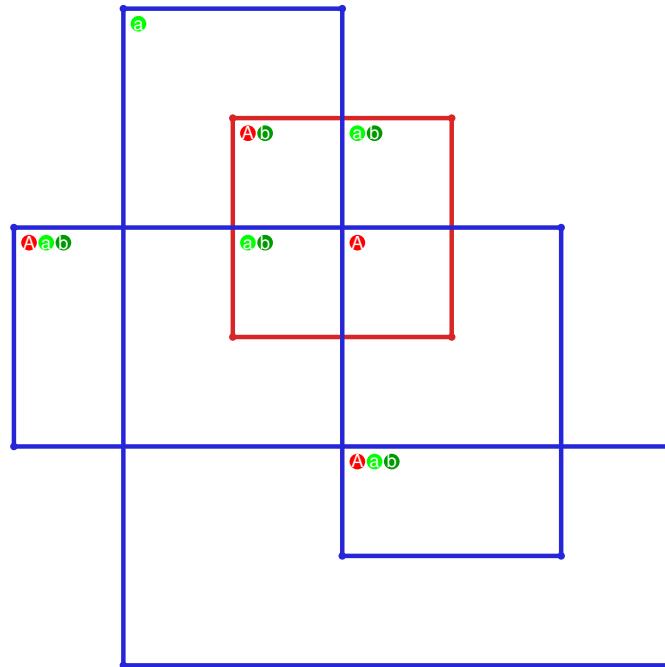


Figure 559: `SnapPy` multiloop plot.

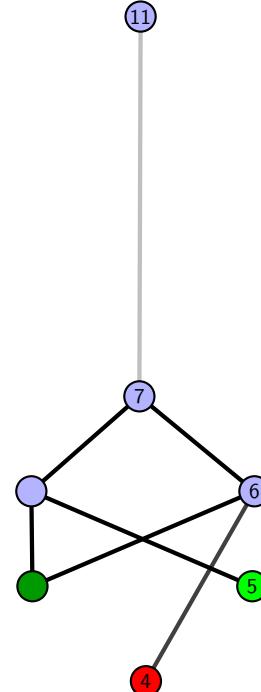


Figure 560: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.181 `[[4, 14, 1, 5], [5, 10, 6, 11], [11, 3, 12, 4], [13, 18, 14, 15], [1, 9, 2, 10], [6, 2, 7, 3], [12, 16, 13, 15], [8, 17, 9, 18], [7, 17, 8, 16]]`

PD code drawn by `SnapPy`: `[(5, 4, 6, 1), (10, 1, 11, 2), (3, 8, 4, 9), (14, 9, 5, 10), (2, 13, 3, 14), (15, 6, 16, 7), (7, 16, 8, 17), (12, 17, 13, 18), (18, 11, 15, 12)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 5, 1], [1, 4, 8, 2], [2, 8, 3, 3], [3, 8, 8, 4], [5, 7, 7, 6]]`

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 224

Pinning number: 4

Average optimal degree: 2.5

Average minimal degree: 2.5

Average overall degree: 3.04

Table 279: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	14	41	65	60	32	9	1	222
Average degree	2.5	2.74	2.91	3.03	3.12	3.19	3.24	3.27	

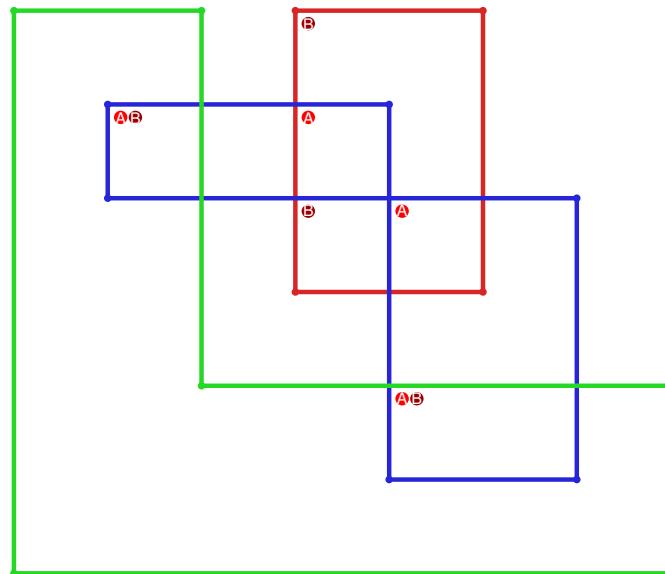


Figure 561: `SnapPy` multiloop plot.

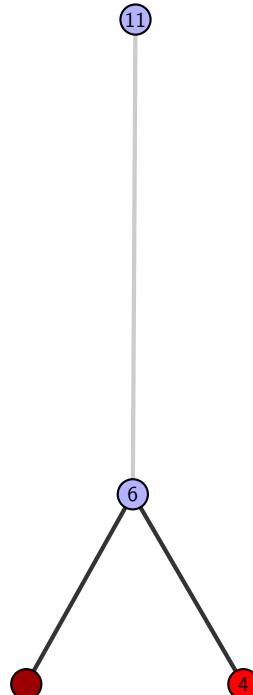


Figure 562: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.182 `[[18, 7, 1, 8], [8, 3, 9, 4], [4, 17, 5, 18], [6, 11, 7, 12], [1, 14, 2, 15], [15, 2, 16, 3], [9, 16, 10, 17], [5, 13, 6, 12], [13, 10, 14, 11]]`

PD code drawn by `SnapPy`: `[(13, 18, 14, 1), (6, 1, 7, 2), (16, 5, 17, 6), (11, 8, 12, 9), (4, 9, 5, 10), (10, 3, 11, 4), (17, 12, 18, 13), (7, 14, 8, 15), (2, 15, 3, 16)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 7, 7, 8], [0, 8, 5, 5], [1, 4, 4, 6], [1, 5, 8, 2], [2, 8, 3, 3], [3, 7, 6, 4]]`

Total optimal pinning sets: 4
Total minimal pinning sets: 6
Total pinning sets: 288
Pinning number: 4

Average optimal degree: 2.62
Average minimal degree: 2.65
Average overall degree: 3.06

Table 280: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	22	61	85	70	34	9	1	282
Average degree	2.62	2.82	2.96	3.07	3.14	3.2	3.24	3.27	

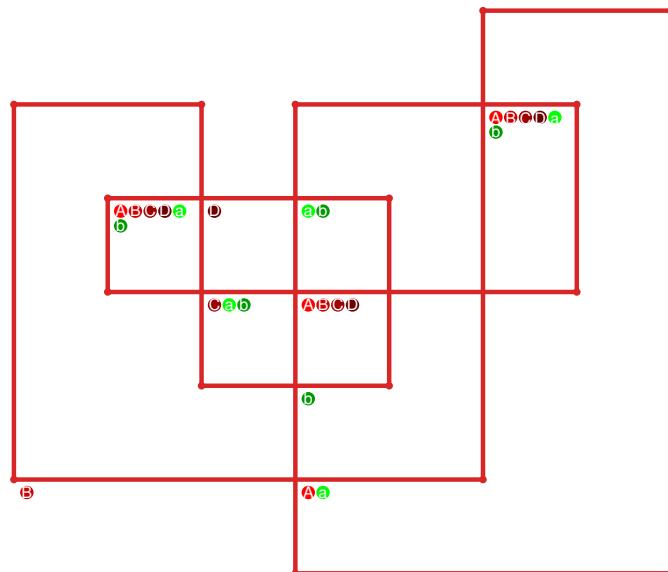


Figure 563: `SnapPy` multiloop plot.

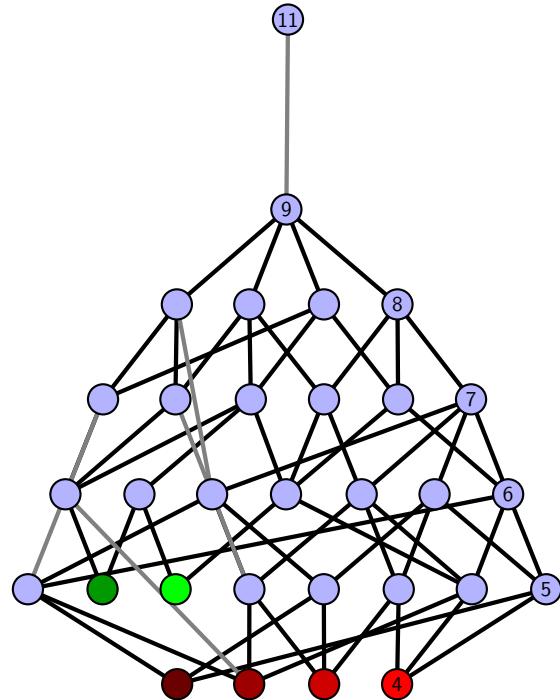


Figure 564: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.183 [[18, 9, 1, 10], [10, 6, 11, 5], [17, 14, 18, 15], [8, 13, 9, 14], [1, 13, 2, 12], [6, 12, 7, 11], [4, 15, 5, 16], [16, 3, 17, 4], [7, 2, 8, 3]]

PD code drawn by SnapPy: [(5, 18, 6, 1), (14, 1, 15, 2), (3, 8, 4, 9), (16, 7, 17, 8), (9, 4, 10, 5), (10, 17, 11, 18), (6, 11, 7, 12), (15, 12, 16, 13), (2, 13, 3, 14)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 3], [0, 2, 8, 4], [0, 3, 8, 5], [1, 4, 8, 1], [1, 7, 7, 2], [2, 6, 6, 8], [3, 7, 5, 4]]

Total optimal pinning sets: 8
 Total minimal pinning sets: 9
 Total pinning sets: 222
 Pinning number: 5

Average optimal degree: 2.7
 Average minimal degree: 2.73
 Average overall degree: 3.06

Table 281: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	8	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	37	69	64	33	9	1	213
Average degree	2.7	2.9	3.04	3.13	3.2	3.24	3.27	

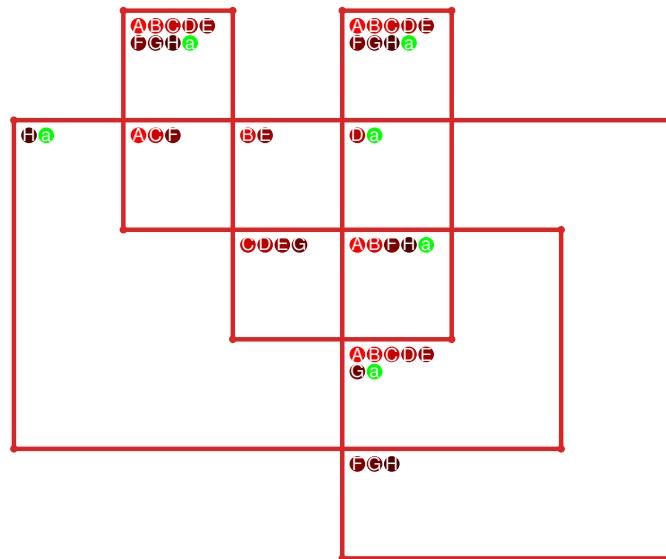


Figure 565: SnapPy multiloop plot.

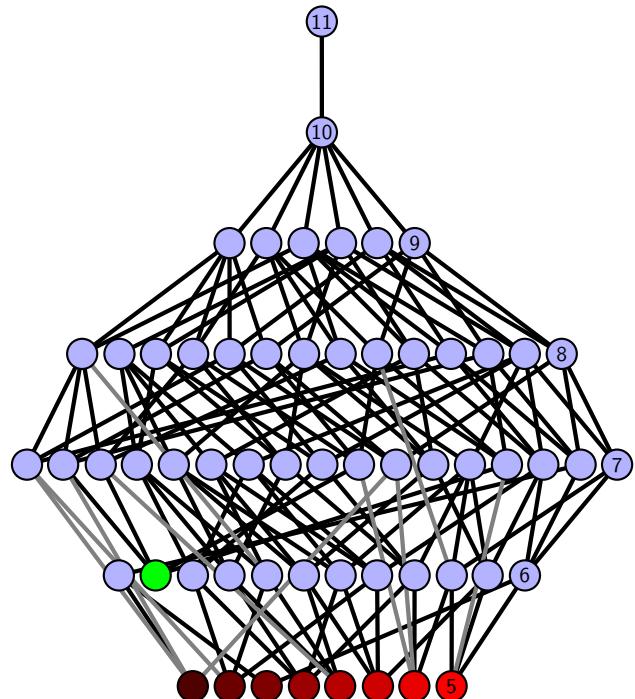


Figure 566: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.184 `[[4, 18, 1, 5], [5, 14, 6, 15], [15, 3, 16, 4], [10, 17, 11, 18], [1, 8, 2, 7], [13, 6, 14, 7], [2, 12, 3, 13], [16, 9, 17, 10], [11, 9, 12, 8]]`

PD code drawn by `SnapPy`: `[(8, 1, 9, 2), (15, 18, 16, 5), (9, 16, 10, 17), (4, 5, 1, 6), (12, 7, 13, 8), (17, 10, 18, 11), (2, 11, 3, 12), (6, 13, 7, 14), (14, 3, 15, 4)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 7, 8], [0, 8, 6, 5], [1, 4, 6, 1], [2, 5, 4, 8], [2, 8, 3, 3], [3, 7, 6, 4]]`

Total optimal pinning sets: 4
Total minimal pinning sets: 6
Total pinning sets: 312
Pinning number: 4

Average optimal degree: 2.62
Average minimal degree: 2.72
Average overall degree: 3.07

Table 282: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	24	68	94	75	35	9	1	306
Average degree	2.62	2.84	2.98	3.08	3.15	3.21	3.24	3.27	

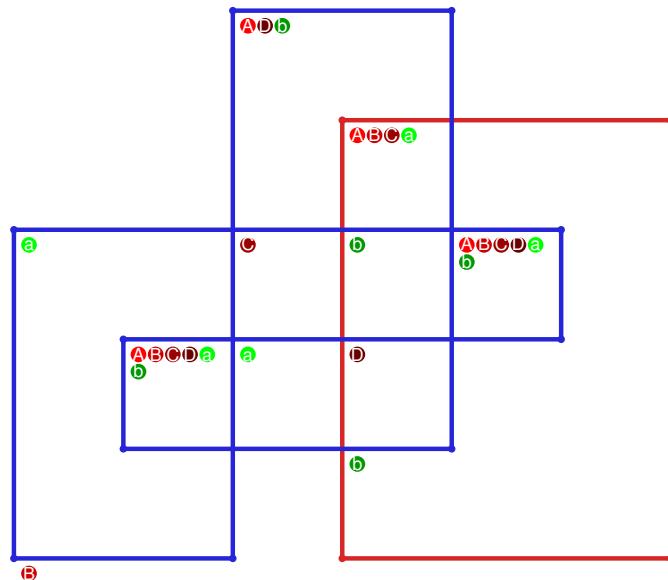


Figure 567: `SnapPy` multiloop plot.

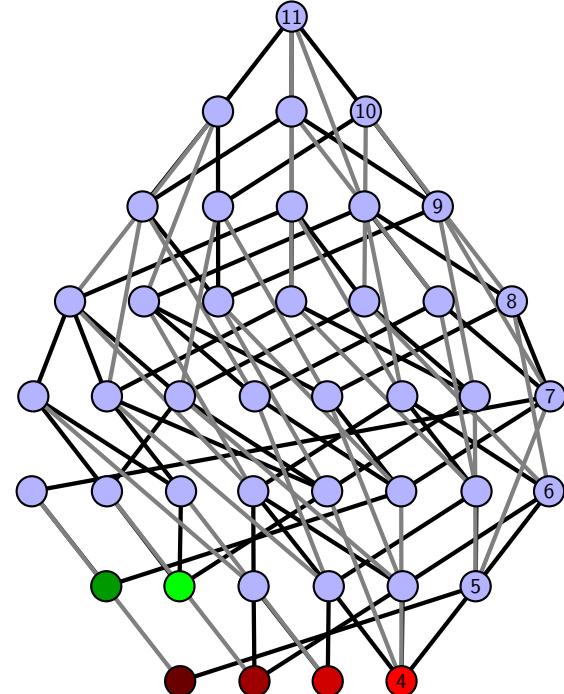


Figure 568: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.185 $[[18, 5, 1, 6], [6, 15, 7, 16], [12, 17, 13, 18], [13, 4, 14, 5], [1, 14, 2, 15], [7, 10, 8, 11], [16, 11, 17, 12], [8, 3, 9, 4], [2, 9, 3, 10]]$

PD code drawn by SnapPy: $[(5, 18, 6, 1), (10, 1, 11, 2), (15, 2, 16, 3), (17, 6, 18, 7), (4, 7, 5, 8), (13, 8, 14, 9), (16, 11, 17, 12), (3, 12, 4, 13), (9, 14, 10, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 3], [0, 2, 7, 4], [0, 3, 8, 1], [1, 8, 7, 6], [1, 5, 2, 2], [3, 5, 8, 8], [4, 7, 7, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 8

Total pinning sets: 254

Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.78

Average overall degree: 3.07

Table 283: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	1	0	0	0	0	0	7
Nonminimal pinning sets	0	7	47	79	69	34	9	1	246
Average degree	2.5	2.75	2.93	3.06	3.14	3.2	3.24	3.27	

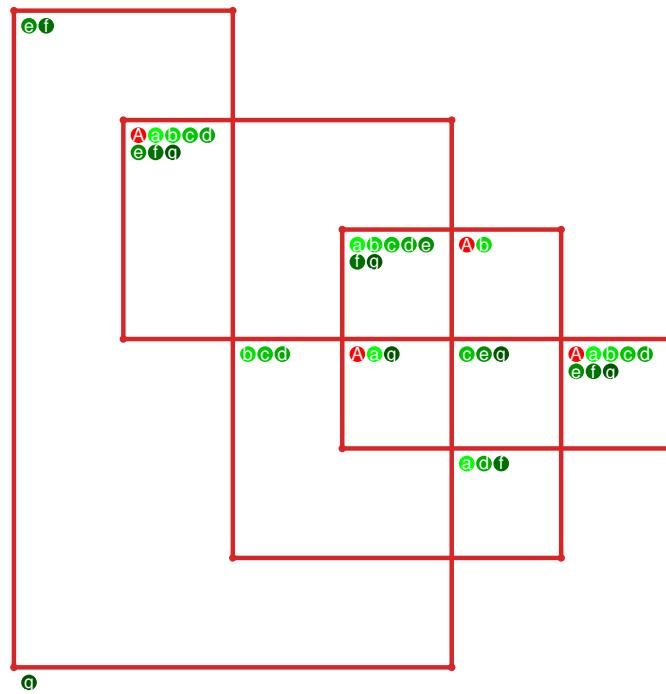


Figure 569: SnapPy multiloop plot.

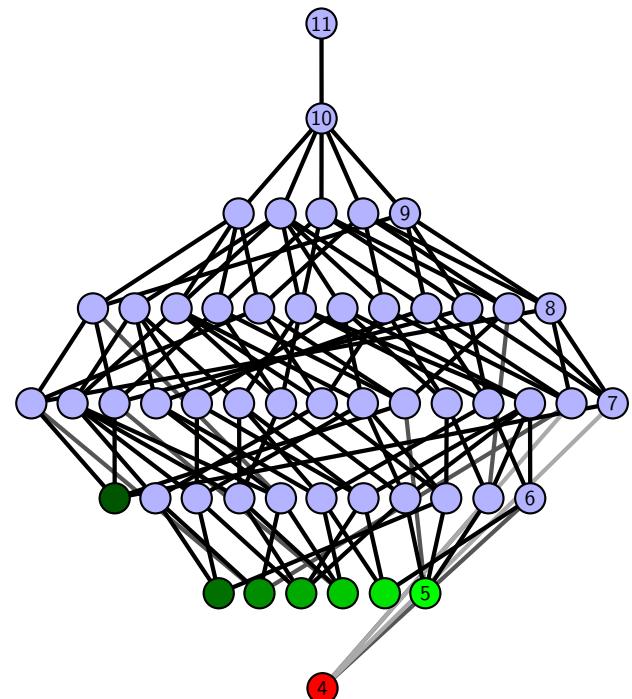


Figure 570: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.186 [[6, 14, 1, 7], [7, 15, 8, 18], [13, 5, 14, 6], [1, 16, 2, 15], [8, 11, 9, 12], [12, 17, 13, 18], [4, 16, 5, 17], [2, 10, 3, 11], [9, 3, 10, 4]]

PD code drawn by `SnapPy`: [(18, 1, 11, 2), (14, 5, 15, 6), (4, 15, 5, 16), (13, 16, 14, 17), (2, 11, 3, 12), (6, 7, 1, 8), (17, 8, 18, 9), (9, 12, 10, 13), (10, 3, 7, 4)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 6, 7, 1], [1, 7, 8, 5], [1, 4, 6, 2], [2, 5, 8, 3], [3, 8, 8, 4], [4, 7, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.75

Total minimal pinning sets: 15

Average minimal degree: 2.93

Total pinning sets: 307

Average overall degree: 3.09

Pinning number: 4

Table 284: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	10	0	0	0	0	0	13
Nonminimal pinning sets	0	14	53	99	80	36	9	1	292
Average degree	2.75	2.86	2.99	3.09	3.16	3.21	3.24	3.27	

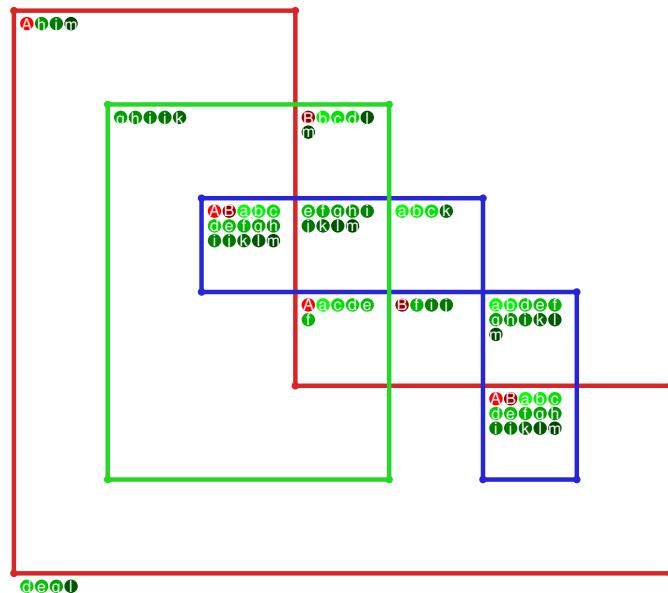


Figure 571: `SnapPy` multiloop plot.

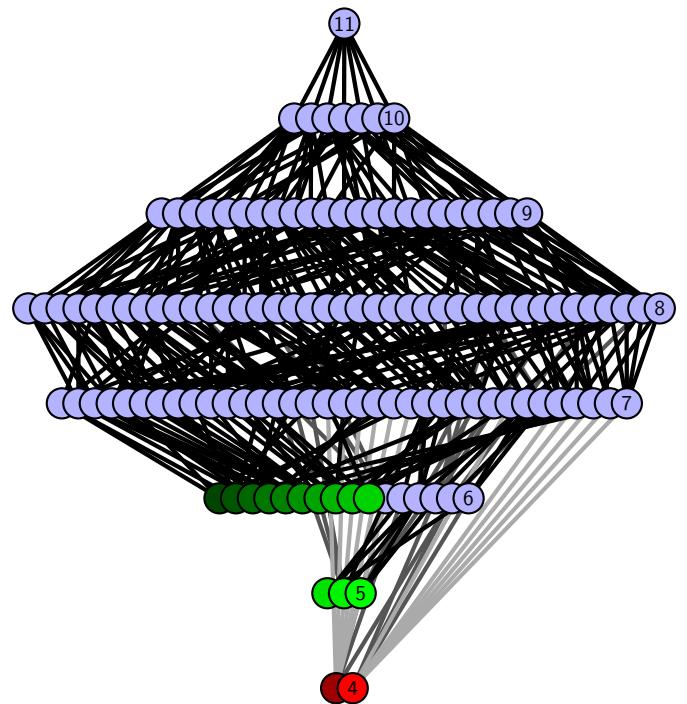


Figure 572: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.187 $[[18, 5, 1, 6], [6, 11, 7, 12], [12, 17, 13, 18], [13, 4, 14, 5], [1, 10, 2, 11], [7, 16, 8, 17], [8, 3, 9, 4], [14, 9, 15, 10], [2, 15, 3, 16]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (11, 2, 12, 3), (16, 3, 17, 4), (12, 7, 13, 8), (17, 8, 18, 9), (4, 9, 5, 10), (18, 13, 1, 14), (5, 14, 6, 15), (10, 15, 11, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 7, 8, 1], [1, 8, 6, 2], [3, 5, 8, 7], [3, 6, 8, 4], [4, 7, 6, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 3.0

Total minimal pinning sets: 13

Average minimal degree: 3.25

Total pinning sets: 395

Average overall degree: 3.23

Pinning number: 4

Table 285: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	7	0	0	0	0	0	11
Nonminimal pinning sets	0	14	66	130	111	49	11	1	382
Average degree	3.0	3.13	3.21	3.23	3.25	3.27	3.27	3.27	

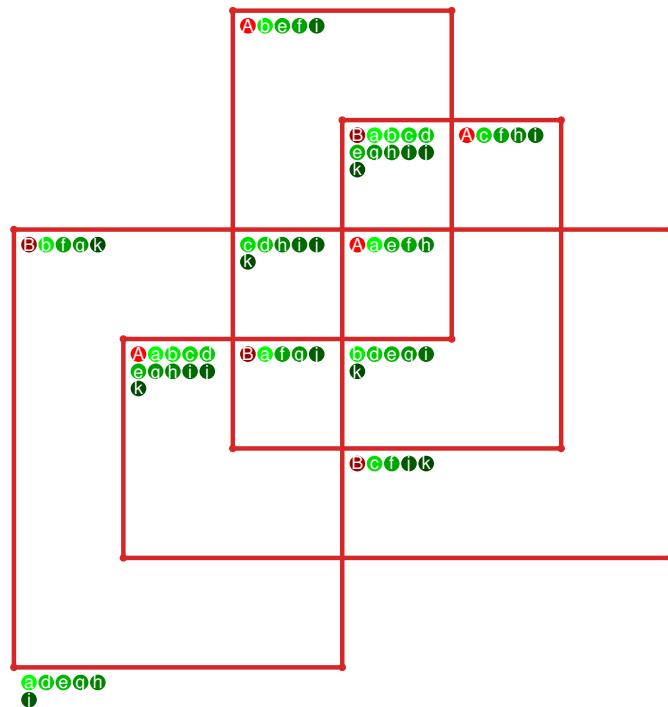


Figure 573: `SnapPy` multiloop plot.

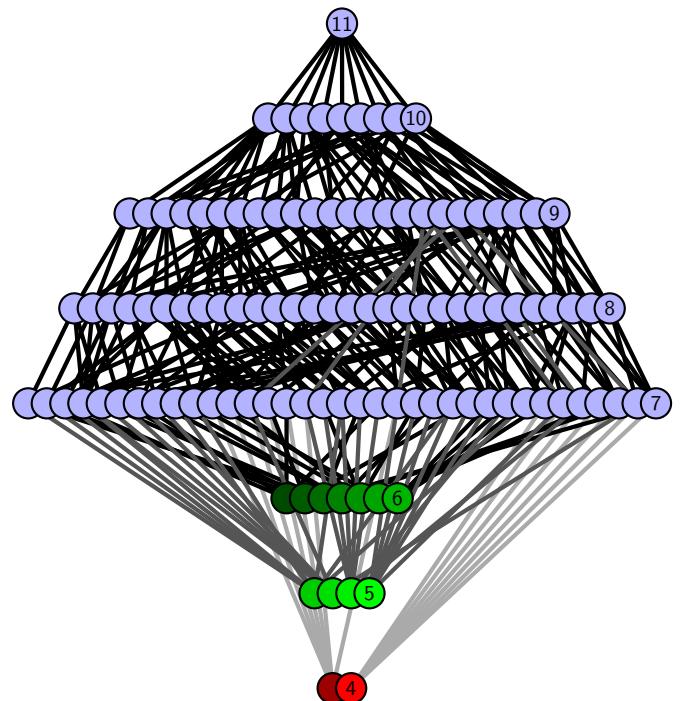


Figure 574: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.188 [[5, 12, 6, 1], [4, 18, 5, 13], [11, 17, 12, 18], [6, 15, 7, 14], [1, 14, 2, 13], [10, 3, 11, 4], [16, 8, 17, 9], [15, 8, 16, 7], [2, 9, 3, 10]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (5, 16, 6, 17), (17, 6, 18, 7), (12, 7, 1, 8), (3, 10, 4, 11), (15, 4, 16, 5), (9, 18, 10, 13), (2, 13, 3, 14), (14, 11, 15, 12)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 8, 1], [1, 8, 8, 2], [2, 8, 7, 7], [3, 6, 6, 3], [4, 6, 5, 5]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 128
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 2.97

Table 286: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	35	40	25	8	1	125
Average degree	2.4	2.69	2.89	3.04	3.15	3.23	3.27	

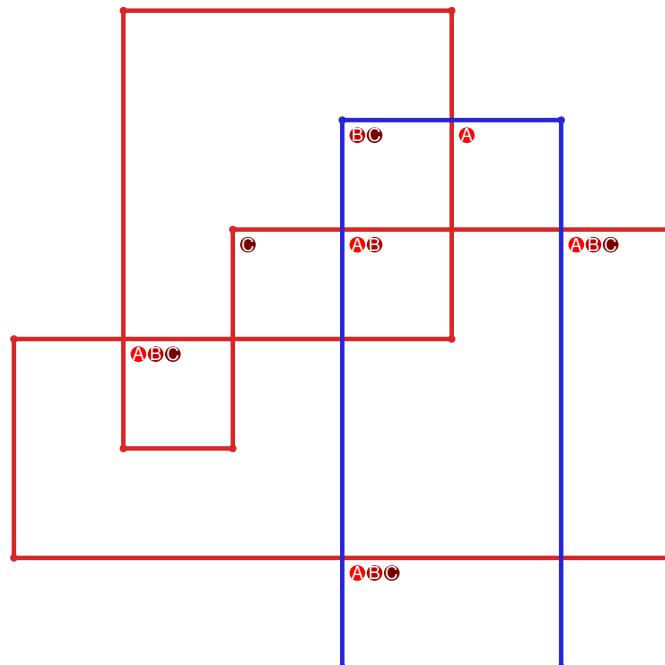


Figure 575: `SnapPy` multiloop plot.

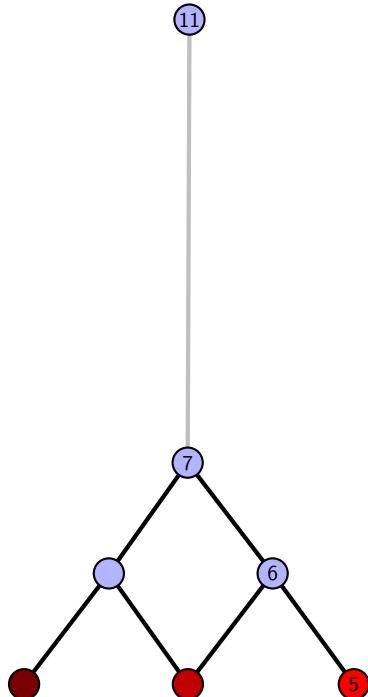


Figure 576: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.189 [[8, 18, 1, 9], [9, 14, 10, 15], [15, 7, 16, 8], [17, 3, 18, 4], [1, 13, 2, 14], [10, 6, 11, 7], [16, 5, 17, 4], [12, 2, 13, 3], [5, 11, 6, 12]]

PD code drawn by `SnapPy`: [(9, 8, 10, 1), (14, 1, 15, 2), (2, 13, 3, 14), (17, 4, 18, 5), (12, 5, 13, 6), (3, 18, 4, 9), (7, 10, 8, 11), (16, 11, 17, 12), (6, 15, 7, 16)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 7, 1], [1, 8, 8, 2], [2, 8, 3, 3], [3, 8, 4, 4], [5, 7, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 4

Table 287: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.25	2.55	2.77	2.93	3.06	3.15	3.23	3.27	

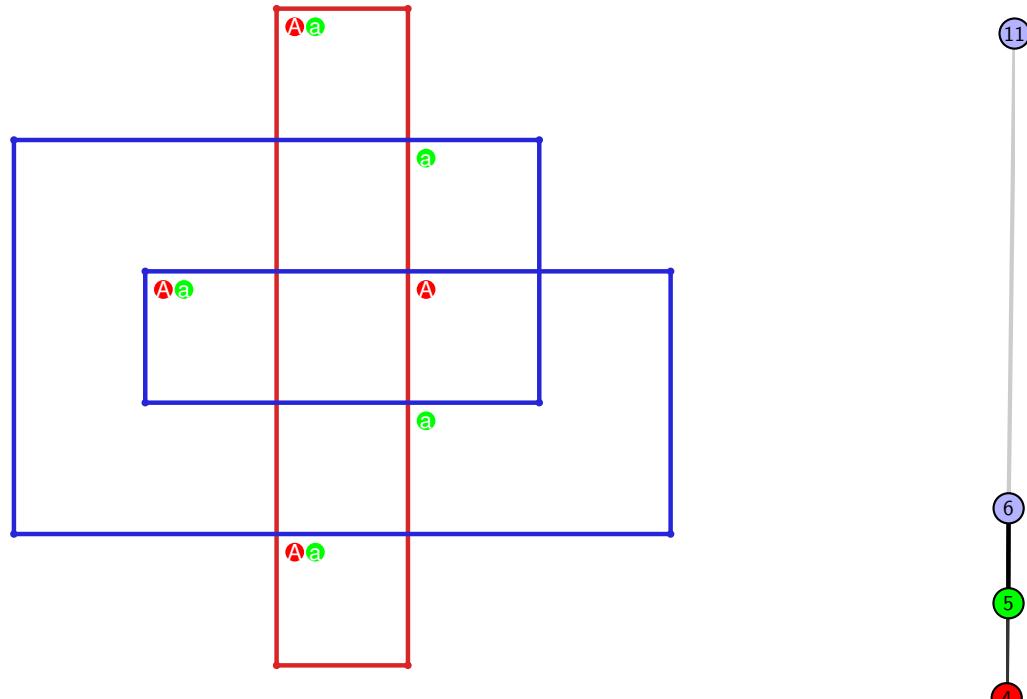


Figure 577: `SnapPy` multiloop plot.

Figure 578: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.190 [[5, 18, 6, 1], [15, 4, 16, 5], [17, 8, 18, 9], [6, 13, 7, 14], [1, 14, 2, 15], [3, 10, 4, 11], [16, 10, 17, 9], [12, 7, 13, 8], [2, 12, 3, 11]]

PD code drawn by `SnapPy`: [(12, 1, 13, 2), (9, 4, 10, 5), (14, 5, 15, 6), (6, 13, 7, 14), (18, 7, 1, 8), (8, 17, 9, 18), (3, 10, 4, 11), (16, 11, 17, 12), (2, 15, 3, 16)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 7], [0, 7, 7, 4], [0, 3, 8, 1], [1, 8, 8, 6], [1, 5, 2, 2], [2, 8, 3, 3], [4, 7, 5, 5]]]

Total optimal pinning sets: 1
Total minimal pinning sets: 4
Total pinning sets: 184
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.46
Average overall degree: 2.98

Table 288: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.25	2.56	2.79	2.96	3.08	3.16	3.23	3.27	

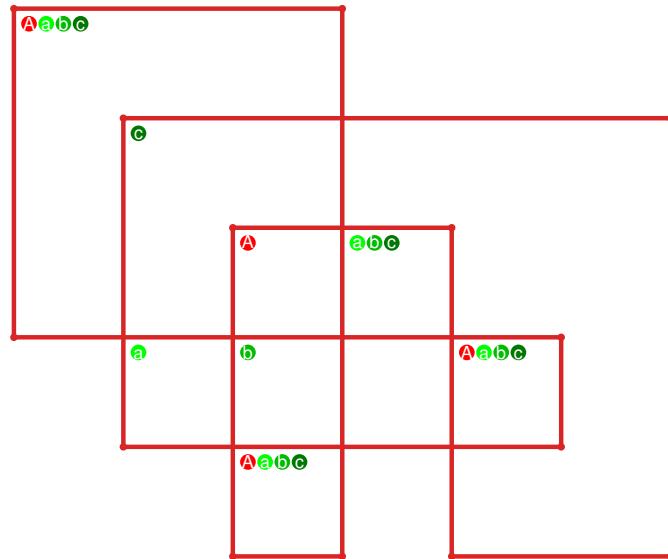


Figure 579: `SnapPy` multiloop plot.

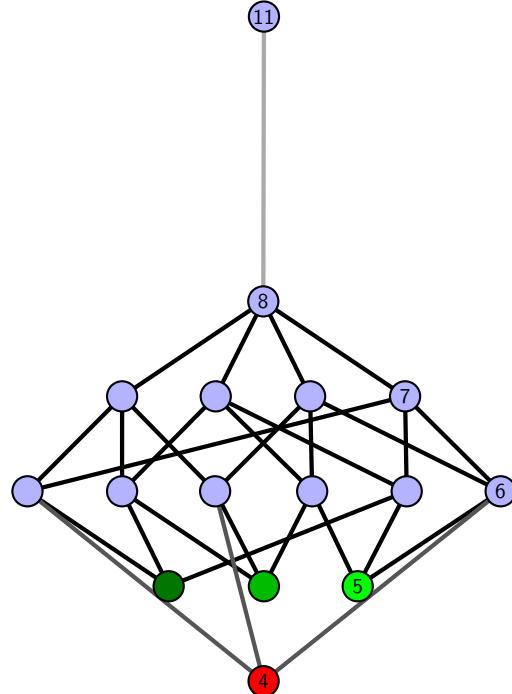


Figure 580: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.191 $[[7, 12, 8, 1], [6, 18, 7, 13], [11, 17, 12, 18], [8, 17, 9, 16], [1, 14, 2, 13], [10, 5, 11, 6], [9, 5, 10, 4], [15, 3, 16, 4], [14, 3, 15, 2]]$

PD code drawn by SnapPy: $[(12, 13, 1, 14), (14, 1, 15, 2), (2, 7, 3, 8), (8, 3, 9, 4), (5, 10, 6, 11), (15, 6, 16, 7), (9, 16, 10, 17), (4, 17, 5, 18), (18, 11, 13, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 8, 8, 1], [1, 6, 6, 2], [3, 5, 5, 7], [3, 6, 8, 8], [4, 7, 7, 4]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 128
 Pinning number: 5

Average optimal degree: 2.47
 Average minimal degree: 2.48
 Average overall degree: 2.98

Table 289: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	15	35	40	25	8	1	124
Average degree	2.47	2.72	2.9	3.04	3.15	3.23	3.27	

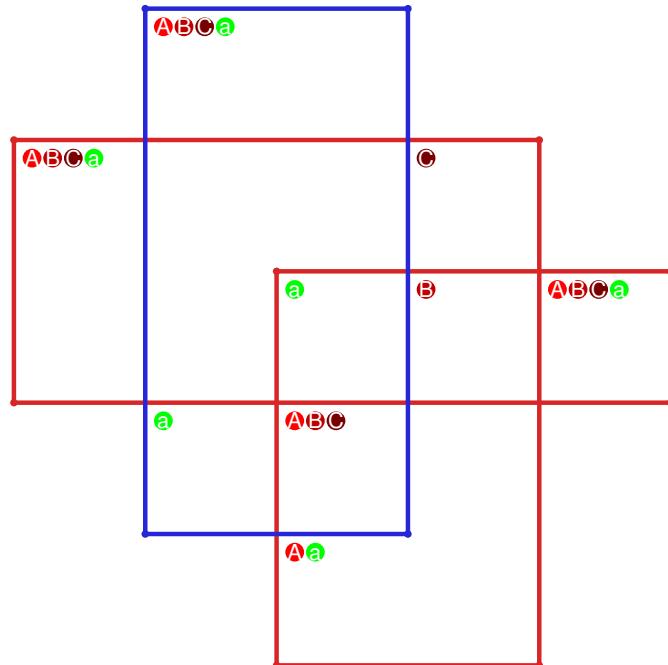


Figure 581: SnapPy multiloop plot.

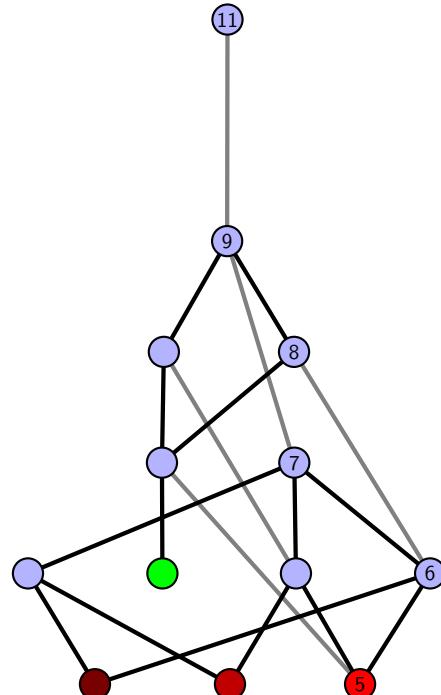


Figure 582: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.192 `[[18, 5, 1, 6], [6, 11, 7, 12], [12, 17, 13, 18], [13, 4, 14, 5], [1, 10, 2, 11], [7, 16, 8, 17], [3, 14, 4, 15], [9, 2, 10, 3], [15, 8, 16, 9]]`

PD code drawn by `SnapPy`: `[(7, 18, 8, 1), (11, 2, 12, 3), (16, 3, 17, 4), (13, 6, 14, 7), (17, 8, 18, 9), (4, 9, 5, 10), (1, 12, 2, 13), (5, 14, 6, 15), (10, 15, 11, 16)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 7, 1], [1, 8, 8, 2], [3, 8, 7, 3], [4, 6, 8, 4], [5, 7, 6, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.38

Total pinning sets: 144

Average overall degree: 2.97

Pinning number: 4

Table 290: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	7	21	39	41	25	8	1	142
Average degree	2.25	2.57	2.77	2.92	3.05	3.15	3.23	3.27	

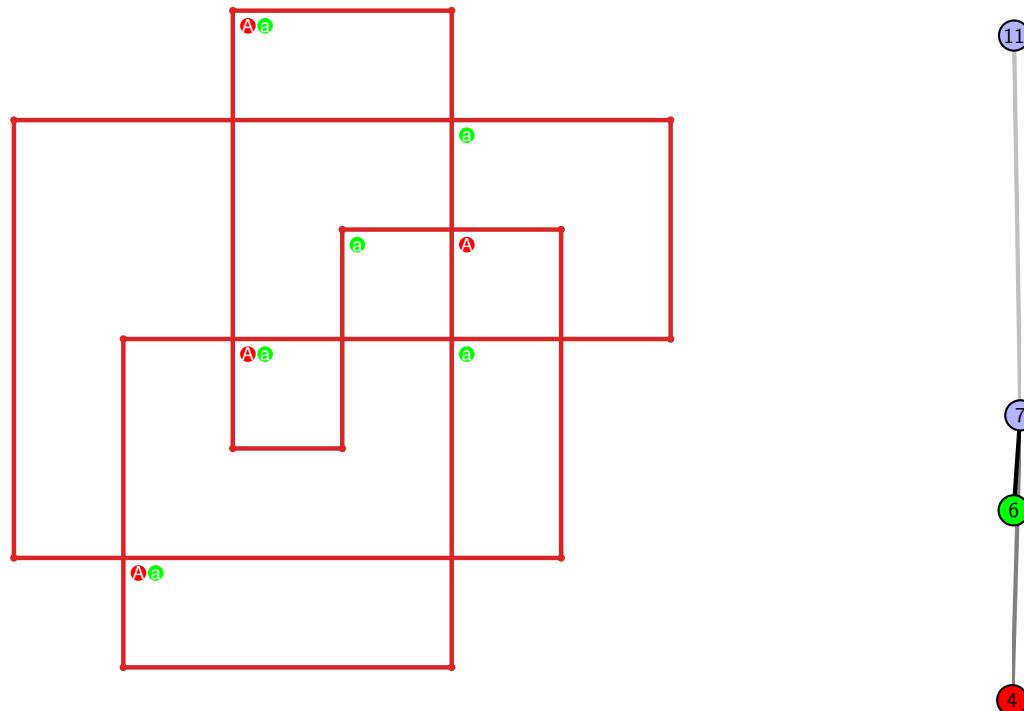


Figure 583: `SnapPy` multiloop plot.

Figure 584: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.193 $[[7, 12, 8, 1], [6, 18, 7, 13], [11, 4, 12, 5], [8, 4, 9, 3], [1, 14, 2, 13], [17, 5, 18, 6], [10, 16, 11, 17], [9, 16, 10, 15], [2, 14, 3, 15]]$

PD code drawn by SnapPy: $[(1, 6, 2, 7), (9, 2, 10, 3), (16, 3, 17, 4), (5, 10, 6, 11), (14, 7, 15, 8), (8, 15, 9, 16), (4, 17, 5, 18), (18, 11, 13, 12), (12, 13, 1, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 8, 8, 1], [1, 6, 2, 1], [2, 5, 7, 7], [3, 6, 6, 8], [3, 7, 4, 4]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 8
 Total pinning sets: 168
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.6
 Average overall degree: 3.01

Table 291: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	5
Nonminimal pinning sets	0	18	52	53	28	8	1	160
Average degree	2.6	2.76	2.95	3.08	3.17	3.23	3.27	

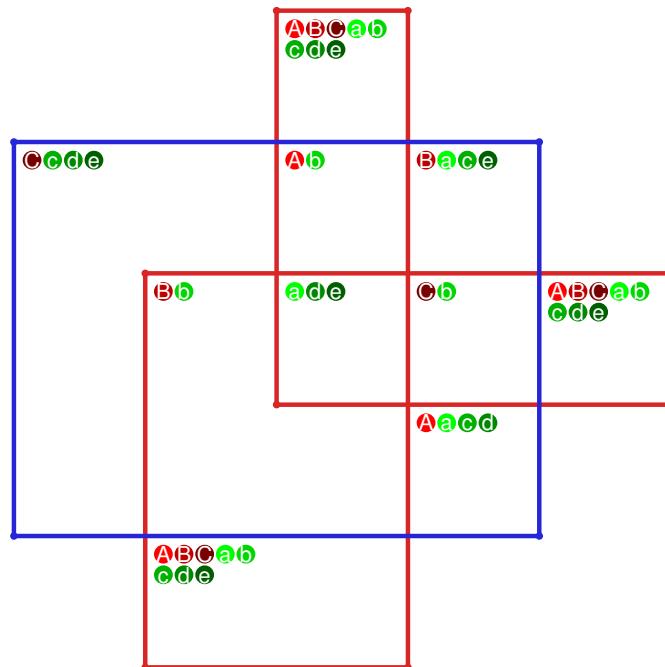


Figure 585: SnapPy multiloop plot.

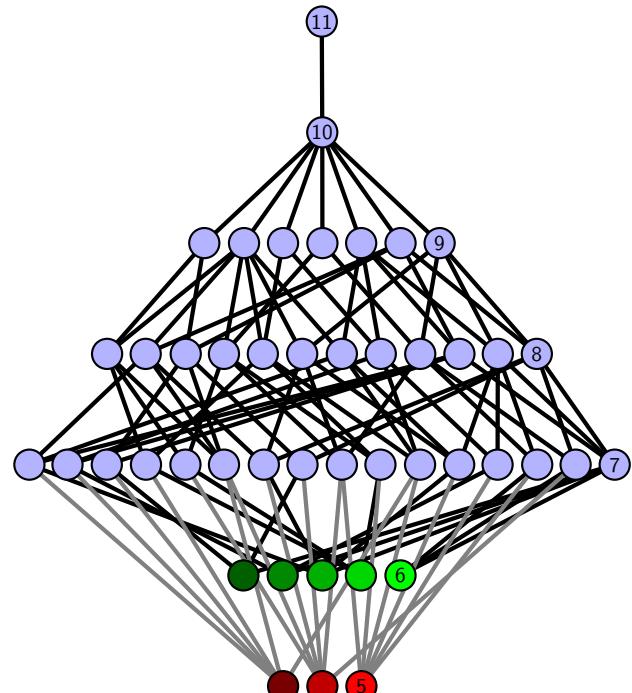


Figure 586: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.194 [[5, 14, 6, 1], [4, 18, 5, 15], [13, 6, 14, 7], [1, 16, 2, 15], [10, 3, 11, 4], [11, 17, 12, 18], [7, 12, 8, 13], [16, 8, 17, 9], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (11, 4, 12, 5), (17, 6, 18, 7), (14, 7, 1, 8), (5, 10, 6, 11), (3, 12, 4, 13), (9, 18, 10, 15), (2, 15, 3, 16), (16, 13, 17, 14)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 7, 8, 1], [1, 8, 8, 5], [1, 4, 7, 6], [2, 5, 7, 2], [3, 6, 5, 8], [3, 7, 4, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.43

Total pinning sets: 208

Average overall degree: 2.98

Pinning number: 4

Table 292: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	13	40	61	54	28	8	1	205
Average degree	2.25	2.6	2.83	2.98	3.09	3.17	3.23	3.27	

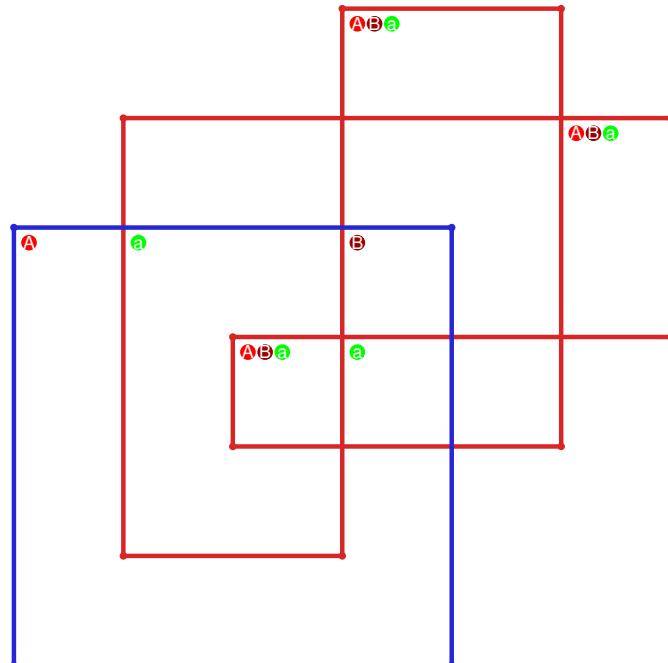


Figure 587: SnapPy multiloop plot.

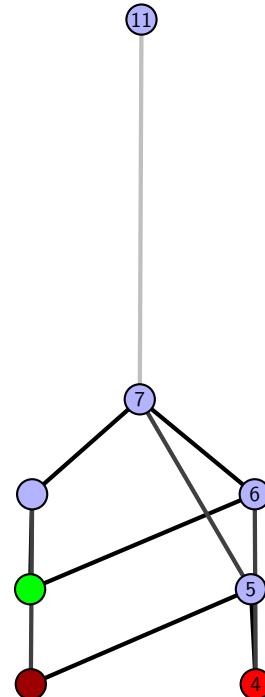


Figure 588: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.195 $[[5, 18, 6, 1], [13, 4, 14, 5], [17, 6, 18, 7], [1, 12, 2, 13], [3, 8, 4, 9], [14, 8, 15, 7], [11, 16, 12, 17], [2, 10, 3, 9], [15, 10, 16, 11]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (14, 3, 15, 4), (4, 11, 5, 12), (18, 5, 1, 6), (6, 17, 7, 18), (12, 7, 13, 8), (16, 9, 17, 10), (8, 13, 9, 14), (2, 15, 3, 16)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 6, 7, 1], [1, 7, 7, 5], [1, 4, 8, 2], [2, 8, 8, 3], [3, 8, 4, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 240
 Pinning number: 4

Average optimal degree: 2.38
 Average minimal degree: 2.38
 Average overall degree: 2.98

Table 293: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.38	2.67	2.87	3.0	3.09	3.17	3.22	3.27	

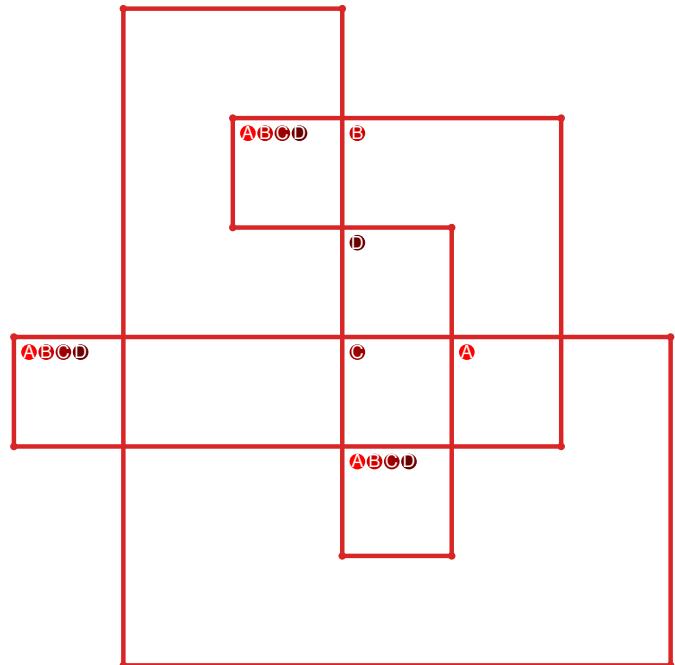


Figure 589: SnapPy multiloop plot.

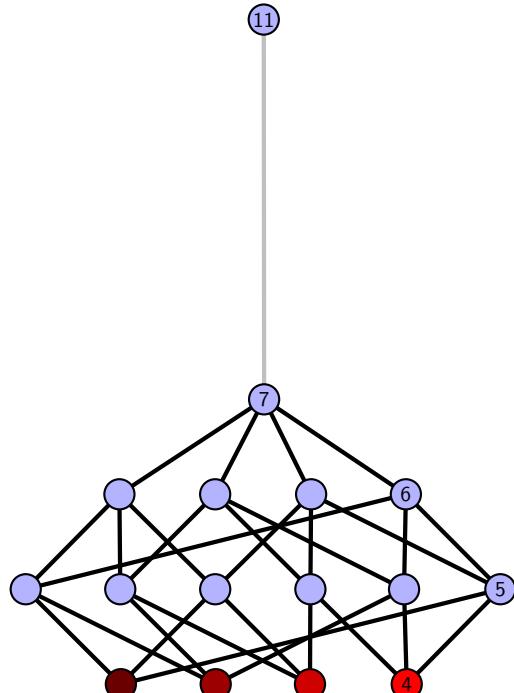


Figure 590: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.196 $[[5, 18, 6, 1], [4, 9, 5, 10], [17, 6, 18, 7], [1, 11, 2, 10], [3, 14, 4, 15], [8, 13, 9, 14], [7, 13, 8, 12], [16, 11, 17, 12], [2, 16, 3, 15]]$

PD code drawn by `SnapPy`: $[(14, 3, 15, 4), (1, 6, 2, 7), (7, 16, 8, 17), (13, 8, 14, 9), (9, 4, 10, 5), (5, 10, 6, 11), (18, 11, 1, 12), (12, 17, 13, 18), (2, 15, 3, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 7, 8, 1], [1, 8, 8, 5], [1, 4, 6, 6], [2, 5, 5, 7], [2, 6, 8, 3], [3, 7, 4, 4]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 8
 Total pinning sets: 188
 Pinning number: 5

Average optimal degree: 2.53
 Average minimal degree: 2.65
 Average overall degree: 3.0

Table 294: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	30	59	54	28	8	1	180
Average degree	2.53	2.79	2.97	3.09	3.17	3.23	3.27	

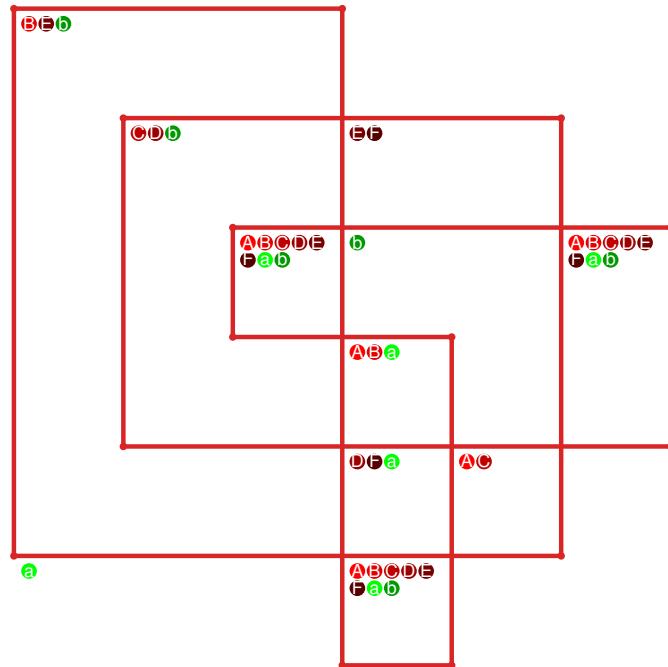


Figure 591: `SnapPy` multiloop plot.

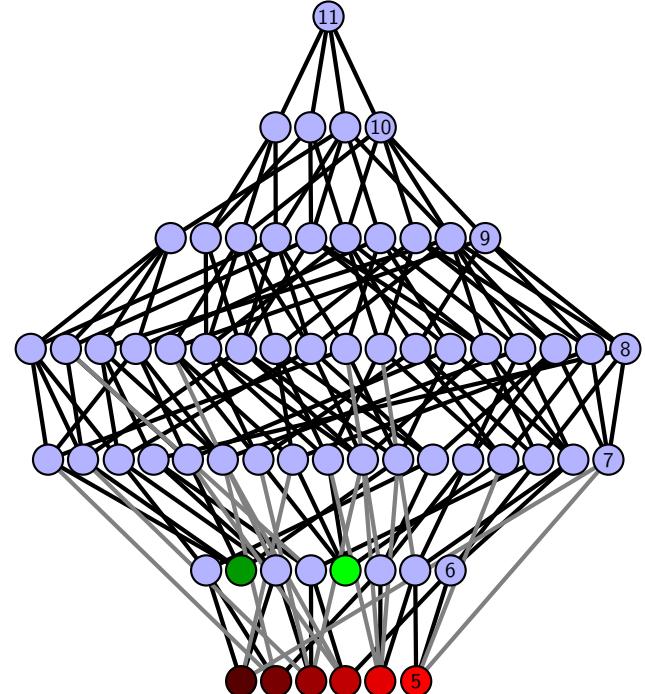


Figure 592: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.197 $[[7, 14, 8, 1], [6, 18, 7, 15], [13, 17, 14, 18], [8, 2, 9, 1], [15, 3, 16, 4], [12, 5, 13, 6], [16, 10, 17, 11], [2, 10, 3, 9], [4, 11, 5, 12]]$

PD code drawn by SnapPy: $[(15, 14, 16, 1), (9, 2, 10, 3), (6, 13, 7, 14), (16, 7, 17, 8), (1, 8, 2, 9), (4, 11, 5, 12), (12, 5, 13, 6), (10, 17, 11, 18), (3, 18, 4, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 0], [1, 7, 6, 8], [1, 8, 8, 2], [2, 8, 4, 7], [3, 6, 4, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 132
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.51
 Average overall degree: 2.98

Table 295: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	1
Nonminimal pinning sets	0	16	35	42	26	8	1	128
Average degree	2.4	2.69	2.89	3.04	3.15	3.23	3.27	

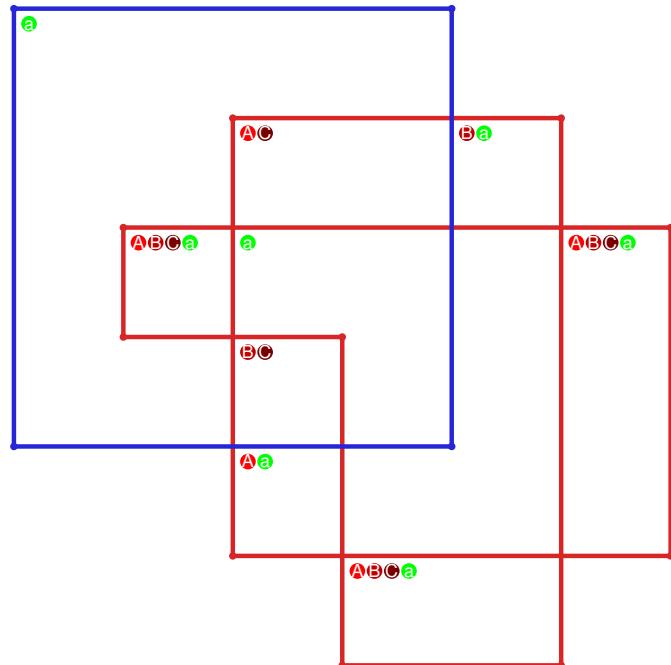


Figure 593: SnapPy multiloop plot.

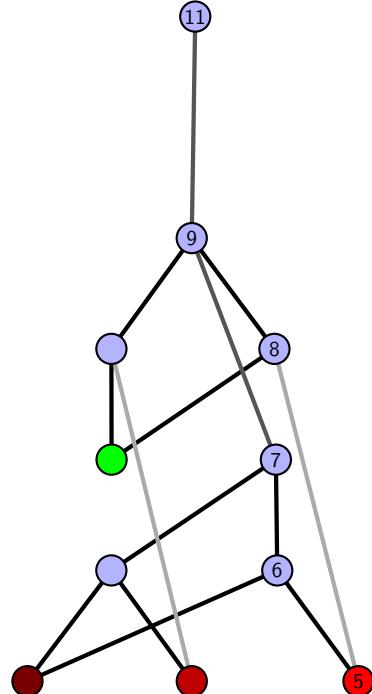


Figure 594: Minimal join sub-semi-lattice of minimal pinning sets.

4.8.198 $[[6, 18, 1, 7], [7, 12, 8, 13], [13, 5, 14, 6], [17, 1, 18, 2], [11, 16, 12, 17], [8, 4, 9, 5], [14, 3, 15, 2], [15, 10, 16, 11], [3, 9, 4, 10]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (12, 1, 13, 2), (16, 3, 17, 4), (4, 13, 5, 14), (5, 8, 6, 9), (14, 9, 15, 10), (18, 11, 7, 12), (10, 15, 11, 16), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 4, 0], [1, 3, 7, 7], [1, 8, 8, 2], [2, 8, 7, 3], [4, 6, 8, 4], [5, 7, 6, 5]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 168
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 2.99

Table 296: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	27	50	49	27	8	1	162
Average degree	2.5	2.77	2.95	3.07	3.16	3.23	3.27	

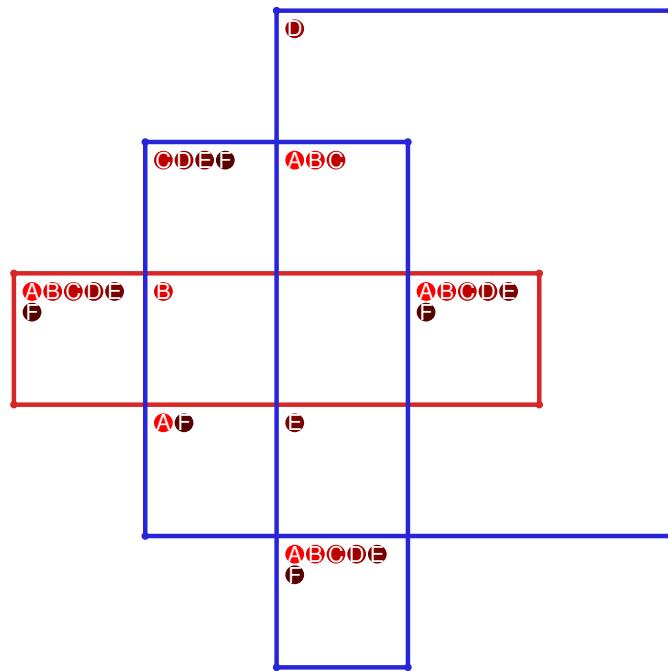


Figure 595: SnapPy multiloop plot.

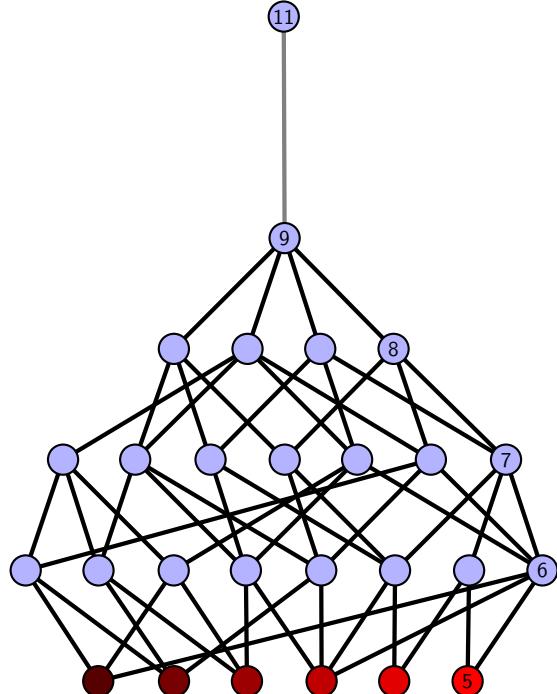


Figure 596: Minimal join sub-semi-lattice of minimal pinning sets.

4.9 12 regions

4.9.1 $[[10, 20, 1, 11], [11, 9, 12, 10], [19, 1, 20, 2], [8, 12, 9, 13], [2, 18, 3, 19], [13, 7, 14, 8], [17, 3, 18, 4], [6, 14, 7, 15], [4, 16, 5, 17], [15, 5, 16, 6]]$

PD code drawn by SnapPy: $[(20, 1, 11, 2), (18, 3, 19, 4), (16, 5, 17, 6), (14, 7, 15, 8), (12, 9, 13, 10), (6, 15, 7, 16), (4, 17, 5, 18), (2, 19, 3, 20), (10, 11, 1, 12), (8, 13, 9, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 6, 2], [3, 7, 7, 3], [4, 8, 8, 4], [5, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 4

Average overall degree: 2.7

Pinning number: 10

Table 297: Pinning sets/average degree by cardinal

Cardinal	10	11	12	Total
Optimal pinning sets	1	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0
Nonminimal pinning sets	0	2	1	3
Average degree	2.0	2.73	3.33	

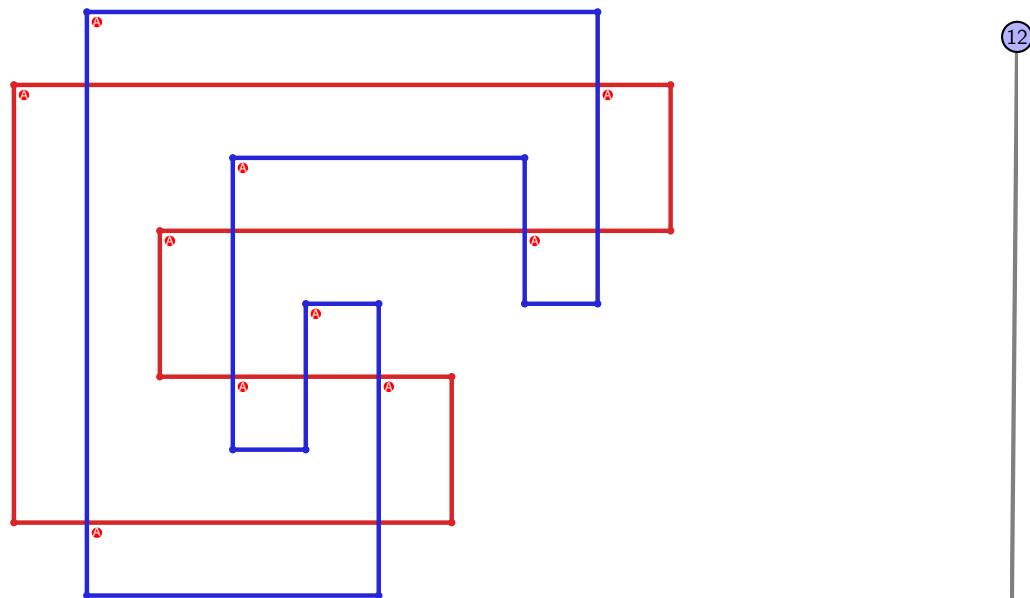


Figure 597: SnapPy multiloop plot.



Figure 598: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.2 $[[20, 9, 1, 10], [10, 19, 11, 20], [11, 8, 12, 9], [1, 18, 2, 19], [7, 12, 8, 13], [17, 2, 18, 3], [13, 6, 14, 7], [3, 16, 4, 17], [5, 14, 6, 15], [15, 4, 16, 5]]$

PD code drawn by `SnapPy`: $[(12, 1, 13, 2), (10, 3, 11, 4), (8, 5, 9, 6), (17, 6, 18, 7), (4, 9, 5, 10), (2, 11, 3, 12), (20, 13, 1, 14), (18, 15, 19, 16), (7, 16, 8, 17), (14, 19, 15, 20)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 5, 1], [2, 6, 6, 2], [3, 7, 7, 3], [4, 8, 8, 4], [5, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.77

Pinning number: 8

Table 298: Pinning sets/average degree by cardinal

Cardinal	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.44	2.8	3.09	3.33	

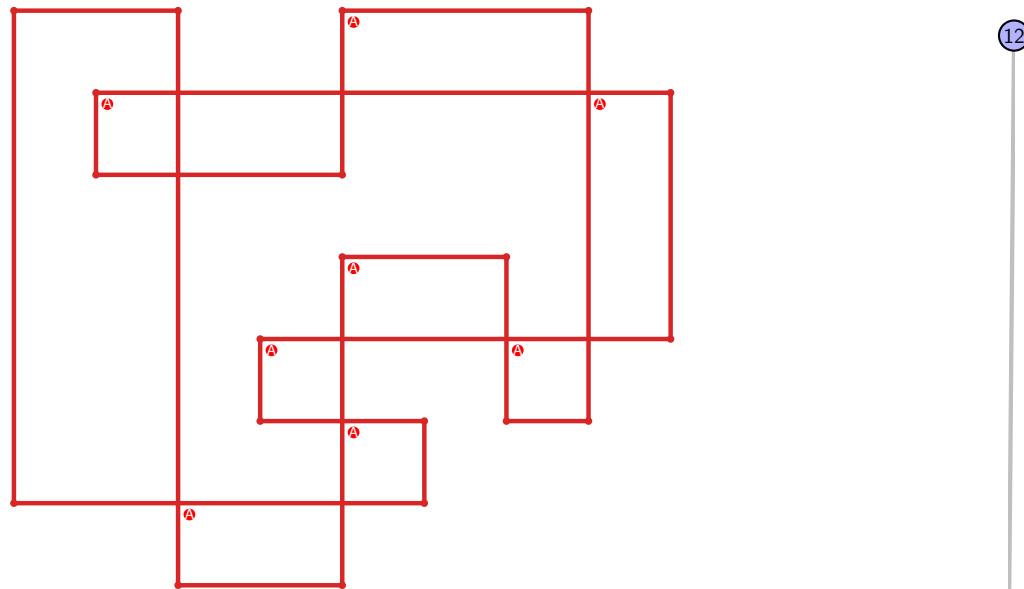


Figure 599: `SnapPy` multiloop plot.

Figure 600: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.3 [[10, 20, 1, 11], [11, 9, 12, 10], [19, 1, 20, 2], [8, 12, 9, 13], [2, 18, 3, 19], [13, 5, 14, 6], [15, 7, 16, 8], [17, 3, 18, 4], [4, 16, 5, 17], [14, 7, 15, 6]]

PD code drawn by `SnapPy`: [(18, 1, 19, 2), (2, 19, 3, 20), (20, 3, 11, 4), (16, 5, 17, 6), (14, 7, 15, 8), (12, 9, 13, 10), (10, 11, 1, 12), (8, 13, 9, 14), (6, 15, 7, 16), (4, 17, 5, 18)]

Planar representation generated by `plantri`: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 7, 7, 2], [3, 8, 9, 9], [3, 9, 9, 8], [4, 8, 8, 4], [5, 7, 7, 6], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.77

Pinning number: 8

Table 299: Pinning sets/average degree by cardinal

Cardinal	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.44	2.8	3.09	3.33	

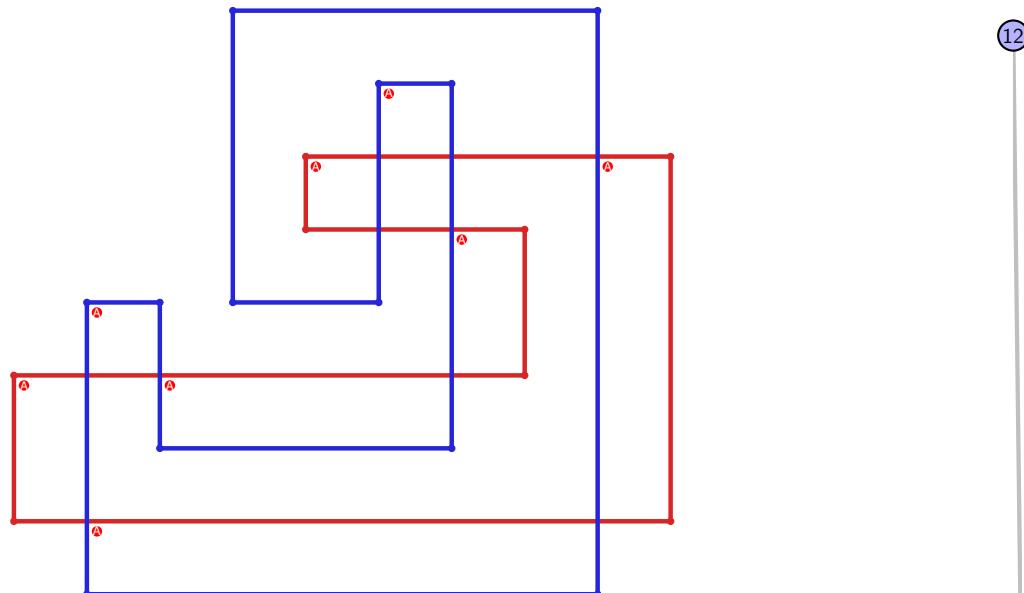


Figure 601: `SnapPy` multiloop plot.



Figure 602: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.4 [[20, 13, 1, 14], [14, 10, 15, 9], [19, 4, 20, 5], [12, 1, 13, 2], [10, 3, 11, 4], [15, 8, 16, 9], [5, 18, 6, 19], [2, 11, 3, 12], [7, 16, 8, 17], [17, 6, 18, 7]]

PD code drawn by `SnapPy`: [(7, 20, 8, 1), (16, 1, 17, 2), (14, 3, 15, 4), (12, 5, 13, 6), (6, 11, 7, 12), (19, 8, 20, 9), (17, 10, 18, 11), (4, 13, 5, 14), (2, 15, 3, 16), (9, 18, 10, 19)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 4], [0, 7, 7, 0], [1, 7, 7, 2], [1, 8, 8, 1], [2, 9, 9, 2], [3, 4, 4, 3], [5, 9, 9, 5], [6, 8, 8, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.77

Pinning number: 8

Table 300: Pinning sets/average degree by cardinal

Cardinal	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.44	2.8	3.09	3.33	

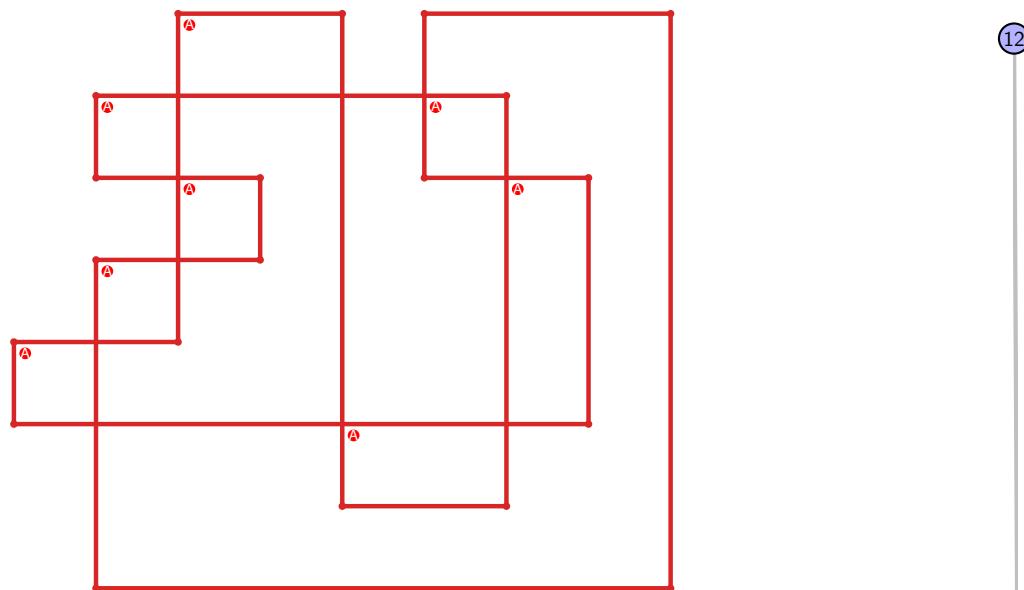


Figure 603: `SnapPy` multiloop plot.



Figure 604: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.5 $[[10, 20, 1, 11], [11, 5, 12, 6], [15, 9, 16, 10], [19, 1, 20, 2], [4, 16, 5, 17], [12, 7, 13, 6], [8, 14, 9, 15], [2, 18, 3, 19], [17, 3, 18, 4], [7, 14, 8, 13]]$

PD code drawn by `SnapPy`: $[(20, 1, 11, 2), (14, 3, 15, 4), (4, 15, 5, 16), (18, 7, 19, 8), (12, 9, 13, 10), (2, 19, 3, 20), (10, 11, 1, 12), (8, 13, 9, 14), (16, 5, 17, 6), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 4], [0, 7, 7, 0], [1, 8, 8, 2], [1, 9, 9, 1], [2, 9, 9, 2], [3, 8, 8, 3], [4, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 16

Average overall degree: 2.77

Pinning number: 8

Table 301: Pinning sets/average degree by cardinal

Cardinal	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	4	6	4	1	15
Average degree	2.0	2.44	2.8	3.09	3.33	

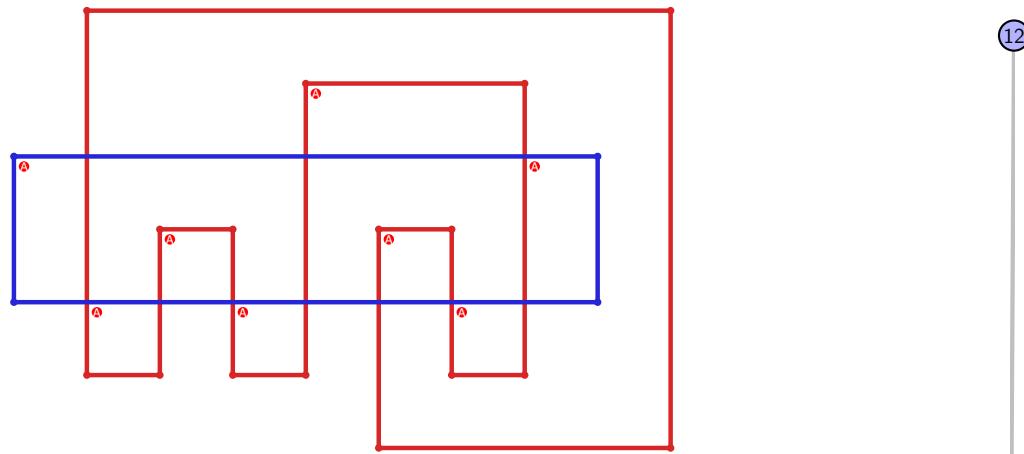


Figure 605: `SnapPy` multiloop plot.



Figure 606: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.6 [[10, 20, 1, 11], [11, 19, 12, 18], [9, 2, 10, 3], [19, 1, 20, 2], [12, 9, 13, 8], [17, 3, 18, 4], [13, 7, 14, 8], [4, 16, 5, 17], [6, 14, 7, 15], [15, 5, 16, 6]]

PD code drawn by `SnapPy`: [(20, 1, 11, 2), (18, 3, 19, 4), (4, 17, 5, 18), (14, 7, 15, 8), (5, 8, 6, 9), (12, 9, 13, 10), (10, 11, 1, 12), (13, 16, 14, 17), (6, 15, 7, 16), (2, 19, 3, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 6], [1, 7, 7, 2], [4, 8, 8, 4], [5, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 1
Total pinning sets: 64
Pinning number: 6

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.85

Table 302: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

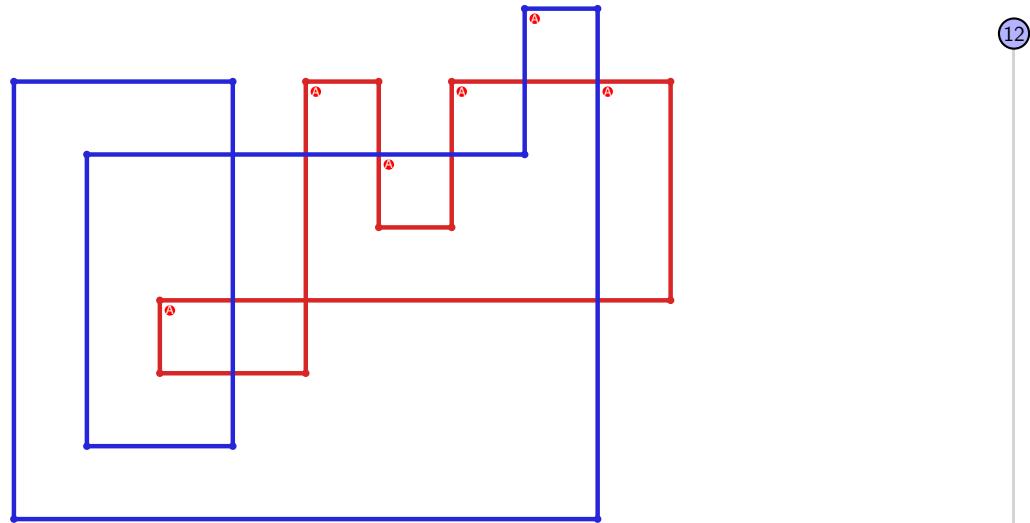


Figure 607: `SnapPy` multiloop plot.



Figure 608: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.7 $[[12, 20, 1, 13], [13, 19, 14, 18], [11, 2, 12, 3], [19, 1, 20, 2], [14, 9, 15, 8], [17, 5, 18, 6], [3, 10, 4, 11], [9, 4, 10, 5], [15, 7, 16, 8], [6, 16, 7, 17]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (13, 2, 14, 3), (19, 4, 20, 5), (5, 18, 6, 19), (12, 7, 1, 8), (15, 10, 16, 11), (8, 11, 9, 12), (3, 20, 4, 13), (14, 17, 15, 18), (9, 16, 10, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 3], [0, 2, 1, 0], [1, 7, 8, 8], [1, 9, 9, 7], [2, 7, 7, 2], [4, 6, 6, 5], [4, 9, 9, 4], [5, 8, 8, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 64
Pinning number: 6

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.85

Table 303: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

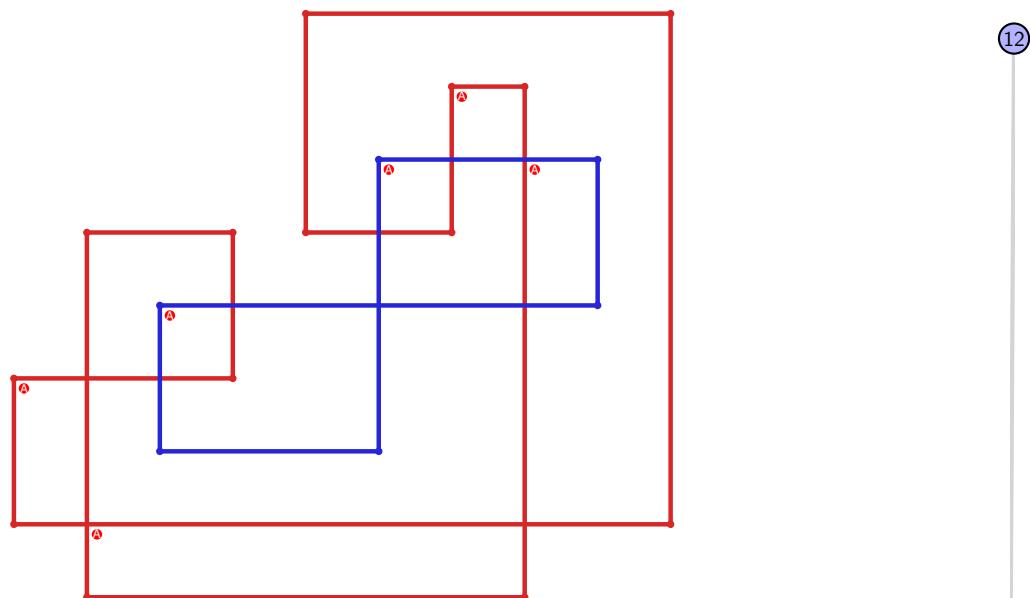


Figure 609: SnapPy multiloop plot.

6

Figure 610: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.8 [[20, 11, 1, 12], [12, 10, 13, 9], [19, 2, 20, 3], [10, 1, 11, 2], [13, 4, 14, 5], [17, 8, 18, 9], [3, 18, 4, 19], [14, 6, 15, 5], [7, 16, 8, 17], [6, 16, 7, 15]]

PD code drawn by `SnapPy`: [(17, 20, 18, 1), (11, 2, 12, 3), (3, 12, 4, 13), (15, 6, 16, 7), (7, 10, 8, 11), (18, 9, 19, 10), (13, 4, 14, 5), (5, 14, 6, 15), (1, 16, 2, 17), (8, 19, 9, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 3], [0, 2, 1, 0], [1, 6, 7, 7], [1, 8, 8, 6], [2, 5, 4, 2], [4, 9, 9, 4], [5, 9, 9, 5], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 304: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

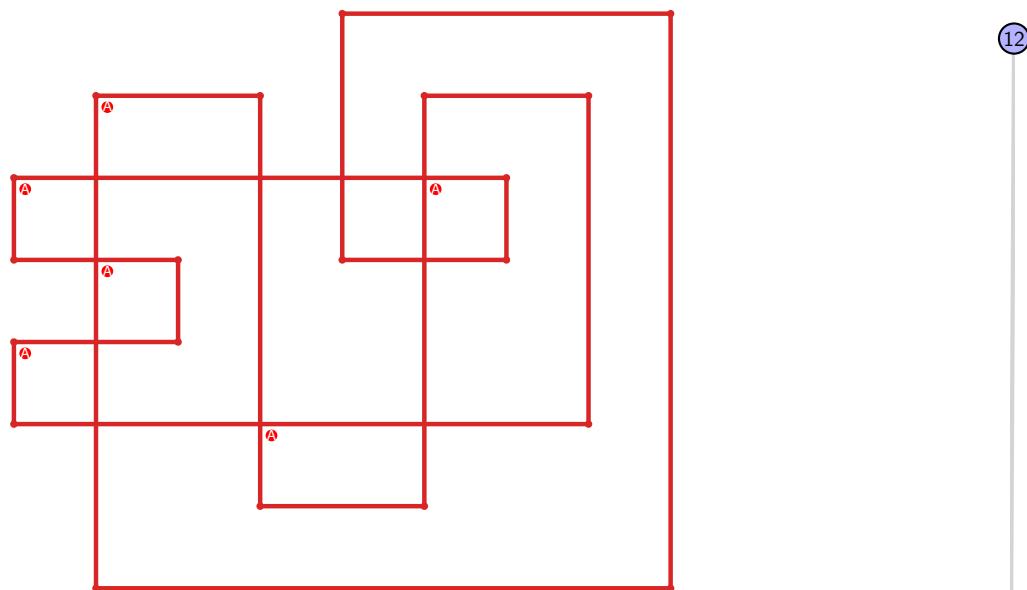


Figure 611: `SnapPy` multiloop plot.

Figure 612: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.9 $[[3, 10, 4, 1], [2, 20, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [12, 19, 13, 20], [5, 18, 6, 17], [8, 14, 9, 15], [18, 13, 19, 14], [6, 16, 7, 17], [15, 7, 16, 8]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (16, 5, 17, 6), (1, 8, 2, 9), (19, 14, 20, 15), (6, 15, 7, 16), (4, 17, 5, 18), (18, 3, 19, 4), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 7, 8, 8], [2, 9, 9, 7], [4, 6, 5, 4], [5, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 64
 Pinning number: 6

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.85

Table 305: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

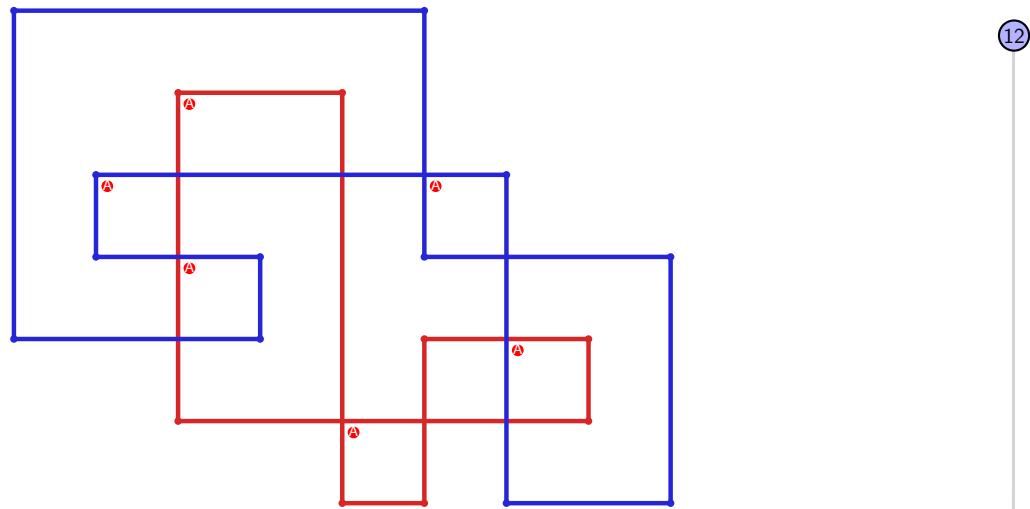


Figure 613: SnapPy multiloop plot.



Figure 614: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.10 $[[3, 20, 4, 1], [2, 13, 3, 14], [19, 6, 20, 7], [4, 11, 5, 12], [1, 15, 2, 14], [15, 12, 16, 13], [7, 18, 8, 19], [10, 5, 11, 6], [16, 10, 17, 9], [17, 8, 18, 9]]$

PD code drawn by `SnapPy`: $[(8, 3, 9, 4), (17, 4, 18, 5), (15, 6, 16, 7), (7, 14, 8, 15), (2, 9, 3, 10), (13, 10, 14, 11), (20, 11, 1, 12), (12, 19, 13, 20), (5, 16, 6, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 7, 5], [0, 5, 1, 1], [1, 4, 3, 8], [2, 9, 9, 2], [2, 8, 3, 3], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 306: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

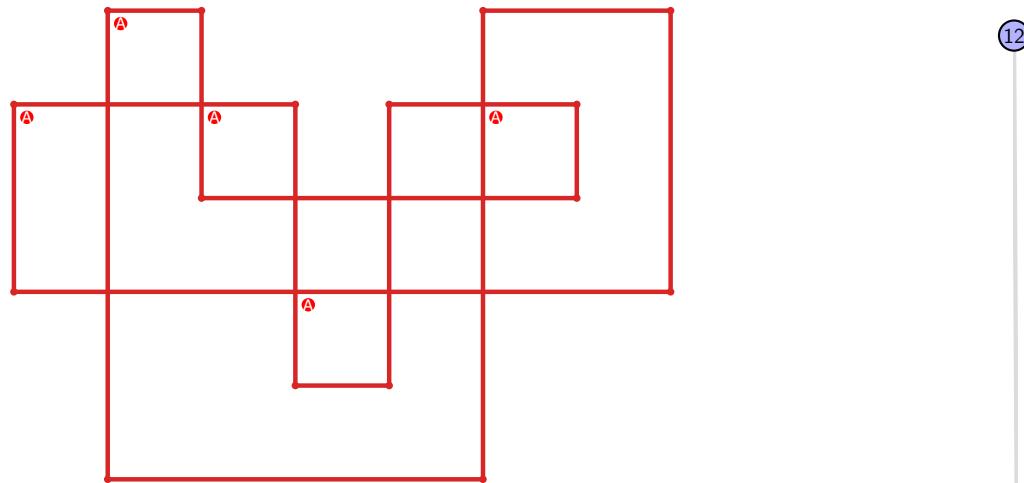


Figure 615: `SnapPy` multiloop plot.

5

Figure 616: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.11 $[[3, 20, 4, 1], [2, 11, 3, 12], [19, 4, 20, 5], [1, 13, 2, 12], [13, 10, 14, 11], [5, 16, 6, 17], [9, 18, 10, 19], [14, 8, 15, 7], [15, 6, 16, 7], [17, 8, 18, 9]]$

PD code drawn by SnapPy: $[(17, 2, 18, 3), (13, 4, 14, 5), (5, 12, 6, 13), (15, 6, 16, 7), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (3, 14, 4, 15), (7, 16, 8, 17), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 8, 8, 9], [2, 9, 9, 4], [4, 9, 8, 8], [5, 7, 7, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 307: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

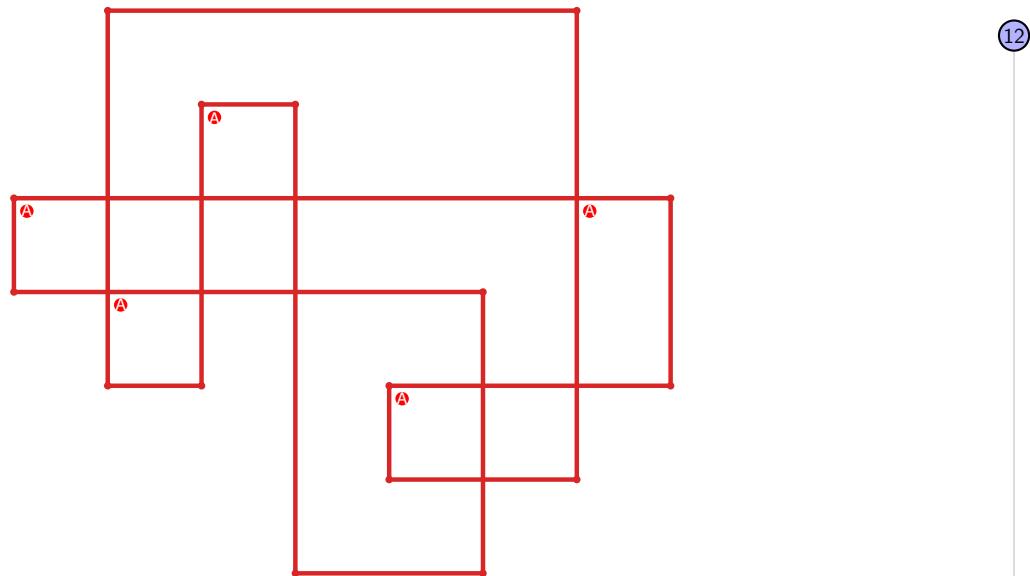


Figure 617: SnapPy multiloop plot.

Figure 618: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.12 $[[16, 20, 1, 17], [17, 11, 18, 12], [15, 4, 16, 5], [19, 1, 20, 2], [10, 18, 11, 19], [12, 10, 13, 9], [5, 14, 6, 15], [6, 3, 7, 4], [2, 7, 3, 8], [13, 8, 14, 9]]$

PD code drawn by `SnapPy`: $[(11, 16, 12, 1), (14, 3, 15, 4), (9, 4, 10, 5), (5, 8, 6, 9), (20, 7, 17, 8), (1, 10, 2, 11), (18, 13, 19, 14), (2, 15, 3, 16), (6, 17, 7, 18), (12, 19, 13, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 4, 0], [1, 3, 5, 1], [1, 4, 9, 9], [2, 9, 7, 2], [2, 6, 8, 8], [3, 7, 7, 9], [5, 8, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 308: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

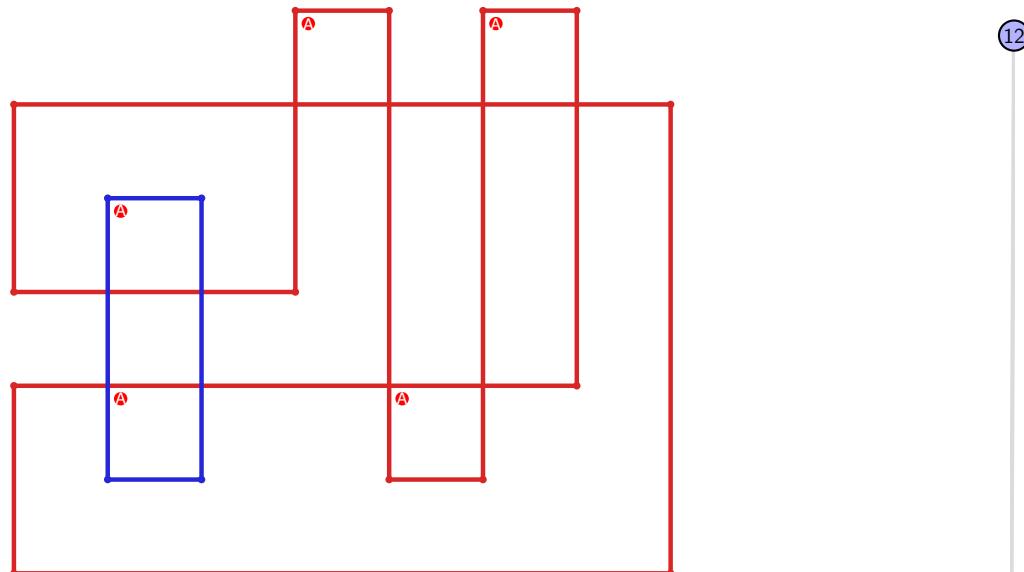


Figure 619: `SnapPy` multiloop plot.



Figure 620: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.13 $[[4, 20, 1, 5], [5, 3, 6, 4], [19, 12, 20, 13], [1, 9, 2, 10], [10, 2, 11, 3], [6, 16, 7, 15], [13, 18, 14, 19], [8, 11, 9, 12], [16, 8, 17, 7], [17, 14, 18, 15]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (16, 1, 17, 2), (18, 11, 19, 12), (3, 20, 4, 5), (19, 6, 20, 7), (14, 7, 15, 8), (12, 9, 13, 10), (10, 17, 11, 18), (8, 13, 9, 14), (2, 15, 3, 16)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 7, 4, 4], [1, 3, 3, 7], [1, 8, 8, 9], [2, 9, 9, 2], [2, 8, 4, 3], [5, 7, 9, 5], [5, 8, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 309: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

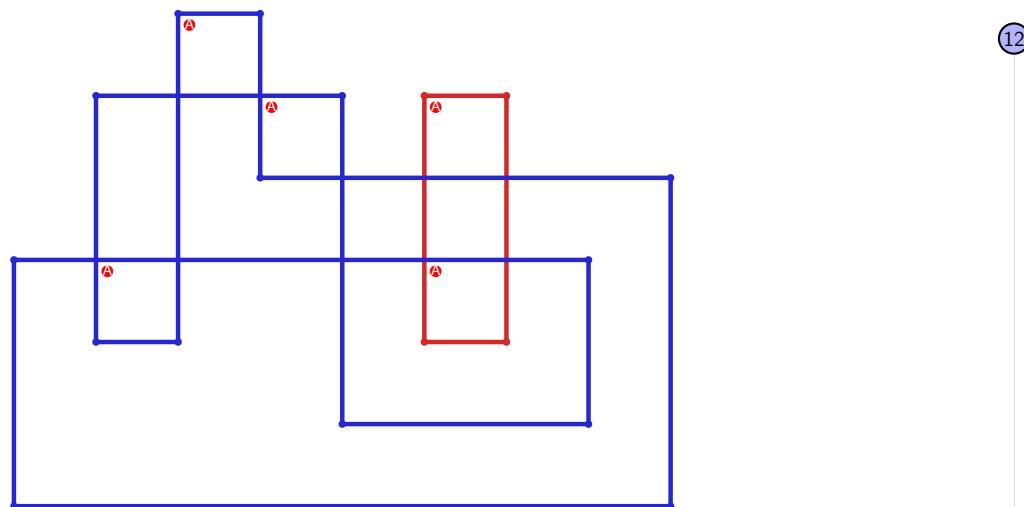


Figure 621: `SnapPy` multiloop plot.

5

Figure 622: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.14 $[[5, 20, 6, 1], [19, 4, 20, 5], [6, 11, 7, 12], [1, 15, 2, 14], [3, 18, 4, 19], [10, 7, 11, 8], [12, 16, 13, 15], [2, 13, 3, 14], [17, 8, 18, 9], [9, 16, 10, 17]]$

PD code drawn by SnapPy: $[(17, 2, 18, 3), (8, 5, 9, 6), (15, 6, 16, 7), (4, 9, 5, 10), (20, 11, 1, 12), (12, 19, 13, 20), (13, 10, 14, 11), (7, 14, 8, 15), (1, 16, 2, 17), (3, 18, 4, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 6], [0, 6, 7, 7], [1, 7, 8, 1], [2, 8, 9, 2], [2, 9, 7, 3], [3, 6, 4, 3], [4, 9, 9, 5], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 310: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

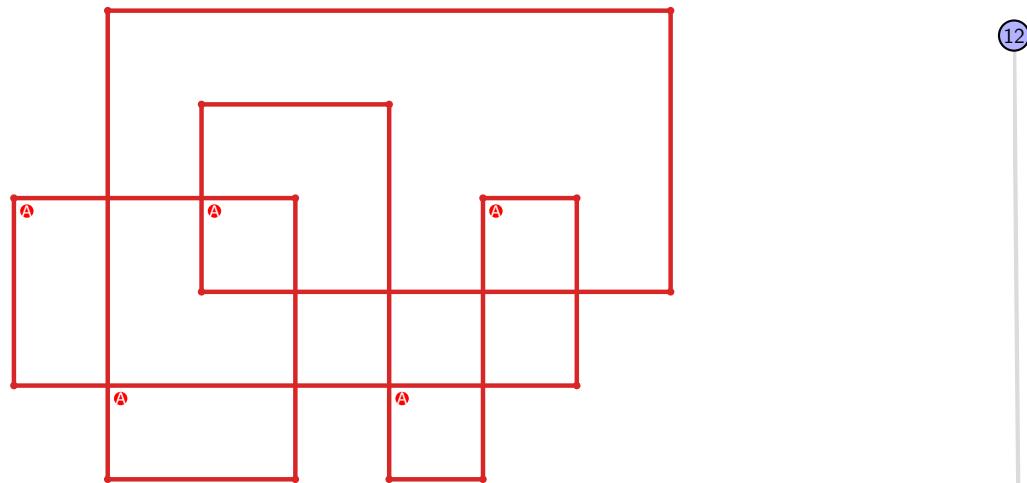


Figure 623: SnapPy multiloop plot.

5

Figure 624: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.15 $[[16, 20, 1, 17], [17, 9, 18, 10], [15, 4, 16, 5], [19, 1, 20, 2], [8, 18, 9, 19], [10, 8, 11, 7], [5, 14, 6, 15], [3, 12, 4, 13], [2, 12, 3, 11], [13, 6, 14, 7]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (2, 5, 3, 6), (17, 4, 18, 5), (6, 13, 7, 14), (14, 7, 15, 8), (16, 9, 1, 10), (19, 12, 20, 13), (10, 15, 11, 16), (11, 20, 12, 17), (3, 18, 4, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 4, 0], [1, 3, 5, 1], [1, 4, 8, 9], [2, 9, 9, 2], [2, 9, 8, 8], [3, 7, 7, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 311: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

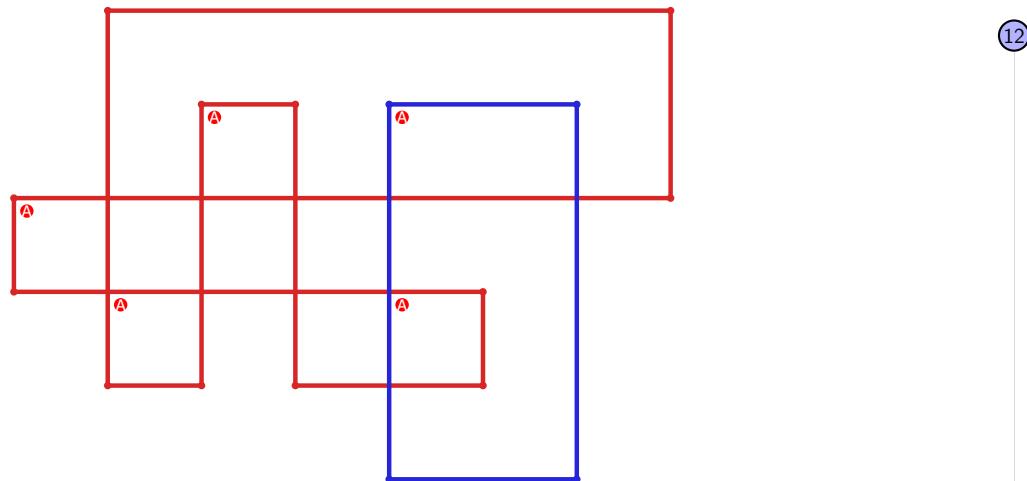


Figure 625: `SnapPy` multiloop plot.

(12)

5

Figure 626: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.16 $[[3, 20, 4, 1], [2, 15, 3, 16], [19, 8, 20, 9], [4, 11, 5, 12], [1, 17, 2, 16], [17, 14, 18, 15], [9, 18, 10, 19], [10, 7, 11, 8], [5, 13, 6, 12], [6, 13, 7, 14]]$

PD code drawn by `SnapPy`: $[(8, 5, 9, 6), (17, 6, 18, 7), (2, 9, 3, 10), (10, 3, 11, 4), (4, 11, 5, 12), (15, 12, 16, 13), (20, 13, 1, 14), (14, 19, 15, 20), (7, 16, 8, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 8], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 7, 2], [2, 6, 9, 3], [3, 9, 9, 3], [5, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 312: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

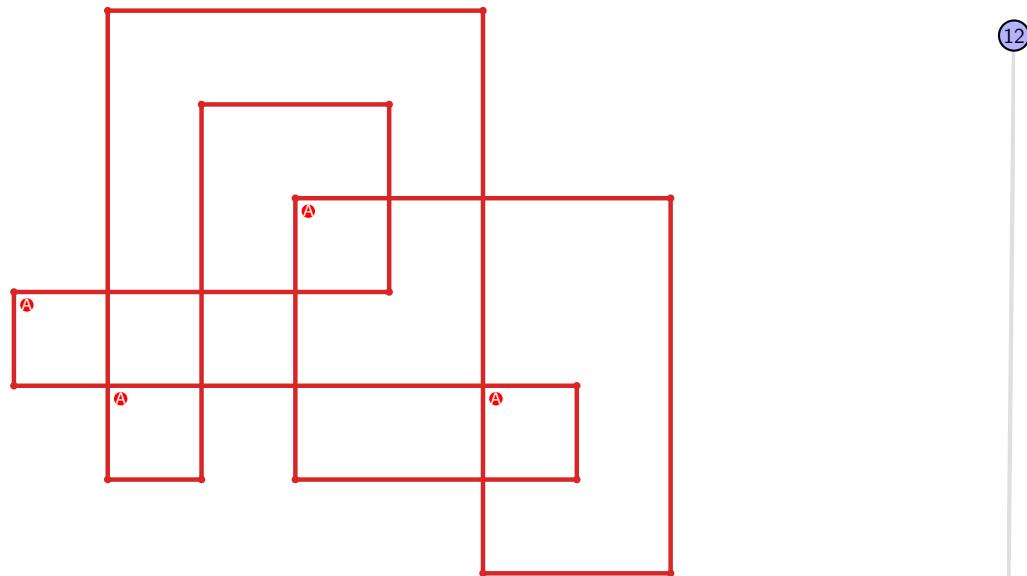


Figure 627: `SnapPy` multiloop plot.



Figure 628: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.17 $[[3, 10, 4, 1], [2, 14, 3, 11], [9, 20, 10, 15], [4, 17, 5, 18], [1, 12, 2, 11], [7, 13, 8, 14], [15, 8, 16, 9], [16, 19, 17, 20], [5, 19, 6, 18], [12, 6, 13, 7]]$

PD code drawn by `SnapPy`: $[(13, 4, 14, 5), (19, 6, 20, 7), (1, 8, 2, 9), (5, 14, 6, 11), (10, 11, 1, 12), (12, 9, 13, 10), (2, 15, 3, 16), (16, 3, 17, 4), (20, 17, 15, 18), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 8], [0, 9, 1, 1], [1, 9, 9, 6], [2, 5, 7, 2], [2, 6, 8, 3], [3, 7, 9, 3], [4, 8, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 313: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

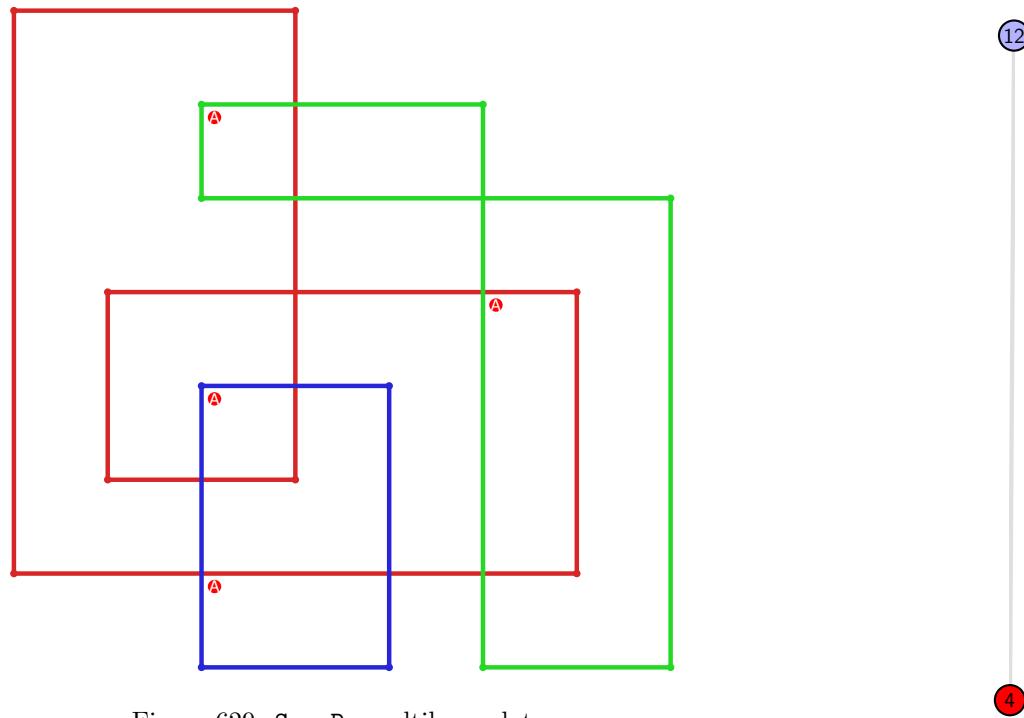


Figure 629: `SnapPy` multiloop plot.

Figure 630: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.18 $[[3, 12, 4, 1], [2, 7, 3, 8], [11, 20, 12, 13], [4, 18, 5, 17], [1, 9, 2, 8], [9, 6, 10, 7], [13, 10, 14, 11], [14, 19, 15, 20], [18, 15, 19, 16], [5, 16, 6, 17]]$

PD code drawn by SnapPy: $[(7, 4, 8, 5), (12, 5, 1, 6), (6, 11, 7, 12), (17, 8, 18, 9), (1, 10, 2, 11), (14, 19, 15, 20), (3, 20, 4, 13), (13, 2, 14, 3), (18, 15, 19, 16), (9, 16, 10, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 9, 9], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 7, 2], [2, 6, 8, 8], [3, 7, 7, 9], [3, 8, 5, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 314: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

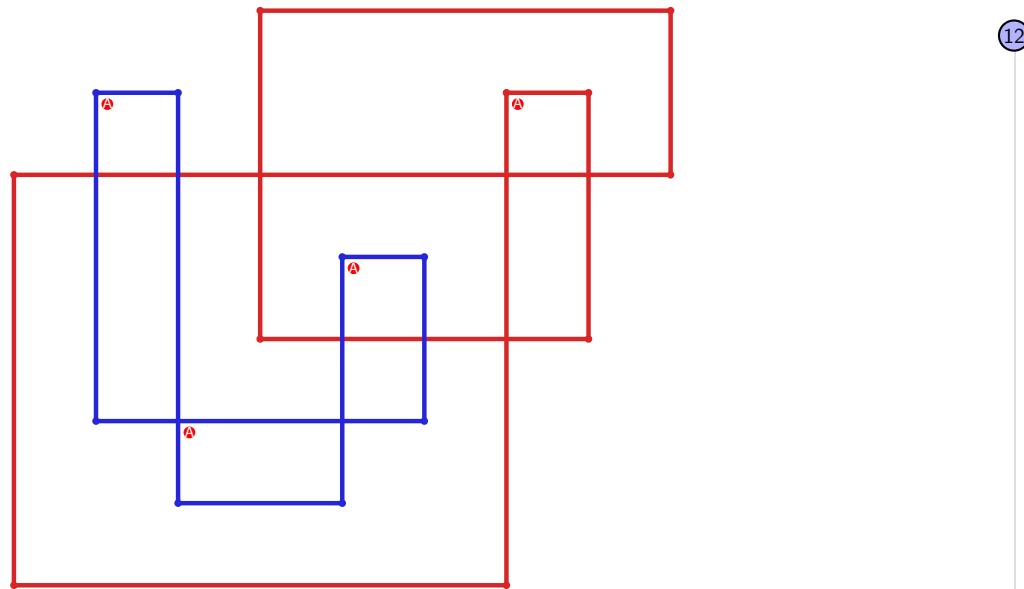


Figure 631: SnapPy multiloop plot.

4

Figure 632: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.19 $[[3, 14, 4, 1], [9, 2, 10, 3], [13, 20, 14, 15], [4, 17, 5, 18], [1, 8, 2, 9], [10, 8, 11, 7], [15, 12, 16, 13], [16, 19, 17, 20], [5, 19, 6, 18], [11, 6, 12, 7]]$

PD code drawn by `SnapPy`: $[(7, 14, 8, 1), (9, 4, 10, 5), (5, 8, 6, 9), (13, 6, 14, 7), (19, 10, 20, 11), (1, 12, 2, 13), (2, 15, 3, 16), (16, 3, 17, 4), (20, 17, 15, 18), (11, 18, 12, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 8], [0, 5, 1, 1], [1, 4, 9, 9], [2, 9, 7, 2], [2, 6, 8, 3], [3, 7, 9, 3], [5, 8, 6, 5]]$

Total optimal pinning sets: 4

Average optimal degree: 2.3

Total minimal pinning sets: 4

Average minimal degree: 2.3

Total pinning sets: 240

Average overall degree: 2.98

Pinning number: 5

Table 315: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.3	2.62	2.84	3.0	3.11	3.2	3.27	3.33	

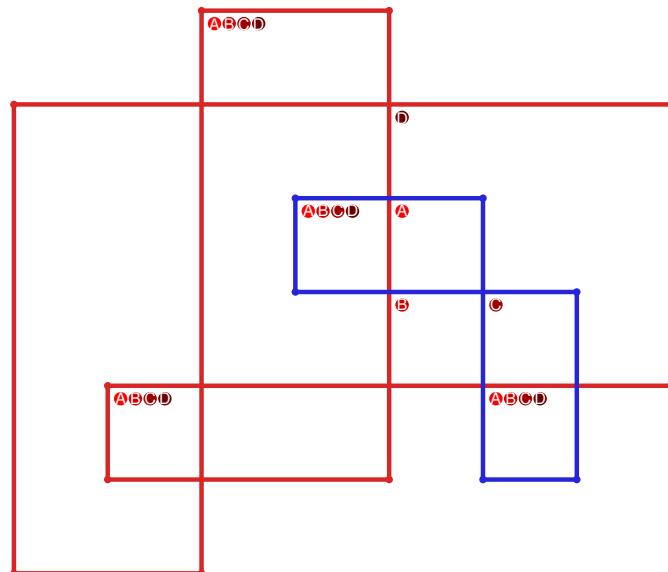


Figure 633: `SnapPy` multiloop plot.

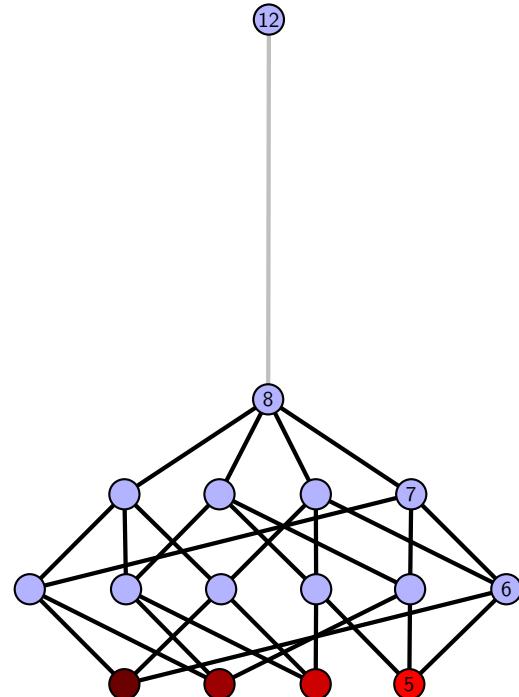


Figure 634: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.20 $[[3, 20, 4, 1], [2, 9, 3, 10], [19, 4, 20, 5], [1, 11, 2, 10], [11, 8, 12, 9], [5, 16, 6, 17], [18, 13, 19, 14], [7, 12, 8, 13], [15, 6, 16, 7], [17, 15, 18, 14]]$

PD code drawn by `SnapPy`: $[(17, 2, 18, 3), (13, 4, 14, 5), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (5, 10, 6, 11), (16, 11, 17, 12), (12, 15, 13, 16), (3, 14, 4, 15), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 8, 8, 9], [2, 9, 9, 7], [4, 6, 8, 4], [5, 7, 9, 5], [5, 8, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 316: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

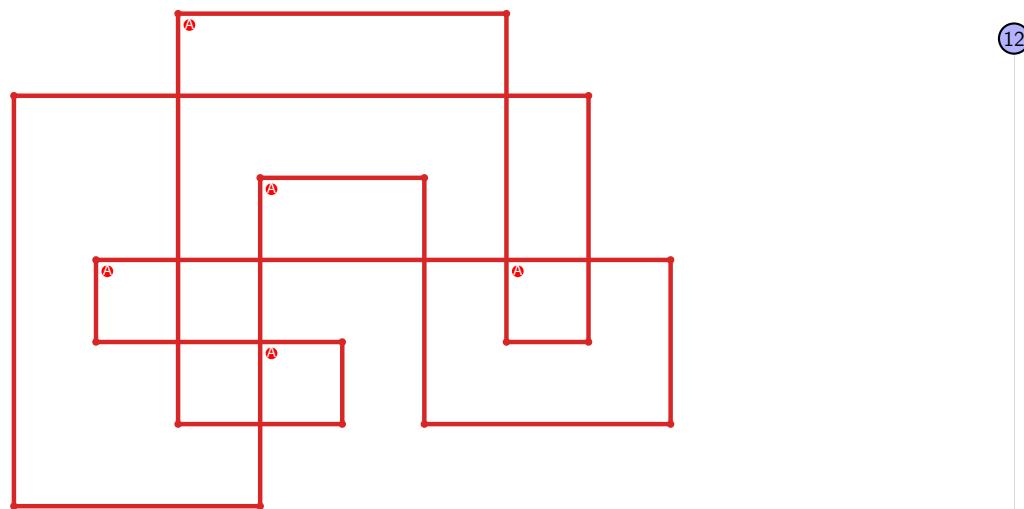


Figure 635: `SnapPy` multiloop plot.

5

Figure 636: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.21 $[[3, 20, 4, 1], [2, 13, 3, 14], [19, 4, 20, 5], [1, 15, 2, 14], [15, 12, 16, 13], [5, 18, 6, 19], [6, 11, 7, 12], [16, 10, 17, 9], [17, 8, 18, 9], [10, 7, 11, 8]]$

PD code drawn by `SnapPy`: $[(17, 2, 18, 3), (8, 5, 9, 6), (15, 6, 16, 7), (7, 14, 8, 15), (4, 9, 5, 10), (13, 10, 14, 11), (20, 11, 1, 12), (12, 19, 13, 20), (3, 16, 4, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 8, 6, 2], [4, 5, 9, 9], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 317: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

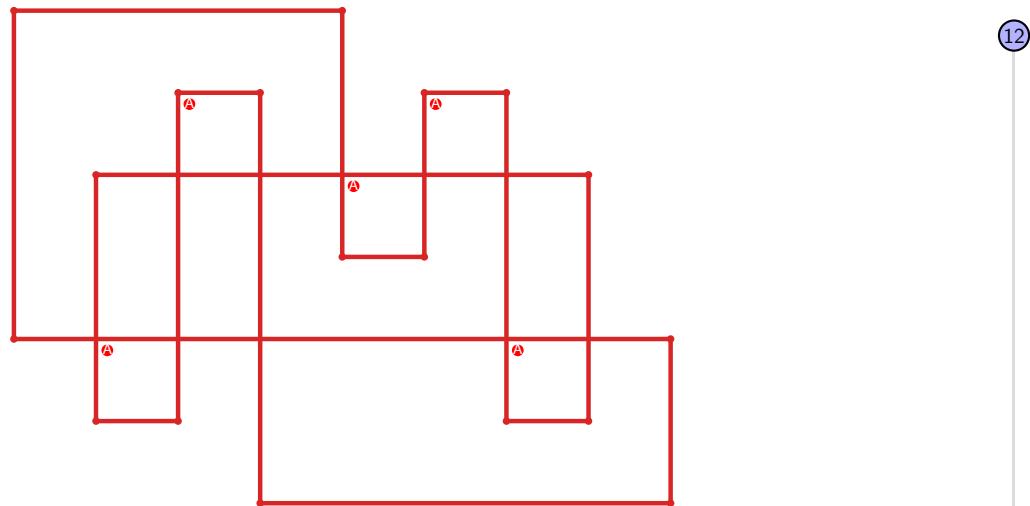


Figure 637: `SnapPy` multiloop plot.

12
5

Figure 638: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.22 $[[3, 20, 4, 1], [2, 15, 3, 16], [19, 8, 20, 9], [4, 13, 5, 14], [1, 17, 2, 16], [17, 14, 18, 15], [9, 18, 10, 19], [10, 7, 11, 8], [12, 5, 13, 6], [6, 11, 7, 12]]$

PD code drawn by SnapPy: $[(9, 2, 10, 3), (7, 4, 8, 5), (16, 5, 17, 6), (3, 8, 4, 9), (1, 10, 2, 11), (14, 11, 15, 12), (19, 12, 20, 13), (13, 18, 14, 19), (6, 15, 7, 16), (20, 17, 1, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 8, 5], [0, 5, 1, 1], [1, 4, 3, 6], [2, 5, 7, 2], [2, 6, 9, 9], [3, 9, 9, 3], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 318: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

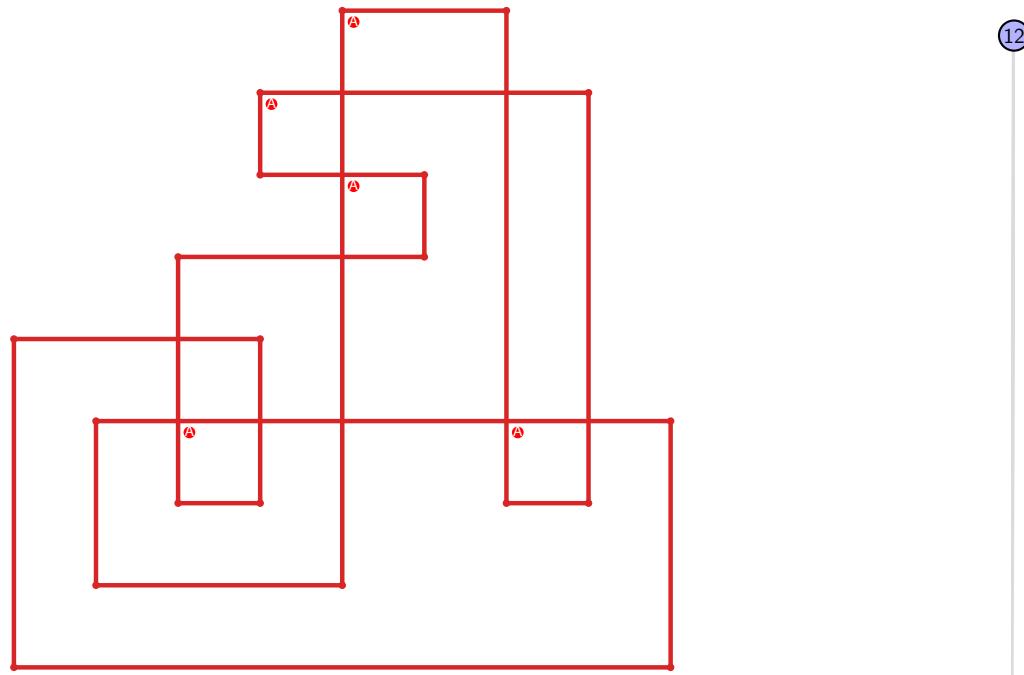


Figure 639: SnapPy multiloop plot.

Figure 640: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.23 $[[3, 20, 4, 1], [9, 2, 10, 3], [19, 4, 20, 5], [1, 8, 2, 9], [10, 8, 11, 7], [5, 15, 6, 14], [18, 11, 19, 12], [6, 15, 7, 16], [16, 13, 17, 14], [12, 17, 13, 18]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (4, 7, 5, 8), (18, 5, 19, 6), (15, 8, 16, 9), (13, 10, 14, 11), (11, 2, 12, 3), (3, 12, 4, 13), (9, 14, 10, 15), (20, 17, 1, 18), (6, 19, 7, 20)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 7, 7, 8], [2, 9, 9, 4], [4, 8, 5, 5], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 319: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

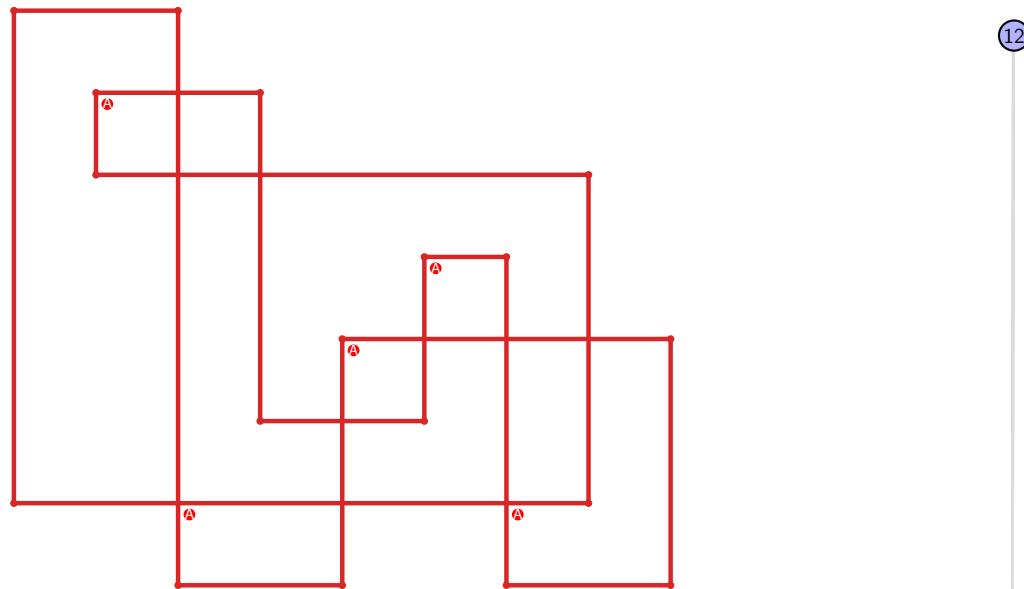


Figure 641: SnapPy multiloop plot.

Figure 642: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.24 $[[3, 10, 4, 1], [2, 20, 3, 11], [15, 9, 16, 10], [4, 18, 5, 19], [1, 12, 2, 11], [12, 19, 13, 20], [8, 14, 9, 15], [16, 7, 17, 6], [17, 5, 18, 6], [13, 7, 14, 8]]$

PD code drawn by `SnapPy`: $[(18, 3, 19, 4), (4, 17, 5, 18), (14, 5, 15, 6), (16, 7, 17, 8), (1, 8, 2, 9), (6, 15, 7, 16), (2, 19, 3, 20), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 8, 5], [0, 5, 1, 1], [1, 4, 3, 9], [2, 9, 9, 2], [2, 9, 8, 8], [3, 7, 7, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 320: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

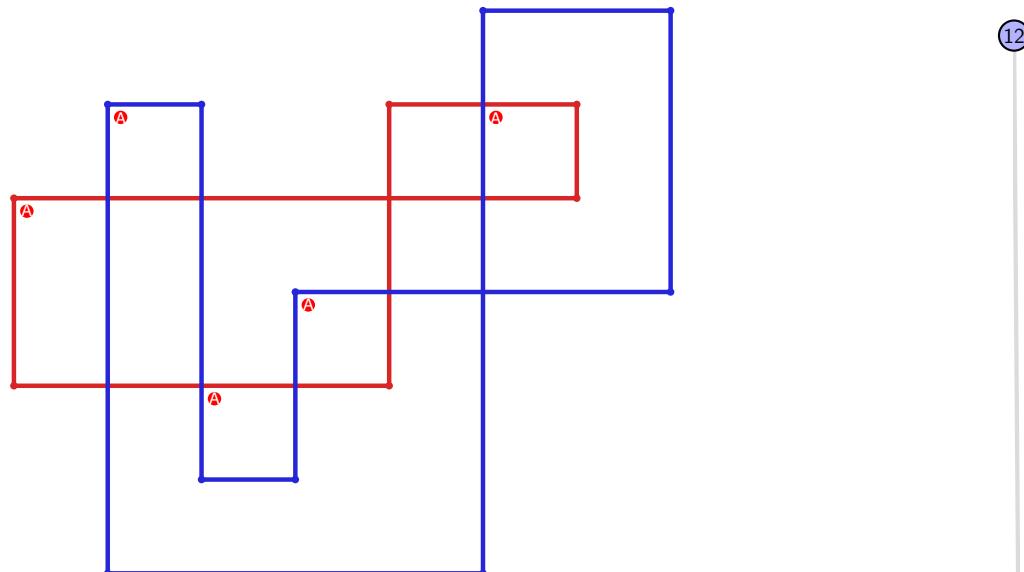


Figure 643: `SnapPy` multiloop plot.



Figure 644: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.25 $[[3, 20, 4, 1], [2, 11, 3, 12], [19, 6, 20, 7], [4, 18, 5, 17], [1, 13, 2, 12], [13, 10, 14, 11], [7, 16, 8, 17], [5, 18, 6, 19], [9, 14, 10, 15], [15, 8, 16, 9]]$

PD code drawn by `SnapPy`: $[(17, 4, 18, 5), (13, 6, 14, 7), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (7, 12, 8, 13), (5, 14, 6, 15), (15, 2, 16, 3), (3, 16, 4, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 7, 6], [0, 5, 1, 1], [1, 4, 8, 8], [2, 9, 9, 3], [2, 3, 3, 2], [5, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Table 321: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

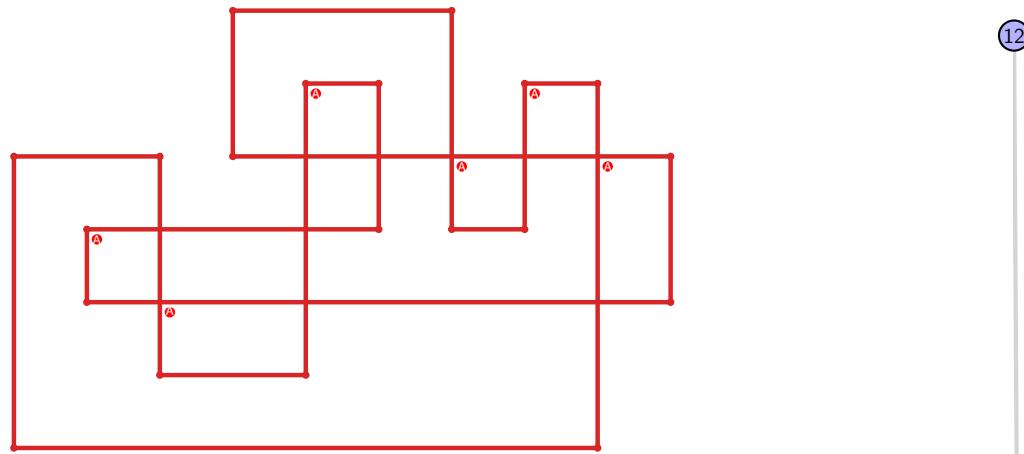


Figure 645: `SnapPy` multiloop plot.

6

Figure 646: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.26 $[[3, 20, 4, 1], [2, 11, 3, 12], [19, 4, 20, 5], [1, 13, 2, 12], [13, 10, 14, 11], [5, 16, 6, 17], [7, 18, 8, 19], [9, 14, 10, 15], [15, 8, 16, 9], [6, 18, 7, 17]]$

PD code drawn by `SnapPy`: $[(17, 2, 18, 3), (13, 6, 14, 7), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (7, 12, 8, 13), (3, 14, 4, 15), (15, 4, 16, 5), (5, 16, 6, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 8, 9, 9], [2, 9, 9, 8], [4, 8, 8, 4], [5, 7, 7, 6], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 322: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

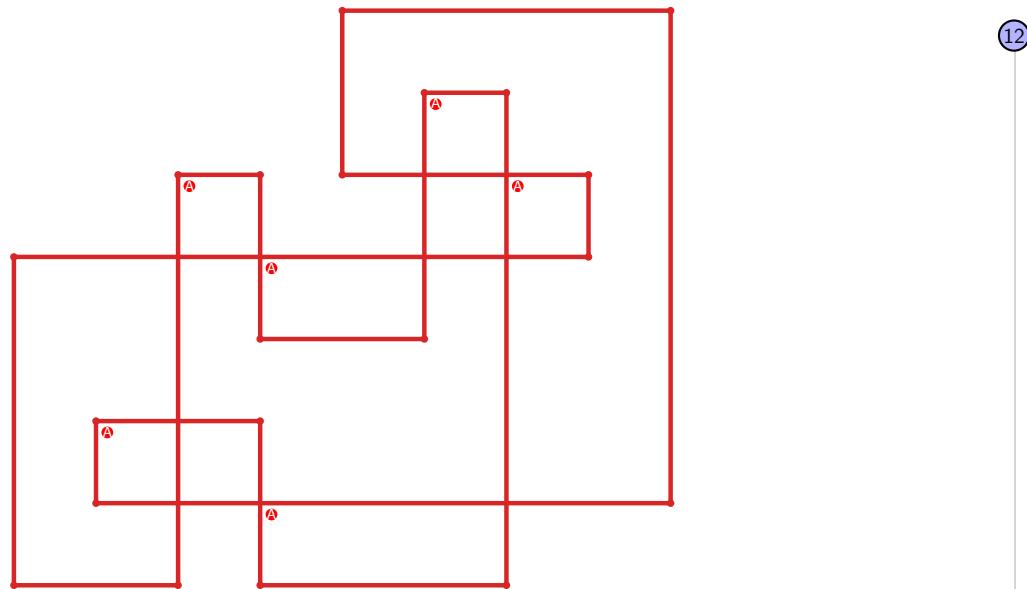


Figure 647: `SnapPy` multiloop plot.

6

Figure 648: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.27 $[[3, 20, 4, 1], [2, 11, 3, 12], [14, 19, 15, 20], [4, 9, 5, 10], [1, 13, 2, 12], [13, 10, 14, 11], [5, 18, 6, 19], [15, 8, 16, 9], [17, 6, 18, 7], [7, 16, 8, 17]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (11, 4, 12, 5), (20, 5, 1, 6), (9, 6, 10, 7), (18, 7, 19, 8), (8, 17, 9, 18), (3, 12, 4, 13), (1, 14, 2, 15), (10, 15, 11, 16), (19, 16, 20, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 6, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 3, 8, 8], [2, 9, 9, 3], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 323: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

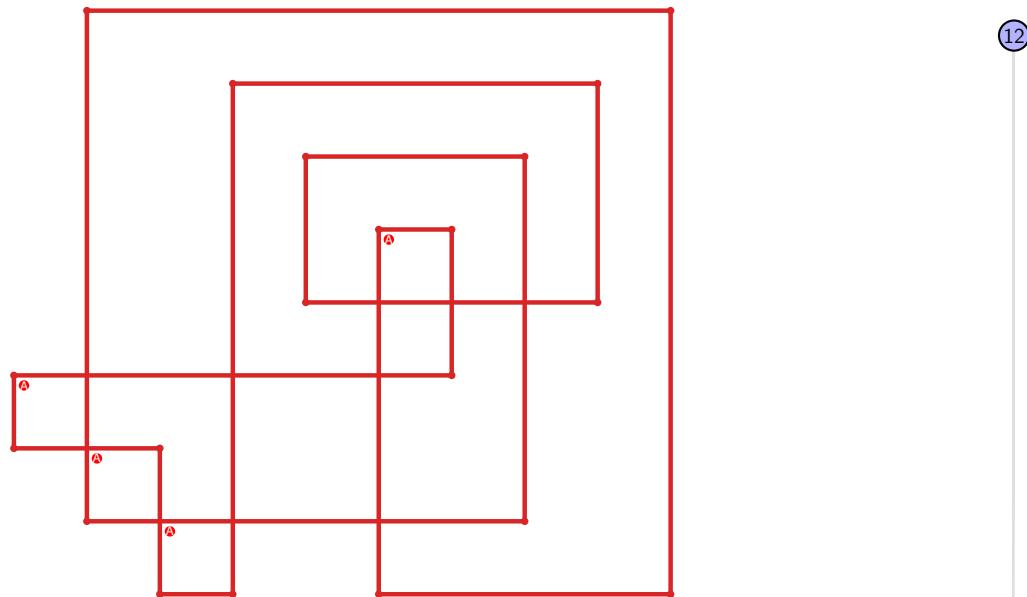


Figure 649: SnapPy multiloop plot.

12

4

Figure 650: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.28 $[[3, 12, 4, 1], [2, 20, 3, 13], [15, 11, 16, 12], [4, 18, 5, 19], [1, 14, 2, 13], [14, 19, 15, 20], [5, 10, 6, 11], [16, 9, 17, 8], [17, 7, 18, 8], [9, 6, 10, 7]]$

PD code drawn by SnapPy: $[(7, 4, 8, 5), (18, 5, 19, 6), (6, 17, 7, 18), (3, 8, 4, 9), (16, 9, 17, 10), (1, 10, 2, 11), (2, 19, 3, 20), (15, 20, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 8, 6, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 3, 9, 9], [2, 9, 8, 8], [3, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 7
 Total pinning sets: 484
 Pinning number: 4

Average optimal degree: 2.33
 Average minimal degree: 2.6
 Average overall degree: 3.05

Table 324: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	21	76	124	126	84	36	9	1	477
Average degree	2.33	2.67	2.88	3.01	3.11	3.19	3.24	3.29	3.33	

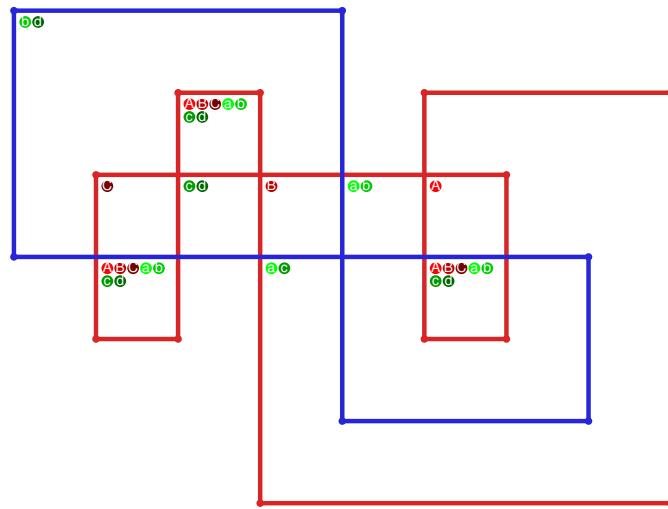


Figure 651: SnapPy multiloop plot.

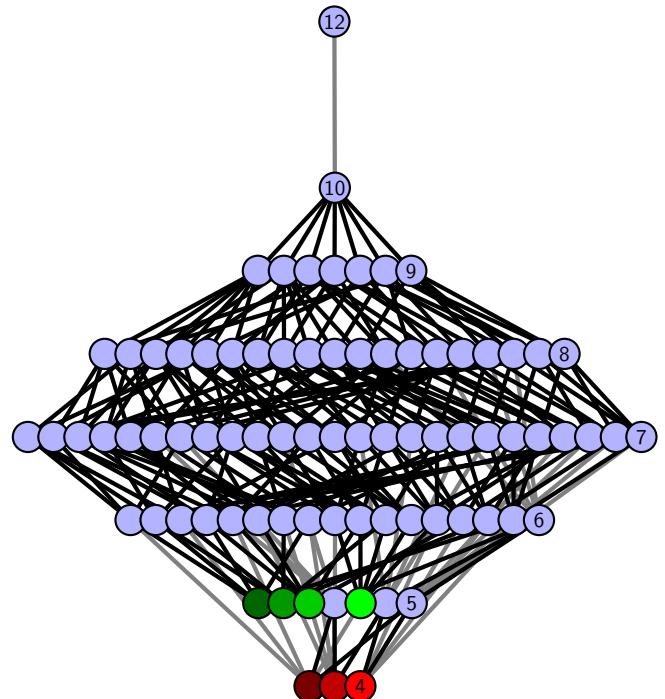


Figure 652: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.29 $[[3, 10, 4, 1], [2, 20, 3, 11], [13, 9, 14, 10], [4, 18, 5, 19], [1, 12, 2, 11], [12, 19, 13, 20], [8, 14, 9, 15], [17, 7, 18, 8], [5, 16, 6, 15], [6, 16, 7, 17]]$

PD code drawn by `SnapPy`: $[(13, 2, 14, 3), (19, 4, 20, 5), (8, 5, 9, 6), (3, 20, 4, 11), (11, 10, 12, 1), (1, 12, 2, 13), (9, 14, 10, 15), (18, 15, 19, 16), (7, 16, 8, 17), (17, 6, 18, 7)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 7, 8, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 8, 7, 2], [3, 6, 9, 9], [3, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 325: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

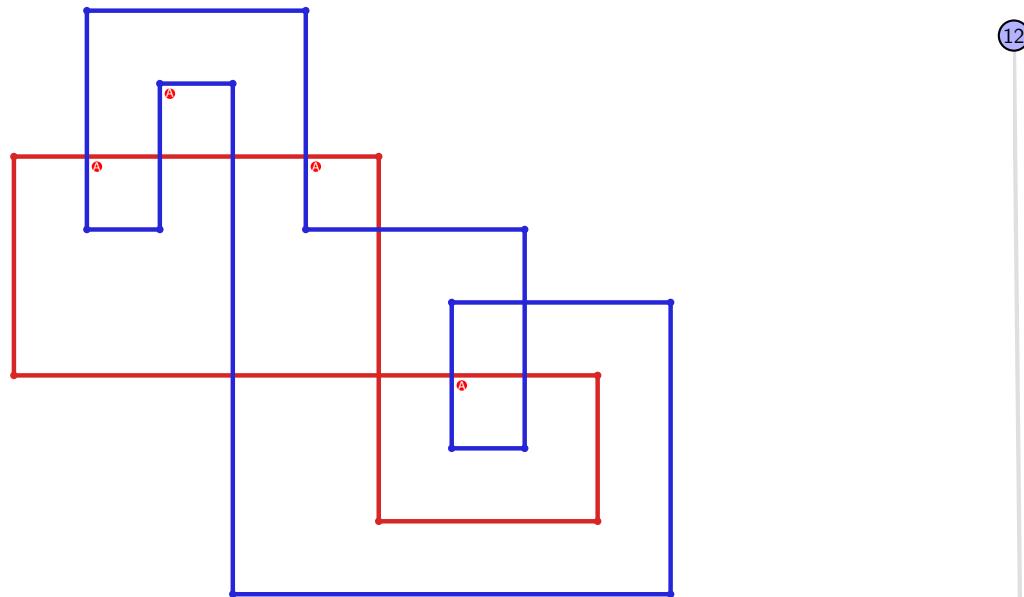


Figure 653: `SnapPy` multiloop plot.

4

Figure 654: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.30 $[[3, 10, 4, 1], [2, 20, 3, 11], [13, 9, 14, 10], [4, 18, 5, 19], [1, 12, 2, 11], [12, 19, 13, 20], [5, 8, 6, 9], [14, 17, 15, 18], [15, 7, 16, 8], [6, 16, 7, 17]]$

PD code drawn by `SnapPy`: $[(16, 5, 17, 6), (3, 6, 4, 7), (14, 7, 15, 8), (1, 8, 2, 9), (4, 17, 5, 18), (15, 18, 16, 19), (2, 19, 3, 20), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 6, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 3, 8, 9], [2, 9, 8, 3], [6, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 13
 Total minimal pinning sets: 13
 Total pinning sets: 919
 Pinning number: 4

Average optimal degree: 2.77
 Average minimal degree: 2.77
 Average overall degree: 3.14

Table 326: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	13	0	0	0	0	0	0	0	0	13
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	82	190	248	210	120	45	10	1	906
Average degree	2.77	2.96	3.07	3.14	3.2	3.24	3.28	3.31	3.33	

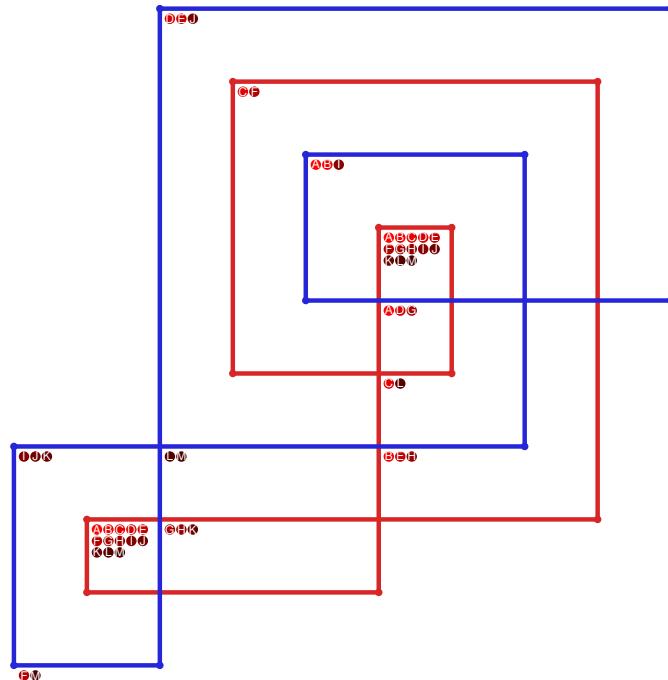


Figure 655: `SnapPy` multiloop plot.

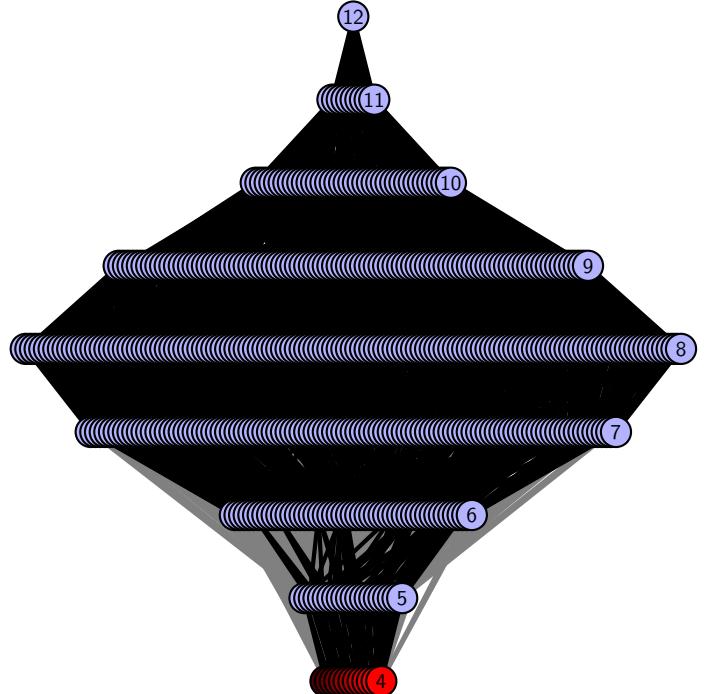


Figure 656: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.31 `[[3, 20, 4, 1], [2, 7, 3, 8], [10, 19, 11, 20], [4, 16, 5, 15], [1, 9, 2, 8], [9, 6, 10, 7], [18, 13, 19, 14], [11, 17, 12, 16], [5, 14, 6, 15], [12, 17, 13, 18]]`

PD code drawn by SnapPy: $[(7, 4, 8, 5), (20, 5, 1, 6), (6, 19, 7, 20), (16, 11, 17, 12), (3, 12, 4, 13), (13, 2, 14, 3), (14, 9, 15, 10), (10, 15, 11, 16), (8, 17, 9, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 8, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 9, 9], [2, 9, 9, 3], [3, 6, 5, 3], [6, 7, 7, 6]]

Total optimal pinning sets: 1
Total pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average minimal degree: 2.8

Pinning number: 4

Table 327: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

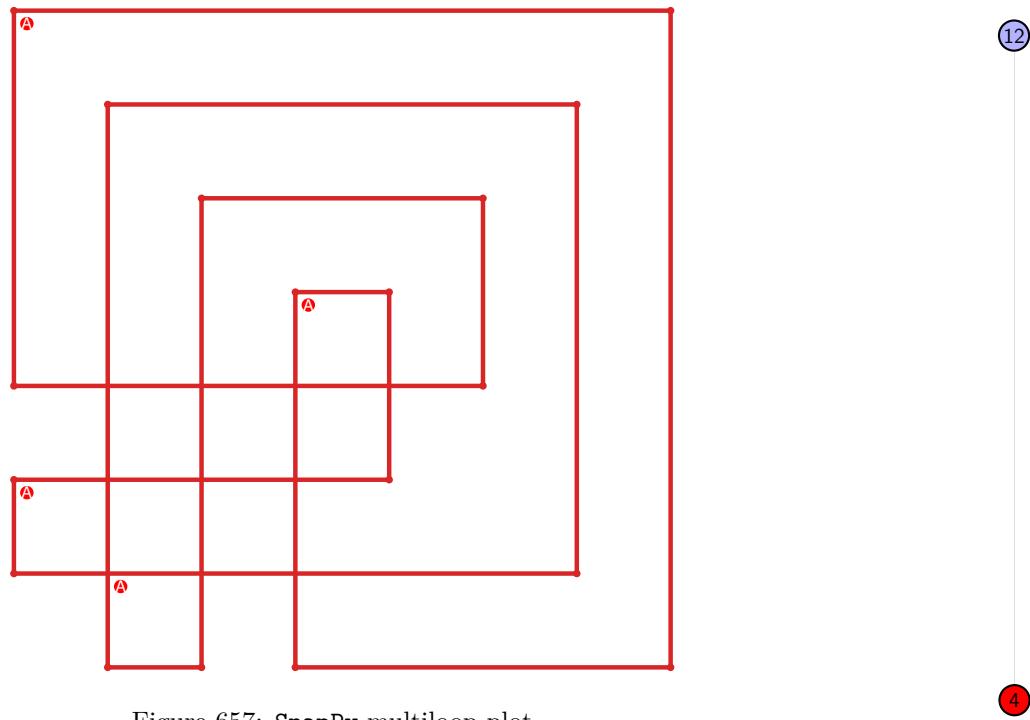


Figure 657: SnapPy multiloop plot.

Figure 658: Minimal join sub-semi-lattice of minimal pinning sets.

$$4.9.32 \quad [[3, 20, 4, 1], [2, 11, 3, 12], [19, 4, 20, 5], [1, 13, 2, 12], [13, 10, 14, 11], [5, 14, 6, 15], [9, 18, 10, 19], [6, 18, 7, 17], [15, 8, 16, 9], [7, 16, 8, 17]]$$

PD code drawn by SnapPy: [(17, 2, 18, 3), (13, 6, 14, 7), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (3, 12, 4, 13), (5, 14, 6, 15), (15, 4, 16, 5), (7, 16, 8, 17), (1, 18, 2, 19)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 6, 5], [2, 4, 7, 8], [2, 8, 7, 4], [5, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1
 Total pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average minimal degree: 2.0

Pinning number: 4

Table 328: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

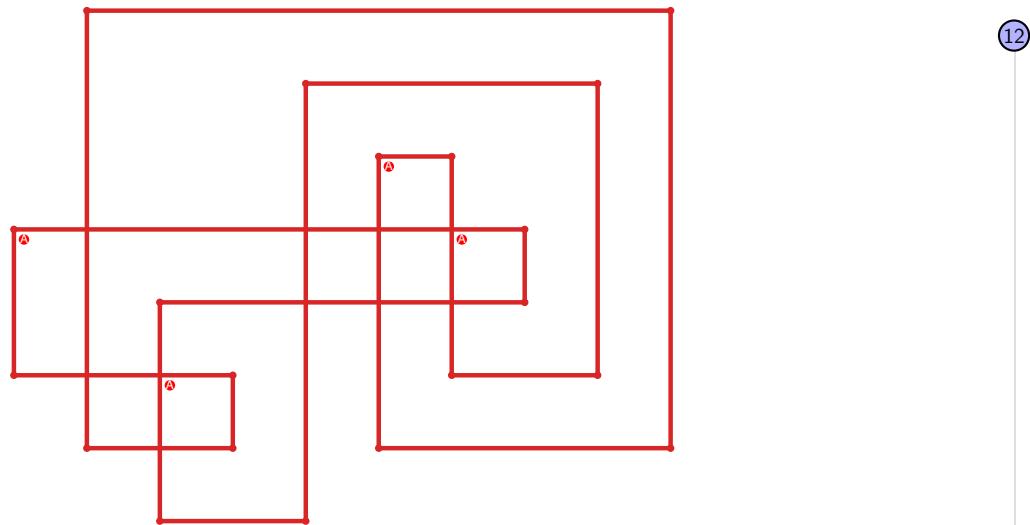


Figure 659: SnapPy multiloop plot.



Figure 660: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.33 $[[3, 16, 4, 1], [2, 20, 3, 17], [15, 8, 16, 9], [4, 12, 5, 11], [1, 18, 2, 17], [19, 9, 20, 10], [5, 14, 6, 15], [7, 12, 8, 13], [10, 18, 11, 19], [13, 6, 14, 7]]$

PD code drawn by SnapPy: $[(11, 4, 12, 5), (13, 6, 14, 7), (20, 7, 17, 8), (9, 2, 10, 3), (5, 10, 6, 11), (3, 12, 4, 13), (1, 14, 2, 15), (16, 17, 1, 18), (18, 15, 19, 16), (8, 19, 9, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 6, 8], [0, 8, 1, 1], [1, 8, 8, 2], [2, 3, 9, 9], [2, 9, 9, 3], [3, 5, 5, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 329: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

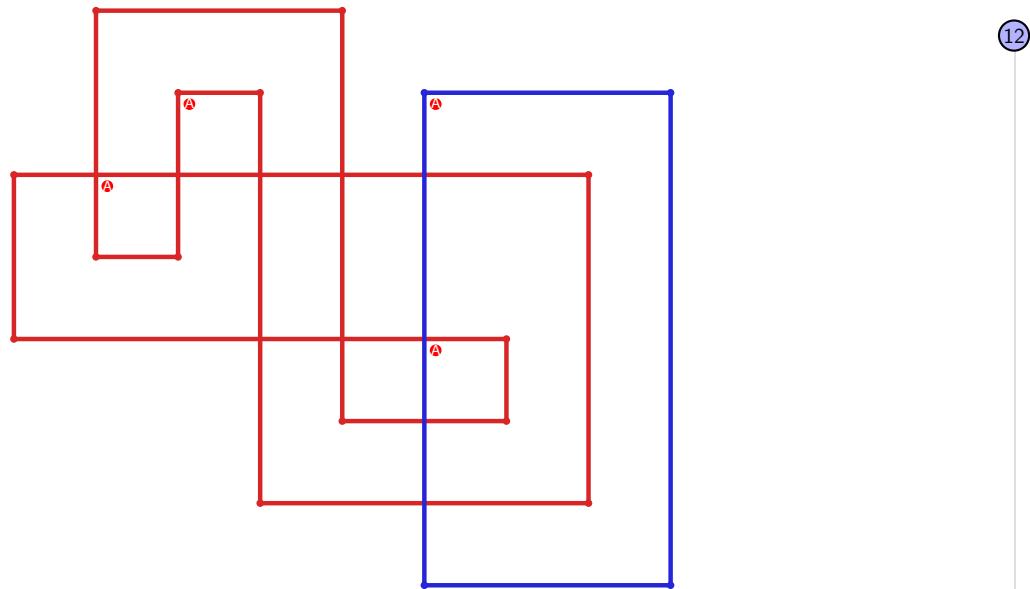


Figure 661: SnapPy multiloop plot.

4

Figure 662: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.34 `[[10, 20, 1, 11], [11, 3, 12, 4], [15, 9, 16, 10], [19, 5, 20, 6], [1, 14, 2, 13], [2, 12, 3, 13], [4, 14, 5, 15], [8, 18, 9, 19], [16, 7, 17, 6], [17, 7, 18, 8]]`

PD code drawn by `SnapPy`: `[(20, 1, 11, 2), (18, 3, 19, 4), (4, 15, 5, 16), (16, 5, 17, 6), (14, 7, 15, 8), (10, 11, 1, 12), (12, 9, 13, 10), (2, 13, 3, 14), (6, 17, 7, 18), (8, 19, 9, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 8], [0, 8, 7, 6], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 3, 2], [2, 3, 9, 9], [2, 9, 9, 3], [7, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 330: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

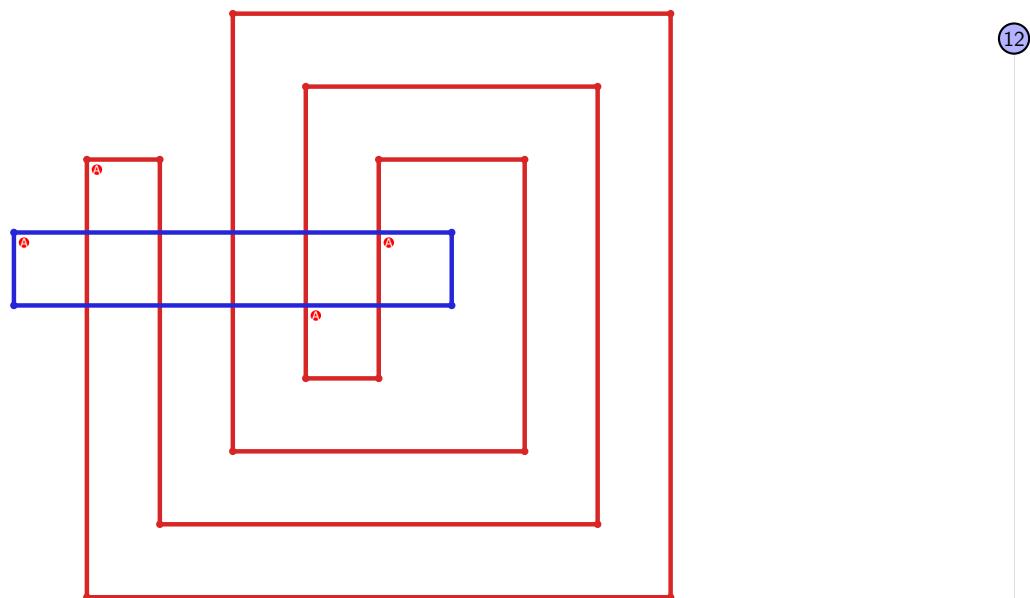


Figure 663: `SnapPy` multiloop plot.

4

Figure 664: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.35 $[[20, 3, 1, 4], [4, 13, 5, 14], [10, 19, 11, 20], [11, 2, 12, 3], [1, 12, 2, 13], [5, 19, 6, 18], [14, 9, 15, 10], [6, 15, 7, 16], [8, 17, 9, 18], [7, 17, 8, 16]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (18, 1, 19, 2), (12, 7, 13, 8), (19, 10, 20, 11), (2, 11, 3, 12), (4, 13, 5, 14), (14, 5, 15, 6), (6, 15, 7, 16), (16, 3, 17, 4), (8, 17, 9, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 5, 3], [0, 2, 4, 4], [0, 3, 3, 1], [1, 2, 7, 8], [1, 8, 7, 2], [5, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 331: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

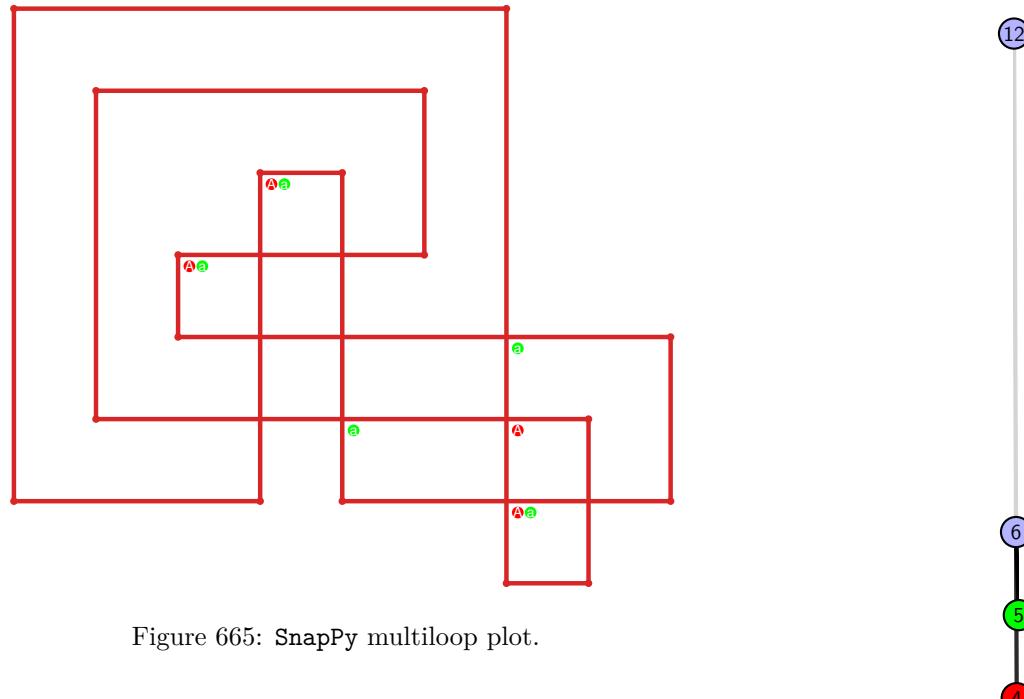


Figure 665: `SnapPy` multiloop plot.

Figure 666: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.36 $[[20, 11, 1, 12], [12, 10, 13, 9], [19, 2, 20, 3], [10, 1, 11, 2], [13, 19, 14, 18], [8, 3, 9, 4], [14, 6, 15, 5], [17, 4, 18, 5], [7, 16, 8, 17], [6, 16, 7, 15]]$

PD code drawn by `SnapPy`: $[(5, 20, 6, 1), (14, 1, 15, 2), (2, 11, 3, 12), (6, 9, 7, 10), (17, 8, 18, 9), (12, 3, 13, 4), (4, 13, 5, 14), (15, 10, 16, 11), (7, 18, 8, 19), (16, 19, 17, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 7], [1, 7, 8, 2], [4, 9, 9, 7], [4, 6, 8, 5], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 436
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.56
 Average overall degree: 3.06

Table 332: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	1	0	0	0	0	0	0	7
Nonminimal pinning sets	0	8	56	111	123	84	36	9	1	428
Average degree	2.5	2.64	2.85	3.0	3.11	3.19	3.24	3.29	3.33	

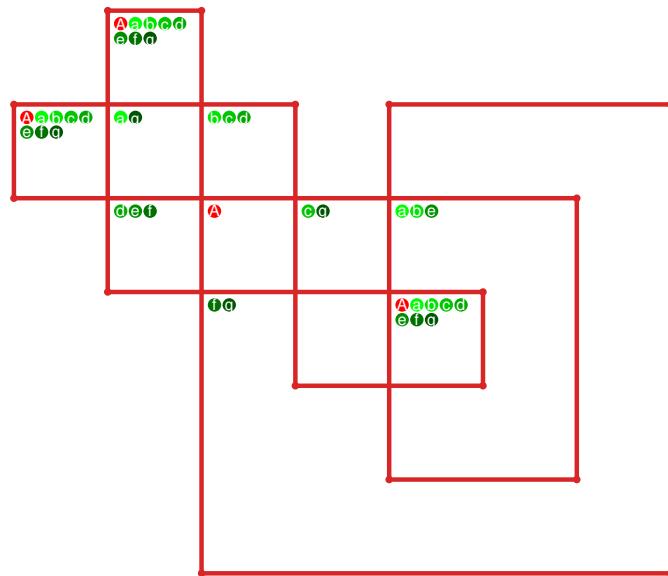


Figure 667: `SnapPy` multiloop plot.

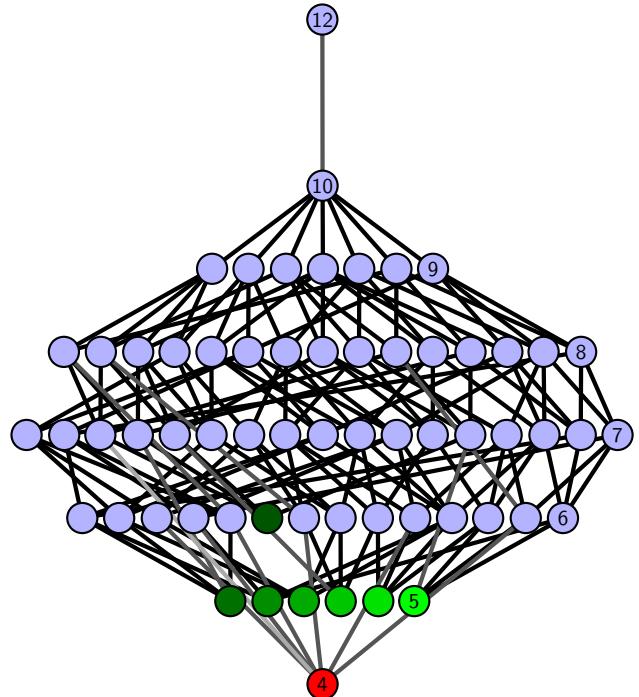


Figure 668: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.37 $[[9, 20, 10, 1], [11, 8, 12, 9], [19, 2, 20, 3], [10, 2, 11, 1], [7, 18, 8, 19], [12, 4, 13, 3], [6, 15, 7, 16], [17, 4, 18, 5], [13, 17, 14, 16], [14, 5, 15, 6]]$

PD code drawn by `SnapPy`: $[(20, 9, 1, 10), (14, 1, 15, 2), (11, 2, 12, 3), (8, 5, 9, 6), (3, 12, 4, 13), (13, 10, 14, 11), (4, 15, 5, 16), (6, 17, 7, 18), (18, 7, 19, 8), (16, 19, 17, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 7], [1, 7, 8, 2], [4, 8, 9, 9], [4, 9, 8, 5], [5, 7, 9, 6], [6, 8, 7, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 608
 Pinning number: 4

Average optimal degree: 2.6
 Average minimal degree: 2.6
 Average overall degree: 3.12

Table 333: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	33	95	156	160	105	43	10	1	603
Average degree	2.6	2.83	2.98	3.09	3.17	3.23	3.27	3.31	3.33	

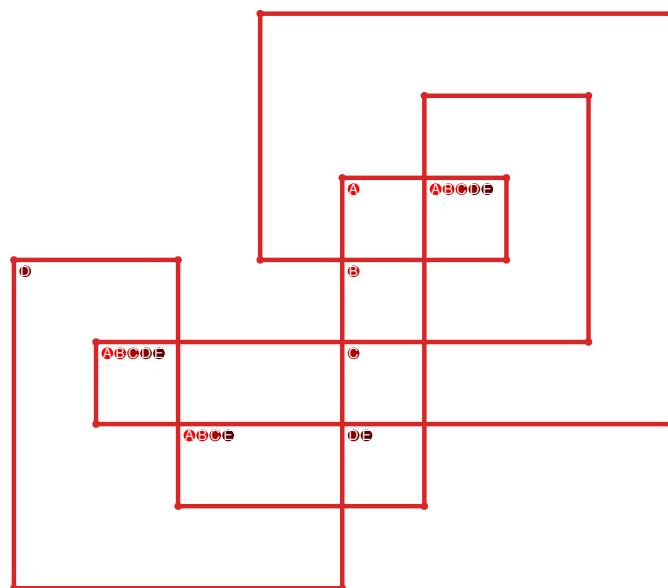


Figure 669: `SnapPy` multiloop plot.

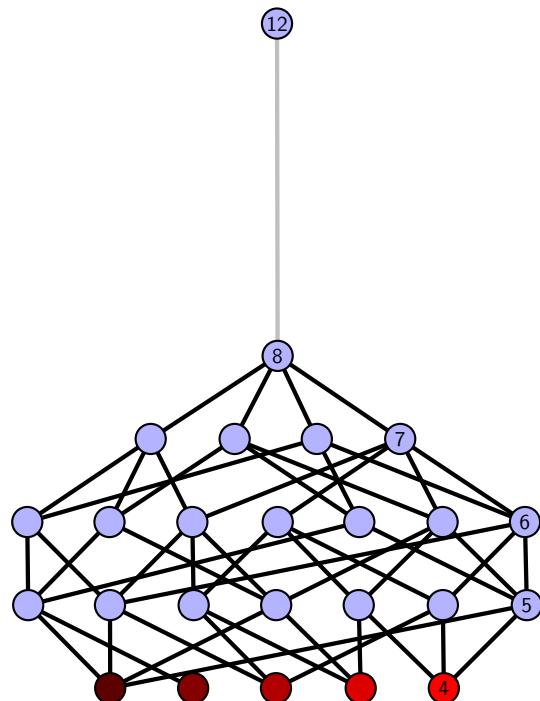


Figure 670: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.38 `[[20, 15, 1, 16], [16, 14, 17, 13], [19, 2, 20, 3], [14, 1, 15, 2], [17, 9, 18, 8], [12, 3, 13, 4], [18, 9, 19, 10], [7, 4, 8, 5], [11, 6, 12, 7], [10, 6, 11, 5]]`

PD code drawn by `SnapPy`: `[(9, 20, 10, 1), (4, 1, 5, 2), (2, 7, 3, 8), (8, 3, 9, 4), (5, 14, 6, 15), (15, 6, 16, 7), (10, 13, 11, 14), (17, 12, 18, 13), (11, 18, 12, 19), (16, 19, 17, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 6, 3], [0, 2, 1, 0], [1, 6, 6, 7], [1, 7, 8, 2], [2, 9, 4, 4], [4, 9, 8, 5], [5, 7, 9, 9], [6, 8, 8, 7]]`

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 384

Average overall degree: 3.03

Pinning number: 4

Table 334: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

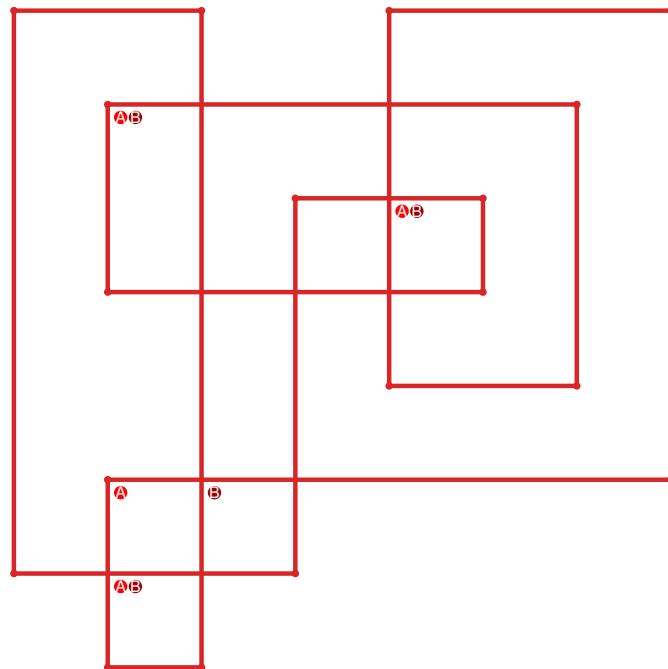


Figure 671: `SnapPy` multiloop plot.

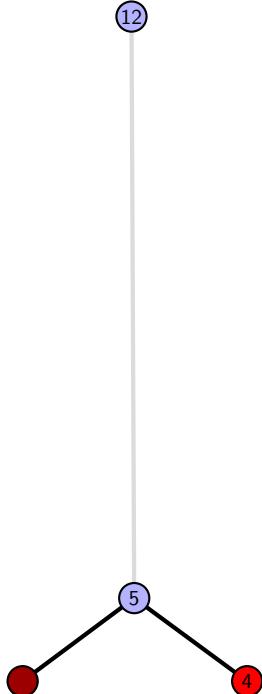


Figure 672: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.39 $[[12, 20, 1, 13], [13, 19, 14, 18], [11, 2, 12, 3], [19, 1, 20, 2], [14, 4, 15, 5], [9, 17, 10, 18], [3, 10, 4, 11], [15, 7, 16, 8], [5, 8, 6, 9], [6, 16, 7, 17]]$

PD code drawn by SnapPy: $[(9, 12, 10, 1), (13, 2, 14, 3), (14, 5, 15, 6), (3, 6, 4, 7), (1, 8, 2, 9), (18, 11, 19, 12), (4, 15, 5, 16), (7, 16, 8, 17), (17, 20, 18, 13), (10, 19, 11, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 3], [0, 2, 1, 0], [1, 6, 7, 8], [1, 8, 9, 6], [2, 5, 4, 2], [4, 9, 9, 8], [4, 7, 9, 5], [5, 8, 7, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 320
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.33
 Average overall degree: 3.03

Table 335: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

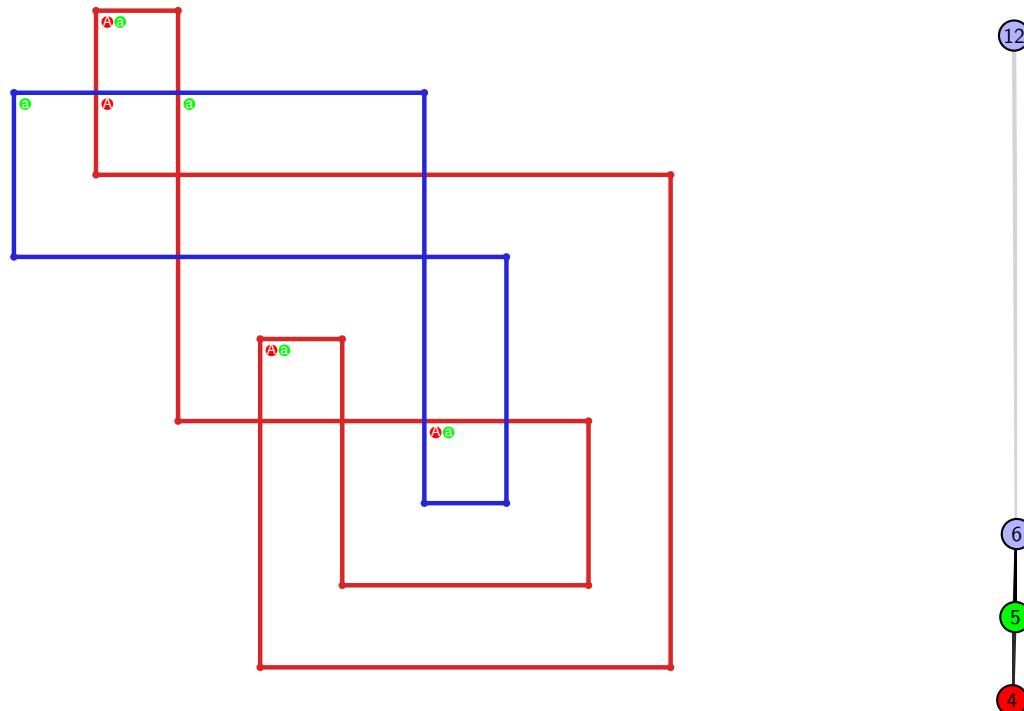


Figure 673: SnapPy multiloop plot.

Figure 674: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.40 $[[8, 16, 1, 9], [9, 15, 10, 14], [7, 2, 8, 3], [15, 1, 16, 2], [10, 7, 11, 6], [13, 3, 14, 4], [11, 17, 12, 20], [5, 19, 6, 20], [4, 19, 5, 18], [12, 17, 13, 18]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (3, 14, 4, 15), (11, 6, 12, 7), (4, 7, 5, 8), (10, 13, 11, 14), (5, 12, 6, 13), (20, 1, 17, 2), (2, 17, 3, 18), (18, 15, 19, 16), (16, 19, 9, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 7], [1, 8, 9, 2], [4, 9, 9, 7], [4, 6, 8, 8], [5, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 7

Total pinning sets: 445

Pinning number: 4

Average optimal degree: 2.25

Average minimal degree: 2.68

Average overall degree: 3.05

Table 336: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	1	0	0	0	0	0	0	5
Nonminimal pinning sets	0	15	63	111	120	83	36	9	1	438
Average degree	2.25	2.65	2.85	3.0	3.1	3.18	3.24	3.29	3.33	

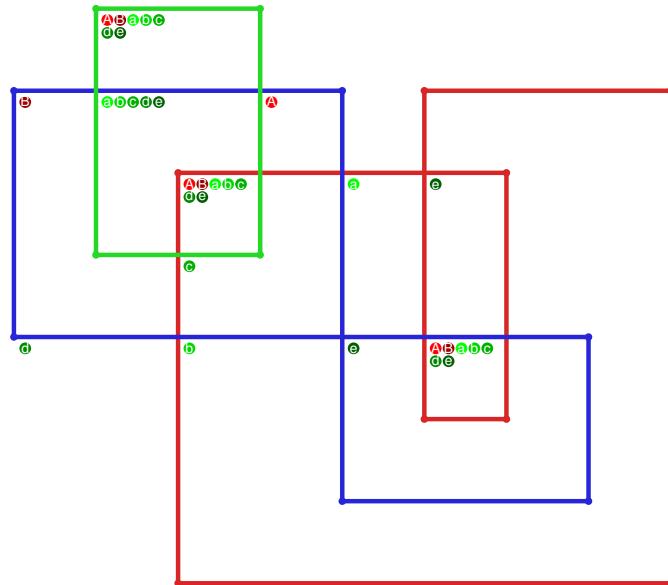


Figure 675: SnapPy multiloop plot.

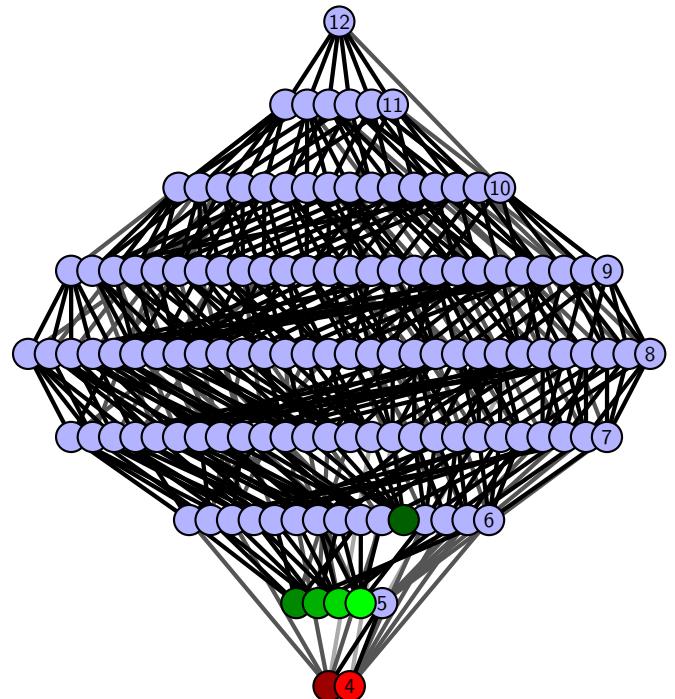


Figure 676: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.41 $[[11, 20, 12, 1], [13, 10, 14, 11], [19, 2, 20, 3], [12, 2, 13, 1], [9, 18, 10, 19], [14, 4, 15, 3], [17, 8, 18, 9], [4, 8, 5, 7], [15, 7, 16, 6], [16, 5, 17, 6]]$

PD code drawn by SnapPy: $[(20, 11, 1, 12), (13, 2, 14, 3), (3, 12, 4, 13), (4, 1, 5, 2), (14, 5, 15, 6), (10, 7, 11, 8), (6, 15, 7, 16), (8, 17, 9, 18), (18, 9, 19, 10), (16, 19, 17, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 4, 3], [0, 2, 1, 0], [1, 2, 6, 6], [1, 7, 8, 2], [4, 9, 7, 4], [5, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 337: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

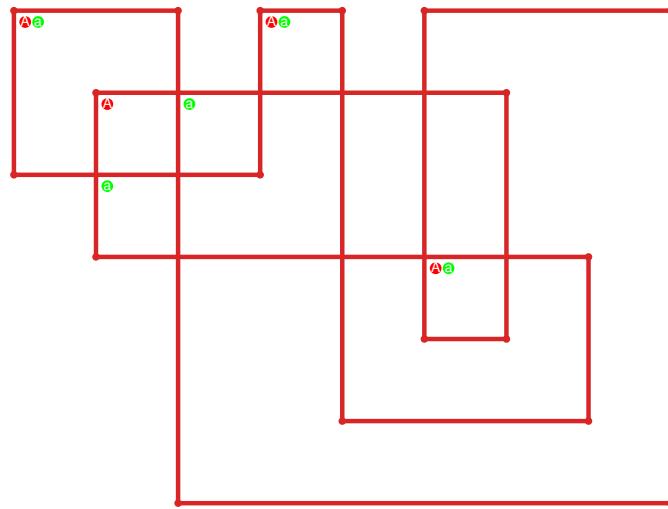


Figure 677: SnapPy multiloop plot.



Figure 678: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.42 [[10, 14, 1, 11], [11, 15, 12, 20], [9, 2, 10, 3], [13, 1, 14, 2], [15, 13, 16, 12], [19, 3, 20, 4], [8, 16, 9, 17], [4, 8, 5, 7], [18, 6, 19, 7], [17, 6, 18, 5]]

PD code drawn by `SnapPy`: [(7, 10, 8, 1), (12, 1, 13, 2), (3, 16, 4, 11), (11, 4, 12, 5), (5, 2, 6, 3), (20, 9, 17, 10), (19, 14, 20, 15), (8, 17, 9, 18), (13, 18, 14, 19), (6, 15, 7, 16)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 4, 0], [1, 3, 6, 1], [1, 7, 8, 2], [2, 9, 7, 4], [5, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 8
Total minimal pinning sets: 8
Total pinning sets: 318
Pinning number: 5

Average optimal degree: 2.55
Average minimal degree: 2.55
Average overall degree: 3.04

Table 338: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	34	71	90	71	34	9	1	310
Average degree	2.55	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

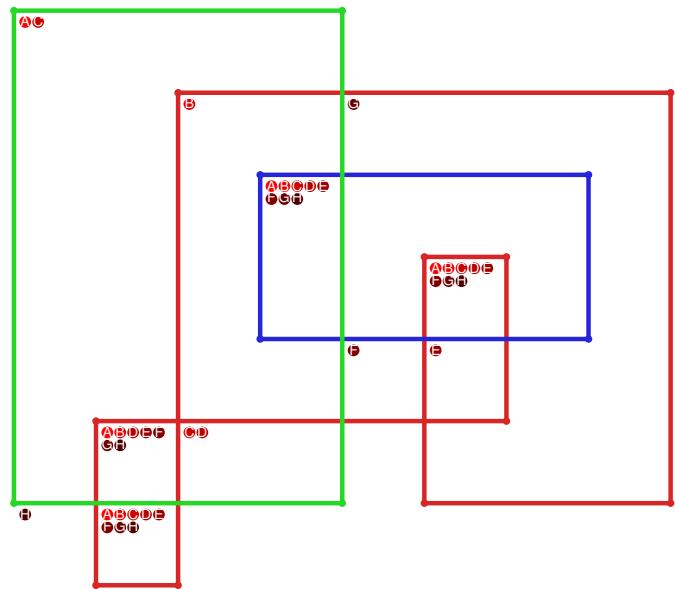


Figure 679: `SnapPy` multiloop plot.

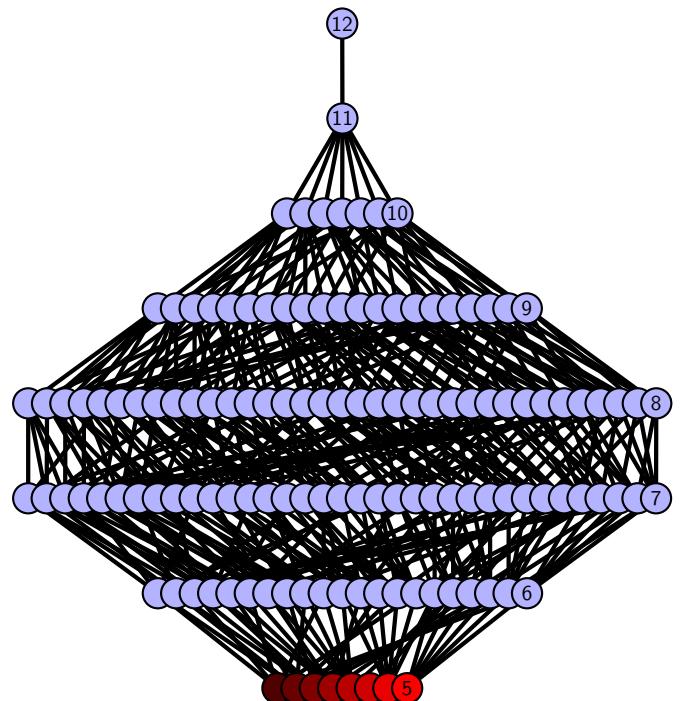


Figure 680: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.43 $[[3, 8, 4, 1], [2, 12, 3, 9], [7, 20, 8, 13], [4, 16, 5, 15], [1, 10, 2, 9], [11, 13, 12, 14], [6, 17, 7, 18], [19, 16, 20, 17], [5, 19, 6, 18], [14, 10, 15, 11]]$

PD code drawn by `SnapPy`: $[(1, 6, 2, 7), (8, 9, 1, 10), (10, 7, 11, 8), (20, 11, 13, 12), (13, 2, 14, 3), (17, 14, 18, 15), (4, 15, 5, 16), (16, 3, 17, 4), (5, 18, 6, 19), (12, 19, 9, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 8, 9], [0, 9, 1, 1], [1, 9, 9, 2], [2, 8, 8, 7], [2, 6, 8, 3], [3, 7, 6, 6], [3, 5, 5, 4]]$

Total optimal pinning sets: 6

Average optimal degree: 2.5

Total minimal pinning sets: 8

Average minimal degree: 2.6

Total pinning sets: 315

Average overall degree: 3.04

Pinning number: 5

Table 339: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	31	71	90	71	34	9	1	307
Average degree	2.5	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

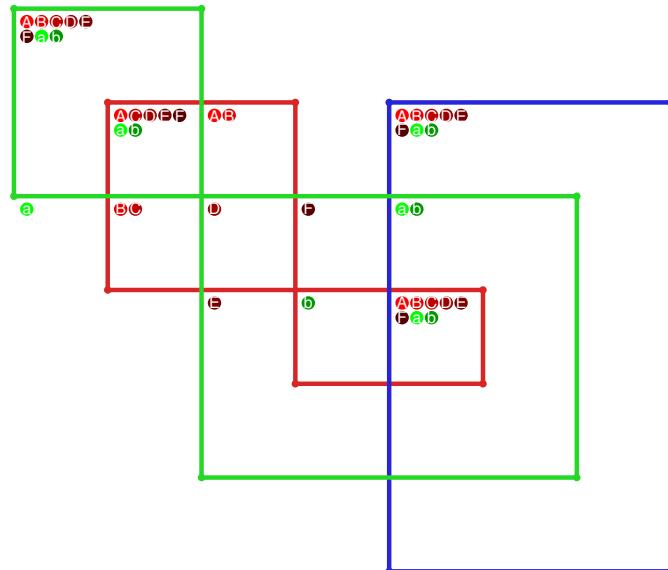


Figure 681: `SnapPy` multiloop plot.

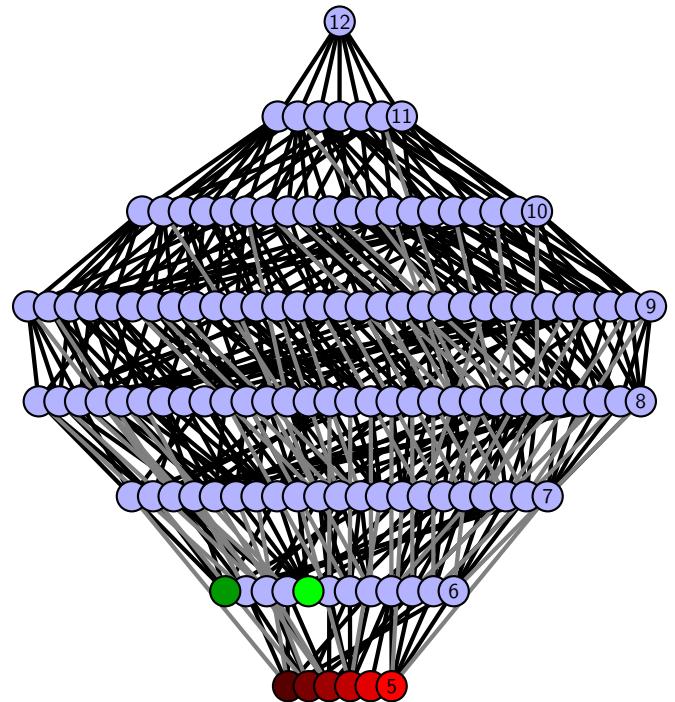


Figure 682: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.44 $[[3, 10, 4, 1], [2, 20, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [12, 19, 13, 20], [5, 13, 6, 14], [18, 8, 19, 9], [6, 16, 7, 17], [14, 17, 15, 18], [15, 7, 16, 8]]$

PD code drawn by `SnapPy`: $[(7, 2, 8, 3), (16, 5, 17, 6), (19, 6, 20, 7), (1, 8, 2, 9), (3, 14, 4, 15), (4, 17, 5, 18), (15, 18, 16, 19), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 6, 5], [2, 4, 7, 8], [2, 8, 9, 4], [5, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 340: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

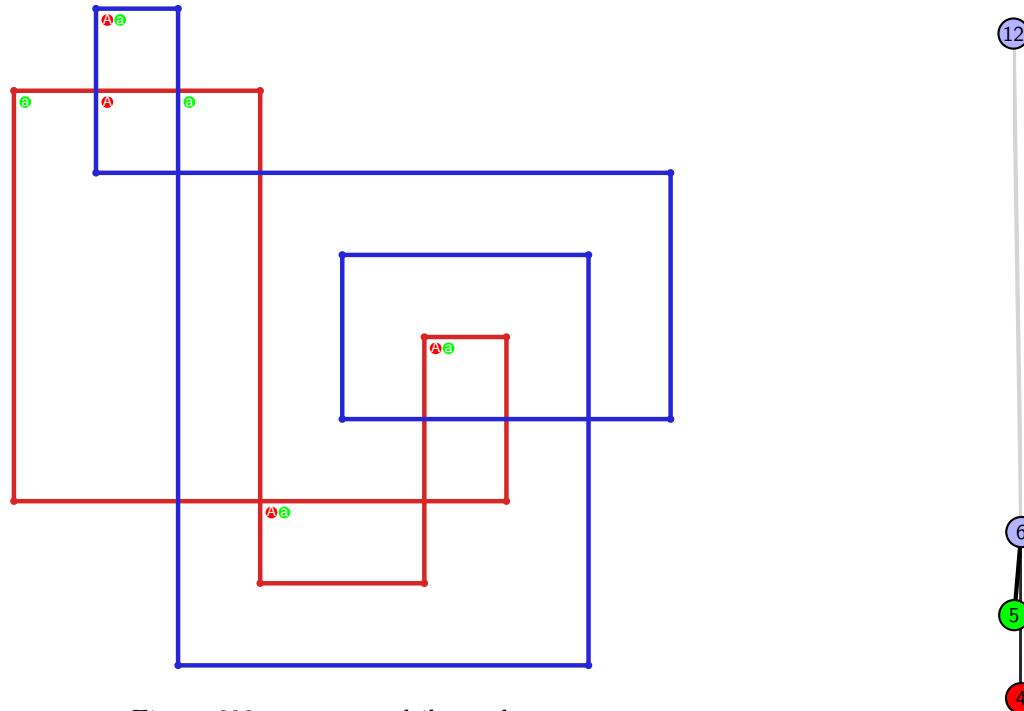


Figure 683: `SnapPy` multiloop plot.

Figure 684: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.45 $[[15, 20, 16, 1], [14, 11, 15, 12], [4, 19, 5, 20], [16, 9, 17, 10], [1, 13, 2, 12], [2, 13, 3, 14], [3, 10, 4, 11], [7, 18, 8, 19], [5, 8, 6, 9], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (1, 4, 2, 5), (12, 5, 13, 6), (19, 6, 20, 7), (10, 7, 11, 8), (8, 17, 9, 18), (18, 9, 19, 10), (3, 14, 4, 15), (20, 15, 1, 16), (11, 16, 12, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 8], [0, 8, 9, 6], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 3, 2], [2, 9, 9, 8], [2, 7, 9, 3], [3, 8, 7, 7]]$

Total optimal pinning sets: 6
Total minimal pinning sets: 7

Total pinning sets: 384
Pinning number: 5

Average optimal degree: 2.67

Average minimal degree: 2.67

Average overall degree: 3.11

Table 341: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	34	86	115	90	41	10	1	377
Average degree	2.67	2.87	3.01	3.12	3.21	3.27	3.31	3.33	

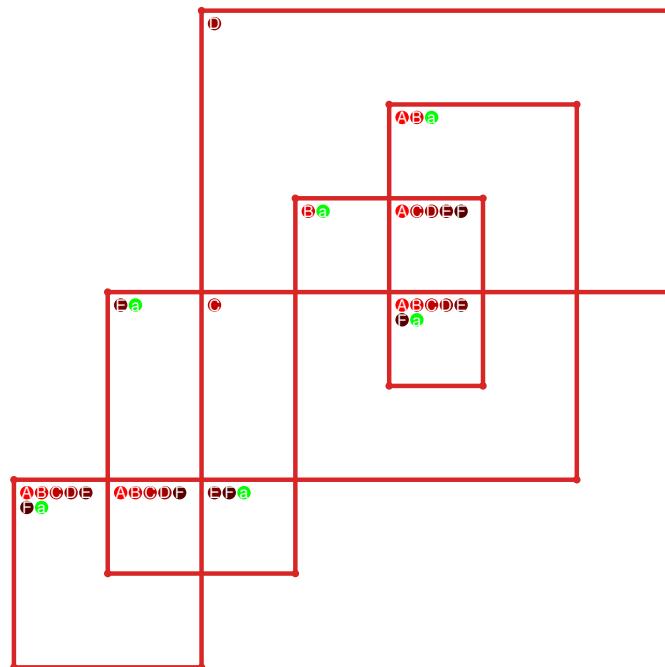


Figure 685: SnapPy multiloop plot.

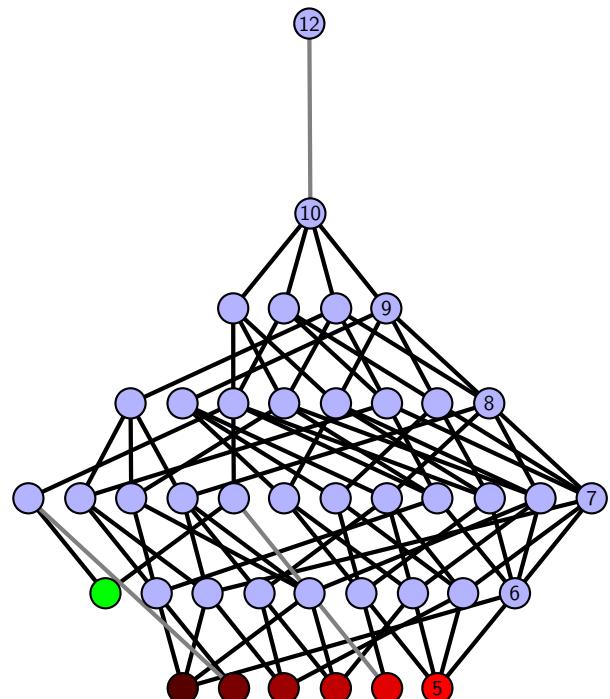


Figure 686: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.46 $[[3, 20, 4, 1], [2, 13, 3, 14], [16, 19, 17, 20], [4, 11, 5, 12], [1, 15, 2, 14], [15, 12, 16, 13], [7, 18, 8, 19], [17, 8, 18, 9], [10, 5, 11, 6], [6, 9, 7, 10]]$

PD code drawn by SnapPy: $[(8, 3, 9, 4), (15, 6, 16, 7), (4, 7, 5, 8), (2, 9, 3, 10), (13, 10, 14, 11), (20, 11, 1, 12), (12, 19, 13, 20), (5, 16, 6, 17), (14, 17, 15, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 8, 8, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 9, 7, 7], [2, 6, 6, 9], [3, 9, 9, 3], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 342: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

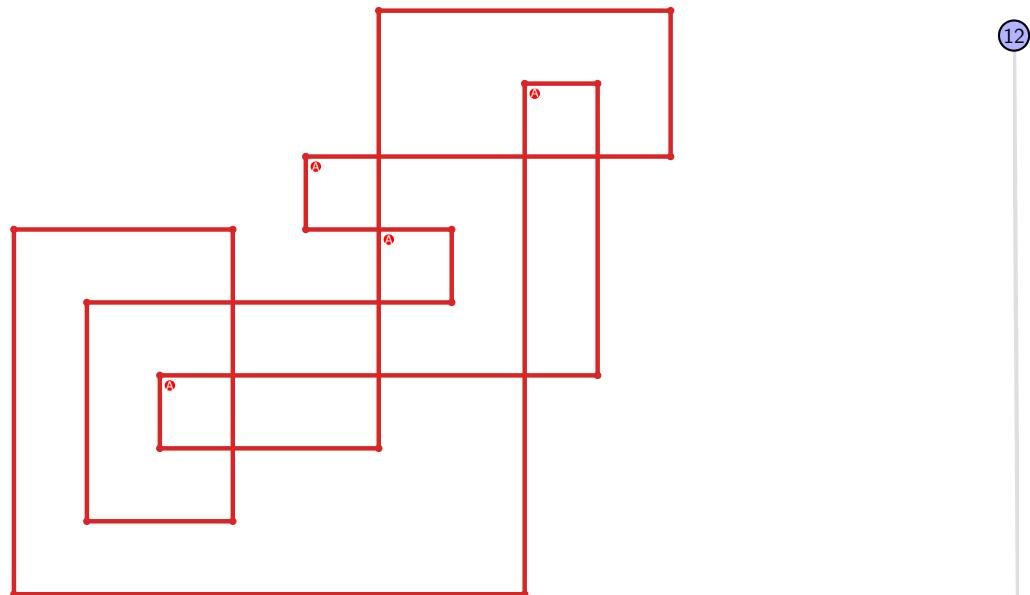


Figure 687: SnapPy multiloop plot.

4

Figure 688: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.47 $[[3, 14, 4, 1], [2, 7, 3, 8], [10, 13, 11, 14], [4, 15, 5, 20], [1, 9, 2, 8], [9, 6, 10, 7], [16, 12, 17, 13], [11, 17, 12, 18], [15, 18, 16, 19], [5, 19, 6, 20]]$

PD code drawn by `SnapPy`: $[(7, 4, 8, 5), (14, 5, 1, 6), (6, 13, 7, 14), (17, 10, 18, 11), (8, 11, 9, 12), (1, 12, 2, 13), (9, 18, 10, 19), (16, 19, 17, 20), (3, 20, 4, 15), (15, 2, 16, 3)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 8, 9, 9], [0, 5, 1, 1], [1, 4, 9, 2], [2, 8, 7, 7], [2, 6, 6, 8], [3, 7, 6, 9], [3, 8, 5, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 512

Average overall degree: 3.03

Pinning number: 3

Table 343: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	36	84	126	126	84	36	9	1	511
Average degree	2.0	2.44	2.71	2.89	3.02	3.11	3.19	3.24	3.29	3.33	

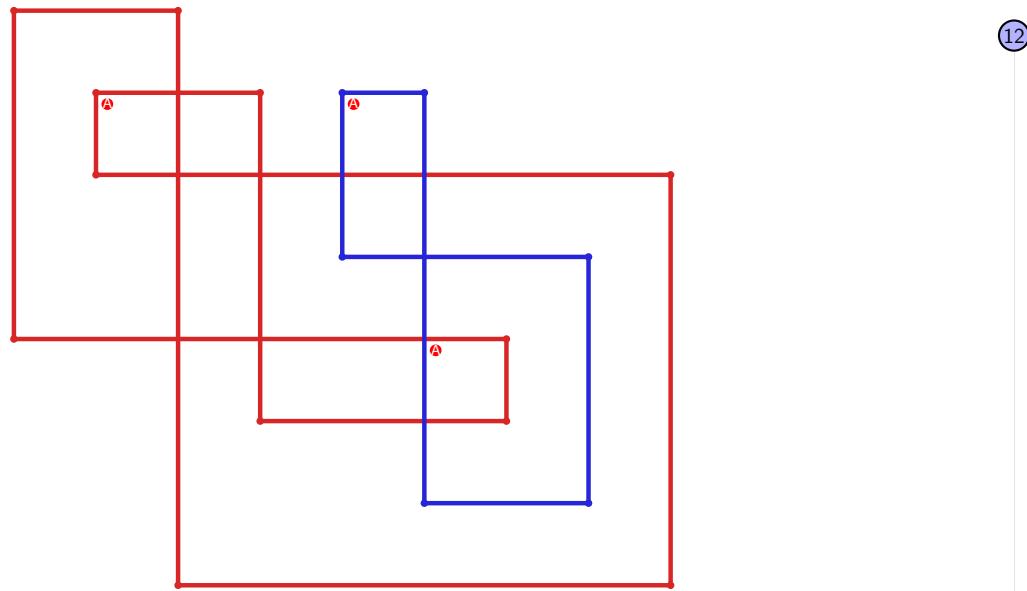


Figure 689: `SnapPy` multiloop plot.

3

Figure 690: Minimal join sub-semi-lattice of minimal pinning sets.

$$4.9.48 \quad [[3, 20, 4, 1], [11, 2, 12, 3], [19, 4, 20, 5], [1, 10, 2, 11], [12, 10, 13, 9], [5, 9, 6, 8], [18, 13, 19, 14], [6, 15, 7, 16], [16, 7, 17, 8], [14, 17, 15, 18]]$$

PD code drawn by SnapPy: [(9, 20, 10, 1), (17, 2, 18, 3), (14, 5, 15, 6), (6, 3, 7, 4), (7, 10, 8, 11), (19, 8, 20, 9), (16, 11, 17, 12), (4, 13, 5, 14), (12, 15, 13, 16), (1, 18, 2, 19)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 6, 5], [2, 4, 7, 8], [2, 9, 9, 4], [5, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]

Total optimal pinning sets: 1
 Total pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average minimal degree: 2.0

Pinning number: 4

Average overall degree: 2.97

Table 344: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

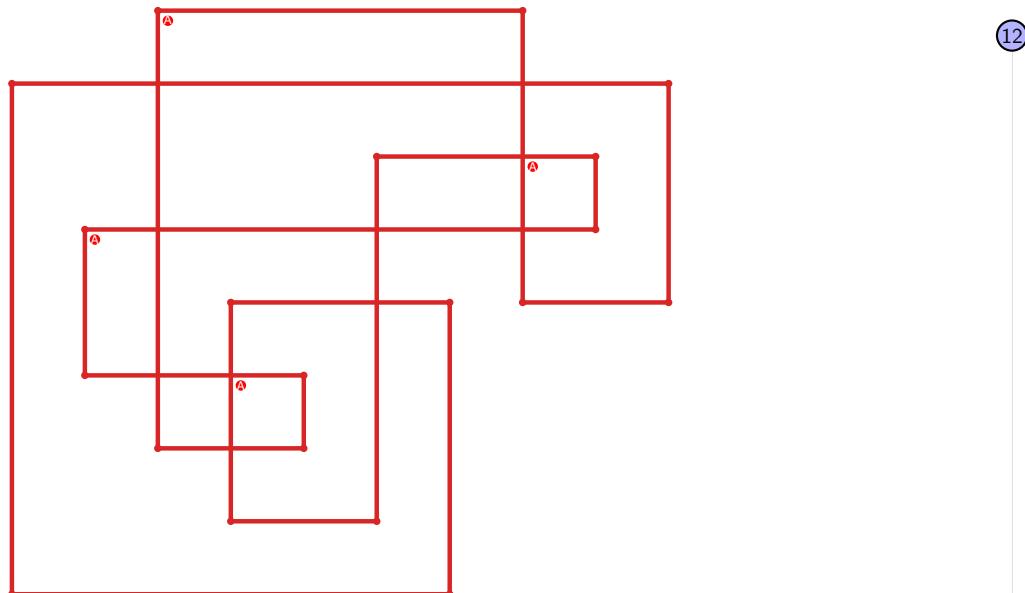


Figure 691: SnapPy multiloop plot.



Figure 692: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.49 $[[3, 16, 4, 1], [2, 9, 3, 10], [12, 15, 13, 16], [4, 7, 5, 8], [1, 11, 2, 10], [11, 8, 12, 9], [14, 20, 15, 17], [13, 20, 14, 19], [6, 18, 7, 19], [5, 18, 6, 17]]$

PD code drawn by SnapPy: $[(2, 5, 3, 6), (9, 6, 10, 7), (16, 7, 1, 8), (8, 15, 9, 16), (10, 13, 11, 14), (1, 14, 2, 15), (20, 3, 17, 4), (4, 17, 5, 18), (18, 11, 19, 12), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 8, 9, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 9, 7, 7], [2, 6, 6, 8], [3, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 7
 Total pinning sets: 506
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.49
 Average overall degree: 3.04

Table 345: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	33	84	126	126	84	36	9	1	499
Average degree	2.5	2.72	2.89	3.02	3.11	3.19	3.24	3.29	3.33	

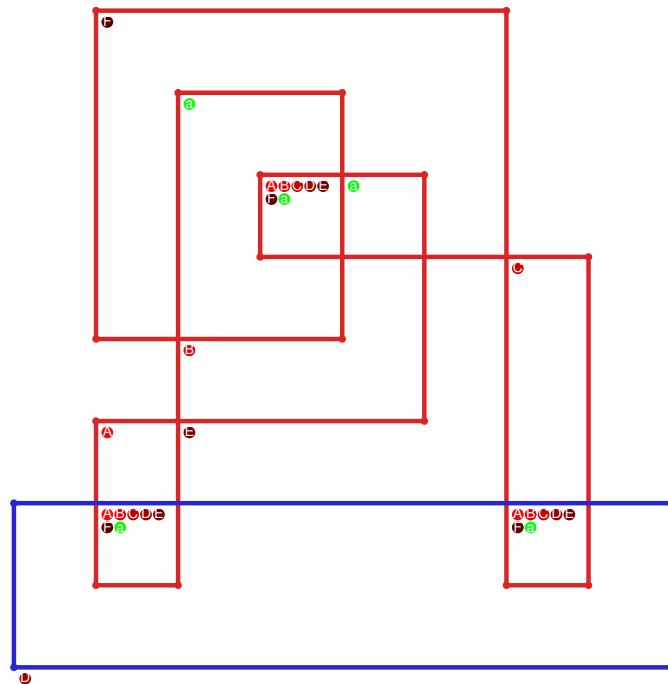


Figure 693: SnapPy multiloop plot.

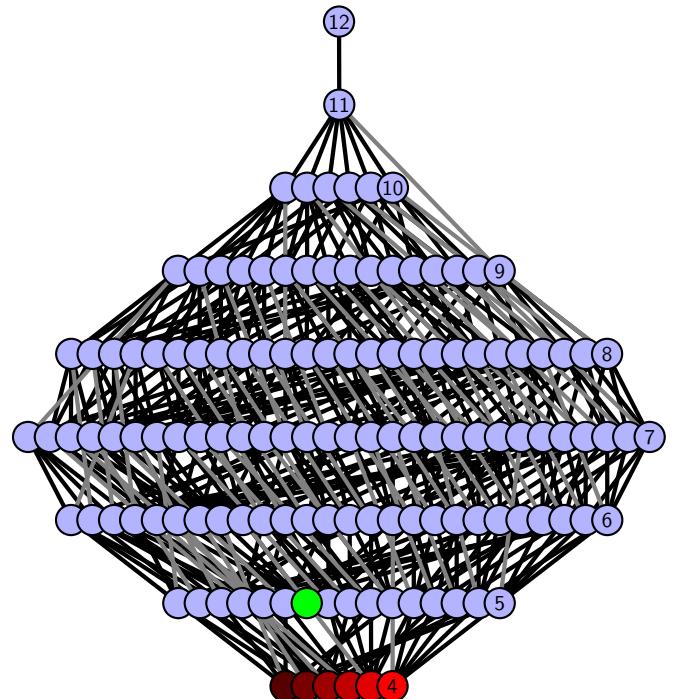


Figure 694: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.50 $[[3, 20, 4, 1], [2, 11, 3, 12], [14, 19, 15, 20], [4, 9, 5, 10], [1, 13, 2, 12], [13, 10, 14, 11], [18, 15, 19, 16], [8, 5, 9, 6], [16, 8, 17, 7], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(6, 3, 7, 4), (15, 4, 16, 5), (5, 14, 6, 15), (2, 7, 3, 8), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (16, 13, 17, 14), (12, 17, 13, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 7, 7, 5], [0, 5, 1, 1], [1, 4, 3, 2], [2, 8, 9, 2], [3, 9, 8, 3], [6, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 346: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

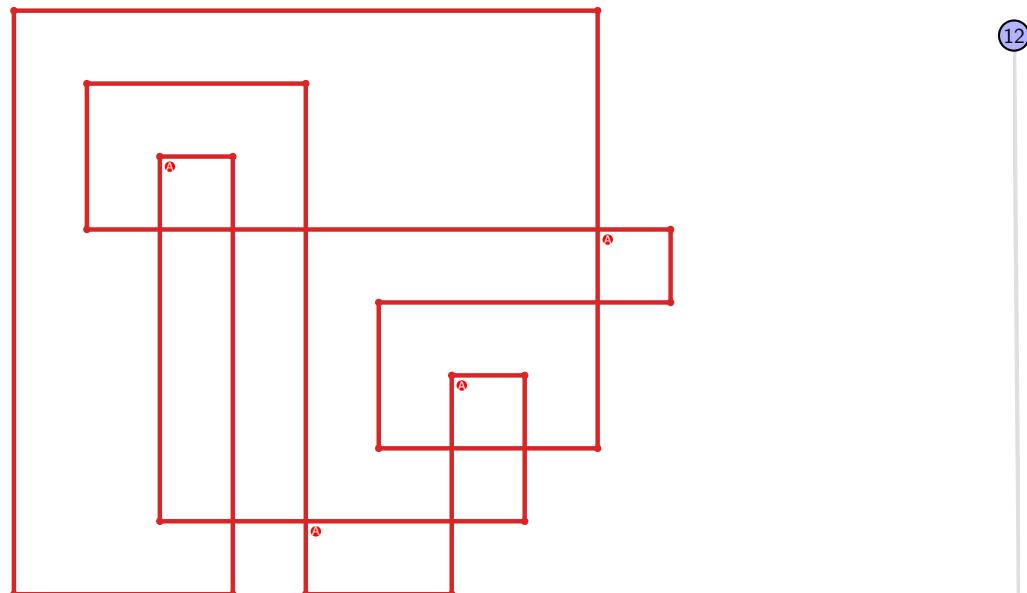


Figure 695: SnapPy multiloop plot.

4

Figure 696: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.51 $[[3, 20, 4, 1], [2, 9, 3, 10], [14, 19, 15, 20], [4, 7, 5, 8], [1, 11, 2, 10], [11, 8, 12, 9], [18, 13, 19, 14], [15, 6, 16, 7], [5, 16, 6, 17], [12, 17, 13, 18]]$

PD code drawn by `SnapPy`: $[(13, 4, 14, 5), (2, 5, 3, 6), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (16, 11, 17, 12), (3, 14, 4, 15), (10, 15, 11, 16), (12, 17, 13, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 5], [0, 5, 1, 1], [1, 4, 3, 9], [2, 9, 9, 2], [2, 8, 8, 3], [3, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 347: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

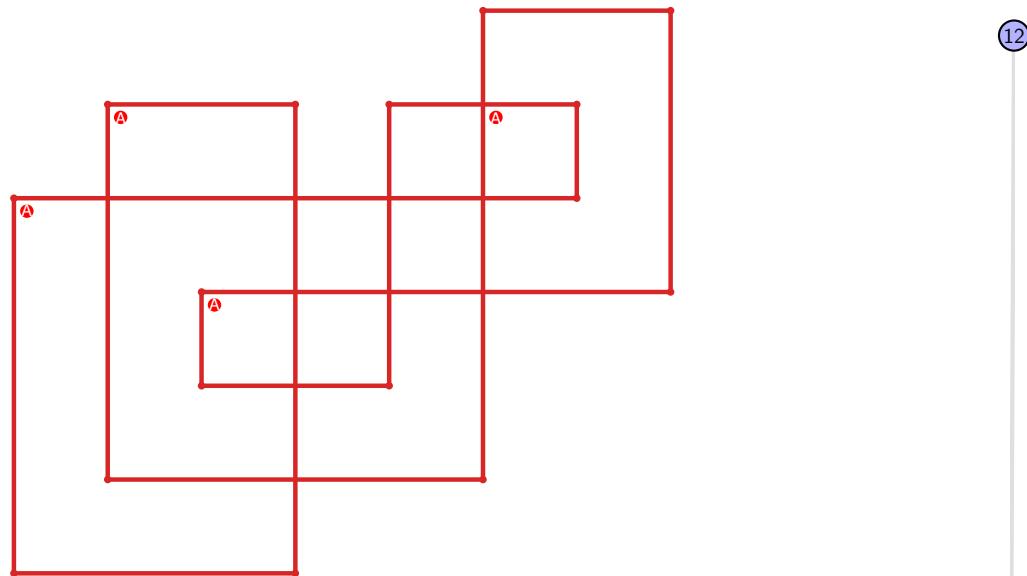


Figure 697: `SnapPy` multiloop plot.

4

Figure 698: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.52 $[[3, 20, 4, 1], [2, 9, 3, 10], [19, 14, 20, 15], [4, 7, 5, 8], [1, 11, 2, 10], [11, 8, 12, 9], [15, 12, 16, 13], [13, 18, 14, 19], [6, 17, 7, 18], [5, 17, 6, 16]]$

PD code drawn by SnapPy: $[(2, 5, 3, 6), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (13, 10, 14, 11), (17, 12, 18, 13), (14, 3, 15, 4), (4, 15, 5, 16), (11, 16, 12, 17), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 8, 9, 5], [0, 5, 1, 1], [1, 4, 3, 6], [2, 5, 9, 7], [2, 6, 8, 2], [3, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 512

Average overall degree: 3.03

Pinning number: 3

Table 348: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	36	84	126	126	84	36	9	1	511
Average degree	2.0	2.44	2.71	2.89	3.02	3.11	3.19	3.24	3.29	3.33	

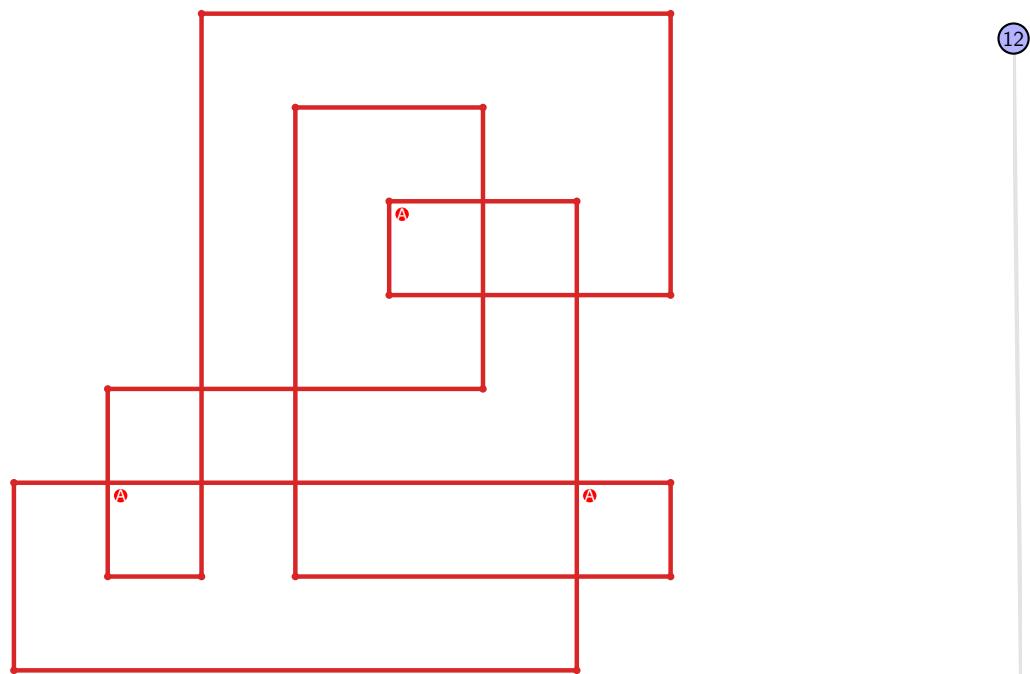


Figure 699: SnapPy multiloop plot.

Figure 700: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.53 [[12, 16, 1, 13], [13, 8, 14, 7], [11, 20, 12, 17], [15, 1, 16, 2], [8, 15, 9, 14], [9, 6, 10, 7], [17, 10, 18, 11], [4, 19, 5, 20], [2, 5, 3, 6], [18, 3, 19, 4]]

PD code drawn by SnapPy: [(16, 1, 13, 2), (12, 3, 1, 4), (7, 4, 8, 5), (5, 20, 6, 17), (15, 8, 16, 9), (18, 11, 19, 12), (10, 19, 11, 20), (17, 6, 18, 7), (9, 14, 10, 15), (2, 13, 3, 14)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 4, 0], [1, 3, 5, 1], [1, 4, 8, 6], [2, 5, 9, 2], [2, 9, 9, 8], [3, 7, 9, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 349: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

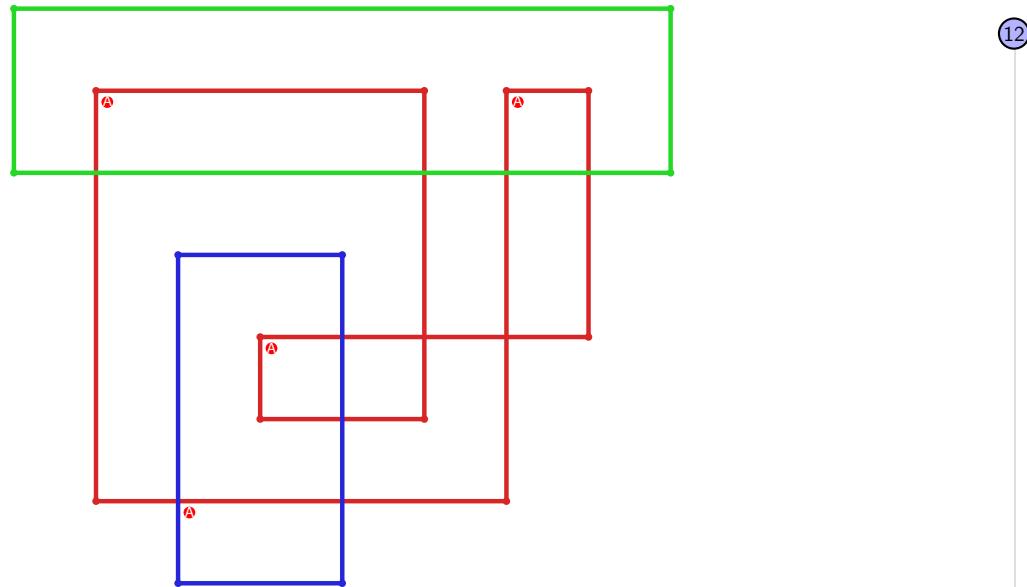


Figure 701: SnapPy multiloop plot.

4

Figure 702: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.54 $[[3, 12, 4, 1], [2, 7, 3, 8], [11, 16, 12, 13], [4, 17, 5, 20], [1, 9, 2, 8], [9, 6, 10, 7], [13, 10, 14, 11], [15, 17, 16, 18], [5, 19, 6, 20], [14, 19, 15, 18]]$

PD code drawn by `SnapPy`: $[(3, 12, 4, 1), (8, 1, 9, 2), (2, 7, 3, 8), (13, 4, 14, 5), (9, 6, 10, 7), (5, 16, 6, 13), (19, 14, 20, 15), (11, 20, 12, 17), (17, 10, 18, 11), (15, 18, 16, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 8], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 9, 2], [2, 9, 9, 3], [3, 9, 5, 3], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 350: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

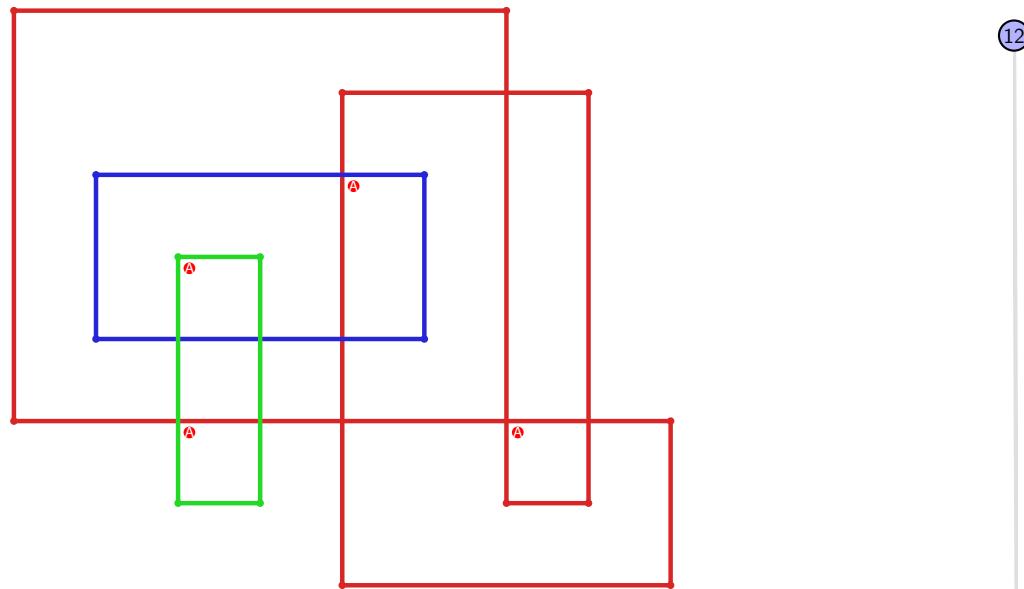


Figure 703: `SnapPy` multiloop plot.

4

Figure 704: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.55 $[[3, 16, 4, 1], [9, 2, 10, 3], [15, 4, 16, 5], [1, 8, 2, 9], [10, 8, 11, 7], [5, 17, 6, 20], [14, 11, 15, 12], [6, 17, 7, 18], [19, 12, 20, 13], [13, 18, 14, 19]]$

PD code drawn by `SnapPy`: $[(12, 1, 13, 2), (4, 7, 5, 8), (14, 5, 15, 6), (11, 8, 12, 9), (20, 9, 17, 10), (16, 13, 1, 14), (6, 15, 7, 16), (17, 2, 18, 3), (3, 18, 4, 19), (10, 19, 11, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 7, 7, 8], [2, 8, 9, 4], [4, 9, 5, 5], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 351: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

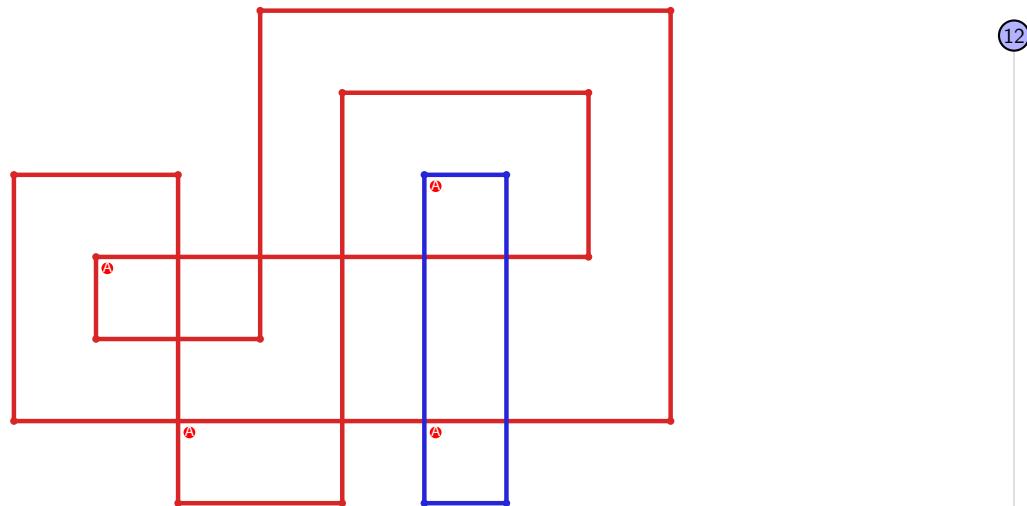


Figure 705: `SnapPy` multiloop plot.

4

Figure 706: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.56 $[[3, 16, 4, 1], [2, 11, 3, 12], [15, 20, 16, 17], [4, 9, 5, 10], [1, 13, 2, 12], [13, 10, 14, 11], [17, 14, 18, 15], [19, 6, 20, 7], [8, 5, 9, 6], [18, 8, 19, 7]]$

PD code drawn by `SnapPy`: $[(6, 3, 7, 4), (17, 4, 18, 5), (5, 20, 6, 17), (2, 7, 3, 8), (11, 8, 12, 9), (16, 9, 1, 10), (10, 15, 11, 16), (19, 12, 20, 13), (1, 14, 2, 15), (13, 18, 14, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 8, 5], [0, 5, 1, 1], [1, 4, 3, 6], [2, 5, 9, 2], [2, 9, 9, 8], [3, 7, 9, 3], [6, 8, 7, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 352: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

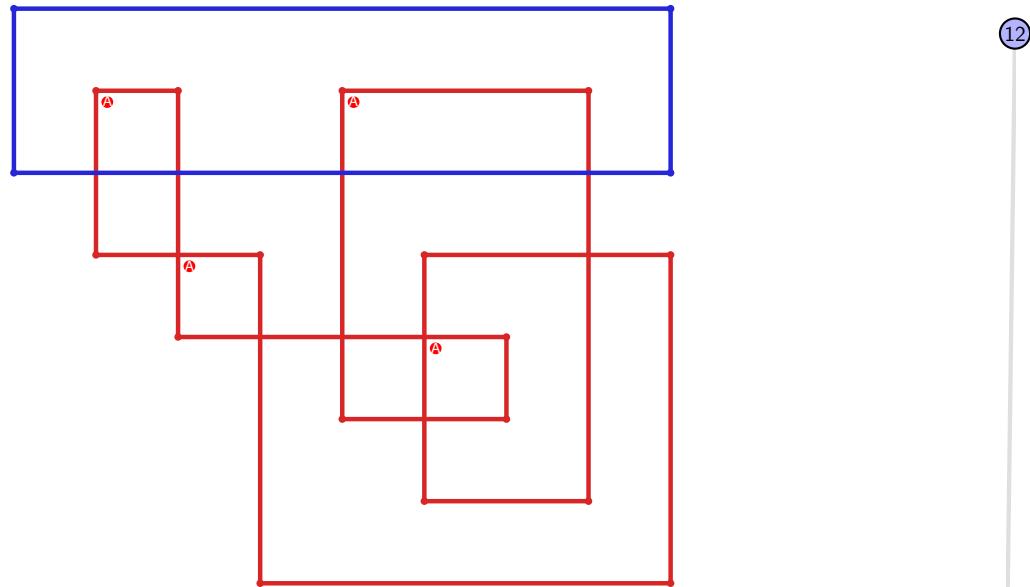


Figure 707: `SnapPy` multiloop plot.



Figure 708: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.57 $[[14, 20, 1, 15], [15, 13, 16, 14], [19, 1, 20, 2], [12, 16, 13, 17], [2, 10, 3, 9], [6, 18, 7, 19], [17, 7, 18, 8], [11, 4, 12, 5], [10, 4, 11, 3], [5, 8, 6, 9]]$

PD code drawn by `SnapPy`: $[(1, 8, 2, 9), (9, 2, 10, 3), (20, 5, 15, 6), (3, 6, 4, 7), (7, 14, 8, 1), (18, 11, 19, 12), (16, 13, 17, 14), (10, 19, 11, 20), (4, 15, 5, 16), (12, 17, 13, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 6, 7, 1], [2, 8, 8, 9], [2, 9, 6, 6], [3, 5, 5, 9], [3, 9, 8, 8], [4, 7, 7, 4], [4, 7, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 353: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

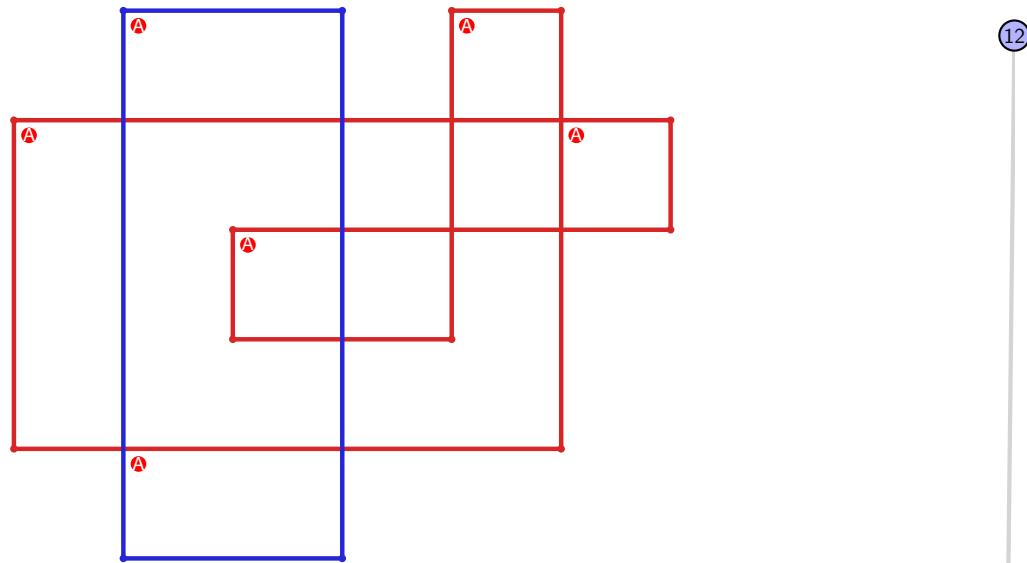


Figure 709: `SnapPy` multiloop plot.



Figure 710: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.58 $[[4, 20, 1, 5], [5, 3, 6, 4], [10, 19, 11, 20], [1, 14, 2, 13], [2, 12, 3, 13], [6, 15, 7, 16], [18, 9, 19, 10], [11, 15, 12, 14], [7, 17, 8, 16], [8, 17, 9, 18]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (11, 18, 12, 19), (4, 5, 1, 6), (6, 3, 7, 4), (7, 20, 8, 5), (15, 8, 16, 9), (9, 16, 10, 17), (17, 10, 18, 11), (19, 12, 20, 13), (2, 13, 3, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 7, 4, 4], [1, 3, 3, 7], [1, 7, 8, 8], [2, 9, 9, 2], [2, 5, 4, 3], [5, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 354: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

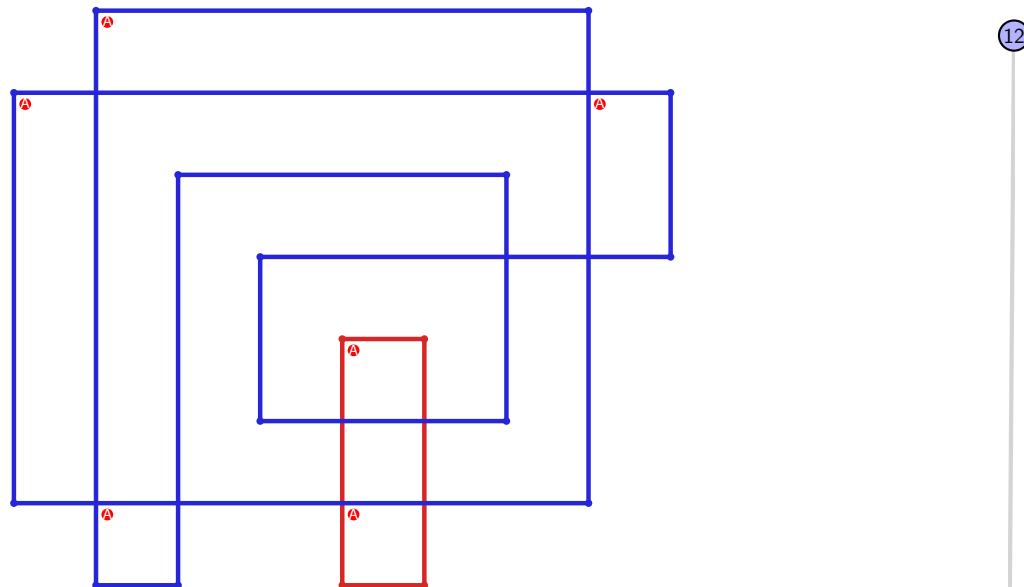


Figure 711: SnapPy multiloop plot.



Figure 712: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.59 $[[7, 12, 8, 1], [11, 6, 12, 7], [8, 2, 9, 1], [10, 20, 11, 13], [15, 5, 16, 6], [2, 18, 3, 19], [9, 14, 10, 13], [14, 19, 15, 20], [4, 16, 5, 17], [17, 3, 18, 4]]$

PD code drawn by `SnapPy`: $[(20, 1, 13, 2), (18, 3, 19, 4), (9, 4, 10, 5), (5, 10, 6, 11), (11, 6, 12, 7), (2, 19, 3, 20), (12, 13, 1, 14), (17, 14, 18, 15), (8, 15, 9, 16), (16, 7, 17, 8)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 6, 0], [1, 6, 6, 7], [1, 7, 8, 8], [2, 9, 9, 7], [2, 7, 3, 3], [3, 6, 5, 4], [4, 9, 9, 4], [5, 8, 8, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 355: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

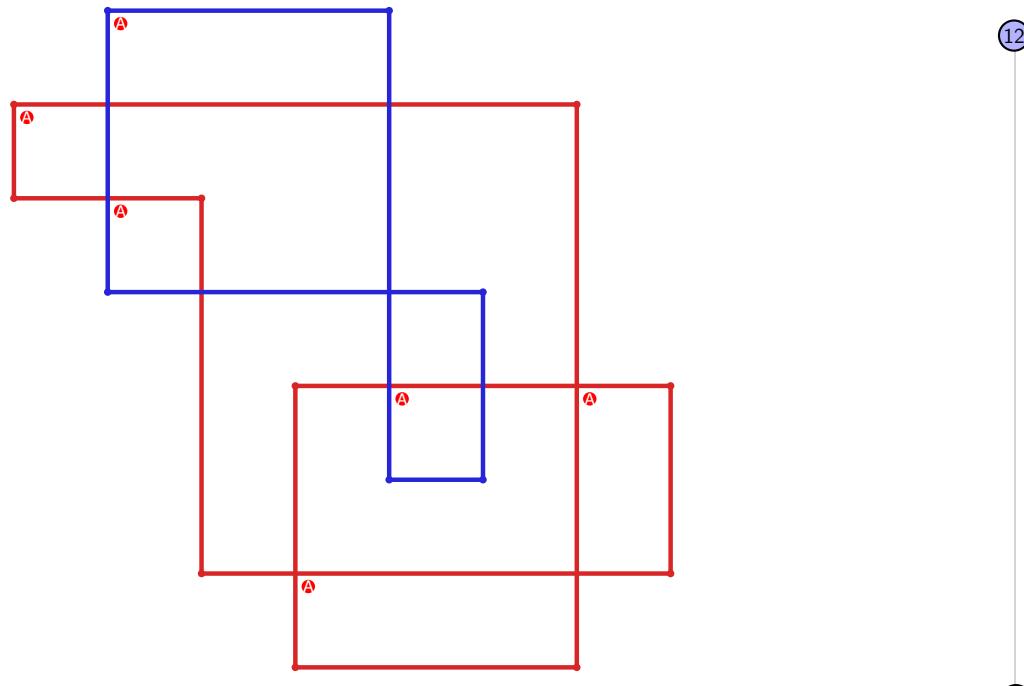


Figure 713: `SnapPy` multiloop plot.

12

6

Figure 714: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.60 $[[4, 20, 1, 5], [5, 3, 6, 4], [8, 19, 9, 20], [1, 14, 2, 13], [2, 12, 3, 13], [6, 17, 7, 18], [18, 7, 19, 8], [9, 17, 10, 16], [14, 11, 15, 12], [10, 15, 11, 16]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (11, 16, 12, 17), (7, 20, 8, 5), (4, 5, 1, 6), (6, 3, 7, 4), (19, 8, 20, 9), (9, 18, 10, 19), (15, 10, 16, 11), (17, 12, 18, 13), (2, 13, 3, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 8, 4, 4], [1, 3, 3, 8], [1, 7, 6, 6], [2, 5, 5, 2], [2, 5, 9, 9], [3, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 356: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

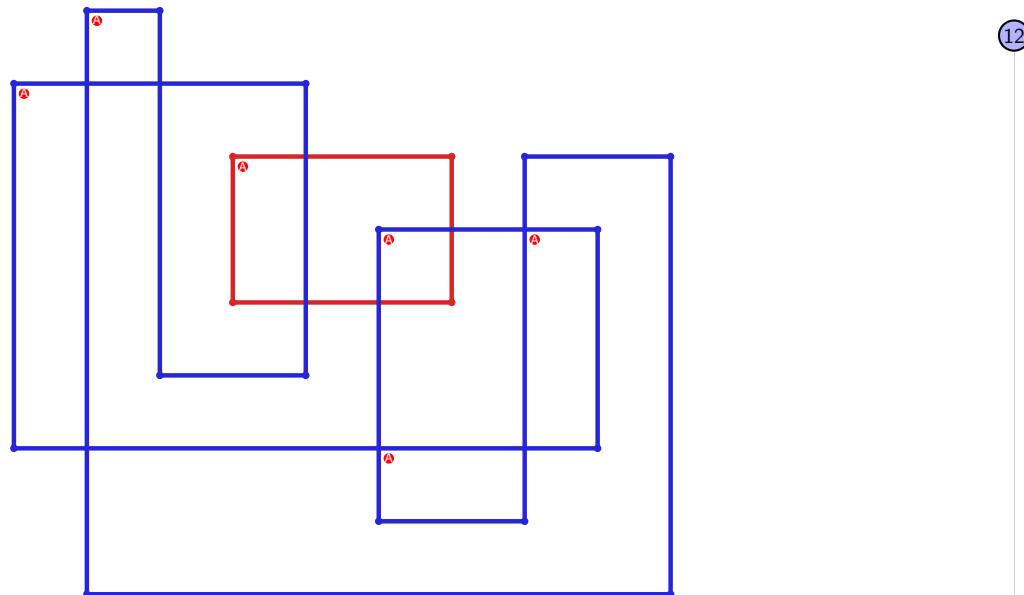


Figure 715: SnapPy multiloop plot.

6

Figure 716: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.61 $[[4, 10, 1, 5], [5, 3, 6, 4], [9, 20, 10, 11], [1, 18, 2, 17], [2, 16, 3, 17], [6, 14, 7, 13], [11, 8, 12, 9], [14, 19, 15, 20], [18, 15, 19, 16], [7, 12, 8, 13]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (10, 19, 11, 20), (2, 15, 3, 16), (18, 11, 19, 12), (12, 17, 13, 18), (7, 14, 8, 5), (4, 5, 1, 6), (6, 3, 7, 4), (13, 8, 14, 9), (20, 9, 15, 10)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 8, 4, 4], [1, 3, 3, 8], [1, 7, 9, 9], [2, 9, 9, 2], [2, 5, 8, 8], [3, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 64
Pinning number: 6

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.85

Table 357: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

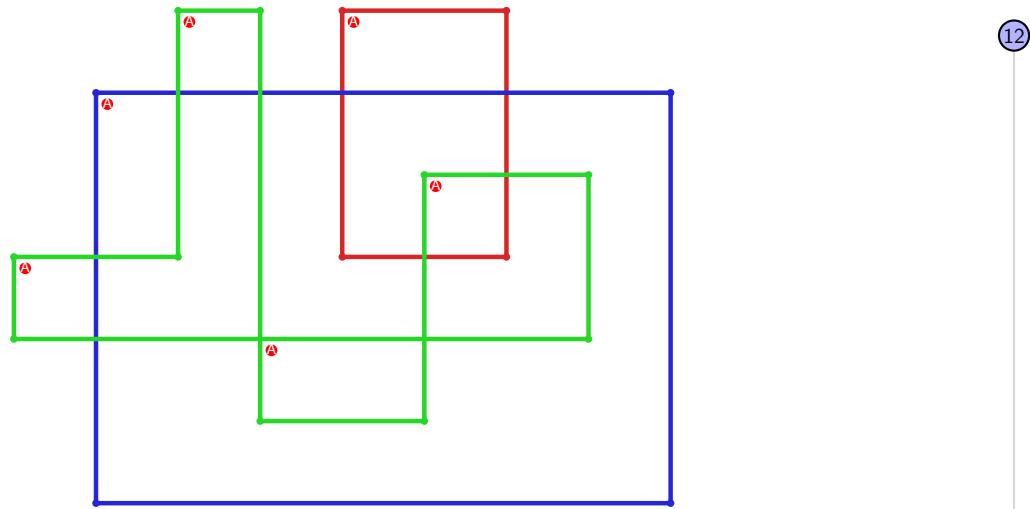


Figure 717: SnapPy multiloop plot.



Figure 718: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.62 $[[5, 20, 6, 1], [19, 4, 20, 5], [6, 16, 7, 15], [1, 13, 2, 12], [3, 18, 4, 19], [16, 8, 17, 7], [9, 14, 10, 15], [13, 10, 14, 11], [2, 11, 3, 12], [17, 8, 18, 9]]$

PD code drawn by `SnapPy`: $[(15, 20, 16, 1), (3, 12, 4, 13), (13, 4, 14, 5), (9, 6, 10, 7), (18, 7, 19, 8), (8, 17, 9, 18), (5, 10, 6, 11), (11, 2, 12, 3), (19, 14, 20, 15), (1, 16, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 6], [0, 7, 8, 8], [1, 8, 9, 1], [2, 9, 9, 2], [2, 9, 7, 7], [3, 6, 6, 8], [3, 7, 4, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 358: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

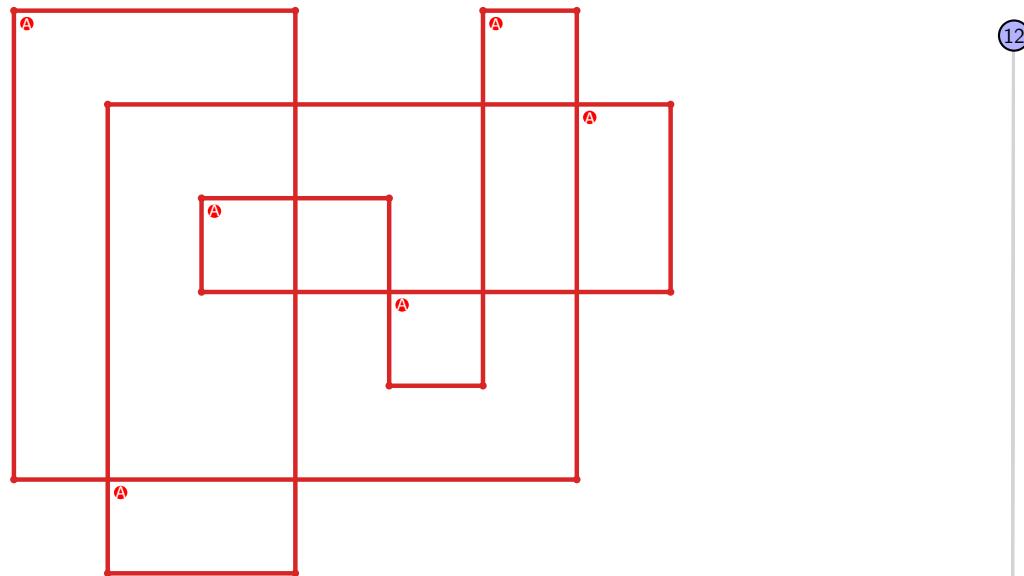


Figure 719: `SnapPy` multiloop plot.

Figure 720: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.63 $[[10, 20, 1, 11], [11, 9, 12, 10], [19, 1, 20, 2], [8, 12, 9, 13], [2, 18, 3, 19], [13, 3, 14, 4], [17, 7, 18, 8], [14, 7, 15, 6], [4, 16, 5, 17], [15, 5, 16, 6]]$

PD code drawn by SnapPy: [(16, 1, 17, 2), (18, 3, 19, 4), (4, 17, 5, 18), (20, 5, 11, 6), (14, 7, 15, 8), (12, 9, 13, 10), (6, 15, 7, 16), (2, 19, 3, 20), (10, 11, 1, 12), (8, 13, 9, 14)]

Planar representation generated by `plantri`: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 5, 2], [3, 4, 7, 8], [3, 8, 7, 4], [5, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1
 Total pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average minimal degree: 2.0

Pinning number: 6

Table 359: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

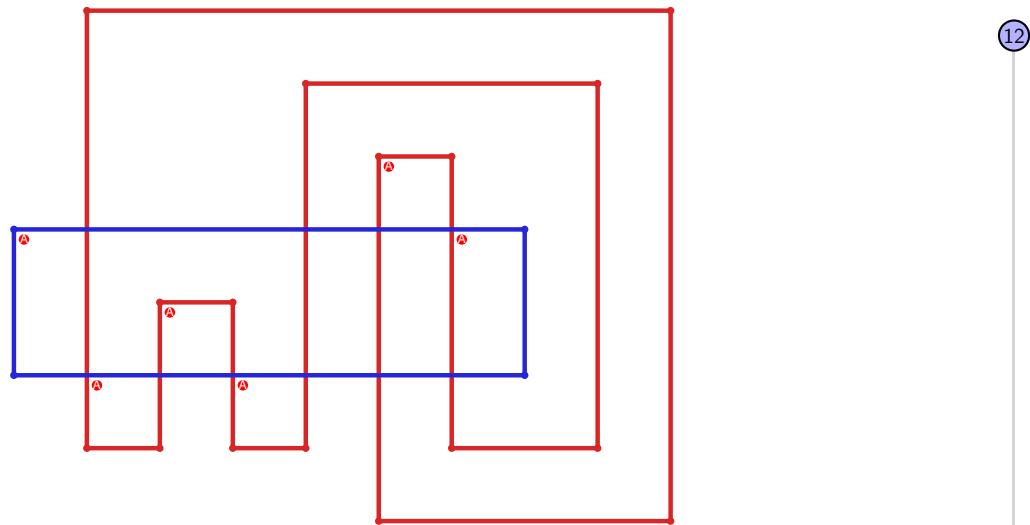
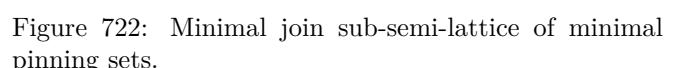


Figure 721: SnapPy multiloop plot.



4.9.64 $[[20, 7, 1, 8], [8, 19, 9, 20], [11, 6, 12, 7], [1, 16, 2, 17], [18, 9, 19, 10], [10, 17, 11, 18], [5, 14, 6, 15], [12, 4, 13, 3], [15, 2, 16, 3], [13, 4, 14, 5]]$

PD code drawn by `SnapPy`: $[(20, 9, 1, 10), (10, 1, 11, 2), (8, 3, 9, 4), (17, 4, 18, 5), (15, 6, 16, 7), (2, 11, 3, 12), (18, 13, 19, 14), (7, 14, 8, 15), (5, 16, 6, 17), (12, 19, 13, 20)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 7], [0, 8, 8, 5], [1, 5, 5, 1], [2, 4, 4, 3], [2, 8, 9, 9], [2, 9, 9, 8], [3, 7, 6, 3], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 360: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

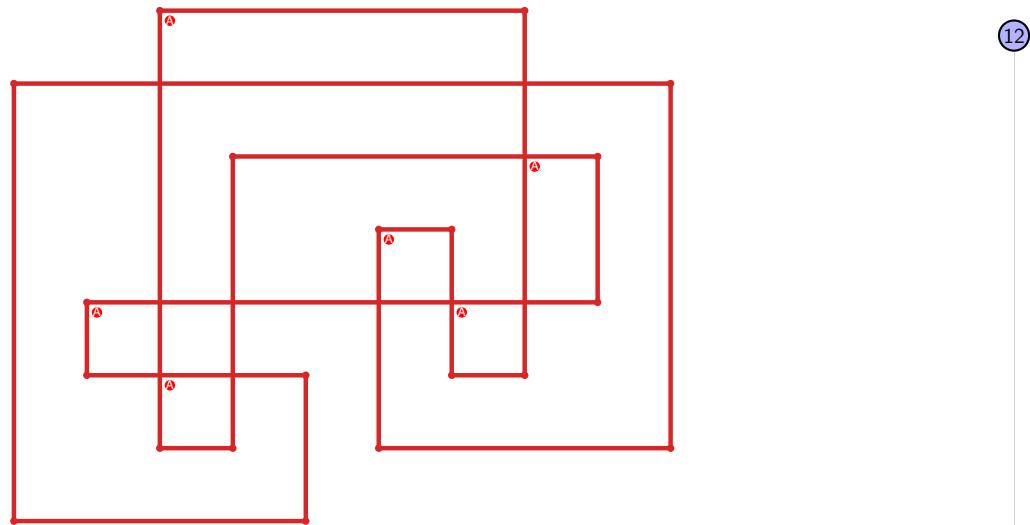


Figure 723: `SnapPy` multiloop plot.

6

Figure 724: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.65 $[[14, 20, 1, 15], [15, 13, 16, 14], [19, 5, 20, 6], [1, 10, 2, 11], [12, 16, 13, 17], [6, 18, 7, 19], [9, 4, 10, 5], [2, 8, 3, 7], [11, 18, 12, 17], [3, 8, 4, 9]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (15, 2, 16, 3), (4, 13, 5, 14), (14, 5, 1, 6), (12, 7, 13, 8), (17, 10, 18, 11), (9, 18, 10, 19), (19, 8, 20, 9), (3, 20, 4, 15), (11, 16, 12, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 6], [0, 6, 7, 8], [1, 8, 8, 1], [2, 8, 7, 2], [2, 9, 9, 3], [3, 9, 9, 5], [3, 5, 4, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 64
Pinning number: 6

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.85

Table 361: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

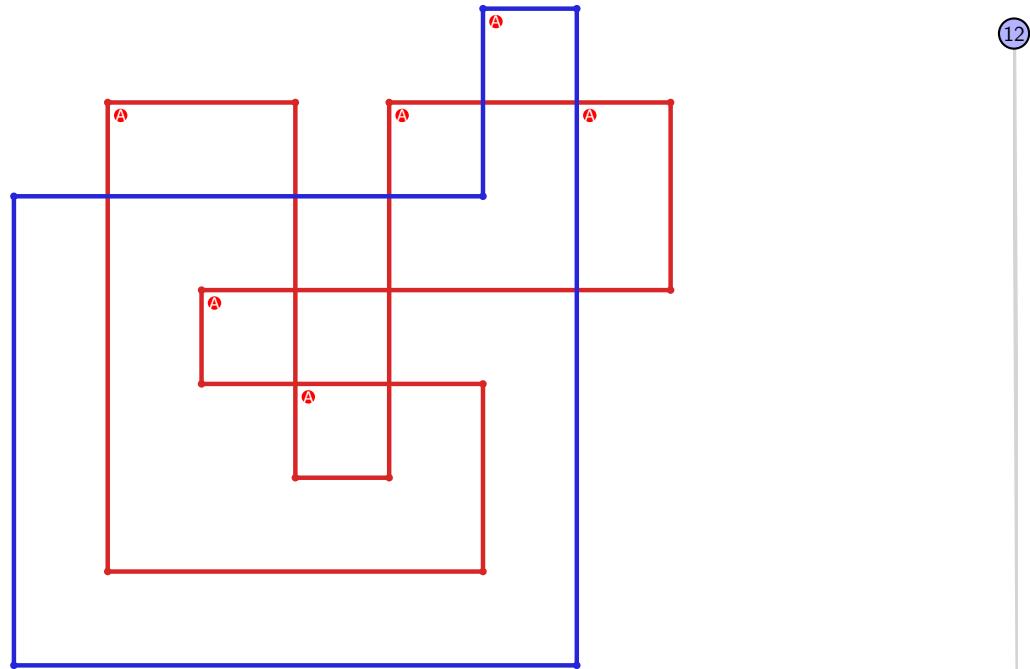


Figure 725: SnapPy multiloop plot.

12

6

Figure 726: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.66 $[[10, 20, 1, 11], [11, 9, 12, 10], [14, 19, 15, 20], [1, 6, 2, 7], [8, 12, 9, 13], [13, 7, 14, 8], [2, 18, 3, 19], [15, 5, 16, 6], [17, 3, 18, 4], [4, 16, 5, 17]]$

PD code drawn by SnapPy: $[(11, 10, 12, 1), (19, 2, 20, 3), (8, 3, 9, 4), (17, 4, 18, 5), (15, 6, 16, 7), (1, 20, 2, 11), (9, 12, 10, 13), (18, 13, 19, 14), (7, 14, 8, 15), (5, 16, 6, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 7], [0, 7, 6, 5], [1, 5, 5, 1], [2, 4, 4, 3], [2, 3, 8, 8], [2, 9, 9, 3], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 362: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

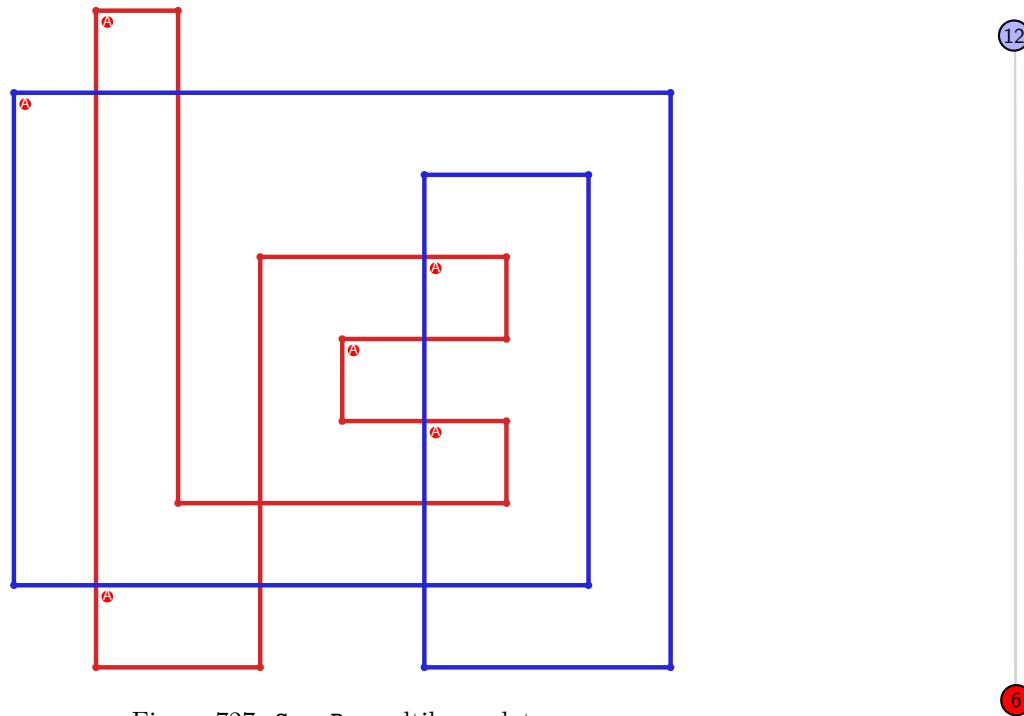


Figure 727: SnapPy multiloop plot.

Figure 728: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.67 $[[10, 20, 1, 11], [11, 7, 12, 8], [19, 9, 20, 10], [1, 14, 2, 13], [6, 12, 7, 13], [8, 18, 9, 19], [14, 5, 15, 4], [2, 16, 3, 17], [17, 5, 18, 6], [15, 3, 16, 4]]$

PD code drawn by `SnapPy`: $[(11, 10, 12, 1), (15, 2, 16, 3), (13, 4, 14, 5), (19, 8, 20, 9), (9, 18, 10, 19), (1, 16, 2, 17), (17, 6, 18, 7), (7, 20, 8, 11), (3, 12, 4, 13), (5, 14, 6, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 5, 0], [0, 6, 7, 4], [1, 3, 8, 1], [1, 8, 2, 2], [3, 8, 9, 9], [3, 9, 9, 8], [4, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 363: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

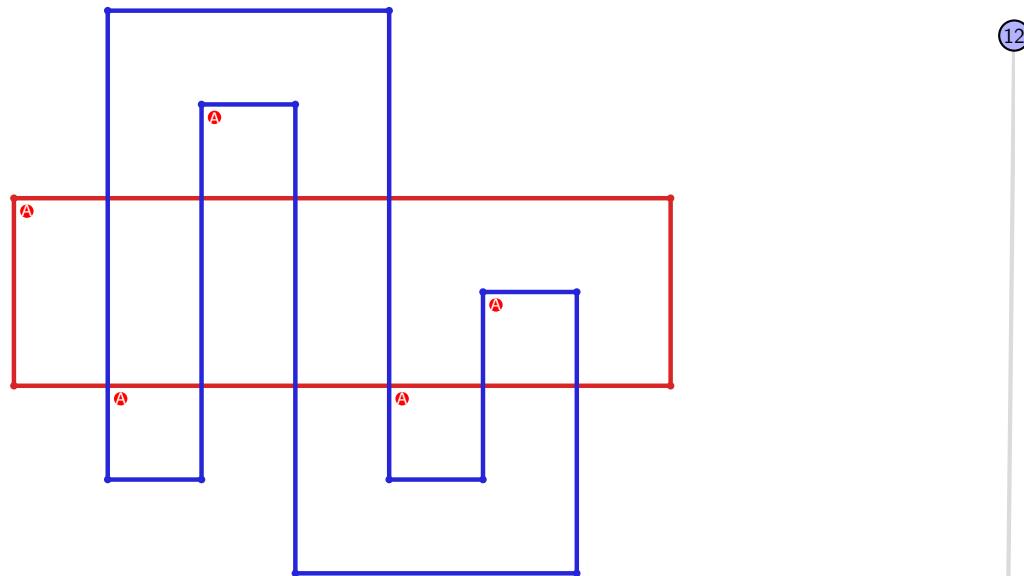


Figure 729: `SnapPy` multiloop plot.

5

Figure 730: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.68 $[[13, 20, 14, 1], [12, 15, 13, 16], [19, 14, 20, 15], [1, 10, 2, 11], [16, 11, 17, 12], [18, 5, 19, 6], [9, 4, 10, 5], [2, 8, 3, 7], [17, 7, 18, 6], [3, 8, 4, 9]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (15, 2, 16, 3), (3, 14, 4, 15), (4, 19, 5, 20), (20, 5, 1, 6), (18, 7, 19, 8), (13, 8, 14, 9), (16, 11, 17, 12), (9, 12, 10, 13), (10, 17, 11, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 6, 7, 4], [1, 3, 8, 1], [2, 8, 8, 6], [3, 5, 9, 9], [3, 9, 9, 8], [4, 7, 5, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 364: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

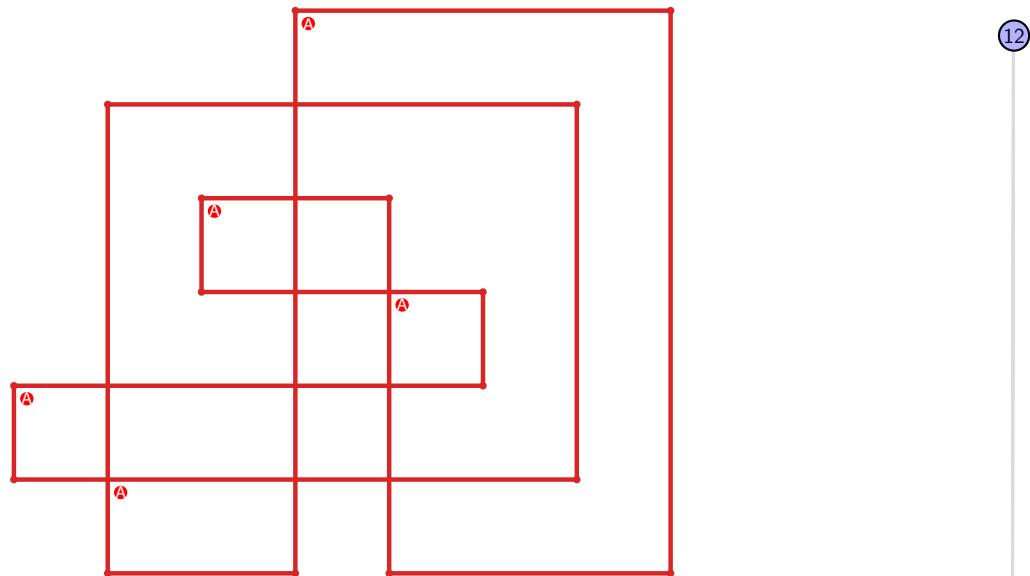


Figure 731: `SnapPy` multiloop plot.



Figure 732: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.69 $[[9, 20, 10, 1], [8, 11, 9, 12], [19, 10, 20, 11], [1, 6, 2, 7], [12, 7, 13, 8], [13, 18, 14, 19], [14, 5, 15, 6], [2, 17, 3, 18], [4, 15, 5, 16], [16, 3, 17, 4]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (17, 2, 18, 3), (8, 3, 9, 4), (15, 6, 16, 7), (4, 7, 5, 8), (20, 11, 1, 12), (18, 13, 19, 14), (9, 14, 10, 15), (5, 16, 6, 17), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 6, 7, 4], [1, 3, 5, 1], [2, 4, 7, 6], [3, 5, 8, 8], [3, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 365: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

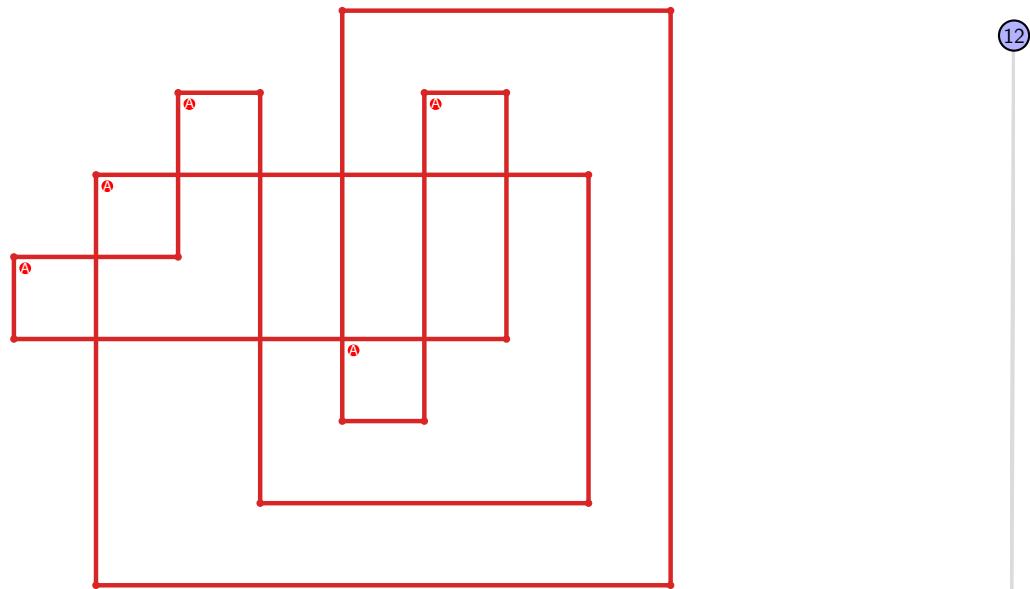


Figure 733: SnapPy multiloop plot.

5

Figure 734: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.70 $[[6, 3, 1, 4], [4, 7, 5, 20], [5, 19, 6, 20], [12, 2, 13, 3], [1, 13, 2, 14], [7, 14, 8, 15], [11, 18, 12, 19], [8, 18, 9, 17], [15, 10, 16, 11], [9, 16, 10, 17]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (4, 1, 5, 2), (10, 19, 11, 20), (5, 8, 6, 9), (16, 9, 17, 10), (18, 11, 19, 12), (12, 17, 13, 18), (20, 13, 7, 14), (3, 14, 4, 15), (15, 2, 16, 3)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 2, 2], [0, 1, 1, 6], [0, 6, 4, 4], [0, 3, 3, 5], [1, 4, 7, 8], [2, 8, 7, 3], [5, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 240
 Pinning number: 5

Average optimal degree: 2.3
 Average minimal degree: 2.3
 Average overall degree: 2.98

Table 366: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.3	2.62	2.84	3.0	3.11	3.2	3.27	3.33	

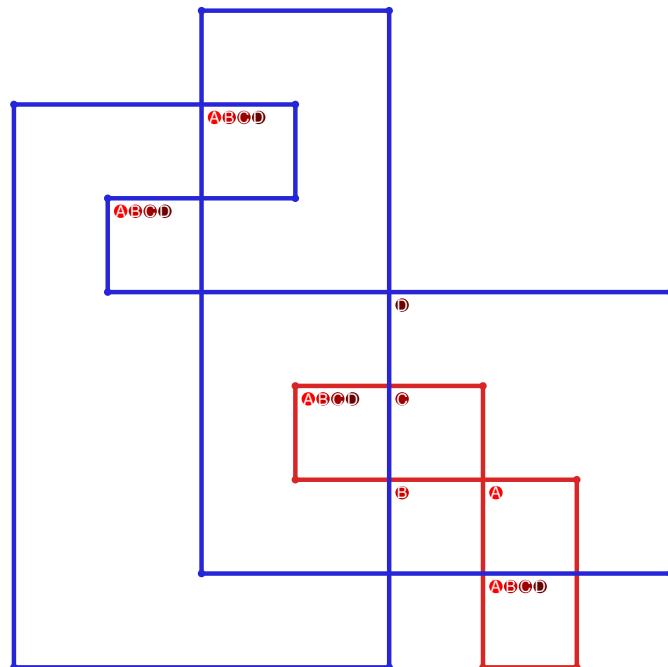


Figure 735: SnapPy multiloop plot.

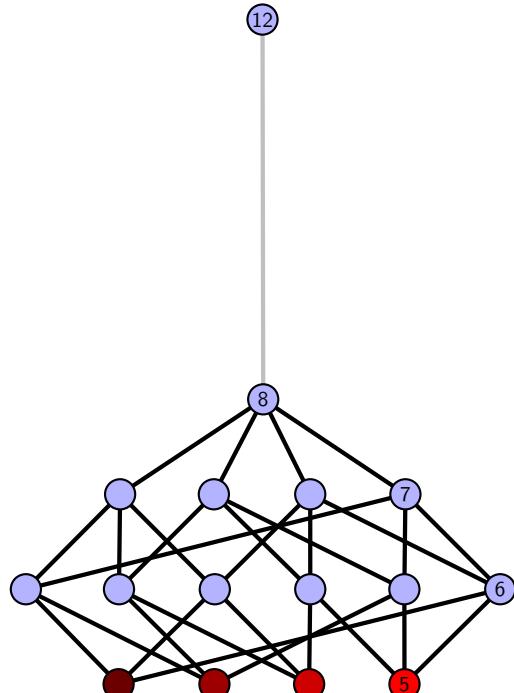


Figure 736: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.71 $[[12, 3, 1, 4], [4, 11, 5, 12], [2, 20, 3, 13], [1, 20, 2, 19], [10, 18, 11, 19], [5, 14, 6, 13], [15, 9, 16, 10], [17, 7, 18, 8], [14, 7, 15, 6], [8, 16, 9, 17]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (4, 15, 5, 16), (18, 5, 19, 6), (16, 7, 17, 8), (2, 9, 3, 10), (6, 17, 7, 18), (8, 19, 9, 20), (20, 11, 13, 12), (12, 13, 1, 14), (14, 3, 15, 4)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 3, 3], [0, 2, 2, 4], [1, 3, 6, 7], [1, 8, 8, 2], [4, 8, 9, 9], [4, 9, 9, 8], [5, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 367: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

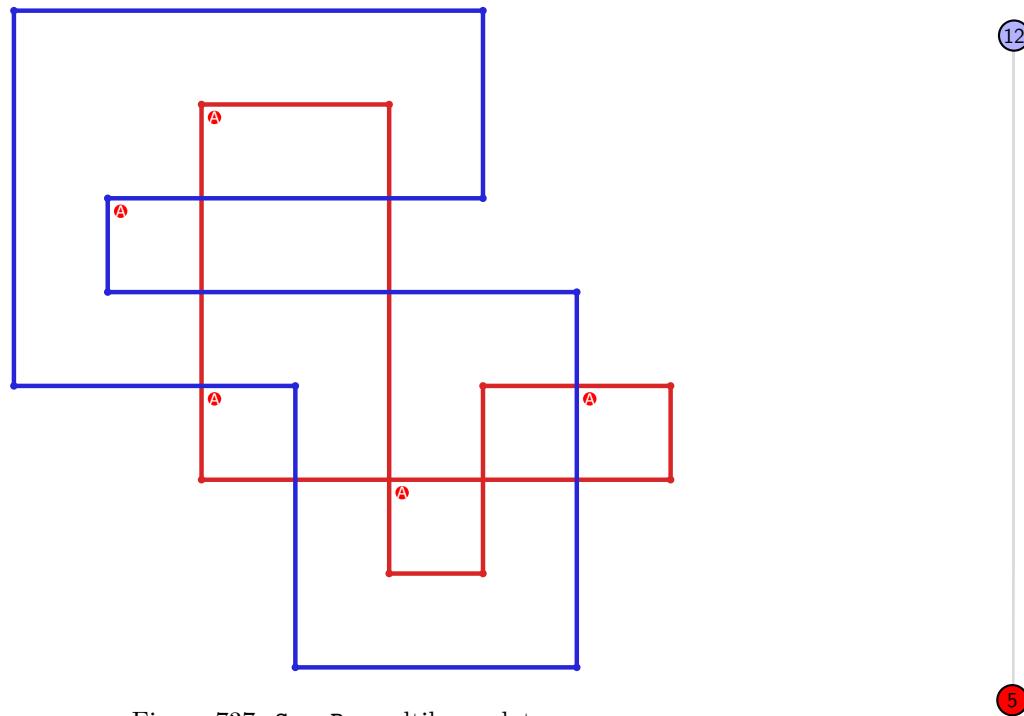


Figure 737: SnapPy multiloop plot.

Figure 738: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.72 $[[14, 3, 1, 4], [4, 13, 5, 14], [2, 20, 3, 15], [1, 20, 2, 19], [12, 18, 13, 19], [5, 16, 6, 15], [6, 11, 7, 12], [17, 9, 18, 10], [16, 9, 17, 8], [10, 7, 11, 8]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (8, 5, 9, 6), (6, 17, 7, 18), (18, 7, 19, 8), (4, 9, 5, 10), (2, 11, 3, 12), (10, 19, 11, 20), (20, 13, 15, 14), (14, 15, 1, 16), (16, 3, 17, 4)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 3, 3], [0, 2, 2, 4], [1, 3, 6, 7], [1, 8, 6, 2], [4, 5, 9, 9], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 368: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

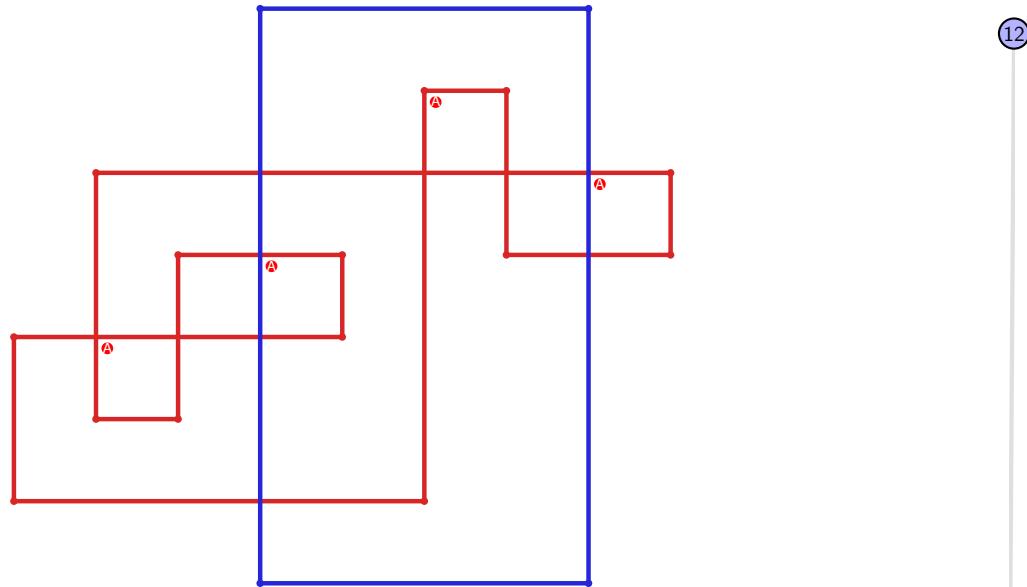


Figure 739: SnapPy multiloop plot.



Figure 740: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.73 [[10, 3, 1, 4], [4, 9, 5, 10], [2, 20, 3, 11], [1, 20, 2, 19], [8, 18, 9, 19], [5, 12, 6, 11], [15, 7, 16, 8], [17, 12, 18, 13], [6, 14, 7, 15], [16, 14, 17, 13]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (16, 5, 17, 6), (2, 7, 3, 8), (14, 17, 15, 18), (4, 15, 5, 16), (6, 19, 7, 20), (20, 9, 11, 10), (10, 11, 1, 12), (12, 3, 13, 4), (18, 13, 19, 14)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 3, 3], [0, 2, 2, 4], [1, 3, 6, 7], [1, 7, 8, 2], [4, 8, 8, 9], [4, 9, 9, 5], [5, 9, 6, 6], [6, 8, 7, 7]]

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 7

Average minimal degree: 2.5

Total pinning sets: 242

Average overall degree: 2.98

Pinning number: 5

Table 369: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	18	54	70	56	28	8	1	235
Average degree	2.27	2.61	2.85	3.0	3.11	3.2	3.27	3.33	

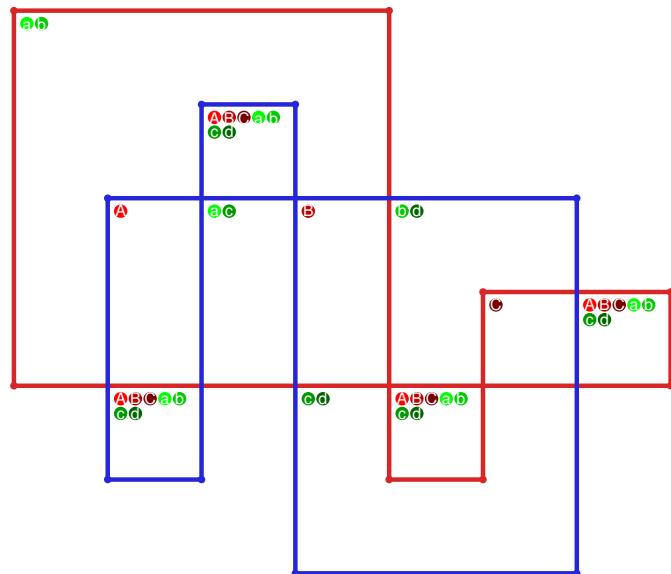


Figure 741: SnapPy multiloop plot.

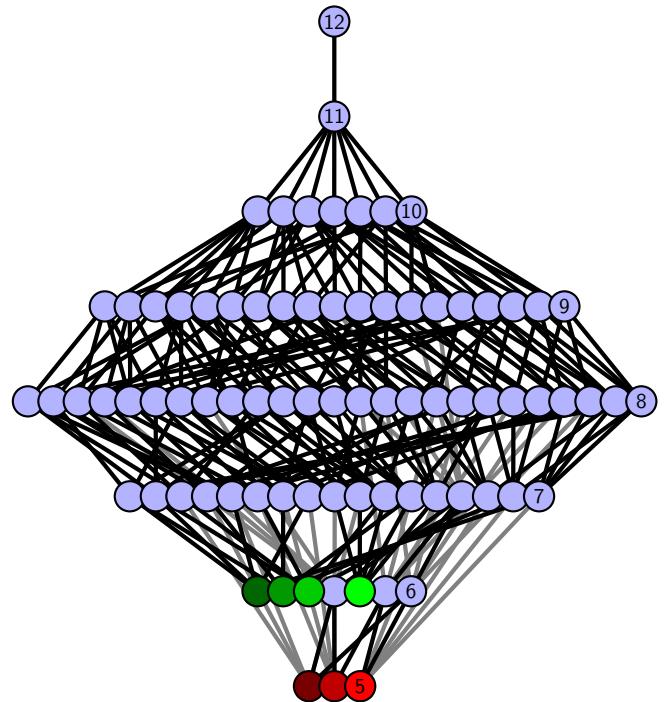


Figure 742: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.74 $[[20, 3, 1, 4], [4, 19, 5, 20], [11, 2, 12, 3], [1, 12, 2, 13], [18, 5, 19, 6], [10, 17, 11, 18], [13, 7, 14, 6], [14, 9, 15, 10], [16, 7, 17, 8], [8, 15, 9, 16]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (18, 1, 19, 2), (16, 3, 17, 4), (4, 11, 5, 12), (14, 5, 15, 6), (12, 7, 13, 8), (19, 10, 20, 11), (6, 13, 7, 14), (8, 15, 9, 16), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 3, 3], [0, 2, 2, 6], [1, 6, 5, 1], [2, 4, 7, 8], [3, 8, 7, 4], [5, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 370: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

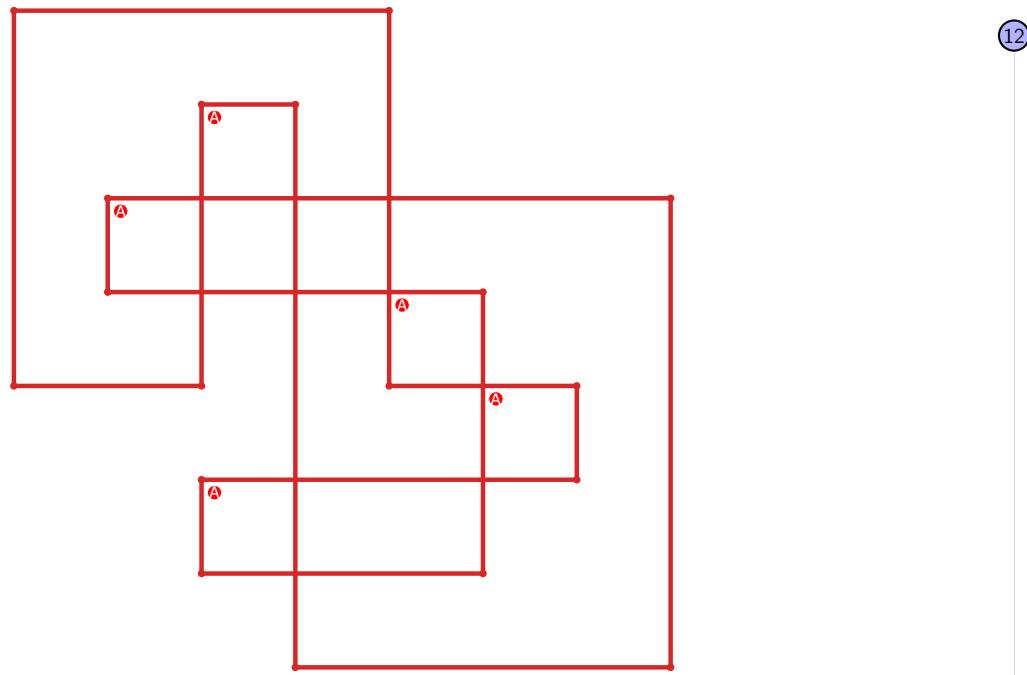


Figure 743: SnapPy multiloop plot.

Figure 744: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.75 $[[10, 20, 1, 11], [11, 3, 12, 4], [17, 9, 18, 10], [19, 1, 20, 2], [2, 18, 3, 19], [12, 5, 13, 4], [6, 16, 7, 17], [8, 14, 9, 15], [5, 14, 6, 13], [15, 7, 16, 8]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (2, 15, 3, 16), (18, 5, 19, 6), (20, 7, 11, 8), (12, 9, 13, 10), (16, 3, 17, 4), (6, 17, 7, 18), (4, 19, 5, 20), (10, 11, 1, 12), (8, 13, 9, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 7, 4], [0, 4, 4, 0], [1, 3, 3, 2], [1, 8, 8, 1], [2, 8, 9, 9], [2, 9, 9, 8], [5, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 371: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

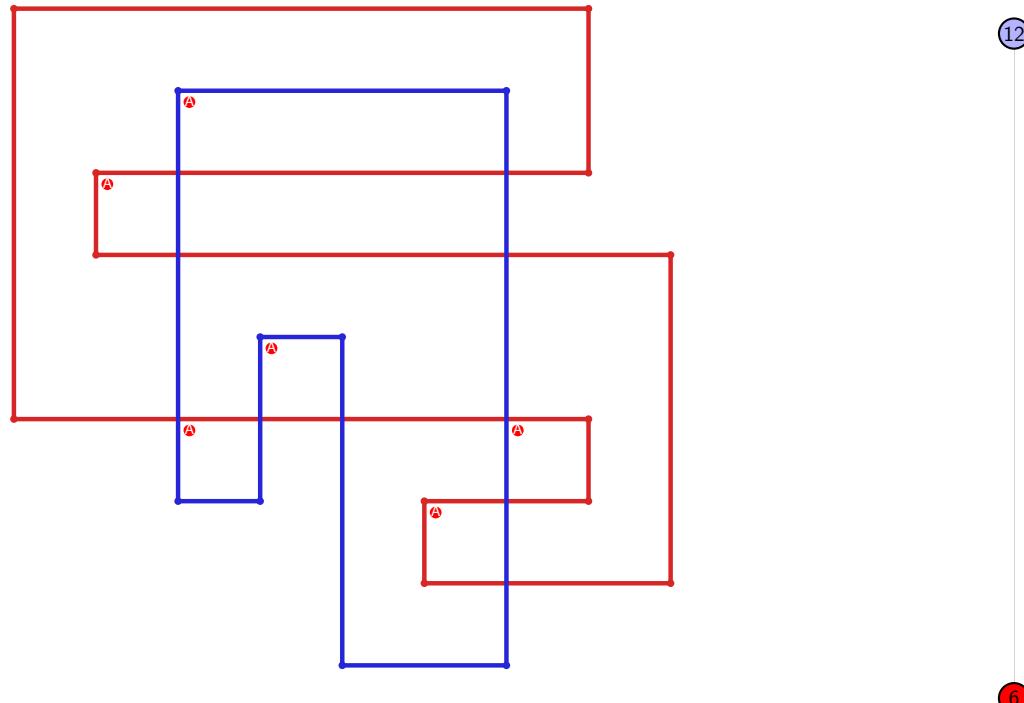


Figure 745: SnapPy multiloop plot.

Figure 746: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.76 $[[15, 20, 16, 1], [19, 14, 20, 15], [16, 7, 17, 8], [1, 12, 2, 13], [13, 18, 14, 19], [6, 17, 7, 18], [8, 4, 9, 3], [11, 2, 12, 3], [5, 10, 6, 11], [4, 10, 5, 9]]$

PD code drawn by SnapPy: $[(12, 3, 13, 4), (5, 20, 6, 1), (1, 6, 2, 7), (17, 8, 18, 9), (15, 10, 16, 11), (2, 13, 3, 14), (9, 14, 10, 15), (11, 16, 12, 17), (7, 18, 8, 19), (19, 4, 20, 5)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 6], [0, 7, 7, 4], [1, 3, 5, 1], [2, 4, 8, 2], [2, 9, 9, 7], [3, 6, 8, 3], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 372: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

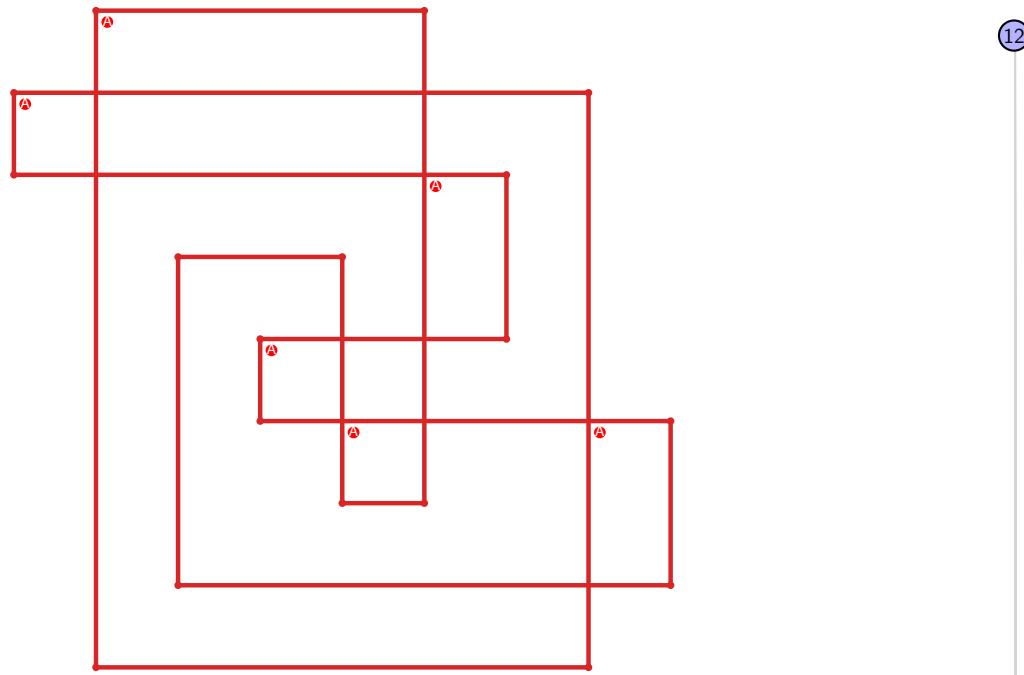


Figure 747: SnapPy multiloop plot.

Figure 748: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.77 $[[10, 20, 1, 11], [11, 9, 12, 10], [19, 7, 20, 8], [1, 14, 2, 13], [8, 12, 9, 13], [6, 18, 7, 19], [14, 3, 15, 2], [15, 5, 16, 6], [17, 3, 18, 4], [4, 16, 5, 17]]$

PD code drawn by `SnapPy`: $[(11, 10, 12, 1), (19, 2, 20, 3), (13, 4, 14, 5), (15, 6, 16, 7), (9, 18, 10, 19), (5, 16, 6, 17), (17, 8, 18, 9), (1, 20, 2, 11), (3, 12, 4, 13), (7, 14, 8, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 6, 6, 4], [1, 3, 2, 1], [2, 7, 8, 2], [3, 8, 7, 3], [5, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 373: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

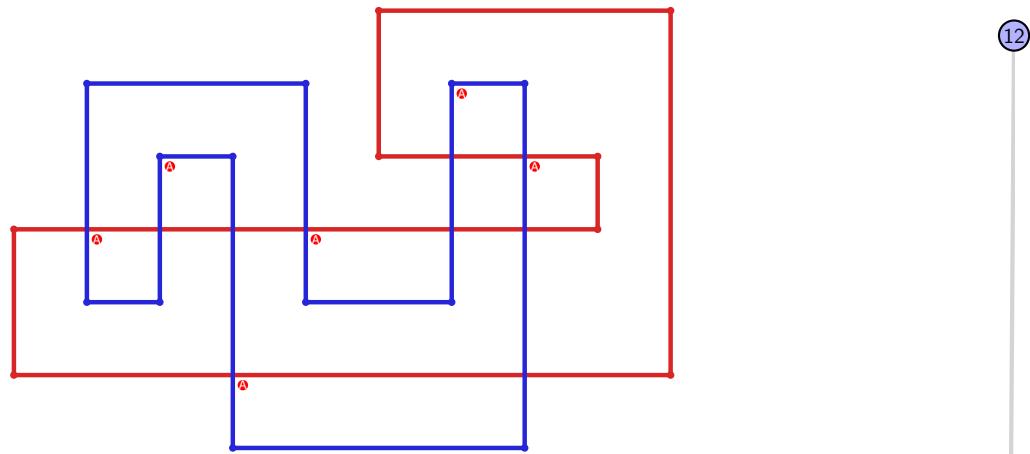


Figure 749: `SnapPy` multiloop plot.



Figure 750: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.78 $[[10, 20, 1, 11], [11, 9, 12, 10], [19, 1, 20, 2], [8, 18, 9, 19], [12, 5, 13, 4], [2, 14, 3, 15], [15, 7, 16, 8], [17, 5, 18, 6], [13, 3, 14, 4], [6, 16, 7, 17]]$

PD code drawn by SnapPy: $[(11, 10, 12, 1), (1, 20, 2, 11), (15, 2, 16, 3), (13, 4, 14, 5), (19, 6, 20, 7), (17, 8, 18, 9), (9, 12, 10, 13), (3, 14, 4, 15), (5, 16, 6, 17), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 3, 0], [1, 2, 6, 7], [1, 7, 8, 8], [2, 8, 8, 6], [3, 5, 9, 9], [3, 9, 9, 4], [4, 5, 5, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 374: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

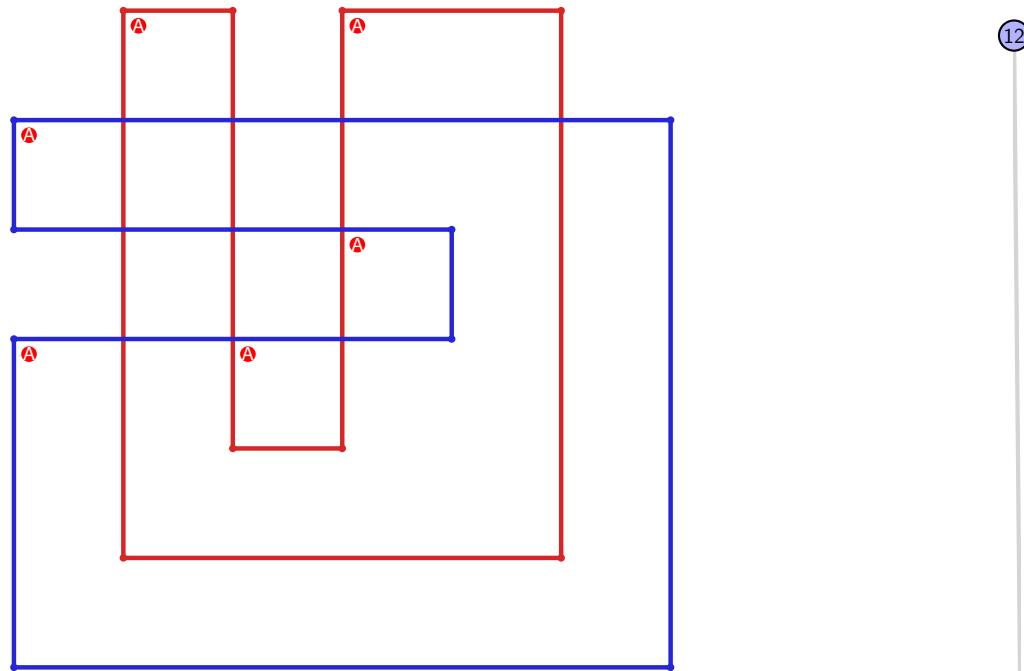


Figure 751: SnapPy multiloop plot.

Figure 752: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.79 $[[5, 10, 6, 1], [9, 4, 10, 5], [6, 2, 7, 1], [8, 20, 9, 11], [15, 3, 16, 4], [2, 16, 3, 17], [7, 12, 8, 11], [14, 19, 15, 20], [17, 13, 18, 12], [18, 13, 19, 14]]$

PD code drawn by `SnapPy`: $[(20, 1, 11, 2), (7, 2, 8, 3), (3, 8, 4, 9), (9, 4, 10, 5), (17, 12, 18, 13), (13, 18, 14, 19), (10, 11, 1, 12), (19, 14, 20, 15), (6, 15, 7, 16), (16, 5, 17, 6)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 6, 0], [1, 6, 6, 7], [1, 7, 5, 5], [2, 4, 4, 8], [2, 8, 3, 3], [3, 9, 9, 4], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 375: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

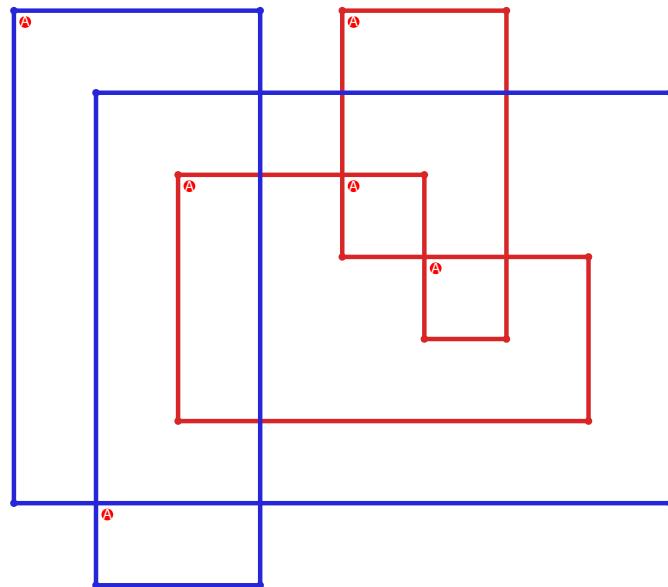


Figure 753: `SnapPy` multiloop plot.

(12)

6

Figure 754: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.80 $[[20, 15, 1, 16], [16, 10, 17, 9], [19, 6, 20, 7], [14, 5, 15, 6], [1, 11, 2, 10], [17, 8, 18, 9], [7, 18, 8, 19], [2, 13, 3, 14], [4, 11, 5, 12], [12, 3, 13, 4]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (12, 3, 13, 4), (17, 4, 18, 5), (15, 6, 16, 7), (7, 14, 8, 15), (8, 19, 9, 20), (2, 9, 3, 10), (20, 11, 1, 12), (18, 13, 19, 14), (5, 16, 6, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 8, 7, 1], [1, 6, 6, 1], [2, 5, 5, 2], [3, 4, 9, 9], [3, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 376: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

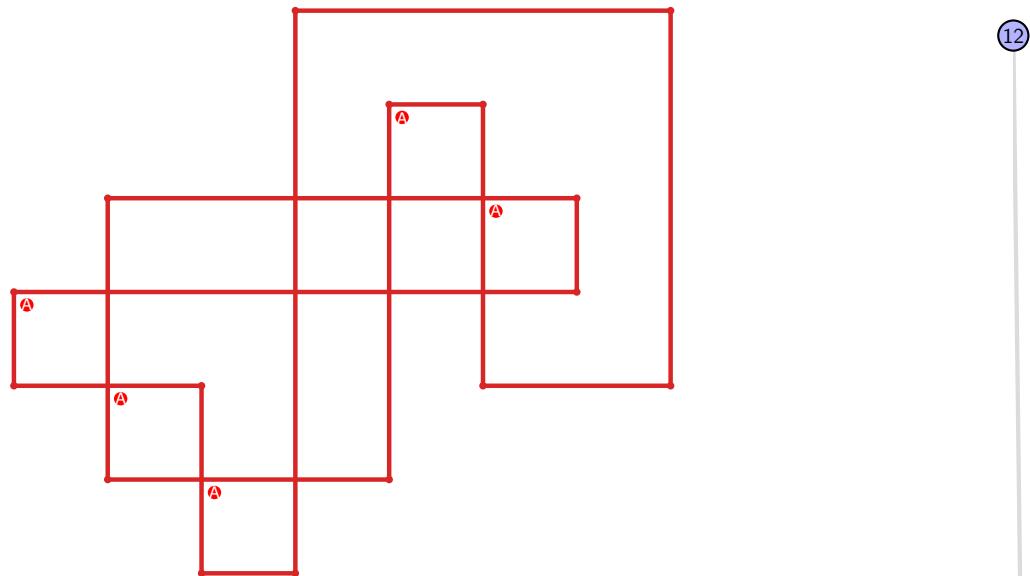


Figure 755: SnapPy multiloop plot.



Figure 756: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.81 $[[20, 7, 1, 8], [8, 17, 9, 18], [10, 19, 11, 20], [11, 6, 12, 7], [1, 16, 2, 17], [9, 19, 10, 18], [5, 14, 6, 15], [12, 4, 13, 3], [15, 2, 16, 3], [13, 4, 14, 5]]$

PD code drawn by SnapPy: $[(13, 20, 14, 1), (1, 10, 2, 11), (11, 2, 12, 3), (9, 4, 10, 5), (18, 5, 19, 6), (3, 12, 4, 13), (19, 14, 20, 15), (6, 15, 7, 16), (16, 7, 17, 8), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 5, 5, 3], [0, 2, 6, 7], [0, 8, 8, 1], [1, 2, 2, 1], [3, 8, 9, 9], [3, 9, 9, 8], [4, 7, 6, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 377: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

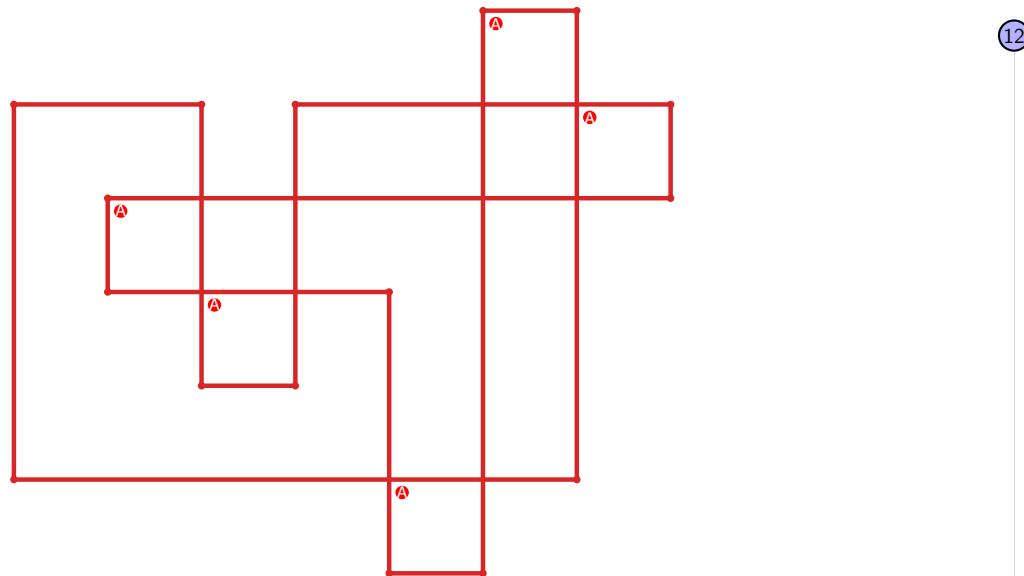


Figure 757: SnapPy multiloop plot.



Figure 758: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.82 $[[14, 20, 1, 15], [15, 7, 16, 8], [19, 13, 20, 14], [1, 18, 2, 17], [6, 16, 7, 17], [8, 4, 9, 3], [12, 18, 13, 19], [2, 12, 3, 11], [5, 10, 6, 11], [4, 10, 5, 9]]$

PD code drawn by SnapPy: $[(14, 5, 1, 6), (15, 4, 16, 5), (6, 1, 7, 2), (2, 7, 3, 8), (8, 13, 9, 14), (19, 10, 20, 11), (11, 20, 12, 15), (3, 16, 4, 17), (17, 12, 18, 13), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 6, 0], [0, 6, 7, 4], [1, 3, 8, 1], [1, 9, 9, 7], [2, 7, 3, 2], [3, 6, 5, 8], [4, 7, 9, 9], [5, 8, 8, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 378: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

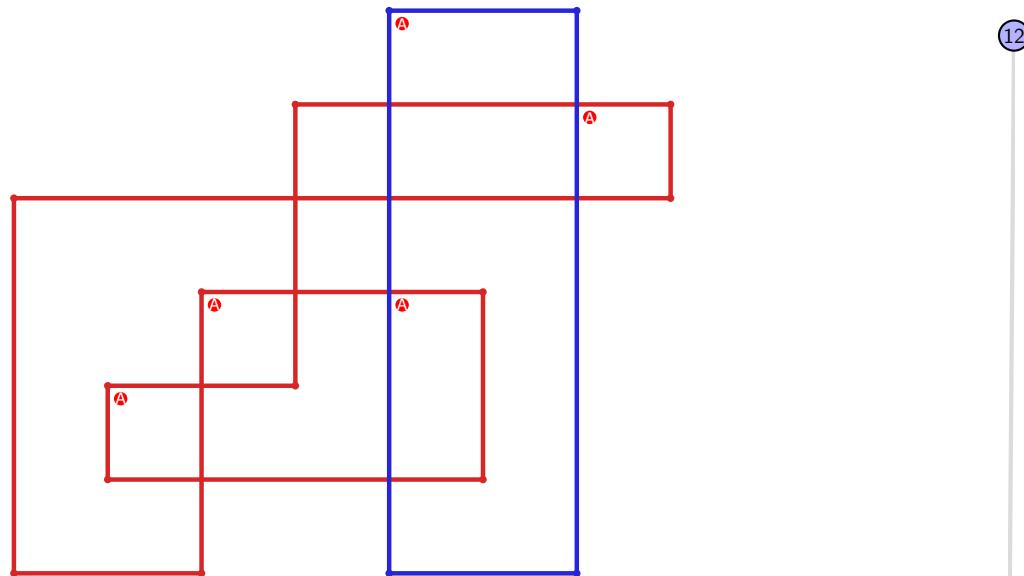


Figure 759: SnapPy multiloop plot.



Figure 760: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.83 $[[12, 20, 1, 13], [13, 7, 14, 8], [19, 11, 20, 12], [1, 11, 2, 10], [6, 9, 7, 10], [14, 9, 15, 8], [18, 2, 19, 3], [5, 17, 6, 18], [15, 4, 16, 3], [16, 4, 17, 5]]$

PD code drawn by `SnapPy`: $[(12, 13, 1, 14), (14, 1, 15, 2), (19, 4, 20, 5), (5, 20, 6, 13), (3, 6, 4, 7), (7, 10, 8, 11), (17, 8, 18, 9), (16, 11, 17, 12), (2, 15, 3, 16), (9, 18, 10, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 3, 0], [0, 2, 6, 4], [1, 3, 7, 5], [1, 4, 8, 1], [2, 8, 7, 3], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 3

Average minimal degree: 2.34

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 5

Table 379: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

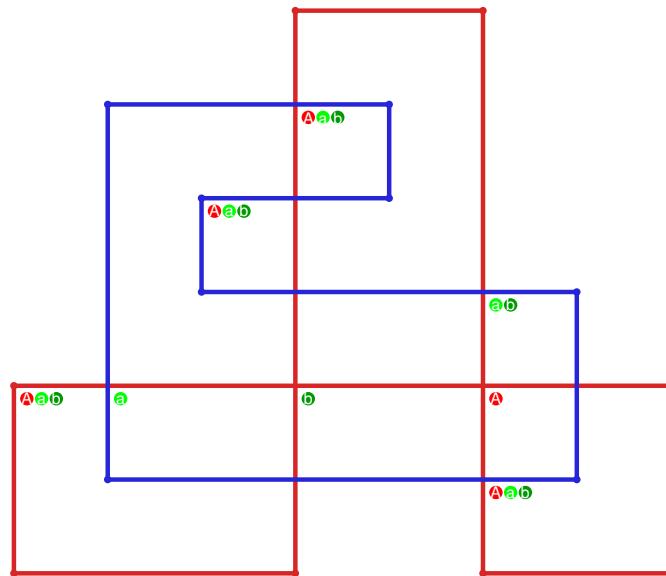


Figure 761: `SnapPy` multiloop plot.

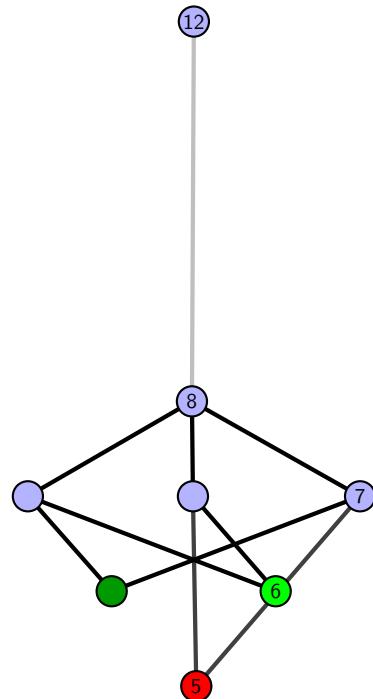


Figure 762: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.84 $[[20, 15, 1, 16], [16, 8, 17, 7], [14, 19, 15, 20], [1, 19, 2, 18], [8, 18, 9, 17], [11, 6, 12, 7], [13, 2, 14, 3], [9, 4, 10, 5], [5, 10, 6, 11], [12, 4, 13, 3]]$

PD code drawn by SnapPy: $[(11, 20, 12, 1), (1, 10, 2, 11), (7, 2, 8, 3), (9, 4, 10, 5), (5, 14, 6, 15), (3, 8, 4, 9), (18, 13, 19, 14), (15, 6, 16, 7), (16, 19, 17, 20), (12, 17, 13, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 3, 0], [0, 2, 6, 4], [1, 3, 7, 1], [1, 8, 8, 9], [2, 9, 9, 3], [4, 9, 8, 8], [5, 7, 7, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 380: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

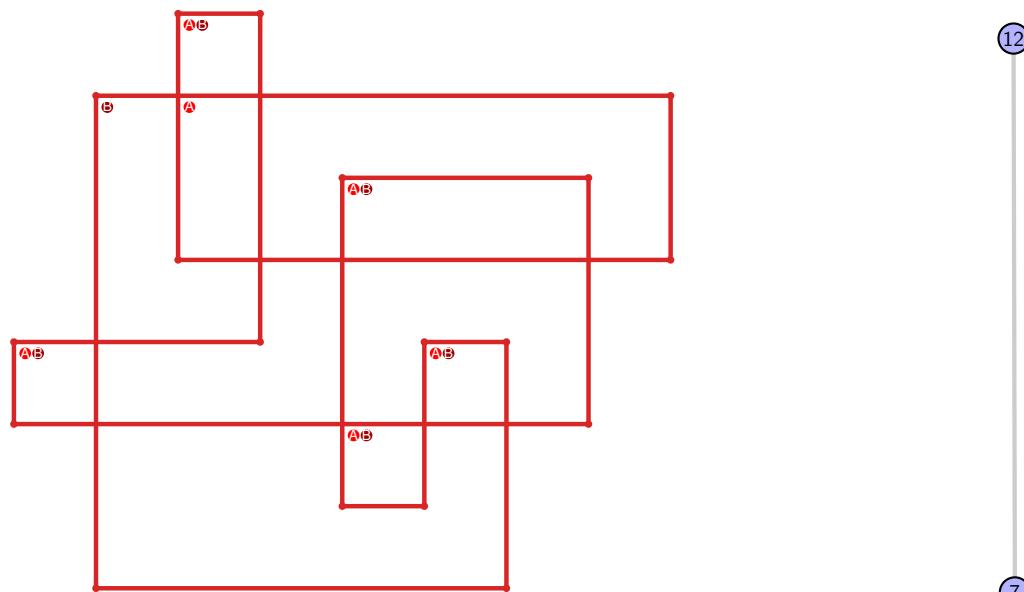


Figure 763: SnapPy multiloop plot.

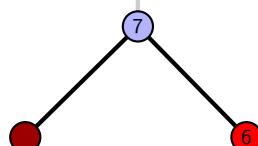


Figure 764: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.85 $[[9, 20, 10, 1], [8, 15, 9, 16], [19, 10, 20, 11], [1, 19, 2, 18], [16, 7, 17, 8], [14, 3, 15, 4], [11, 3, 12, 2], [6, 17, 7, 18], [4, 13, 5, 14], [12, 5, 13, 6]]$

PD code drawn by SnapPy: $[(20, 9, 1, 10), (12, 1, 13, 2), (10, 3, 11, 4), (14, 5, 15, 6), (17, 8, 18, 9), (2, 11, 3, 12), (6, 13, 7, 14), (4, 15, 5, 16), (16, 19, 17, 20), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 3, 0], [0, 2, 6, 7], [1, 7, 7, 1], [1, 8, 8, 6], [2, 5, 9, 3], [3, 9, 4, 4], [5, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 381: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

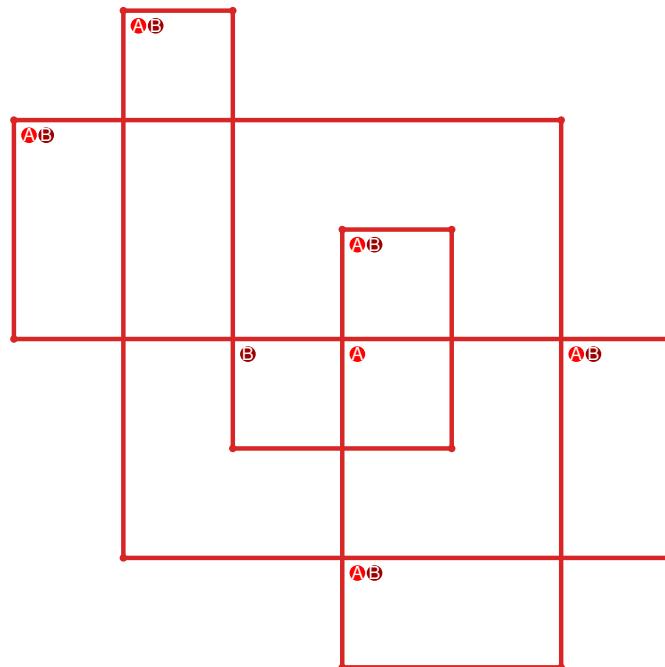


Figure 765: SnapPy multiloop plot.

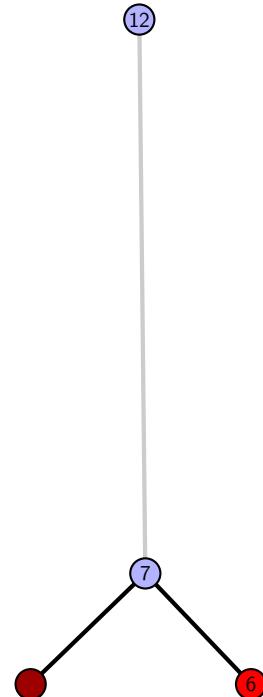


Figure 766: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.86 $[[14, 20, 1, 15], [15, 13, 16, 14], [7, 19, 8, 20], [1, 11, 2, 10], [12, 9, 13, 10], [16, 4, 17, 5], [18, 6, 19, 7], [8, 4, 9, 3], [11, 3, 12, 2], [17, 6, 18, 5]]$

PD code drawn by `SnapPy`: $[(14, 5, 1, 6), (20, 1, 15, 2), (2, 15, 3, 16), (16, 3, 17, 4), (9, 6, 10, 7), (7, 12, 8, 13), (19, 10, 20, 11), (13, 8, 14, 9), (4, 17, 5, 18), (11, 18, 12, 19)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 8, 8, 4], [1, 3, 8, 7], [1, 7, 9, 9], [2, 9, 9, 2], [2, 5, 4, 8], [3, 7, 4, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 382: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

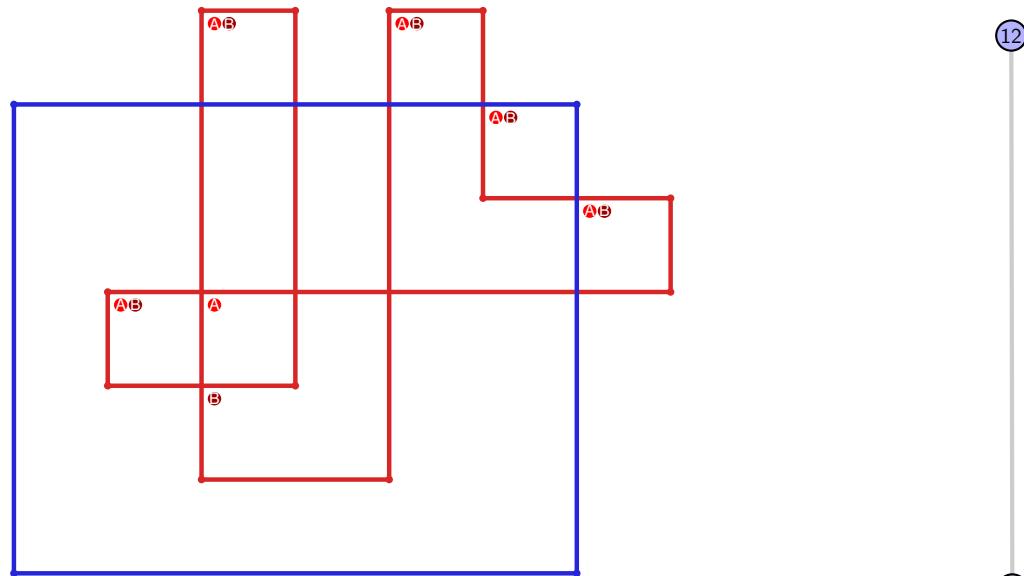


Figure 767: `SnapPy` multiloop plot.

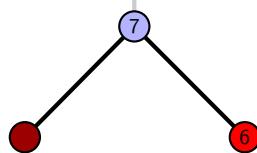


Figure 768: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.87 $[[9, 20, 10, 1], [8, 5, 9, 6], [14, 19, 15, 20], [10, 2, 11, 1], [6, 11, 7, 12], [12, 7, 13, 8], [13, 4, 14, 5], [18, 15, 19, 16], [2, 18, 3, 17], [3, 16, 4, 17]]$

PD code drawn by `SnapPy`: $[(10, 1, 11, 2), (5, 2, 6, 3), (9, 4, 10, 5), (3, 8, 4, 9), (15, 12, 16, 13), (20, 13, 1, 14), (14, 19, 15, 20), (11, 16, 12, 17), (6, 17, 7, 18), (18, 7, 19, 8)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 5, 6], [0, 6, 7, 7], [0, 8, 4, 0], [1, 3, 5, 5], [1, 4, 4, 6], [1, 5, 9, 2], [2, 9, 8, 2], [3, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 383: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

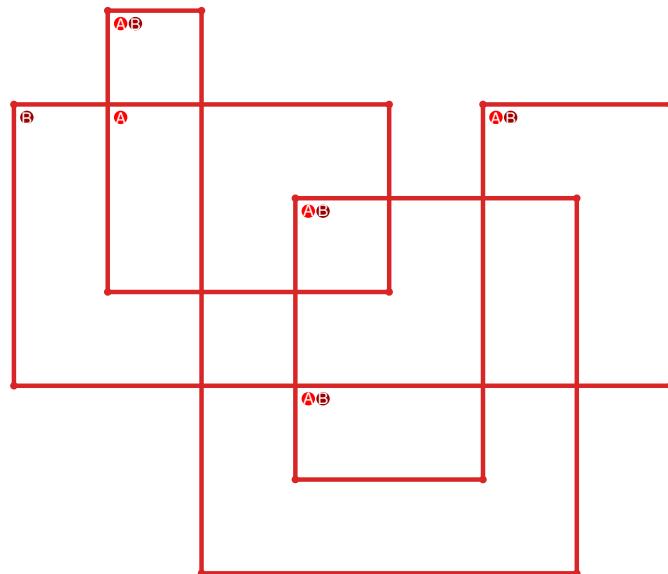


Figure 769: `SnapPy` multiloop plot.

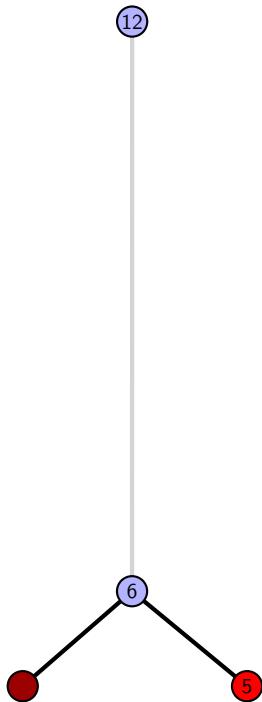


Figure 770: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.88 $[[20, 9, 1, 10], [10, 13, 11, 14], [4, 19, 5, 20], [8, 15, 9, 16], [1, 12, 2, 13], [11, 2, 12, 3], [14, 3, 15, 4], [18, 5, 19, 6], [16, 7, 17, 8], [6, 17, 7, 18]]$

PD code drawn by SnapPy: $[(13, 20, 14, 1), (11, 2, 12, 3), (15, 4, 16, 5), (16, 7, 17, 8), (5, 8, 6, 9), (3, 10, 4, 11), (1, 12, 2, 13), (19, 14, 20, 15), (6, 17, 7, 18), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 8, 8, 6], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 3, 2], [2, 9, 9, 2], [3, 9, 9, 3], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 80
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.23
 Average overall degree: 2.91

Table 384: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

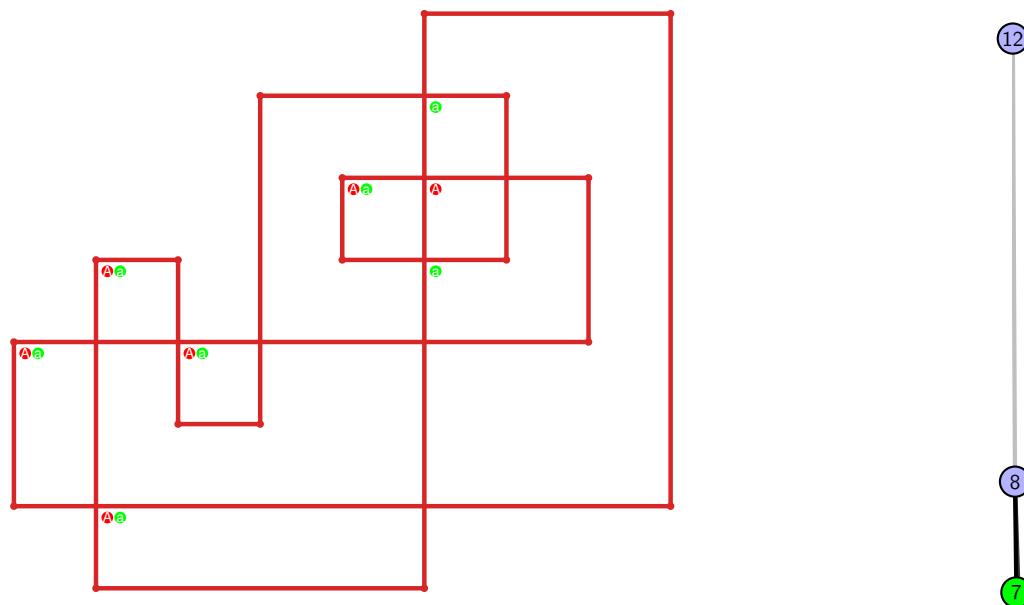


Figure 771: SnapPy multiloop plot.



Figure 772: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.89 $[[12, 20, 1, 13], [13, 16, 14, 17], [4, 11, 5, 12], [7, 19, 8, 20], [1, 15, 2, 16], [14, 2, 15, 3], [17, 3, 18, 4], [10, 5, 11, 6], [6, 9, 7, 10], [18, 8, 19, 9]]$

PD code drawn by `SnapPy`: $[(13, 12, 14, 1), (16, 1, 17, 2), (8, 3, 9, 4), (17, 6, 18, 7), (4, 7, 5, 8), (2, 9, 3, 10), (11, 14, 12, 15), (20, 15, 13, 16), (5, 18, 6, 19), (10, 19, 11, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 8, 9, 9], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 9, 2], [2, 8, 8, 2], [3, 7, 7, 9], [3, 8, 6, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 385: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

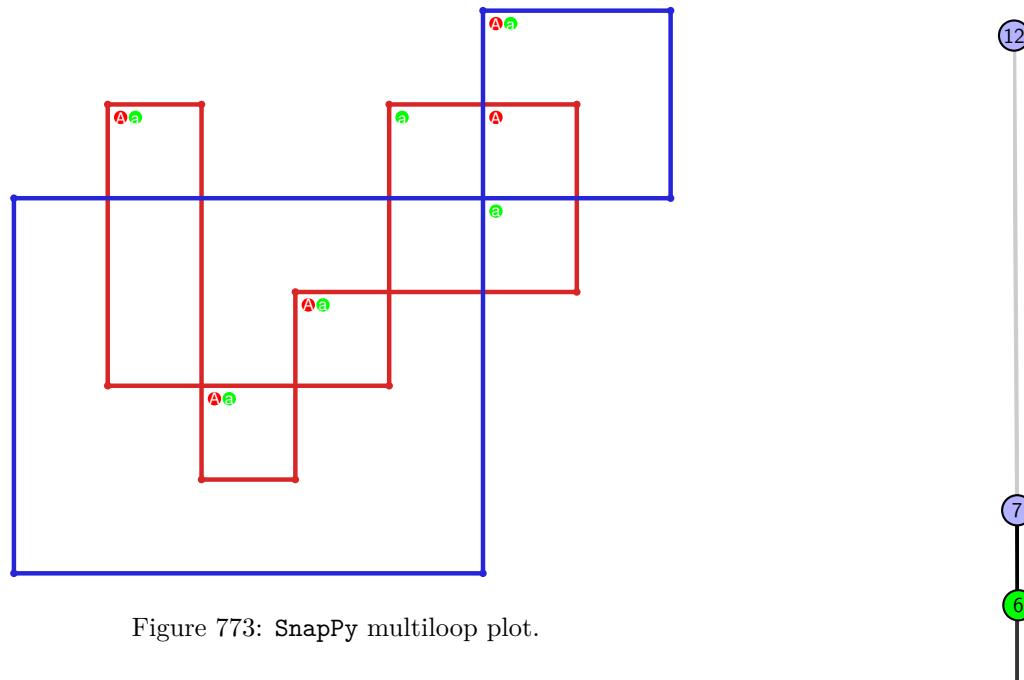


Figure 773: `SnapPy` multiloop plot.



Figure 774: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.90 $[[13, 20, 14, 1], [12, 9, 13, 10], [19, 14, 20, 15], [1, 11, 2, 10], [2, 11, 3, 12], [3, 8, 4, 9], [15, 4, 16, 5], [7, 18, 8, 19], [16, 6, 17, 5], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (2, 13, 3, 14), (14, 3, 15, 4), (20, 5, 1, 6), (9, 6, 10, 7), (7, 18, 8, 19), (19, 8, 20, 9), (16, 11, 17, 12), (4, 15, 5, 16), (10, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 4, 4, 1], [1, 3, 3, 5], [1, 4, 7, 6], [2, 5, 8, 8], [2, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 6

Table 386: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

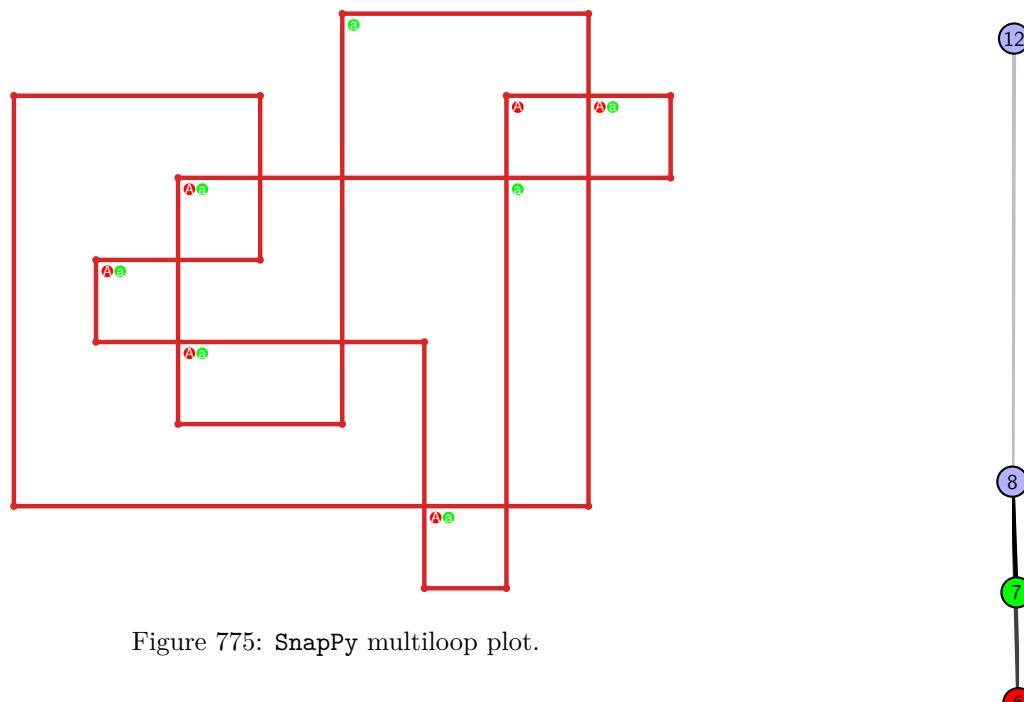


Figure 775: SnapPy multiloop plot.

12

8

7

6

Figure 776: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.91 $[[5, 10, 6, 1], [4, 20, 5, 11], [15, 9, 16, 10], [6, 18, 7, 19], [1, 12, 2, 11], [13, 3, 14, 4], [14, 19, 15, 20], [8, 16, 9, 17], [17, 7, 18, 8], [12, 3, 13, 2]]$

PD code drawn by `SnapPy`: $[(11, 10, 12, 1), (15, 4, 16, 5), (13, 6, 14, 7), (2, 7, 3, 8), (9, 20, 10, 11), (5, 14, 6, 15), (3, 16, 4, 17), (12, 17, 13, 18), (1, 18, 2, 19), (19, 8, 20, 9)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 8, 8, 6], [0, 9, 9, 1], [1, 9, 9, 6], [1, 5, 3, 2], [2, 8, 8, 2], [3, 7, 7, 3], [4, 5, 5, 4]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 120
 Pinning number: 6

Average optimal degree: 2.25
 Average minimal degree: 2.25
 Average overall degree: 2.92

Table 387: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	34	35	21	7	1	116
Average degree	2.25	2.6	2.85	3.02	3.14	3.25	3.33	

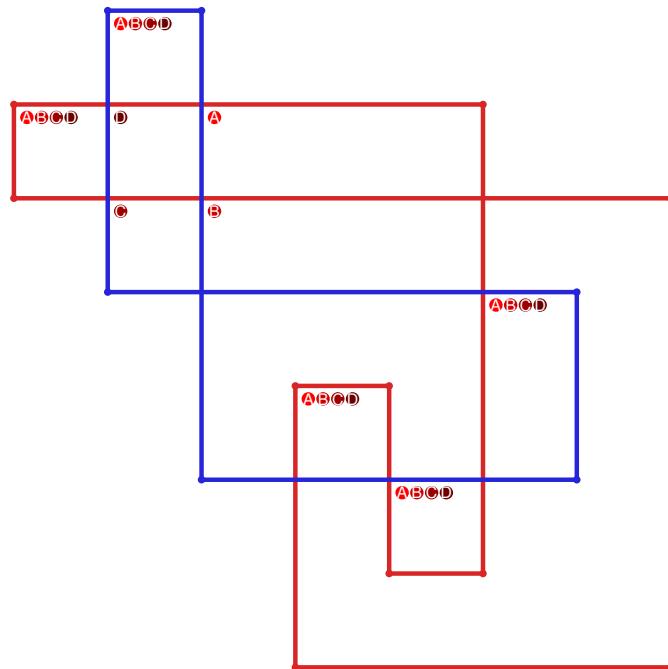


Figure 777: `SnapPy` multiloop plot.

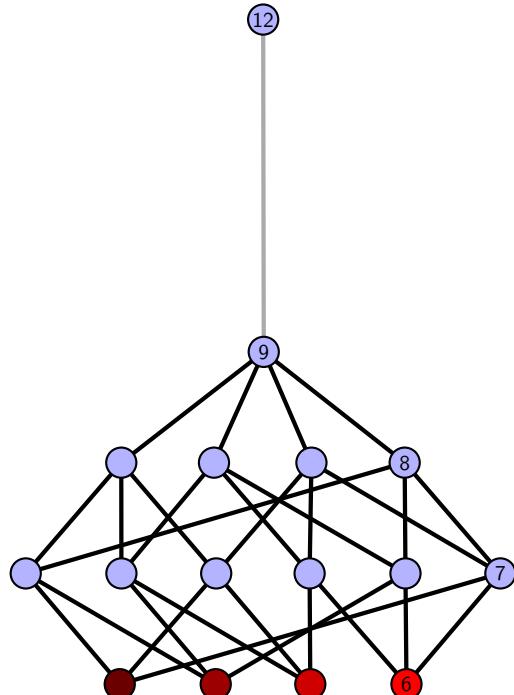


Figure 778: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.92 $[[20, 7, 1, 8], [8, 13, 9, 14], [4, 19, 5, 20], [6, 17, 7, 18], [1, 12, 2, 13], [9, 15, 10, 14], [16, 3, 17, 4], [18, 5, 19, 6], [11, 2, 12, 3], [15, 11, 16, 10]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (14, 1, 15, 2), (16, 3, 17, 4), (18, 5, 19, 6), (8, 13, 9, 14), (19, 10, 20, 11), (6, 11, 7, 12), (12, 7, 13, 8), (4, 15, 5, 16), (2, 17, 3, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 7], [0, 7, 7, 6], [0, 8, 8, 1], [1, 9, 9, 1], [2, 9, 8, 3], [2, 3, 3, 2], [4, 6, 9, 4], [5, 8, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 388: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

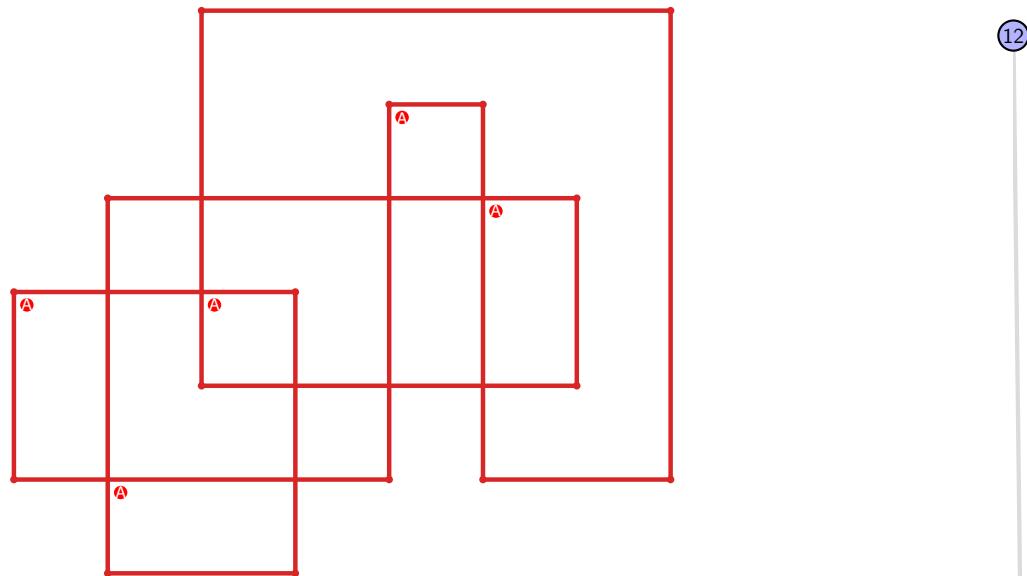


Figure 779: `SnapPy` multiloop plot.

5

Figure 780: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.93 $[[7, 16, 8, 1], [6, 20, 7, 17], [15, 10, 16, 11], [8, 14, 9, 13], [1, 18, 2, 17], [19, 5, 20, 6], [11, 5, 12, 4], [9, 14, 10, 15], [12, 3, 13, 4], [18, 3, 19, 2]]$

PD code drawn by `SnapPy`: $[(16, 17, 1, 18), (10, 1, 11, 2), (2, 9, 3, 10), (18, 3, 19, 4), (13, 8, 14, 9), (11, 6, 12, 7), (7, 12, 8, 13), (5, 14, 6, 15), (4, 19, 5, 20), (20, 15, 17, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 7], [0, 7, 7, 8], [0, 9, 9, 1], [1, 9, 6, 1], [2, 5, 8, 8], [2, 3, 3, 2], [3, 6, 6, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 389: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

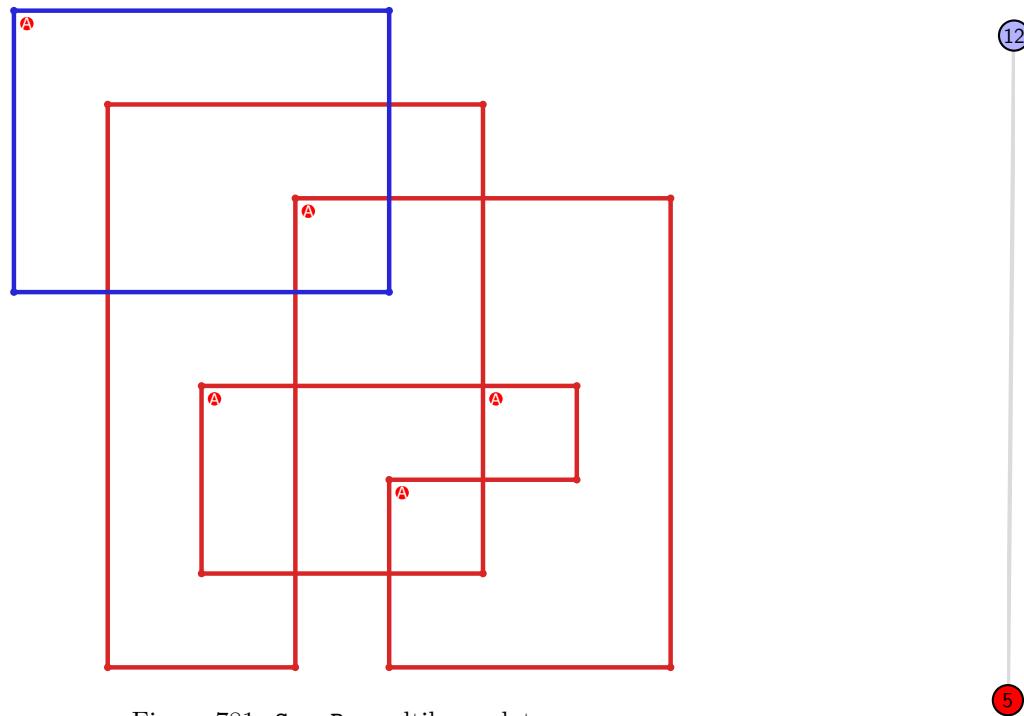


Figure 781: `SnapPy` multiloop plot.

Figure 782: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.94 [[11, 16, 12, 1], [10, 20, 11, 17], [4, 15, 5, 16], [12, 7, 13, 8], [1, 18, 2, 17], [19, 9, 20, 10], [3, 8, 4, 9], [14, 5, 15, 6], [6, 13, 7, 14], [18, 3, 19, 2]]

PD code drawn by SnapPy: [(11, 2, 12, 3), (9, 4, 10, 5), (16, 5, 1, 6), (17, 6, 18, 7), (3, 10, 4, 11), (1, 12, 2, 13), (8, 13, 9, 14), (15, 20, 16, 17), (7, 18, 8, 19), (19, 14, 20, 15)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 7], [0, 8, 8, 6], [0, 9, 9, 1], [1, 9, 6, 1], [2, 5, 9, 3], [2, 8, 8, 2], [3, 7, 7, 3], [4, 6, 5, 4]]

Total optimal pinning sets: 3

Average optimal degree: 2.22

Total minimal pinning sets: 3

Average minimal degree: 2.22

Total pinning sets: 112

Average overall degree: 2.92

Pinning number: 6

Table 390: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

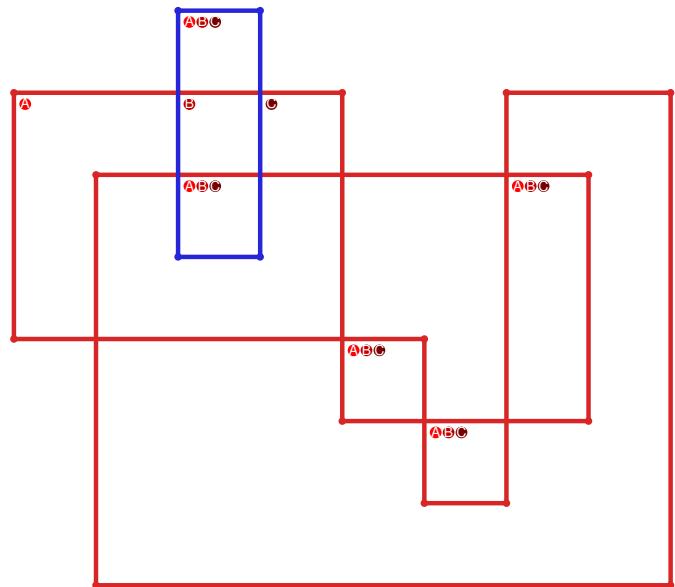


Figure 783: SnapPy multiloop plot.

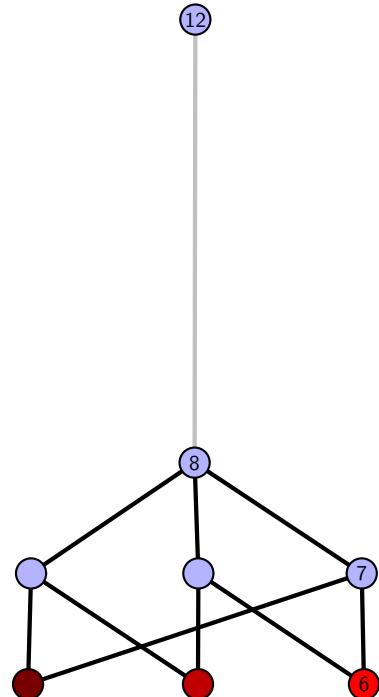


Figure 784: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.95 $[[8, 16, 1, 9], [9, 17, 10, 20], [13, 7, 14, 8], [15, 5, 16, 6], [1, 18, 2, 17], [10, 19, 11, 20], [4, 12, 5, 13], [6, 14, 7, 15], [18, 3, 19, 2], [11, 3, 12, 4]]$

PD code drawn by `SnapPy`: $[(12, 1, 13, 2), (10, 3, 11, 4), (6, 17, 7, 18), (16, 7, 9, 8), (8, 9, 1, 10), (2, 11, 3, 12), (4, 13, 5, 14), (15, 18, 16, 19), (19, 14, 20, 15), (20, 5, 17, 6)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 7], [0, 7, 7, 6], [0, 8, 8, 1], [1, 8, 9, 1], [2, 9, 9, 3], [2, 3, 3, 2], [4, 9, 5, 4], [5, 8, 6, 6]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 112

Pinning number: 6

Average optimal degree: 2.22

Average minimal degree: 2.22

Average overall degree: 2.92

Table 391: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

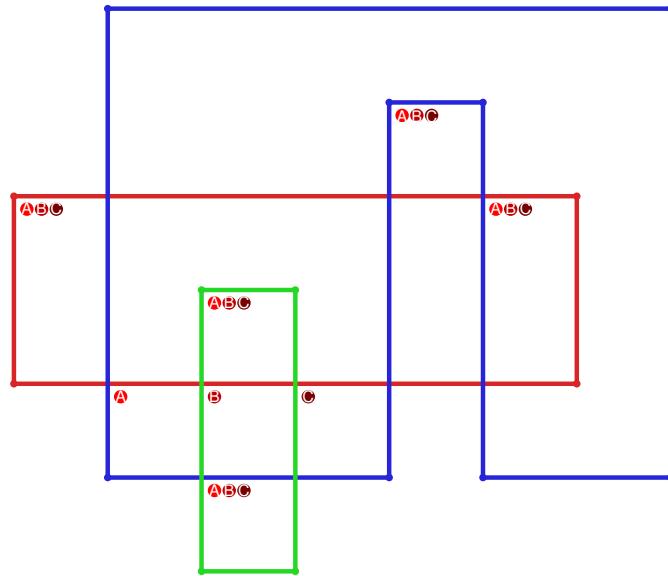


Figure 785: `SnapPy` multiloop plot.

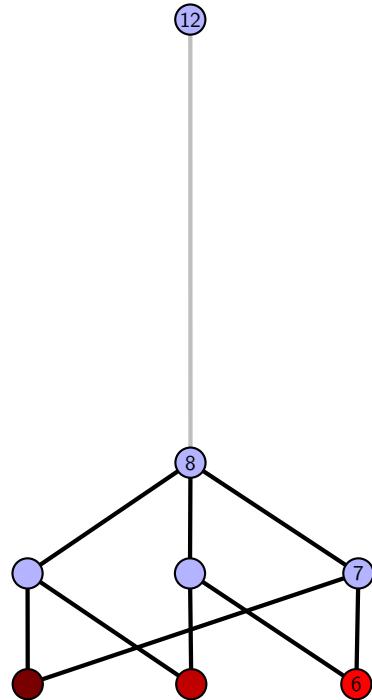


Figure 786: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.96 $[[20, 9, 1, 10], [10, 13, 11, 14], [8, 19, 9, 20], [1, 12, 2, 13], [11, 2, 12, 3], [14, 3, 15, 4], [16, 7, 17, 8], [18, 5, 19, 6], [15, 5, 16, 4], [6, 17, 7, 18]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (1, 12, 2, 13), (15, 2, 16, 3), (13, 4, 14, 5), (17, 6, 18, 7), (18, 9, 19, 10), (7, 10, 8, 11), (3, 14, 4, 15), (5, 16, 6, 17), (8, 19, 9, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 4, 4, 1], [1, 3, 3, 5], [1, 4, 8, 8], [2, 8, 9, 9], [2, 9, 9, 8], [5, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 6

Table 392: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

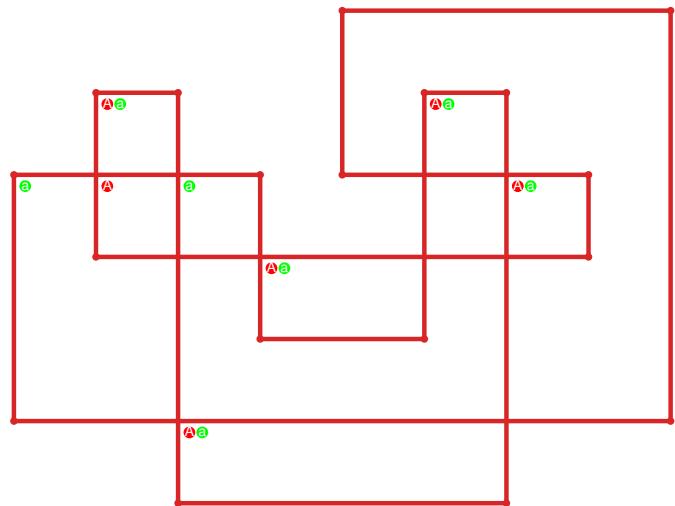


Figure 787: `SnapPy` multiloop plot.



Figure 788: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.97 $[[20, 9, 1, 10], [10, 13, 11, 14], [8, 19, 9, 20], [1, 12, 2, 13], [11, 2, 12, 3], [14, 3, 15, 4], [18, 7, 19, 8], [15, 7, 16, 6], [4, 17, 5, 18], [16, 5, 17, 6]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (13, 2, 14, 3), (3, 12, 4, 13), (15, 4, 16, 5), (17, 6, 18, 7), (18, 9, 19, 10), (7, 10, 8, 11), (1, 14, 2, 15), (5, 16, 6, 17), (8, 19, 9, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 4, 4, 1], [1, 3, 3, 5], [1, 4, 7, 8], [2, 8, 7, 2], [5, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 6

Table 393: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

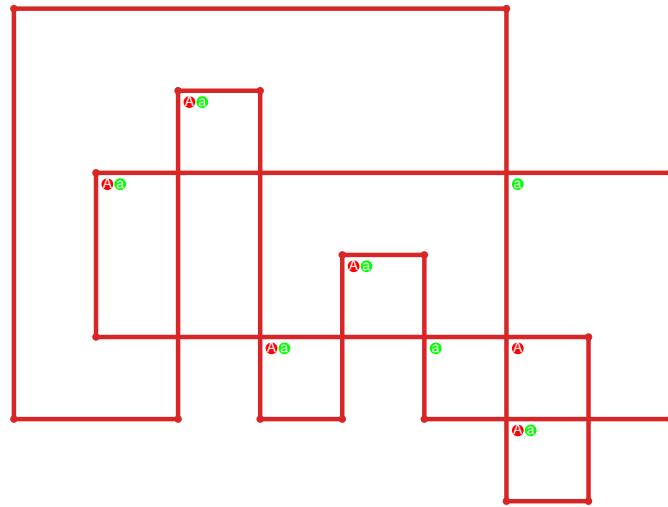


Figure 789: `SnapPy` multiloop plot.



Figure 790: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.98 $[[20, 9, 1, 10], [10, 13, 11, 14], [6, 19, 7, 20], [8, 15, 9, 16], [1, 12, 2, 13], [11, 2, 12, 3], [14, 3, 15, 4], [18, 5, 19, 6], [7, 17, 8, 16], [4, 17, 5, 18]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (12, 1, 13, 2), (16, 3, 17, 4), (18, 7, 19, 8), (19, 10, 20, 11), (8, 11, 9, 12), (6, 13, 7, 14), (14, 5, 15, 6), (2, 15, 3, 16), (4, 17, 5, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 8], [0, 8, 8, 6], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 3, 9], [2, 9, 9, 2], [2, 9, 3, 3], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 394: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

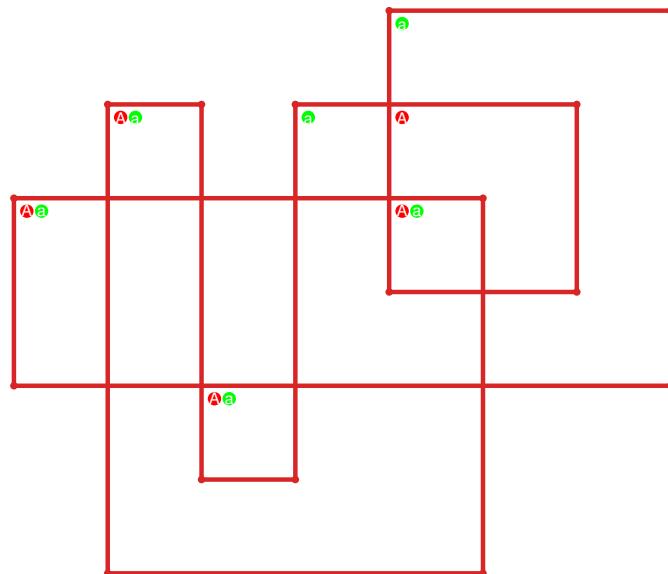


Figure 791: `SnapPy` multiloop plot.



Figure 792: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.99 $[[13, 20, 14, 1], [12, 9, 13, 10], [19, 4, 20, 5], [14, 2, 15, 1], [10, 15, 11, 16], [16, 11, 17, 12], [17, 8, 18, 9], [5, 18, 6, 19], [6, 3, 7, 4], [2, 7, 3, 8]]$

PD code drawn by SnapPy: $[(4, 1, 5, 2), (17, 2, 18, 3), (20, 5, 1, 6), (15, 6, 16, 7), (10, 7, 11, 8), (14, 9, 15, 10), (8, 13, 9, 14), (3, 16, 4, 17), (11, 18, 12, 19), (19, 12, 20, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 6], [0, 7, 7, 8], [0, 9, 4, 0], [1, 3, 5, 5], [1, 4, 4, 6], [1, 5, 9, 7], [2, 6, 8, 2], [2, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 395: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

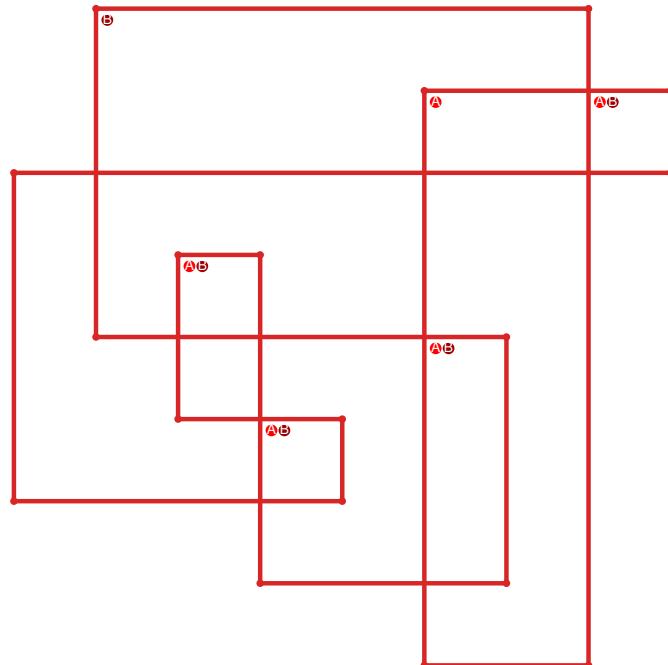


Figure 793: SnapPy multiloop plot.

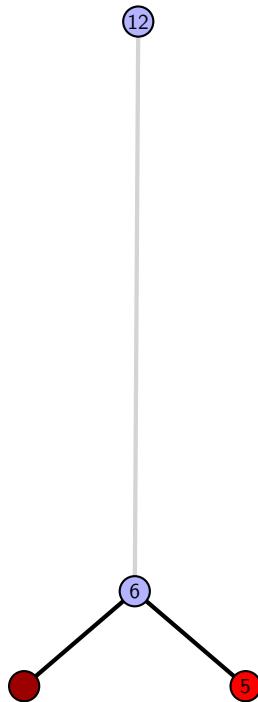


Figure 794: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.100 $[[6, 14, 1, 7], [7, 10, 8, 11], [5, 20, 6, 15], [17, 13, 18, 14], [1, 9, 2, 10], [8, 2, 9, 3], [11, 3, 12, 4], [15, 4, 16, 5], [16, 19, 17, 20], [12, 18, 13, 19]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (16, 1, 17, 2), (12, 5, 13, 6), (4, 13, 5, 14), (11, 14, 12, 7), (18, 9, 19, 10), (3, 10, 4, 11), (8, 19, 9, 20), (17, 20, 18, 15), (2, 15, 3, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 8], [0, 8, 9, 9], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 9, 7], [2, 6, 8, 2], [2, 7, 9, 3], [3, 8, 6, 3]]$

Total optimal pinning sets: 4

Average optimal degree: 2.5

Total minimal pinning sets: 8

Average minimal degree: 2.54

Total pinning sets: 300

Average overall degree: 3.05

Pinning number: 5

Table 396: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	22	66	89	71	34	9	1	292
Average degree	2.5	2.73	2.92	3.06	3.16	3.24	3.29	3.33	

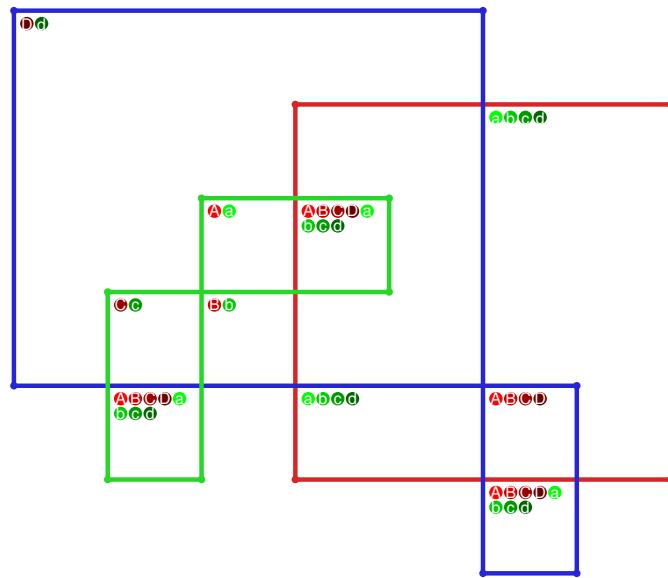


Figure 795: `SnapPy` multiloop plot.

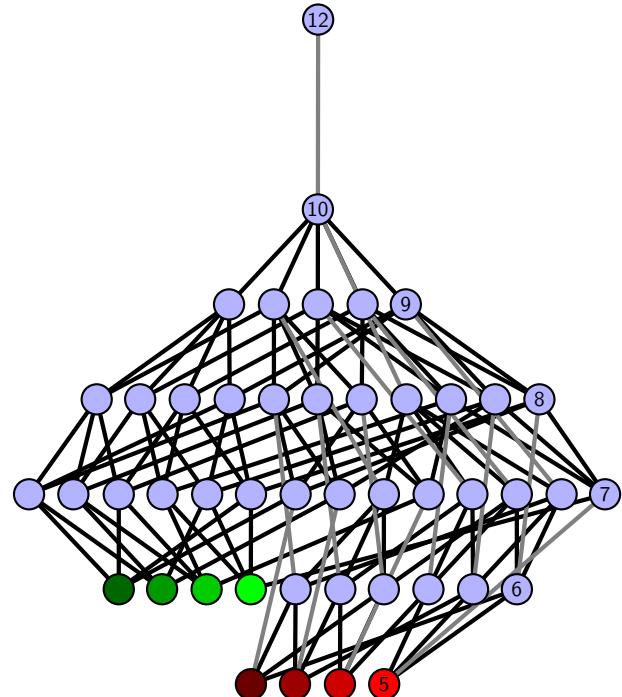


Figure 796: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.101 [[20, 7, 1, 8], [8, 11, 9, 12], [6, 19, 7, 20], [1, 10, 2, 11], [9, 2, 10, 3], [12, 3, 13, 4], [16, 5, 17, 6], [18, 13, 19, 14], [4, 15, 5, 16], [17, 15, 18, 14]]

PD code drawn by `SnapPy`: [(14, 1, 15, 2), (15, 4, 16, 5), (2, 5, 3, 6), (12, 7, 13, 8), (8, 11, 9, 12), (18, 9, 19, 10), (20, 13, 1, 14), (3, 16, 4, 17), (6, 17, 7, 18), (10, 19, 11, 20)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 4, 4, 1], [1, 3, 3, 5], [1, 4, 7, 8], [2, 8, 8, 9], [2, 9, 9, 5], [5, 9, 6, 6], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 397: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

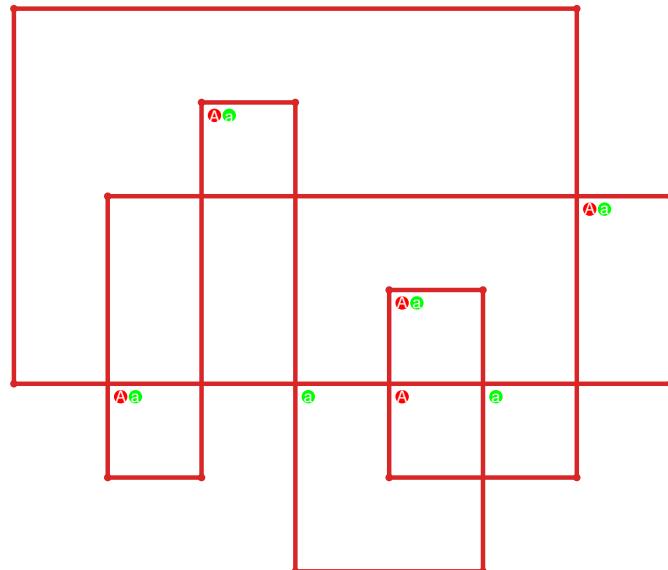


Figure 797: `SnapPy` multiloop plot.



Figure 798: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.102 $[[5, 20, 6, 1], [4, 13, 5, 14], [19, 8, 20, 9], [6, 11, 7, 12], [1, 15, 2, 14], [16, 3, 17, 4], [17, 12, 18, 13], [9, 18, 10, 19], [10, 7, 11, 8], [15, 3, 16, 2]]$

PD code drawn by `SnapPy`: $[(13, 20, 14, 1), (7, 4, 8, 5), (16, 5, 17, 6), (3, 8, 4, 9), (14, 9, 15, 10), (1, 10, 2, 11), (11, 18, 12, 19), (6, 15, 7, 16), (2, 17, 3, 18), (19, 12, 20, 13)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 8], [0, 8, 8, 6], [0, 9, 9, 1], [1, 9, 9, 6], [1, 5, 3, 7], [2, 6, 8, 2], [2, 7, 3, 3], [4, 5, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 398: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

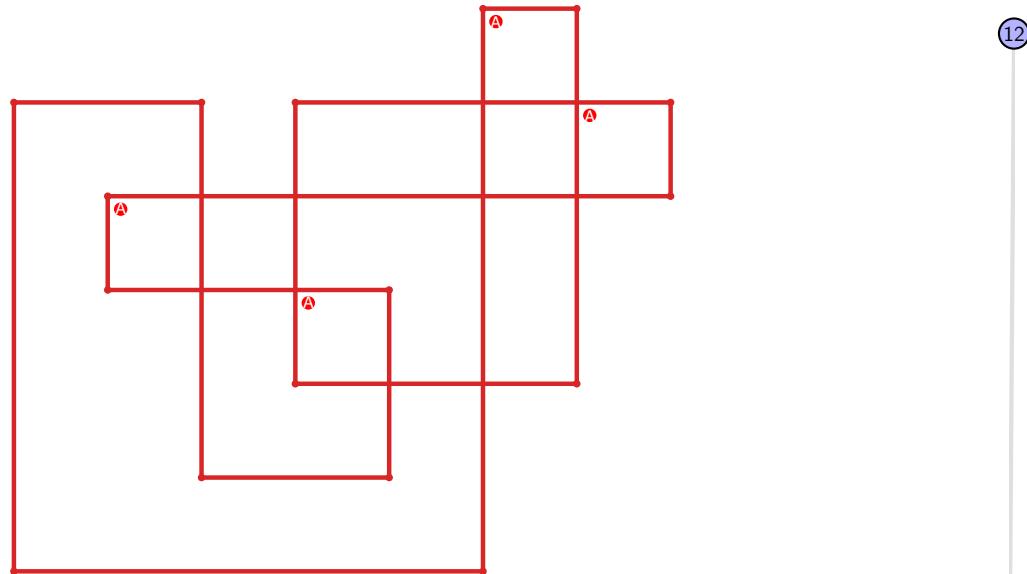


Figure 799: `SnapPy` multiloop plot.



Figure 800: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.103 [[6, 16, 1, 7], [7, 17, 8, 20], [13, 5, 14, 6], [15, 10, 16, 11], [1, 18, 2, 17], [8, 19, 9, 20], [4, 12, 5, 13], [14, 12, 15, 11], [9, 3, 10, 4], [18, 3, 19, 2]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (4, 17, 5, 18), (14, 5, 15, 6), (10, 15, 11, 16), (16, 9, 7, 10), (6, 7, 1, 8), (2, 11, 3, 12), (13, 18, 14, 19), (19, 12, 20, 13), (20, 3, 17, 4)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 6, 7], [0, 7, 7, 8], [0, 9, 9, 1], [1, 9, 8, 1], [2, 8, 7, 2], [2, 6, 3, 3], [3, 6, 5, 9], [4, 8, 5, 4]]

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 399: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

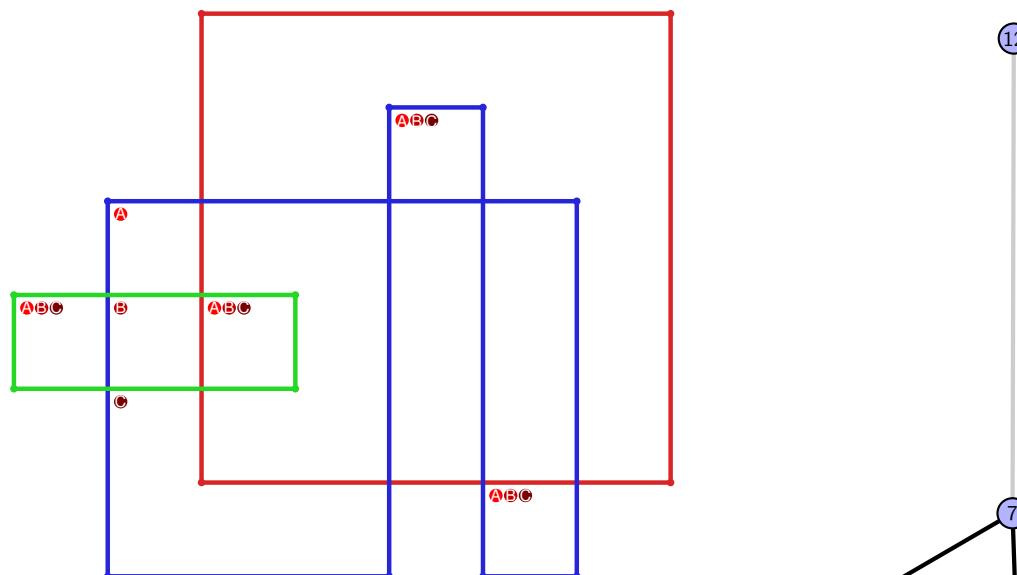


Figure 801: `SnapPy` multiloop plot.

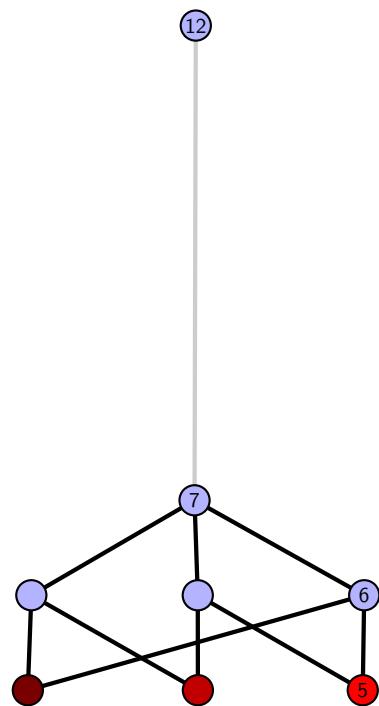


Figure 802: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.104 $[[6, 20, 1, 7], [7, 10, 8, 11], [5, 15, 6, 16], [19, 12, 20, 13], [1, 9, 2, 10], [8, 2, 9, 3], [11, 3, 12, 4], [16, 4, 17, 5], [17, 14, 18, 15], [13, 18, 14, 19]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (13, 4, 14, 5), (16, 5, 17, 6), (3, 14, 4, 15), (12, 15, 13, 16), (10, 17, 11, 18), (8, 19, 9, 20), (1, 20, 2, 7), (18, 9, 19, 10), (2, 11, 3, 12)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 8], [0, 9, 9, 6], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 3, 7], [2, 6, 8, 2], [2, 7, 9, 9], [3, 8, 8, 3]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 400: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

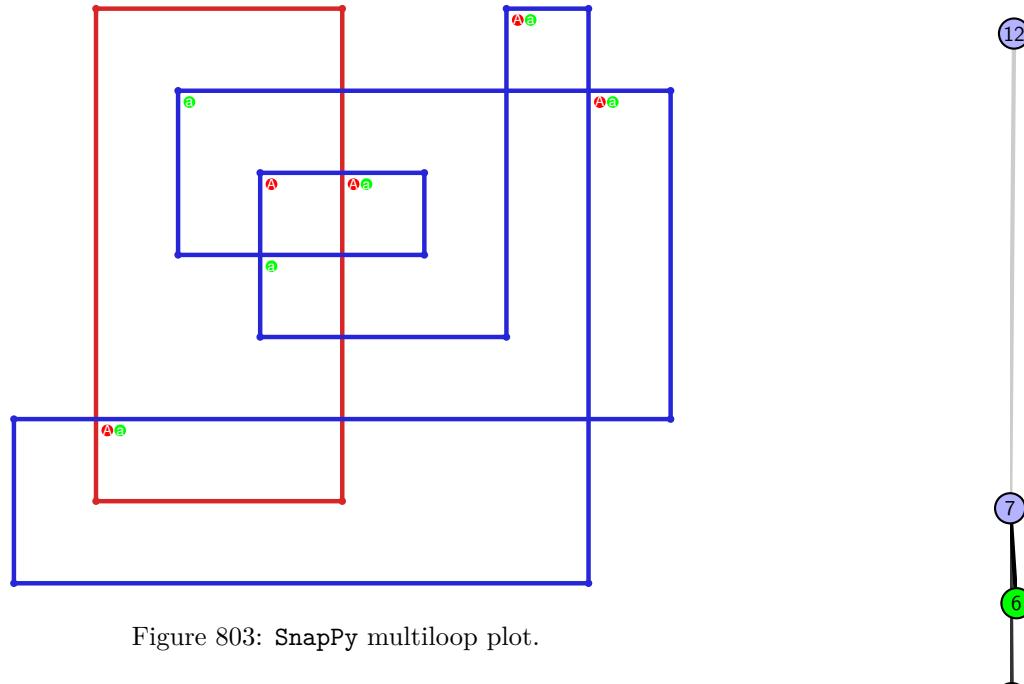


Figure 803: `SnapPy` multiloop plot.

Figure 804: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.105 [[20, 9, 1, 10], [10, 13, 11, 14], [4, 19, 5, 20], [8, 17, 9, 18], [1, 12, 2, 13], [11, 2, 12, 3], [14, 3, 15, 4], [18, 5, 19, 6], [16, 7, 17, 8], [15, 7, 16, 6]]

PD code drawn by `SnapPy`: [(11, 20, 12, 1), (15, 2, 16, 3), (3, 12, 4, 13), (13, 4, 14, 5), (17, 6, 18, 7), (18, 9, 19, 10), (7, 10, 8, 11), (5, 14, 6, 15), (1, 16, 2, 17), (8, 19, 9, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 7, 8, 8], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 9, 2], [2, 9, 3, 2], [3, 9, 9, 3], [6, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.97

Table 401: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

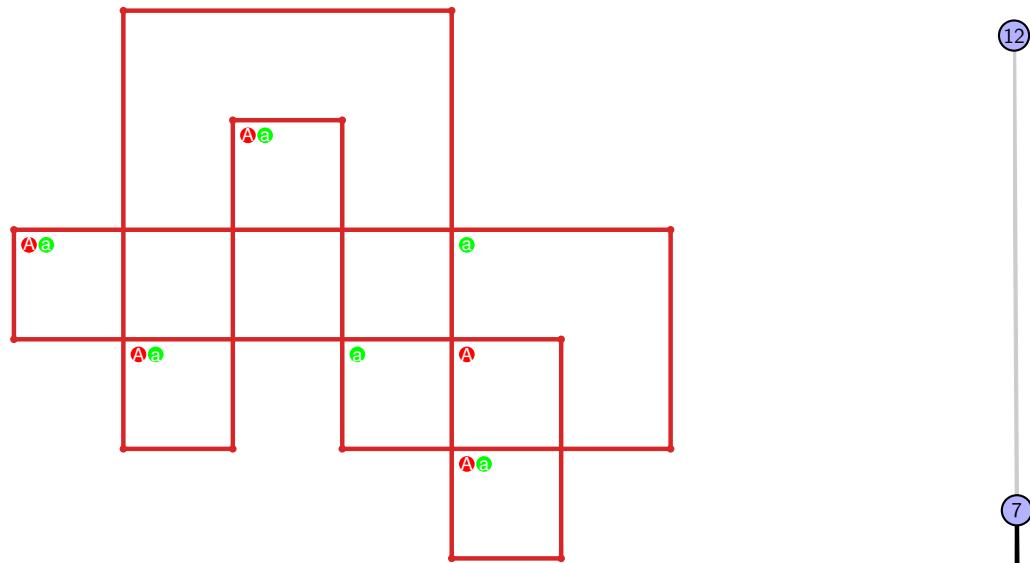


Figure 805: `SnapPy` multiloop plot.



Figure 806: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.106 [[20, 7, 1, 8], [8, 11, 9, 12], [14, 19, 15, 20], [6, 17, 7, 18], [1, 10, 2, 11], [9, 2, 10, 3], [12, 3, 13, 4], [4, 13, 5, 14], [18, 15, 19, 16], [16, 5, 17, 6]]

PD code drawn by `SnapPy`: [(9, 20, 10, 1), (13, 2, 14, 3), (17, 4, 18, 5), (18, 7, 19, 8), (5, 8, 6, 9), (1, 10, 2, 11), (15, 12, 16, 13), (3, 14, 4, 15), (11, 16, 12, 17), (6, 19, 7, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 8, 8], [0, 8, 9, 9], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 7, 7], [2, 6, 6, 9], [2, 9, 3, 2], [3, 8, 7, 3]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.97

Table 402: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

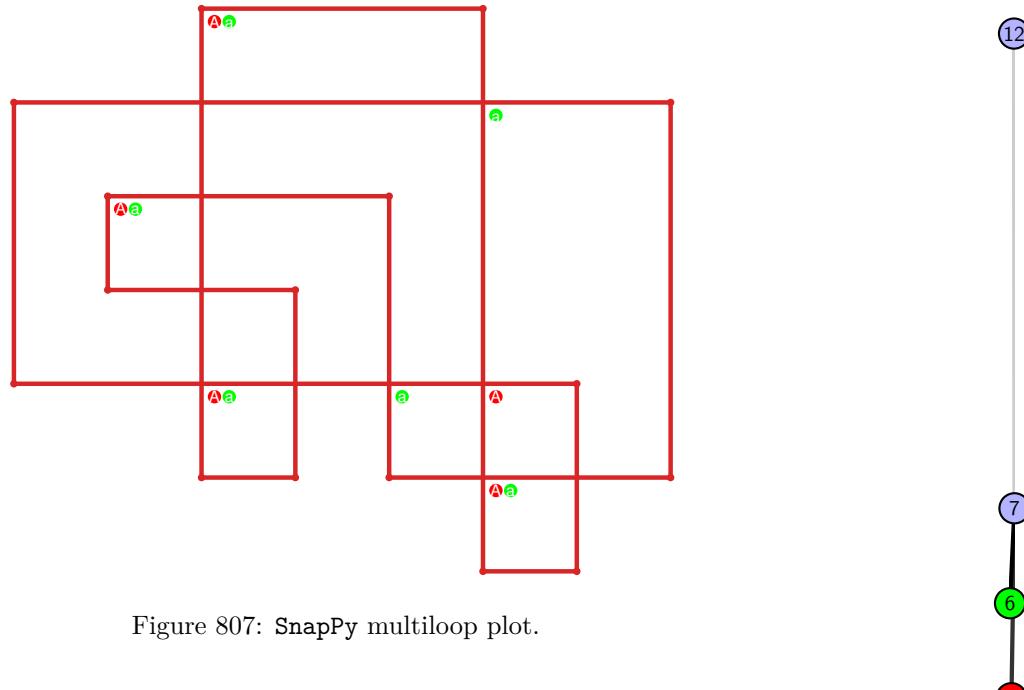


Figure 807: `SnapPy` multiloop plot.

Figure 808: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.107 `[[5, 20, 6, 1], [4, 9, 5, 10], [14, 19, 15, 20], [6, 18, 7, 17], [1, 11, 2, 10], [12, 3, 13, 4], [13, 8, 14, 9], [18, 15, 19, 16], [7, 16, 8, 17], [11, 3, 12, 2]]`

PD code drawn by `SnapPy`: `[(9, 20, 10, 1), (10, 5, 11, 6), (1, 6, 2, 7), (7, 18, 8, 19), (15, 12, 16, 13), (4, 13, 5, 14), (14, 3, 15, 4), (11, 16, 12, 17), (2, 17, 3, 18), (19, 8, 20, 9)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 7, 8, 8], [0, 9, 9, 1], [1, 9, 9, 6], [1, 5, 8, 2], [2, 8, 3, 2], [3, 7, 6, 3], [4, 5, 5, 4]]`

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 218
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 2.99

Table 403: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	1	0	0	0	0	0	7
Nonminimal pinning sets	0	7	43	67	56	28	8	1	210
Average degree	2.4	2.55	2.8	2.99	3.11	3.2	3.27	3.33	

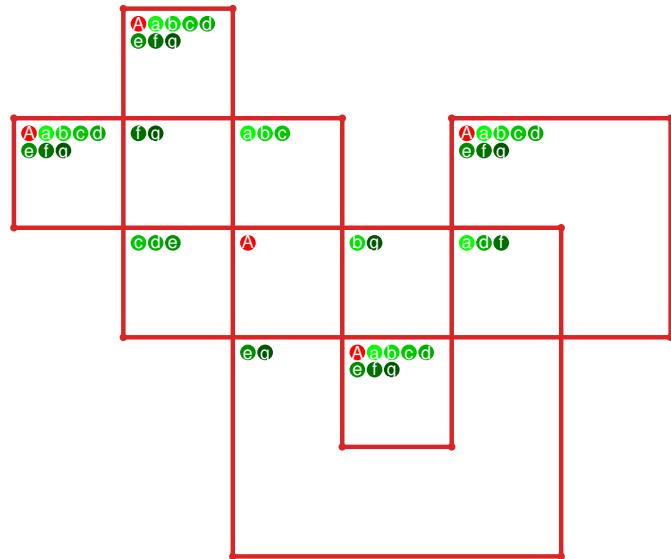


Figure 809: `SnapPy` multiloop plot.

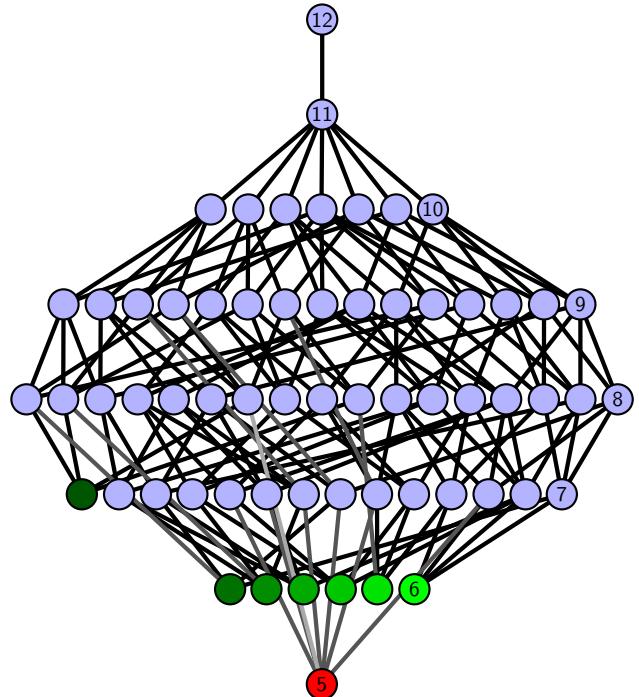


Figure 810: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.108 [[3, 10, 4, 1], [2, 20, 3, 11], [13, 9, 14, 10], [4, 14, 5, 15], [1, 12, 2, 11], [12, 19, 13, 20], [8, 18, 9, 19], [5, 16, 6, 15], [17, 7, 18, 8], [16, 7, 17, 6]]

PD code drawn by SnapPy: [(10, 11, 1, 12), (12, 1, 13, 2), (18, 3, 19, 4), (7, 4, 8, 5), (8, 19, 9, 20), (20, 9, 11, 10), (2, 13, 3, 14), (17, 14, 18, 15), (6, 15, 7, 16), (16, 5, 17, 6)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 6, 2], [2, 5, 8, 8], [3, 9, 9, 3], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.33

Total minimal pinning sets: 5

Average minimal degree: 2.3

Total pinning sets: 100

Average overall degree: 2.93

Pinning number: 6

Table 404: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	6	27	33	21	7	1	95
Average degree	2.33	2.49	2.78	3.0	3.14	3.25	3.33	

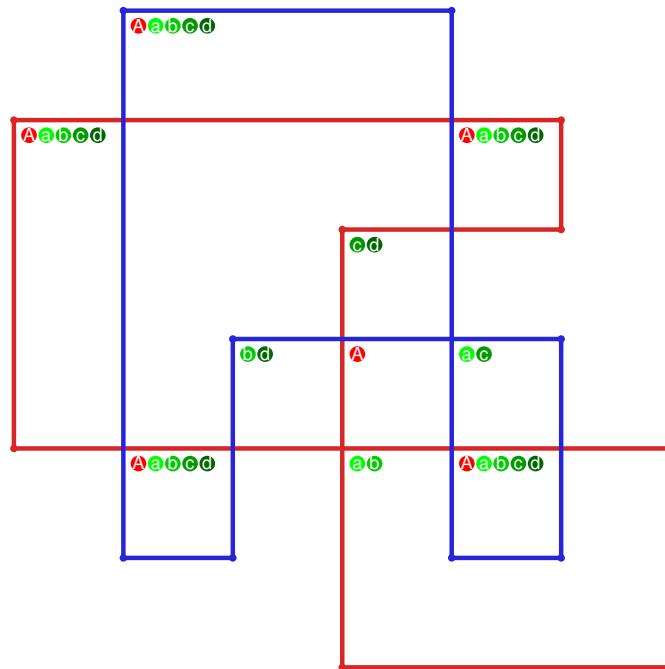


Figure 811: SnapPy multiloop plot.

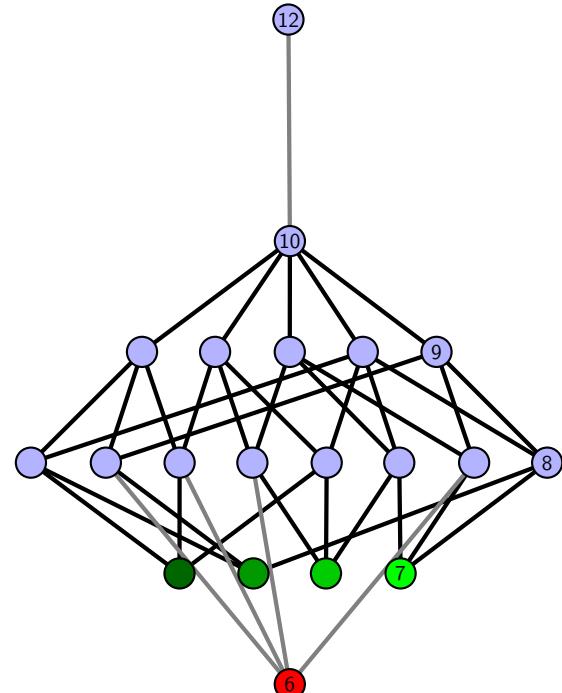


Figure 812: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.109 $[[3, 20, 4, 1], [11, 2, 12, 3], [14, 19, 15, 20], [4, 15, 5, 16], [1, 10, 2, 11], [12, 10, 13, 9], [13, 8, 14, 9], [18, 7, 19, 8], [5, 17, 6, 16], [6, 17, 7, 18]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (16, 5, 17, 6), (11, 6, 12, 7), (7, 10, 8, 11), (19, 8, 20, 9), (2, 13, 3, 14), (14, 3, 15, 4), (4, 15, 5, 16), (12, 17, 13, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 8, 8], [0, 5, 1, 1], [1, 4, 6, 6], [2, 5, 5, 7], [2, 6, 9, 9], [3, 9, 9, 3], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 405: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

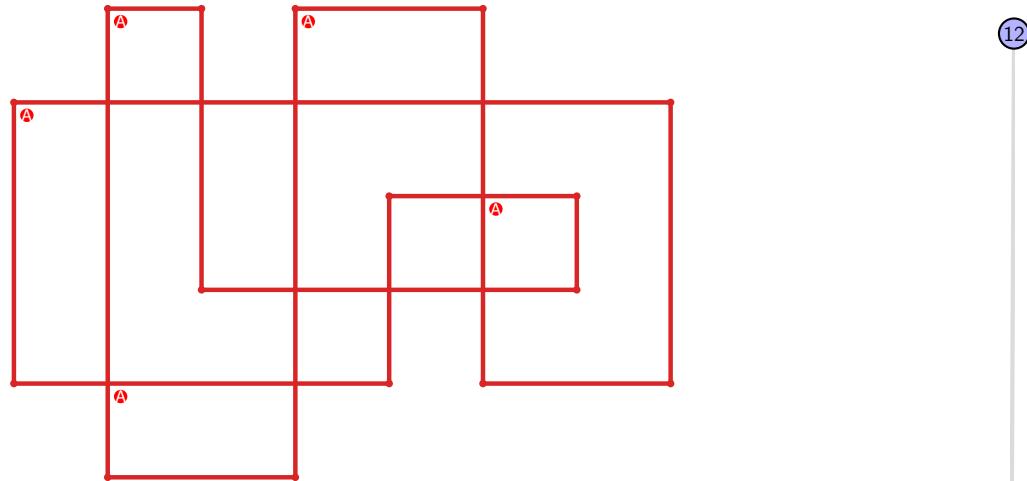


Figure 813: `SnapPy` multiloop plot.



Figure 814: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.110 `[[3, 10, 4, 1], [2, 20, 3, 11], [13, 9, 14, 10], [4, 14, 5, 15], [1, 12, 2, 11], [12, 19, 13, 20], [8, 18, 9, 19], [5, 18, 6, 17], [15, 7, 16, 8], [6, 16, 7, 17]]`

PD code drawn by `SnapPy`: `[(16, 5, 17, 6), (14, 7, 15, 8), (1, 8, 2, 9), (2, 15, 3, 16), (4, 17, 5, 18), (18, 3, 19, 4), (6, 19, 7, 20), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 6, 2], [2, 5, 8, 7], [3, 6, 9, 9], [3, 9, 9, 6], [7, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 5

Average minimal degree: 2.47

Total pinning sets: 392

Average overall degree: 3.06

Pinning number: 4

Table 406: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	1	0	0	0	0	0	0	4
Nonminimal pinning sets	0	8	44	94	113	82	36	9	1	387
Average degree	2.5	2.65	2.83	2.98	3.1	3.18	3.24	3.29	3.33	

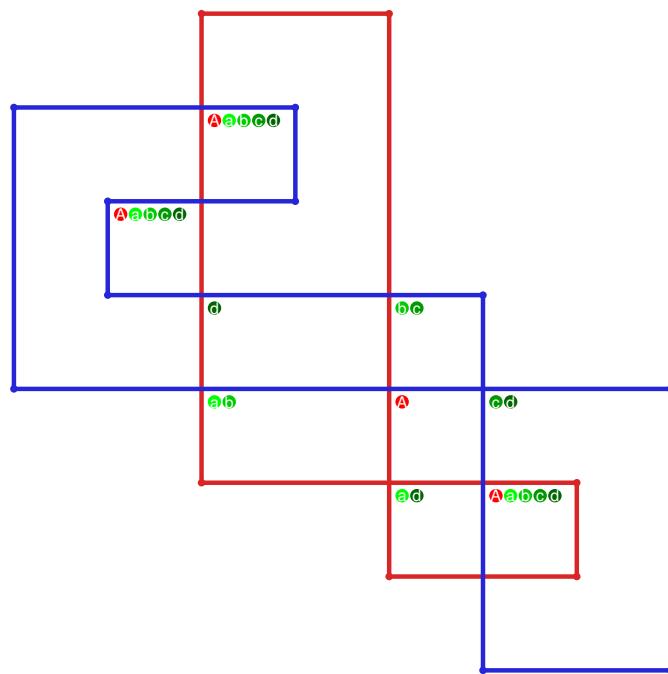


Figure 815: `SnapPy` multiloop plot.

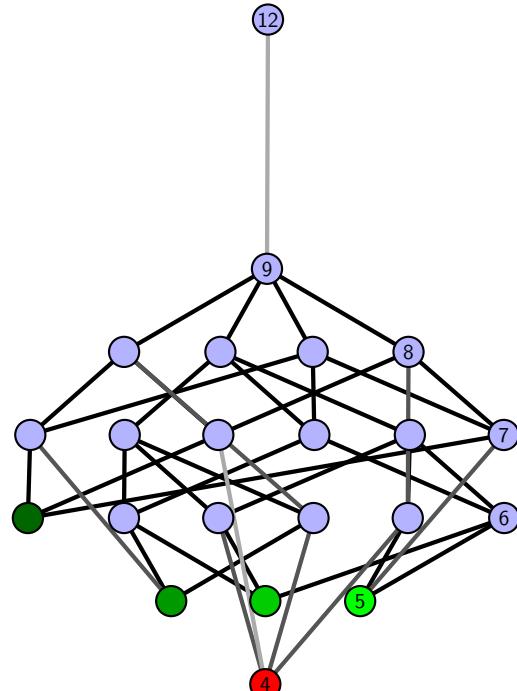


Figure 816: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.111 $[[3, 20, 4, 1], [2, 11, 3, 12], [14, 19, 15, 20], [4, 15, 5, 16], [1, 13, 2, 12], [13, 10, 14, 11], [18, 9, 19, 10], [5, 9, 6, 8], [16, 8, 17, 7], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (5, 14, 6, 15), (6, 3, 7, 4), (16, 7, 17, 8), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (2, 13, 3, 14), (12, 17, 13, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 6, 2], [2, 5, 9, 7], [3, 6, 9, 8], [3, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 3

Average optimal degree: 2.8

Total minimal pinning sets: 14

Average minimal degree: 2.77

Total pinning sets: 418

Average overall degree: 3.13

Pinning number: 5

Table 407: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	10	1	0	0	0	0	0	11
Nonminimal pinning sets	0	21	94	134	101	43	10	1	404
Average degree	2.8	2.89	3.03	3.15	3.22	3.27	3.31	3.33	

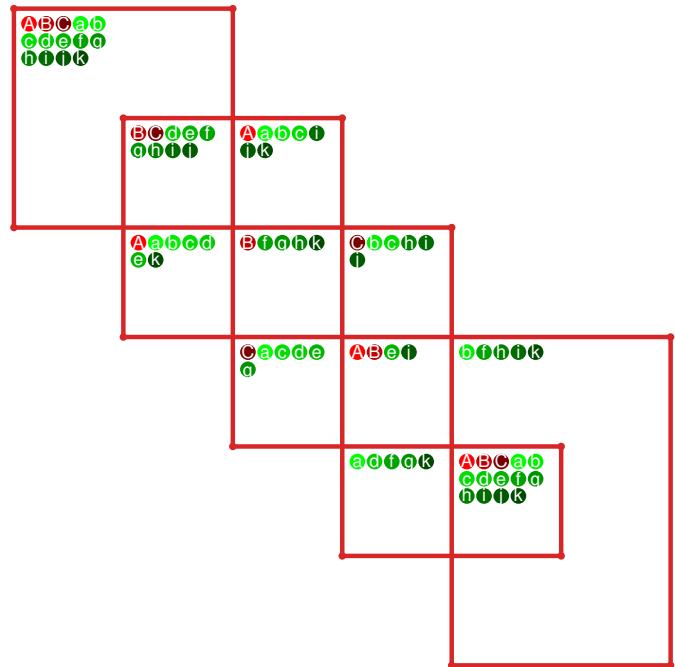


Figure 817: SnapPy multiloop plot.

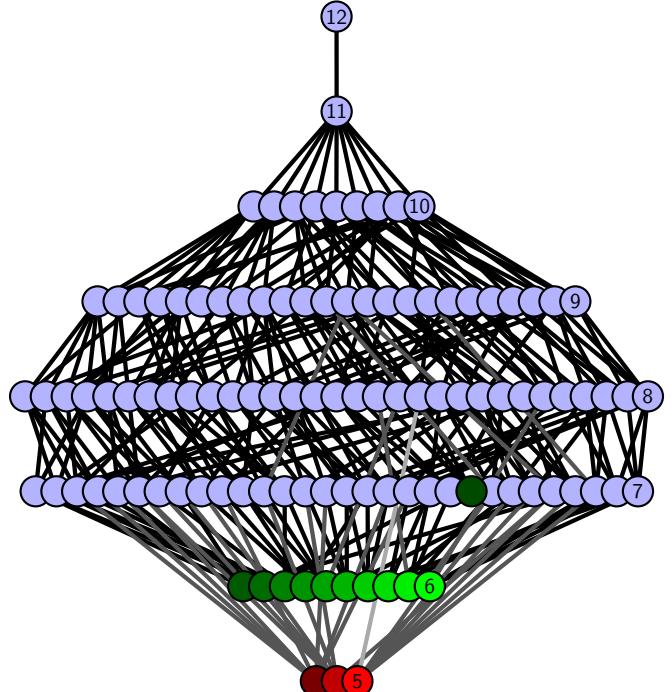


Figure 818: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.112 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 10, 20, 11], [4, 10, 5, 9], [1, 12, 2, 13], [14, 12, 15, 11], [15, 18, 16, 19], [5, 8, 6, 9], [6, 17, 7, 18], [16, 7, 17, 8]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (14, 5, 15, 6), (3, 6, 4, 7), (7, 2, 8, 3), (17, 8, 18, 9), (9, 12, 10, 13), (19, 10, 20, 11), (4, 15, 5, 16), (13, 16, 14, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 6, 2], [2, 5, 8, 9], [3, 9, 8, 3], [6, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 6

Average minimal degree: 2.51

Total pinning sets: 396

Average overall degree: 3.06

Pinning number: 4

Table 408: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	2	0	0	0	0	0	0	5
Nonminimal pinning sets	0	8	44	96	114	82	36	9	1	390
Average degree	2.5	2.65	2.83	2.98	3.1	3.18	3.24	3.29	3.33	

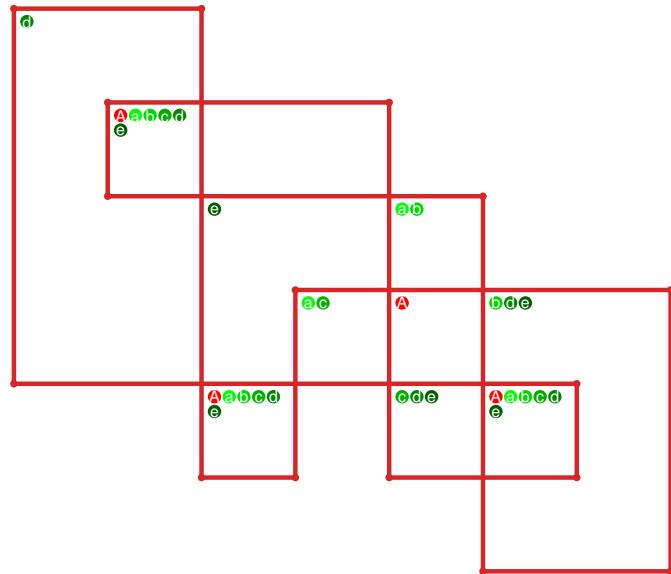


Figure 819: `SnapPy` multiloop plot.

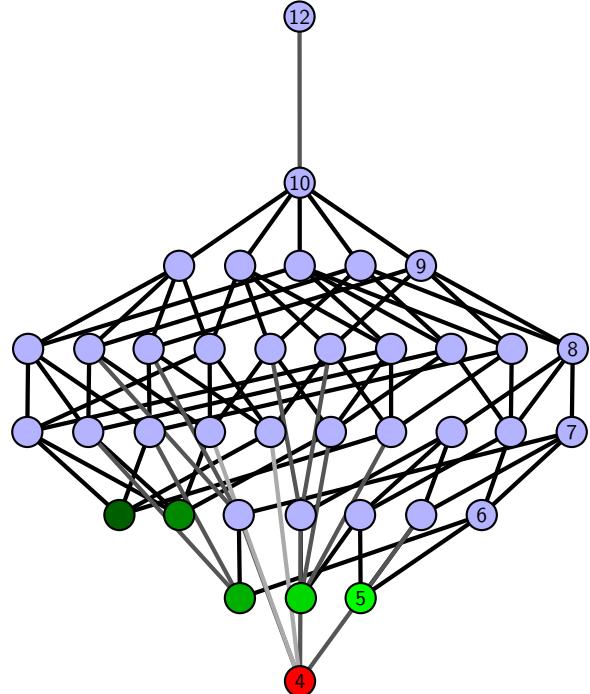


Figure 820: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.113 $[[3, 20, 4, 1], [2, 9, 3, 10], [12, 19, 13, 20], [4, 13, 5, 14], [1, 11, 2, 10], [11, 8, 12, 9], [18, 7, 19, 8], [5, 16, 6, 17], [14, 17, 15, 18], [15, 6, 16, 7]]$

PD code drawn by SnapPy: $[(13, 4, 14, 5), (16, 5, 17, 6), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (2, 11, 3, 12), (3, 14, 4, 15), (12, 15, 13, 16), (10, 17, 11, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 6, 2], [2, 5, 8, 9], [3, 9, 9, 8], [3, 7, 9, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.75

Total minimal pinning sets: 10

Average minimal degree: 2.66

Total pinning sets: 500

Average overall degree: 3.13

Pinning number: 4

Table 409: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	4	0	0	0	0	0	0	9
Nonminimal pinning sets	0	8	54	124	147	103	43	10	1	490
Average degree	2.75	2.82	2.94	3.06	3.16	3.23	3.27	3.31	3.33	

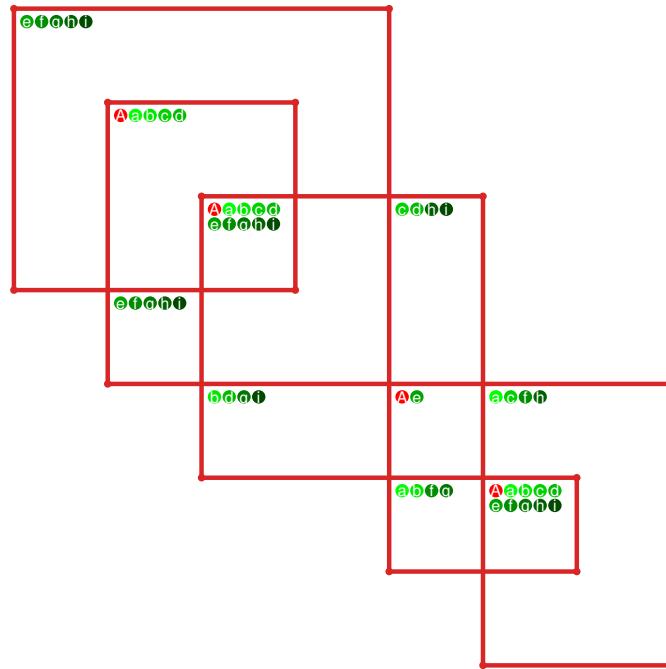


Figure 821: SnapPy multiloop plot.

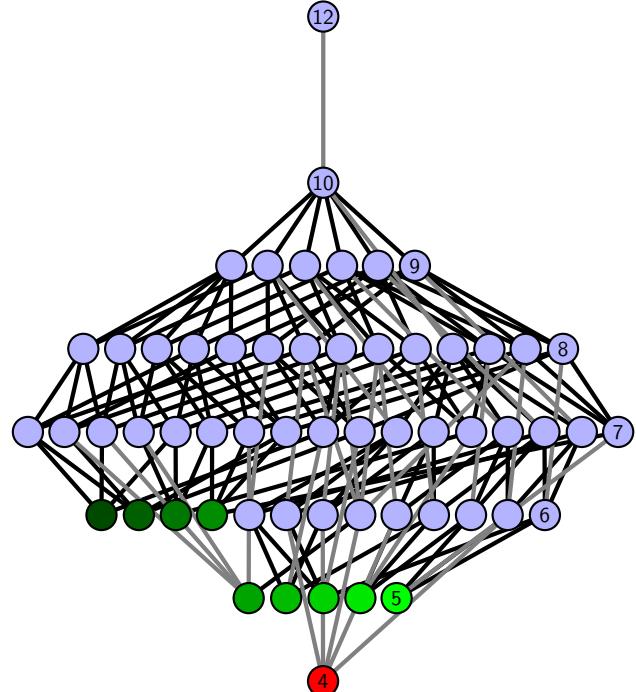


Figure 822: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.114 [[3, 16, 4, 1], [11, 2, 12, 3], [15, 8, 16, 9], [4, 8, 5, 7], [1, 10, 2, 11], [12, 10, 13, 9], [14, 20, 15, 17], [5, 20, 6, 19], [6, 18, 7, 19], [13, 18, 14, 17]]

PD code drawn by SnapPy: [(9, 16, 10, 1), (5, 2, 6, 3), (13, 6, 14, 7), (7, 10, 8, 11), (15, 8, 16, 9), (1, 14, 2, 15), (18, 3, 19, 4), (12, 19, 13, 20), (20, 11, 17, 12), (4, 17, 5, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 9, 2], [2, 9, 9, 7], [3, 6, 8, 8], [3, 7, 7, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 7
 Total pinning sets: 446
 Pinning number: 4

Average optimal degree: 2.38
 Average minimal degree: 2.54
 Average overall degree: 3.05

Table 410: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	0	5
Nonminimal pinning sets	0	15	64	111	120	83	36	9	1	439
Average degree	2.38	2.65	2.85	3.0	3.1	3.18	3.24	3.29	3.33	

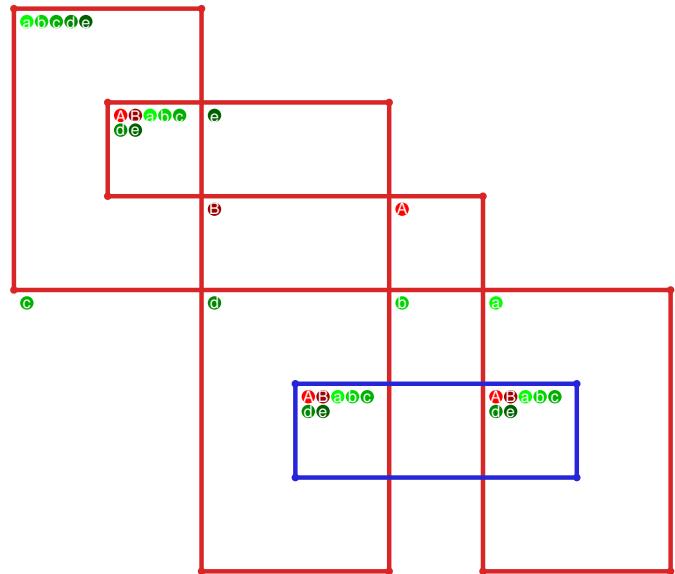


Figure 823: SnapPy multiloop plot.

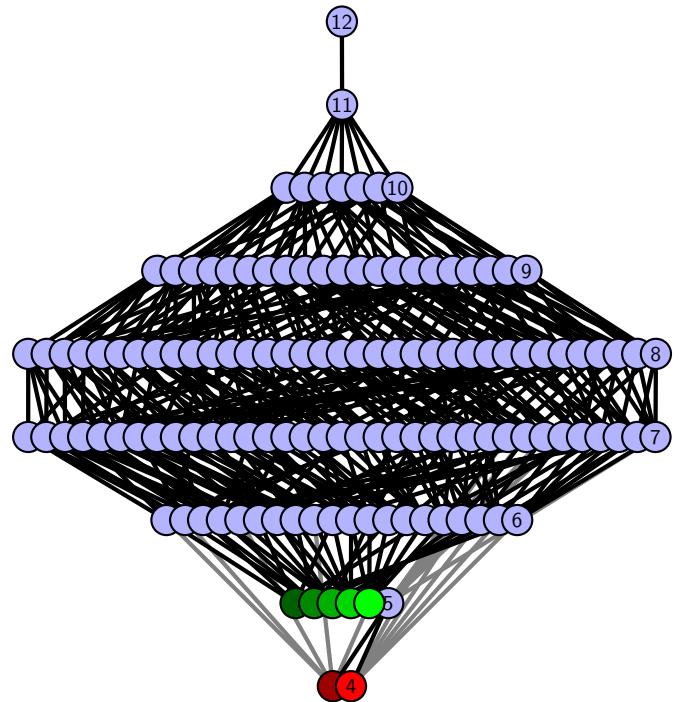


Figure 824: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.115 $[[3, 10, 4, 1], [2, 20, 3, 11], [13, 9, 14, 10], [4, 8, 5, 7], [1, 12, 2, 11], [12, 19, 13, 20], [8, 14, 9, 15], [5, 18, 6, 17], [6, 16, 7, 17], [18, 15, 19, 16]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (14, 7, 15, 8), (1, 8, 2, 9), (6, 15, 7, 16), (19, 16, 20, 17), (4, 17, 5, 18), (18, 3, 19, 4), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 8], [0, 5, 1, 1], [1, 4, 9, 2], [2, 9, 3, 2], [3, 9, 8, 8], [3, 7, 7, 9], [5, 8, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 11

Average minimal degree: 2.53

Total pinning sets: 482

Average overall degree: 3.05

Pinning number: 4

Table 411: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	9	0	0	0	0	0	0	0	9
Nonminimal pinning sets	0	15	76	124	126	84	36	9	1	471
Average degree	2.5	2.67	2.88	3.01	3.11	3.19	3.24	3.29	3.33	

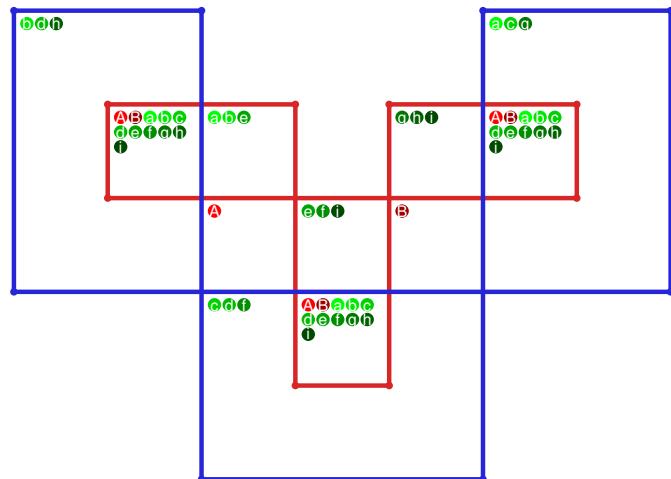


Figure 825: SnapPy multiloop plot.

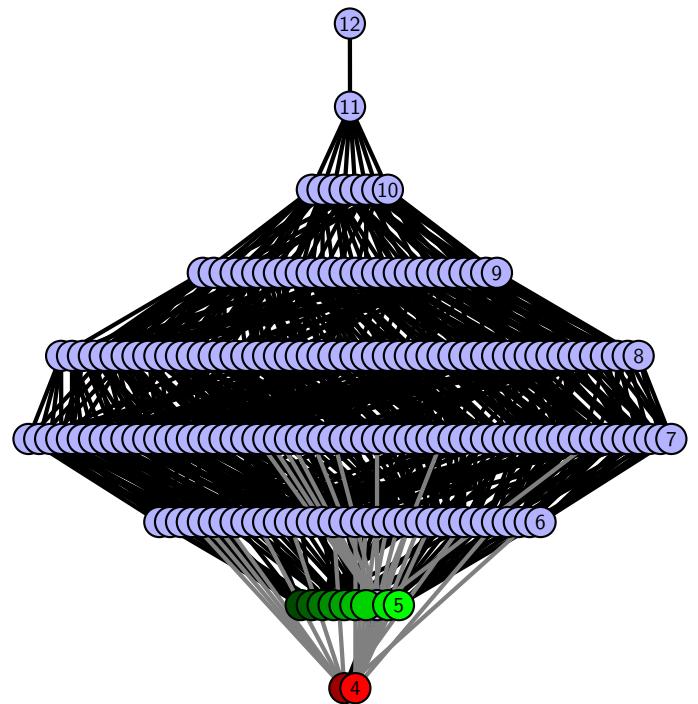


Figure 826: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.116 $[[3, 20, 4, 1], [2, 15, 3, 16], [19, 8, 20, 9], [4, 8, 5, 7], [1, 17, 2, 16], [17, 14, 18, 15], [9, 18, 10, 19], [5, 13, 6, 12], [6, 11, 7, 12], [13, 10, 14, 11]]$

PD code drawn by SnapPy: $[(3, 20, 4, 1), (15, 4, 16, 5), (9, 6, 10, 7), (2, 7, 3, 8), (8, 1, 9, 2), (13, 10, 14, 11), (18, 11, 19, 12), (12, 17, 13, 18), (5, 14, 6, 15), (19, 16, 20, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 9, 2], [3, 9, 8, 8], [3, 7, 7, 9], [5, 8, 7, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 9
 Total pinning sets: 505
 Pinning number: 4

Average optimal degree: 2.6
 Average minimal degree: 2.51
 Average overall degree: 3.05

Table 412: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	30	84	126	126	84	36	9	1	496
Average degree	2.6	2.73	2.89	3.02	3.11	3.19	3.24	3.29	3.33	

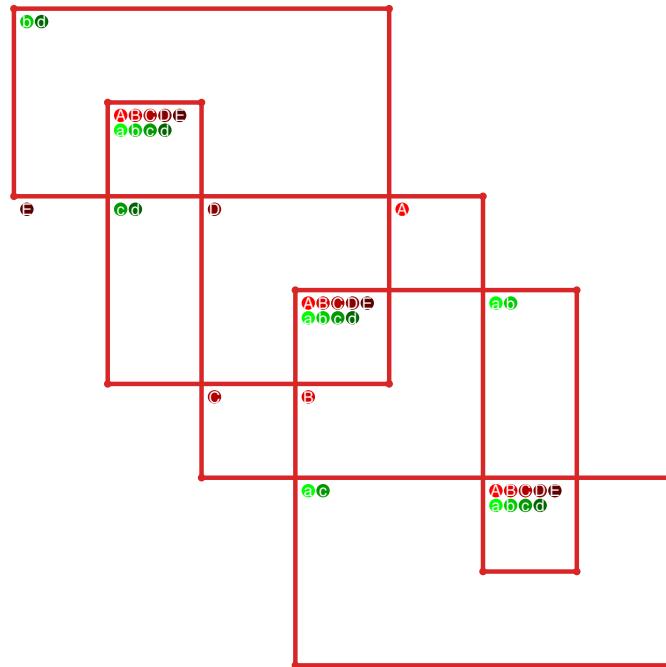


Figure 827: SnapPy multiloop plot.

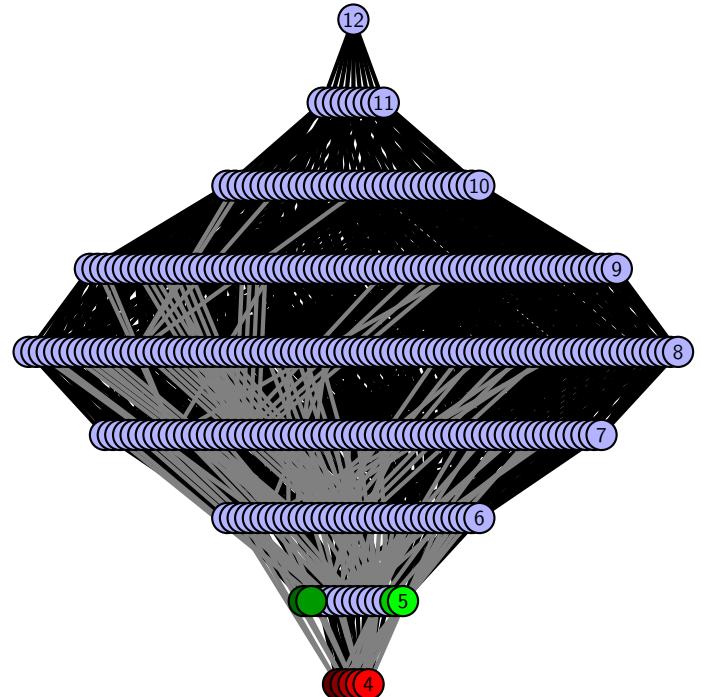


Figure 828: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.117 $[[3, 10, 4, 1], [2, 20, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [12, 19, 13, 20], [5, 18, 6, 17], [8, 16, 9, 17], [18, 13, 19, 14], [6, 14, 7, 15], [15, 7, 16, 8]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (16, 5, 17, 6), (1, 8, 2, 9), (19, 14, 20, 15), (4, 15, 5, 16), (6, 17, 7, 18), (18, 3, 19, 4), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 7, 8, 6], [2, 5, 9, 9], [4, 8, 5, 4], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 128
 Pinning number: 5

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.91

Table 413: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

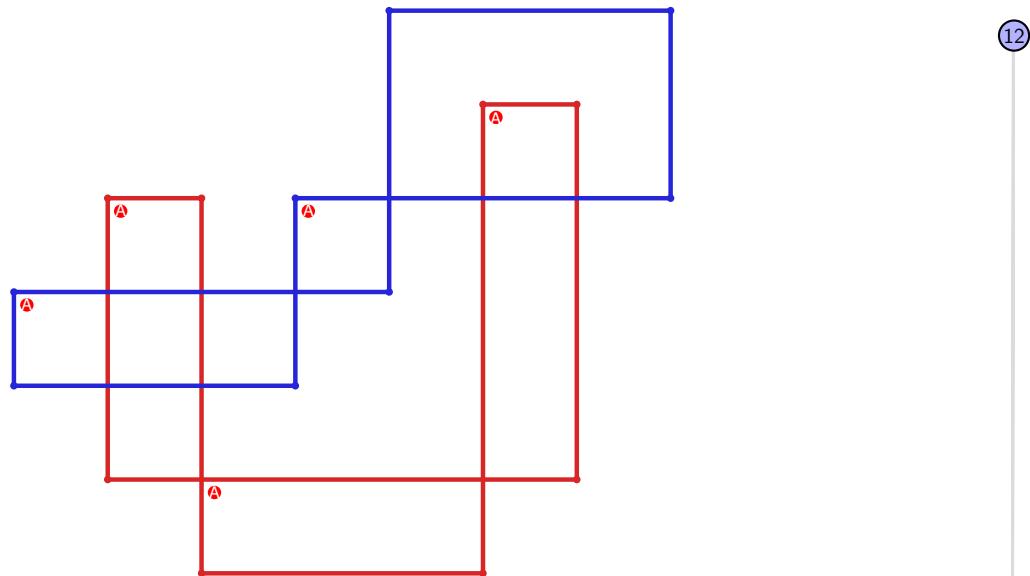


Figure 829: SnapPy multiloop plot.



Figure 830: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.118 $[[3, 8, 4, 1], [2, 20, 3, 9], [13, 7, 14, 8], [4, 14, 5, 15], [1, 10, 2, 9], [10, 19, 11, 20], [12, 17, 13, 18], [6, 16, 7, 17], [5, 16, 6, 15], [18, 11, 19, 12]]$

PD code drawn by SnapPy: $[(14, 5, 15, 6), (1, 6, 2, 7), (19, 12, 20, 13), (2, 15, 3, 16), (16, 3, 17, 4), (4, 17, 5, 18), (13, 18, 14, 19), (11, 20, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 8, 8], [0, 5, 1, 1], [1, 4, 9, 9], [2, 9, 9, 7], [2, 6, 8, 8], [3, 7, 7, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 414: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

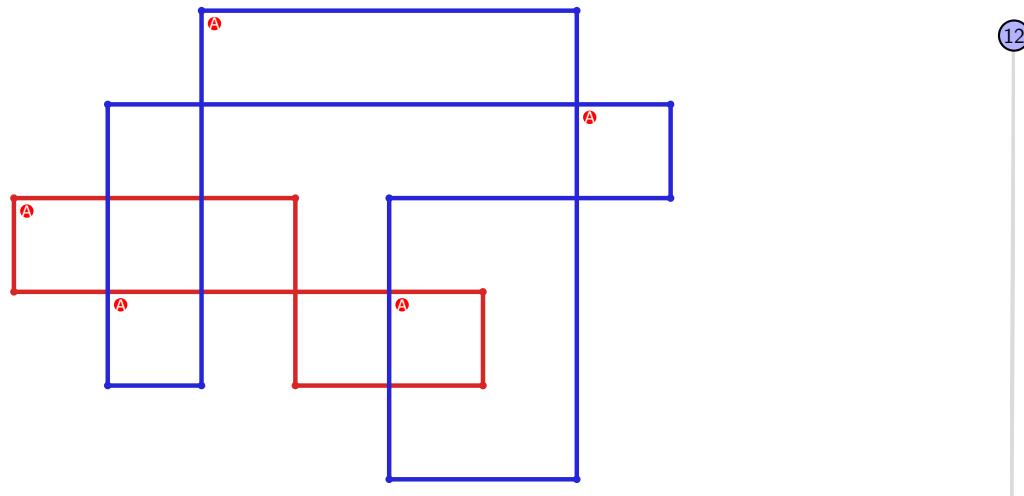


Figure 831: SnapPy multiloop plot.

12

Figure 832: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.119 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 4, 20, 5], [1, 12, 2, 13], [14, 12, 15, 11], [5, 18, 6, 19], [15, 9, 16, 8], [17, 10, 18, 11], [6, 10, 7, 9], [16, 7, 17, 8]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (17, 2, 18, 3), (14, 5, 15, 6), (6, 13, 7, 14), (7, 4, 8, 5), (15, 8, 16, 9), (9, 12, 10, 13), (19, 10, 20, 11), (3, 16, 4, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 7, 8, 2], [4, 8, 9, 9], [4, 9, 8, 5], [5, 7, 9, 6], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 415: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

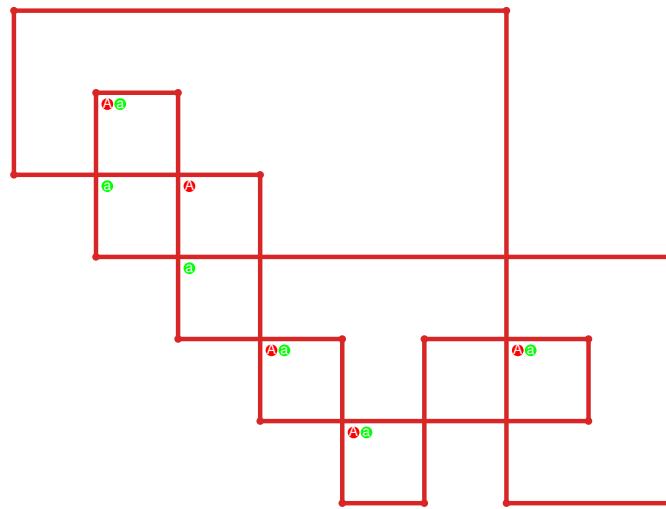


Figure 833: `SnapPy` multiloop plot.



Figure 834: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.120 $[[3, 20, 4, 1], [11, 2, 12, 3], [19, 4, 20, 5], [1, 10, 2, 11], [12, 10, 13, 9], [5, 14, 6, 15], [15, 18, 16, 19], [13, 8, 14, 9], [6, 17, 7, 18], [16, 7, 17, 8]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (17, 2, 18, 3), (14, 5, 15, 6), (11, 6, 12, 7), (7, 10, 8, 11), (19, 8, 20, 9), (3, 12, 4, 13), (4, 15, 5, 16), (13, 16, 14, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 7, 8, 6], [2, 5, 8, 9], [4, 9, 5, 4], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 416: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

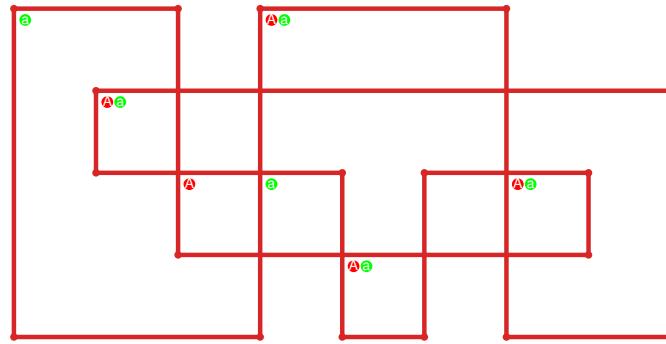


Figure 835: `SnapPy` multiloop plot.



Figure 836: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.121 $[[16, 20, 1, 17], [17, 8, 18, 7], [15, 2, 16, 3], [19, 1, 20, 2], [8, 19, 9, 18], [9, 6, 10, 7], [3, 10, 4, 11], [11, 14, 12, 15], [12, 5, 13, 6], [4, 13, 5, 14]]$

PD code drawn by SnapPy: $[(13, 16, 14, 1), (10, 3, 11, 4), (7, 4, 8, 5), (5, 20, 6, 17), (1, 8, 2, 9), (2, 11, 3, 12), (9, 12, 10, 13), (18, 15, 19, 16), (17, 6, 18, 7), (14, 19, 15, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 4, 0], [1, 3, 5, 1], [1, 4, 8, 6], [2, 5, 9, 7], [2, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 417: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

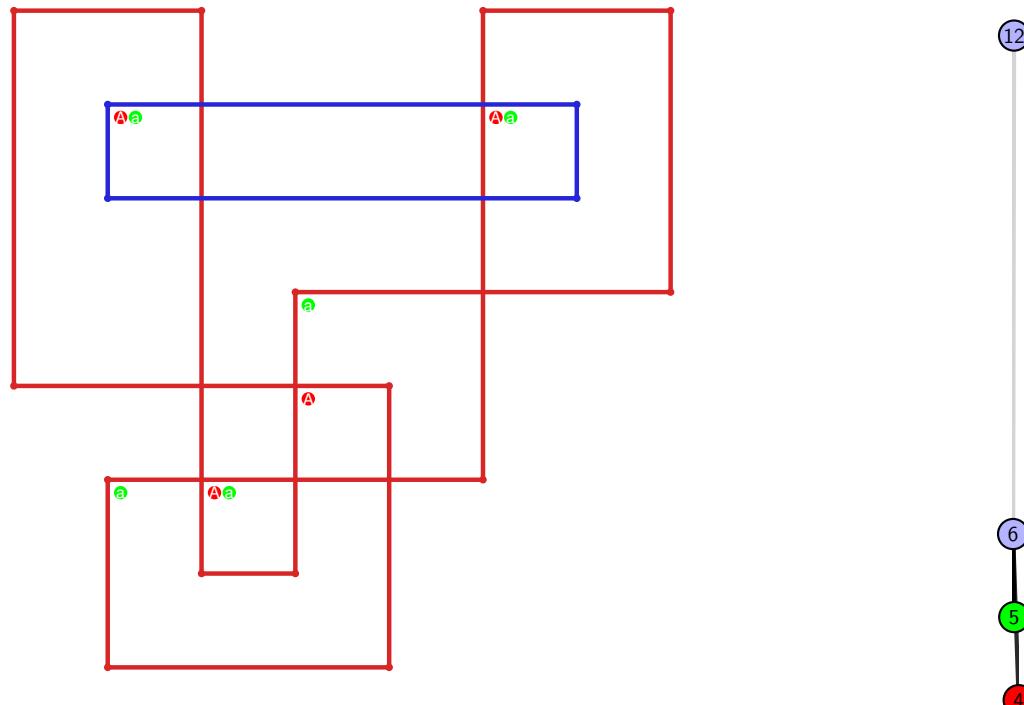


Figure 837: SnapPy multiloop plot.

Figure 838: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.122 $[[3, 6, 4, 1], [2, 20, 3, 7], [5, 15, 6, 16], [4, 15, 5, 14], [1, 8, 2, 7], [8, 19, 9, 20], [16, 9, 17, 10], [10, 13, 11, 14], [11, 18, 12, 19], [17, 12, 18, 13]]$

PD code drawn by SnapPy: $[(1, 4, 2, 5), (17, 10, 18, 11), (18, 13, 19, 14), (11, 14, 12, 15), (15, 2, 16, 3), (3, 16, 4, 17), (12, 19, 13, 20), (9, 20, 10, 7), (6, 7, 1, 8), (8, 5, 9, 6)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 3, 3], [0, 2, 2, 7], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 9, 7], [3, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 384
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.25
 Average overall degree: 3.03

Table 418: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

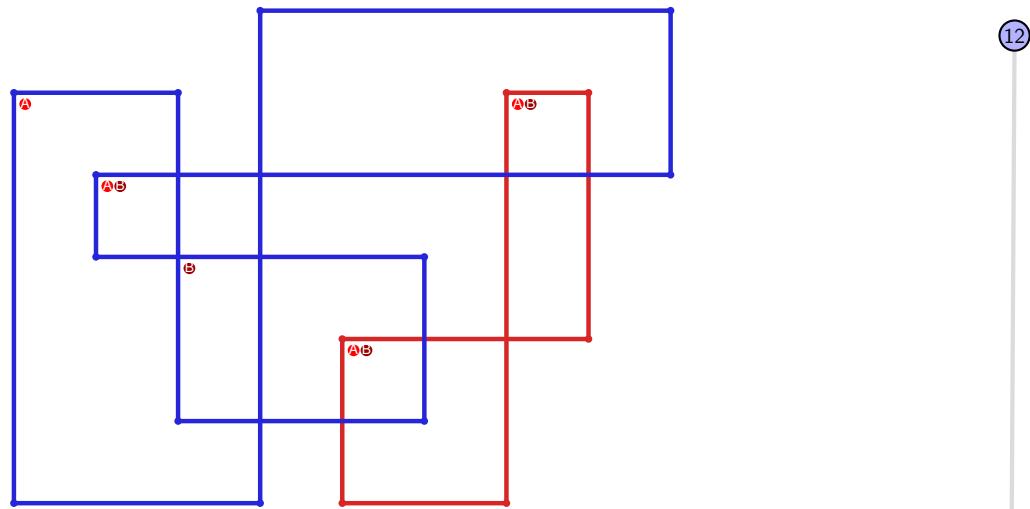


Figure 839: SnapPy multiloop plot.

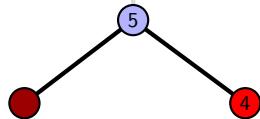


Figure 840: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.123 [[10, 20, 1, 11], [11, 14, 12, 15], [19, 9, 20, 10], [1, 13, 2, 14], [12, 2, 13, 3], [15, 3, 16, 4], [4, 18, 5, 19], [5, 8, 6, 9], [16, 6, 17, 7], [7, 17, 8, 18]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (12, 3, 13, 4), (2, 5, 3, 6), (15, 6, 16, 7), (18, 9, 19, 10), (8, 19, 9, 20), (17, 20, 18, 11), (4, 13, 5, 14), (1, 14, 2, 15), (7, 16, 8, 17)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 4, 4, 1], [1, 3, 3, 5], [1, 4, 8, 6], [2, 5, 9, 7], [2, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 200
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.49
 Average overall degree: 3.03

Table 419: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	3
Nonminimal pinning sets	0	7	31	58	58	32	9	1	196
Average degree	2.4	2.63	2.82	2.99	3.12	3.23	3.29	3.33	

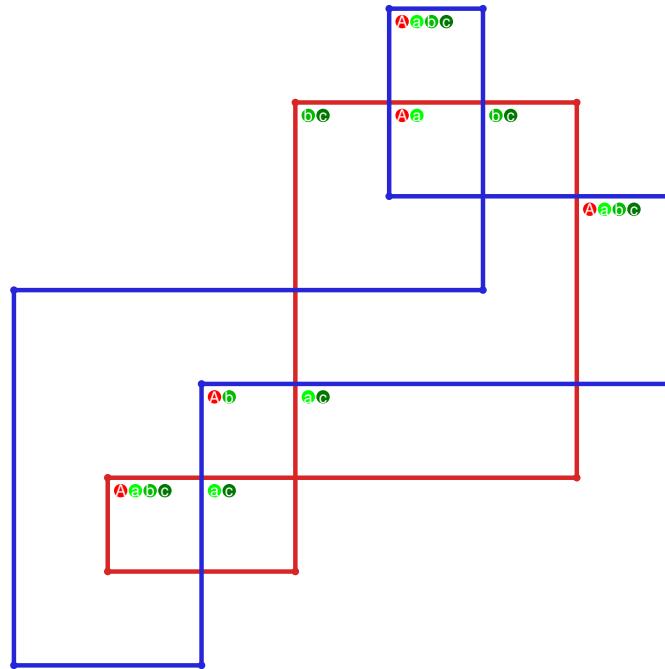


Figure 841: SnapPy multiloop plot.

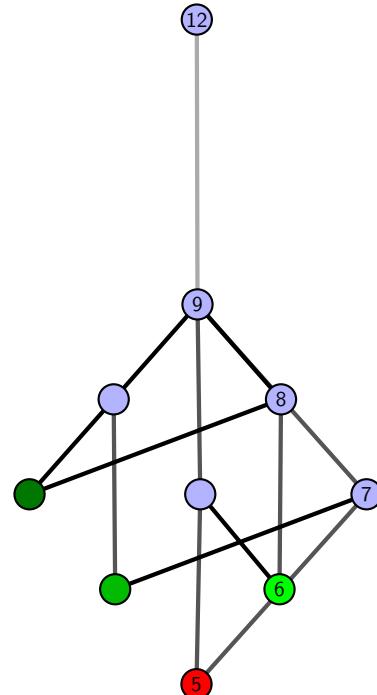


Figure 842: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.124 [[5, 20, 6, 1], [15, 4, 16, 5], [19, 10, 20, 11], [6, 10, 7, 9], [1, 14, 2, 15], [3, 12, 4, 13], [16, 12, 17, 11], [18, 7, 19, 8], [8, 17, 9, 18], [13, 2, 14, 3]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (15, 4, 16, 5), (6, 3, 7, 4), (16, 7, 17, 8), (8, 13, 9, 14), (20, 9, 1, 10), (18, 11, 19, 12), (5, 14, 6, 15), (2, 17, 3, 18), (10, 19, 11, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 7, 8], [0, 9, 9, 1], [1, 9, 9, 6], [1, 5, 8, 2], [2, 8, 8, 3], [3, 7, 7, 6], [4, 5, 5, 4]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 8
 Total pinning sets: 276
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.56
 Average overall degree: 3.05

Table 420: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	6
Nonminimal pinning sets	0	13	57	84	70	34	9	1	268
Average degree	2.5	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

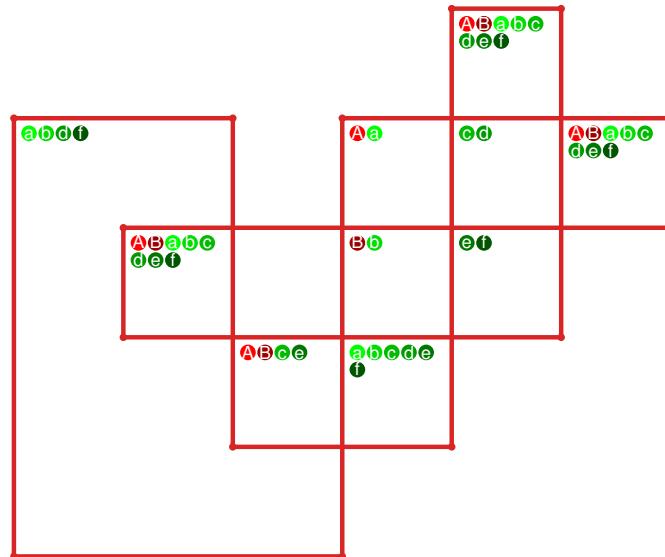


Figure 843: SnapPy multiloop plot.

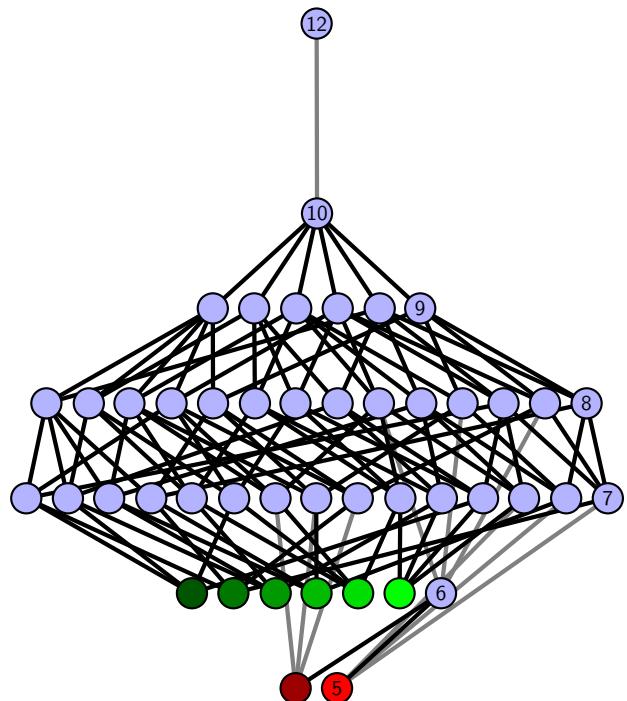


Figure 844: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.125 $[[8, 20, 1, 9], [9, 3, 10, 4], [15, 7, 16, 8], [16, 19, 17, 20], [1, 11, 2, 12], [12, 2, 13, 3], [10, 13, 11, 14], [4, 14, 5, 15], [18, 6, 19, 7], [17, 6, 18, 5]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (18, 1, 19, 2), (3, 14, 4, 15), (15, 4, 16, 5), (12, 5, 13, 6), (7, 20, 8, 9), (19, 10, 20, 11), (2, 11, 3, 12), (13, 16, 14, 17), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 8, 3], [0, 2, 8, 9], [0, 6, 5, 5], [1, 4, 4, 6], [1, 5, 4, 7], [1, 6, 9, 2], [2, 9, 9, 3], [3, 8, 8, 7]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 6
 Total pinning sets: 368
 Pinning number: 5

Average optimal degree: 2.64
 Average minimal degree: 2.64
 Average overall degree: 3.11

Table 421: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	30	80	111	89	41	10	1	362
Average degree	2.64	2.85	3.0	3.12	3.21	3.27	3.31	3.33	

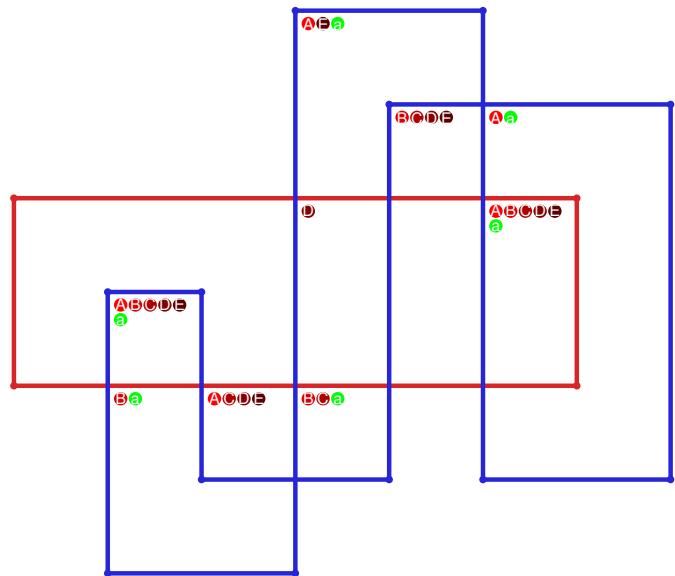


Figure 845: `SnapPy` multiloop plot.

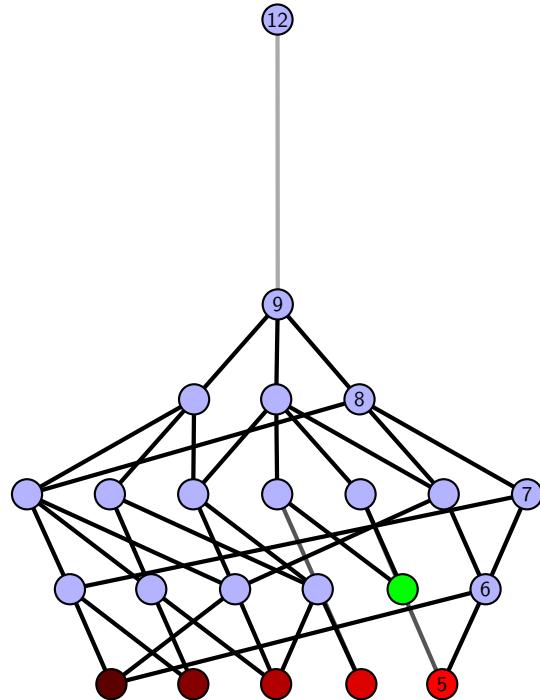


Figure 846: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.126 $[[7, 10, 8, 1], [6, 20, 7, 11], [9, 13, 10, 14], [8, 13, 9, 12], [1, 12, 2, 11], [15, 5, 16, 6], [16, 19, 17, 20], [14, 3, 15, 2], [18, 4, 19, 5], [17, 4, 18, 3]]$

PD code drawn by `SnapPy`: $[(10, 11, 1, 12), (12, 1, 13, 2), (19, 2, 20, 3), (4, 7, 5, 8), (9, 18, 10, 19), (16, 5, 17, 6), (6, 17, 7, 18), (20, 13, 11, 14), (3, 14, 4, 15), (15, 8, 16, 9)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 3, 3], [0, 2, 2, 4], [0, 3, 7, 1], [1, 7, 8, 6], [1, 5, 8, 9], [2, 9, 5, 4], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 400
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.59
 Average overall degree: 3.1

Table 422: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	40	90	116	90	41	10	1	396
Average degree	2.5	2.72	2.89	3.02	3.12	3.21	3.27	3.31	3.33	

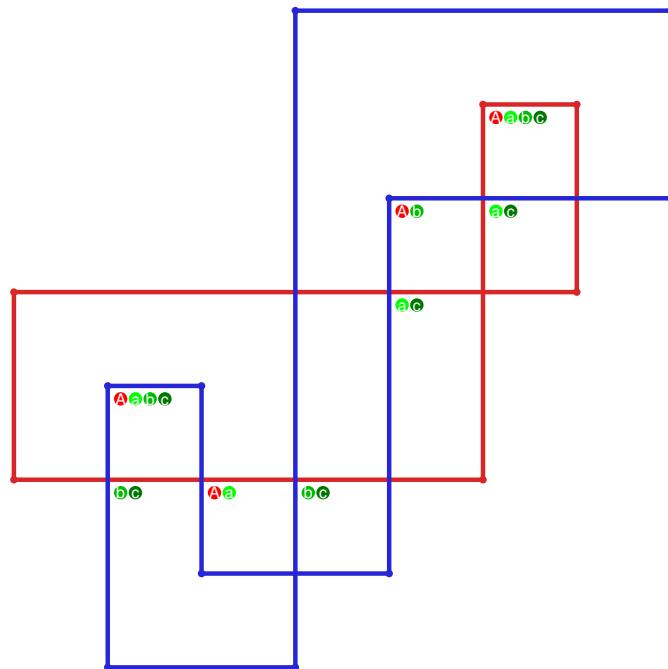


Figure 847: `SnapPy` multiloop plot.

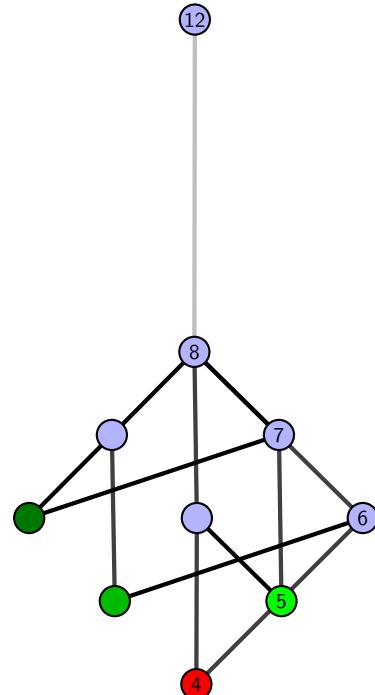


Figure 848: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.127 `[[12, 20, 1, 13], [13, 10, 14, 9], [19, 11, 20, 12], [1, 11, 2, 10], [14, 4, 15, 5], [5, 8, 6, 9], [18, 2, 19, 3], [3, 17, 4, 18], [15, 7, 16, 8], [6, 16, 7, 17]]`

PD code drawn by `SnapPy`: `[(18, 1, 19, 2), (19, 4, 20, 5), (2, 5, 3, 6), (6, 17, 7, 18), (7, 10, 8, 11), (15, 8, 16, 9), (14, 11, 15, 12), (3, 20, 4, 13), (12, 13, 1, 14), (9, 16, 10, 17)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 6, 1], [1, 7, 8, 5], [1, 4, 8, 9], [2, 7, 7, 3], [4, 6, 6, 9], [4, 9, 9, 5], [5, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.49

Total pinning sets: 200

Average overall degree: 3.03

Pinning number: 5

Table 423: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	3
Nonminimal pinning sets	0	7	31	58	58	32	9	1	196
Average degree	2.4	2.63	2.82	2.99	3.12	3.23	3.29	3.33	

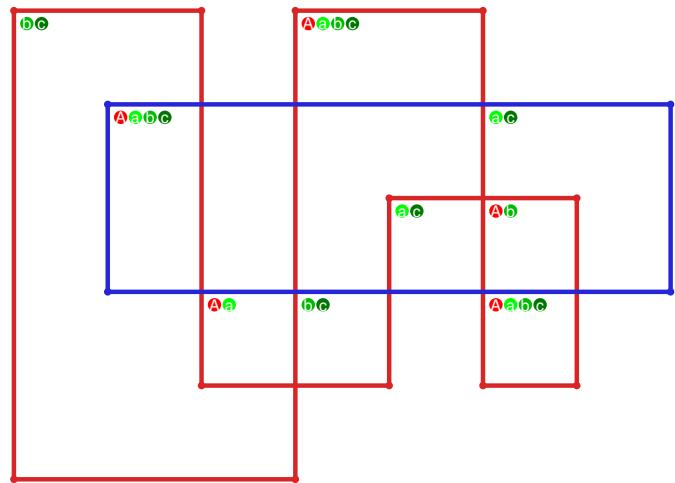


Figure 849: `SnapPy` multiloop plot.

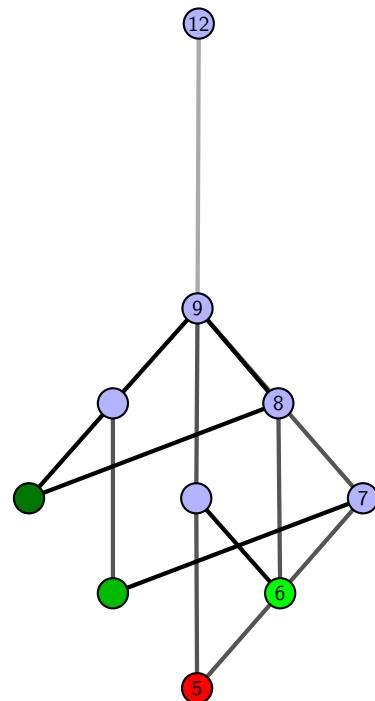


Figure 850: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.128 $[[7, 20, 8, 1], [6, 17, 7, 18], [19, 8, 20, 9], [1, 19, 2, 18], [10, 5, 11, 6], [11, 16, 12, 17], [9, 3, 10, 2], [4, 13, 5, 14], [15, 12, 16, 13], [3, 15, 4, 14]]$

PD code drawn by `SnapPy`: $[(7, 2, 8, 3), (16, 5, 17, 6), (12, 9, 13, 10), (1, 10, 2, 11), (11, 20, 12, 1), (8, 13, 9, 14), (3, 14, 4, 15), (15, 18, 16, 19), (4, 17, 5, 18), (19, 6, 20, 7)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 6, 1], [1, 6, 7, 5], [1, 4, 8, 8], [2, 9, 4, 3], [4, 9, 9, 8], [5, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 256
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.59
 Average overall degree: 3.05

Table 424: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	7	49	79	69	34	9	1	248
Average degree	2.4	2.64	2.87	3.04	3.15	3.24	3.29	3.33	

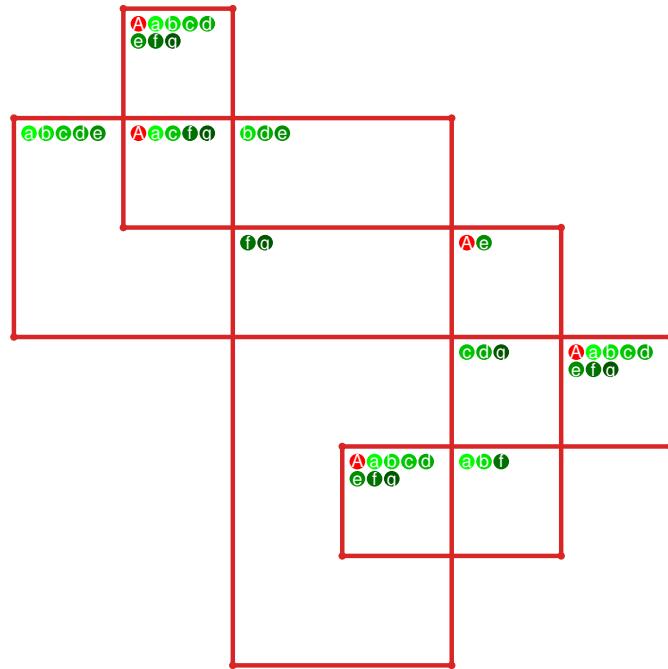


Figure 851: `SnapPy` multiloop plot.

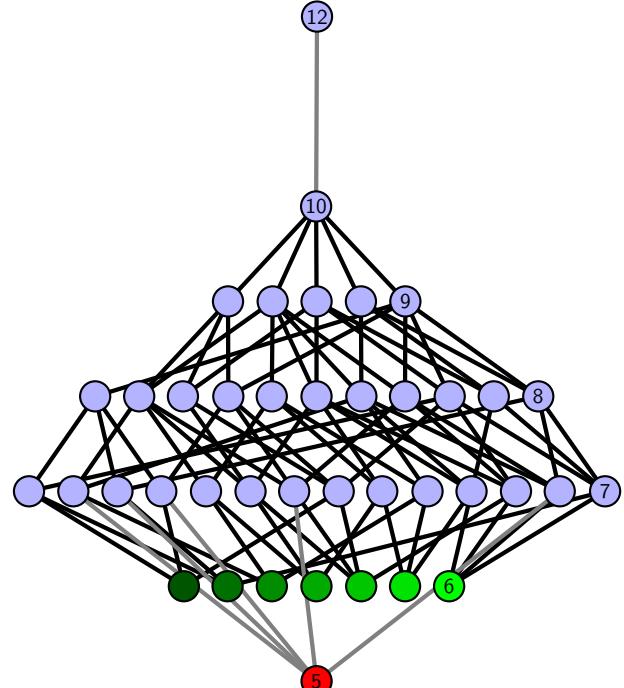


Figure 852: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.129 [[20, 9, 1, 10], [10, 18, 11, 17], [8, 19, 9, 20], [1, 19, 2, 18], [11, 7, 12, 6], [16, 5, 17, 6], [7, 2, 8, 3], [12, 15, 13, 16], [13, 4, 14, 5], [3, 14, 4, 15]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (13, 2, 14, 3), (3, 8, 4, 9), (17, 6, 18, 7), (20, 11, 1, 12), (9, 12, 10, 13), (14, 7, 15, 8), (15, 18, 16, 19), (5, 16, 6, 17), (4, 19, 5, 20)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 6, 1], [1, 6, 7, 5], [1, 4, 7, 8], [2, 9, 4, 3], [4, 9, 8, 5], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 11
Total minimal pinning sets: 12

Total pinning sets: 286

Pinning number: 6

Average optimal degree: 2.73

Average minimal degree: 2.74

Average overall degree: 3.11

Table 425: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	11	0	0	0	0	0	0	11
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	50	91	82	40	10	1	274
Average degree	2.73	2.93	3.09	3.19	3.26	3.31	3.33	

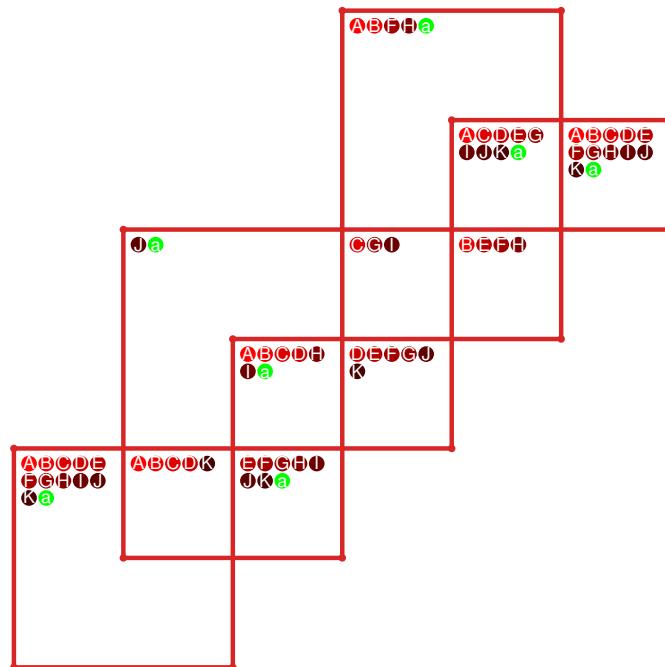


Figure 853: SnapPy multiloop plot.

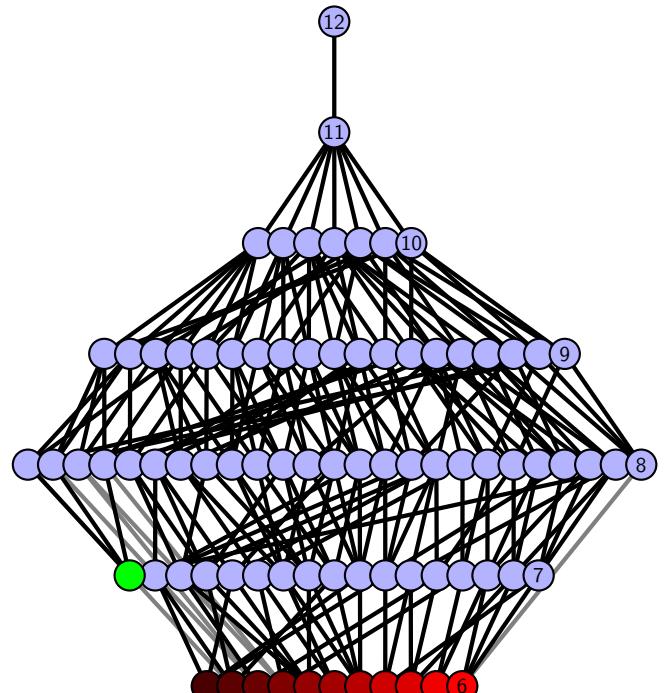


Figure 854: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.130 $[[4, 20, 1, 5], [5, 12, 6, 13], [19, 3, 20, 4], [1, 11, 2, 12], [6, 18, 7, 17], [13, 17, 14, 16], [9, 18, 10, 19], [10, 2, 11, 3], [7, 15, 8, 14], [8, 15, 9, 16]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (14, 1, 15, 2), (3, 6, 4, 7), (16, 7, 17, 8), (9, 18, 10, 19), (19, 10, 20, 11), (11, 8, 12, 9), (12, 17, 13, 18), (20, 13, 5, 14), (2, 15, 3, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 7, 7, 1], [1, 6, 8, 5], [1, 4, 8, 9], [2, 9, 4, 7], [2, 6, 3, 3], [4, 9, 9, 5], [5, 8, 8, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 6
 Total pinning sets: 280
 Pinning number: 5

Average optimal degree: 2.47
 Average minimal degree: 2.51
 Average overall degree: 3.05

Table 426: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	18	58	84	70	34	9	1	274
Average degree	2.47	2.71	2.9	3.05	3.16	3.24	3.29	3.33	

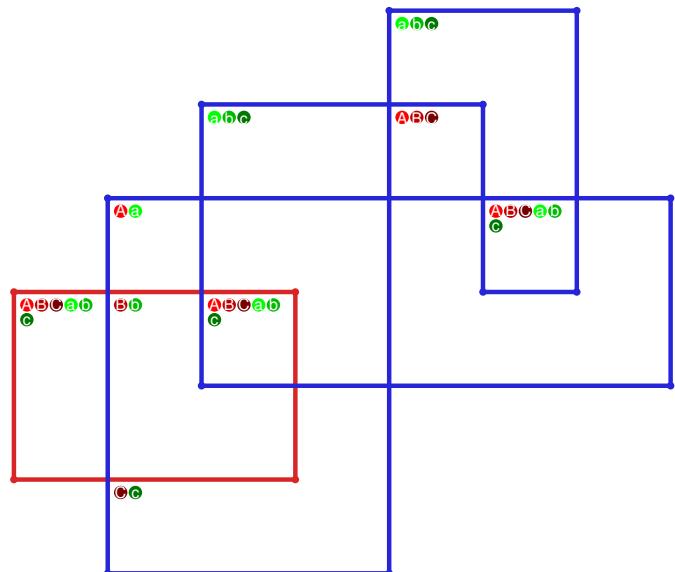


Figure 855: `SnapPy` multiloop plot.

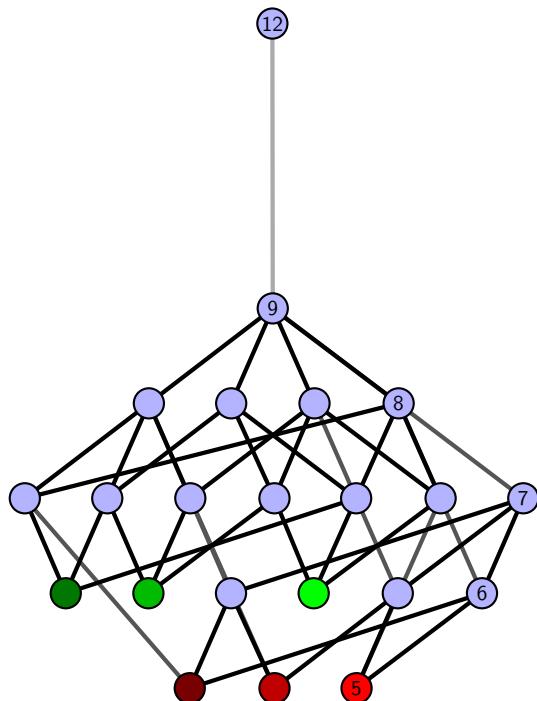


Figure 856: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.131 $[[9, 20, 10, 1], [13, 8, 14, 9], [19, 4, 20, 5], [10, 4, 11, 3], [1, 12, 2, 13], [7, 18, 8, 19], [14, 18, 15, 17], [5, 17, 6, 16], [11, 2, 12, 3], [6, 15, 7, 16]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (1, 8, 2, 9), (17, 2, 18, 3), (11, 6, 12, 7), (19, 10, 20, 11), (4, 13, 5, 14), (14, 3, 15, 4), (15, 12, 16, 13), (5, 16, 6, 17), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 5, 3], [0, 2, 8, 8], [0, 8, 8, 1], [1, 2, 9, 6], [1, 5, 9, 7], [2, 6, 9, 9], [3, 4, 4, 3], [5, 7, 7, 6]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 312
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.04

Table 427: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	31	70	90	71	34	9	1	306
Average degree	2.5	2.76	2.93	3.06	3.16	3.24	3.29	3.33	

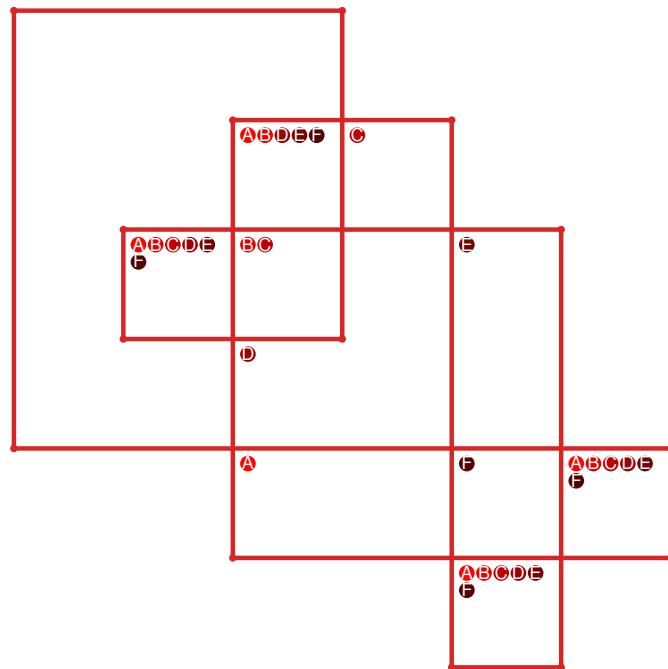


Figure 857: SnapPy multiloop plot.

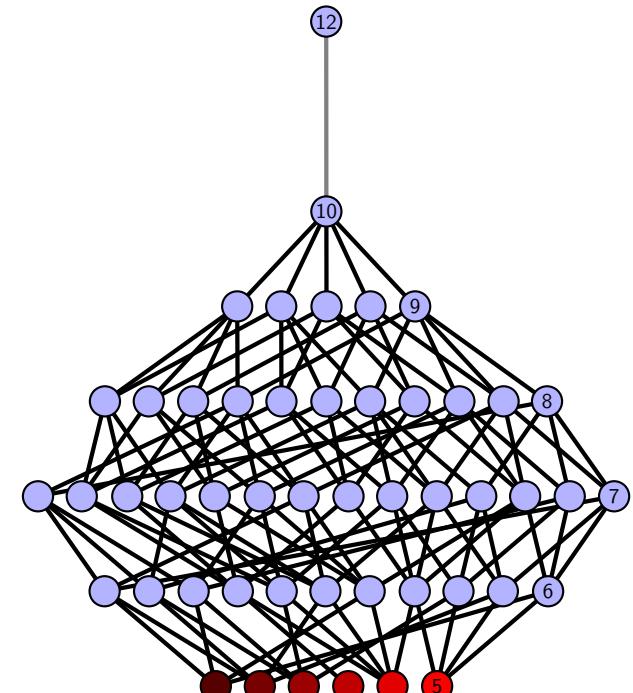


Figure 858: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.132 $[[12, 3, 1, 4], [4, 13, 5, 20], [11, 15, 12, 16], [2, 14, 3, 15], [1, 14, 2, 13], [5, 19, 6, 20], [16, 9, 17, 8], [18, 10, 19, 11], [6, 10, 7, 9], [17, 7, 18, 8]]$

PD code drawn by `SnapPy`: $[(10, 1, 11, 2), (16, 5, 17, 6), (6, 15, 7, 16), (7, 4, 8, 5), (17, 8, 18, 9), (3, 18, 4, 19), (19, 2, 20, 3), (20, 11, 13, 12), (12, 13, 1, 14), (9, 14, 10, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 4, 4], [0, 3, 3, 1], [1, 7, 8, 1], [2, 8, 9, 9], [2, 9, 8, 5], [5, 7, 9, 6], [6, 8, 7, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 200
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.49
 Average overall degree: 3.03

Table 428: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	3
Nonminimal pinning sets	0	7	31	58	58	32	9	1	196
Average degree	2.4	2.63	2.82	2.99	3.12	3.22	3.29	3.33	

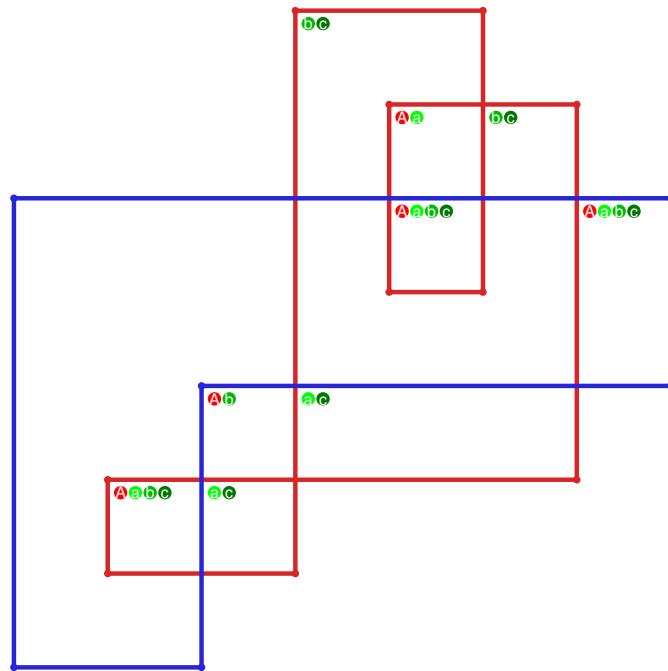


Figure 859: `SnapPy` multiloop plot.

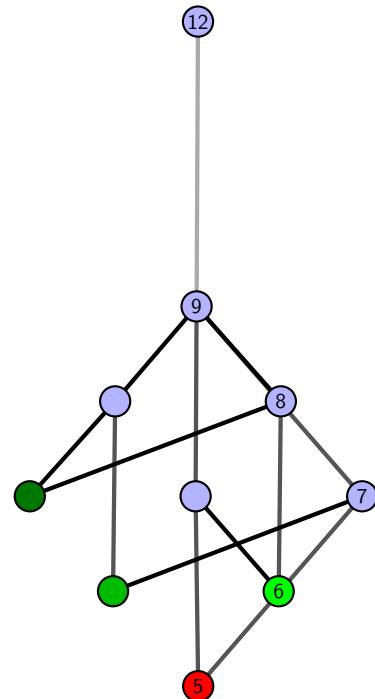


Figure 860: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.133 [[12, 20, 1, 13], [13, 5, 14, 6], [17, 11, 18, 12], [3, 19, 4, 20], [1, 4, 2, 5], [14, 11, 15, 10], [6, 10, 7, 9], [16, 8, 17, 9], [18, 2, 19, 3], [15, 8, 16, 7]]

PD code drawn by `SnapPy`: [(13, 12, 14, 1), (11, 2, 12, 3), (16, 3, 17, 4), (5, 18, 6, 19), (19, 6, 20, 7), (7, 4, 8, 5), (8, 17, 9, 18), (20, 9, 13, 10), (1, 14, 2, 15), (10, 15, 11, 16)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 5, 8], [0, 8, 8, 4], [0, 3, 8, 1], [1, 2, 9, 6], [1, 5, 9, 7], [2, 6, 9, 9], [2, 4, 3, 3], [5, 7, 7, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 400
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.59
 Average overall degree: 3.1

Table 429: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	40	90	116	90	41	10	1	396
Average degree	2.5	2.72	2.89	3.02	3.12	3.21	3.27	3.31	3.33	

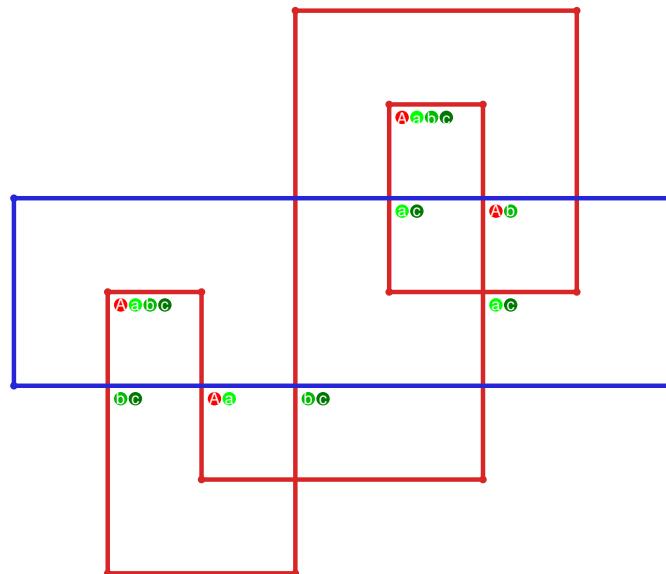


Figure 861: `SnapPy` multiloop plot.

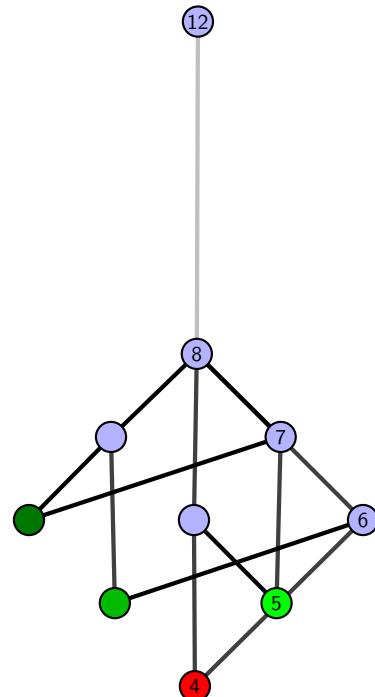


Figure 862: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.134 [[10, 20, 1, 11], [11, 3, 12, 4], [15, 9, 16, 10], [16, 19, 17, 20], [1, 17, 2, 18], [18, 2, 19, 3], [12, 9, 13, 8], [4, 8, 5, 7], [14, 6, 15, 7], [13, 6, 14, 5]]

PD code drawn by `SnapPy`: [(1, 20, 2, 11), (11, 2, 12, 3), (3, 10, 4, 1), (4, 19, 5, 20), (12, 5, 13, 6), (15, 8, 16, 9), (18, 9, 19, 10), (7, 14, 8, 15), (13, 16, 14, 17), (6, 17, 7, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 8, 6, 3], [0, 2, 5, 4], [0, 3, 5, 5], [1, 4, 4, 3], [1, 2, 9, 7], [1, 6, 9, 8], [2, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 4

Average minimal degree: 2.59

Total pinning sets: 400

Average overall degree: 3.1

Pinning number: 4

Table 430: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	40	90	116	90	41	10	1	396
Average degree	2.5	2.72	2.89	3.02	3.12	3.21	3.27	3.31	3.33	

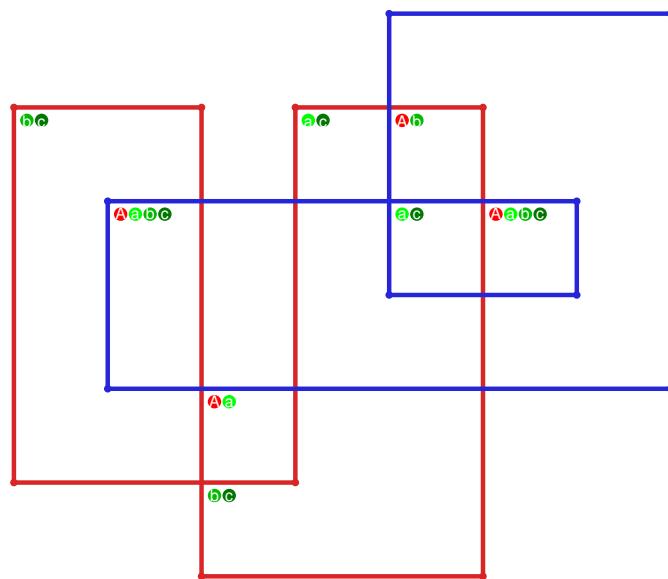


Figure 863: `SnapPy` multiloop plot.

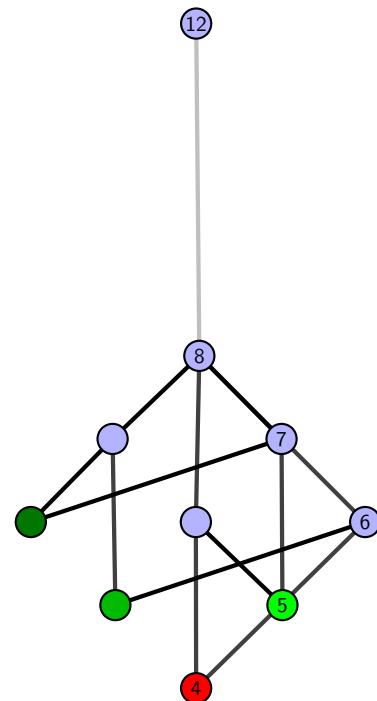


Figure 864: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.135 $[[10, 20, 1, 11], [11, 18, 12, 19], [19, 9, 20, 10], [1, 17, 2, 18], [12, 8, 13, 9], [16, 6, 17, 7], [2, 6, 3, 5], [7, 13, 8, 14], [15, 3, 16, 4], [4, 14, 5, 15]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (3, 10, 4, 1), (13, 4, 14, 5), (19, 6, 20, 7), (16, 7, 17, 8), (5, 20, 6, 11), (2, 11, 3, 12), (9, 14, 10, 15), (18, 15, 19, 16), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 7, 2], [3, 7, 8, 6], [3, 5, 8, 9], [4, 9, 5, 4], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 200
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.49
 Average overall degree: 3.03

Table 431: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	3
Nonminimal pinning sets	0	7	31	58	58	32	9	1	196
Average degree	2.4	2.63	2.82	2.99	3.12	3.22	3.29	3.33	

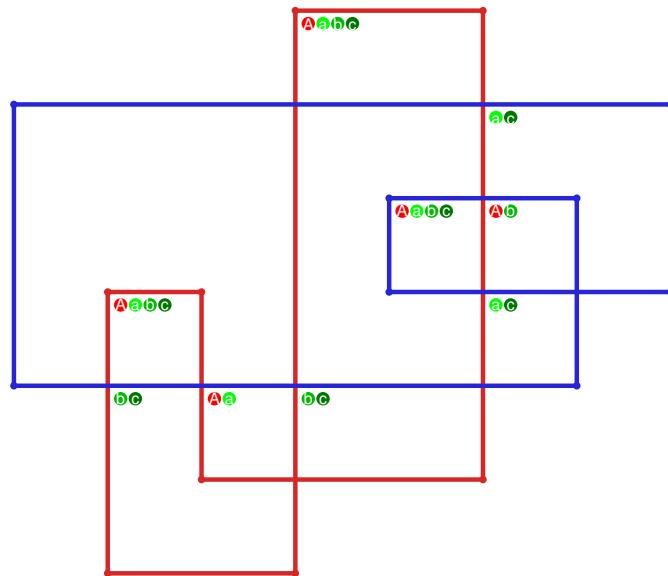


Figure 865: SnapPy multiloop plot.

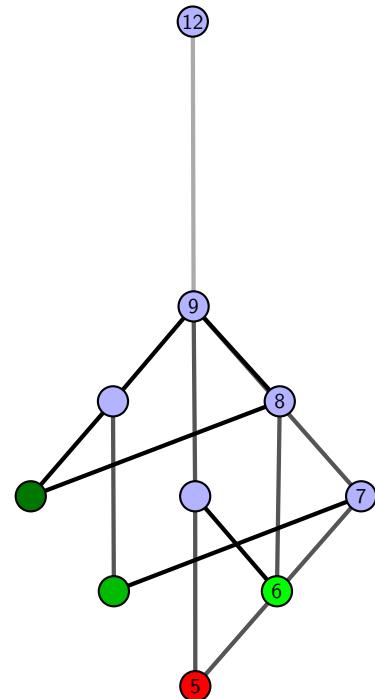


Figure 866: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.136 $[[8, 20, 1, 9], [9, 18, 10, 19], [19, 7, 20, 8], [1, 17, 2, 18], [10, 6, 11, 7], [11, 16, 12, 17], [2, 12, 3, 13], [13, 5, 14, 6], [15, 3, 16, 4], [4, 14, 5, 15]]$

PD code drawn by `SnapPy`: $[(20, 1, 9, 2), (17, 2, 18, 3), (14, 3, 15, 4), (10, 7, 11, 8), (6, 19, 7, 20), (8, 9, 1, 10), (18, 11, 19, 12), (5, 12, 6, 13), (16, 13, 17, 14), (4, 15, 5, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 5, 2], [3, 4, 8, 6], [3, 5, 8, 7], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 432: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

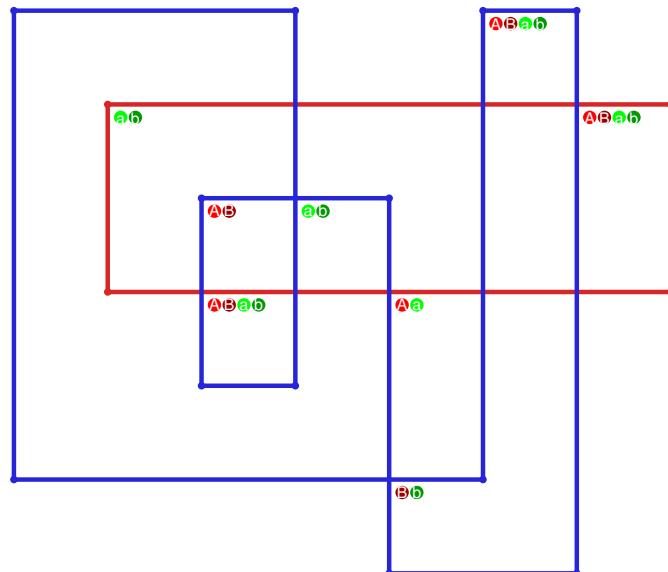


Figure 867: `SnapPy` multiloop plot.

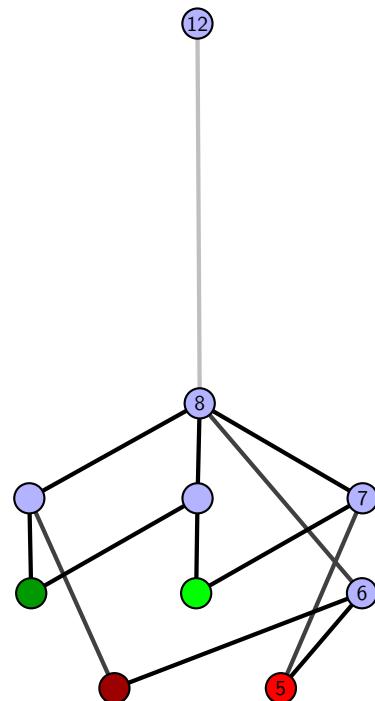


Figure 868: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.137 [[20, 15, 1, 16], [16, 13, 17, 14], [14, 19, 15, 20], [1, 12, 2, 13], [17, 9, 18, 8], [18, 7, 19, 8], [11, 6, 12, 7], [2, 6, 3, 5], [9, 5, 10, 4], [10, 3, 11, 4]]

PD code drawn by `SnapPy`: [(20, 5, 1, 6), (1, 18, 2, 19), (7, 2, 8, 3), (14, 3, 15, 4), (4, 13, 5, 14), (17, 8, 18, 9), (12, 9, 13, 10), (16, 11, 17, 12), (10, 15, 11, 16), (6, 19, 7, 20)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 5, 0], [0, 6, 7, 1], [1, 8, 5, 5], [2, 4, 4, 6], [3, 5, 9, 7], [3, 6, 9, 8], [4, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 433: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

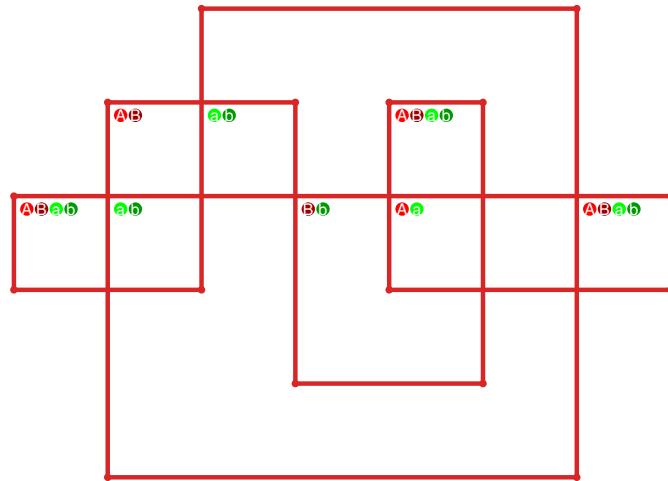


Figure 869: `SnapPy` multiloop plot.

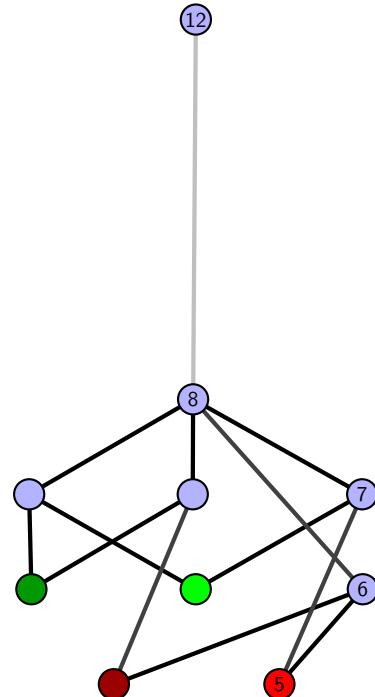


Figure 870: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.138 [[20, 11, 1, 12], [12, 9, 13, 10], [10, 19, 11, 20], [1, 8, 2, 9], [13, 18, 14, 19], [14, 7, 15, 8], [2, 6, 3, 5], [17, 4, 18, 5], [6, 15, 7, 16], [3, 16, 4, 17]]

PD code drawn by SnapPy: [(13, 20, 14, 1), (1, 18, 2, 19), (10, 3, 11, 4), (17, 4, 18, 5), (8, 5, 9, 6), (16, 7, 17, 8), (2, 11, 3, 12), (19, 12, 20, 13), (9, 14, 10, 15), (6, 15, 7, 16)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 5, 2], [3, 4, 8, 8], [3, 8, 9, 7], [4, 6, 9, 9], [5, 9, 6, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 434: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

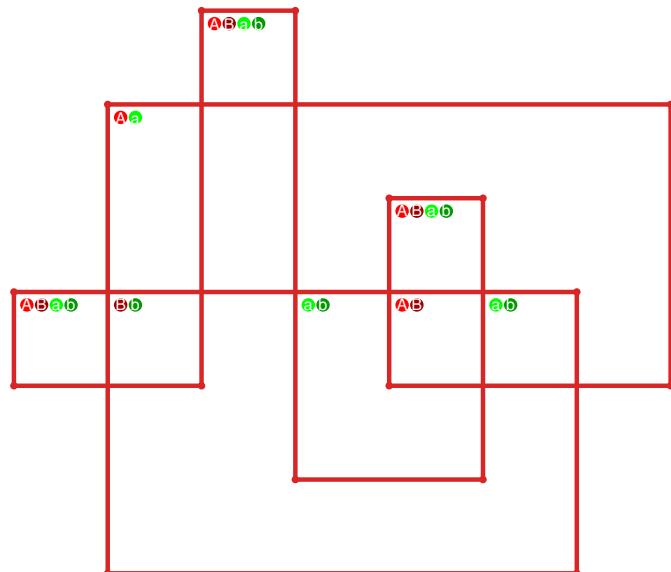


Figure 871: SnapPy multiloop plot.

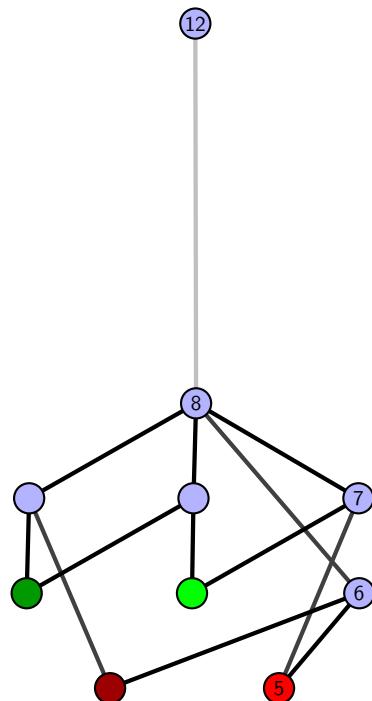


Figure 872: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.139 $[[12, 20, 1, 13], [13, 18, 14, 19], [19, 11, 20, 12], [1, 17, 2, 18], [14, 10, 15, 11], [16, 6, 17, 7], [2, 6, 3, 5], [9, 4, 10, 5], [15, 8, 16, 7], [3, 8, 4, 9]]$

PD code drawn by SnapPy: $[(5, 12, 6, 1), (1, 10, 2, 11), (13, 2, 14, 3), (3, 20, 4, 13), (11, 4, 12, 5), (19, 6, 20, 7), (16, 7, 17, 8), (9, 14, 10, 15), (18, 15, 19, 16), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 8, 2], [3, 8, 8, 6], [3, 5, 9, 7], [4, 6, 9, 9], [4, 9, 5, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 312
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.04

Table 435: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	31	70	90	71	34	9	1	306
Average degree	2.5	2.76	2.93	3.06	3.16	3.24	3.29	3.33	

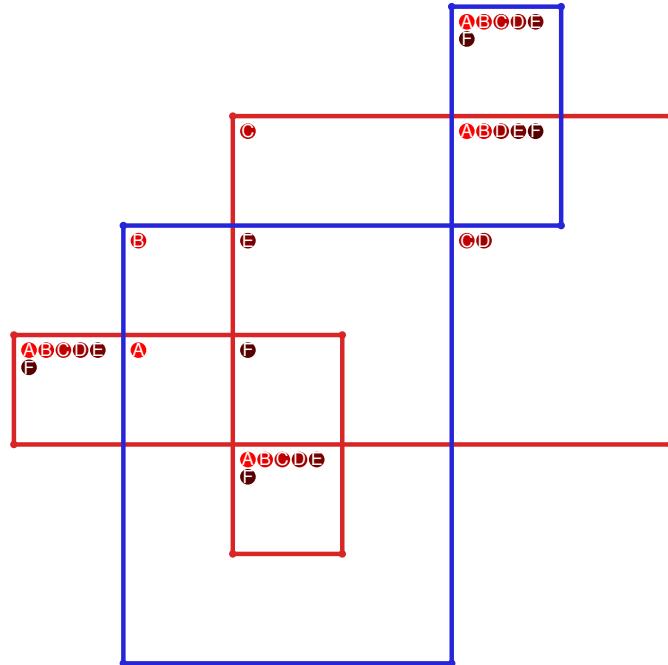


Figure 873: SnapPy multiloop plot.

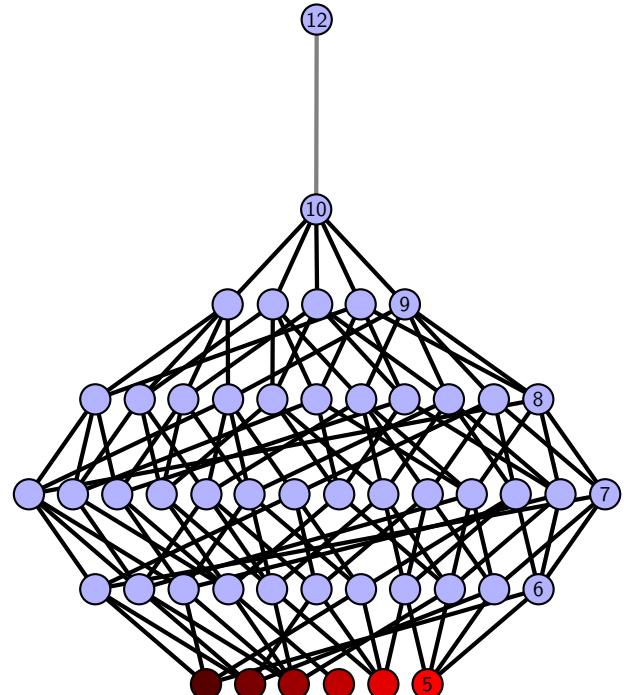


Figure 874: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.140 `[[11, 20, 12, 1], [10, 13, 11, 14], [19, 12, 20, 13], [1, 15, 2, 14], [18, 9, 19, 10], [15, 9, 16, 8], [2, 8, 3, 7], [4, 17, 5, 18], [16, 5, 17, 6], [3, 6, 4, 7]]`

PD code drawn by `SnapPy`: `[(14, 3, 15, 4), (1, 4, 2, 5), (5, 20, 6, 1), (6, 13, 7, 14), (16, 7, 17, 8), (17, 10, 18, 11), (8, 11, 9, 12), (12, 19, 13, 20), (2, 15, 3, 16), (9, 18, 10, 19)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 5, 2], [3, 4, 8, 6], [3, 5, 9, 9], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]`

Total optimal pinning sets: 3
 Total minimal pinning sets: 6
 Total pinning sets: 280
 Pinning number: 5

Average optimal degree: 2.47
 Average minimal degree: 2.51
 Average overall degree: 3.05

Table 436: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	18	58	84	70	34	9	1	274
Average degree	2.47	2.71	2.9	3.05	3.16	3.24	3.29	3.33	

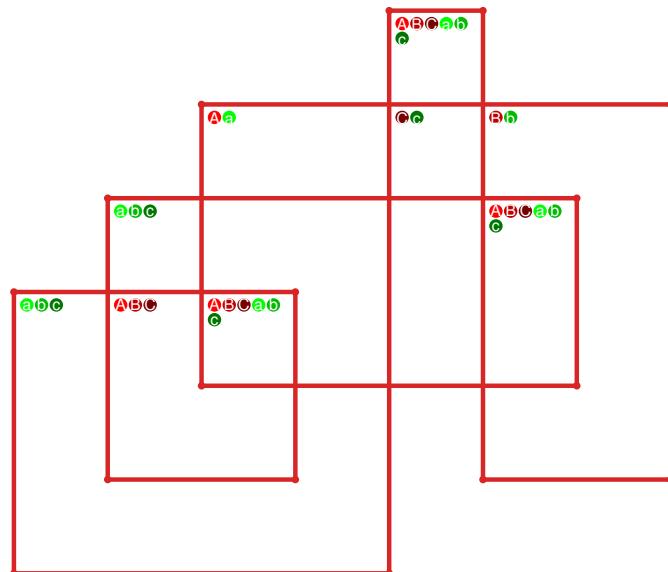


Figure 875: `SnapPy` multiloop plot.

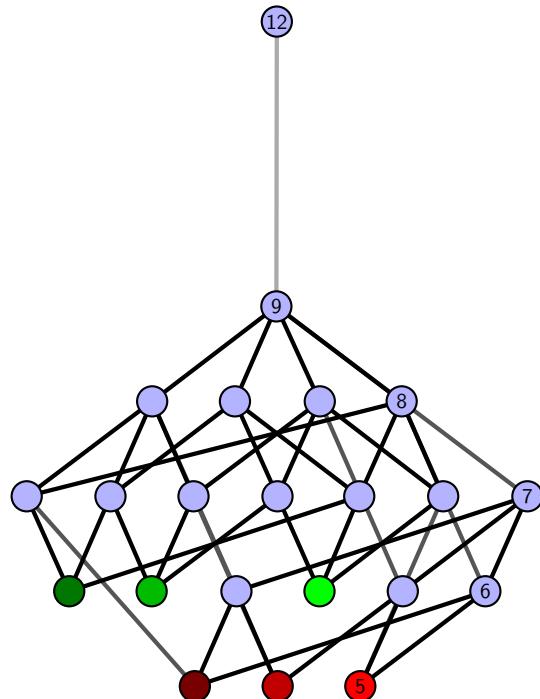


Figure 876: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.141 [[20, 11, 1, 12], [12, 9, 13, 10], [10, 19, 11, 20], [1, 8, 2, 9], [13, 18, 14, 19], [14, 7, 15, 8], [2, 15, 3, 16], [17, 4, 18, 5], [6, 3, 7, 4], [16, 6, 17, 5]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (15, 2, 16, 3), (3, 14, 4, 15), (12, 5, 13, 6), (19, 6, 20, 7), (10, 7, 11, 8), (18, 9, 19, 10), (20, 13, 1, 14), (11, 16, 12, 17), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 5, 2], [3, 4, 8, 6], [3, 5, 8, 9], [4, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]

Total optimal pinning sets: 3
Total minimal pinning sets: 6

Total pinning sets: 320

Pinning number: 5

Average optimal degree: 2.6
Average minimal degree: 2.63

Average overall degree: 3.1

Table 437: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	19	64	97	83	40	10	1	314
Average degree	2.6	2.8	2.97	3.1	3.2	3.27	3.31	3.33	

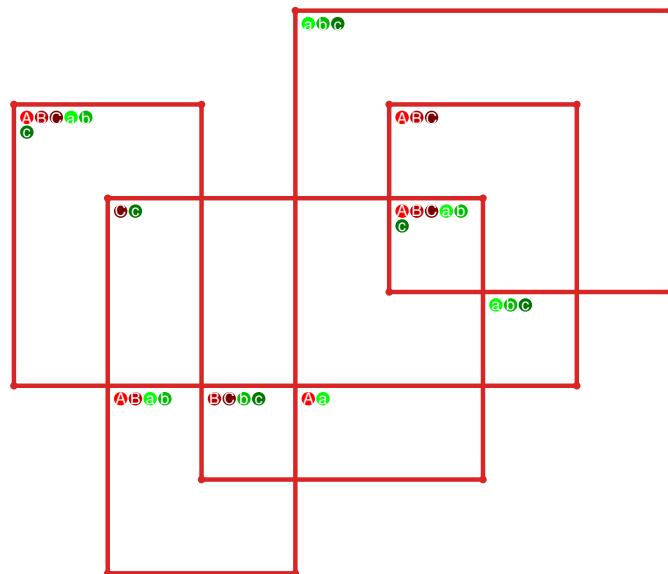


Figure 877: SnapPy multiloop plot.

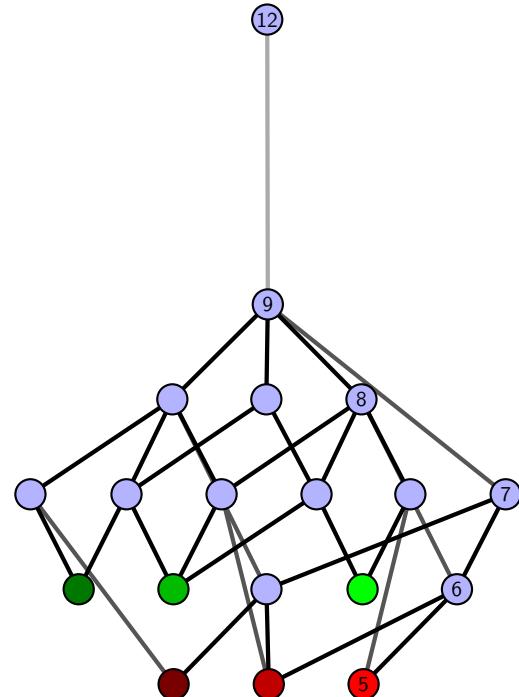


Figure 878: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.142 `[[20, 11, 1, 12], [12, 9, 13, 10], [10, 19, 11, 20], [1, 15, 2, 14], [8, 13, 9, 14], [18, 7, 19, 8], [15, 7, 16, 6], [2, 6, 3, 5], [17, 4, 18, 5], [16, 4, 17, 3]]`

PD code drawn by `SnapPy`: `[(1, 14, 2, 15), (15, 2, 16, 3), (3, 20, 4, 1), (4, 13, 5, 14), (16, 5, 17, 6), (10, 7, 11, 8), (18, 9, 19, 10), (6, 11, 7, 12), (12, 19, 13, 20), (8, 17, 9, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 6, 7, 4], [1, 3, 5, 1], [2, 4, 8, 6], [3, 5, 9, 7], [3, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 438: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

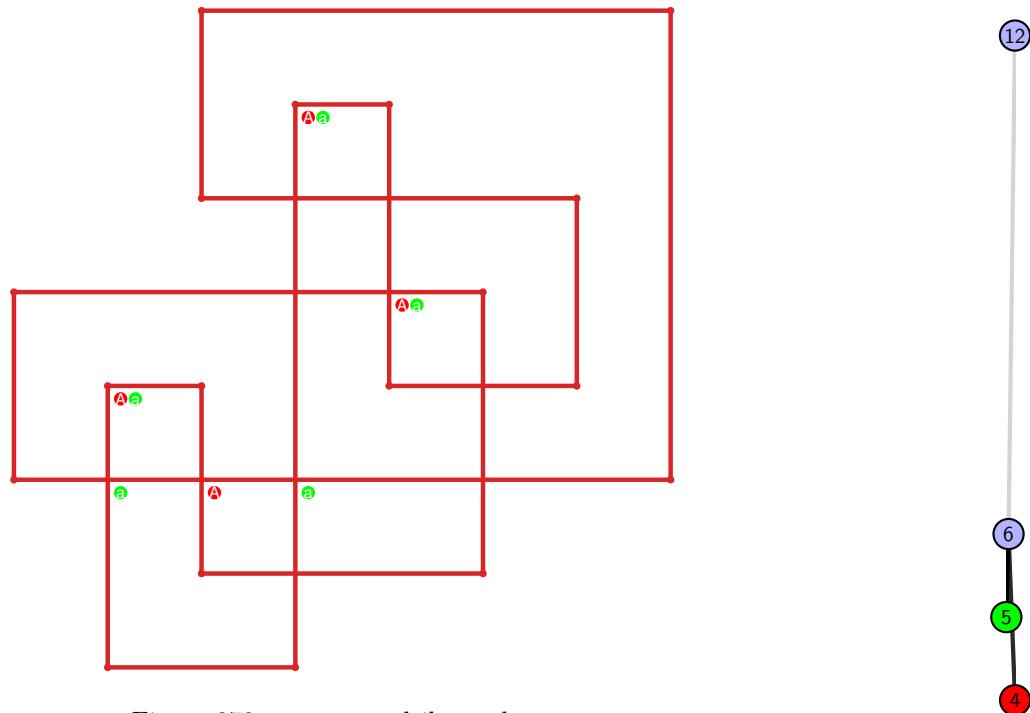


Figure 879: `SnapPy` multiloop plot.

Figure 880: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.143 [[20, 7, 1, 8], [8, 19, 9, 20], [6, 17, 7, 18], [1, 11, 2, 10], [18, 9, 19, 10], [5, 14, 6, 15], [16, 3, 17, 4], [11, 3, 12, 2], [15, 12, 16, 13], [13, 4, 14, 5]]

PD code drawn by SnapPy: [(20, 9, 1, 10), (14, 1, 15, 2), (11, 2, 12, 3), (18, 5, 19, 6), (16, 7, 17, 8), (8, 19, 9, 20), (13, 10, 14, 11), (3, 12, 4, 13), (4, 15, 5, 16), (6, 17, 7, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 6], [0, 7, 7, 4], [1, 3, 2, 1], [2, 8, 9, 9], [2, 9, 8, 7], [3, 6, 8, 3], [5, 7, 6, 9], [5, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 439: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

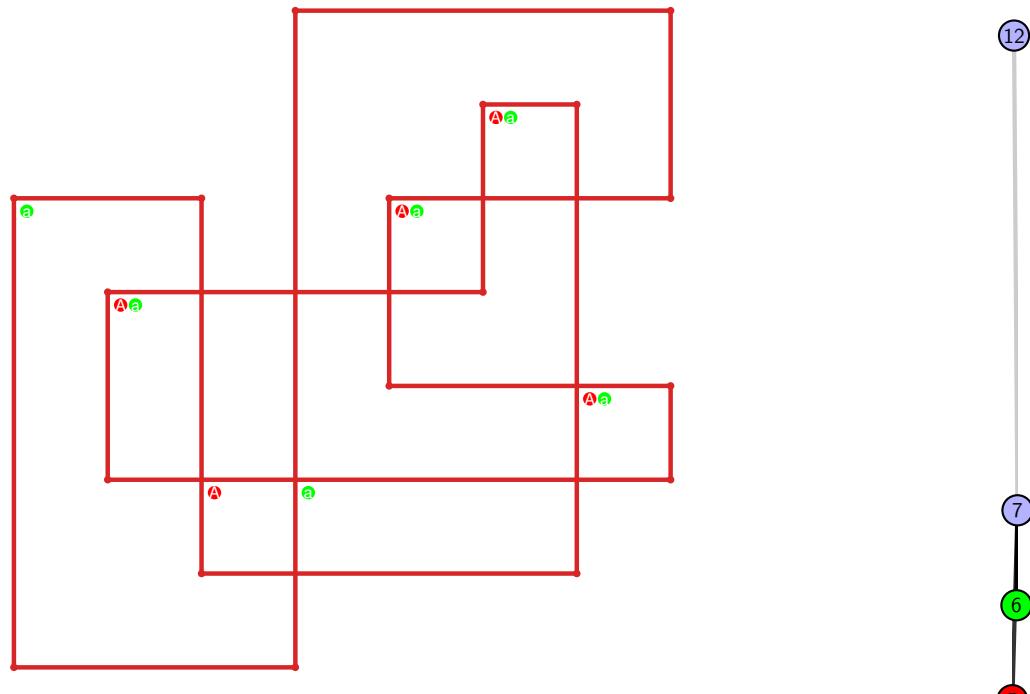


Figure 881: SnapPy multiloop plot.

Figure 882: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.144 [[20, 15, 1, 16], [16, 19, 17, 20], [14, 7, 15, 8], [1, 11, 2, 10], [18, 9, 19, 10], [17, 9, 18, 8], [13, 4, 14, 5], [6, 11, 7, 12], [2, 6, 3, 5], [3, 12, 4, 13]]

PD code drawn by `SnapPy`: [(11, 2, 12, 3), (3, 20, 4, 1), (12, 5, 13, 6), (6, 15, 7, 16), (16, 7, 17, 8), (8, 19, 9, 20), (4, 9, 5, 10), (1, 10, 2, 11), (18, 13, 19, 14), (14, 17, 15, 18)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 7], [0, 7, 8, 4], [1, 3, 5, 5], [1, 4, 4, 2], [2, 8, 9, 9], [2, 9, 8, 3], [3, 7, 9, 6], [6, 8, 7, 6]]

Total optimal pinning sets: 5
Total minimal pinning sets: 5
Total pinning sets: 304
Pinning number: 5

Average optimal degree: 2.48
Average minimal degree: 2.48
Average overall degree: 3.04

Table 440: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	28	67	89	71	34	9	1	299
Average degree	2.48	2.74	2.93	3.06	3.16	3.24	3.29	3.33	

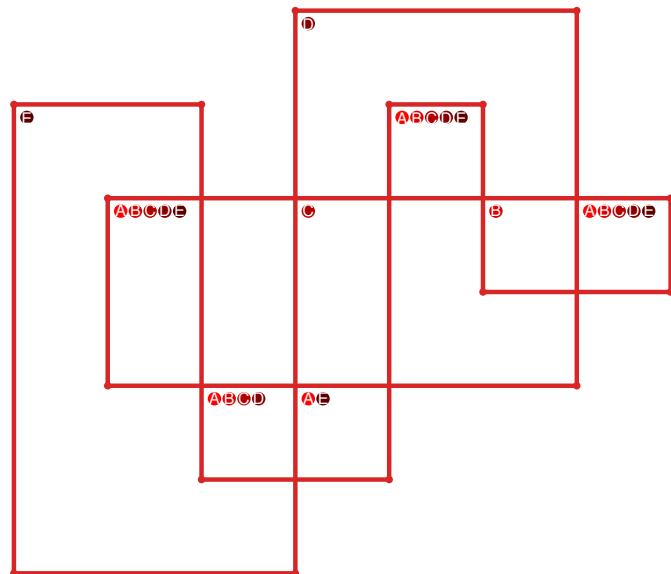


Figure 883: `SnapPy` multiloop plot.

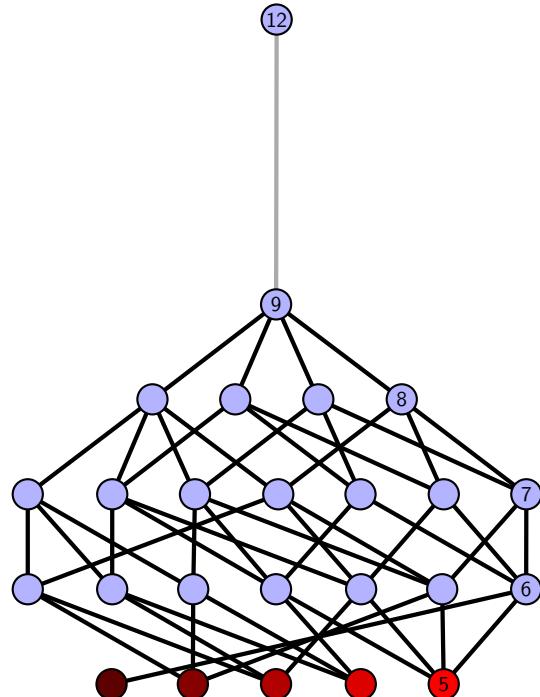


Figure 884: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.145 [[20, 11, 1, 12], [12, 19, 13, 20], [10, 1, 11, 2], [18, 9, 19, 10], [13, 3, 14, 2], [4, 17, 5, 18], [5, 8, 6, 9], [3, 15, 4, 14], [7, 16, 8, 17], [6, 16, 7, 15]]

PD code drawn by `SnapPy`: [(20, 11, 1, 12), (3, 6, 4, 7), (16, 7, 17, 8), (18, 9, 19, 10), (12, 1, 13, 2), (13, 4, 14, 5), (5, 14, 6, 15), (2, 15, 3, 16), (10, 17, 11, 18), (8, 19, 9, 20)]

Planar representation generated by `plantri`: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 4, 3, 0], [1, 2, 5, 6], [1, 7, 7, 2], [3, 7, 8, 6], [3, 5, 8, 9], [4, 9, 5, 4], [5, 9, 9, 6], [6, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.97

Table 441: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

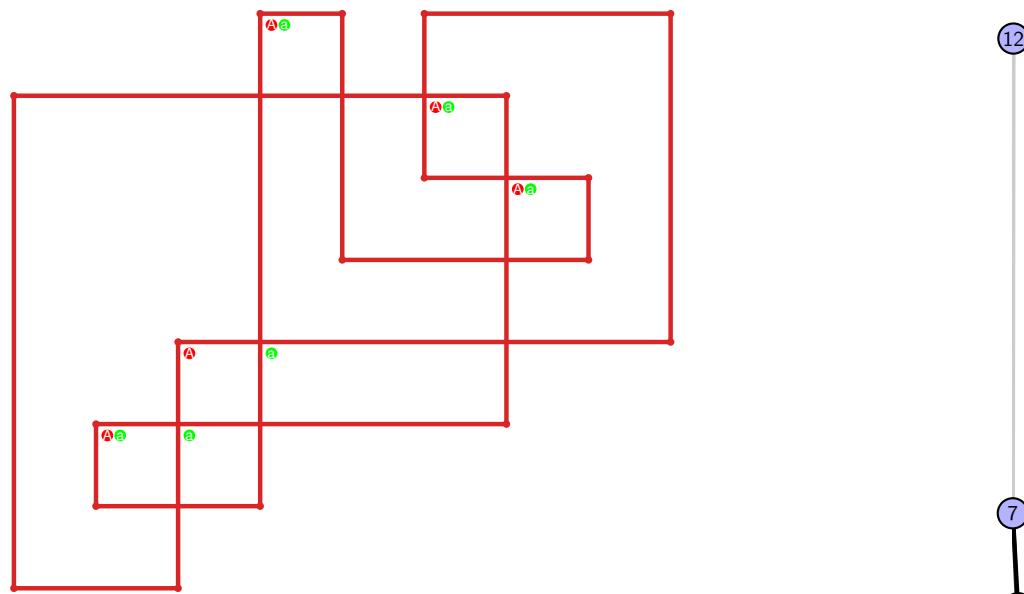


Figure 885: `SnapPy` multiloop plot.



Figure 886: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.146 [[20, 9, 1, 10], [10, 19, 11, 20], [8, 1, 9, 2], [18, 7, 19, 8], [11, 3, 12, 2], [12, 17, 13, 18], [13, 6, 14, 7], [3, 14, 4, 15], [5, 16, 6, 17], [4, 16, 5, 15]]

PD code drawn by SnapPy: [(10, 3, 11, 4), (15, 4, 16, 5), (17, 6, 18, 7), (20, 11, 1, 12), (12, 1, 13, 2), (2, 13, 3, 14), (9, 14, 10, 15), (7, 16, 8, 17), (5, 18, 6, 19), (19, 8, 20, 9)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 4, 3, 0], [1, 2, 5, 6], [1, 7, 5, 2], [3, 4, 8, 6], [3, 5, 8, 7], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 442: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

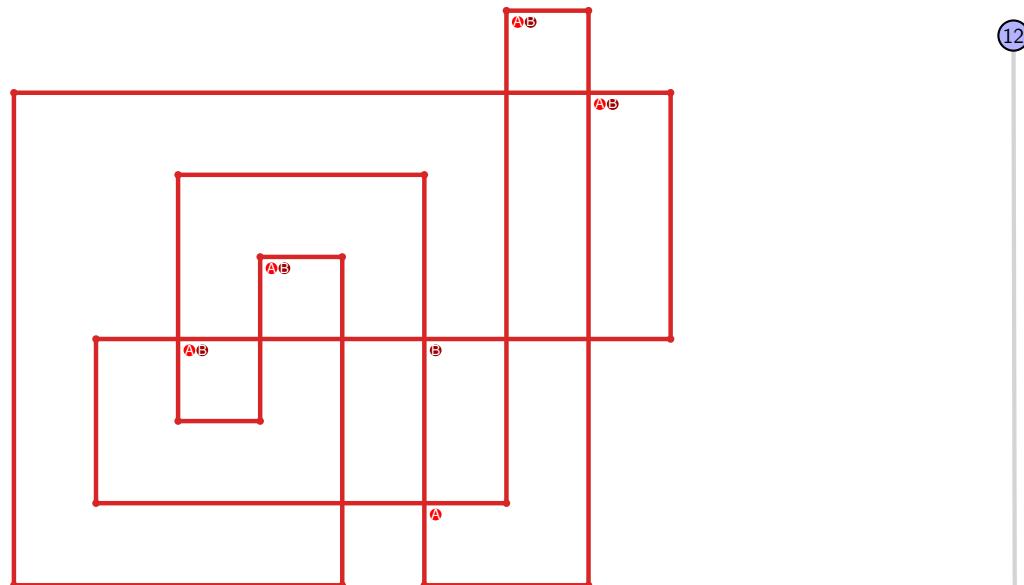


Figure 887: SnapPy multiloop plot.

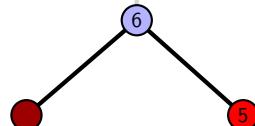


Figure 888: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.147 $[[5, 20, 6, 1], [19, 4, 20, 5], [6, 2, 7, 1], [7, 18, 8, 19], [3, 14, 4, 15], [2, 14, 3, 13], [17, 12, 18, 13], [8, 12, 9, 11], [15, 11, 16, 10], [16, 9, 17, 10]]$

PD code drawn by `SnapPy`: $[(16, 1, 17, 2), (13, 6, 14, 7), (7, 12, 8, 13), (8, 5, 9, 6), (14, 9, 15, 10), (10, 19, 11, 20), (20, 11, 1, 12), (4, 15, 5, 16), (2, 17, 3, 18), (18, 3, 19, 4)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 3, 0], [1, 2, 6, 7], [1, 8, 5, 5], [2, 4, 4, 6], [3, 5, 9, 7], [3, 6, 9, 8], [4, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 443: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

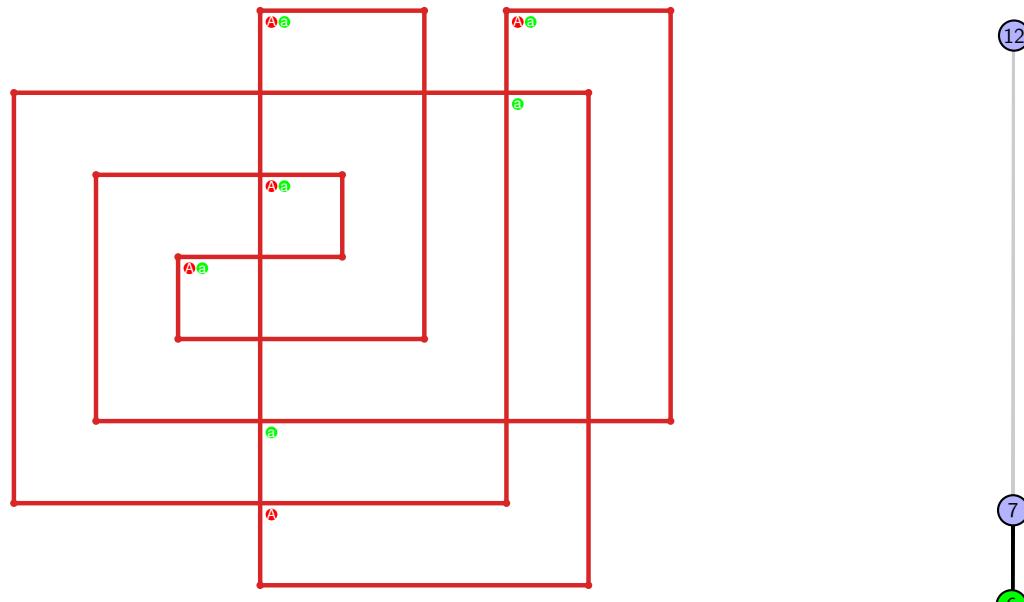


Figure 889: `SnapPy` multiloop plot.



Figure 890: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.148 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 2, 11, 1], [7, 18, 8, 19], [2, 18, 3, 17], [11, 6, 12, 7], [3, 15, 4, 14], [5, 16, 6, 17], [12, 16, 13, 15], [4, 13, 5, 14]]$

PD code drawn by SnapPy: $[(8, 3, 9, 4), (16, 5, 17, 6), (1, 10, 2, 11), (11, 20, 12, 1), (12, 9, 13, 10), (2, 13, 3, 14), (14, 19, 15, 20), (4, 15, 5, 16), (6, 17, 7, 18), (18, 7, 19, 8)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 5, 4, 1], [2, 3, 6, 7], [2, 7, 8, 3], [4, 8, 9, 9], [4, 9, 8, 5], [5, 7, 9, 6], [6, 8, 7, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.97

Table 444: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

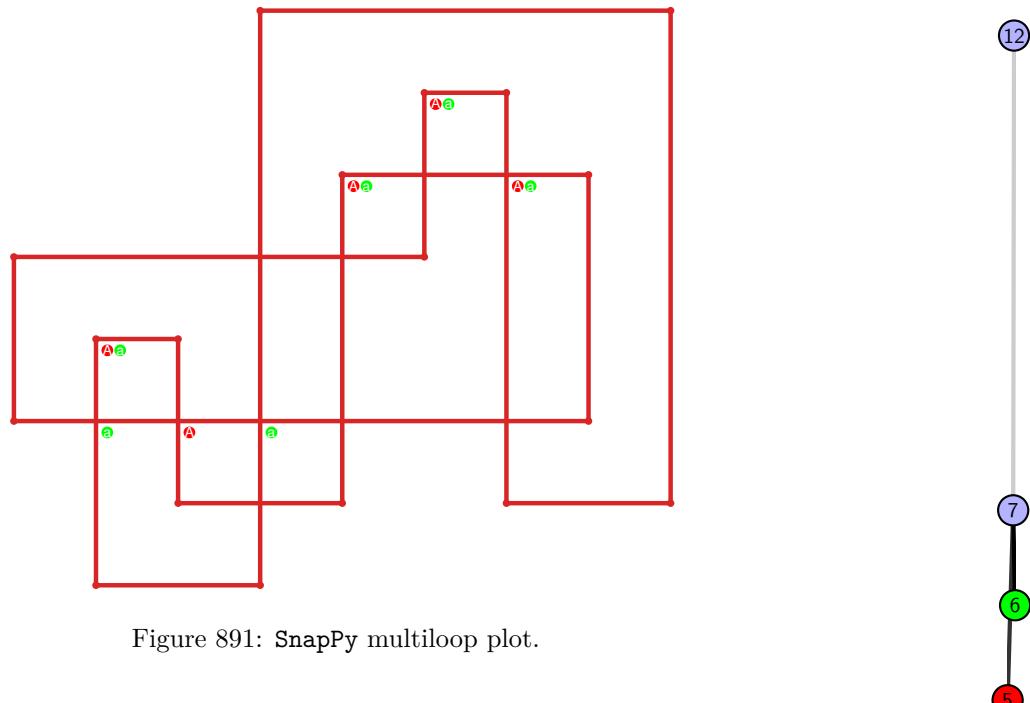


Figure 891: SnapPy multiloop plot.

Figure 892: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.149 $[[5, 20, 6, 1], [13, 4, 14, 5], [19, 8, 20, 9], [6, 2, 7, 1], [3, 12, 4, 13], [14, 18, 15, 17], [9, 17, 10, 16], [11, 18, 12, 19], [7, 2, 8, 3], [15, 11, 16, 10]]$

PD code drawn by `SnapPy`: $[(14, 3, 15, 4), (5, 10, 6, 11), (18, 7, 19, 8), (11, 4, 12, 5), (12, 9, 13, 10), (6, 13, 7, 14), (20, 15, 1, 16), (16, 1, 17, 2), (2, 17, 3, 18), (8, 19, 9, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 7, 8], [0, 8, 8, 0], [1, 8, 7, 1], [1, 7, 9, 6], [2, 5, 9, 9], [2, 9, 5, 4], [2, 4, 3, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 445: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

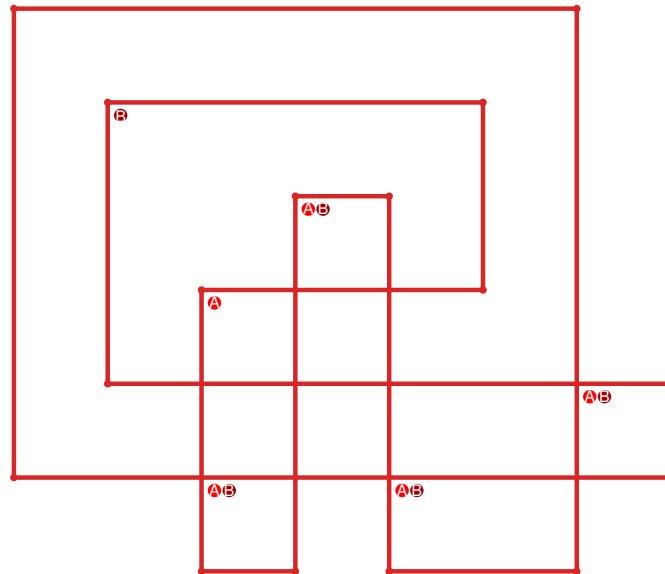


Figure 893: `SnapPy` multiloop plot.

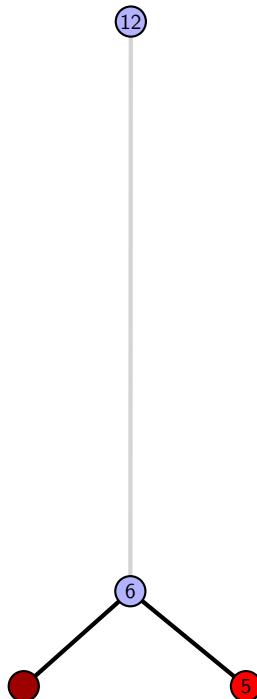


Figure 894: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.150 $[[8, 16, 1, 9], [9, 3, 10, 4], [13, 7, 14, 8], [15, 20, 16, 17], [1, 12, 2, 11], [2, 10, 3, 11], [4, 12, 5, 13], [6, 18, 7, 19], [14, 18, 15, 17], [19, 5, 20, 6]]$

PD code drawn by `SnapPy`: $[(18, 1, 19, 2), (14, 5, 15, 6), (10, 7, 11, 8), (4, 15, 5, 16), (16, 3, 17, 4), (6, 17, 7, 18), (2, 13, 3, 14), (20, 11, 13, 12), (12, 19, 9, 20), (8, 9, 1, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 8], [0, 8, 8, 9], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 9, 2], [2, 9, 9, 8], [2, 7, 3, 3], [3, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 446: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

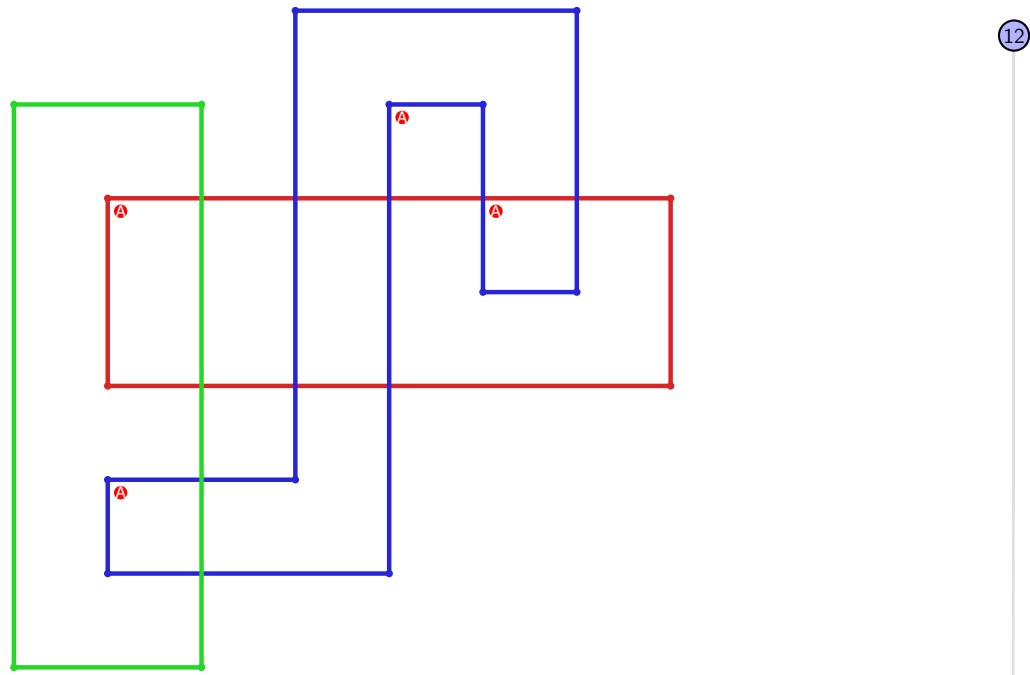


Figure 895: `SnapPy` multiloop plot.

Figure 896: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.151 $[[13, 20, 14, 1], [3, 12, 4, 13], [19, 8, 20, 9], [14, 18, 15, 17], [1, 10, 2, 11], [11, 2, 12, 3], [4, 10, 5, 9], [7, 18, 8, 19], [15, 7, 16, 6], [16, 5, 17, 6]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (14, 3, 15, 4), (4, 13, 5, 14), (17, 6, 18, 7), (7, 2, 8, 3), (19, 8, 20, 9), (1, 10, 2, 11), (15, 12, 16, 13), (5, 16, 6, 17), (11, 18, 12, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 7, 8, 9], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 9, 2], [2, 8, 3, 2], [3, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 447: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

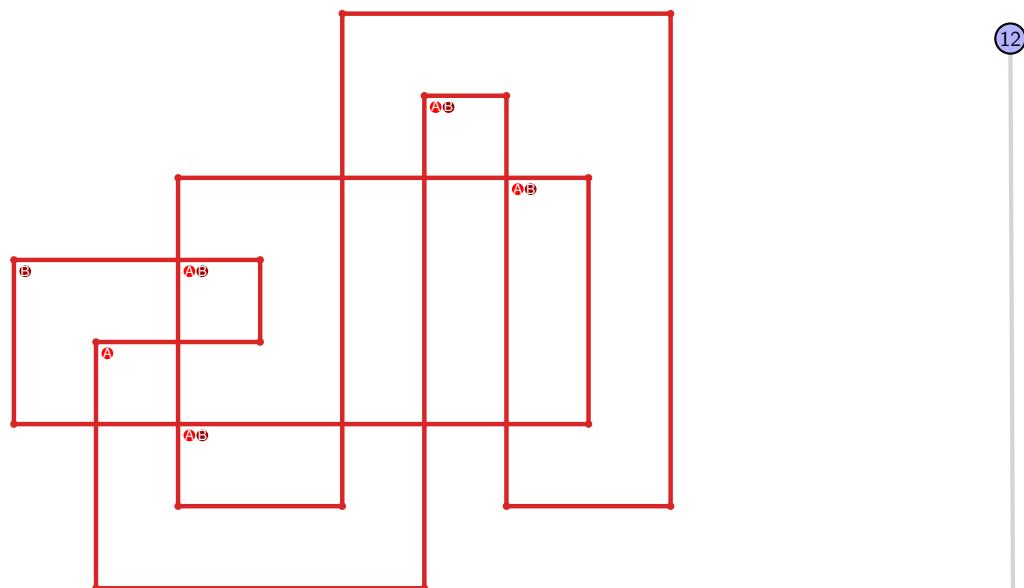


Figure 897: SnapPy multiloop plot.

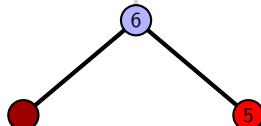


Figure 898: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.152 $[[20, 13, 1, 14], [14, 3, 15, 4], [8, 19, 9, 20], [9, 12, 10, 13], [1, 17, 2, 16], [2, 15, 3, 16], [4, 17, 5, 18], [18, 7, 19, 8], [11, 6, 12, 7], [10, 6, 11, 5]]$

PD code drawn by `SnapPy`: $[(12, 1, 13, 2), (3, 8, 4, 9), (9, 4, 10, 5), (16, 5, 17, 6), (7, 10, 8, 11), (18, 11, 19, 12), (20, 13, 1, 14), (14, 19, 15, 20), (2, 15, 3, 16), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 3], [0, 2, 8, 9], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 9, 7], [2, 6, 8, 2], [3, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 448: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

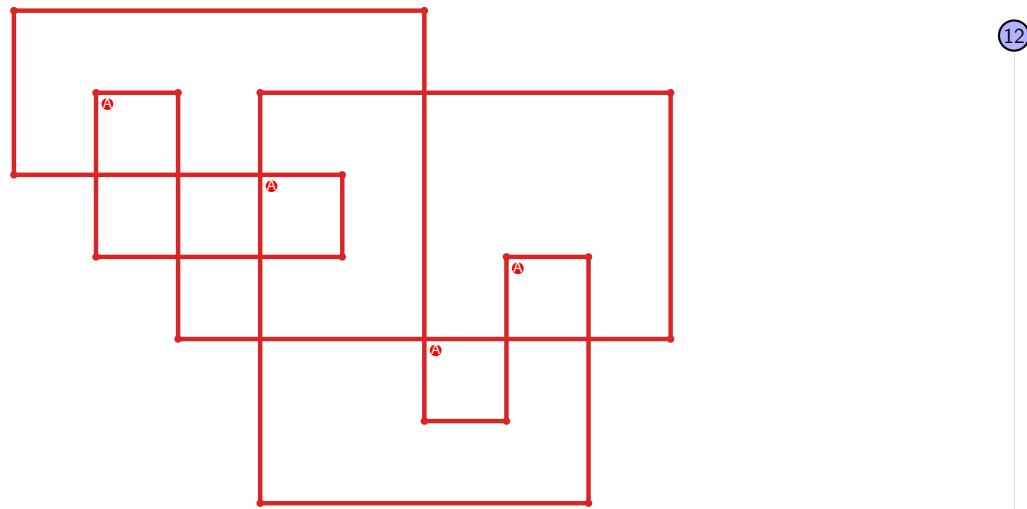


Figure 899: `SnapPy` multiloop plot.

(4)

Figure 900: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.153 [[8, 20, 1, 9], [9, 3, 10, 4], [13, 7, 14, 8], [14, 19, 15, 20], [1, 12, 2, 11], [2, 10, 3, 11], [4, 12, 5, 13], [6, 16, 7, 17], [18, 15, 19, 16], [5, 18, 6, 17]]

PD code drawn by `SnapPy`: [(20, 1, 9, 2), (12, 5, 13, 6), (8, 9, 1, 10), (10, 7, 11, 8), (2, 11, 3, 12), (17, 14, 18, 15), (4, 15, 5, 16), (16, 3, 17, 4), (13, 18, 14, 19), (6, 19, 7, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 3], [0, 2, 8, 8], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 9, 2], [2, 9, 9, 8], [3, 7, 9, 3], [6, 8, 7, 7]]

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 224

Pinning number: 5

Average optimal degree: 2.27

Average minimal degree: 2.27

Average overall degree: 2.98

Table 449: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

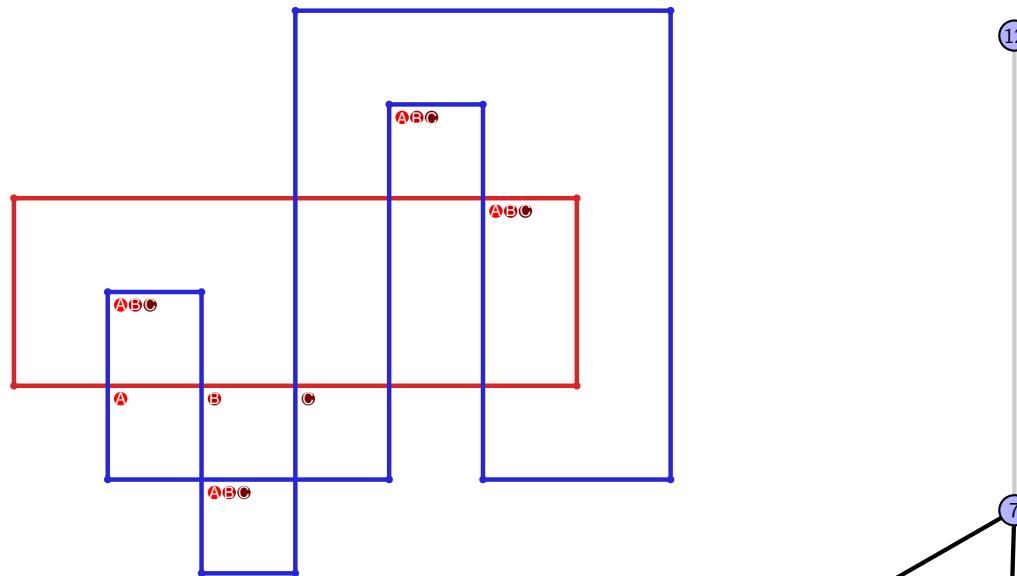


Figure 901: `SnapPy` multiloop plot.

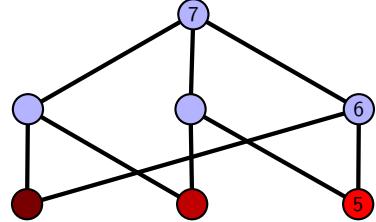


Figure 902: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.154 [[13, 20, 14, 1], [3, 12, 4, 13], [19, 8, 20, 9], [14, 8, 15, 7], [1, 10, 2, 11], [11, 2, 12, 3], [4, 10, 5, 9], [18, 15, 19, 16], [6, 17, 7, 18], [5, 17, 6, 16]]

PD code drawn by `SnapPy`: [(9, 20, 10, 1), (5, 12, 6, 13), (17, 6, 18, 7), (7, 2, 8, 3), (19, 8, 20, 9), (1, 10, 2, 11), (16, 13, 17, 14), (14, 3, 15, 4), (4, 15, 5, 16), (11, 18, 12, 19)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 3], [0, 2, 7, 8], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 9, 2], [2, 9, 8, 3], [3, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 256
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 3.03

Table 450: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

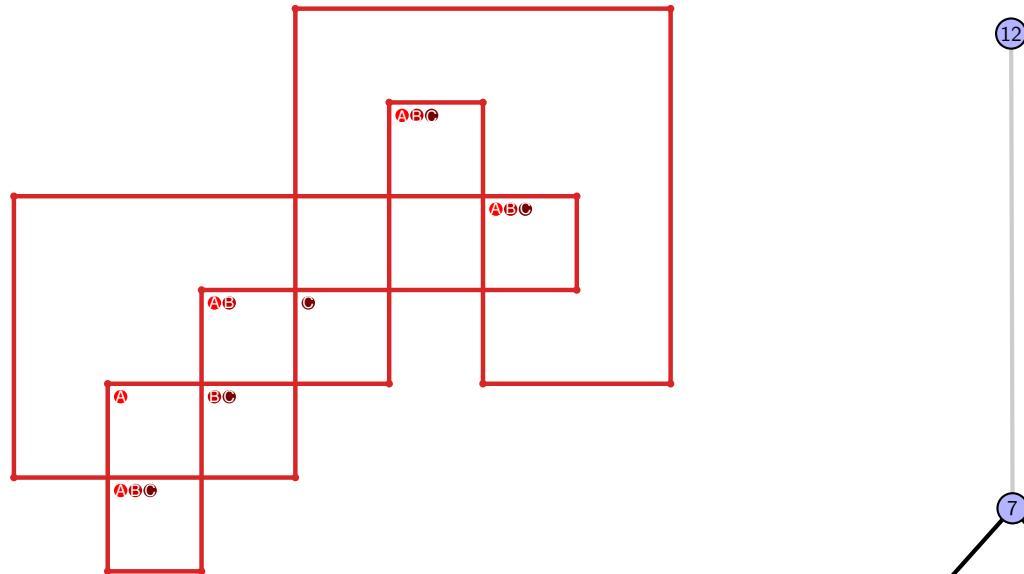


Figure 903: `SnapPy` multiloop plot.

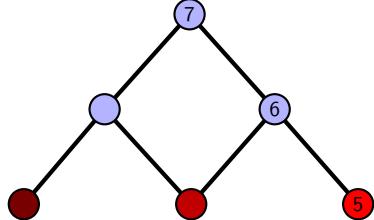


Figure 904: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.155 $[[14, 20, 1, 15], [15, 13, 16, 14], [16, 19, 17, 20], [1, 12, 2, 13], [18, 8, 19, 9], [17, 8, 18, 7], [11, 6, 12, 7], [2, 6, 3, 5], [9, 5, 10, 4], [10, 3, 11, 4]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (2, 7, 3, 8), (3, 14, 4, 1), (9, 4, 10, 5), (5, 20, 6, 15), (15, 6, 16, 7), (13, 10, 14, 11), (18, 11, 19, 12), (19, 16, 20, 17), (12, 17, 13, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 7, 1], [2, 8, 5, 5], [2, 4, 4, 6], [3, 5, 9, 7], [3, 6, 9, 8], [4, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 320
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.33
 Average overall degree: 3.03

Table 451: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

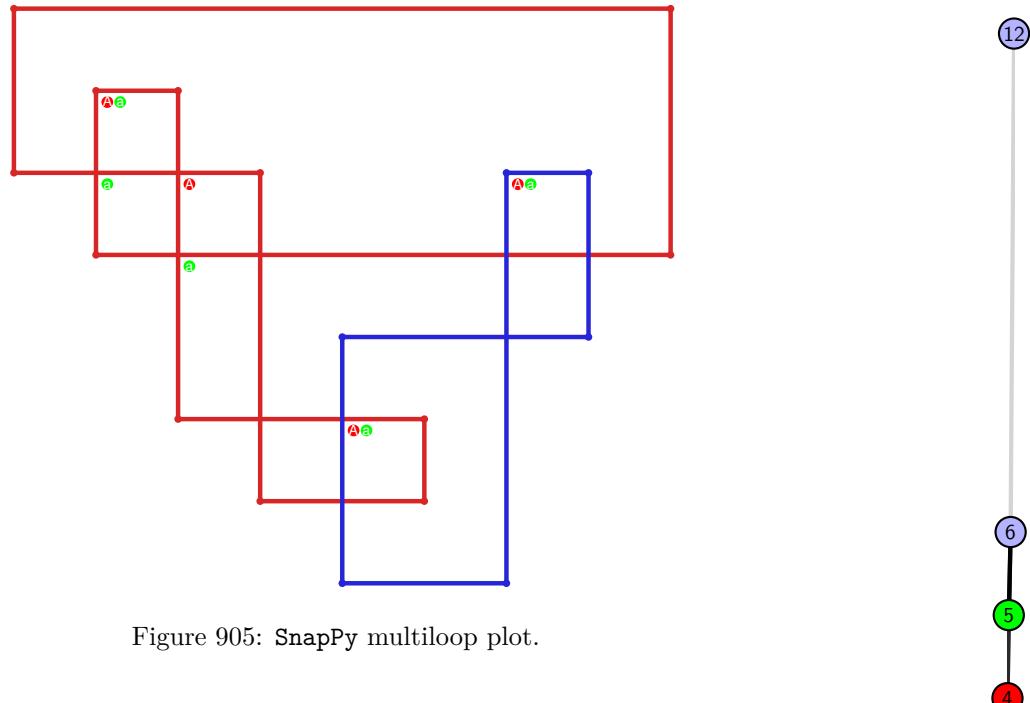


Figure 905: SnapPy multiloop plot.

Figure 906: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.156 `[[11, 20, 12, 1], [19, 10, 20, 11], [12, 10, 13, 9], [1, 18, 2, 19], [13, 8, 14, 9], [17, 6, 18, 7], [2, 6, 3, 5], [7, 14, 8, 15], [16, 3, 17, 4], [4, 15, 5, 16]]`

PD code drawn by `SnapPy`: `[(1, 18, 2, 19), (13, 2, 14, 3), (9, 4, 10, 5), (5, 8, 6, 9), (15, 6, 16, 7), (3, 10, 4, 11), (20, 11, 1, 12), (17, 14, 18, 15), (7, 16, 8, 17), (12, 19, 13, 20)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 6, 1], [2, 7, 7, 2], [3, 7, 8, 6], [3, 5, 8, 9], [4, 9, 5, 4], [5, 9, 9, 6], [6, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 452: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

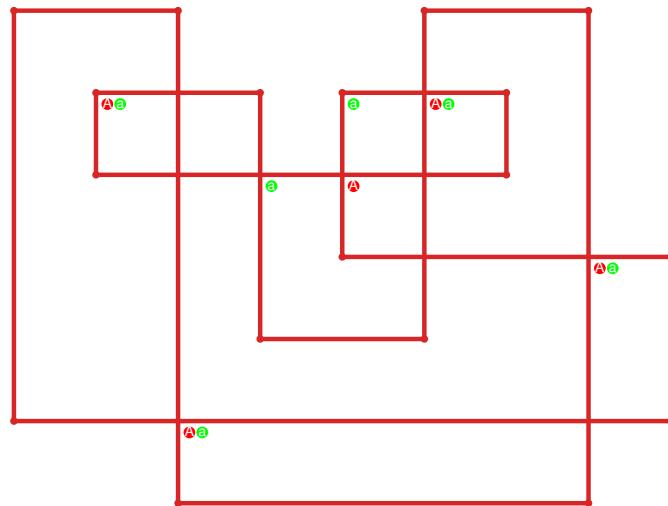


Figure 907: `SnapPy` multiloop plot.



Figure 908: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.157 `[[13, 20, 14, 1], [19, 12, 20, 13], [14, 12, 15, 11], [1, 18, 2, 19], [15, 7, 16, 6], [17, 10, 18, 11], [2, 8, 3, 7], [16, 5, 17, 6], [9, 4, 10, 5], [8, 4, 9, 3]]`

PD code drawn by `SnapPy`: `[(20, 5, 1, 6), (6, 1, 7, 2), (13, 2, 14, 3), (3, 12, 4, 13), (4, 19, 5, 20), (14, 7, 15, 8), (8, 11, 9, 12), (16, 9, 17, 10), (18, 15, 19, 16), (10, 17, 11, 18)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 7], [2, 7, 8, 3], [3, 9, 9, 4], [4, 8, 5, 4], [5, 7, 9, 9], [6, 8, 8, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 453: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

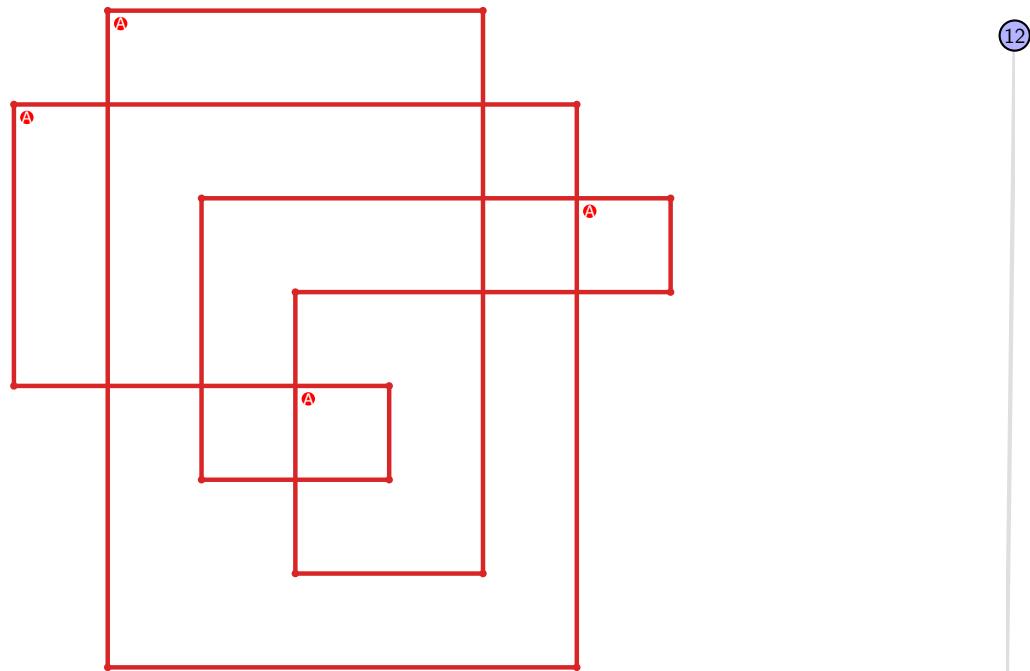


Figure 909: `SnapPy` multiloop plot.

Figure 910: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.158 [[13, 20, 14, 1], [19, 12, 20, 13], [14, 12, 15, 11], [1, 18, 2, 19], [15, 4, 16, 5], [17, 10, 18, 11], [2, 7, 3, 8], [8, 3, 9, 4], [16, 6, 17, 5], [6, 9, 7, 10]]

PD code drawn by `SnapPy`: [(6, 1, 7, 2), (13, 2, 14, 3), (3, 14, 4, 15), (20, 5, 1, 6), (4, 7, 5, 8), (15, 8, 16, 9), (9, 12, 10, 13), (17, 10, 18, 11), (19, 16, 20, 17), (11, 18, 12, 19)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 7, 8, 8], [2, 8, 9, 3], [3, 9, 7, 7], [4, 6, 6, 9], [4, 9, 5, 4], [5, 8, 7, 6]]

Total optimal pinning sets: 2
Total minimal pinning sets: 6
Total pinning sets: 456
Pinning number: 4

Average optimal degree: 2.38
Average minimal degree: 2.52
Average overall degree: 3.05

Table 454: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	15	65	116	124	84	36	9	1	450
Average degree	2.38	2.65	2.86	3.0	3.11	3.19	3.24	3.29	3.33	

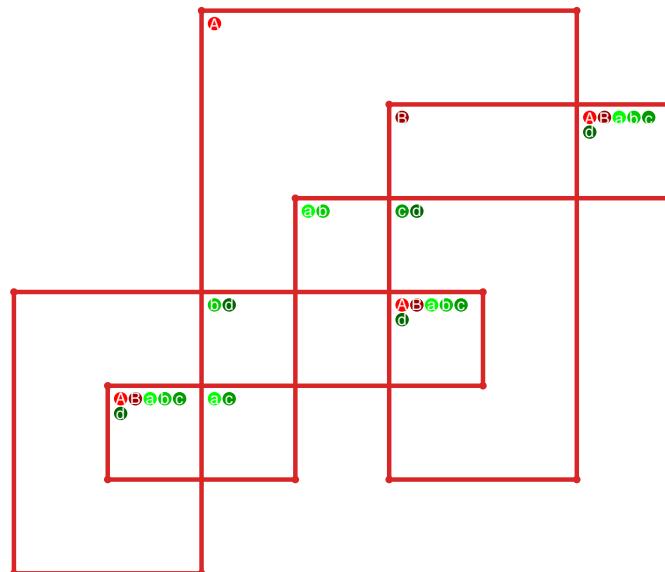


Figure 911: `SnapPy` multiloop plot.

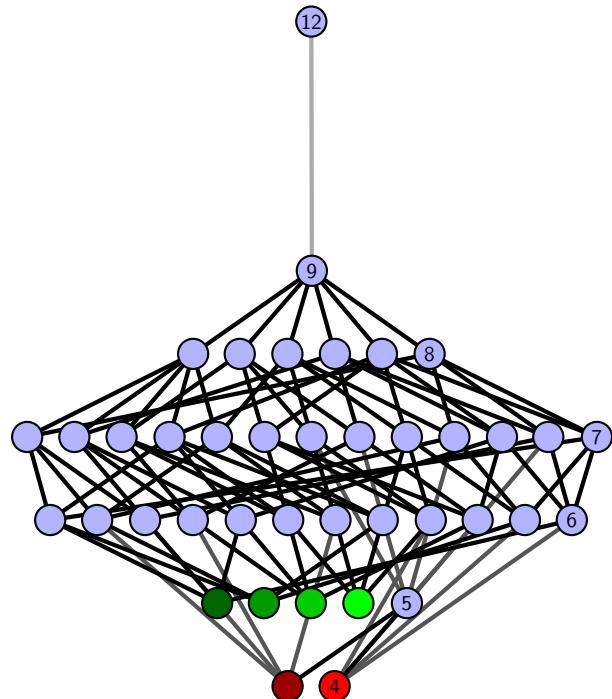


Figure 912: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.159 $[[16, 7, 1, 8], [8, 15, 9, 16], [9, 6, 10, 7], [1, 14, 2, 15], [5, 20, 6, 17], [10, 4, 11, 3], [13, 2, 14, 3], [17, 13, 18, 12], [19, 4, 20, 5], [11, 19, 12, 18]]$

PD code drawn by SnapPy: $[(11, 16, 12, 1), (1, 8, 2, 9), (17, 2, 18, 3), (7, 4, 8, 5), (14, 5, 15, 6), (10, 19, 11, 20), (15, 12, 16, 13), (6, 13, 7, 14), (20, 9, 17, 10), (3, 18, 4, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 6, 1], [2, 7, 8, 8], [2, 8, 9, 6], [3, 5, 7, 3], [4, 6, 9, 9], [4, 9, 5, 4], [5, 8, 7, 7]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 256

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.97

Table 455: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

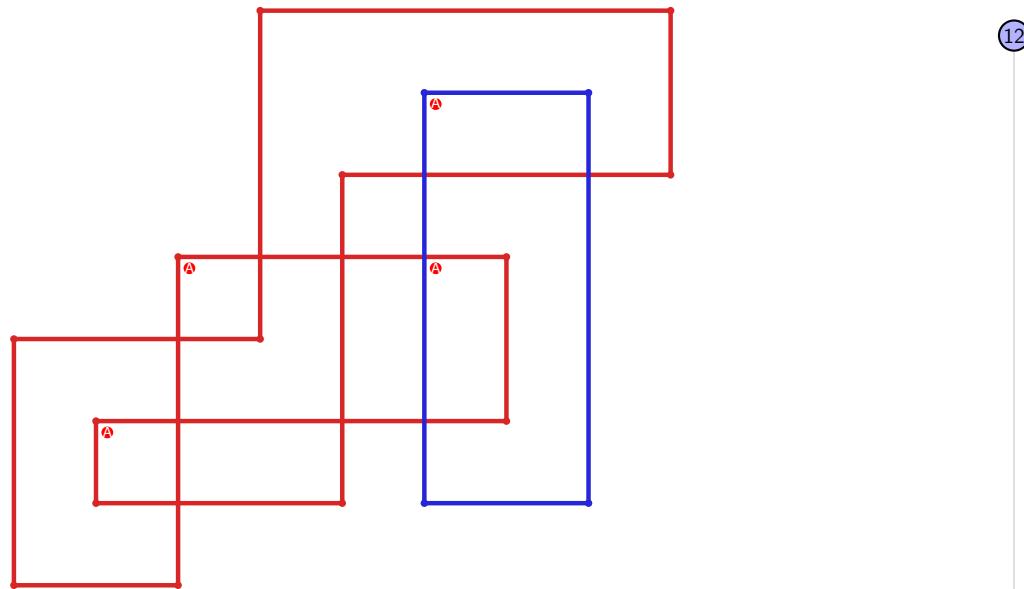


Figure 913: SnapPy multiloop plot.

4

Figure 914: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.160 $[[16, 9, 1, 10], [10, 15, 11, 16], [11, 8, 12, 9], [1, 14, 2, 15], [7, 20, 8, 17], [12, 6, 13, 5], [13, 4, 14, 5], [2, 18, 3, 17], [19, 6, 20, 7], [3, 18, 4, 19]]$

PD code drawn by SnapPy: $[(11, 2, 12, 3), (3, 10, 4, 11), (19, 4, 20, 5), (9, 6, 10, 7), (14, 7, 15, 8), (15, 12, 16, 13), (8, 13, 9, 14), (17, 16, 18, 1), (1, 18, 2, 19), (5, 20, 6, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 7, 1], [2, 7, 8, 8], [2, 8, 6, 6], [3, 5, 5, 9], [3, 9, 9, 4], [4, 9, 5, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 456: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

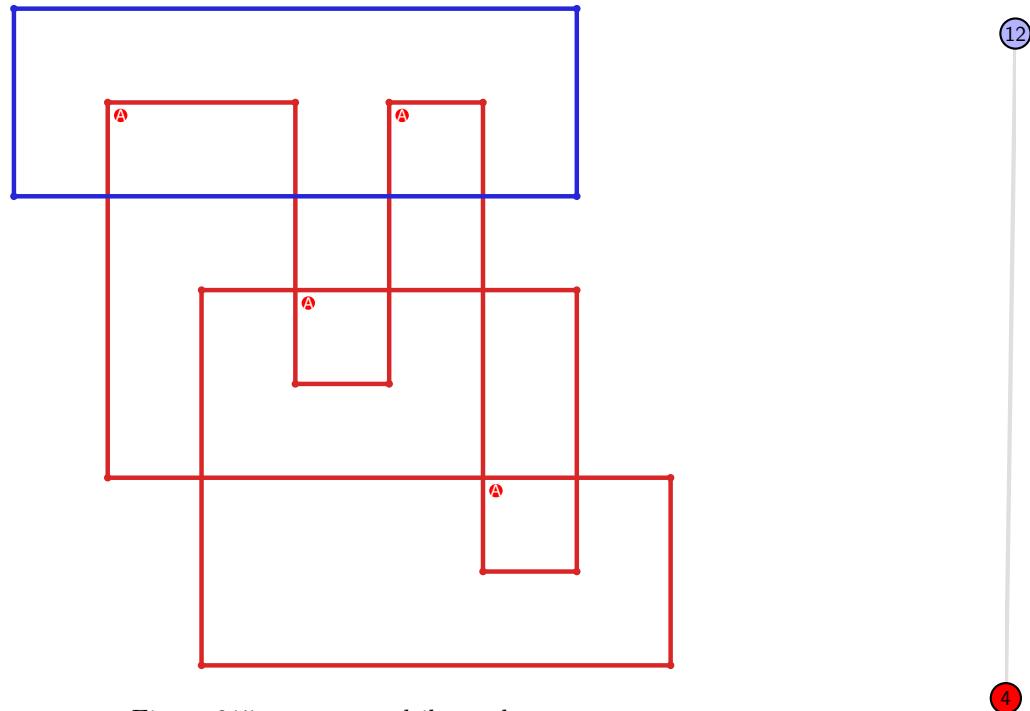


Figure 915: SnapPy multiloop plot.

Figure 916: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.161 $[[12, 16, 1, 13], [13, 11, 14, 12], [15, 5, 16, 6], [1, 10, 2, 11], [14, 7, 15, 6], [9, 4, 10, 5], [2, 17, 3, 20], [7, 20, 8, 19], [8, 18, 9, 19], [3, 17, 4, 18]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (17, 2, 18, 3), (3, 20, 4, 17), (10, 7, 11, 8), (19, 8, 20, 9), (9, 18, 10, 19), (15, 4, 16, 5), (16, 11, 13, 12), (12, 13, 1, 14), (5, 14, 6, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 8, 9, 3], [3, 9, 9, 7], [4, 6, 8, 8], [5, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 256

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.97

Table 457: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

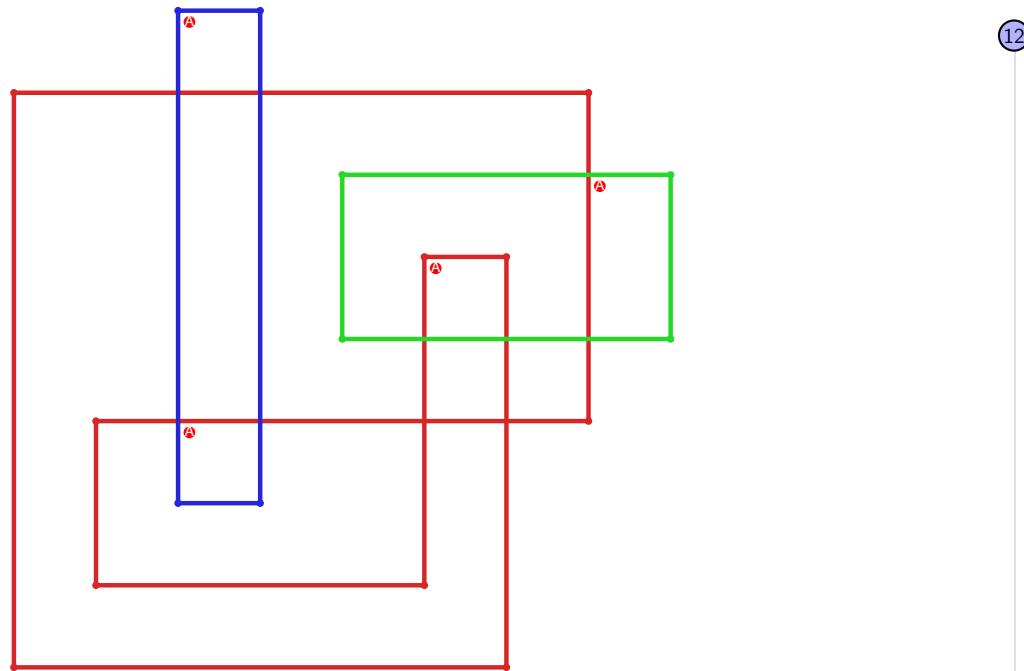


Figure 917: SnapPy multiloop plot.

4

Figure 918: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.162 $[[8, 16, 1, 9], [9, 7, 10, 8], [10, 15, 11, 16], [1, 6, 2, 7], [14, 20, 15, 17], [11, 5, 12, 6], [2, 18, 3, 17], [19, 13, 20, 14], [4, 12, 5, 13], [18, 4, 19, 3]]$

PD code drawn by SnapPy: $[(1, 10, 2, 11), (20, 3, 13, 4), (7, 4, 8, 5), (18, 5, 19, 6), (2, 13, 3, 14), (11, 14, 12, 15), (19, 16, 20, 17), (6, 17, 7, 18), (15, 12, 16, 9), (9, 8, 10, 1)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 7], [2, 8, 8, 3], [3, 9, 9, 4], [4, 9, 8, 4], [5, 7, 9, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 458: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

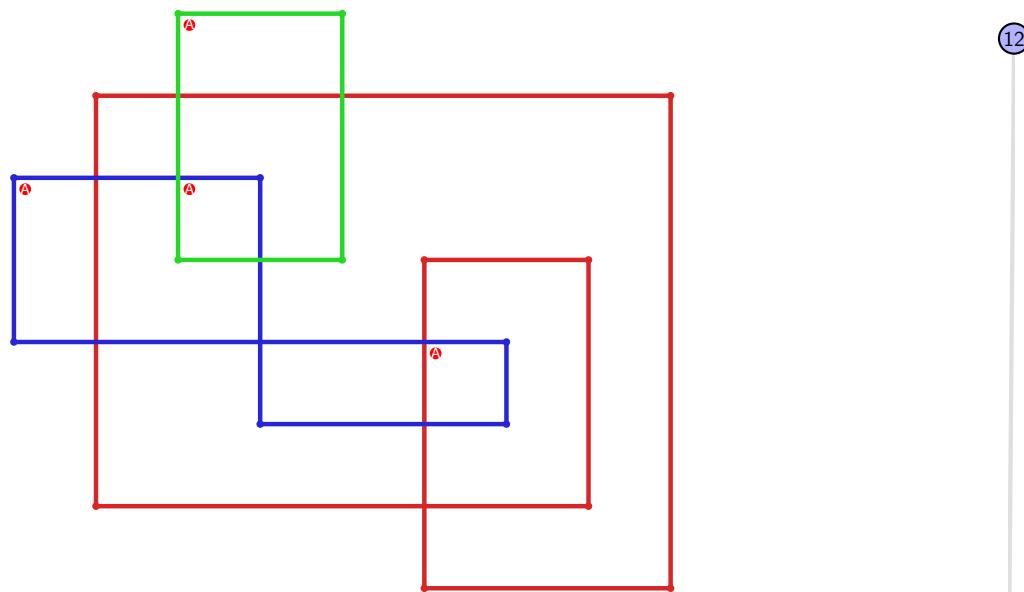


Figure 919: SnapPy multiloop plot.



Figure 920: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.163 $[[7, 16, 8, 1], [6, 9, 7, 10], [15, 8, 16, 9], [1, 11, 2, 10], [14, 5, 15, 6], [11, 5, 12, 4], [2, 17, 3, 20], [13, 19, 14, 20], [12, 19, 13, 18], [3, 17, 4, 18]]$

PD code drawn by SnapPy: $[(1, 8, 2, 9), (11, 2, 12, 3), (12, 5, 13, 6), (3, 6, 4, 7), (7, 14, 8, 15), (4, 13, 5, 14), (18, 9, 19, 10), (10, 19, 11, 20), (20, 15, 17, 16), (16, 17, 1, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 4, 0], [0, 5, 6, 1], [1, 7, 5, 2], [3, 4, 8, 9], [3, 9, 9, 7], [4, 6, 8, 8], [5, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 318
 Pinning number: 5

Average optimal degree: 2.55
 Average minimal degree: 2.55
 Average overall degree: 3.04

Table 459: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	34	71	90	71	34	9	1	310
Average degree	2.55	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

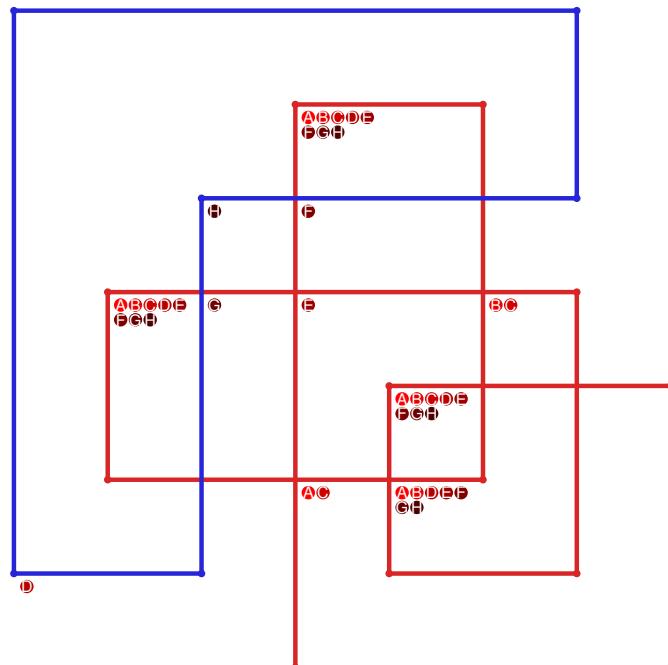


Figure 921: SnapPy multiloop plot.

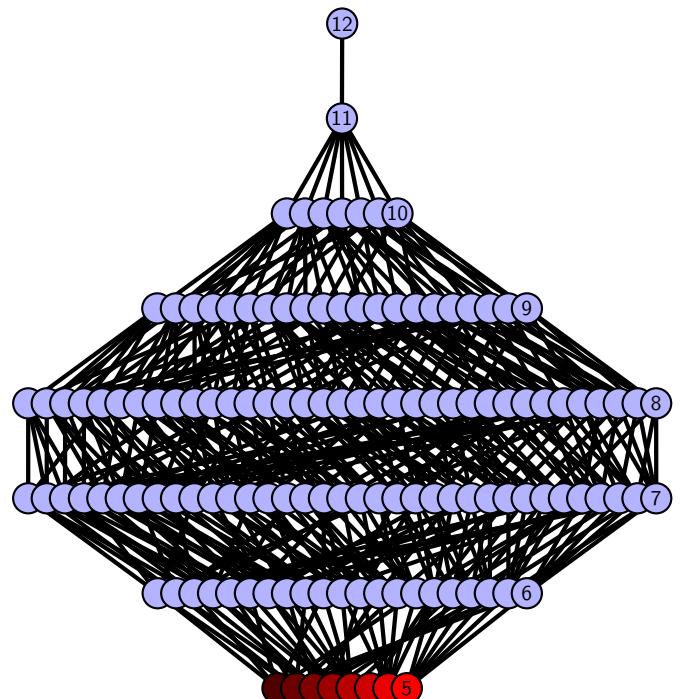


Figure 922: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.164 [[16, 13, 1, 14], [14, 8, 15, 7], [15, 6, 16, 7], [12, 5, 13, 6], [1, 9, 2, 8], [11, 20, 12, 17], [4, 9, 5, 10], [2, 18, 3, 17], [19, 10, 20, 11], [3, 18, 4, 19]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (12, 3, 13, 4), (4, 11, 5, 12), (5, 14, 6, 15), (1, 6, 2, 7), (18, 7, 19, 8), (13, 10, 14, 11), (8, 19, 9, 20), (20, 15, 17, 16), (16, 17, 1, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 2, 2], [0, 1, 1, 3], [0, 2, 5, 6], [0, 6, 7, 1], [3, 7, 8, 8], [3, 8, 9, 4], [4, 9, 9, 5], [5, 9, 6, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 318
 Pinning number: 5

Average optimal degree: 2.55
 Average minimal degree: 2.55
 Average overall degree: 3.04

Table 460: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	34	71	90	71	34	9	1	310
Average degree	2.55	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

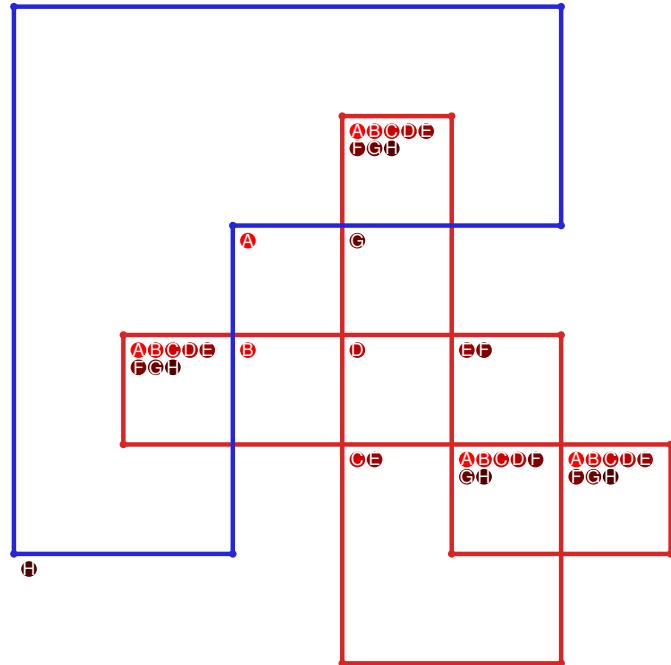


Figure 923: SnapPy multiloop plot.

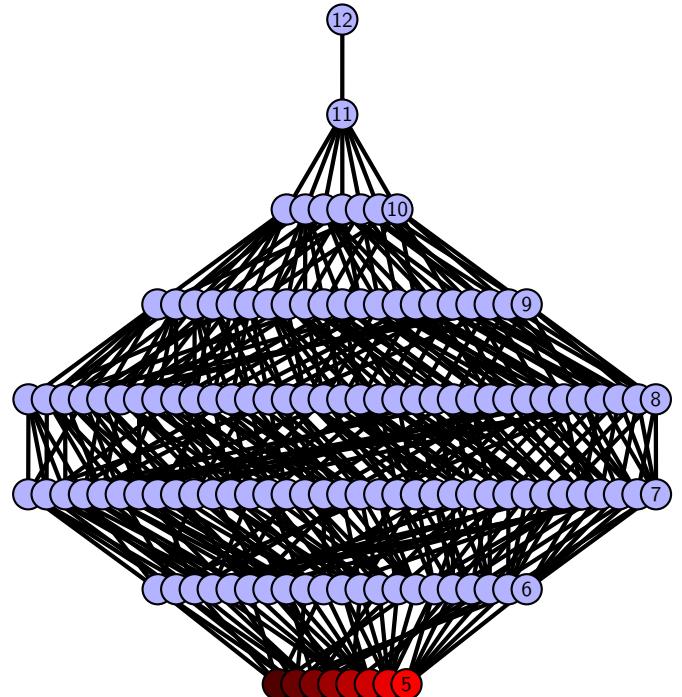


Figure 924: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.165 $[[11, 20, 12, 1], [19, 10, 20, 11], [12, 10, 13, 9], [1, 18, 2, 19], [13, 7, 14, 6], [8, 3, 9, 4], [17, 2, 18, 3], [7, 17, 8, 16], [14, 5, 15, 6], [4, 15, 5, 16]]$

PD code drawn by SnapPy: $[(15, 20, 16, 1), (6, 1, 7, 2), (12, 3, 13, 4), (4, 11, 5, 12), (7, 10, 8, 11), (17, 8, 18, 9), (2, 13, 3, 14), (14, 5, 15, 6), (19, 16, 20, 17), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 6, 1], [2, 7, 8, 8], [2, 9, 7, 6], [3, 5, 7, 3], [4, 6, 5, 9], [4, 9, 9, 4], [5, 8, 8, 7]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 461: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

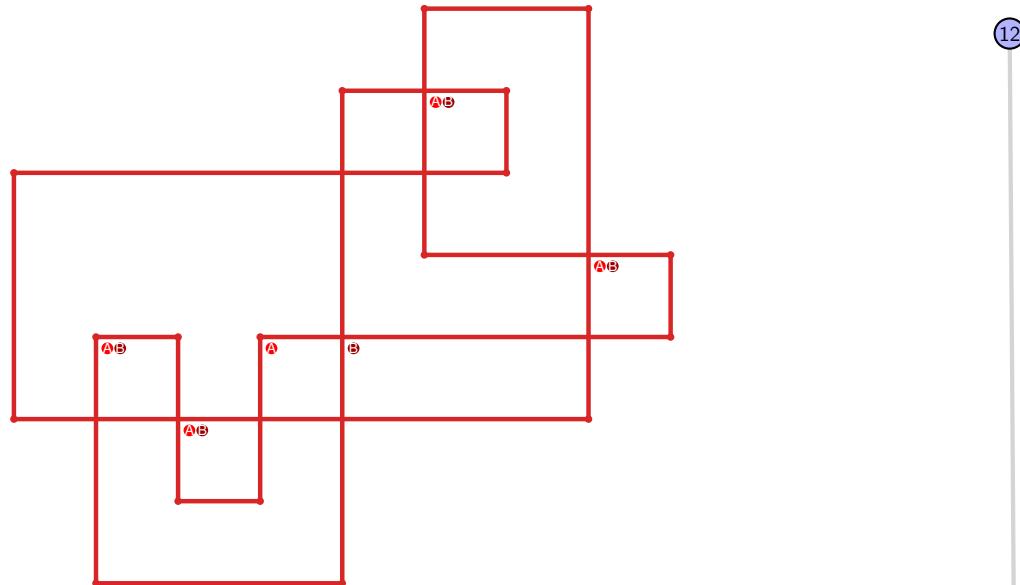


Figure 925: SnapPy multiloop plot.

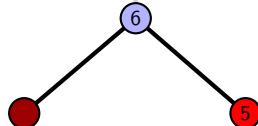


Figure 926: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.166 `[[10, 7, 1, 8], [8, 11, 9, 20], [9, 19, 10, 20], [6, 18, 7, 19], [1, 12, 2, 11], [5, 15, 6, 16], [17, 12, 18, 13], [2, 17, 3, 16], [14, 4, 15, 5], [13, 4, 14, 3]]`

PD code drawn by `SnapPy`: `[(1, 18, 2, 19), (19, 2, 20, 3), (8, 5, 9, 6), (3, 20, 4, 11), (11, 10, 12, 1), (4, 13, 5, 14), (7, 14, 8, 15), (15, 6, 16, 7), (16, 9, 17, 10), (12, 17, 13, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 2, 2], [0, 1, 1, 3], [0, 2, 5, 6], [0, 6, 7, 1], [3, 7, 8, 8], [3, 9, 7, 4], [4, 6, 9, 5], [5, 9, 9, 5], [6, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.51

Total pinning sets: 224

Average overall degree: 3.04

Pinning number: 5

Table 462: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	7	39	67	63	33	9	1	219
Average degree	2.4	2.62	2.84	3.01	3.14	3.23	3.29	3.33	

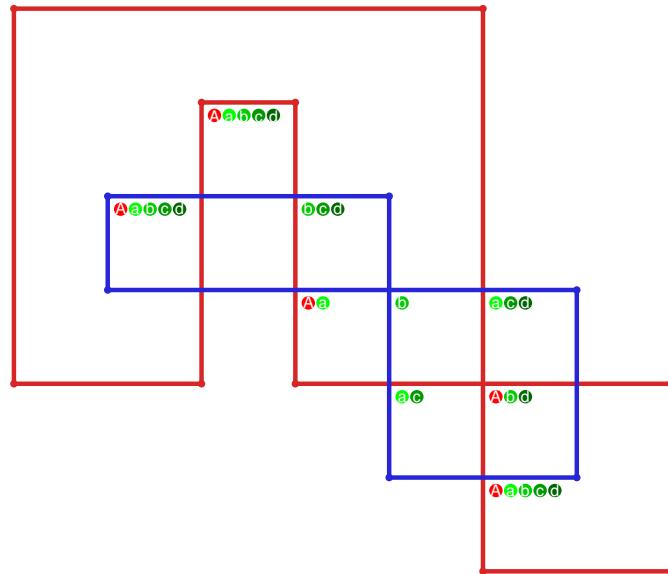


Figure 927: `SnapPy` multiloop plot.

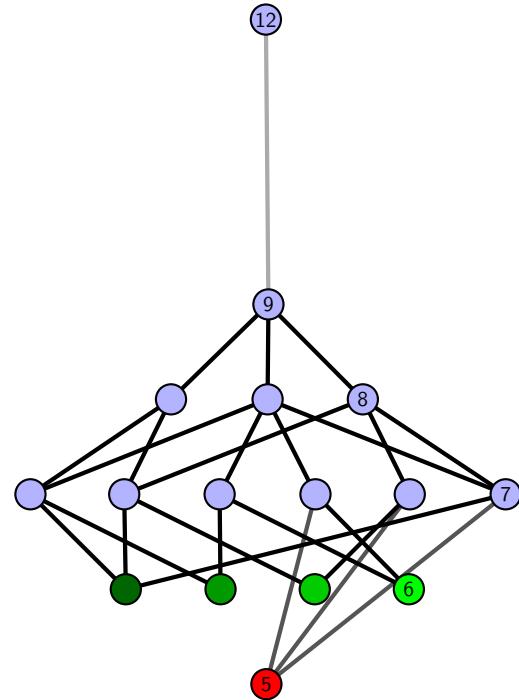


Figure 928: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.167 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 8, 11, 7], [1, 18, 2, 19], [11, 6, 12, 7], [12, 17, 13, 18], [2, 13, 3, 14], [14, 5, 15, 6], [16, 3, 17, 4], [4, 15, 5, 16]]$

PD code drawn by `SnapPy`: $[(14, 1, 15, 2), (12, 3, 13, 4), (9, 4, 10, 5), (5, 8, 6, 9), (17, 6, 18, 7), (20, 11, 1, 12), (2, 13, 3, 14), (10, 15, 11, 16), (19, 16, 20, 17), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 6, 1], [2, 7, 5, 2], [3, 4, 8, 6], [3, 5, 8, 7], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 463: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

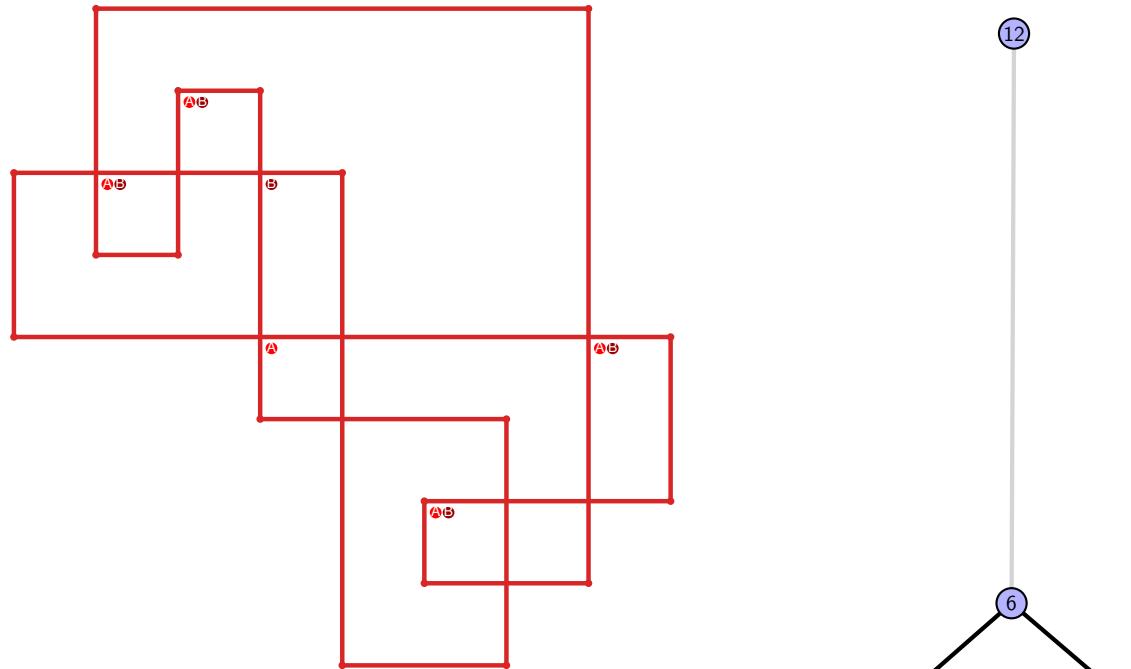


Figure 929: `SnapPy` multiloop plot.

Figure 930: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.168 [[11, 20, 12, 1], [19, 10, 20, 11], [12, 10, 13, 9], [1, 18, 2, 19], [13, 7, 14, 6], [17, 8, 18, 9], [2, 8, 3, 7], [14, 5, 15, 6], [16, 3, 17, 4], [4, 15, 5, 16]]

PD code drawn by `SnapPy`: [(14, 1, 15, 2), (12, 3, 13, 4), (4, 11, 5, 12), (5, 20, 6, 1), (15, 6, 16, 7), (7, 10, 8, 11), (17, 8, 18, 9), (2, 13, 3, 14), (19, 16, 20, 17), (9, 18, 10, 19)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 7], [2, 8, 6, 3], [3, 5, 8, 4], [4, 9, 9, 4], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 3

Average minimal degree: 2.34

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 5

Table 464: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

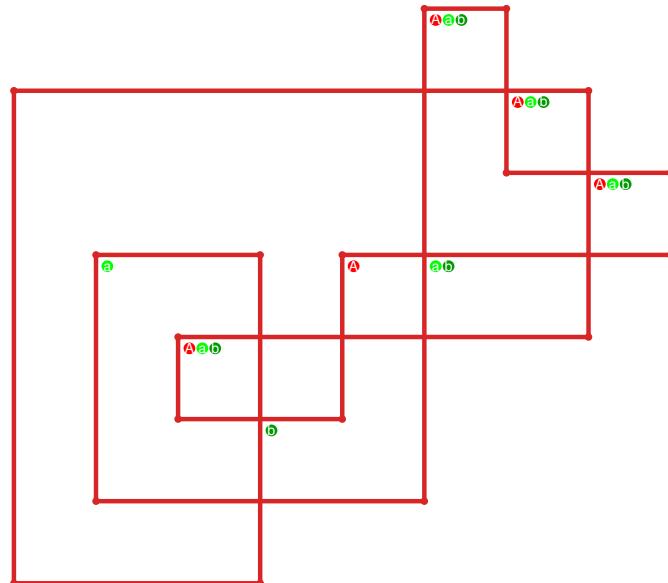


Figure 931: `SnapPy` multiloop plot.

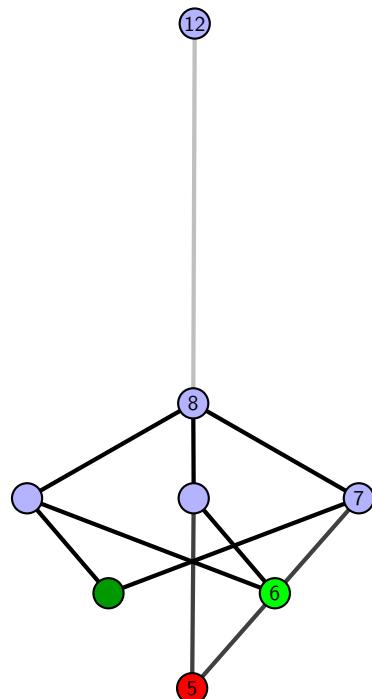


Figure 932: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.169 [[16, 20, 1, 17], [17, 15, 18, 16], [7, 19, 8, 20], [1, 14, 2, 15], [18, 6, 19, 7], [8, 13, 9, 14], [2, 9, 3, 10], [10, 5, 11, 6], [12, 3, 13, 4], [4, 11, 5, 12]]

PD code drawn by `SnapPy`: [(6, 1, 7, 2), (17, 2, 18, 3), (14, 5, 15, 6), (16, 7, 1, 8), (4, 9, 5, 10), (13, 10, 14, 11), (20, 11, 17, 12), (8, 15, 9, 16), (3, 18, 4, 19), (12, 19, 13, 20)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 8, 6, 3], [3, 5, 8, 7], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 465: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

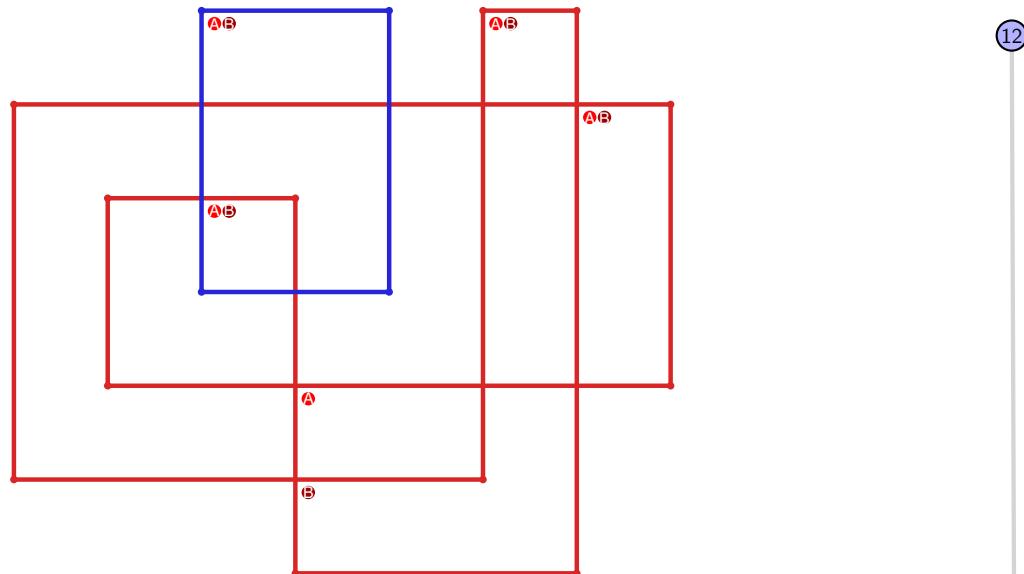


Figure 933: `SnapPy` multiloop plot.

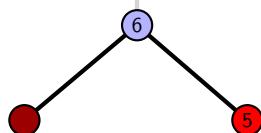


Figure 934: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.170 `[[10, 20, 1, 11], [11, 9, 12, 10], [12, 19, 13, 20], [1, 8, 2, 9], [4, 18, 5, 19], [13, 7, 14, 8], [2, 14, 3, 15], [15, 3, 16, 4], [17, 5, 18, 6], [6, 16, 7, 17]]`

PD code drawn by `SnapPy`: `[(12, 1, 13, 2), (14, 3, 15, 4), (20, 5, 11, 6), (9, 6, 10, 7), (18, 7, 19, 8), (10, 11, 1, 12), (4, 13, 5, 14), (2, 15, 3, 16), (19, 16, 20, 17), (8, 17, 9, 18)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 7, 8, 8], [2, 9, 6, 3], [3, 5, 7, 7], [4, 6, 6, 9], [4, 9, 9, 4], [5, 8, 8, 7]]`

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 224

Pinning number: 5

Average optimal degree: 2.27

Average minimal degree: 2.27

Average overall degree: 2.98

Table 466: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

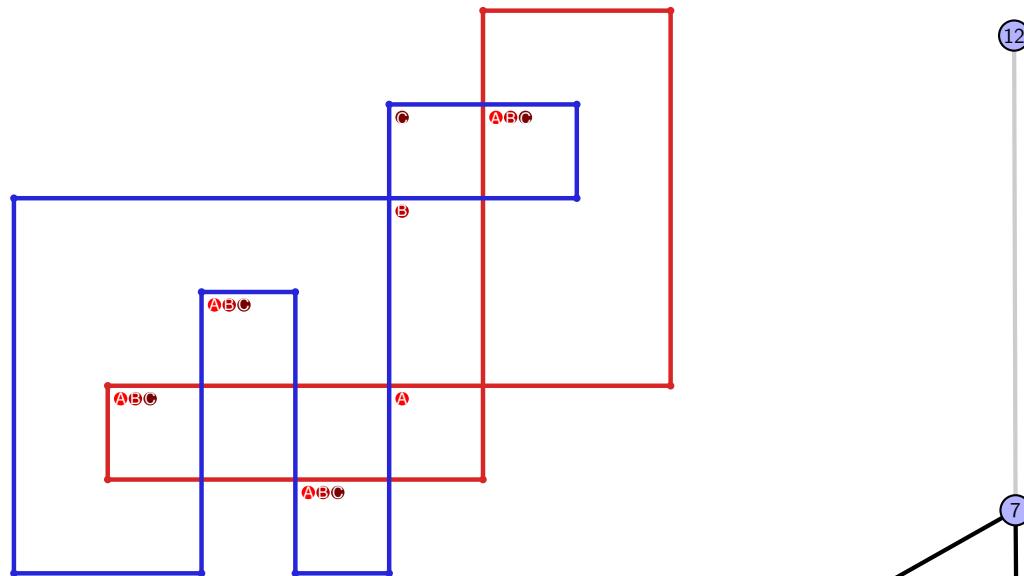


Figure 935: `SnapPy` multiloop plot.

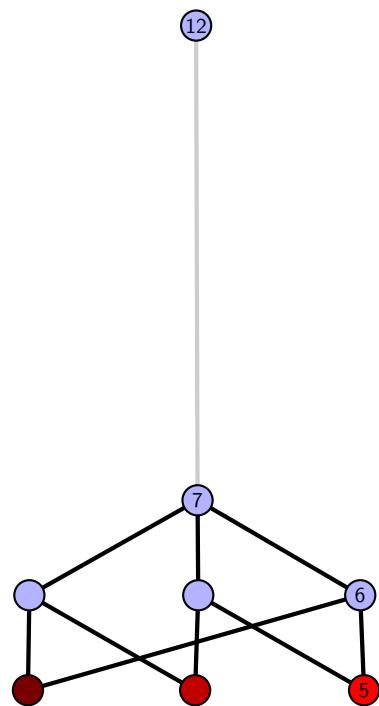


Figure 936: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.171 $[[14, 7, 1, 8], [8, 13, 9, 14], [9, 6, 10, 7], [1, 12, 2, 13], [5, 20, 6, 15], [10, 18, 11, 17], [11, 16, 12, 17], [2, 16, 3, 15], [19, 4, 20, 5], [18, 4, 19, 3]]$

PD code drawn by SnapPy: $[(15, 14, 16, 1), (5, 2, 6, 3), (10, 3, 11, 4), (11, 8, 12, 9), (4, 9, 5, 10), (13, 20, 14, 15), (7, 18, 8, 19), (19, 6, 20, 7), (1, 16, 2, 17), (17, 12, 18, 13)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 6, 7, 1], [2, 7, 8, 8], [2, 9, 6, 6], [3, 5, 5, 7], [3, 6, 9, 4], [4, 9, 9, 4], [5, 8, 8, 7]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 256

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.97

Table 467: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

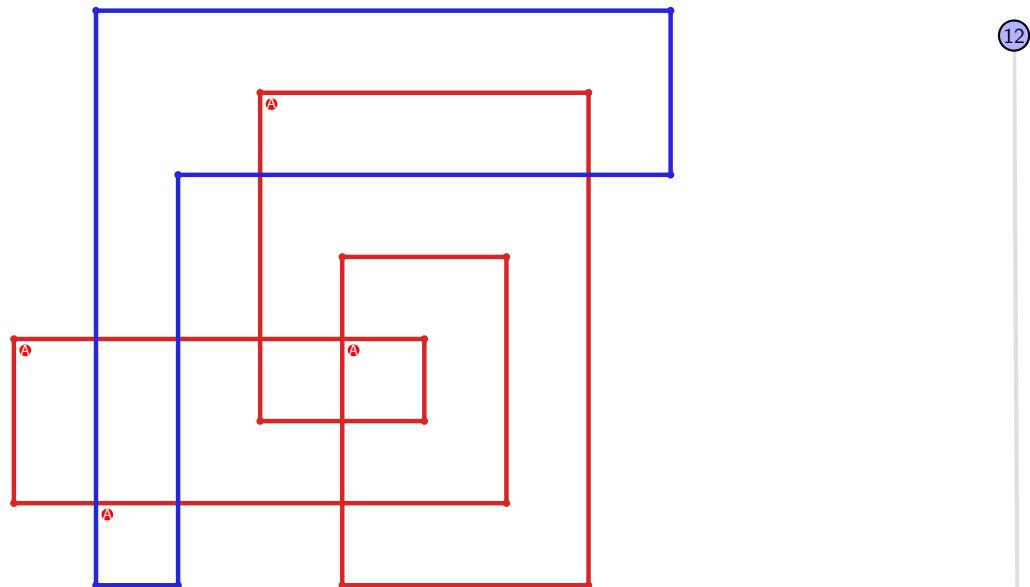


Figure 937: SnapPy multiloop plot.



Figure 938: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.172 $[[12, 20, 1, 13], [13, 11, 14, 12], [14, 19, 15, 20], [1, 10, 2, 11], [6, 18, 7, 19], [15, 9, 16, 10], [2, 16, 3, 17], [17, 5, 18, 6], [7, 5, 8, 4], [8, 3, 9, 4]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (2, 5, 3, 6), (14, 3, 15, 4), (20, 7, 13, 8), (11, 8, 12, 9), (18, 9, 19, 10), (12, 13, 1, 14), (4, 15, 5, 16), (19, 16, 20, 17), (10, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 7, 7, 8], [2, 9, 6, 3], [3, 5, 9, 7], [4, 6, 8, 4], [4, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 5
Total minimal pinning sets: 5
Total pinning sets: 320
Pinning number: 5

Average optimal degree: 2.48
Average minimal degree: 2.48
Average overall degree: 3.05

Table 468: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	29	71	95	75	35	9	1	315
Average degree	2.48	2.75	2.93	3.07	3.17	3.24	3.29	3.33	

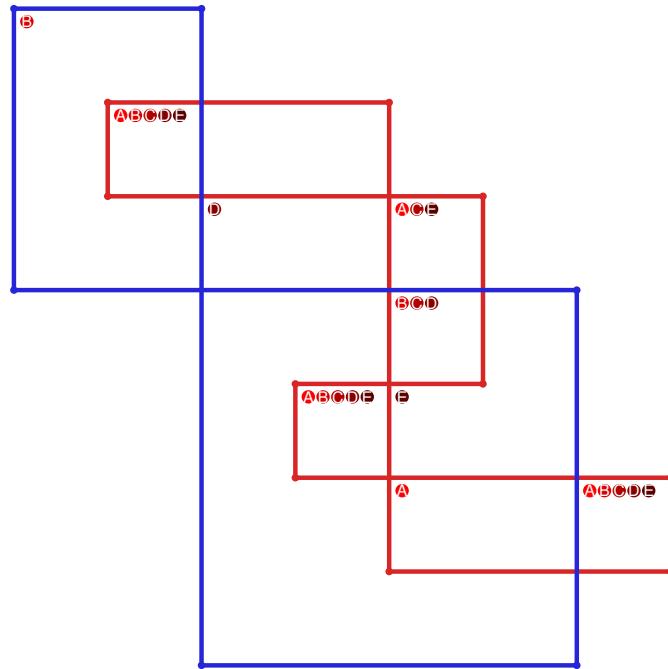


Figure 939: SnapPy multiloop plot.

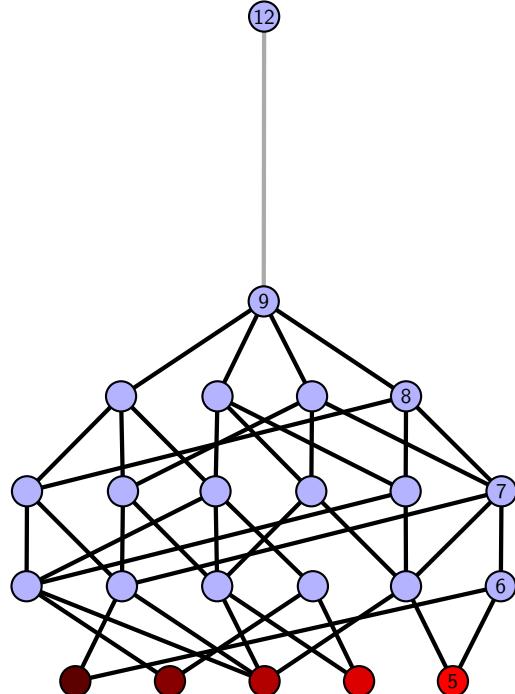


Figure 940: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.173 $[[10, 20, 1, 11], [11, 9, 12, 10], [12, 19, 13, 20], [1, 8, 2, 9], [15, 18, 16, 19], [13, 7, 14, 8], [2, 14, 3, 15], [17, 5, 18, 6], [16, 5, 17, 4], [6, 3, 7, 4]]$

PD code drawn by SnapPy: $[(10, 11, 1, 12), (12, 1, 13, 2), (18, 3, 19, 4), (7, 4, 8, 5), (16, 5, 17, 6), (2, 9, 3, 10), (8, 19, 9, 20), (20, 13, 11, 14), (17, 14, 18, 15), (6, 15, 7, 16)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 8], [2, 9, 6, 3], [3, 5, 9, 4], [4, 9, 8, 8], [4, 7, 7, 9], [5, 8, 7, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 640
 Pinning number: 4

Average optimal degree: 2.6
 Average minimal degree: 2.6
 Average overall degree: 3.12

Table 469: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	34	100	166	170	110	44	10	1	635
Average degree	2.6	2.84	2.99	3.1	3.18	3.23	3.28	3.31	3.33	

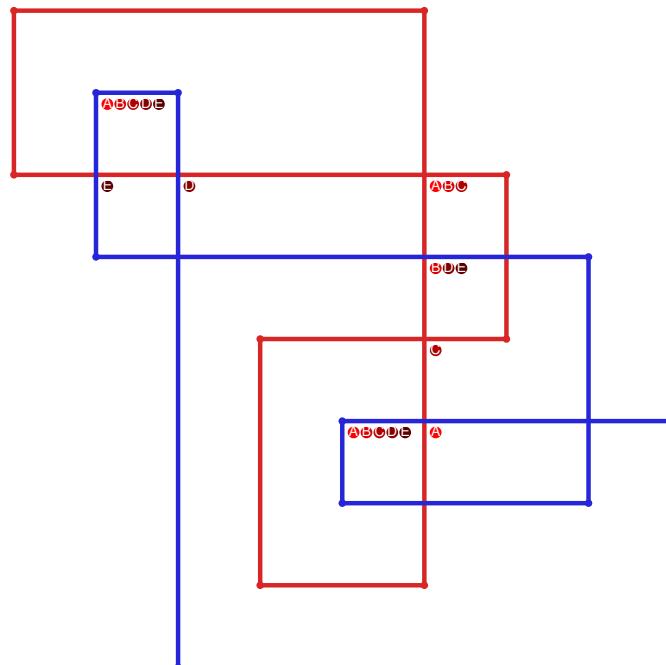


Figure 941: SnapPy multiloop plot.

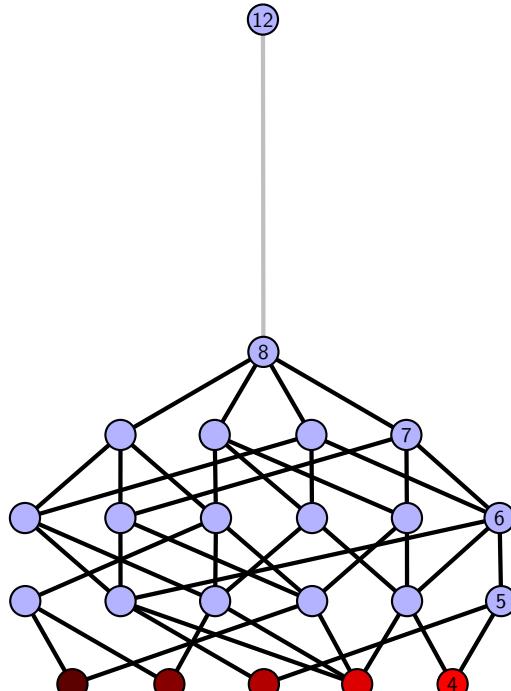


Figure 942: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.174 [[16, 20, 1, 17], [17, 15, 18, 16], [7, 19, 8, 20], [1, 14, 2, 15], [18, 6, 19, 7], [8, 4, 9, 3], [13, 2, 14, 3], [10, 5, 11, 6], [4, 11, 5, 12], [9, 12, 10, 13]]

PD code drawn by SnapPy: [(11, 16, 12, 1), (1, 6, 2, 7), (8, 3, 9, 4), (17, 4, 18, 5), (2, 9, 3, 10), (7, 10, 8, 11), (15, 12, 16, 13), (20, 13, 17, 14), (5, 18, 6, 19), (14, 19, 15, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 6, 6, 1], [1, 7, 2, 2], [2, 8, 9, 6], [3, 5, 9, 3], [4, 9, 8, 8], [5, 7, 7, 9], [5, 8, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 470: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

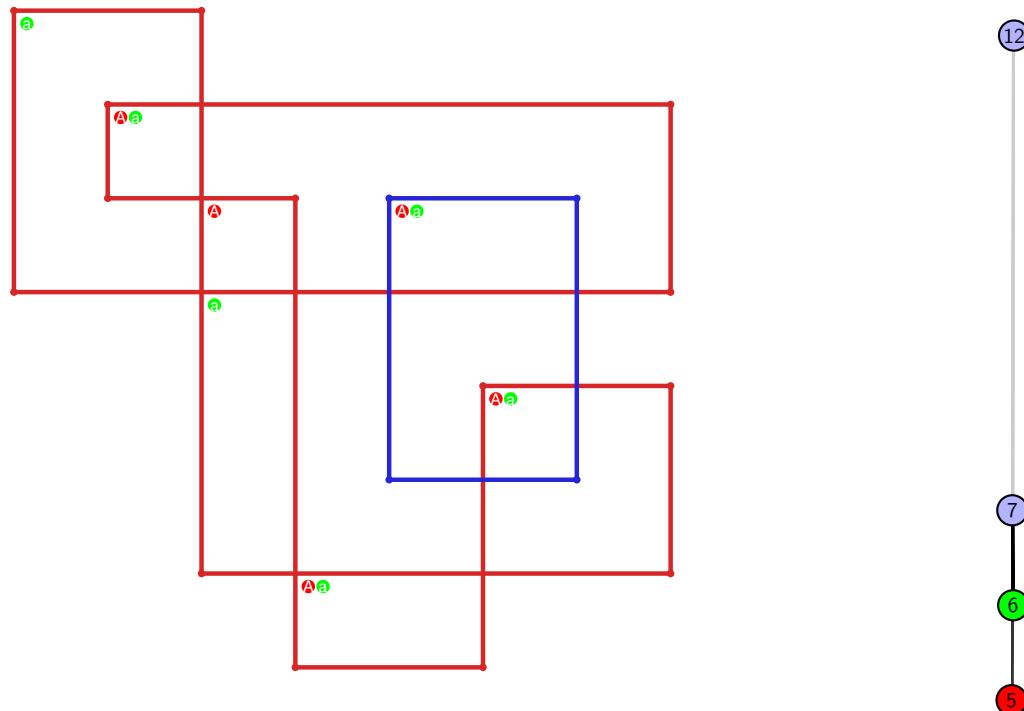


Figure 943: SnapPy multiloop plot.

Figure 944: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.175 $[[20, 17, 1, 18], [18, 13, 19, 14], [14, 19, 15, 20], [16, 7, 17, 8], [1, 12, 2, 13], [15, 9, 16, 8], [11, 6, 12, 7], [2, 6, 3, 5], [9, 5, 10, 4], [10, 3, 11, 4]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (2, 7, 3, 8), (3, 20, 4, 1), (9, 4, 10, 5), (14, 5, 15, 6), (6, 13, 7, 14), (19, 10, 20, 11), (16, 11, 17, 12), (18, 15, 19, 16), (12, 17, 13, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 2, 2], [0, 1, 1, 5], [0, 5, 5, 6], [0, 6, 7, 1], [2, 8, 3, 3], [3, 9, 7, 4], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 471: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

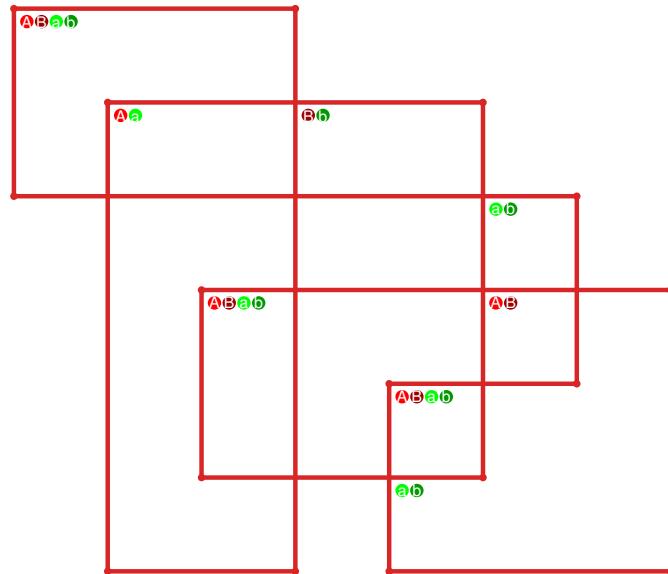


Figure 945: `SnapPy` multiloop plot.

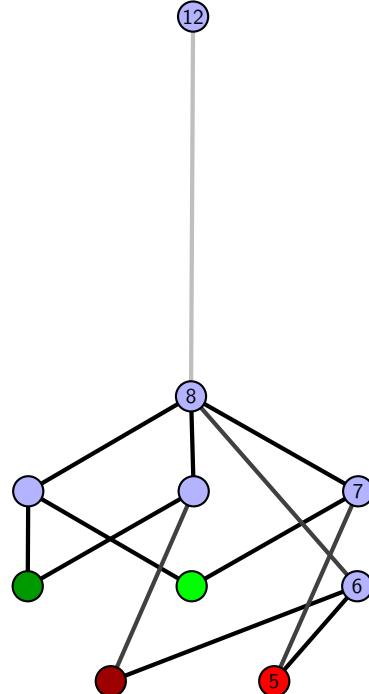


Figure 946: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.176 [[20, 11, 1, 12], [12, 19, 13, 20], [10, 7, 11, 8], [1, 18, 2, 19], [13, 9, 14, 8], [14, 9, 15, 10], [17, 6, 18, 7], [2, 6, 3, 5], [15, 5, 16, 4], [16, 3, 17, 4]]

PD code drawn by `SnapPy`: [(14, 1, 15, 2), (2, 13, 3, 14), (3, 20, 4, 1), (15, 4, 16, 5), (8, 5, 9, 6), (6, 11, 7, 12), (12, 7, 13, 8), (18, 9, 19, 10), (19, 16, 20, 17), (10, 17, 11, 18)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 5, 6], [0, 6, 7, 1], [1, 5, 5, 2], [2, 4, 4, 8], [2, 9, 7, 3], [3, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 472: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

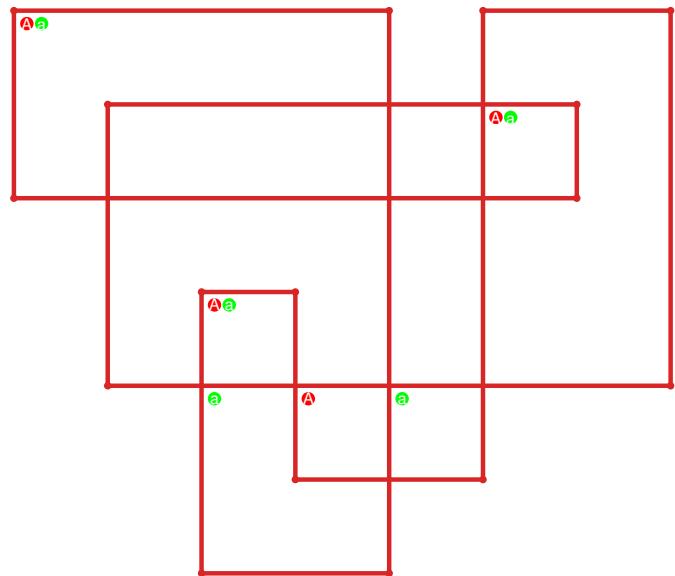


Figure 947: `SnapPy` multiloop plot.



Figure 948: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.177 [[20, 9, 1, 10], [10, 19, 11, 20], [8, 13, 9, 14], [1, 18, 2, 19], [11, 15, 12, 14], [12, 7, 13, 8], [17, 6, 18, 7], [2, 6, 3, 5], [15, 5, 16, 4], [16, 3, 17, 4]]

PD code drawn by `SnapPy`: [(20, 11, 1, 12), (1, 18, 2, 19), (13, 2, 14, 3), (8, 3, 9, 4), (16, 5, 17, 6), (4, 9, 5, 10), (10, 7, 11, 8), (17, 14, 18, 15), (6, 15, 7, 16), (12, 19, 13, 20)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 5, 5], [0, 6, 7, 1], [1, 8, 5, 2], [2, 4, 6, 2], [3, 5, 9, 7], [3, 6, 9, 8], [4, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 320
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.33
 Average overall degree: 3.03

Table 473: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

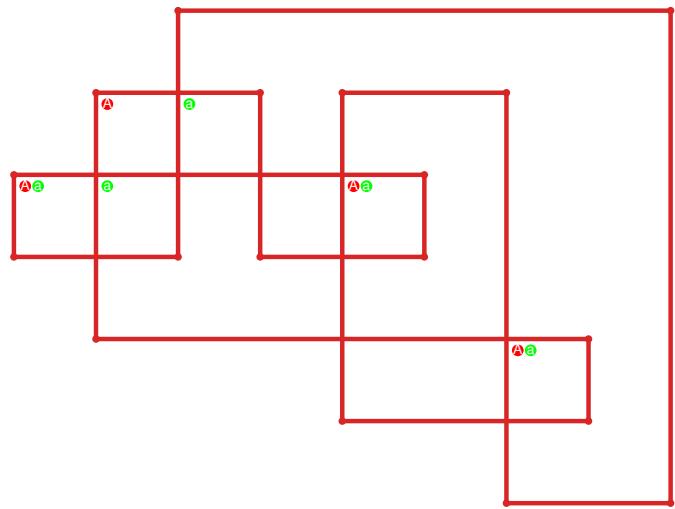


Figure 949: `SnapPy` multiloop plot.



Figure 950: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.178 [[11, 20, 12, 1], [19, 10, 20, 11], [12, 8, 13, 7], [1, 18, 2, 19], [9, 14, 10, 15], [8, 14, 9, 13], [17, 6, 18, 7], [2, 6, 3, 5], [15, 5, 16, 4], [16, 3, 17, 4]]

PD code drawn by `SnapPy`: [(20, 11, 1, 12), (1, 18, 2, 19), (13, 2, 14, 3), (3, 8, 4, 9), (15, 6, 16, 7), (9, 4, 10, 5), (5, 10, 6, 11), (17, 14, 18, 15), (7, 16, 8, 17), (12, 19, 13, 20)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 5, 5, 6], [0, 6, 7, 1], [1, 8, 5, 5], [2, 4, 4, 2], [2, 9, 7, 3], [3, 6, 9, 8], [4, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 2
Total pinning sets: 160
Pinning number: 5

Average optimal degree: 2.2
Average minimal degree: 2.27
Average overall degree: 2.97

Table 474: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

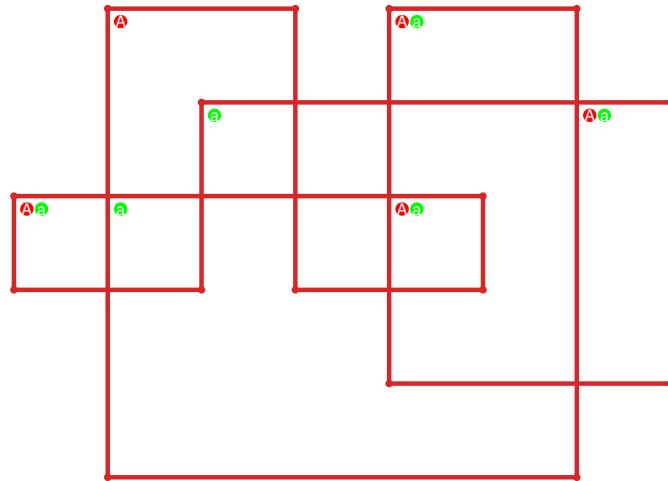


Figure 951: `SnapPy` multiloop plot.



Figure 952: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.179 $[[16, 20, 1, 17], [17, 15, 18, 16], [19, 9, 20, 10], [1, 14, 2, 15], [18, 11, 19, 10], [13, 8, 14, 9], [2, 8, 3, 7], [11, 4, 12, 5], [5, 12, 6, 13], [3, 6, 4, 7]]$

PD code drawn by `SnapPy`: $[(9, 2, 10, 3), (1, 4, 2, 5), (5, 16, 6, 1), (11, 6, 12, 7), (18, 7, 19, 8), (8, 17, 9, 18), (3, 10, 4, 11), (15, 12, 16, 13), (20, 13, 17, 14), (14, 19, 15, 20)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 8, 6, 3], [3, 5, 9, 9], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 475: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

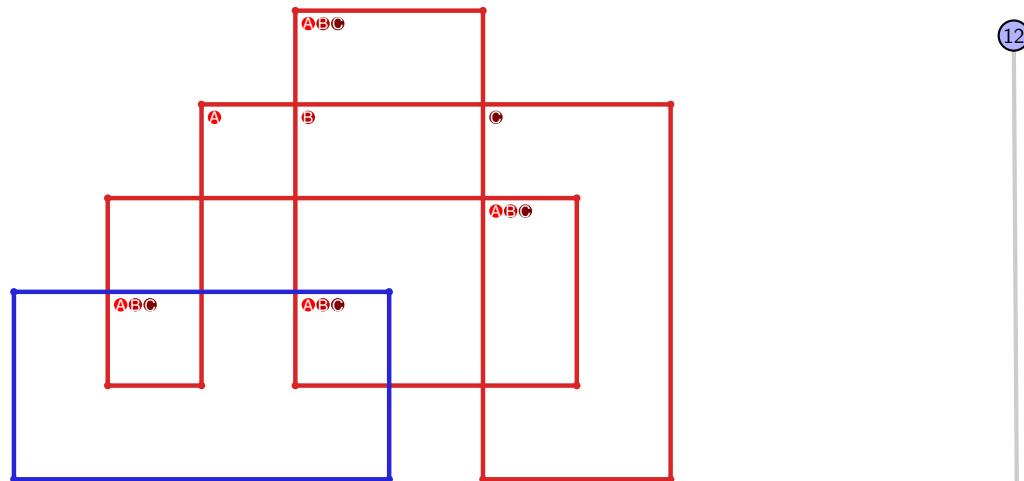


Figure 953: `SnapPy` multiloop plot.

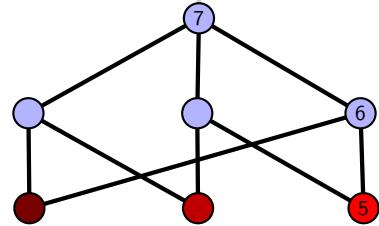


Figure 954: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.180 `[[10, 14, 1, 11], [11, 9, 12, 10], [13, 20, 14, 15], [1, 8, 2, 9], [12, 16, 13, 15], [7, 19, 8, 20], [2, 19, 3, 18], [16, 5, 17, 4], [6, 3, 7, 4], [17, 5, 18, 6]]`

PD code drawn by `SnapPy`: `[(4, 1, 5, 2), (2, 15, 3, 16), (16, 3, 11, 4), (9, 6, 10, 7), (18, 7, 19, 8), (8, 17, 9, 18), (11, 10, 12, 1), (5, 12, 6, 13), (20, 13, 17, 14), (14, 19, 15, 20)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 8, 6, 3], [3, 5, 8, 9], [4, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]`

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 3

Average minimal degree: 2.4

Total pinning sets: 256

Average overall degree: 3.03

Pinning number: 5

Table 476: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

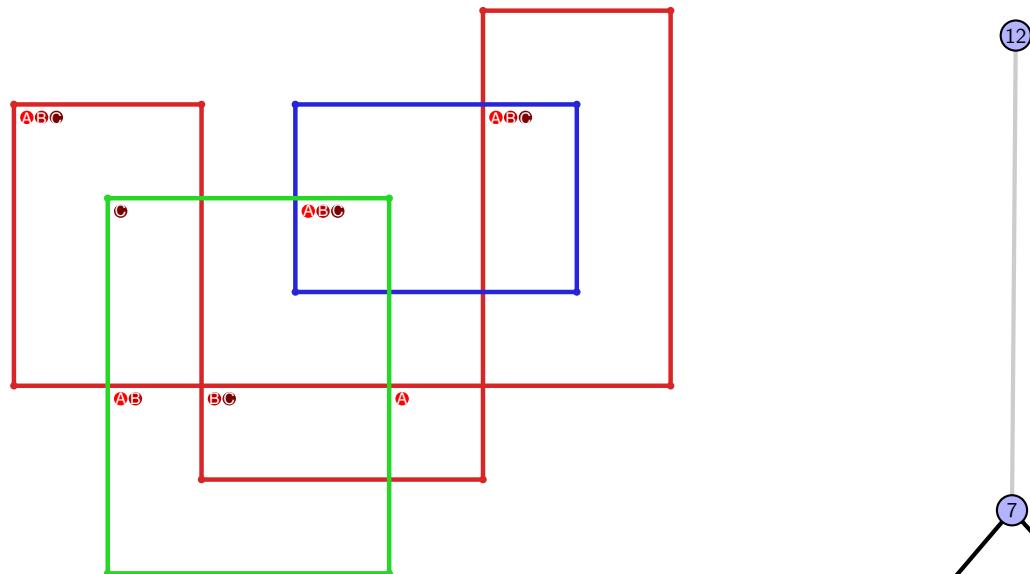


Figure 955: `SnapPy` multiloop plot.

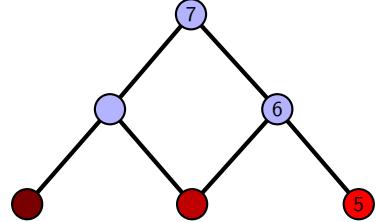


Figure 956: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.181 $[[20, 5, 1, 6], [6, 3, 7, 4], [4, 19, 5, 20], [1, 15, 2, 14], [2, 13, 3, 14], [7, 18, 8, 19], [15, 8, 16, 9], [9, 12, 10, 13], [10, 17, 11, 18], [16, 11, 17, 12]]$

PD code drawn by SnapPy: $[(4, 1, 5, 2), (18, 3, 19, 4), (13, 6, 14, 7), (14, 9, 15, 10), (7, 10, 8, 11), (20, 11, 1, 12), (12, 19, 13, 20), (8, 15, 9, 16), (5, 16, 6, 17), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 2], [0, 1, 5, 0], [0, 6, 4, 4], [1, 3, 3, 7], [1, 8, 6, 2], [3, 5, 9, 7], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4

Total pinning sets: 288

Pinning number: 5

Average optimal degree: 2.4

Average minimal degree: 2.4

Average overall degree: 3.03

Table 477: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

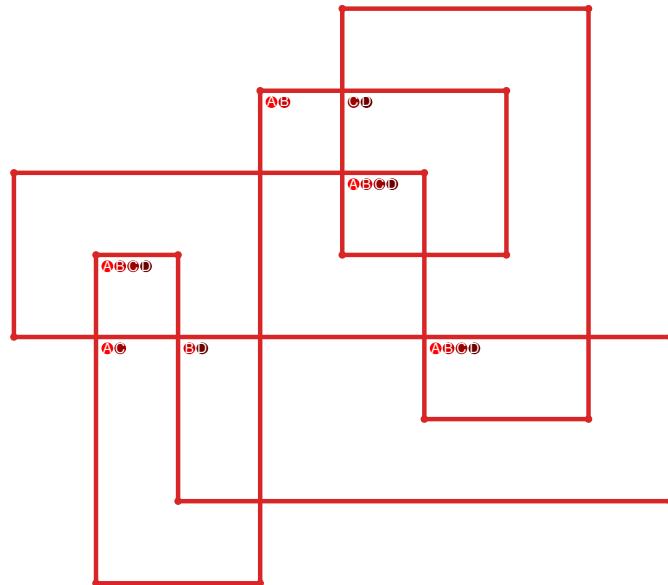


Figure 957: SnapPy multiloop plot.

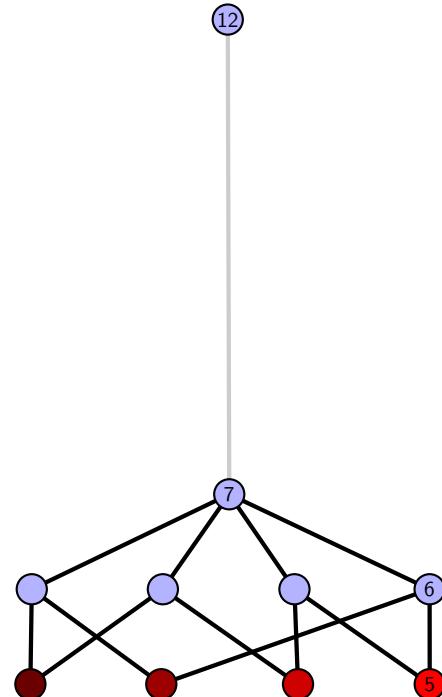


Figure 958: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.182 [[20, 7, 1, 8], [8, 19, 9, 20], [9, 6, 10, 7], [1, 17, 2, 16], [18, 15, 19, 16], [12, 5, 13, 6], [10, 4, 11, 3], [17, 3, 18, 2], [11, 14, 12, 15], [4, 13, 5, 14]]

PD code drawn by `SnapPy`: [(3, 20, 4, 1), (14, 1, 15, 2), (18, 7, 19, 8), (5, 8, 6, 9), (12, 9, 13, 10), (10, 15, 11, 16), (2, 13, 3, 14), (16, 11, 17, 12), (17, 4, 18, 5), (6, 19, 7, 20)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 7, 7, 4], [1, 3, 7, 8], [2, 8, 9, 9], [2, 9, 8, 7], [3, 6, 4, 3], [4, 6, 9, 5], [5, 8, 6, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 352
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.42
 Average overall degree: 3.04

Table 478: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	39	81	100	76	35	9	1	349
Average degree	2.25	2.56	2.79	2.95	3.08	3.17	3.24	3.29	3.33	

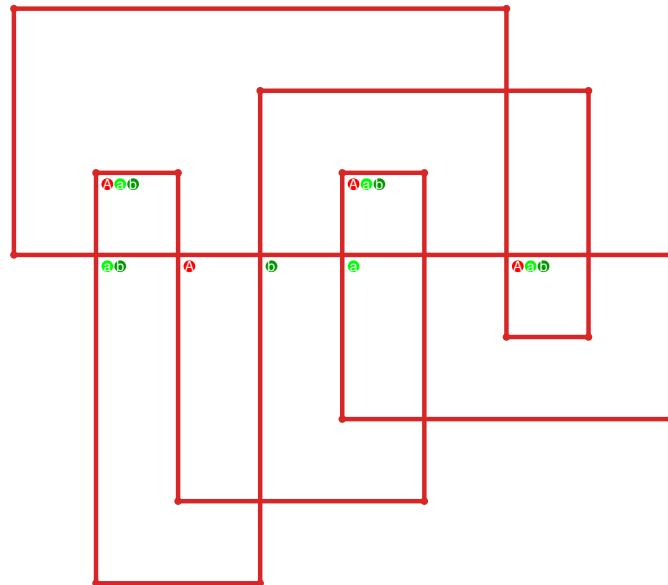


Figure 959: `SnapPy` multiloop plot.

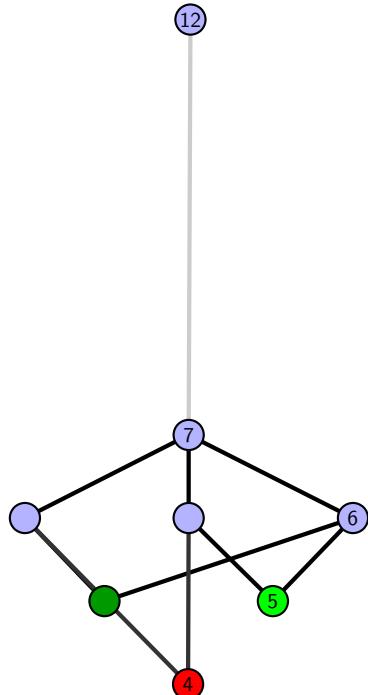


Figure 960: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.183 [[20, 9, 1, 10], [10, 19, 11, 20], [11, 8, 12, 9], [1, 5, 2, 4], [18, 3, 19, 4], [14, 7, 15, 8], [12, 6, 13, 5], [2, 17, 3, 18], [13, 16, 14, 17], [6, 15, 7, 16]]

PD code drawn by `SnapPy`: [(15, 20, 16, 1), (1, 18, 2, 19), (2, 9, 3, 10), (11, 4, 12, 5), (8, 5, 9, 6), (17, 6, 18, 7), (3, 12, 4, 13), (10, 13, 11, 14), (19, 14, 20, 15), (7, 16, 8, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 7, 4], [1, 3, 7, 7], [2, 8, 9, 9], [2, 9, 8, 3], [3, 8, 4, 4], [5, 7, 6, 9], [5, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.42

Total pinning sets: 352

Average overall degree: 3.04

Pinning number: 4

Table 479: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	39	81	100	76	35	9	1	349
Average degree	2.25	2.56	2.79	2.95	3.08	3.17	3.24	3.29	3.33	

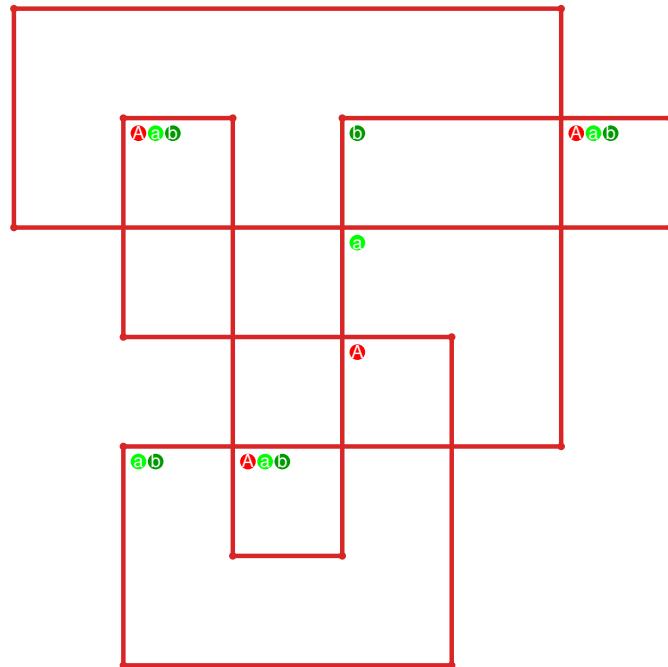


Figure 961: `SnapPy` multiloop plot.

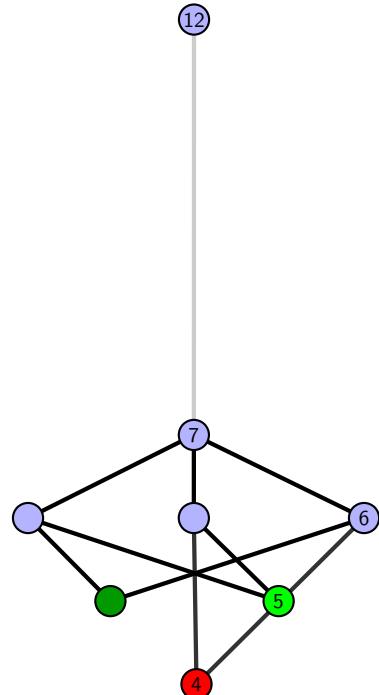


Figure 962: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.184 [[20, 17, 1, 18], [18, 3, 19, 4], [4, 19, 5, 20], [5, 16, 6, 17], [1, 13, 2, 12], [2, 11, 3, 12], [8, 15, 9, 16], [6, 14, 7, 13], [7, 10, 8, 11], [14, 9, 15, 10]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (11, 6, 12, 7), (4, 7, 5, 8), (19, 8, 20, 9), (9, 18, 10, 19), (10, 3, 11, 4), (5, 12, 6, 13), (2, 13, 3, 14), (17, 14, 18, 15), (1, 16, 2, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 2, 2], [0, 1, 1, 3], [0, 2, 6, 7], [0, 7, 5, 5], [1, 4, 4, 8], [3, 8, 9, 9], [3, 9, 8, 4], [5, 7, 9, 6], [6, 8, 7, 6]]

Total optimal pinning sets: 4

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.4

Total pinning sets: 288

Average overall degree: 3.03

Pinning number: 5

Table 480: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

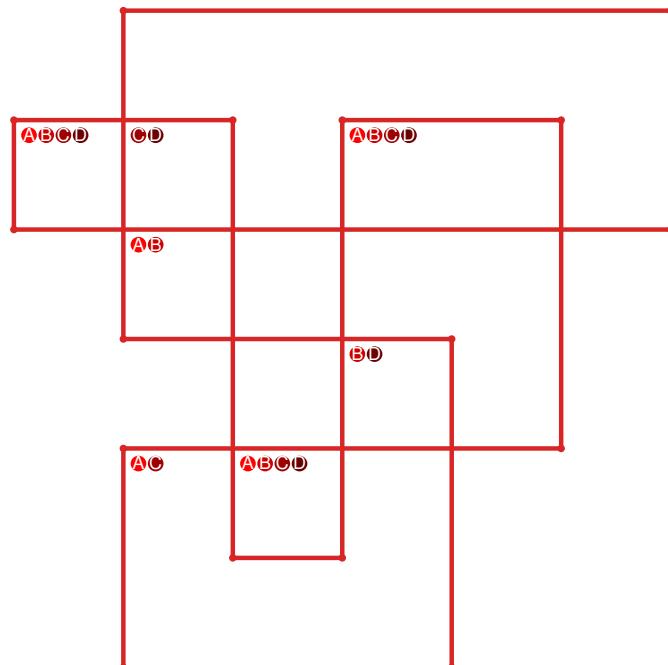


Figure 963: SnapPy multiloop plot.

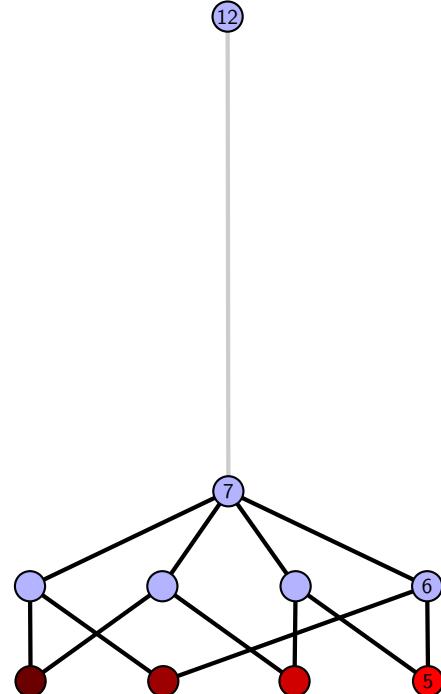


Figure 964: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.185 $[[4, 20, 1, 5], [5, 3, 6, 4], [6, 19, 7, 20], [1, 11, 2, 12], [12, 2, 13, 3], [18, 7, 19, 8], [10, 17, 11, 18], [13, 17, 14, 16], [8, 16, 9, 15], [9, 14, 10, 15]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (14, 1, 15, 2), (11, 16, 12, 17), (3, 20, 4, 5), (18, 7, 19, 8), (8, 17, 9, 18), (9, 6, 10, 7), (19, 10, 20, 11), (15, 12, 16, 13), (2, 13, 3, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 4, 4], [1, 3, 3, 7], [2, 8, 6, 2], [3, 5, 9, 7], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 481: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

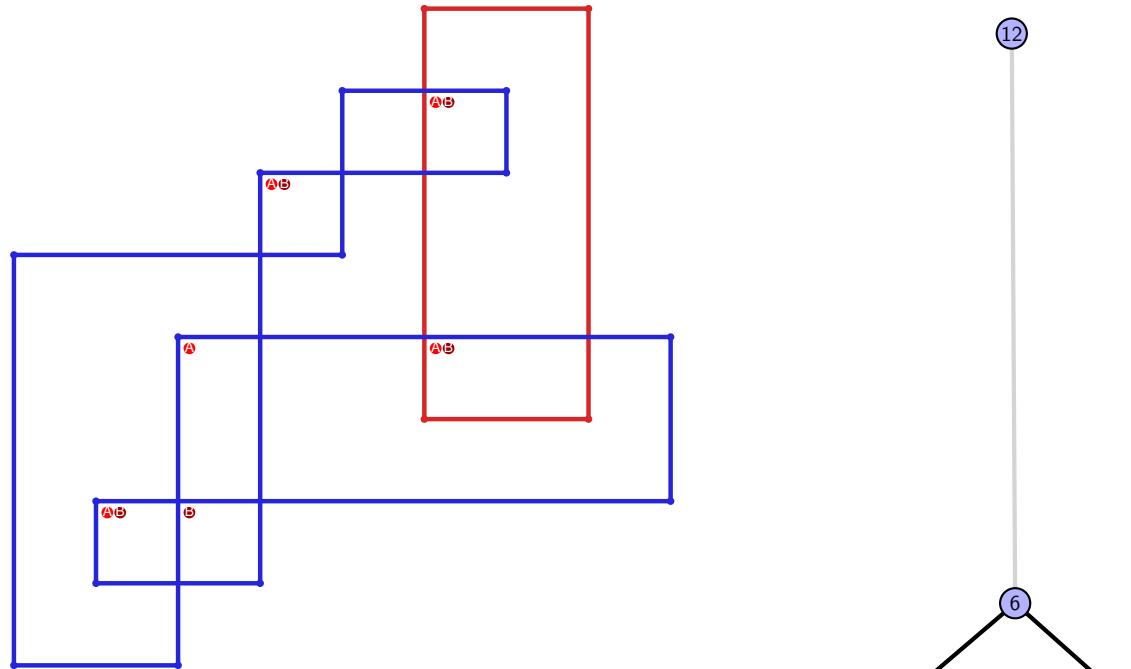


Figure 965: SnapPy multiloop plot.

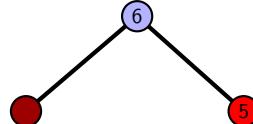


Figure 966: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.186 $[[4, 20, 1, 5], [5, 3, 6, 4], [6, 19, 7, 20], [1, 13, 2, 14], [14, 2, 15, 3], [9, 18, 10, 19], [7, 12, 8, 13], [15, 8, 16, 9], [17, 10, 18, 11], [11, 16, 12, 17]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (12, 1, 13, 2), (6, 15, 7, 16), (8, 17, 9, 18), (14, 19, 15, 20), (3, 20, 4, 5), (18, 7, 19, 8), (16, 9, 17, 10), (13, 10, 14, 11), (2, 11, 3, 12)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 4, 4], [1, 3, 3, 7], [2, 7, 8, 8], [2, 9, 7, 3], [4, 6, 9, 5], [5, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 482: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

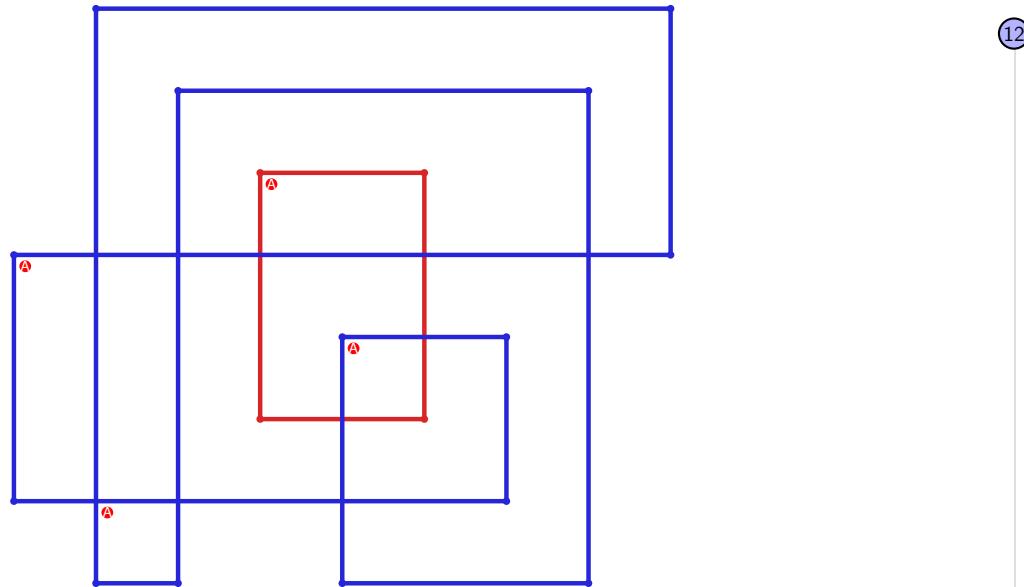


Figure 967: `SnapPy` multiloop plot.

4

Figure 968: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.187 $[[4, 8, 1, 5], [5, 3, 6, 4], [7, 20, 8, 9], [1, 13, 2, 14], [14, 2, 15, 3], [6, 10, 7, 9], [12, 19, 13, 20], [15, 19, 16, 18], [10, 18, 11, 17], [11, 16, 12, 17]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (18, 1, 19, 2), (2, 17, 3, 18), (3, 16, 4, 5), (14, 7, 15, 8), (8, 13, 9, 14), (9, 6, 10, 7), (15, 10, 16, 11), (20, 11, 17, 12), (12, 19, 13, 20)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 6, 4, 4], [1, 3, 3, 7], [1, 8, 2, 2], [2, 9, 7, 3], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 483: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

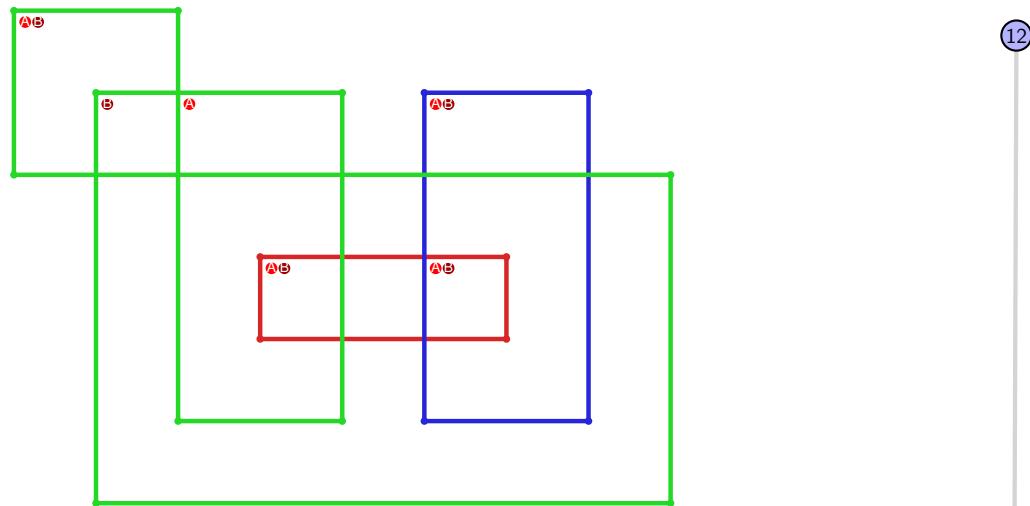


Figure 969: `SnapPy` multiloop plot.

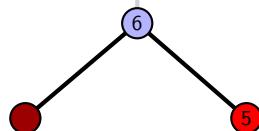


Figure 970: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.188 $[[11, 20, 12, 1], [19, 10, 20, 11], [12, 10, 13, 9], [1, 16, 2, 17], [3, 18, 4, 19], [13, 7, 14, 6], [15, 8, 16, 9], [2, 18, 3, 17], [4, 8, 5, 7], [14, 5, 15, 6]]$

PD code drawn by SnapPy: $[(12, 3, 13, 4), (4, 11, 5, 12), (5, 2, 6, 3), (13, 6, 14, 7), (7, 10, 8, 11), (17, 8, 18, 9), (19, 14, 20, 15), (15, 20, 16, 1), (1, 16, 2, 17), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 7, 7], [1, 7, 7, 8], [2, 8, 9, 9], [2, 9, 8, 3], [3, 4, 4, 3], [4, 6, 9, 5], [5, 8, 6, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 484: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

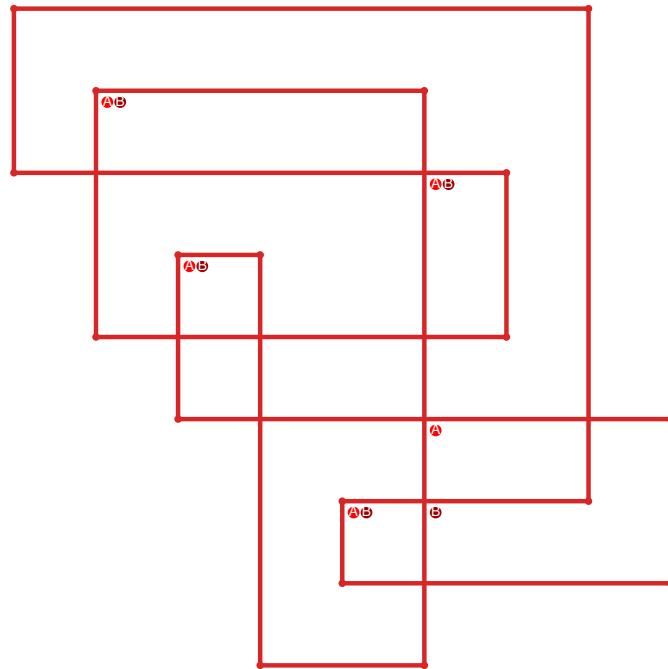


Figure 971: SnapPy multiloop plot.

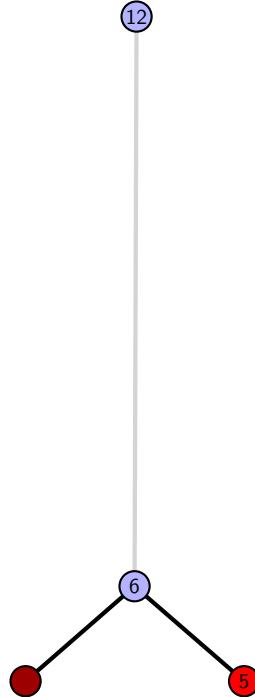


Figure 972: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.189 $[[4, 12, 1, 5], [5, 3, 6, 4], [8, 11, 9, 12], [1, 13, 2, 20], [2, 19, 3, 20], [6, 14, 7, 15], [15, 7, 16, 8], [16, 10, 17, 11], [9, 17, 10, 18], [13, 18, 14, 19]]$

PD code drawn by SnapPy: $[(6, 3, 7, 4), (17, 8, 18, 9), (18, 11, 19, 12), (9, 12, 10, 5), (4, 5, 1, 6), (10, 19, 11, 20), (15, 20, 16, 13), (2, 13, 3, 14), (14, 1, 15, 2), (7, 16, 8, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 7, 8], [0, 9, 4, 4], [1, 3, 3, 9], [1, 9, 6, 6], [2, 5, 5, 7], [2, 6, 8, 8], [2, 7, 7, 9], [3, 8, 5, 4]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 485: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

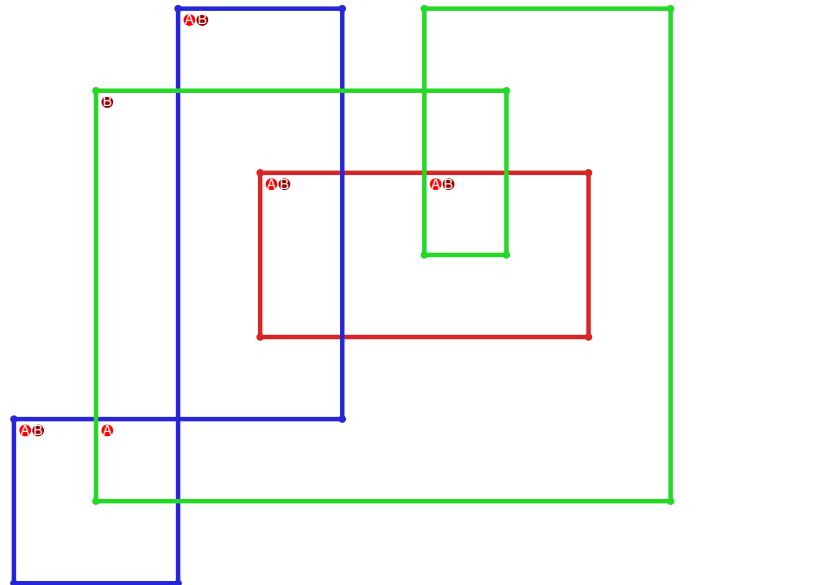


Figure 973: SnapPy multiloop plot.

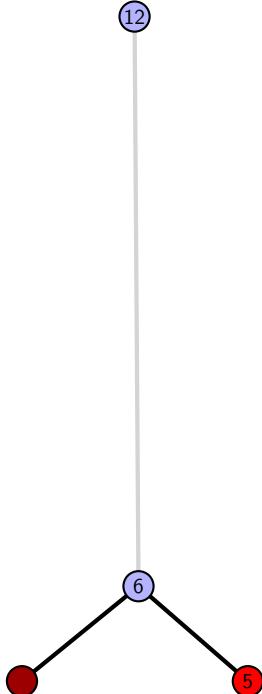


Figure 974: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.190 `[[16, 20, 1, 17], [17, 12, 18, 11], [15, 6, 16, 7], [19, 1, 20, 2], [12, 19, 13, 18], [13, 10, 14, 11], [7, 14, 8, 15], [5, 2, 6, 3], [9, 4, 10, 5], [8, 4, 9, 3]]`

PD code drawn by `SnapPy`: `[(3, 16, 4, 1), (1, 6, 2, 7), (7, 2, 8, 3), (13, 4, 14, 5), (11, 8, 12, 9), (9, 20, 10, 17), (5, 12, 6, 13), (18, 15, 19, 16), (17, 10, 18, 11), (14, 19, 15, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 4, 0], [1, 3, 5, 1], [1, 4, 8, 6], [2, 5, 9, 2], [2, 9, 8, 3], [5, 7, 9, 9], [6, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 486: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

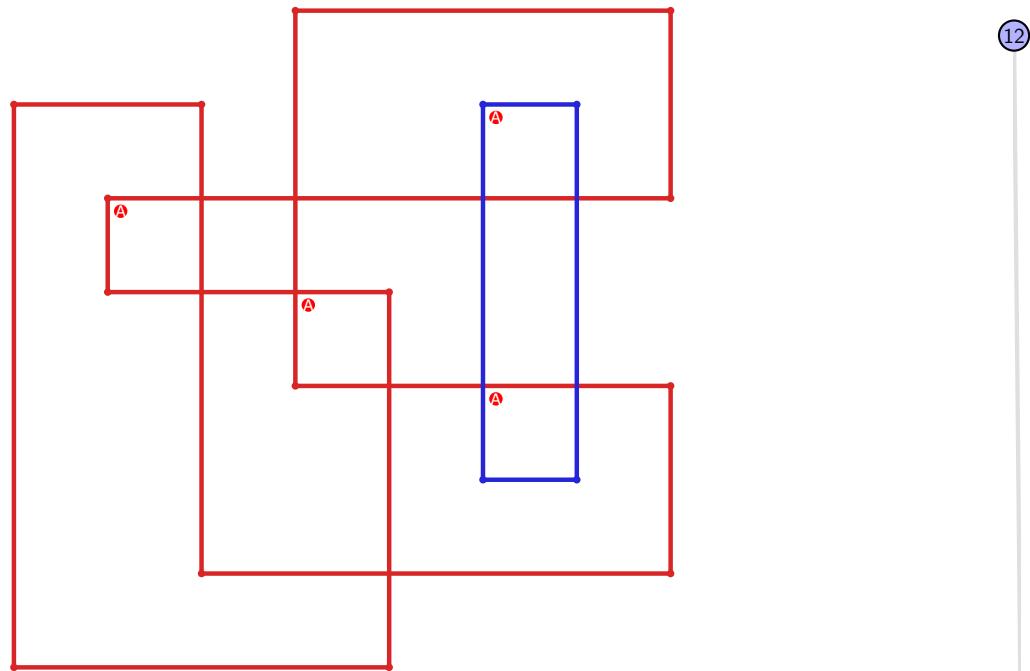


Figure 975: `SnapPy` multiloop plot.

Figure 976: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.191 $[[16, 20, 1, 17], [17, 11, 18, 12], [15, 8, 16, 9], [19, 1, 20, 2], [10, 18, 11, 19], [12, 10, 13, 9], [5, 14, 6, 15], [7, 2, 8, 3], [13, 4, 14, 5], [6, 4, 7, 3]]$

PD code drawn by SnapPy: $[(5, 16, 6, 1), (1, 4, 2, 5), (11, 2, 12, 3), (13, 6, 14, 7), (7, 10, 8, 11), (20, 9, 17, 10), (3, 12, 4, 13), (18, 15, 19, 16), (8, 17, 9, 18), (14, 19, 15, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 4, 0], [1, 3, 5, 1], [1, 4, 8, 2], [2, 8, 8, 9], [2, 9, 9, 3], [5, 9, 6, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 487: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

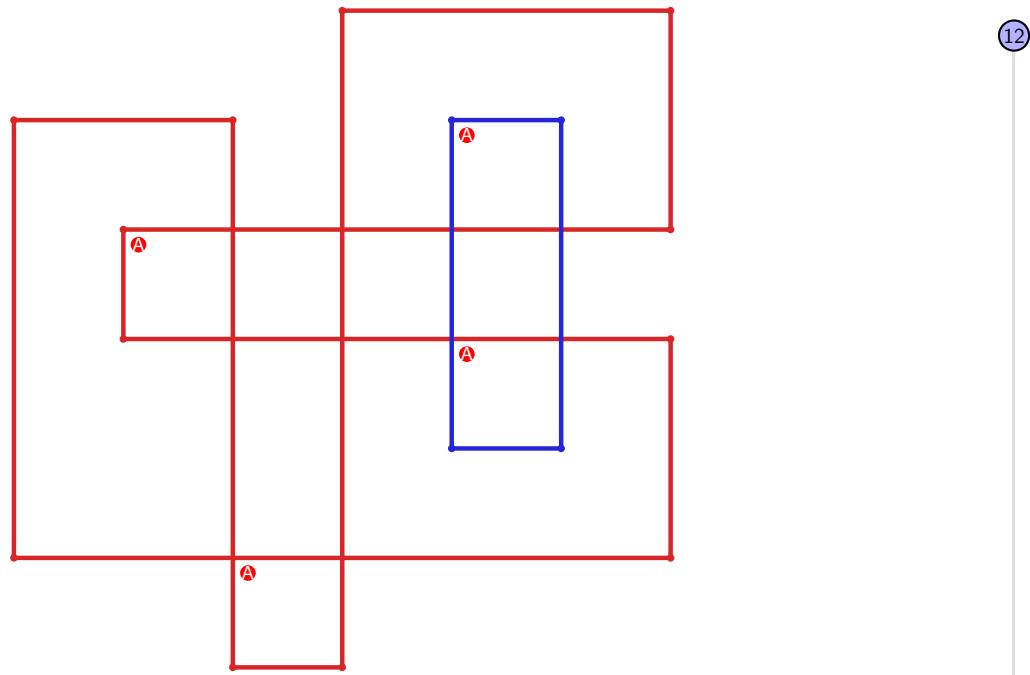


Figure 977: SnapPy multiloop plot.

Figure 978: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.192 $[[8, 12, 1, 9], [9, 13, 10, 20], [15, 7, 16, 8], [11, 1, 12, 2], [13, 11, 14, 10], [14, 19, 15, 20], [6, 3, 7, 4], [16, 3, 17, 2], [18, 4, 19, 5], [5, 17, 6, 18]]$

PD code drawn by `SnapPy`: $[(8, 9, 1, 10), (4, 1, 5, 2), (11, 2, 12, 3), (16, 5, 9, 6), (20, 7, 17, 8), (19, 14, 20, 15), (6, 17, 7, 18), (3, 10, 4, 11), (15, 12, 16, 13), (13, 18, 14, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 4, 0], [1, 3, 5, 1], [1, 4, 8, 2], [2, 8, 9, 7], [2, 6, 9, 3], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 488: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

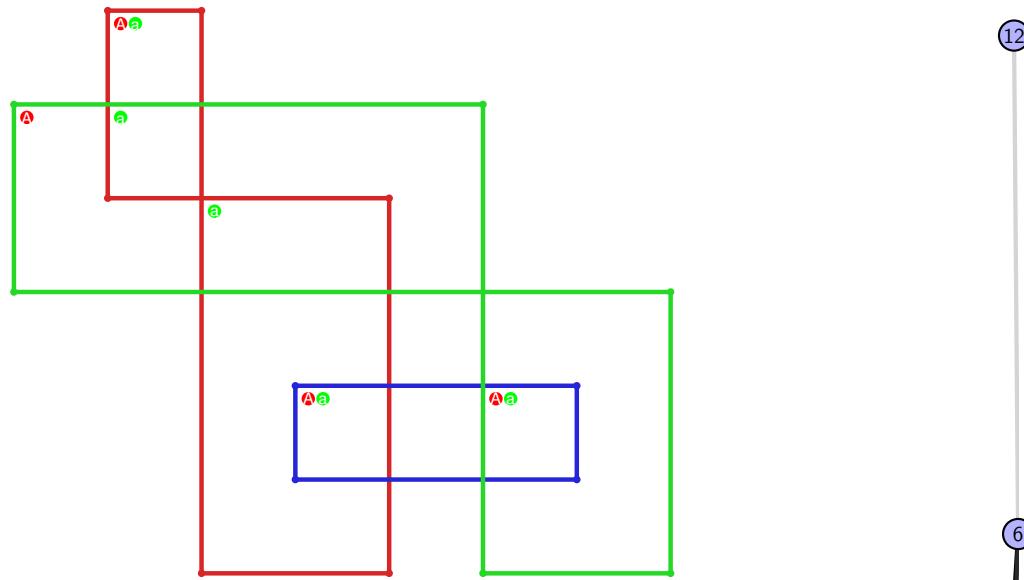


Figure 979: `SnapPy` multiloop plot.



Figure 980: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.193 $[[3, 12, 4, 1], [2, 20, 3, 13], [11, 4, 12, 5], [1, 14, 2, 13], [14, 19, 15, 20], [5, 15, 6, 16], [7, 10, 8, 11], [8, 18, 9, 19], [6, 17, 7, 16], [17, 9, 18, 10]]$

PD code drawn by SnapPy: $[(9, 2, 10, 3), (18, 7, 19, 8), (5, 8, 6, 9), (1, 10, 2, 11), (3, 16, 4, 17), (17, 4, 18, 5), (6, 19, 7, 20), (15, 20, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 5], [2, 4, 8, 8], [2, 8, 9, 7], [4, 6, 9, 9], [5, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 489: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

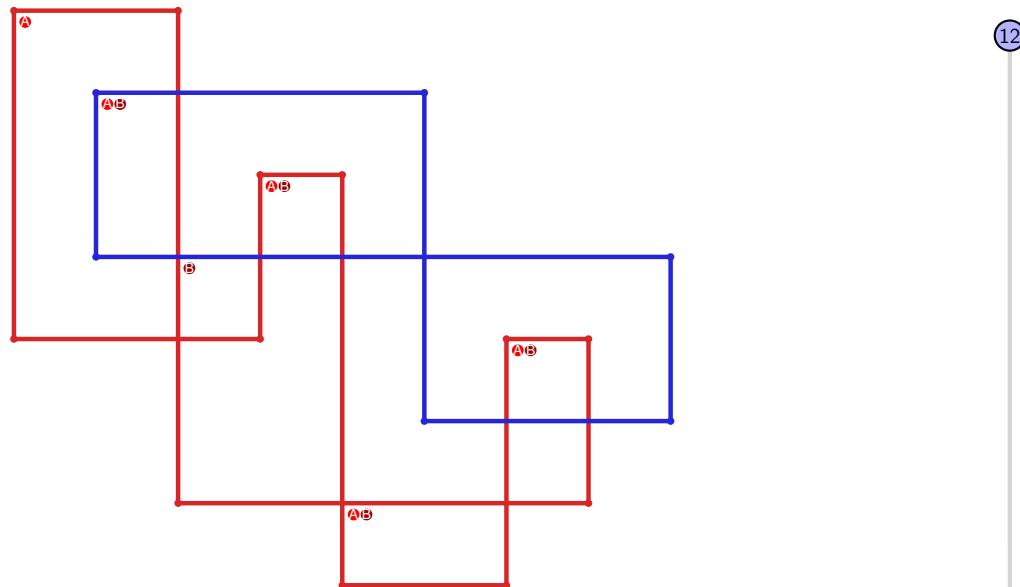


Figure 981: SnapPy multiloop plot.

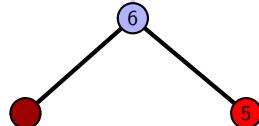


Figure 982: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.194 $[[13, 20, 14, 1], [12, 9, 13, 10], [4, 19, 5, 20], [14, 18, 15, 17], [1, 11, 2, 10], [2, 11, 3, 12], [3, 8, 4, 9], [18, 5, 19, 6], [15, 6, 16, 7], [7, 16, 8, 17]]$

PD code drawn by SnapPy: $[(15, 2, 16, 3), (12, 3, 13, 4), (20, 5, 1, 6), (9, 6, 10, 7), (7, 18, 8, 19), (19, 8, 20, 9), (4, 13, 5, 14), (14, 11, 15, 12), (1, 16, 2, 17), (10, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 7, 8, 9], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 9, 2], [2, 8, 3, 2], [3, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 6

Total pinning sets: 232

Pinning number: 5

Average optimal degree: 2.4

Average minimal degree: 2.54

Average overall degree: 3.04

Table 490: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	5
Nonminimal pinning sets	0	7	42	70	64	33	9	1	226
Average degree	2.4	2.62	2.85	3.02	3.14	3.23	3.29	3.33	

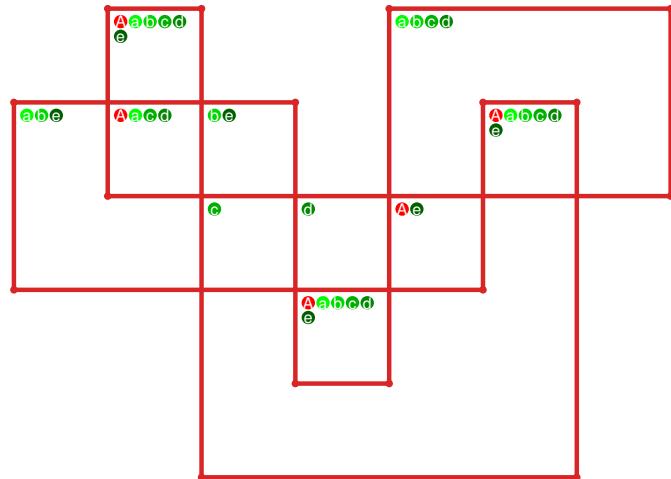


Figure 983: SnapPy multiloop plot.

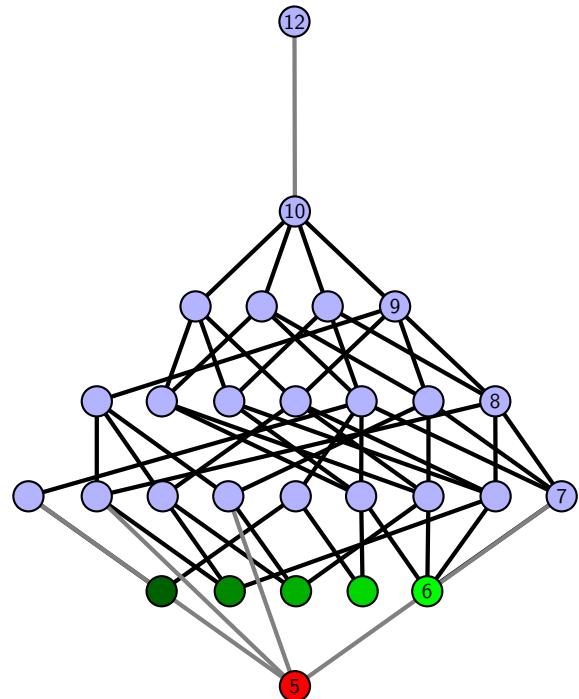


Figure 984: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.195 $[[3, 10, 4, 1], [2, 20, 3, 11], [9, 17, 10, 18], [4, 8, 5, 7], [1, 12, 2, 11], [12, 19, 13, 20], [18, 13, 19, 14], [16, 8, 17, 9], [5, 16, 6, 15], [6, 14, 7, 15]]$

PD code drawn by `SnapPy`: $[(5, 2, 6, 3), (17, 6, 18, 7), (1, 8, 2, 9), (19, 14, 20, 15), (4, 15, 5, 16), (16, 3, 17, 4), (7, 18, 8, 19), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 8, 9], [0, 5, 1, 1], [1, 4, 6, 6], [2, 5, 5, 9], [2, 8, 3, 2], [3, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 491: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

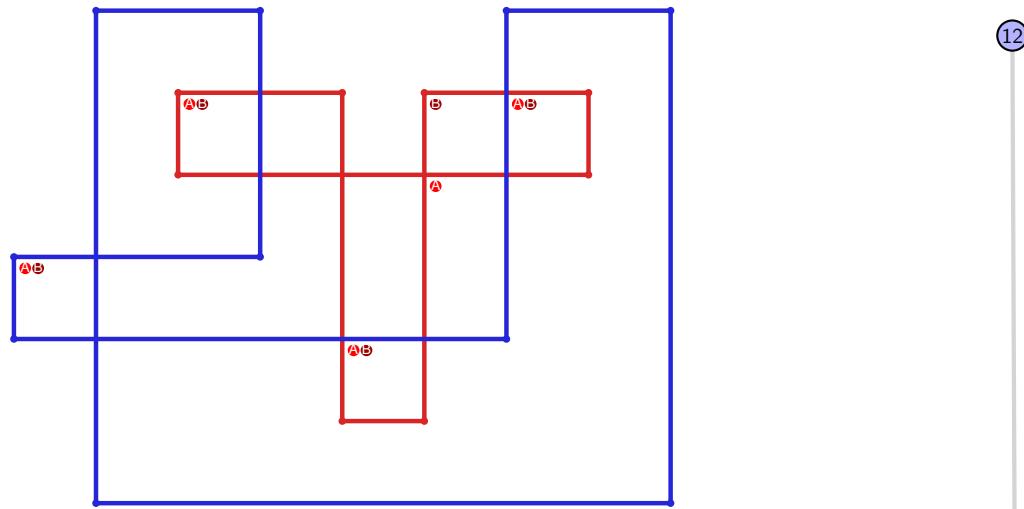


Figure 985: `SnapPy` multiloop plot.

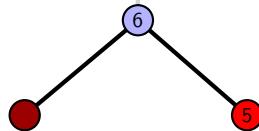


Figure 986: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.196 $[[3, 20, 4, 1], [2, 9, 3, 10], [12, 19, 13, 20], [4, 18, 5, 17], [1, 11, 2, 10], [11, 8, 12, 9], [18, 13, 19, 14], [5, 14, 6, 15], [7, 16, 8, 17], [6, 16, 7, 15]]$

PD code drawn by `SnapPy`: $[(9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (16, 11, 17, 12), (3, 12, 4, 13), (13, 4, 14, 5), (5, 14, 6, 15), (15, 2, 16, 3), (10, 17, 11, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 7, 3, 2], [3, 6, 9, 9], [3, 9, 9, 5], [7, 8, 8, 7]]$

Total optimal pinning sets: 4

Average optimal degree: 2.3

Total minimal pinning sets: 4

Average minimal degree: 2.3

Total pinning sets: 240

Average overall degree: 2.98

Pinning number: 5

Table 492: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.3	2.62	2.84	3.0	3.11	3.2	3.27	3.33	

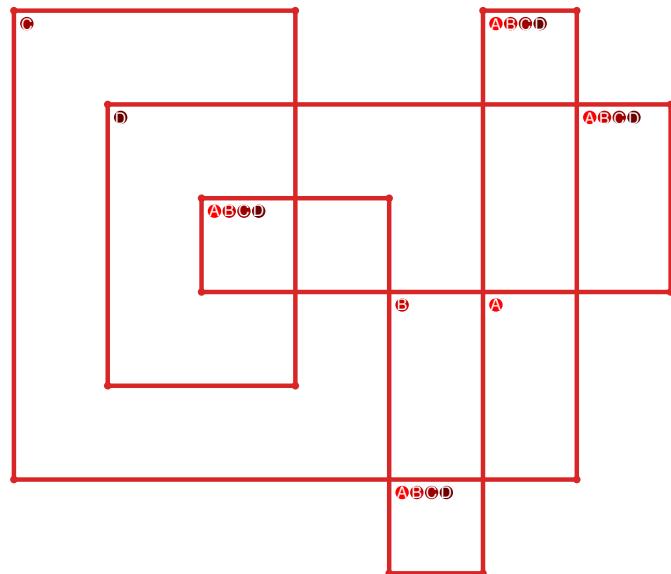


Figure 987: `SnapPy` multiloop plot.

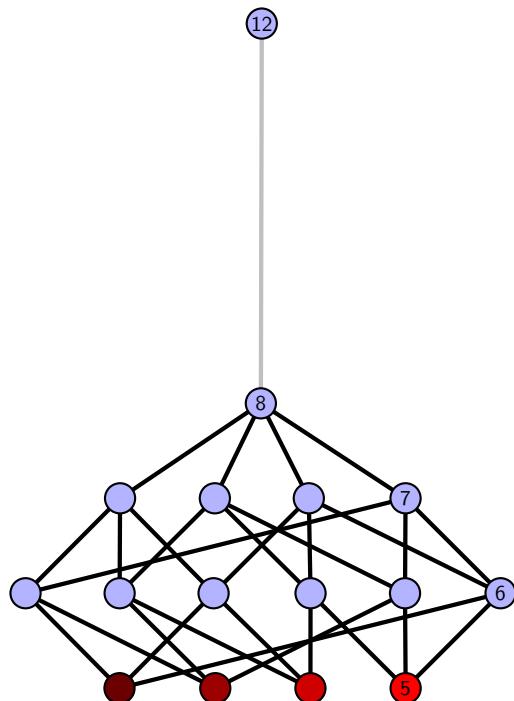


Figure 988: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.197 $[[3, 10, 4, 1], [2, 14, 3, 11], [9, 20, 10, 15], [4, 8, 5, 7], [1, 12, 2, 11], [13, 15, 14, 16], [19, 8, 20, 9], [5, 19, 6, 18], [6, 17, 7, 18], [12, 17, 13, 16]]$

PD code drawn by `SnapPy`: $[(5, 2, 6, 3), (17, 6, 18, 7), (1, 8, 2, 9), (10, 11, 1, 12), (12, 9, 13, 10), (16, 3, 17, 4), (7, 18, 8, 19), (14, 19, 11, 20), (20, 13, 15, 14), (4, 15, 5, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 8], [0, 9, 1, 1], [1, 9, 9, 2], [2, 7, 3, 2], [3, 6, 8, 8], [3, 7, 7, 9], [4, 8, 5, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 493: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

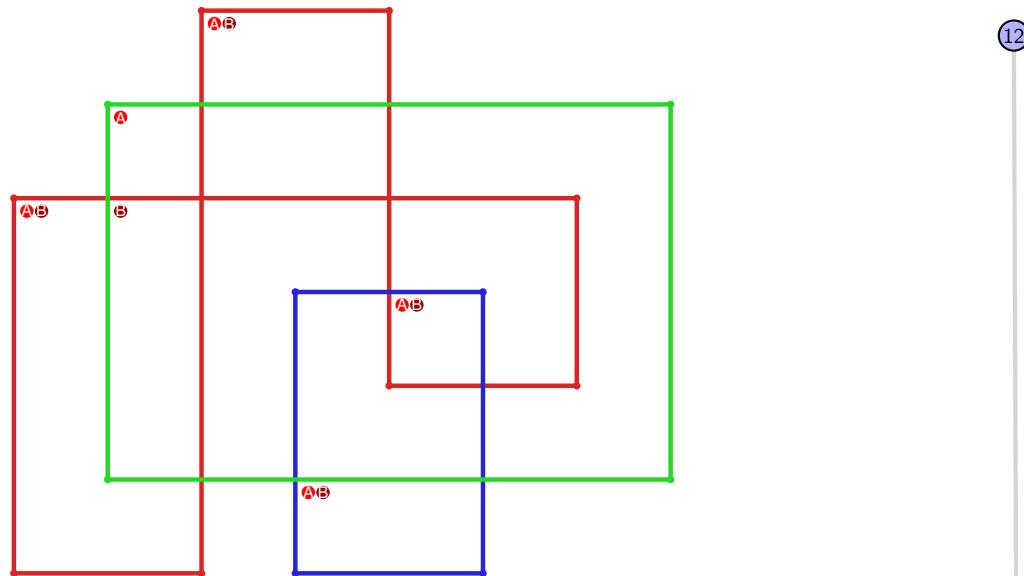


Figure 989: `SnapPy` multiloop plot.

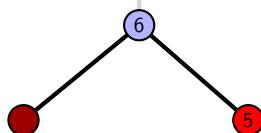


Figure 990: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.198 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 10, 20, 11], [4, 8, 5, 7], [1, 12, 2, 13], [14, 12, 15, 11], [9, 18, 10, 19], [8, 18, 9, 17], [5, 17, 6, 16], [6, 15, 7, 16]]$

PD code drawn by SnapPy: $[(1, 18, 2, 19), (13, 4, 14, 5), (5, 8, 6, 9), (15, 6, 16, 7), (20, 9, 1, 10), (10, 19, 11, 20), (11, 2, 12, 3), (3, 12, 4, 13), (17, 14, 18, 15), (7, 16, 8, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 7, 8, 9], [0, 5, 1, 1], [1, 4, 9, 2], [2, 7, 7, 2], [3, 6, 6, 8], [3, 7, 9, 9], [3, 8, 8, 5]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 494: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

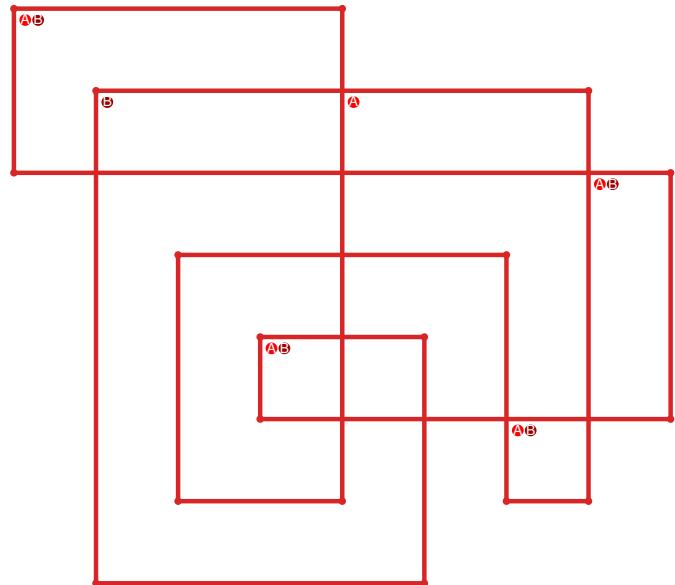


Figure 991: SnapPy multiloop plot.

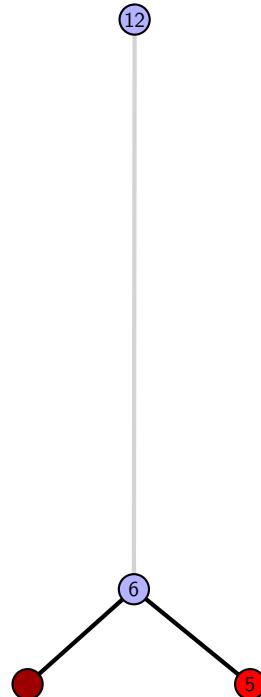


Figure 992: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.199 $[[3, 20, 4, 1], [2, 15, 3, 16], [10, 19, 11, 20], [4, 8, 5, 7], [1, 17, 2, 16], [17, 14, 18, 15], [18, 9, 19, 10], [11, 9, 12, 8], [5, 12, 6, 13], [13, 6, 14, 7]]$

PD code drawn by `SnapPy`: $[(11, 4, 12, 5), (5, 2, 6, 3), (6, 9, 7, 10), (16, 7, 17, 8), (3, 10, 4, 11), (15, 12, 16, 13), (20, 13, 1, 14), (14, 19, 15, 20), (8, 17, 9, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 9], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 7, 2], [2, 6, 8, 3], [3, 7, 9, 9], [3, 8, 8, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 384

Average overall degree: 3.03

Pinning number: 4

Table 495: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

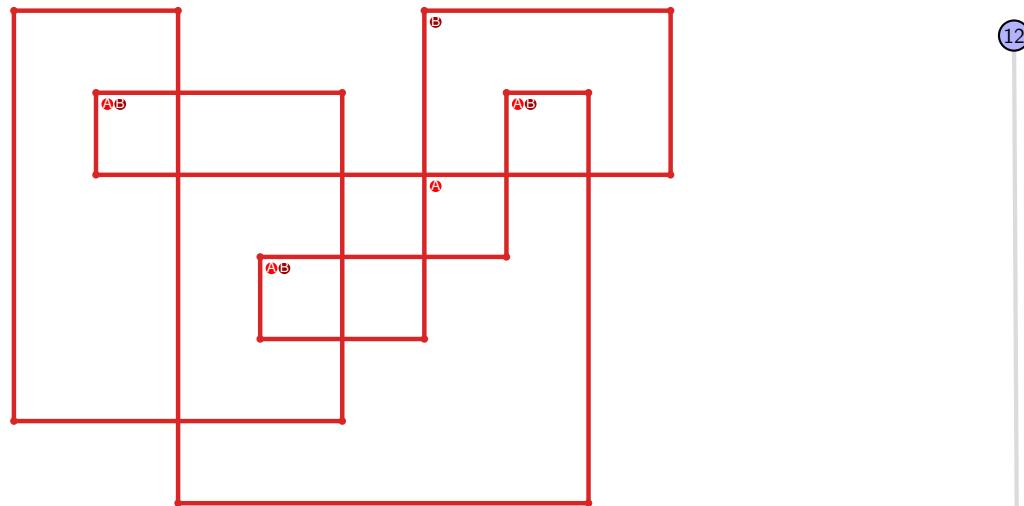


Figure 993: `SnapPy` multiloop plot.

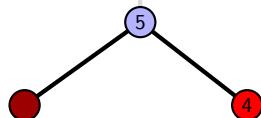


Figure 994: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.200 [[3, 12, 4, 1], [2, 20, 3, 13], [15, 11, 16, 12], [4, 10, 5, 9], [1, 14, 2, 13], [14, 19, 15, 20], [10, 16, 11, 17], [5, 8, 6, 9], [6, 18, 7, 19], [17, 7, 18, 8]]

PD code drawn by SnapPy: [(18, 5, 19, 6), (3, 6, 4, 7), (7, 2, 8, 3), (16, 9, 17, 10), (1, 10, 2, 11), (8, 17, 9, 18), (4, 19, 5, 20), (15, 20, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 9, 3, 2], [3, 9, 8, 3], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 5
Total minimal pinning sets: 5
Total pinning sets: 248
Pinning number: 5

Average optimal degree: 2.32
Average minimal degree: 2.32
Average overall degree: 2.97

Table 496: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	25	55	70	56	28	8	1	243
Average degree	2.32	2.64	2.85	3.0	3.11	3.2	3.27	3.33	

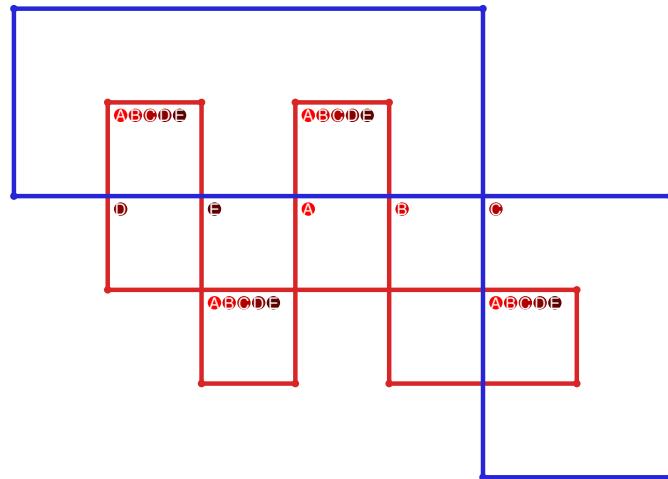


Figure 995: SnapPy multiloop plot.

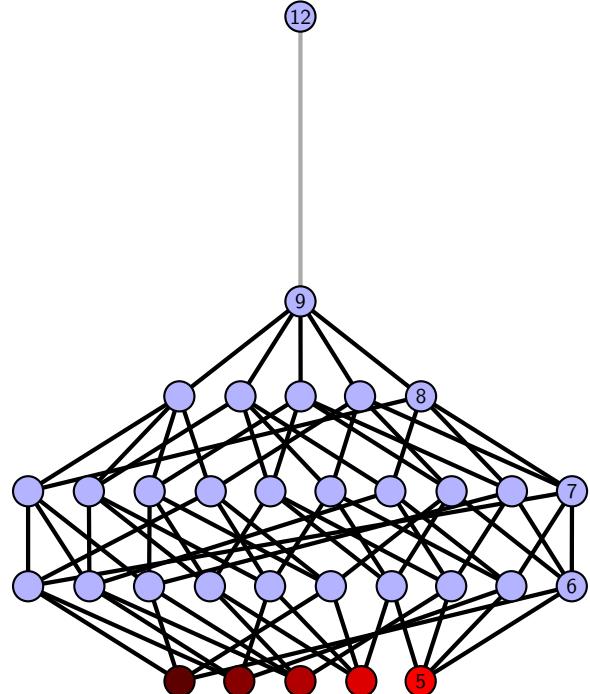


Figure 996: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.201 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 10, 20, 11], [4, 18, 5, 17], [1, 12, 2, 13], [14, 12, 15, 11], [9, 18, 10, 19], [5, 9, 6, 8], [16, 7, 17, 8], [15, 7, 16, 6]]$

PD code drawn by `SnapPy`: $[(2, 11, 3, 12), (12, 3, 13, 4), (4, 1, 5, 2), (15, 6, 16, 7), (7, 10, 8, 11), (17, 8, 18, 9), (13, 20, 14, 1), (5, 14, 6, 15), (19, 16, 20, 17), (9, 18, 10, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 8], [0, 5, 1, 1], [1, 4, 9, 2], [2, 7, 3, 2], [3, 6, 9, 8], [3, 7, 9, 9], [5, 8, 8, 7]]$

Total optimal pinning sets: 5
Total minimal pinning sets: 5
Total pinning sets: 304
Pinning number: 5

Average optimal degree: 2.48
Average minimal degree: 2.48
Average overall degree: 3.04

Table 497: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	28	67	89	71	34	9	1	299
Average degree	2.48	2.74	2.93	3.06	3.16	3.24	3.29	3.33	

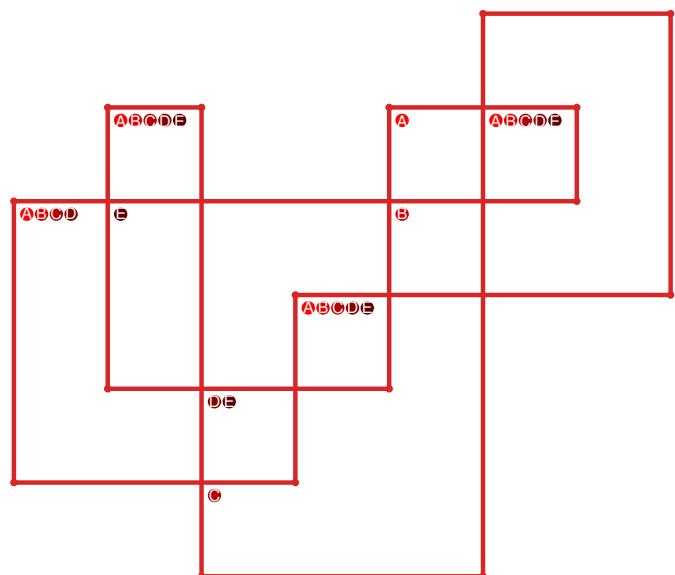


Figure 997: `SnapPy` multiloop plot.

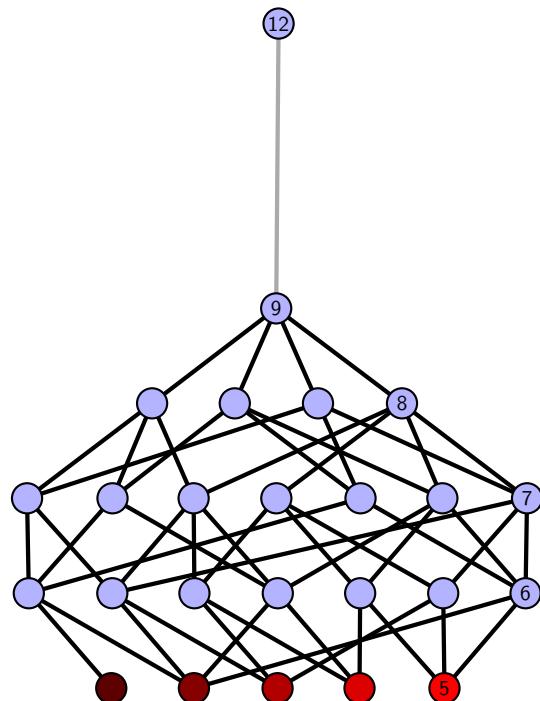


Figure 998: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.202 $[[3, 20, 4, 1], [9, 2, 10, 3], [19, 4, 20, 5], [1, 8, 2, 9], [10, 8, 11, 7], [5, 14, 6, 15], [15, 18, 16, 19], [11, 16, 12, 17], [13, 6, 14, 7], [17, 12, 18, 13]]$

PD code drawn by SnapPy: $[(7, 20, 8, 1), (17, 2, 18, 3), (11, 4, 12, 5), (5, 8, 6, 9), (19, 6, 20, 7), (15, 10, 16, 11), (3, 12, 4, 13), (9, 14, 10, 15), (13, 16, 14, 17), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 8], [2, 8, 8, 6], [2, 5, 9, 7], [4, 6, 9, 9], [4, 9, 5, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 498: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

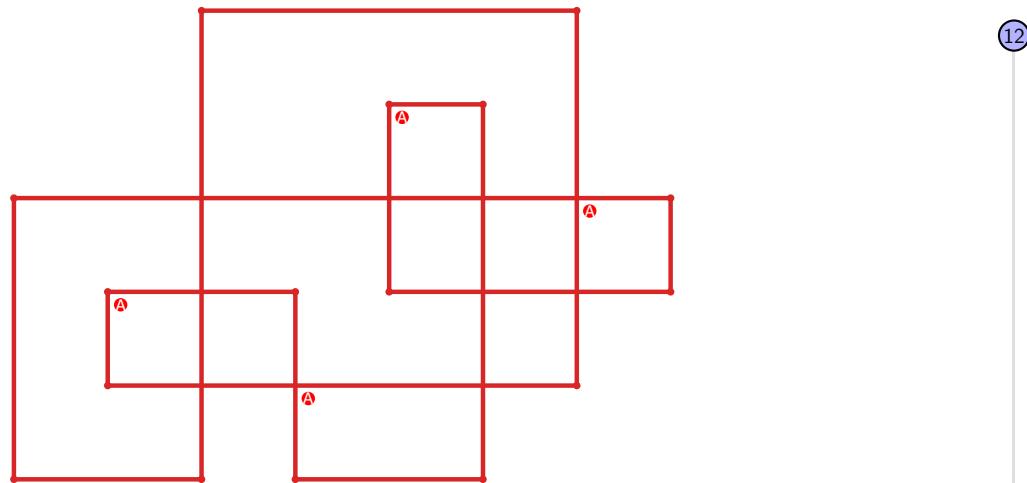


Figure 999: SnapPy multiloop plot.

Figure 1000: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.203 $[[6, 20, 1, 7], [7, 10, 8, 11], [15, 5, 16, 6], [16, 19, 17, 20], [1, 9, 2, 10], [8, 2, 9, 3], [11, 3, 12, 4], [4, 14, 5, 15], [18, 13, 19, 14], [17, 13, 18, 12]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (11, 2, 12, 3), (18, 5, 19, 6), (4, 19, 5, 20), (17, 20, 18, 7), (8, 13, 9, 14), (14, 9, 15, 10), (1, 10, 2, 11), (12, 15, 13, 16), (3, 16, 4, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 3], [0, 2, 8, 9], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 9, 7], [2, 6, 8, 2], [3, 7, 9, 9], [3, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 499: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

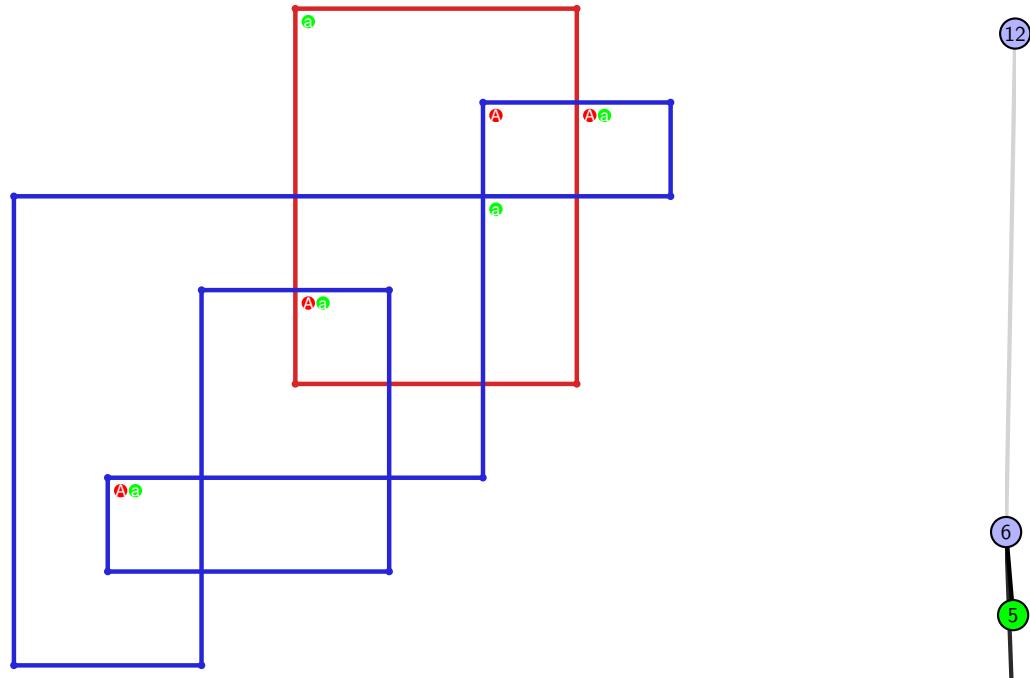


Figure 1001: SnapPy multiloop plot.

Figure 1002: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.204 $[[3, 20, 4, 1], [15, 2, 16, 3], [19, 8, 20, 9], [4, 8, 5, 7], [1, 14, 2, 15], [16, 14, 17, 13], [9, 18, 10, 19], [5, 10, 6, 11], [11, 6, 12, 7], [17, 12, 18, 13]]$

PD code drawn by SnapPy: $[(13, 20, 14, 1), (9, 4, 10, 5), (5, 2, 6, 3), (17, 6, 18, 7), (3, 8, 4, 9), (15, 10, 16, 11), (11, 14, 12, 15), (19, 12, 20, 13), (7, 16, 8, 17), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 9, 9], [2, 9, 7, 2], [3, 6, 8, 8], [3, 7, 7, 9], [5, 8, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 500: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

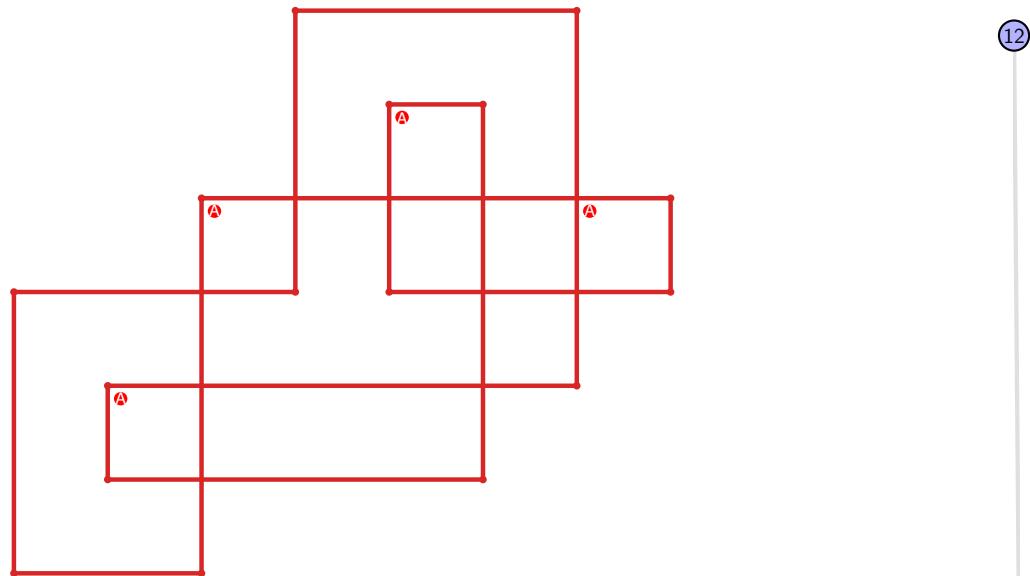


Figure 1003: SnapPy multiloop plot.



Figure 1004: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.205 $[[3, 16, 4, 1], [2, 20, 3, 17], [15, 8, 16, 9], [4, 8, 5, 7], [1, 18, 2, 17], [13, 19, 14, 20], [9, 14, 10, 15], [5, 10, 6, 11], [11, 6, 12, 7], [18, 12, 19, 13]]$

PD code drawn by SnapPy: $[(9, 4, 10, 5), (5, 2, 6, 3), (13, 6, 14, 7), (3, 8, 4, 9), (19, 10, 20, 11), (7, 12, 8, 13), (1, 14, 2, 15), (11, 20, 12, 17), (16, 17, 1, 18), (18, 15, 19, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 9, 1, 1], [1, 9, 9, 6], [2, 5, 7, 2], [3, 6, 8, 8], [3, 7, 7, 9], [4, 8, 5, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1
Total pinning sets: 256
Pinning number: 4

Average optimal degree: 2.0
Average minimal degree: 2.0
Average overall degree: 2.97

Table 501: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

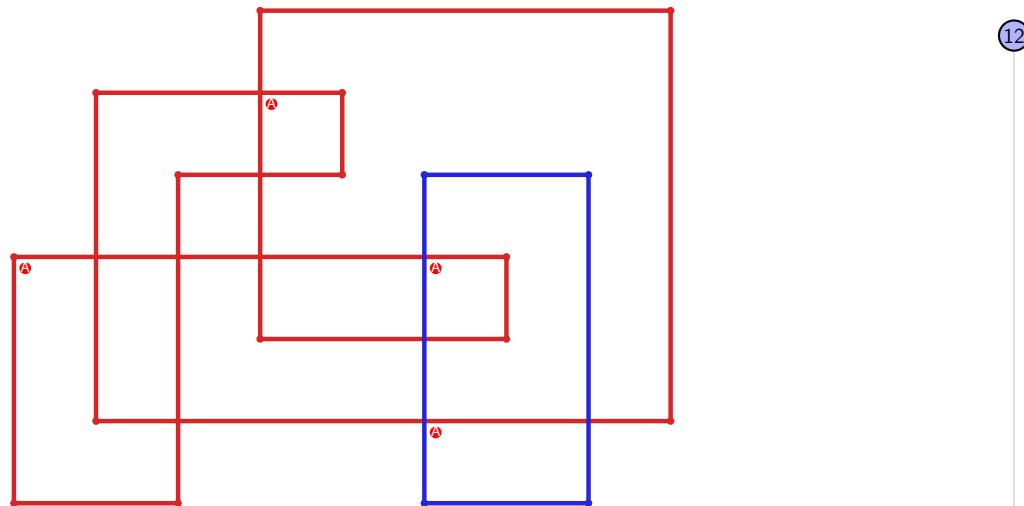


Figure 1005: SnapPy multiloop plot.

4

Figure 1006: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.206 $[[3, 12, 4, 1], [2, 20, 3, 13], [11, 8, 12, 9], [4, 8, 5, 7], [1, 14, 2, 13], [14, 19, 15, 20], [9, 15, 10, 16], [16, 10, 17, 11], [5, 17, 6, 18], [18, 6, 19, 7]]$

PD code drawn by SnapPy: $[(19, 4, 20, 5), (5, 2, 6, 3), (9, 6, 10, 7), (17, 8, 18, 9), (1, 10, 2, 11), (7, 16, 8, 17), (3, 18, 4, 19), (15, 20, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 8, 9], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 7, 7], [2, 6, 6, 8], [3, 7, 9, 9], [3, 8, 8, 5]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 432
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.51
 Average overall degree: 3.06

Table 502: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	0	7
Nonminimal pinning sets	0	8	58	109	120	83	36	9	1	424
Average degree	2.5	2.64	2.84	3.0	3.1	3.18	3.24	3.29	3.33	

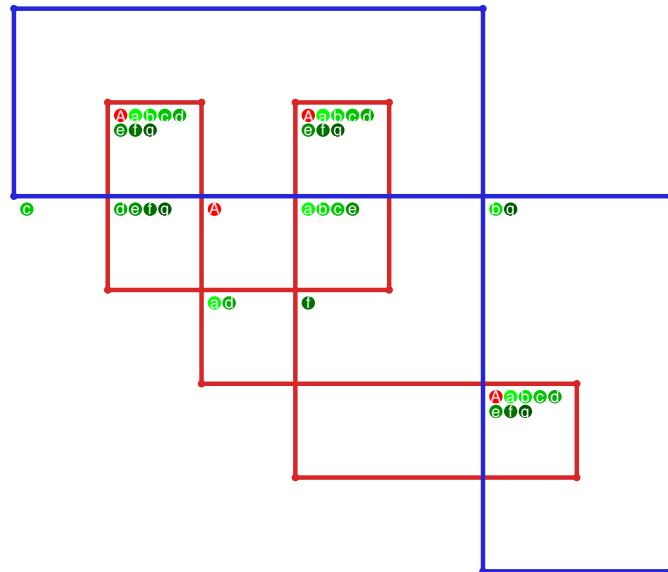


Figure 1007: SnapPy multiloop plot.

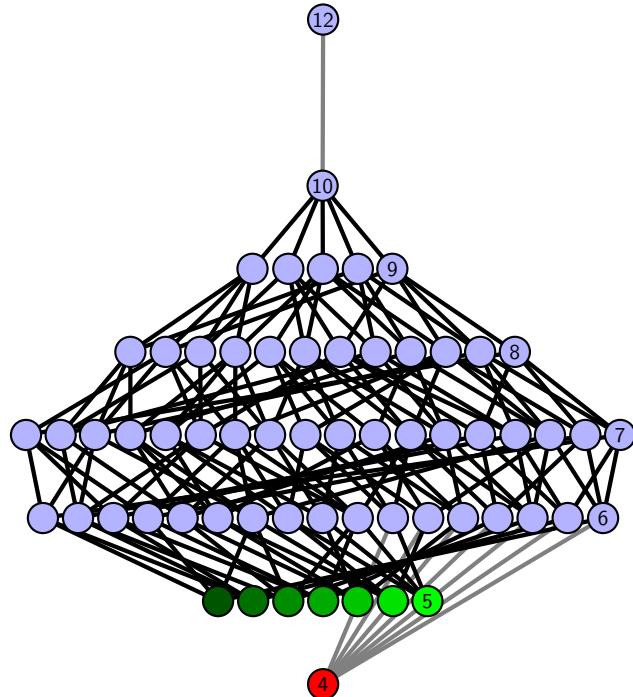


Figure 1008: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.207 `[[3, 10, 4, 1], [2, 20, 3, 11], [9, 15, 10, 16], [4, 8, 5, 7], [1, 12, 2, 11], [12, 19, 13, 20], [16, 13, 17, 14], [14, 8, 15, 9], [5, 17, 6, 18], [18, 6, 19, 7]]`

PD code drawn by `SnapPy`: `[(19, 4, 20, 5), (5, 2, 6, 3), (15, 6, 16, 7), (1, 8, 2, 9), (17, 14, 18, 15), (7, 16, 8, 17), (3, 18, 4, 19), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 8, 9], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 8, 7], [2, 6, 3, 2], [3, 6, 9, 9], [3, 8, 8, 5]]`

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 448
 Pinning number: 4

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 3.05

Table 503: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	21	64	111	120	83	36	9	1	445
Average degree	2.33	2.65	2.85	3.0	3.1	3.18	3.24	3.29	3.33	

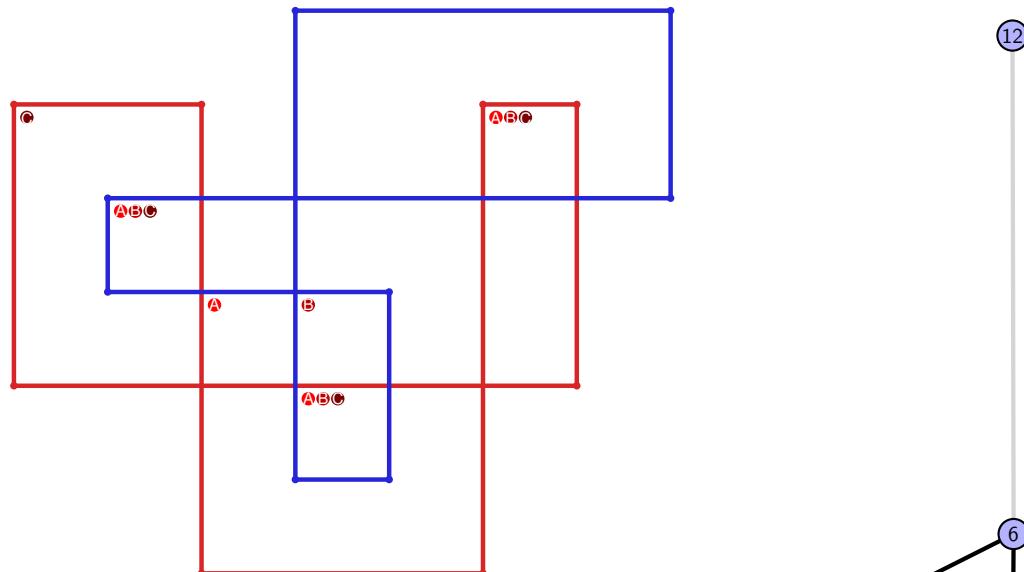


Figure 1009: `SnapPy` multiloop plot.

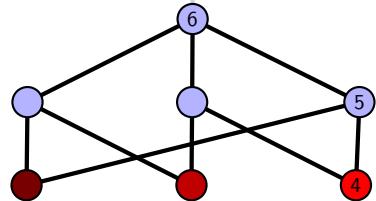


Figure 1010: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.208 $[[3, 20, 4, 1], [2, 15, 3, 16], [19, 10, 20, 11], [4, 10, 5, 9], [1, 17, 2, 16], [17, 14, 18, 15], [11, 18, 12, 19], [5, 8, 6, 9], [6, 13, 7, 14], [12, 7, 13, 8]]$

PD code drawn by SnapPy: $[(8, 3, 9, 4), (1, 4, 2, 5), (5, 20, 6, 1), (15, 6, 16, 7), (2, 9, 3, 10), (13, 10, 14, 11), (18, 11, 19, 12), (12, 17, 13, 18), (7, 14, 8, 15), (19, 16, 20, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 9, 2], [3, 9, 8, 3], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 504: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

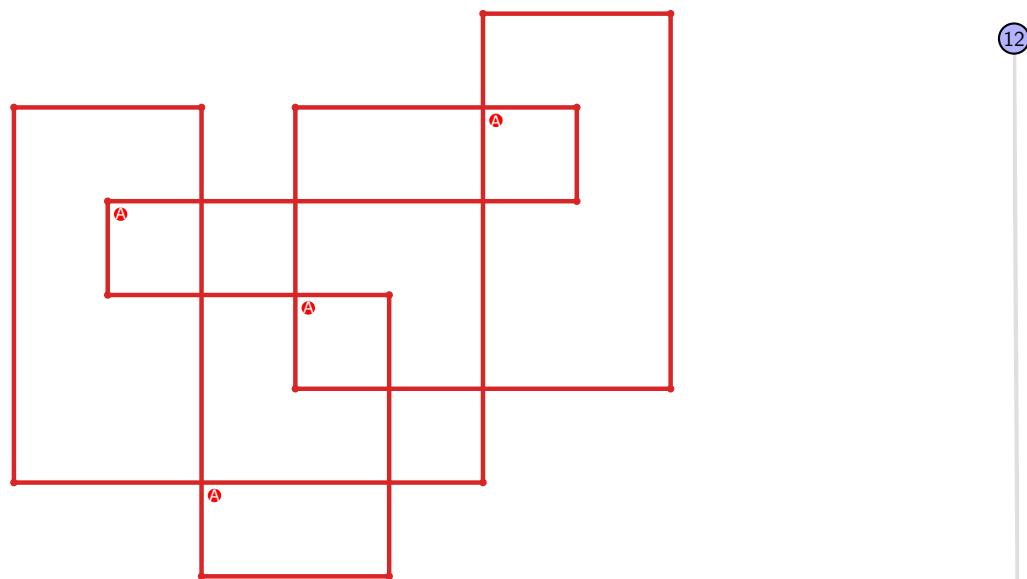


Figure 1011: SnapPy multiloop plot.

Figure 1012: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.209 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 8, 20, 9], [4, 8, 5, 7], [1, 12, 2, 13], [14, 12, 15, 11], [9, 18, 10, 19], [5, 17, 6, 16], [6, 15, 7, 16], [17, 10, 18, 11]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (5, 2, 6, 3), (17, 6, 18, 7), (15, 8, 16, 9), (9, 12, 10, 13), (19, 10, 20, 11), (4, 13, 5, 14), (14, 3, 15, 4), (7, 16, 8, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 9], [2, 9, 9, 2], [3, 9, 8, 8], [3, 7, 7, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 505: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

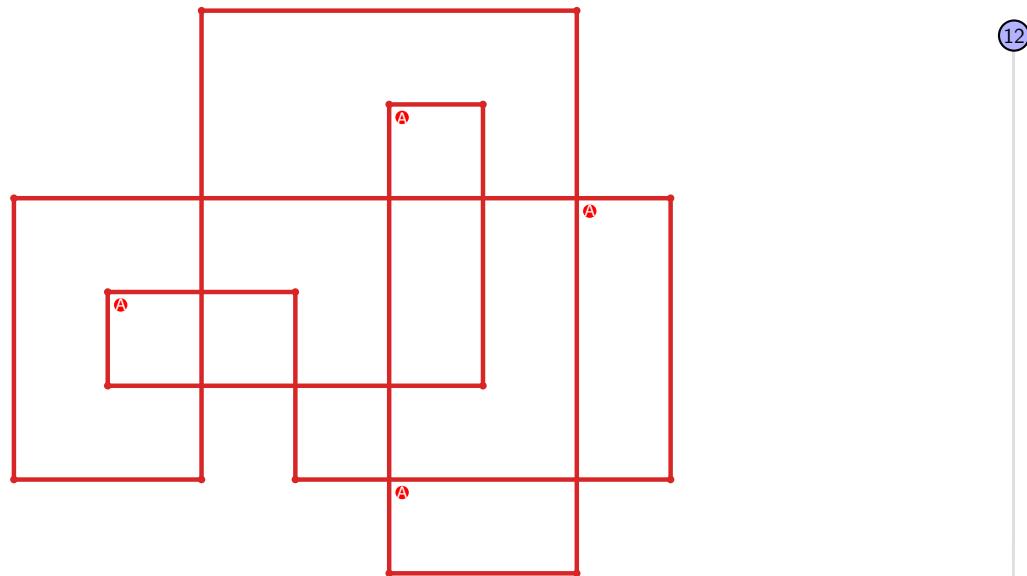


Figure 1013: `SnapPy` multiloop plot.

Figure 1014: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.210 $[[3, 20, 4, 1], [2, 15, 3, 16], [10, 19, 11, 20], [4, 11, 5, 12], [1, 17, 2, 16], [17, 14, 18, 15], [18, 9, 19, 10], [5, 9, 6, 8], [12, 8, 13, 7], [13, 6, 14, 7]]$

PD code drawn by `SnapPy`: $[(11, 4, 12, 5), (5, 10, 6, 11), (6, 3, 7, 4), (16, 7, 17, 8), (2, 9, 3, 10), (15, 12, 16, 13), (20, 13, 1, 14), (14, 19, 15, 20), (8, 17, 9, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 7, 2], [3, 6, 9, 8], [3, 7, 9, 9], [5, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 384

Average overall degree: 3.03

Pinning number: 4

Table 506: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

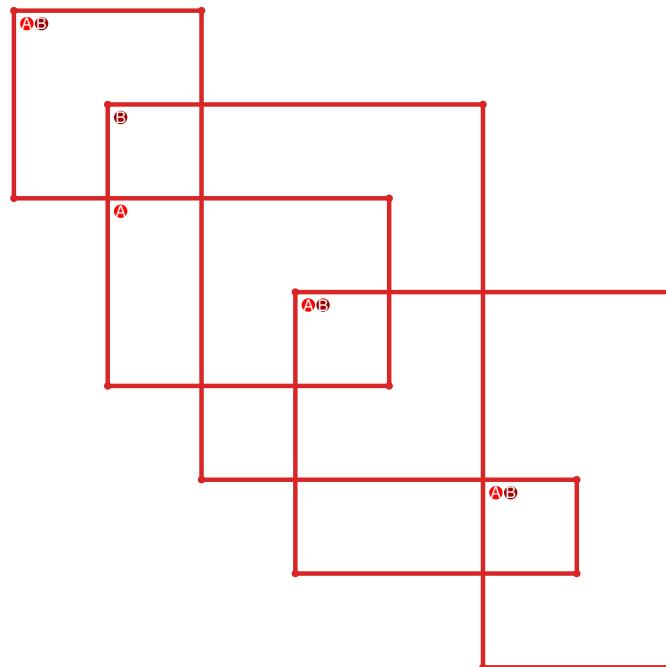


Figure 1015: `SnapPy` multiloop plot.

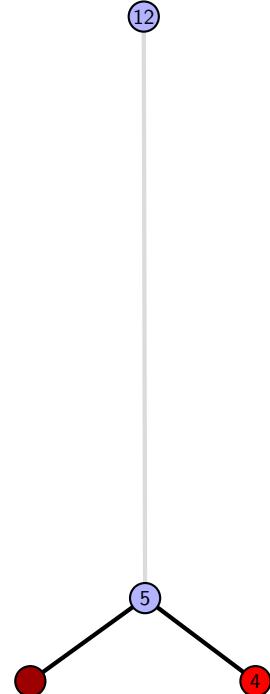


Figure 1016: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.211 $[[3, 20, 4, 1], [2, 9, 3, 10], [19, 4, 20, 5], [1, 11, 2, 10], [11, 8, 12, 9], [5, 12, 6, 13], [13, 18, 14, 19], [7, 16, 8, 17], [6, 16, 7, 15], [17, 14, 18, 15]]$

PD code drawn by SnapPy: $[(17, 2, 18, 3), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (3, 10, 4, 11), (15, 12, 16, 13), (13, 4, 14, 5), (5, 14, 6, 15), (11, 16, 12, 17), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 5], [2, 4, 8, 6], [2, 5, 9, 9], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 507: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

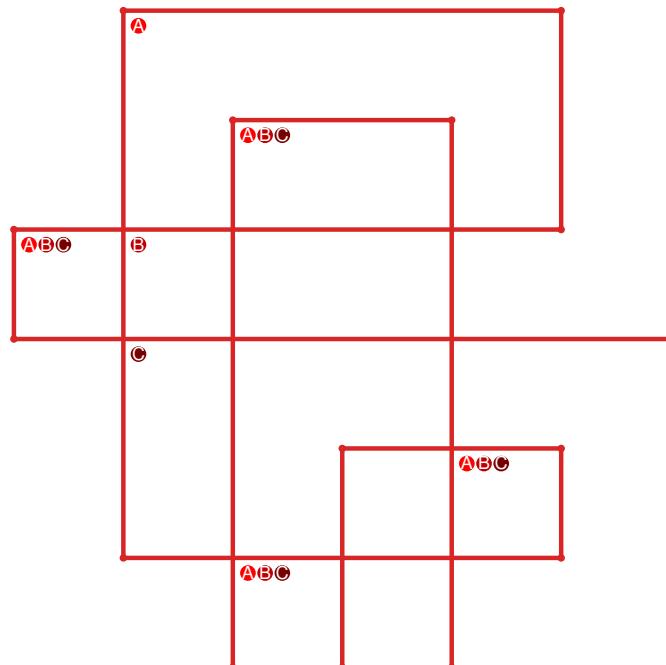


Figure 1017: SnapPy multiloop plot.

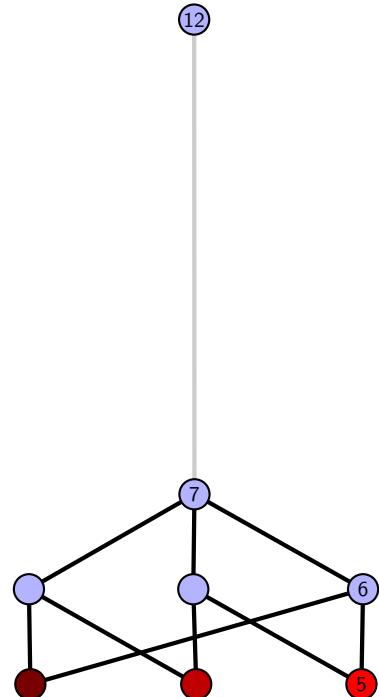


Figure 1018: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.212 $[[3, 20, 4, 1], [2, 13, 3, 14], [19, 10, 20, 11], [4, 10, 5, 9], [1, 15, 2, 14], [15, 12, 16, 13], [11, 16, 12, 17], [7, 18, 8, 19], [5, 8, 6, 9], [17, 6, 18, 7]]$

PD code drawn by `SnapPy`: $[(15, 4, 16, 5), (3, 6, 4, 7), (7, 2, 8, 3), (17, 8, 18, 9), (13, 10, 14, 11), (20, 11, 1, 12), (12, 19, 13, 20), (9, 14, 10, 15), (5, 16, 6, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 8, 8], [0, 5, 1, 1], [1, 4, 6, 6], [2, 5, 5, 9], [2, 9, 9, 8], [3, 7, 9, 3], [6, 8, 7, 7]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 508: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

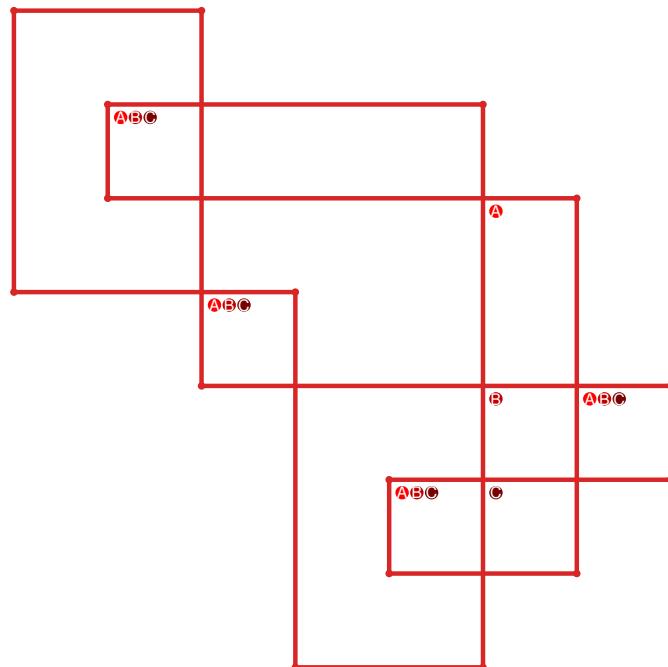


Figure 1019: `SnapPy` multiloop plot.

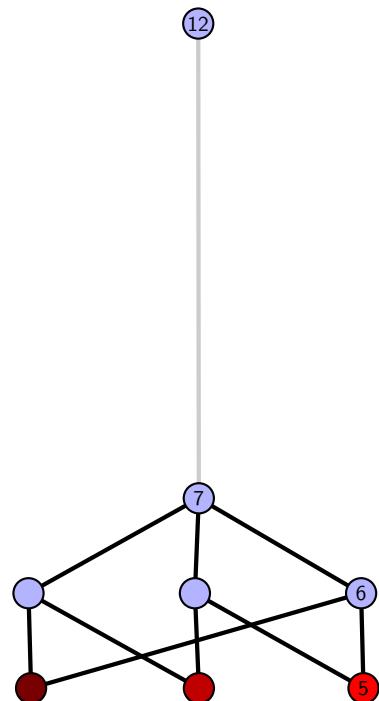


Figure 1020: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.213 $[[3, 14, 4, 1], [9, 2, 10, 3], [13, 6, 14, 7], [4, 15, 5, 20], [1, 8, 2, 9], [10, 8, 11, 7], [18, 12, 19, 13], [5, 15, 6, 16], [16, 19, 17, 20], [11, 17, 12, 18]]$

PD code drawn by `SnapPy`: $[(7, 14, 8, 1), (11, 4, 12, 5), (5, 8, 6, 9), (13, 6, 14, 7), (19, 10, 20, 11), (1, 12, 2, 13), (9, 18, 10, 19), (17, 20, 18, 15), (15, 2, 16, 3), (3, 16, 4, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 7, 8], [0, 5, 1, 1], [1, 4, 9, 2], [2, 9, 9, 8], [2, 8, 3, 3], [3, 7, 6, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 512
 Pinning number: 3

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 3.03

Table 509: Pinning sets/average degree by cardinal

Cardinal	3	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	36	84	126	126	84	36	9	1	511
Average degree	2.0	2.44	2.71	2.89	3.02	3.11	3.19	3.24	3.29	3.33	

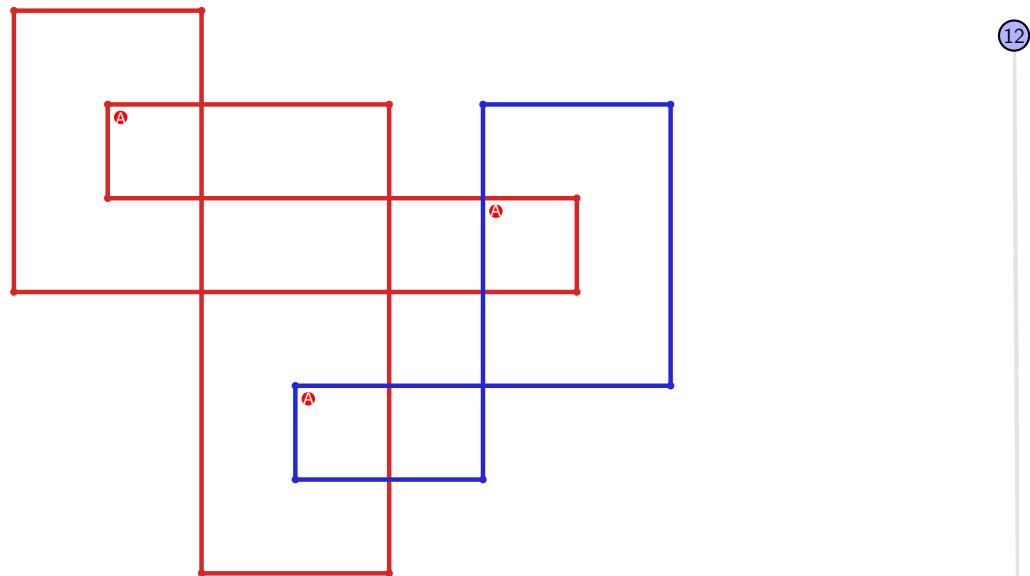


Figure 1021: `SnapPy` multiloop plot.

Figure 1022: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.214 $[[3, 20, 4, 1], [15, 2, 16, 3], [19, 12, 20, 13], [4, 12, 5, 11], [1, 14, 2, 15], [16, 14, 17, 13], [18, 7, 19, 8], [5, 10, 6, 11], [17, 9, 18, 8], [9, 6, 10, 7]]$

PD code drawn by SnapPy: $[(3, 20, 4, 1), (12, 1, 13, 2), (2, 11, 3, 12), (19, 4, 20, 5), (5, 18, 6, 19), (13, 6, 14, 7), (7, 10, 8, 11), (15, 8, 16, 9), (17, 14, 18, 15), (9, 16, 10, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 8, 9], [3, 9, 9, 3], [5, 9, 6, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 224

Pinning number: 5

Average optimal degree: 2.27

Average minimal degree: 2.27

Average overall degree: 2.98

Table 510: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

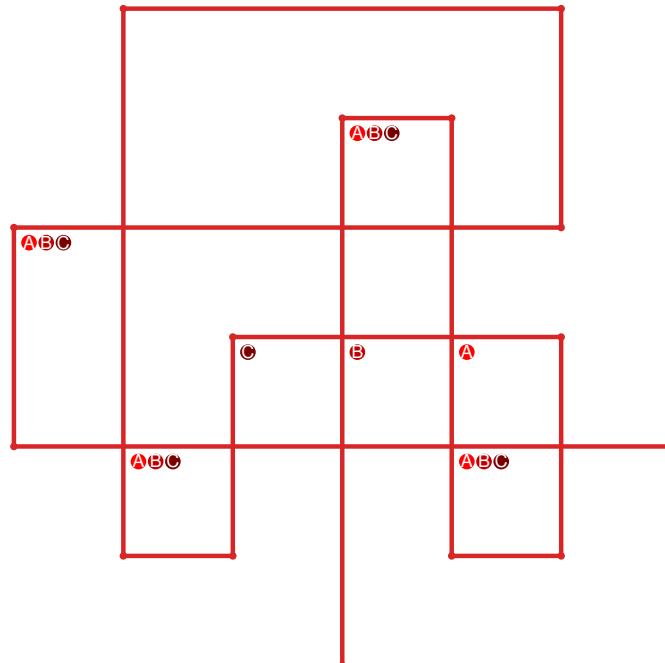


Figure 1023: SnapPy multiloop plot.

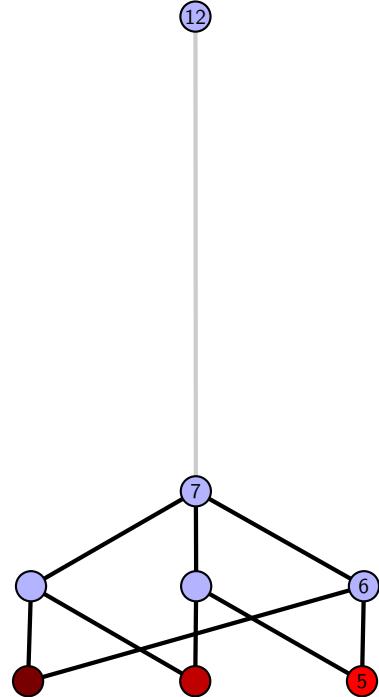


Figure 1024: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.215 $[[3, 12, 4, 1], [2, 20, 3, 13], [11, 4, 12, 5], [1, 14, 2, 13], [14, 19, 15, 20], [5, 15, 6, 16], [16, 10, 17, 11], [8, 18, 9, 19], [6, 9, 7, 10], [17, 7, 18, 8]]$

PD code drawn by SnapPy: $[(9, 2, 10, 3), (18, 5, 19, 6), (4, 7, 5, 8), (17, 8, 18, 9), (1, 10, 2, 11), (3, 16, 4, 17), (6, 19, 7, 20), (15, 20, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 5], [2, 4, 8, 6], [2, 5, 8, 9], [4, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 256
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 3.03

Table 511: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

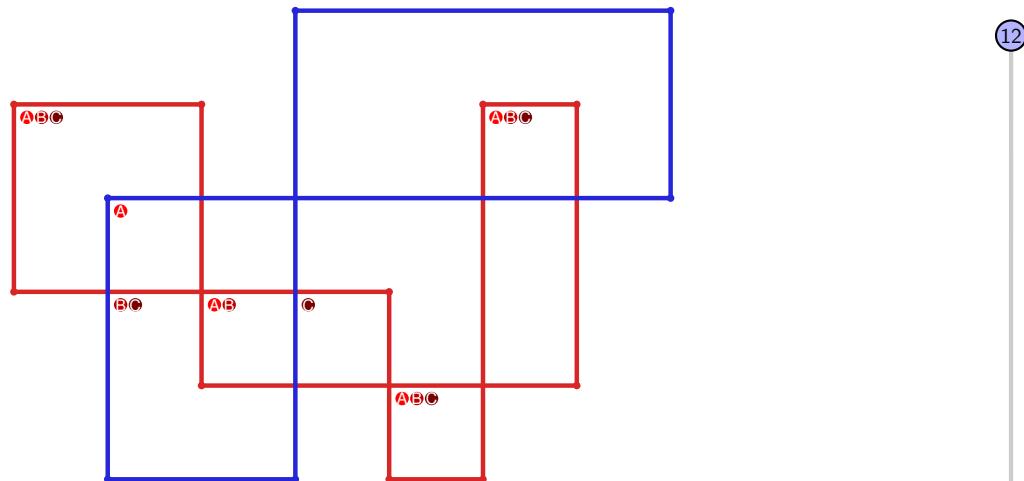


Figure 1025: SnapPy multiloop plot.

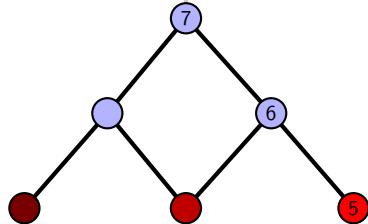


Figure 1026: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.216 $[[3, 10, 4, 1], [2, 20, 3, 11], [9, 17, 10, 18], [4, 17, 5, 16], [1, 12, 2, 11], [12, 19, 13, 20], [18, 13, 19, 14], [8, 5, 9, 6], [15, 7, 16, 8], [14, 7, 15, 6]]$

PD code drawn by `SnapPy`: $[(6, 3, 7, 4), (4, 15, 5, 16), (16, 5, 17, 6), (1, 8, 2, 9), (19, 14, 20, 15), (17, 2, 18, 3), (7, 18, 8, 19), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 6, 6], [2, 5, 5, 9], [2, 9, 8, 3], [3, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 3

Average minimal degree: 2.4

Total pinning sets: 256

Average overall degree: 3.03

Pinning number: 5

Table 512: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

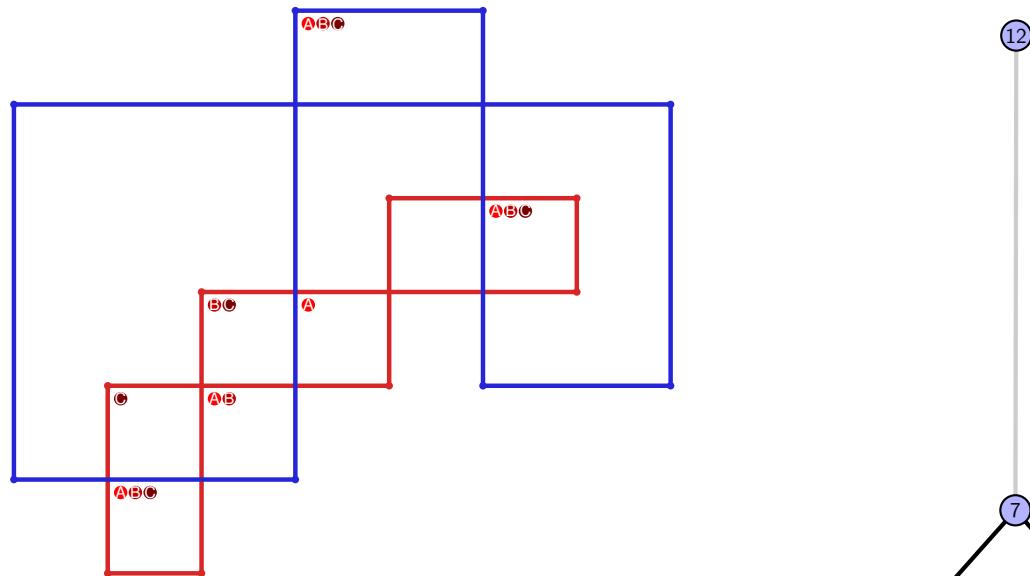


Figure 1027: `SnapPy` multiloop plot.

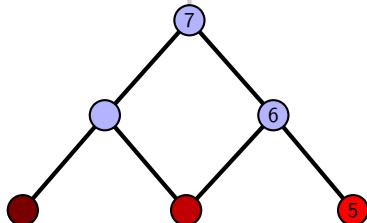


Figure 1028: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.217 $[[3, 20, 4, 1], [2, 11, 3, 12], [14, 19, 15, 20], [4, 15, 5, 16], [1, 13, 2, 12], [13, 10, 14, 11], [18, 5, 19, 6], [16, 8, 17, 7], [9, 6, 10, 7], [17, 8, 18, 9]]$

PD code drawn by `SnapPy`: $[(16, 3, 17, 4), (7, 4, 8, 5), (5, 14, 6, 15), (15, 6, 16, 7), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (2, 13, 3, 14), (12, 17, 13, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 9, 3], [3, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 10

Average minimal degree: 2.75

Total pinning sets: 496

Average overall degree: 3.12

Pinning number: 4

Table 513: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	5	0	0	0	0	0	0	9
Nonminimal pinning sets	0	8	51	123	147	103	43	10	1	486
Average degree	2.5	2.75	2.92	3.05	3.16	3.23	3.27	3.31	3.33	

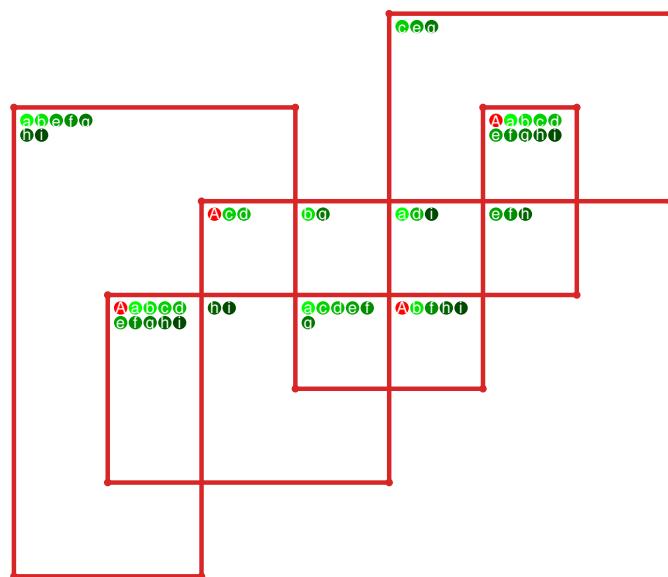


Figure 1029: `SnapPy` multiloop plot.

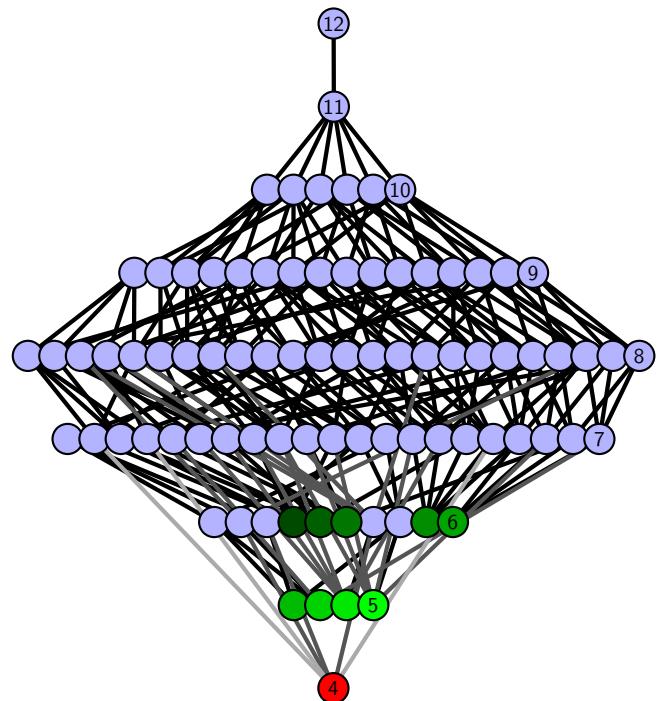


Figure 1030: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.218 $[[3, 20, 4, 1], [2, 9, 3, 10], [12, 19, 13, 20], [4, 13, 5, 14], [1, 11, 2, 10], [11, 8, 12, 9], [18, 5, 19, 6], [14, 18, 15, 17], [7, 16, 8, 17], [6, 16, 7, 15]]$

PD code drawn by SnapPy: $[(16, 3, 17, 4), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (2, 11, 3, 12), (13, 4, 14, 5), (5, 14, 6, 15), (15, 12, 16, 13), (10, 17, 11, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 9, 7, 3], [3, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 7
 Total pinning sets: 376
 Pinning number: 5

Average optimal degree: 2.64
 Average minimal degree: 2.67
 Average overall degree: 3.11

Table 514: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	30	83	114	90	41	10	1	369
Average degree	2.64	2.85	3.01	3.12	3.21	3.27	3.31	3.33	

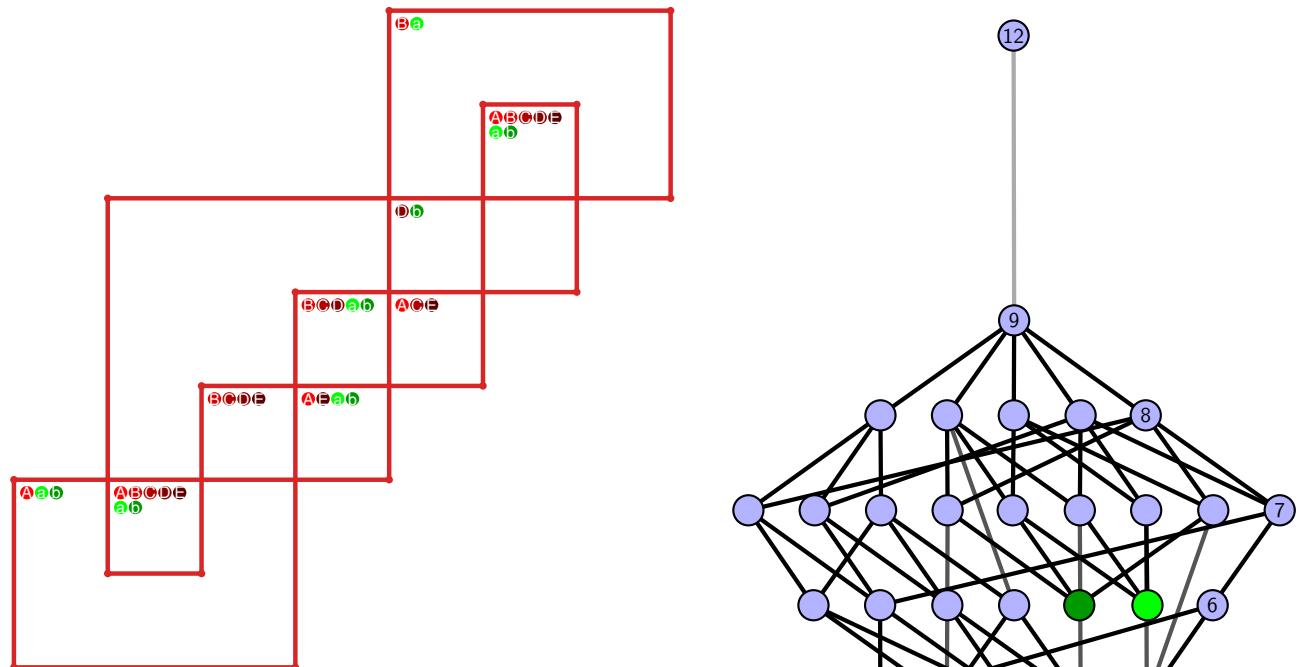


Figure 1031: SnapPy multiloop plot.

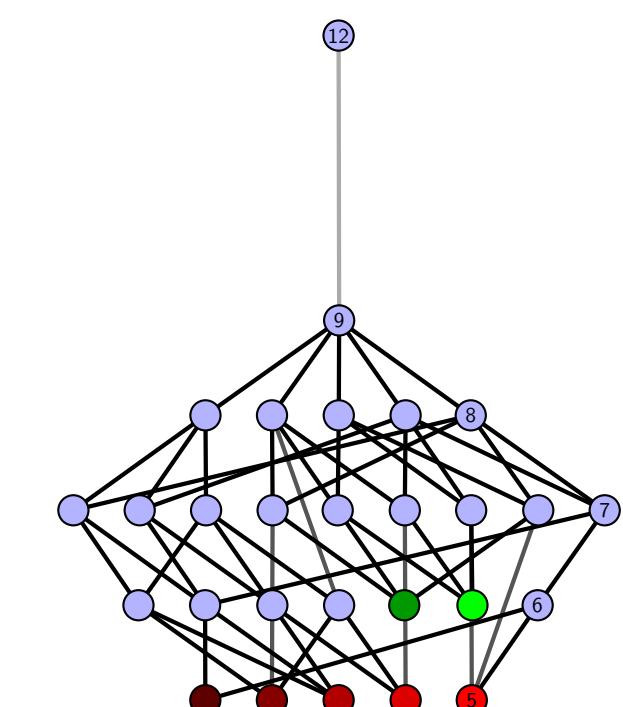


Figure 1032: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.219 $[[3, 20, 4, 1], [2, 9, 3, 10], [12, 19, 13, 20], [4, 13, 5, 14], [1, 11, 2, 10], [11, 8, 12, 9], [18, 15, 19, 16], [5, 15, 6, 14], [7, 16, 8, 17], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (2, 11, 3, 12), (12, 3, 13, 4), (16, 13, 17, 14), (5, 14, 6, 15), (10, 17, 11, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 9, 7], [3, 6, 9, 3], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 9
 Total pinning sets: 300
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.59
 Average overall degree: 3.06

Table 515: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	14	64	93	75	35	9	1	291
Average degree	2.5	2.7	2.91	3.06	3.17	3.24	3.29	3.33	

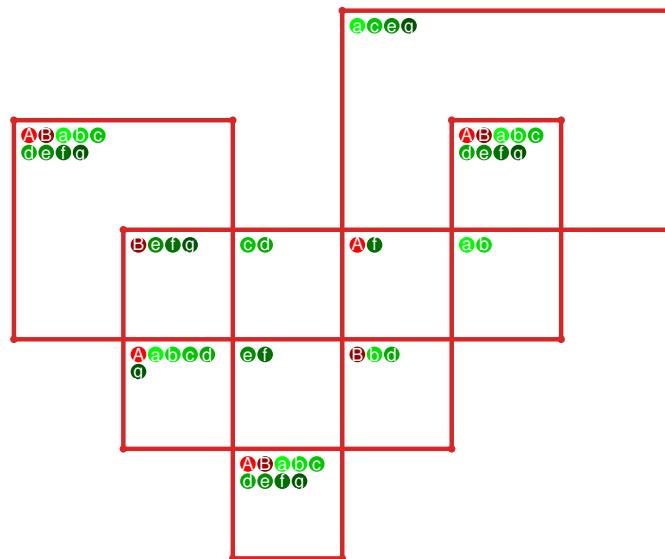


Figure 1033: SnapPy multiloop plot.

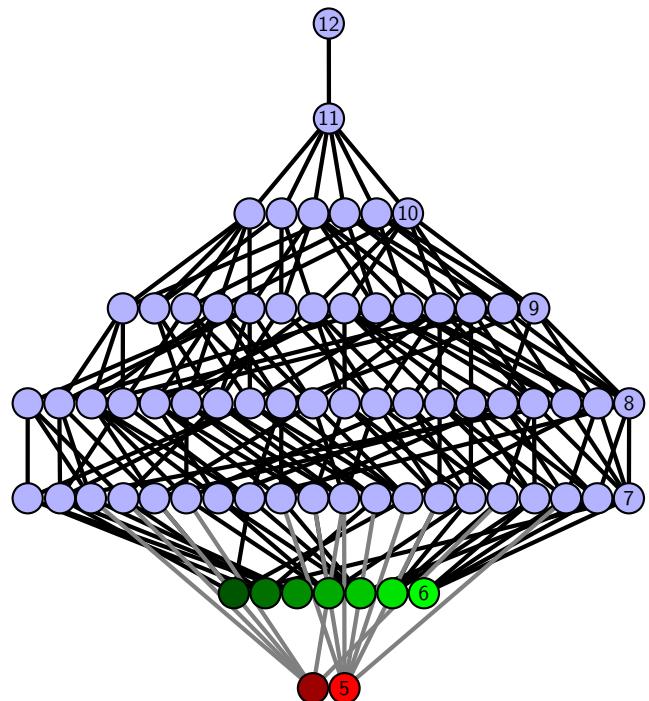


Figure 1034: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.220 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 10, 20, 11], [4, 10, 5, 9], [1, 12, 2, 13], [14, 12, 15, 11], [18, 5, 19, 6], [8, 17, 9, 18], [15, 7, 16, 6], [16, 7, 17, 8]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (16, 3, 17, 4), (4, 13, 5, 14), (14, 5, 15, 6), (7, 2, 8, 3), (17, 8, 18, 9), (9, 12, 10, 13), (19, 10, 20, 11), (6, 15, 7, 16), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 7, 3], [3, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 4

Average optimal degree: 2.45

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 288

Average overall degree: 3.04

Pinning number: 5

Table 516: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.45	2.72	2.91	3.05	3.16	3.24	3.29	3.33	

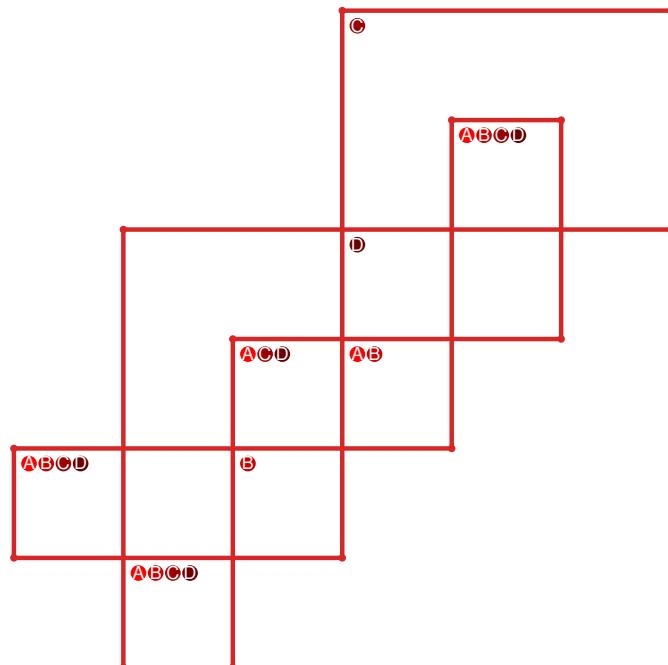


Figure 1035: `SnapPy` multiloop plot.

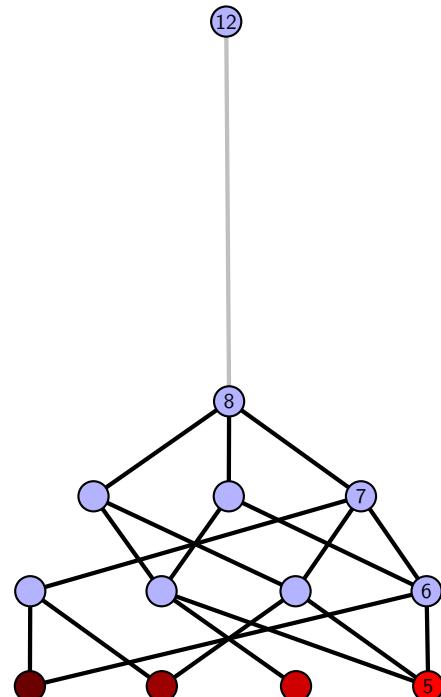


Figure 1036: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.221 $[[3, 10, 4, 1], [2, 20, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [12, 19, 13, 20], [5, 13, 6, 14], [14, 8, 15, 9], [15, 18, 16, 19], [6, 16, 7, 17], [17, 7, 18, 8]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (18, 5, 19, 6), (15, 6, 16, 7), (1, 8, 2, 9), (3, 14, 4, 15), (4, 17, 5, 18), (16, 19, 17, 20), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 5], [2, 4, 8, 6], [2, 5, 9, 7], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2
Total pinning sets: 384
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.25
Average overall degree: 3.03

Table 517: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

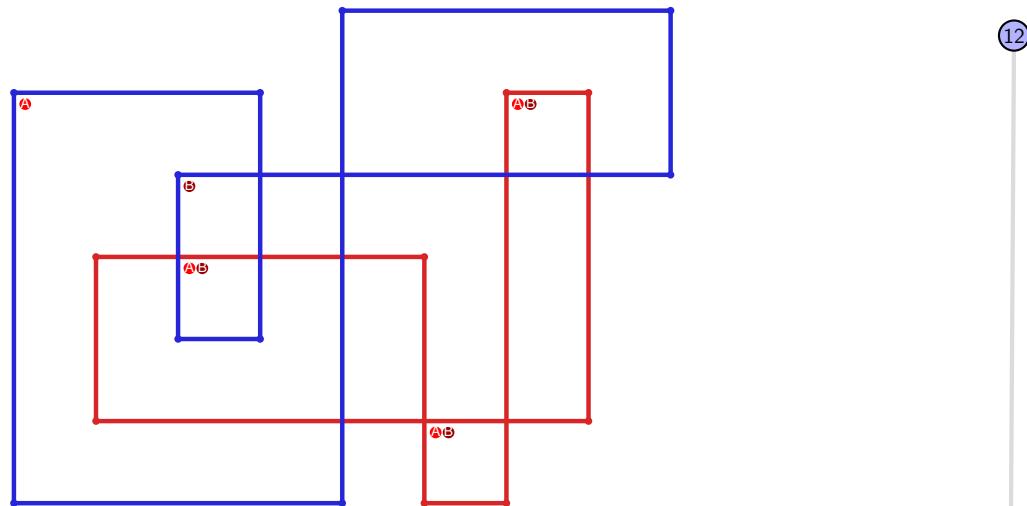


Figure 1037: SnapPy multiloop plot.

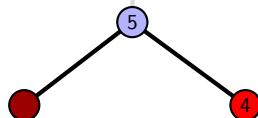


Figure 1038: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.222 [[15, 20, 16, 1], [14, 11, 15, 12], [4, 19, 5, 20], [16, 5, 17, 6], [1, 13, 2, 12], [2, 13, 3, 14], [3, 10, 4, 11], [7, 18, 8, 19], [17, 8, 18, 9], [6, 9, 7, 10]]

PD code drawn by SnapPy: [(13, 2, 14, 3), (14, 5, 15, 6), (3, 6, 4, 7), (20, 7, 1, 8), (11, 8, 12, 9), (9, 18, 10, 19), (19, 10, 20, 11), (4, 15, 5, 16), (1, 16, 2, 17), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 8, 9], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 9, 2], [2, 9, 8, 8], [3, 7, 7, 9], [3, 8, 7, 6]]

Total optimal pinning sets: 6
 Total minimal pinning sets: 9
 Total pinning sets: 420
 Pinning number: 5

Average optimal degree: 2.67
 Average minimal degree: 2.7
 Average overall degree: 3.12

Table 518: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	36	98	128	96	42	10	1	411
Average degree	2.67	2.87	3.02	3.14	3.22	3.27	3.31	3.33	

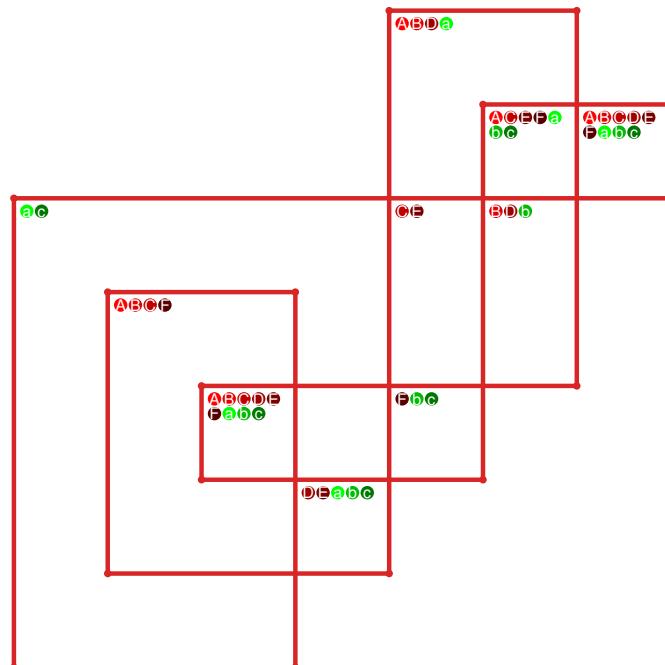


Figure 1039: SnapPy multiloop plot.

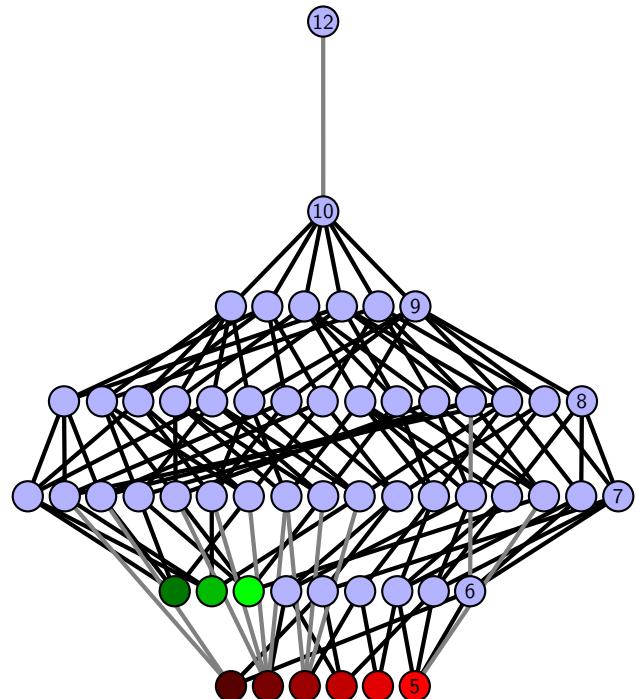


Figure 1040: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.223 [[15, 20, 16, 1], [14, 3, 15, 4], [6, 19, 7, 20], [16, 7, 17, 8], [1, 5, 2, 4], [2, 13, 3, 14], [5, 12, 6, 13], [9, 18, 10, 19], [17, 10, 18, 11], [8, 11, 9, 12]]

PD code drawn by `SnapPy`: [(12, 1, 13, 2), (2, 19, 3, 20), (14, 5, 15, 6), (15, 8, 16, 9), (6, 9, 7, 10), (3, 10, 4, 11), (20, 11, 1, 12), (7, 16, 8, 17), (4, 17, 5, 18), (13, 18, 14, 19)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 8, 9], [0, 6, 5, 1], [1, 4, 6, 1], [2, 5, 4, 9], [2, 9, 8, 8], [3, 7, 7, 9], [3, 8, 7, 6]]

Total optimal pinning sets: 1
Total minimal pinning sets: 7

Total pinning sets: 472

Pinning number: 4

Average optimal degree: 2.5

Average minimal degree: 2.67

Average overall degree: 3.11

Table 519: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	0	6
Nonminimal pinning sets	0	8	57	115	135	97	42	10	1	465
Average degree	2.5	2.73	2.91	3.05	3.14	3.22	3.27	3.31	3.33	

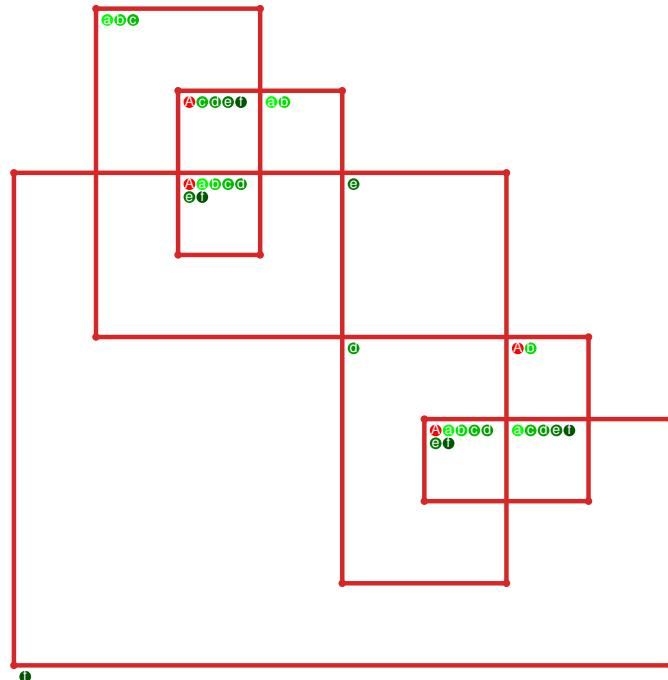


Figure 1041: `SnapPy` multiloop plot.

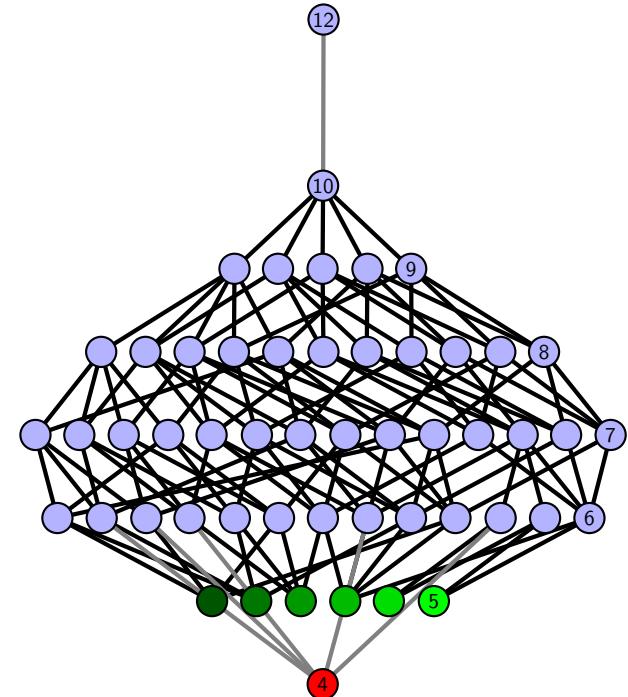


Figure 1042: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.224 [[15, 20, 16, 1], [3, 14, 4, 15], [19, 10, 20, 11], [16, 10, 17, 9], [1, 12, 2, 13], [13, 2, 14, 3], [4, 12, 5, 11], [18, 7, 19, 8], [17, 7, 18, 6], [8, 5, 9, 6]]

PD code drawn by SnapPy: [(11, 20, 12, 1), (6, 3, 7, 4), (4, 15, 5, 16), (16, 5, 17, 6), (7, 14, 8, 15), (17, 8, 18, 9), (9, 2, 10, 3), (19, 10, 20, 11), (1, 12, 2, 13), (13, 18, 14, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 3], [0, 2, 8, 9], [0, 6, 5, 5], [1, 4, 4, 1], [1, 4, 9, 2], [2, 9, 8, 8], [3, 7, 7, 9], [3, 8, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 384

Average overall degree: 3.03

Pinning number: 4

Table 520: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

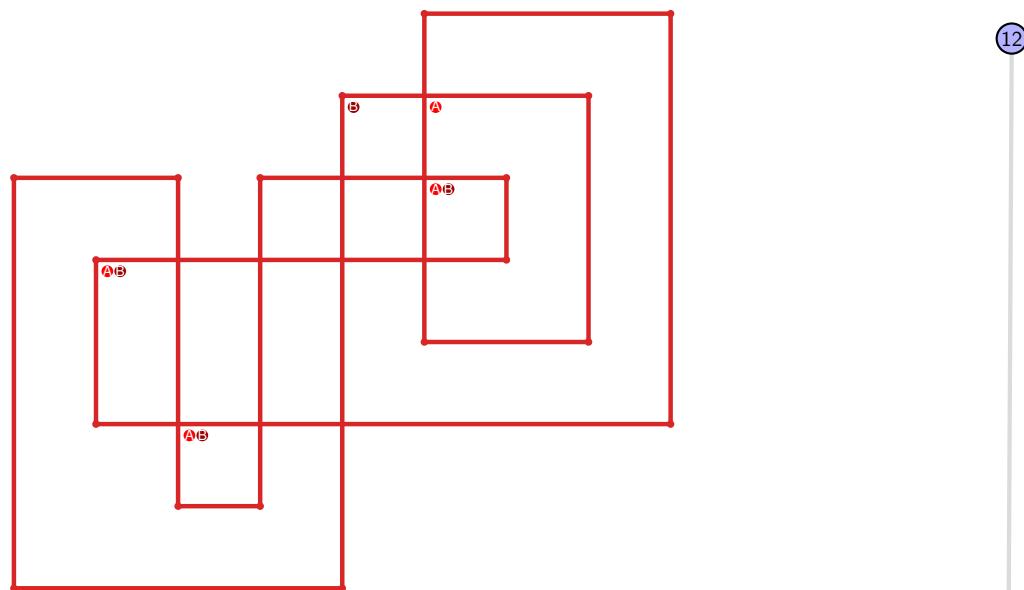


Figure 1043: SnapPy multiloop plot.

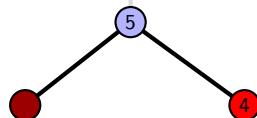


Figure 1044: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.225 $[[8, 20, 1, 9], [9, 7, 10, 8], [10, 19, 11, 20], [1, 6, 2, 7], [18, 11, 19, 12], [5, 17, 6, 18], [2, 17, 3, 16], [12, 16, 13, 15], [4, 14, 5, 15], [3, 14, 4, 13]]$

PD code drawn by SnapPy: $[(7, 4, 8, 5), (14, 5, 15, 6), (11, 16, 12, 17), (18, 1, 19, 2), (2, 19, 3, 20), (20, 17, 9, 18), (9, 8, 10, 1), (3, 10, 4, 11), (15, 12, 16, 13), (6, 13, 7, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 4], [0, 5, 6, 1], [2, 7, 5, 2], [3, 4, 8, 6], [3, 5, 9, 7], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 384
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.25
 Average overall degree: 3.03

Table 521: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

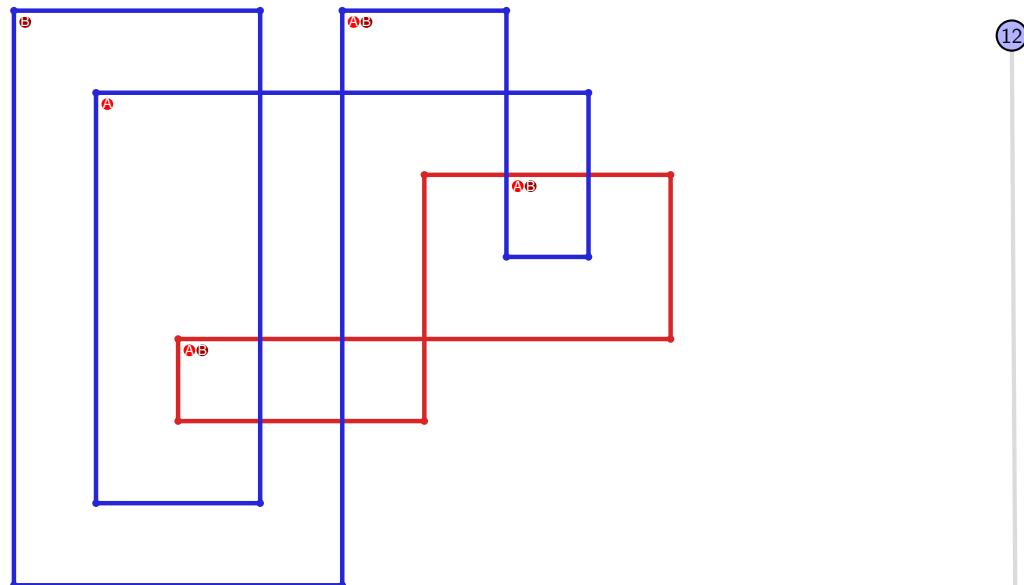


Figure 1045: SnapPy multiloop plot.

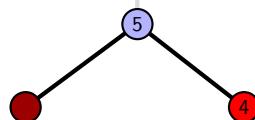


Figure 1046: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.226 $[[8, 20, 1, 9], [9, 7, 10, 8], [10, 19, 11, 20], [1, 6, 2, 7], [13, 18, 14, 19], [11, 5, 12, 6], [2, 12, 3, 13], [17, 14, 18, 15], [4, 16, 5, 17], [3, 16, 4, 15]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (5, 2, 6, 3), (14, 3, 15, 4), (6, 17, 7, 18), (10, 19, 11, 20), (20, 7, 9, 8), (8, 9, 1, 10), (18, 11, 19, 12), (15, 12, 16, 13), (4, 13, 5, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 2, 0], [0, 1, 4, 5], [0, 5, 6, 1], [2, 6, 7, 7], [2, 8, 6, 3], [3, 5, 9, 4], [4, 9, 8, 4], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 448
 Pinning number: 4

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 3.05

Table 522: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	21	64	111	120	83	36	9	1	445
Average degree	2.33	2.65	2.85	3.0	3.1	3.18	3.24	3.29	3.33	

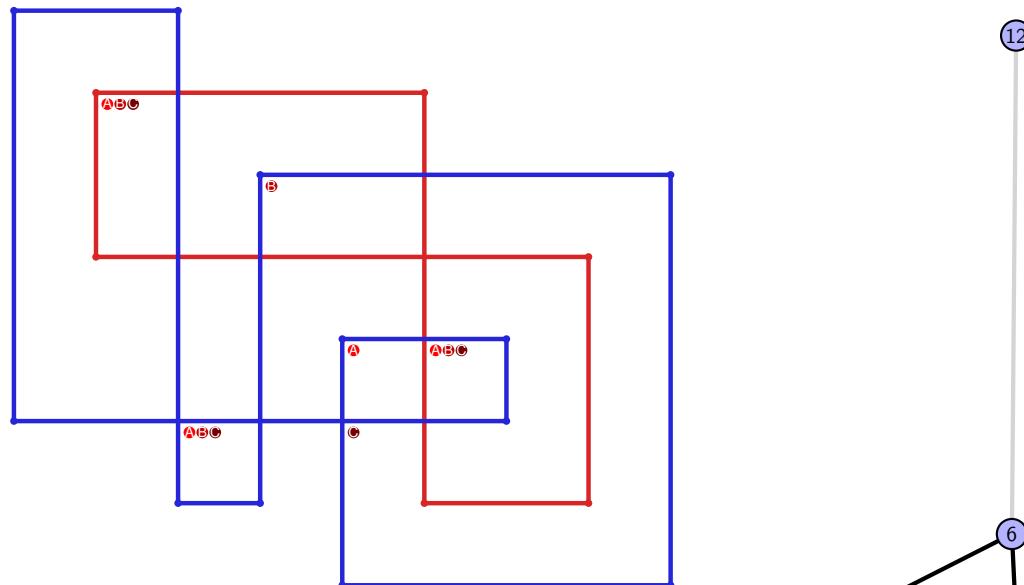


Figure 1047: SnapPy multiloop plot.

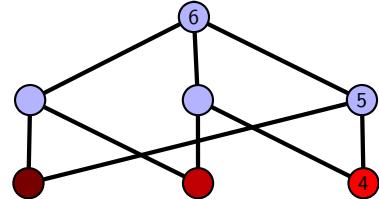


Figure 1048: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.227 $[[8, 12, 1, 9], [9, 7, 10, 8], [11, 20, 12, 13], [1, 6, 2, 7], [10, 14, 11, 13], [5, 19, 6, 20], [2, 19, 3, 18], [14, 18, 15, 17], [4, 16, 5, 17], [3, 16, 4, 15]]$

PD code drawn by SnapPy: $[(7, 4, 8, 5), (18, 5, 19, 6), (6, 17, 7, 18), (14, 1, 15, 2), (2, 15, 3, 16), (16, 13, 9, 14), (9, 8, 10, 1), (3, 10, 4, 11), (20, 11, 17, 12), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 4, 5], [0, 5, 6, 1], [1, 7, 2, 2], [2, 8, 6, 3], [3, 5, 9, 7], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 7

Average minimal degree: 2.62

Total pinning sets: 379

Average overall degree: 3.04

Pinning number: 4

Table 523: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	2	0	0	0	0	0	0	6
Nonminimal pinning sets	0	8	46	91	105	77	35	9	1	372
Average degree	2.25	2.58	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

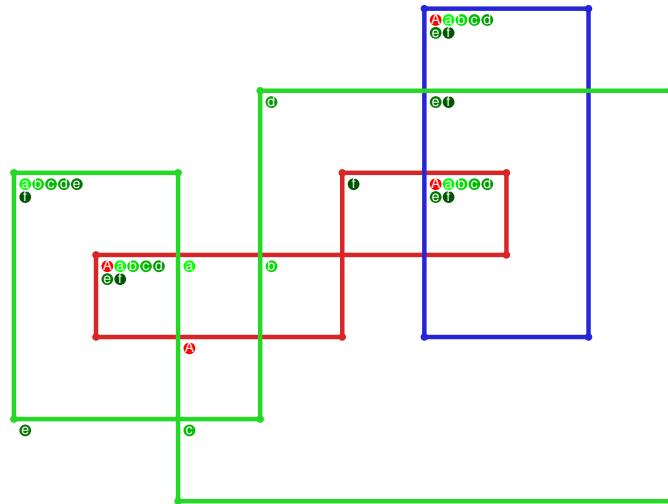


Figure 1049: SnapPy multiloop plot.

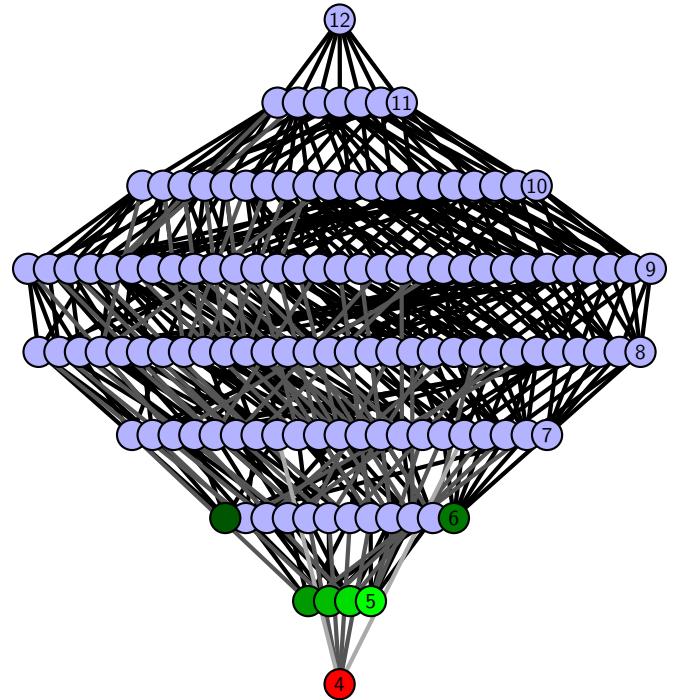


Figure 1050: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.228 $[[4, 14, 1, 5], [5, 3, 6, 4], [6, 13, 7, 14], [1, 15, 2, 20], [2, 19, 3, 20], [9, 12, 10, 13], [7, 16, 8, 15], [8, 18, 9, 19], [11, 17, 12, 18], [10, 17, 11, 16]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (16, 19, 17, 20), (13, 20, 14, 11), (2, 11, 3, 12), (8, 17, 9, 18), (18, 9, 19, 10), (15, 10, 16, 5), (4, 5, 1, 6), (6, 3, 7, 4), (7, 14, 8, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 4, 4], [1, 3, 3, 7], [2, 7, 8, 9], [2, 9, 7, 3], [4, 6, 8, 5], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 7
 Total pinning sets: 382
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.55
 Average overall degree: 3.04

Table 524: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	0	6
Nonminimal pinning sets	0	8	49	91	105	77	35	9	1	375
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

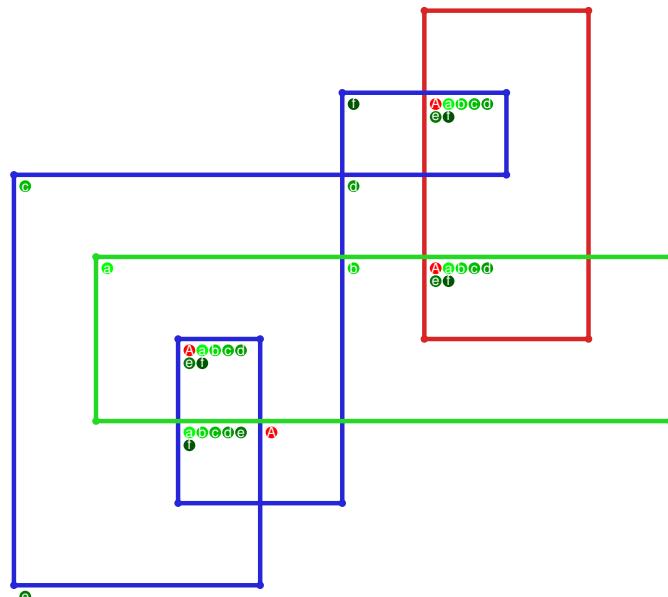


Figure 1051: SnapPy multiloop plot.

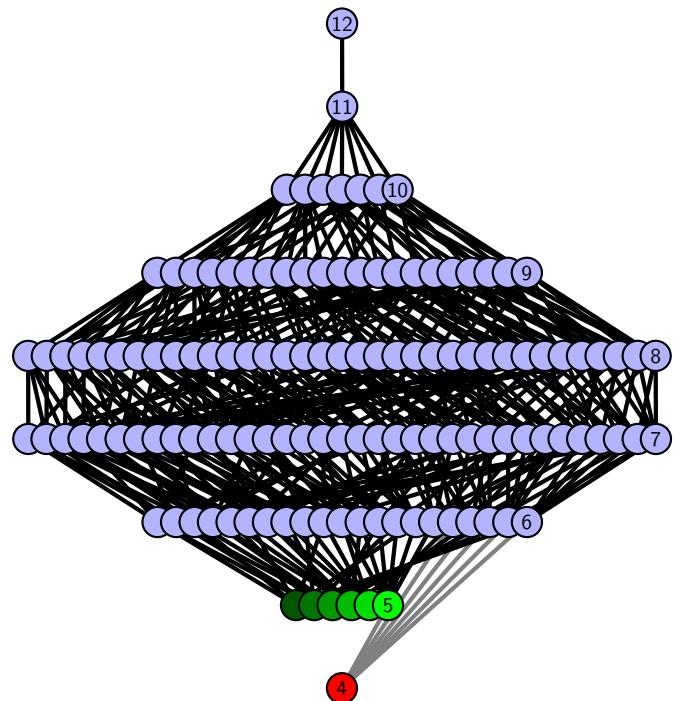


Figure 1052: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.229 $[[3, 20, 4, 1], [9, 2, 10, 3], [19, 6, 20, 7], [4, 16, 5, 15], [1, 8, 2, 9], [10, 8, 11, 7], [18, 13, 19, 14], [5, 16, 6, 17], [14, 11, 15, 12], [12, 17, 13, 18]]$

PD code drawn by SnapPy: $[(7, 20, 8, 1), (17, 4, 18, 5), (5, 8, 6, 9), (19, 6, 20, 7), (12, 9, 13, 10), (16, 11, 17, 12), (13, 2, 14, 3), (3, 14, 4, 15), (10, 15, 11, 16), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 7], [0, 7, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 9, 9], [2, 9, 3, 3], [3, 9, 6, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4
Total pinning sets: 480
Pinning number: 4

Average optimal degree: 2.38
Average minimal degree: 2.38
Average overall degree: 3.05

Table 525: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	26	74	121	125	84	36	9	1	476
Average degree	2.38	2.68	2.87	3.01	3.11	3.19	3.24	3.29	3.33	

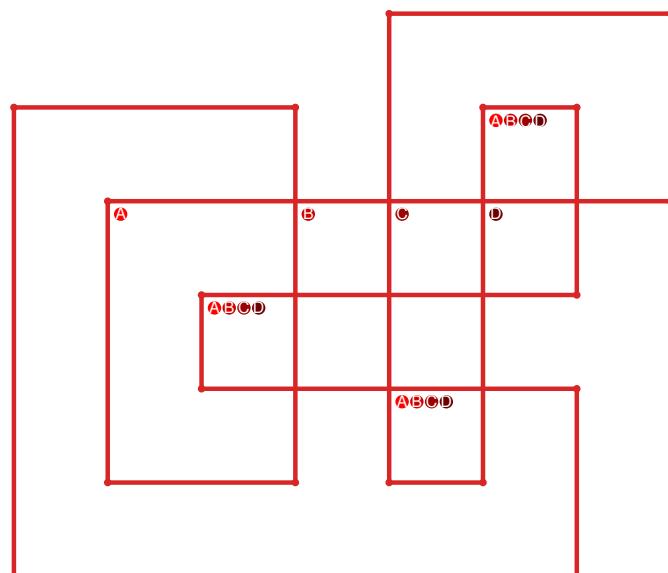


Figure 1053: SnapPy multiloop plot.

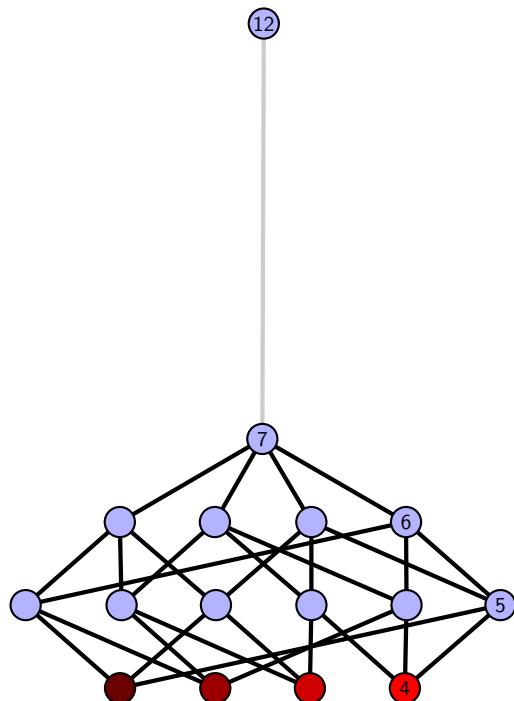


Figure 1054: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.230 $[[3, 20, 4, 1], [11, 2, 12, 3], [19, 8, 20, 9], [4, 18, 5, 17], [1, 10, 2, 11], [12, 10, 13, 9], [7, 18, 8, 19], [5, 15, 6, 14], [16, 13, 17, 14], [6, 15, 7, 16]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (17, 6, 18, 7), (7, 10, 8, 11), (19, 8, 20, 9), (14, 11, 15, 12), (12, 3, 13, 4), (4, 13, 5, 14), (15, 2, 16, 3), (5, 16, 6, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 6], [0, 6, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 9, 3, 2], [3, 9, 9, 8], [3, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 384

Average overall degree: 3.03

Pinning number: 4

Table 526: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

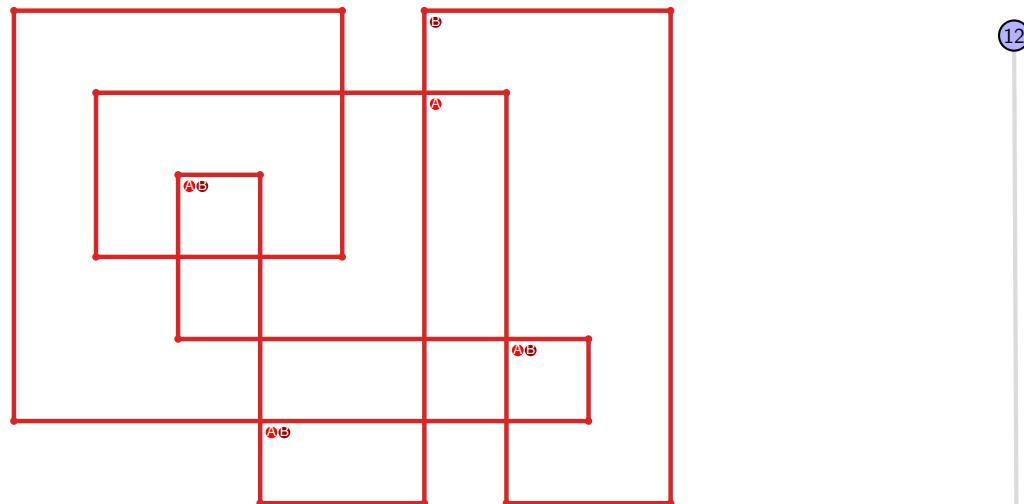


Figure 1055: `SnapPy` multiloop plot.

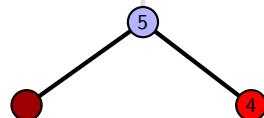


Figure 1056: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.231 $[[3, 20, 4, 1], [2, 11, 3, 12], [14, 19, 15, 20], [4, 15, 5, 16], [1, 13, 2, 12], [13, 10, 14, 11], [7, 18, 8, 19], [5, 17, 6, 16], [6, 9, 7, 10], [17, 8, 18, 9]]$

PD code drawn by SnapPy: $[(15, 6, 16, 7), (4, 7, 5, 8), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (2, 13, 3, 14), (14, 3, 15, 4), (5, 16, 6, 17), (12, 17, 13, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 9, 9], [3, 9, 8, 3], [5, 7, 9, 6], [6, 8, 7, 6]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 8
 Total pinning sets: 324
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.54
 Average overall degree: 3.05

Table 527: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	24	73	98	76	35	9	1	316
Average degree	2.5	2.73	2.93	3.07	3.17	3.24	3.29	3.33	

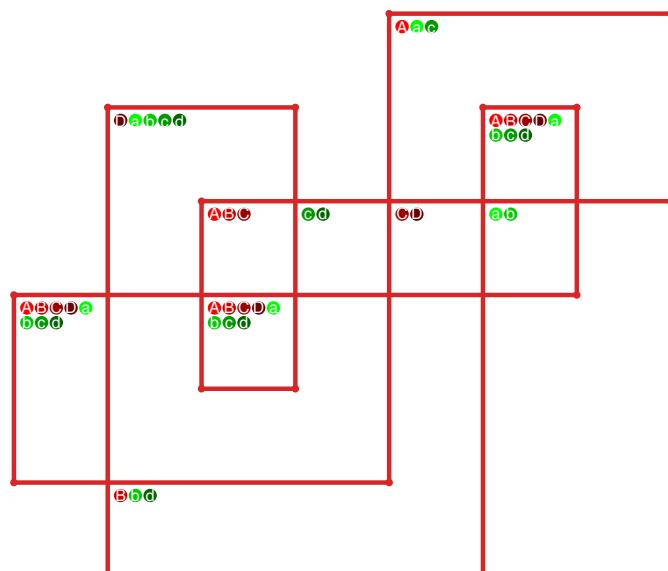


Figure 1057: SnapPy multiloop plot.

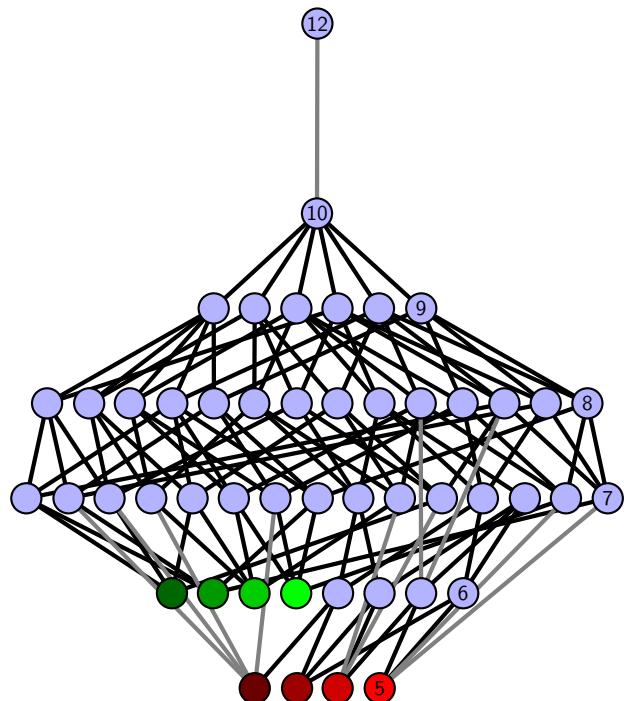


Figure 1058: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.232 $[[3, 20, 4, 1], [2, 15, 3, 16], [8, 19, 9, 20], [4, 9, 5, 10], [1, 17, 2, 16], [17, 14, 18, 15], [18, 7, 19, 8], [5, 12, 6, 13], [10, 13, 11, 14], [11, 6, 12, 7]]$

PD code drawn by `SnapPy`: $[(9, 4, 10, 5), (16, 5, 17, 6), (2, 7, 3, 8), (3, 10, 4, 11), (8, 11, 9, 12), (15, 12, 16, 13), (20, 13, 1, 14), (14, 19, 15, 20), (6, 17, 7, 18), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 9, 2], [3, 9, 9, 8], [3, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.25

Total pinning sets: 384

Average overall degree: 3.03

Pinning number: 4

Table 528: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

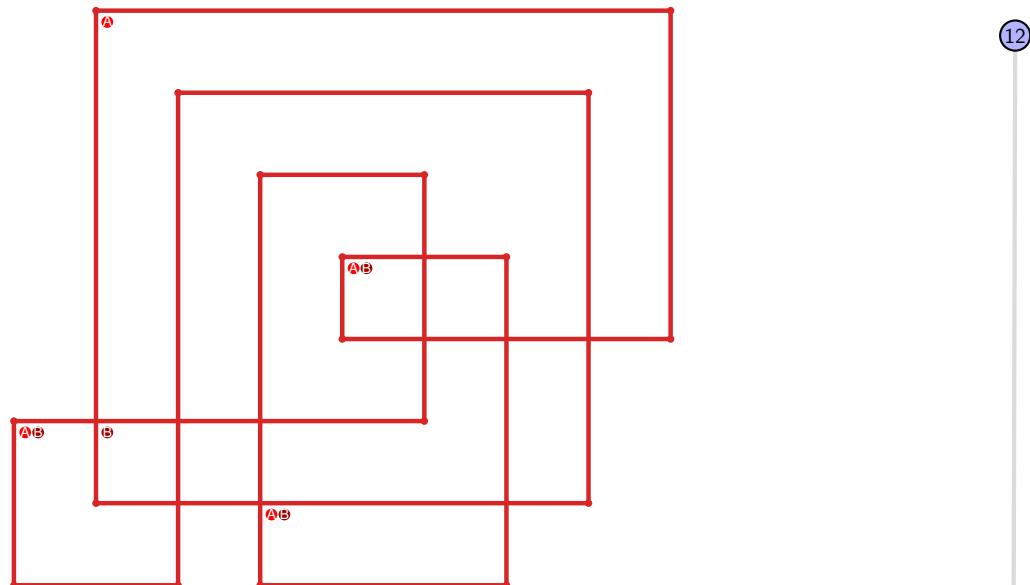


Figure 1059: `SnapPy` multiloop plot.

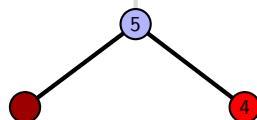


Figure 1060: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.233 $[[3, 8, 4, 1], [2, 16, 3, 9], [11, 7, 12, 8], [4, 12, 5, 13], [1, 10, 2, 9], [10, 15, 11, 16], [6, 20, 7, 17], [5, 20, 6, 19], [13, 19, 14, 18], [14, 17, 15, 18]]$

PD code drawn by SnapPy: $[(12, 5, 13, 6), (1, 6, 2, 7), (2, 13, 3, 14), (11, 16, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8), (19, 14, 20, 15), (20, 3, 17, 4), (4, 17, 5, 18), (15, 18, 16, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 9, 2], [2, 9, 7, 7], [3, 6, 6, 8], [3, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 10

Average minimal degree: 2.59

Total pinning sets: 435

Average overall degree: 3.05

Pinning number: 4

Table 529: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	2	0	0	0	0	0	0	9
Nonminimal pinning sets	0	8	58	110	120	83	36	9	1	425
Average degree	2.5	2.63	2.84	3.0	3.1	3.18	3.24	3.29	3.33	

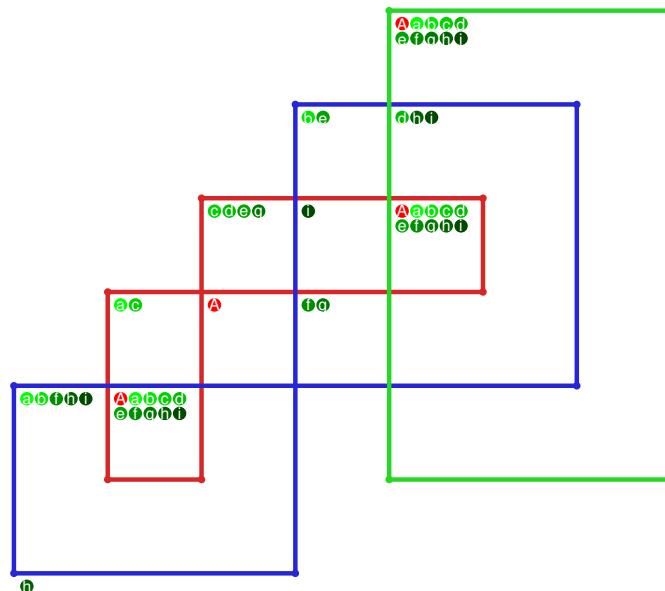


Figure 1061: SnapPy multiloop plot.

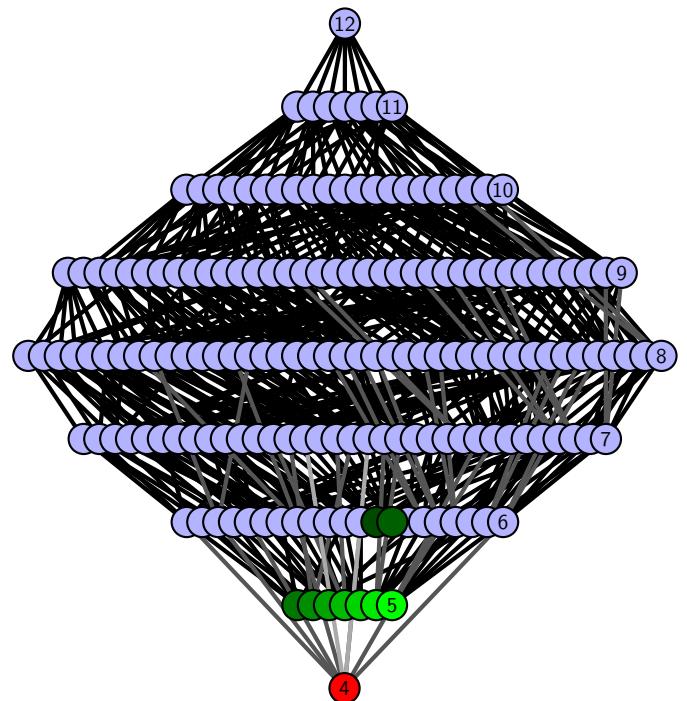


Figure 1062: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.234 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 10, 20, 11], [4, 10, 5, 9], [1, 12, 2, 13], [14, 12, 15, 11], [18, 7, 19, 8], [5, 17, 6, 16], [8, 15, 9, 16], [6, 17, 7, 18]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (6, 1, 7, 2), (16, 7, 17, 8), (8, 11, 9, 12), (18, 9, 19, 10), (5, 12, 6, 13), (13, 2, 14, 3), (3, 14, 4, 15), (20, 17, 1, 18), (10, 19, 11, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 9, 9], [3, 9, 9, 8], [3, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 448
 Pinning number: 4

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 3.05

Table 530: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	21	64	111	120	83	36	9	1	445
Average degree	2.33	2.65	2.85	3.0	3.1	3.18	3.24	3.29	3.33	

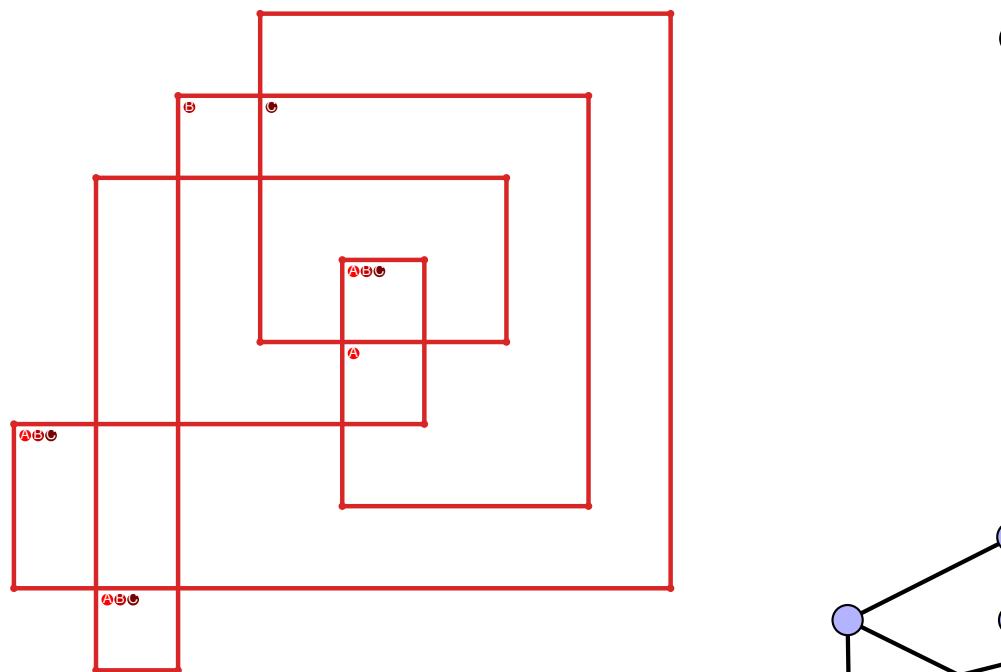


Figure 1063: SnapPy multiloop plot.

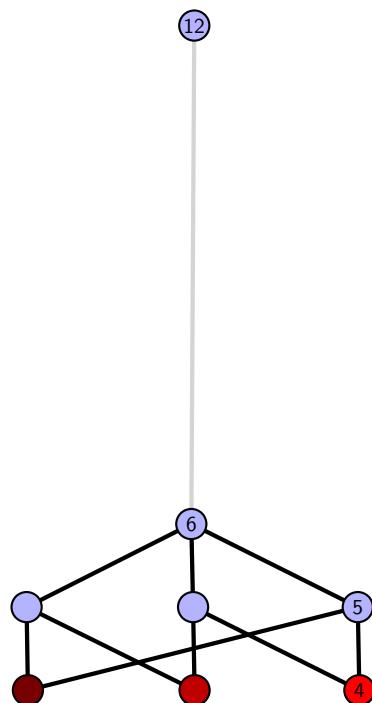


Figure 1064: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.235 $[[3, 20, 4, 1], [2, 11, 3, 12], [14, 19, 15, 20], [4, 15, 5, 16], [1, 13, 2, 12], [13, 10, 14, 11], [7, 18, 8, 19], [5, 8, 6, 9], [16, 9, 17, 10], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (3, 6, 4, 7), (14, 7, 15, 8), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (2, 13, 3, 14), (5, 16, 6, 17), (12, 17, 13, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 9, 9, 7], [3, 6, 9, 8], [3, 7, 9, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 508
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.76
 Average overall degree: 3.12

Table 531: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	1	0	0	0	0	0	0	7
Nonminimal pinning sets	0	8	60	127	148	103	43	10	1	500
Average degree	2.5	2.74	2.93	3.07	3.16	3.23	3.27	3.31	3.33	

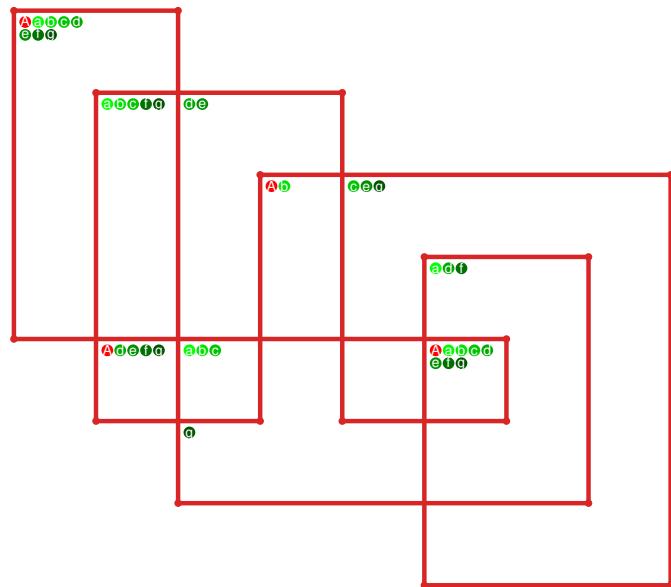


Figure 1065: SnapPy multiloop plot.

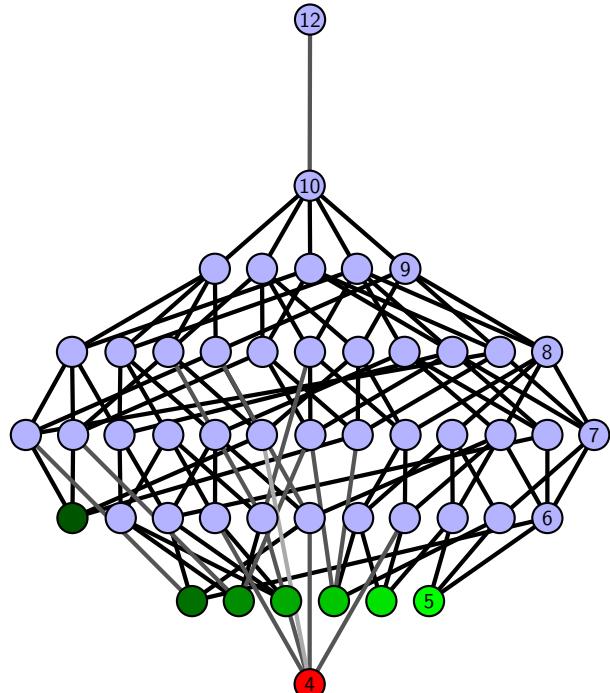


Figure 1066: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.236 $[[3, 20, 4, 1], [2, 9, 3, 10], [12, 19, 13, 20], [4, 13, 5, 14], [1, 11, 2, 10], [11, 8, 12, 9], [15, 18, 16, 19], [5, 16, 6, 17], [14, 7, 15, 8], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (12, 5, 13, 6), (9, 6, 10, 7), (20, 7, 1, 8), (8, 19, 9, 20), (2, 11, 3, 12), (3, 14, 4, 15), (13, 16, 14, 17), (10, 17, 11, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 5, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 2], [2, 8, 9, 7], [3, 6, 9, 9], [3, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 9
 Total pinning sets: 600
 Pinning number: 4

Average optimal degree: 2.62
 Average minimal degree: 2.72
 Average overall degree: 3.13

Table 532: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	0	7
Nonminimal pinning sets	0	16	85	157	168	110	44	10	1	591
Average degree	2.62	2.81	2.97	3.09	3.17	3.23	3.28	3.31	3.33	

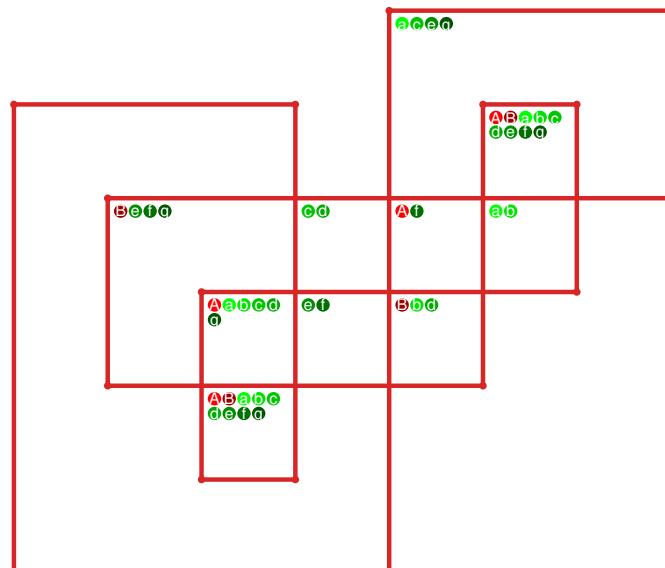


Figure 1067: SnapPy multiloop plot.

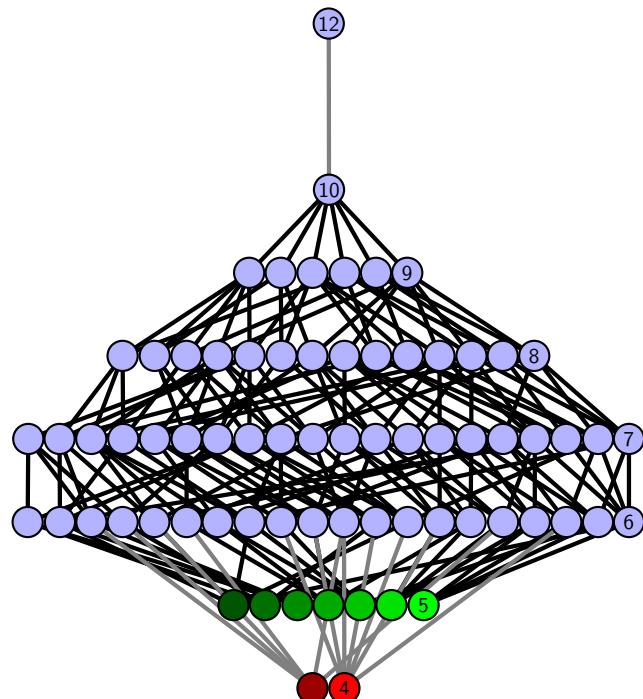


Figure 1068: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.237 $[[3, 14, 4, 1], [2, 7, 3, 8], [13, 20, 14, 15], [4, 20, 5, 19], [1, 9, 2, 8], [9, 6, 10, 7], [15, 12, 16, 13], [5, 18, 6, 19], [10, 18, 11, 17], [11, 16, 12, 17]]$

PD code drawn by SnapPy: $[(7, 4, 8, 5), (14, 5, 1, 6), (6, 13, 7, 14), (17, 10, 18, 11), (1, 12, 2, 13), (19, 8, 20, 9), (3, 20, 4, 15), (15, 2, 16, 3), (11, 16, 12, 17), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 7, 8], [2, 9, 9, 2], [3, 8, 5, 3], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 533: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

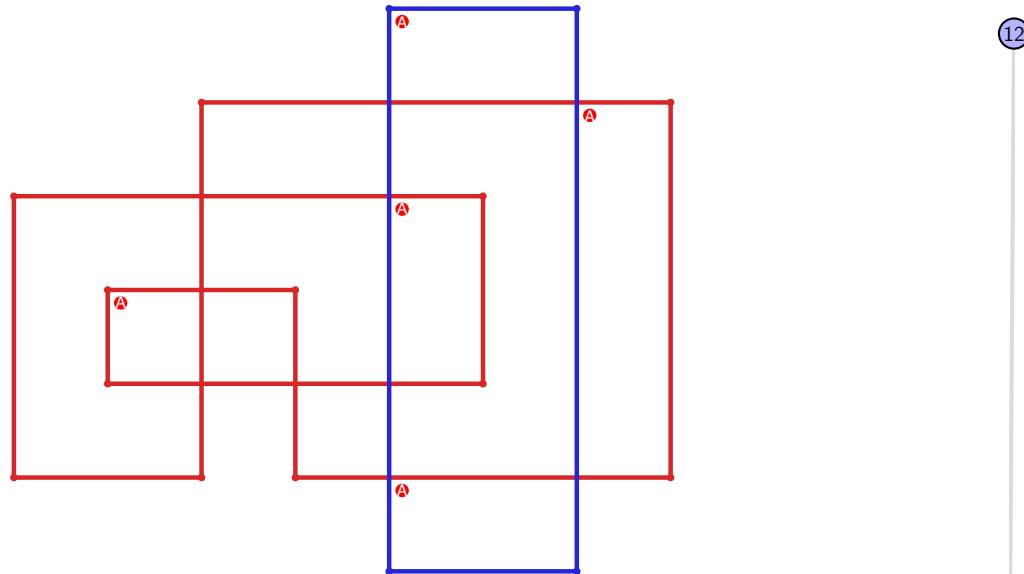


Figure 1069: SnapPy multiloop plot.

12
5

Figure 1070: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.238 [[3, 10, 4, 1], [2, 20, 3, 11], [15, 9, 16, 10], [4, 16, 5, 17], [1, 12, 2, 11], [12, 19, 13, 20], [8, 14, 9, 15], [5, 18, 6, 17], [6, 18, 7, 19], [13, 7, 14, 8]]

PD code drawn by `SnapPy`: [(14, 5, 15, 6), (16, 7, 17, 8), (1, 8, 2, 9), (6, 15, 7, 16), (2, 17, 3, 18), (18, 3, 19, 4), (4, 19, 5, 20), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 9], [2, 9, 9, 2], [3, 8, 8, 3], [5, 7, 7, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 534: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

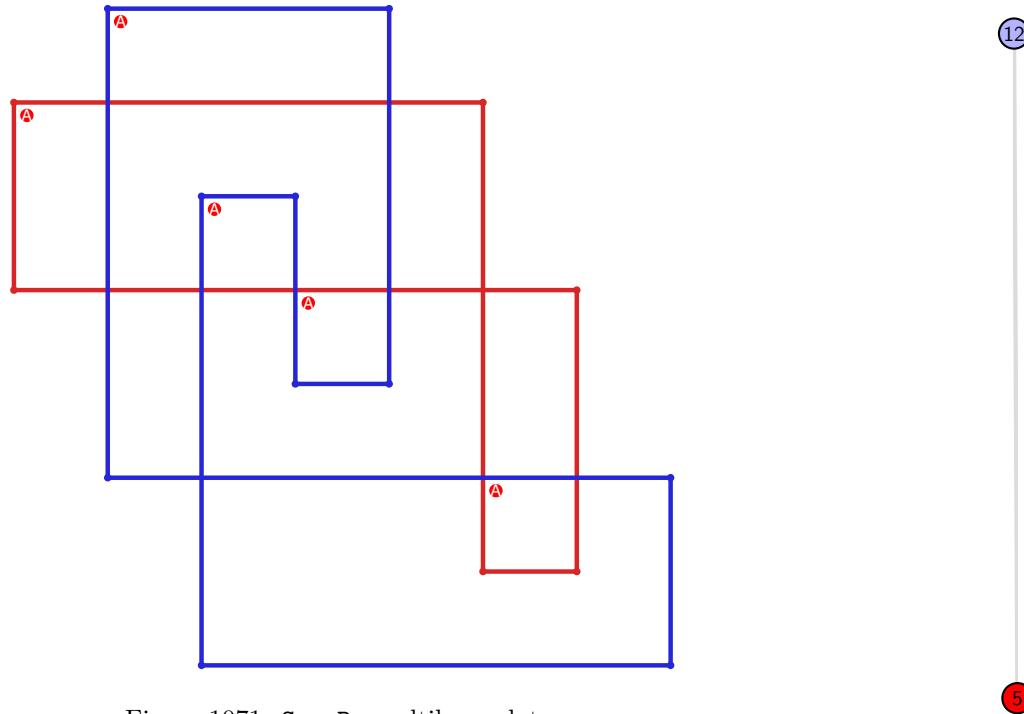


Figure 1071: `SnapPy` multiloop plot.

Figure 1072: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.239 $[[3, 20, 4, 1], [15, 2, 16, 3], [19, 4, 20, 5], [1, 14, 2, 15], [16, 14, 17, 13], [5, 11, 6, 10], [18, 9, 19, 10], [17, 9, 18, 8], [12, 7, 13, 8], [11, 7, 12, 6]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (3, 8, 4, 9), (9, 4, 10, 5), (5, 14, 6, 15), (15, 6, 16, 7), (7, 2, 8, 3), (10, 13, 11, 14), (18, 11, 19, 12), (20, 17, 1, 18), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 8], [2, 9, 9, 6], [2, 5, 7, 7], [4, 6, 6, 8], [4, 7, 9, 9], [5, 8, 8, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 535: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

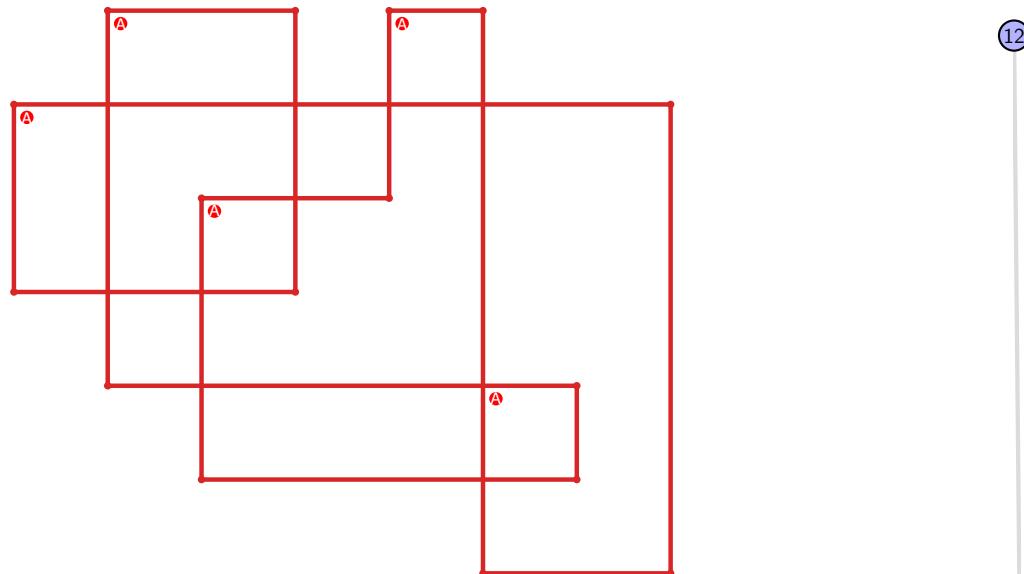


Figure 1073: SnapPy multiloop plot.

5

Figure 1074: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.240 $[[3, 16, 4, 1], [2, 9, 3, 10], [15, 4, 16, 5], [1, 11, 2, 10], [11, 8, 12, 9], [5, 14, 6, 15], [7, 20, 8, 17], [12, 20, 13, 19], [13, 18, 14, 19], [6, 18, 7, 17]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (9, 6, 10, 7), (16, 7, 1, 8), (8, 15, 9, 16), (3, 12, 4, 13), (1, 14, 2, 15), (19, 10, 20, 11), (5, 20, 6, 17), (17, 4, 18, 5), (11, 18, 12, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 8, 9, 2], [4, 9, 9, 7], [4, 6, 8, 8], [5, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 112
 Pinning number: 6

Average optimal degree: 2.22
 Average minimal degree: 2.22
 Average overall degree: 2.92

Table 536: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

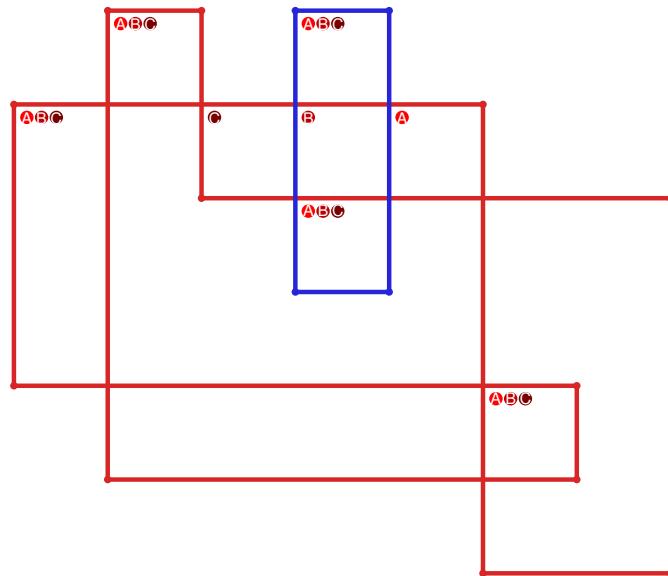


Figure 1075: SnapPy multiloop plot.

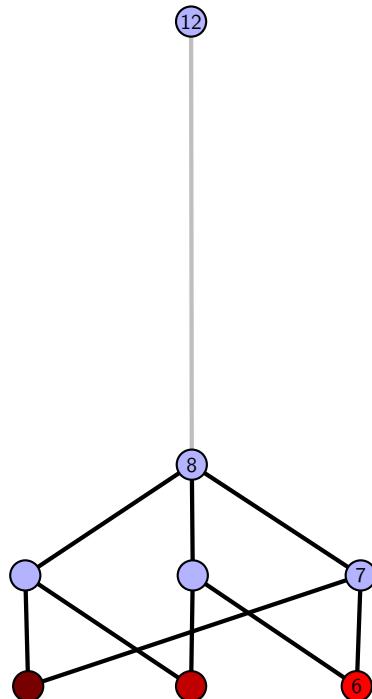


Figure 1076: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.241 $[[3, 16, 4, 1], [2, 9, 3, 10], [15, 4, 16, 5], [1, 11, 2, 10], [11, 8, 12, 9], [5, 17, 6, 20], [14, 19, 15, 20], [7, 12, 8, 13], [17, 7, 18, 6], [18, 13, 19, 14]]$

PD code drawn by `SnapPy`: $[(13, 2, 14, 3), (4, 17, 5, 18), (9, 6, 10, 7), (16, 7, 1, 8), (8, 15, 9, 16), (5, 10, 6, 11), (18, 11, 19, 12), (1, 14, 2, 15), (12, 19, 13, 20), (20, 3, 17, 4)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 8, 8, 6], [2, 5, 9, 9], [4, 9, 8, 4], [5, 7, 9, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 112
 Pinning number: 6

Average optimal degree: 2.22
 Average minimal degree: 2.22
 Average overall degree: 2.92

Table 537: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

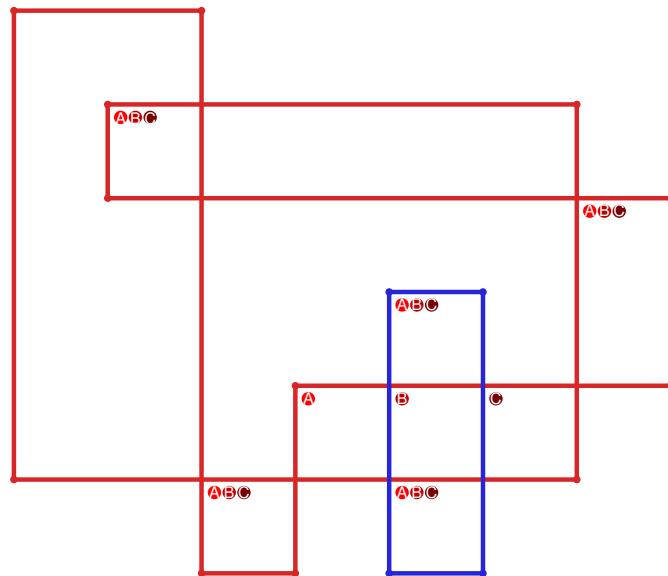


Figure 1077: `SnapPy` multiloop plot.

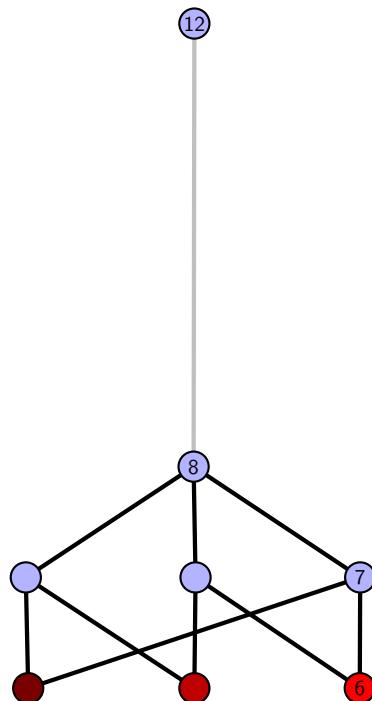


Figure 1078: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.242 $[[3, 20, 4, 1], [13, 2, 14, 3], [19, 4, 20, 5], [1, 12, 2, 13], [14, 12, 15, 11], [5, 9, 6, 8], [18, 7, 19, 8], [15, 10, 16, 11], [9, 16, 10, 17], [6, 17, 7, 18]]$

PD code drawn by SnapPy: $[(11, 20, 12, 1), (17, 2, 18, 3), (16, 5, 17, 6), (6, 3, 7, 4), (13, 8, 14, 9), (9, 12, 10, 13), (19, 10, 20, 11), (7, 14, 8, 15), (4, 15, 5, 16), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 8, 9, 6], [2, 5, 9, 9], [4, 8, 8, 4], [5, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 6

Table 538: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

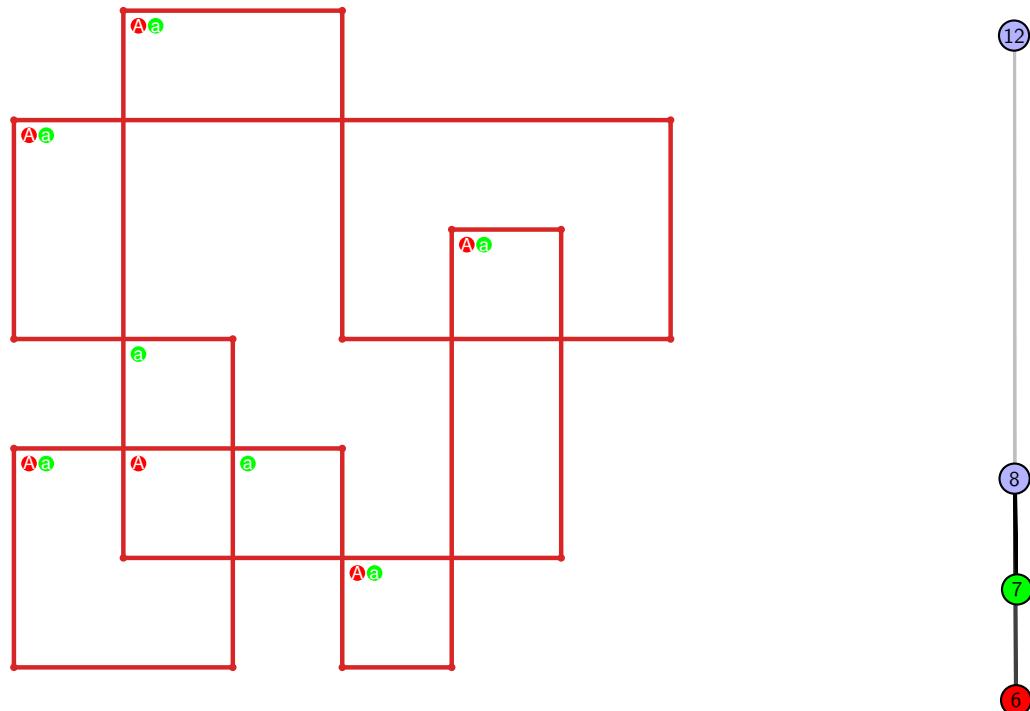


Figure 1079: SnapPy multiloop plot.

Figure 1080: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.243 $[[3, 20, 4, 1], [11, 2, 12, 3], [16, 19, 17, 20], [4, 17, 5, 18], [1, 10, 2, 11], [12, 10, 13, 9], [15, 6, 16, 7], [18, 5, 19, 6], [13, 8, 14, 9], [7, 14, 8, 15]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (16, 3, 17, 4), (13, 4, 14, 5), (11, 6, 12, 7), (7, 10, 8, 11), (19, 8, 20, 9), (5, 12, 6, 13), (2, 15, 3, 16), (14, 17, 15, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 8], [2, 9, 9, 7], [2, 6, 3, 3], [5, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 80
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.23
 Average overall degree: 2.91

Table 539: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

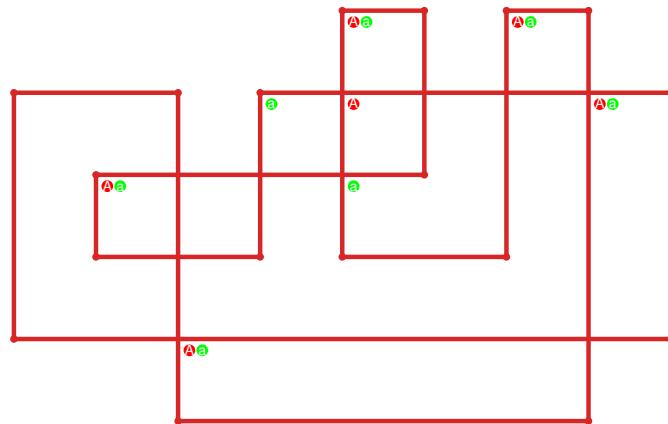


Figure 1081: SnapPy multiloop plot.



Figure 1082: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.244 [[12, 20, 1, 13], [13, 6, 14, 5], [8, 11, 9, 12], [9, 19, 10, 20], [1, 7, 2, 6], [14, 4, 15, 5], [17, 7, 18, 8], [18, 10, 19, 11], [2, 17, 3, 16], [3, 15, 4, 16]]

PD code drawn by SnapPy: [(19, 2, 20, 3), (3, 18, 4, 19), (4, 11, 5, 12), (14, 5, 15, 6), (15, 8, 16, 9), (6, 9, 7, 10), (1, 20, 2, 13), (13, 12, 14, 1), (7, 16, 8, 17), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 6, 8, 1], [1, 9, 9, 1], [2, 8, 4, 7], [2, 6, 3, 3], [4, 6, 9, 9], [5, 8, 8, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 540: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

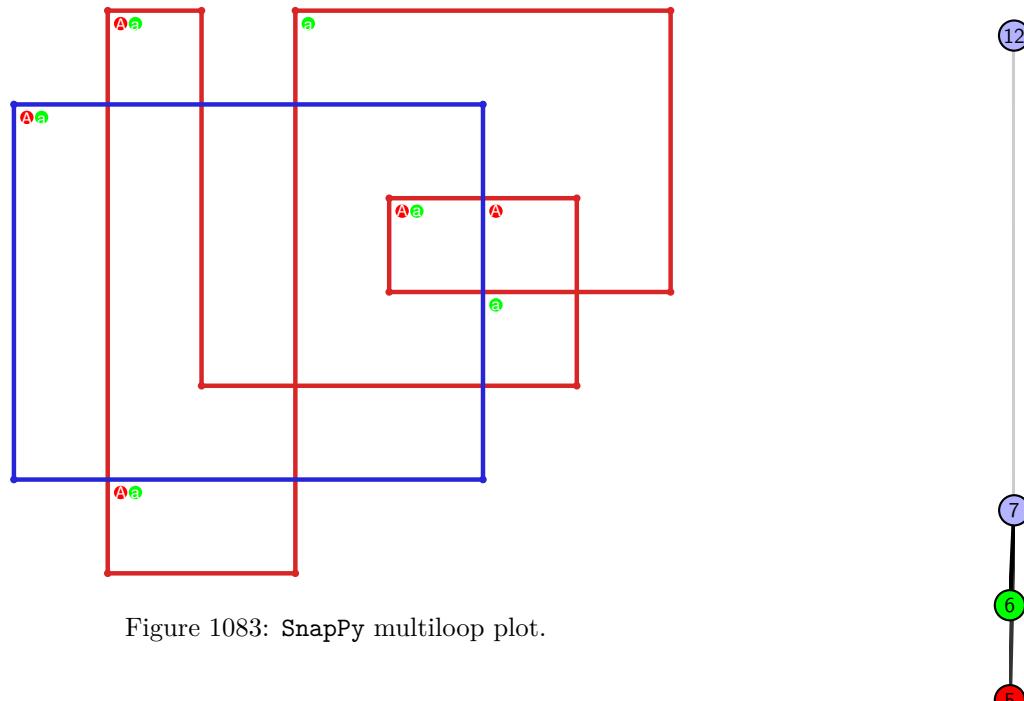


Figure 1083: SnapPy multiloop plot.

Figure 1084: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.245 [[8, 20, 1, 9], [9, 14, 10, 15], [4, 7, 5, 8], [5, 19, 6, 20], [1, 13, 2, 14], [10, 16, 11, 15], [17, 3, 18, 4], [18, 6, 19, 7], [12, 2, 13, 3], [16, 12, 17, 11]]

PD code drawn by `SnapPy`: [(9, 8, 10, 1), (14, 1, 15, 2), (15, 4, 16, 5), (2, 5, 3, 6), (20, 13, 9, 14), (7, 10, 8, 11), (18, 11, 19, 12), (12, 19, 13, 20), (3, 16, 4, 17), (6, 17, 7, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 8, 8, 1], [1, 9, 9, 1], [2, 9, 8, 7], [2, 6, 3, 3], [4, 6, 9, 4], [5, 8, 6, 5]]

Total optimal pinning sets: 1
Total minimal pinning sets: 2

Total pinning sets: 160

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.27

Average overall degree: 2.97

Table 541: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

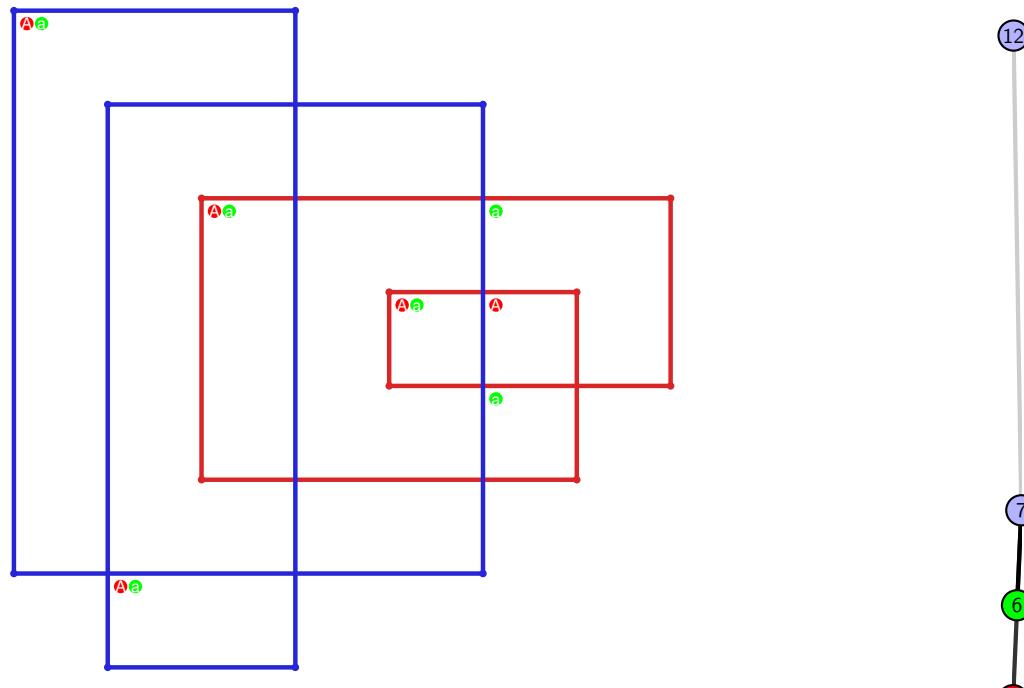


Figure 1085: `SnapPy` multiloop plot.

Figure 1086: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.246 $[[5, 20, 6, 1], [11, 4, 12, 5], [16, 19, 17, 20], [6, 17, 7, 18], [1, 10, 2, 11], [3, 12, 4, 13], [15, 8, 16, 9], [18, 7, 19, 8], [9, 14, 10, 15], [2, 14, 3, 13]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (15, 4, 16, 5), (12, 5, 13, 6), (18, 7, 19, 8), (20, 9, 1, 10), (10, 19, 11, 20), (6, 11, 7, 12), (3, 14, 4, 15), (13, 16, 14, 17), (2, 17, 3, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 8, 9, 1], [1, 9, 9, 1], [2, 8, 8, 7], [2, 6, 3, 3], [4, 6, 6, 9], [4, 8, 5, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 542: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

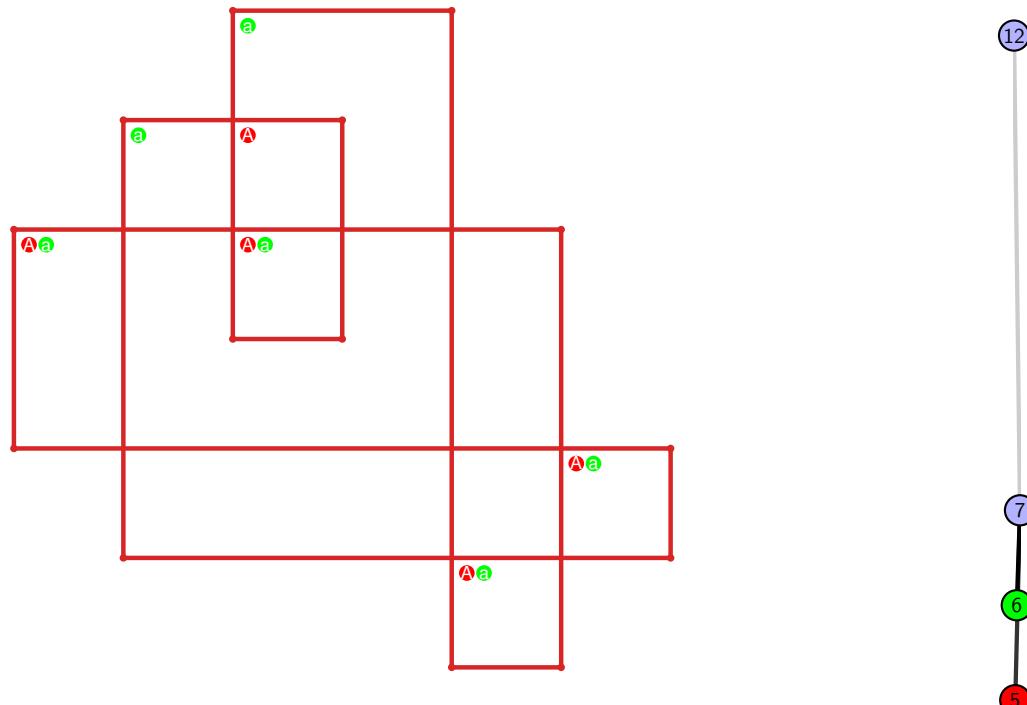


Figure 1087: `SnapPy` multiloop plot.

Figure 1088: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.247 `[[5, 10, 6, 1], [4, 20, 5, 11], [13, 9, 14, 10], [6, 14, 7, 15], [1, 12, 2, 11], [19, 3, 20, 4], [12, 17, 13, 18], [8, 16, 9, 17], [7, 16, 8, 15], [2, 18, 3, 19]]`

PD code drawn by `SnapPy`: `[(11, 10, 12, 1), (15, 6, 16, 7), (2, 7, 3, 8), (3, 16, 4, 17), (17, 4, 18, 5), (5, 18, 6, 19), (14, 19, 15, 20), (9, 20, 10, 11), (1, 12, 2, 13), (13, 8, 14, 9)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 8, 8], [0, 6, 9, 1], [1, 9, 9, 1], [2, 9, 4, 7], [2, 6, 8, 8], [3, 7, 7, 3], [4, 6, 5, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 543: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

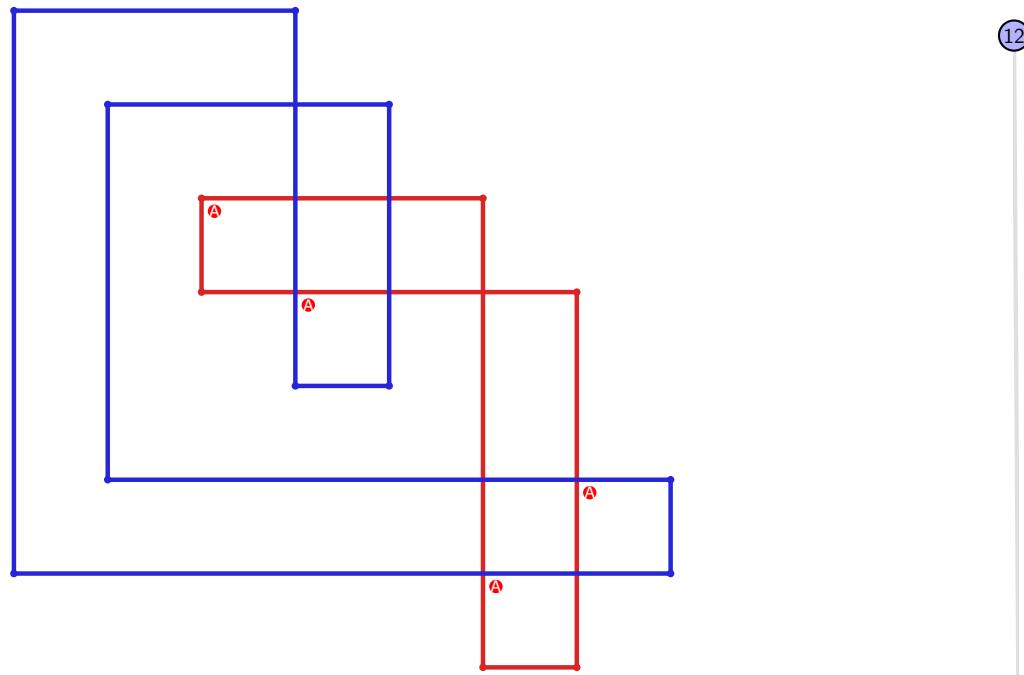


Figure 1089: `SnapPy` multiloop plot.

Figure 1090: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.248 $[[5, 16, 6, 1], [4, 11, 5, 12], [15, 20, 16, 17], [6, 20, 7, 19], [1, 13, 2, 12], [10, 3, 11, 4], [17, 14, 18, 15], [7, 18, 8, 19], [13, 8, 14, 9], [2, 9, 3, 10]]$

PD code drawn by `SnapPy`: $[(7, 16, 8, 1), (10, 5, 11, 6), (15, 6, 16, 7), (1, 8, 2, 9), (9, 14, 10, 15), (20, 11, 17, 12), (2, 13, 3, 14), (4, 17, 5, 18), (18, 3, 19, 4), (12, 19, 13, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 7], [0, 8, 9, 1], [1, 9, 9, 1], [2, 8, 7, 2], [3, 6, 8, 3], [4, 7, 6, 9], [4, 8, 5, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 544: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

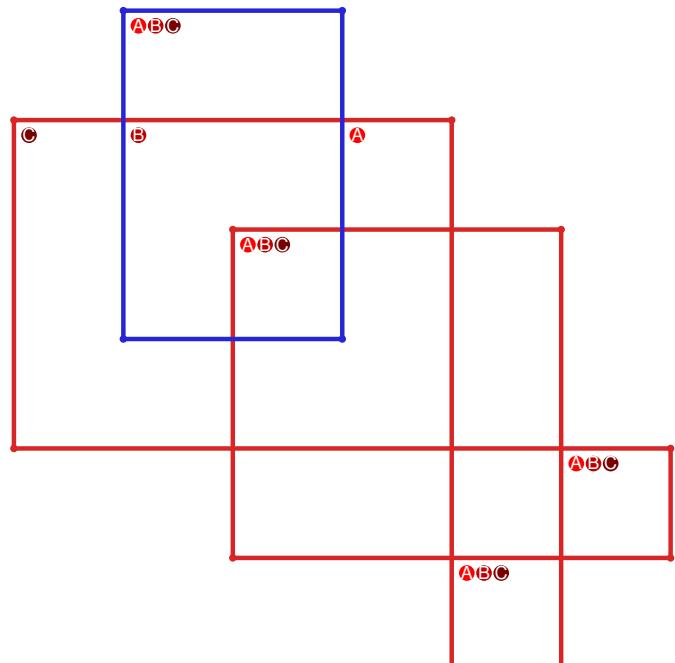


Figure 1091: `SnapPy` multiloop plot.

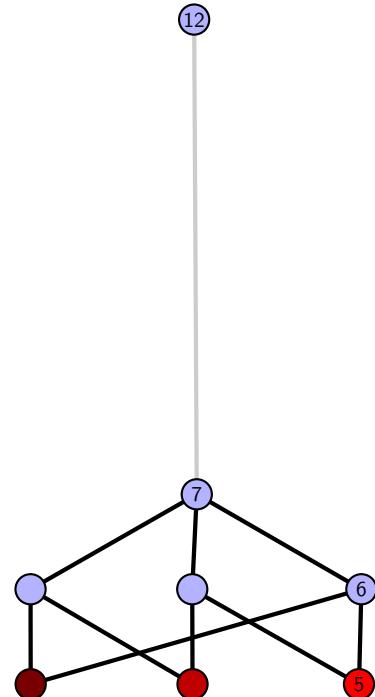


Figure 1092: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.249 $[[14, 20, 1, 15], [15, 6, 16, 5], [10, 13, 11, 14], [11, 19, 12, 20], [1, 7, 2, 6], [16, 4, 17, 5], [17, 9, 18, 10], [18, 12, 19, 13], [7, 3, 8, 2], [8, 3, 9, 4]]$

PD code drawn by `SnapPy`: $[(5, 14, 6, 1), (16, 1, 17, 2), (2, 15, 3, 16), (3, 12, 4, 13), (17, 6, 18, 7), (18, 9, 19, 10), (7, 10, 8, 11), (13, 4, 14, 5), (8, 19, 9, 20), (11, 20, 12, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 7], [0, 8, 8, 1], [1, 9, 6, 1], [2, 5, 9, 7], [2, 6, 3, 3], [4, 9, 9, 4], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 545: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

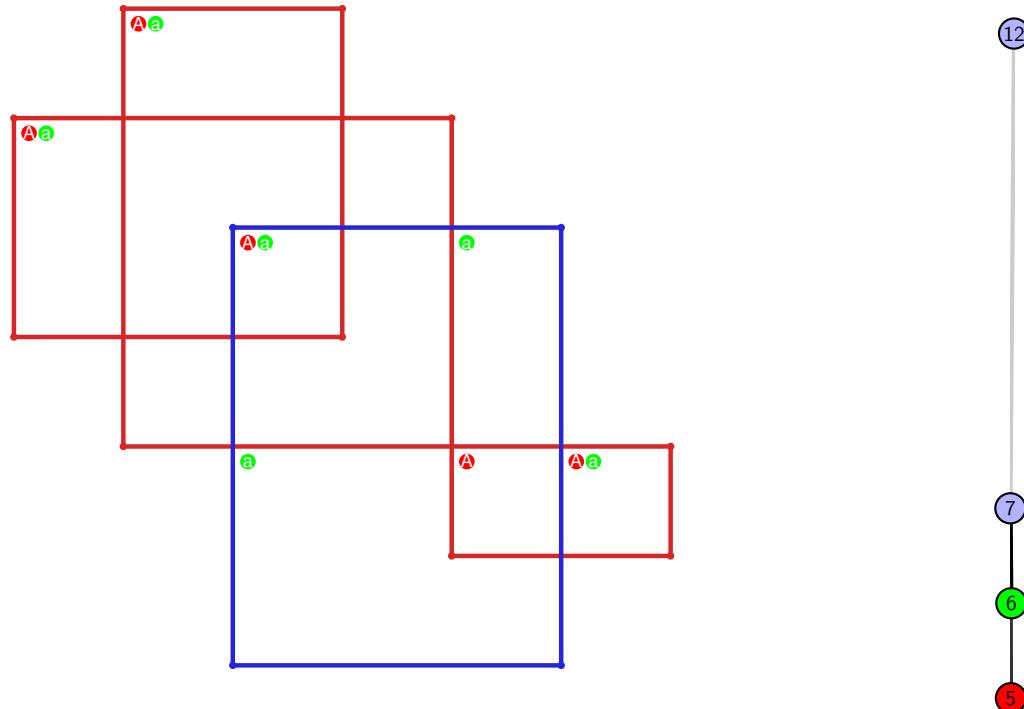


Figure 1093: `SnapPy` multiloop plot.

Figure 1094: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.250 $[[4, 20, 1, 5], [5, 12, 6, 13], [19, 3, 20, 4], [1, 11, 2, 12], [6, 14, 7, 13], [9, 18, 10, 19], [10, 2, 11, 3], [14, 18, 15, 17], [7, 17, 8, 16], [8, 15, 9, 16]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (14, 1, 15, 2), (3, 6, 4, 7), (16, 7, 17, 8), (8, 17, 9, 18), (19, 10, 20, 11), (11, 18, 12, 19), (12, 9, 13, 10), (20, 13, 5, 14), (2, 15, 3, 16)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 4], [0, 5, 6, 0], [0, 6, 6, 1], [1, 7, 8, 1], [2, 9, 7, 6], [2, 5, 3, 3], [4, 5, 9, 8], [4, 7, 9, 9], [5, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 6
 Total pinning sets: 140
 Pinning number: 6

Average optimal degree: 2.39
 Average minimal degree: 2.43
 Average overall degree: 2.98

Table 546: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	15	40	44	26	8	1	134
Average degree	2.39	2.65	2.89	3.06	3.18	3.27	3.33	

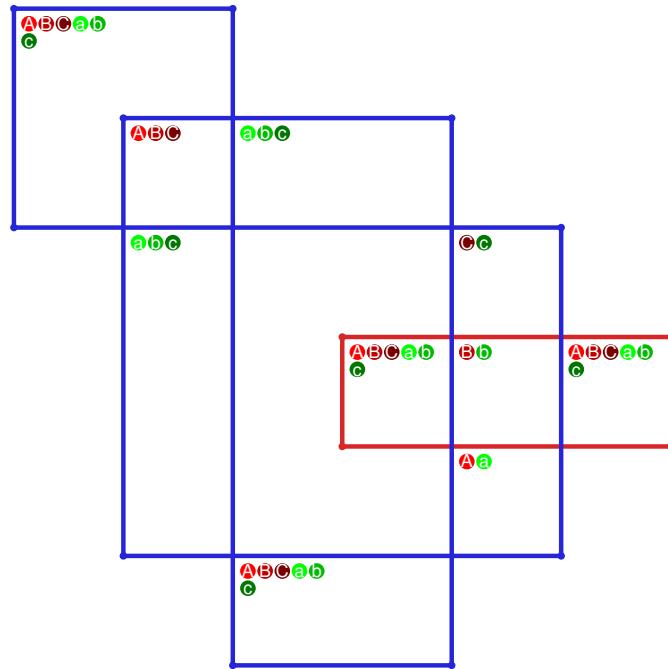


Figure 1095: SnapPy multiloop plot.

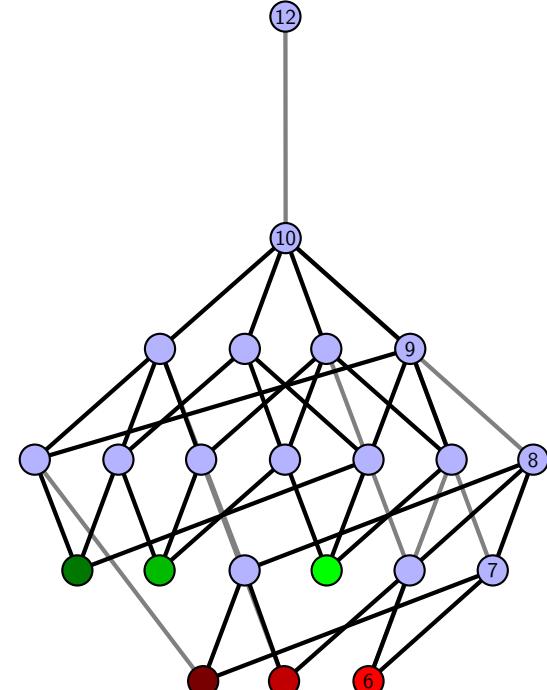


Figure 1096: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.251 $[[4, 10, 1, 5], [5, 11, 6, 16], [9, 3, 10, 4], [1, 12, 2, 11], [6, 17, 7, 20], [15, 19, 16, 20], [8, 13, 9, 14], [2, 12, 3, 13], [17, 8, 18, 7], [18, 14, 19, 15]]$

PD code drawn by SnapPy: $[(16, 1, 11, 2), (2, 11, 3, 12), (14, 19, 15, 20), (20, 7, 17, 8), (9, 12, 10, 13), (10, 3, 5, 4), (4, 5, 1, 6), (15, 6, 16, 7), (8, 17, 9, 18), (18, 13, 19, 14)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 7, 7, 1], [1, 8, 8, 5], [1, 4, 9, 9], [2, 9, 8, 7], [2, 6, 3, 3], [4, 6, 9, 4], [5, 8, 6, 5]]$

Total optimal pinning sets: 9
 Total minimal pinning sets: 9
 Total pinning sets: 196
 Pinning number: 6

Average optimal degree: 2.44
 Average minimal degree: 2.44
 Average overall degree: 2.99

Table 547: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	9	0	0	0	0	0	0	9
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	36	60	54	28	8	1	187
Average degree	2.44	2.76	2.97	3.1	3.2	3.27	3.33	

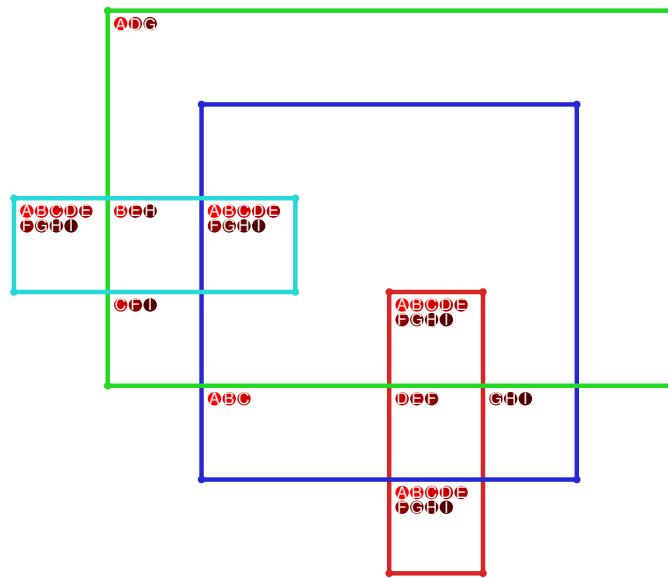


Figure 1097: SnapPy multiloop plot.

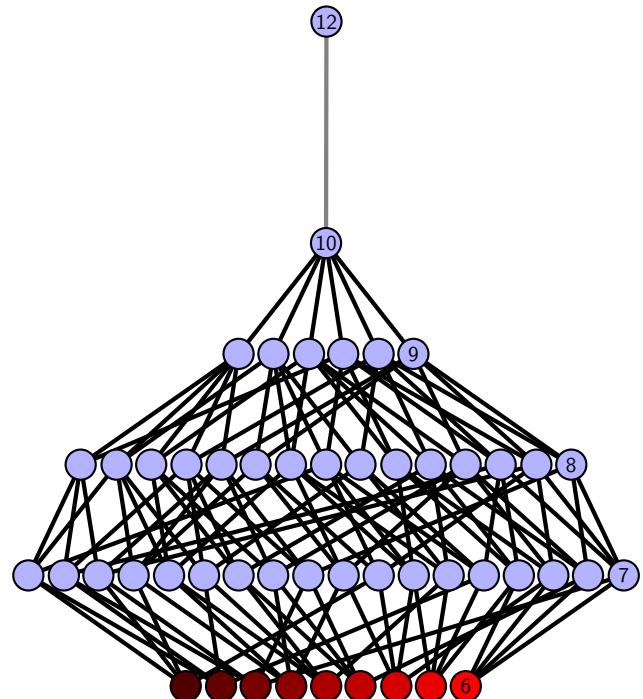


Figure 1098: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.252 [[12, 3, 1, 4], [4, 13, 5, 20], [11, 15, 12, 16], [2, 14, 3, 15], [1, 14, 2, 13], [5, 9, 6, 8], [19, 7, 20, 8], [16, 10, 17, 11], [9, 17, 10, 18], [6, 18, 7, 19]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (18, 5, 19, 6), (6, 3, 7, 4), (15, 8, 16, 9), (7, 16, 8, 17), (4, 17, 5, 18), (19, 2, 20, 3), (20, 11, 13, 12), (12, 13, 1, 14), (9, 14, 10, 15)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 3], [0, 2, 4, 4], [0, 3, 3, 1], [1, 8, 9, 6], [1, 5, 9, 9], [2, 8, 8, 2], [5, 7, 7, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.42

Total pinning sets: 100

Average overall degree: 2.97

Pinning number: 6

Table 548: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	6	23	34	24	8	1	96
Average degree	2.33	2.57	2.79	3.0	3.17	3.27	3.33	

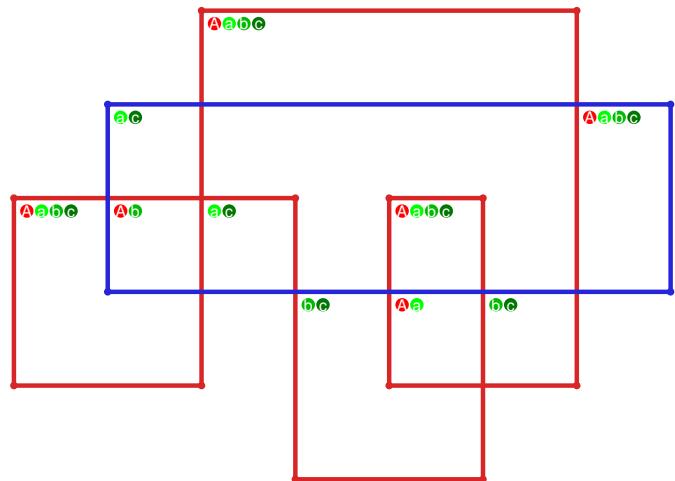


Figure 1099: SnapPy multiloop plot.

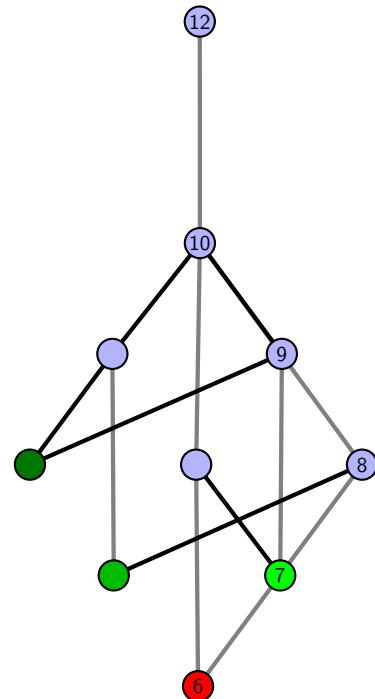


Figure 1100: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.253 [[10, 3, 1, 4], [4, 11, 5, 20], [9, 13, 10, 14], [2, 12, 3, 13], [1, 12, 2, 11], [5, 19, 6, 20], [14, 8, 15, 9], [15, 18, 16, 19], [6, 16, 7, 17], [17, 7, 18, 8]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (16, 5, 17, 6), (13, 6, 14, 7), (4, 15, 5, 16), (14, 17, 15, 18), (3, 18, 4, 19), (19, 2, 20, 3), (20, 9, 11, 10), (10, 11, 1, 12), (7, 12, 8, 13)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 4, 4], [0, 3, 3, 1], [1, 7, 8, 1], [2, 9, 7, 2], [5, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 100
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.42
 Average overall degree: 2.97

Table 549: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	6	23	34	24	8	1	96
Average degree	2.33	2.57	2.79	3.0	3.17	3.27	3.33	

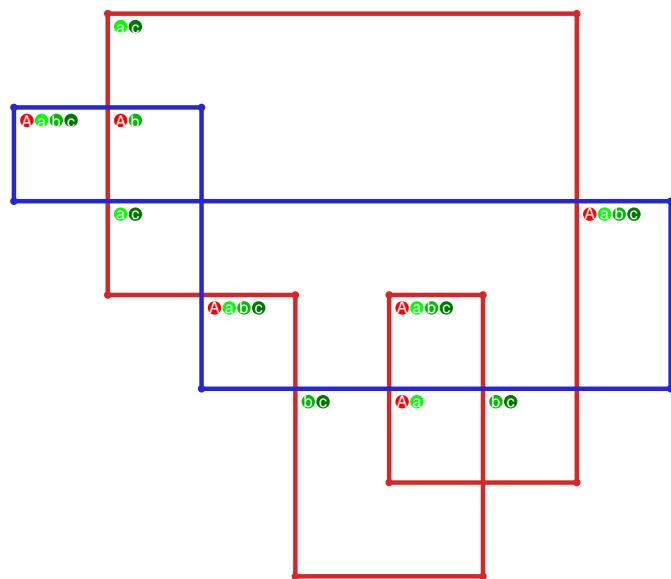


Figure 1101: SnapPy multiloop plot.

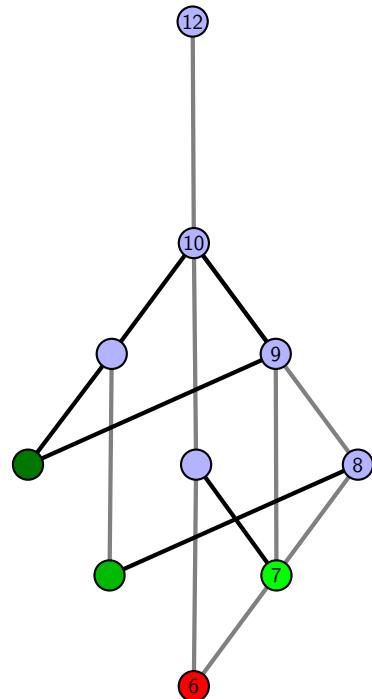


Figure 1102: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.254 [[10, 20, 1, 11], [11, 6, 12, 5], [19, 9, 20, 10], [1, 7, 2, 6], [12, 16, 13, 15], [4, 14, 5, 15], [8, 18, 9, 19], [7, 18, 8, 17], [2, 17, 3, 16], [13, 3, 14, 4]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (2, 19, 3, 20), (3, 8, 4, 9), (17, 6, 18, 7), (1, 12, 2, 13), (13, 20, 14, 11), (14, 9, 15, 10), (15, 4, 16, 5), (5, 16, 6, 17), (7, 18, 8, 19)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 7, 8, 1], [1, 8, 9, 5], [1, 4, 9, 9], [2, 7, 7, 2], [3, 6, 6, 8], [3, 7, 9, 4], [4, 8, 5, 5]]

Total optimal pinning sets: 2
Total minimal pinning sets: 5
Total pinning sets: 132
Pinning number: 6

Average optimal degree: 2.42
Average minimal degree: 2.42
Average overall degree: 2.99

Table 550: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	12	37	43	26	8	1	127
Average degree	2.42	2.63	2.87	3.06	3.18	3.27	3.33	

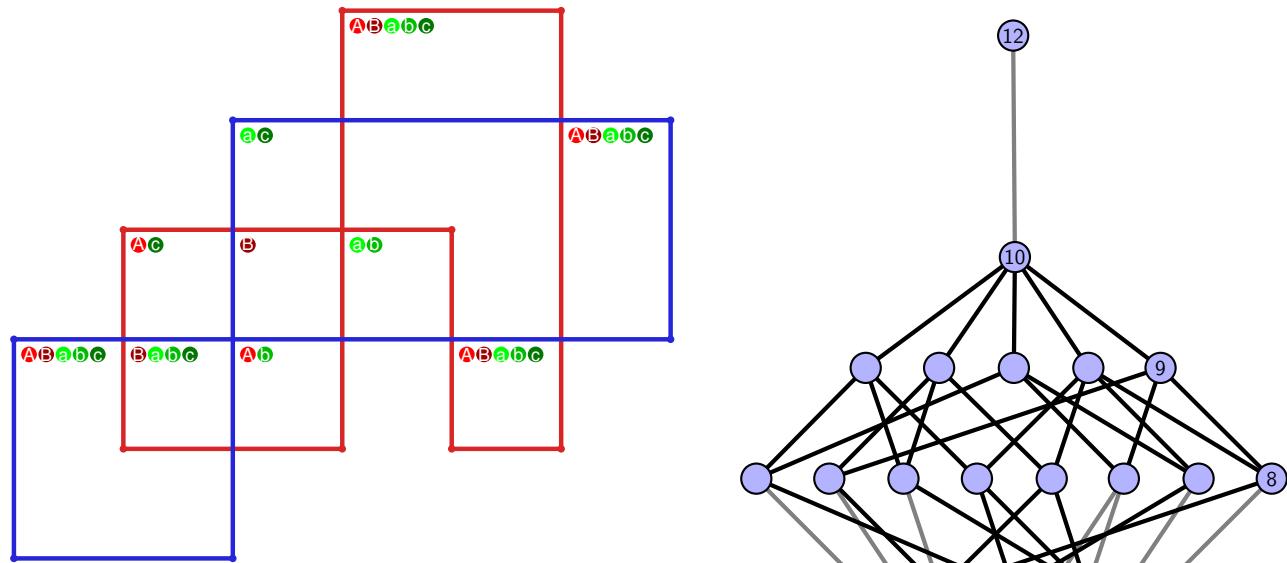


Figure 1103: SnapPy multiloop plot.

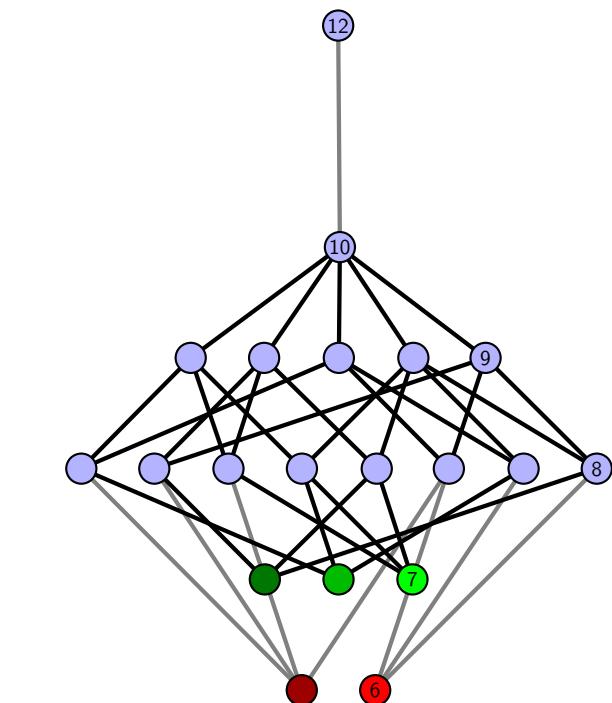


Figure 1104: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.255 $[[7, 20, 8, 1], [11, 6, 12, 7], [19, 8, 20, 9], [1, 10, 2, 11], [5, 12, 6, 13], [9, 18, 10, 19], [2, 18, 3, 17], [13, 17, 14, 16], [4, 15, 5, 16], [3, 15, 4, 14]]$

PD code drawn by SnapPy: $[(8, 3, 9, 4), (16, 5, 17, 6), (18, 7, 19, 8), (2, 9, 3, 10), (11, 20, 12, 1), (1, 12, 2, 13), (13, 10, 14, 11), (14, 19, 15, 20), (6, 15, 7, 16), (4, 17, 5, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 4], [0, 5, 5, 0], [0, 5, 6, 1], [1, 7, 8, 1], [2, 6, 3, 2], [3, 5, 9, 7], [4, 6, 9, 8], [4, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 6
Total minimal pinning sets: 6
Total pinning sets: 156
Pinning number: 6

Average optimal degree: 2.42
Average minimal degree: 2.42
Average overall degree: 2.98

Table 551: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	25	45	45	26	8	1	150
Average degree	2.42	2.72	2.92	3.07	3.18	3.27	3.33	

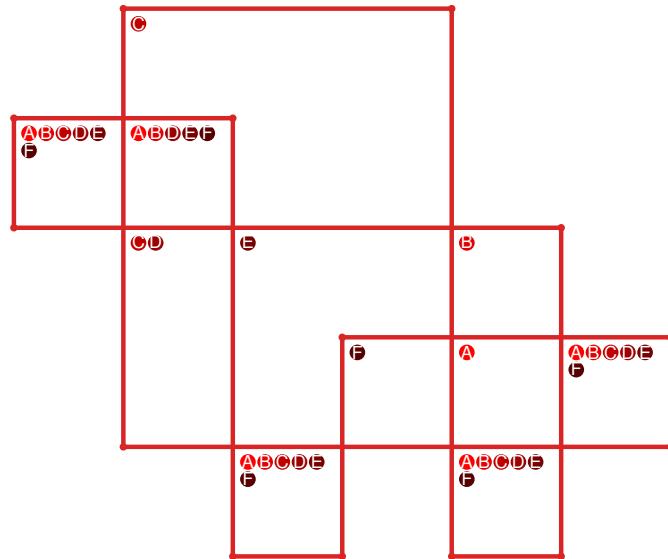


Figure 1105: SnapPy multiloop plot.

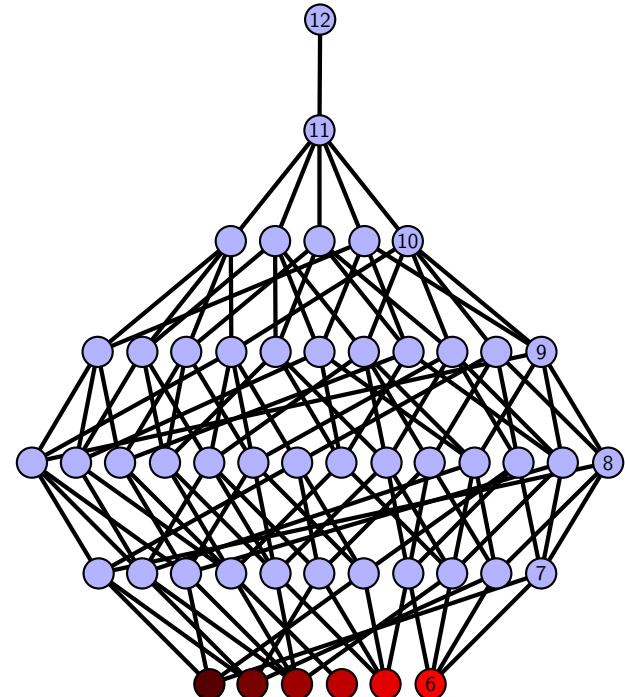


Figure 1106: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.256 [[10, 20, 1, 11], [11, 17, 12, 16], [19, 9, 20, 10], [1, 18, 2, 17], [12, 7, 13, 6], [15, 5, 16, 6], [8, 18, 9, 19], [2, 8, 3, 7], [13, 3, 14, 4], [4, 14, 5, 15]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (13, 2, 14, 3), (3, 20, 4, 11), (4, 9, 5, 10), (17, 6, 18, 7), (1, 12, 2, 13), (14, 19, 15, 20), (15, 8, 16, 9), (5, 16, 6, 17), (7, 18, 8, 19)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 6, 7, 1], [1, 7, 8, 5], [1, 4, 9, 9], [2, 7, 3, 2], [3, 6, 8, 4], [4, 7, 9, 9], [5, 8, 8, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.44

Total pinning sets: 192

Average overall degree: 3.0

Pinning number: 5

Table 552: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	2	0	0	0	0	0	4
Nonminimal pinning sets	0	7	31	58	54	28	8	1	187
Average degree	2.4	2.59	2.77	2.96	3.1	3.2	3.27	3.33	

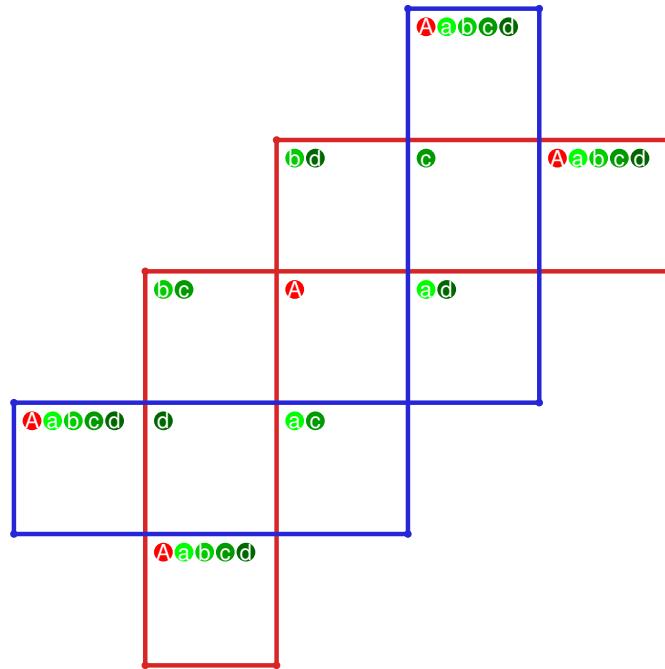


Figure 1107: SnapPy multiloop plot.

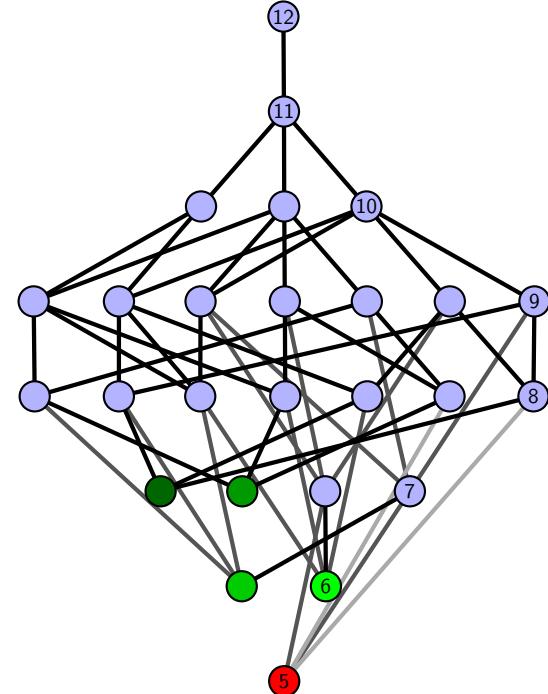


Figure 1108: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.257 $[[10, 20, 1, 11], [11, 8, 12, 7], [19, 9, 20, 10], [1, 9, 2, 8], [12, 6, 13, 7], [18, 2, 19, 3], [5, 13, 6, 14], [3, 16, 4, 15], [17, 14, 18, 15], [4, 16, 5, 17]]$

PD code drawn by SnapPy: $[(11, 10, 12, 1), (15, 4, 16, 5), (5, 14, 6, 15), (6, 9, 7, 10), (12, 7, 13, 8), (3, 16, 4, 17), (20, 17, 11, 18), (18, 1, 19, 2), (2, 19, 3, 20), (8, 13, 9, 14)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 4], [0, 5, 3, 0], [0, 2, 5, 1], [1, 6, 6, 1], [2, 7, 8, 3], [4, 8, 9, 4], [5, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.42

Total pinning sets: 100

Average overall degree: 2.97

Pinning number: 6

Table 553: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	6	23	34	24	8	1	96
Average degree	2.33	2.57	2.79	3.0	3.17	3.27	3.33	

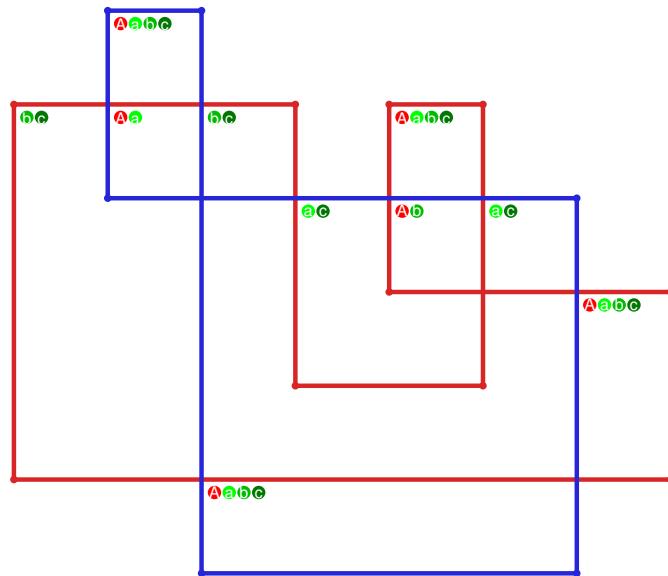


Figure 1109: SnapPy multiloop plot.

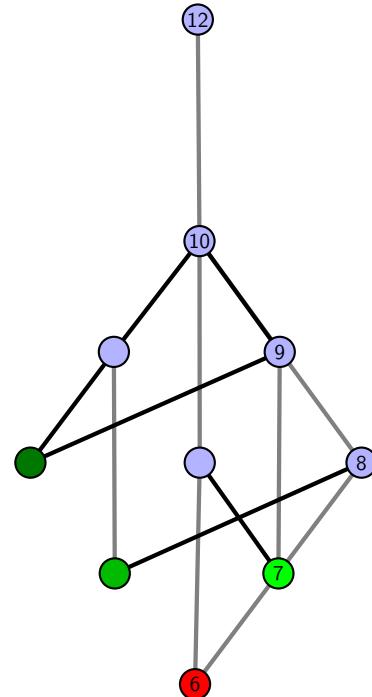


Figure 1110: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.258 [[12, 20, 1, 13], [13, 10, 14, 9], [19, 11, 20, 12], [1, 11, 2, 10], [14, 8, 15, 9], [18, 2, 19, 3], [4, 7, 5, 8], [15, 5, 16, 6], [3, 17, 4, 18], [6, 16, 7, 17]]

PD code drawn by SnapPy: [(13, 12, 14, 1), (18, 3, 19, 4), (2, 5, 3, 6), (17, 6, 18, 7), (7, 16, 8, 17), (8, 11, 9, 12), (14, 9, 15, 10), (4, 19, 5, 20), (1, 20, 2, 13), (10, 15, 11, 16)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 4], [0, 5, 3, 0], [0, 2, 5, 1], [1, 6, 7, 1], [2, 8, 8, 3], [4, 8, 9, 7], [4, 6, 9, 9], [5, 9, 6, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 100
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.42
 Average overall degree: 2.97

Table 554: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	3
Nonminimal pinning sets	0	6	23	34	24	8	1	96
Average degree	2.33	2.57	2.79	3.0	3.17	3.27	3.33	

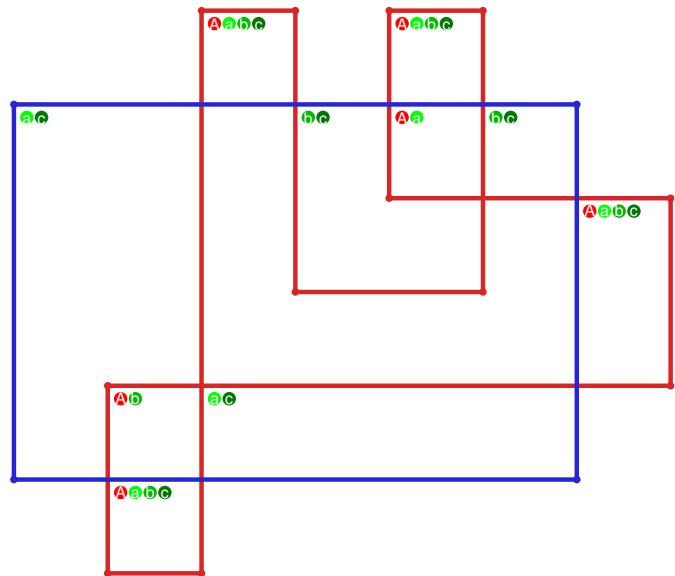


Figure 1111: SnapPy multiloop plot.

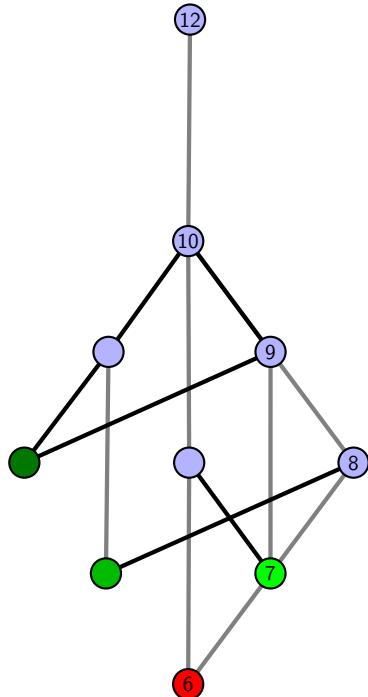


Figure 1112: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.259 $[[6, 20, 1, 7], [7, 19, 8, 18], [5, 2, 6, 3], [19, 1, 20, 2], [8, 17, 9, 18], [3, 14, 4, 13], [4, 12, 5, 13], [16, 9, 17, 10], [14, 11, 15, 12], [10, 15, 11, 16]]$

PD code drawn by SnapPy: $[(13, 4, 14, 5), (2, 5, 3, 6), (10, 17, 11, 18), (8, 19, 9, 20), (1, 20, 2, 7), (7, 6, 8, 1), (18, 9, 19, 10), (16, 11, 17, 12), (12, 15, 13, 16), (3, 14, 4, 15)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 6, 3], [0, 2, 1, 0], [1, 7, 7, 1], [2, 8, 6, 6], [2, 5, 5, 8], [4, 9, 9, 4], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 555: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

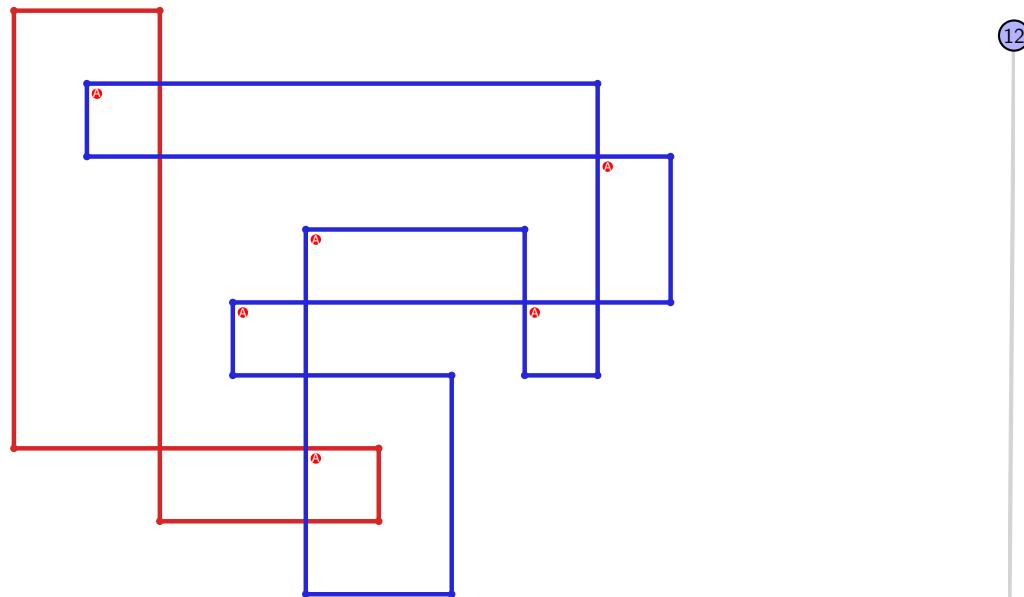


Figure 1113: SnapPy multiloop plot.

6

Figure 1114: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.260 $[[3, 12, 4, 1], [2, 20, 3, 13], [11, 4, 12, 5], [1, 14, 2, 13], [14, 19, 15, 20], [5, 10, 6, 11], [18, 15, 19, 16], [9, 6, 10, 7], [16, 9, 17, 8], [17, 7, 18, 8]]$

PD code drawn by SnapPy: $[(9, 2, 10, 3), (7, 4, 8, 5), (18, 5, 19, 6), (6, 17, 7, 18), (3, 8, 4, 9), (1, 10, 2, 11), (19, 16, 20, 17), (15, 20, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 4, 1, 1], [1, 3, 6, 6], [2, 7, 7, 2], [4, 8, 9, 4], [5, 9, 8, 5], [6, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 556: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

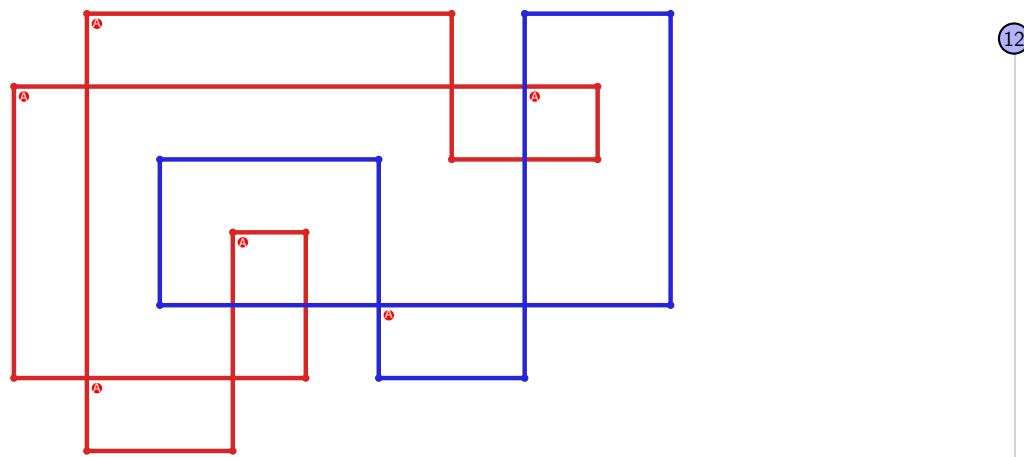


Figure 1115: SnapPy multiloop plot.

6

Figure 1116: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.261 $[[3, 14, 4, 1], [2, 20, 3, 15], [13, 6, 14, 7], [4, 12, 5, 11], [1, 16, 2, 15], [16, 19, 17, 20], [7, 10, 8, 11], [5, 12, 6, 13], [8, 18, 9, 19], [17, 9, 18, 10]]$

PD code drawn by SnapPy: $[(11, 4, 12, 5), (18, 7, 19, 8), (5, 8, 6, 9), (9, 2, 10, 3), (3, 10, 4, 11), (1, 12, 2, 13), (6, 19, 7, 20), (17, 20, 18, 15), (14, 15, 1, 16), (16, 13, 17, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 7, 6], [0, 5, 1, 1], [1, 4, 8, 9], [2, 9, 8, 3], [2, 3, 3, 2], [5, 6, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 557: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

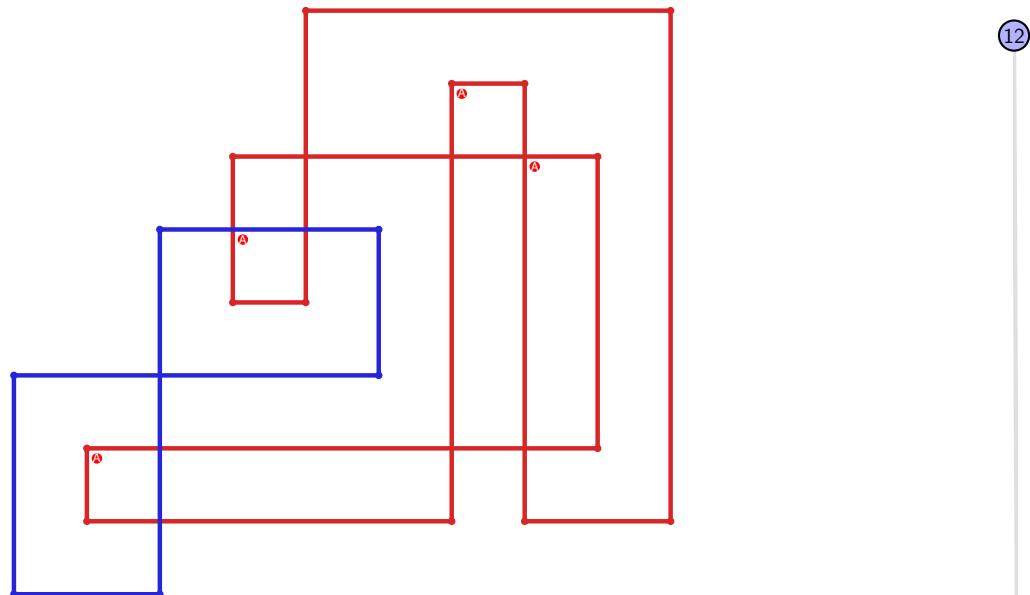


Figure 1117: SnapPy multiloop plot.

4

Figure 1118: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.262 $[[3, 14, 4, 1], [2, 20, 3, 15], [6, 13, 7, 14], [4, 7, 5, 8], [1, 16, 2, 15], [16, 19, 17, 20], [12, 5, 13, 6], [8, 12, 9, 11], [18, 10, 19, 11], [17, 10, 18, 9]]$

PD code drawn by SnapPy: $[(10, 3, 11, 4), (2, 5, 3, 6), (7, 18, 8, 19), (19, 8, 20, 9), (9, 6, 10, 7), (4, 11, 5, 12), (1, 12, 2, 13), (17, 20, 18, 15), (14, 15, 1, 16), (16, 13, 17, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 8, 9], [2, 7, 3, 2], [3, 6, 9, 8], [5, 7, 9, 9], [5, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 558: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

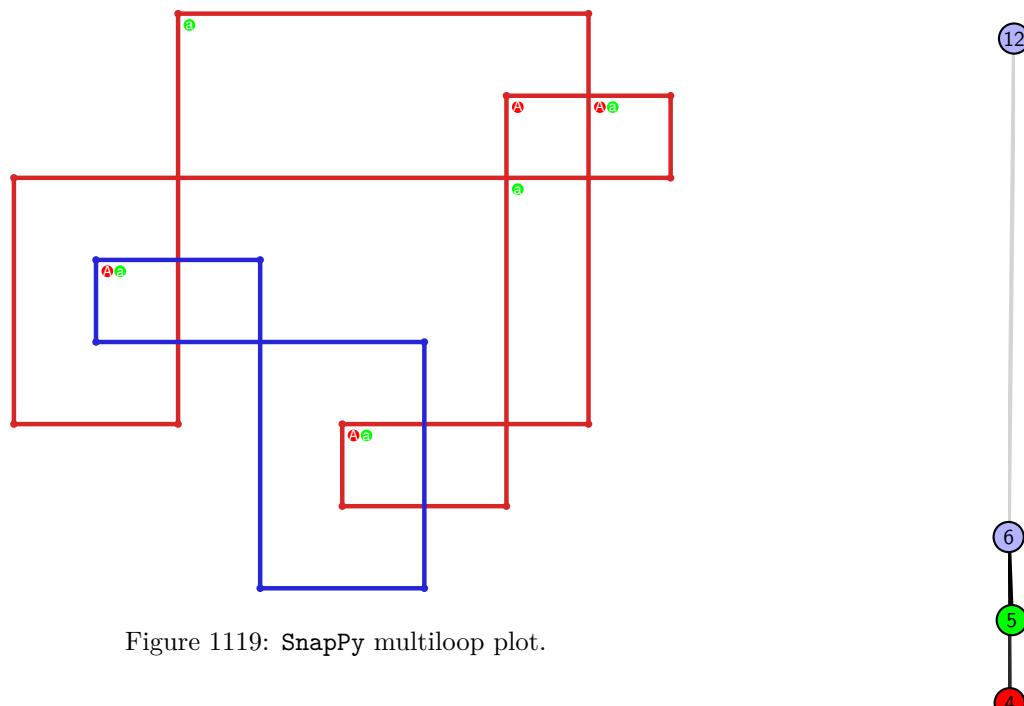


Figure 1119: SnapPy multiloop plot.

Figure 1120: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.263 $[[3, 6, 4, 1], [2, 12, 3, 7], [5, 20, 6, 13], [4, 20, 5, 19], [1, 8, 2, 7], [8, 11, 9, 12], [13, 18, 14, 19], [10, 16, 11, 17], [9, 16, 10, 15], [17, 14, 18, 15]]$

PD code drawn by SnapPy: $[(1, 4, 2, 5), (9, 12, 10, 7), (6, 7, 1, 8), (8, 5, 9, 6), (17, 10, 18, 11), (11, 18, 12, 19), (15, 20, 16, 13), (13, 2, 14, 3), (3, 14, 4, 15), (19, 16, 20, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 3, 3], [0, 2, 2, 6], [0, 5, 1, 1], [1, 4, 7, 8], [2, 9, 9, 3], [5, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 559: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

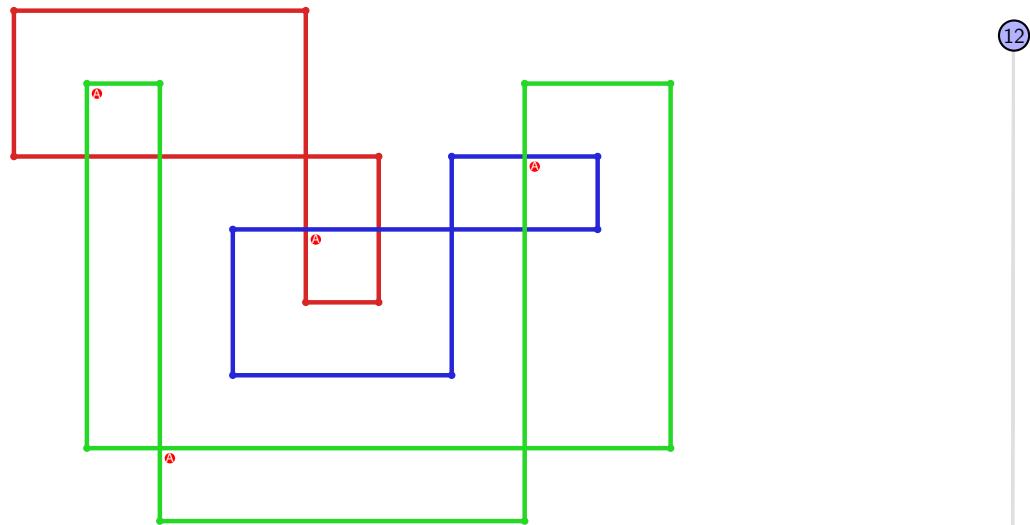


Figure 1121: SnapPy multiloop plot.

12
4

Figure 1122: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.264 $[[4, 8, 1, 5], [5, 9, 6, 14], [3, 20, 4, 15], [7, 1, 8, 2], [9, 7, 10, 6], [10, 13, 11, 14], [15, 18, 16, 19], [19, 2, 20, 3], [16, 12, 17, 13], [11, 17, 12, 18]]$

PD code drawn by SnapPy: $[(8, 1, 5, 2), (15, 2, 16, 3), (7, 10, 8, 11), (4, 5, 1, 6), (18, 13, 19, 14), (11, 14, 12, 9), (9, 6, 10, 7), (17, 20, 18, 15), (3, 16, 4, 17), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 4, 0], [1, 3, 5, 1], [1, 4, 8, 9], [2, 9, 8, 7], [2, 6, 3, 2], [5, 6, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 560: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

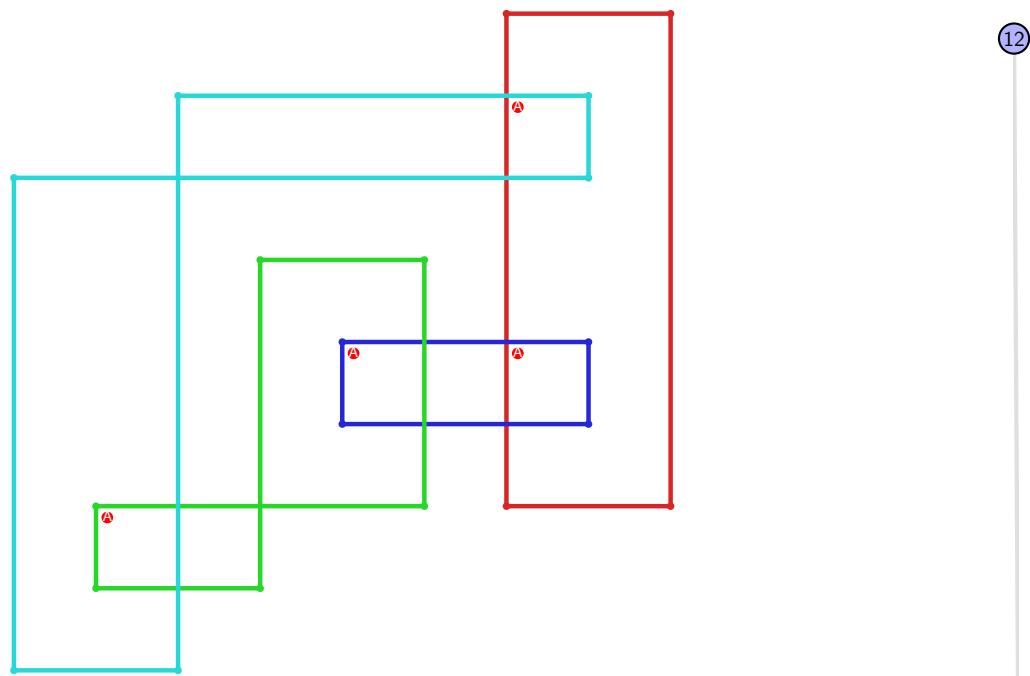


Figure 1123: SnapPy multiloop plot.

Figure 1124: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.265 $[[3, 10, 4, 1], [2, 20, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [12, 19, 13, 20], [5, 8, 6, 9], [18, 13, 19, 14], [15, 7, 16, 8], [6, 16, 7, 17], [14, 17, 15, 18]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (16, 5, 17, 6), (3, 6, 4, 7), (1, 8, 2, 9), (19, 14, 20, 15), (4, 17, 5, 18), (15, 18, 16, 19), (13, 20, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 4, 1, 1], [1, 3, 6, 6], [2, 7, 8, 2], [4, 9, 9, 4], [5, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 561: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

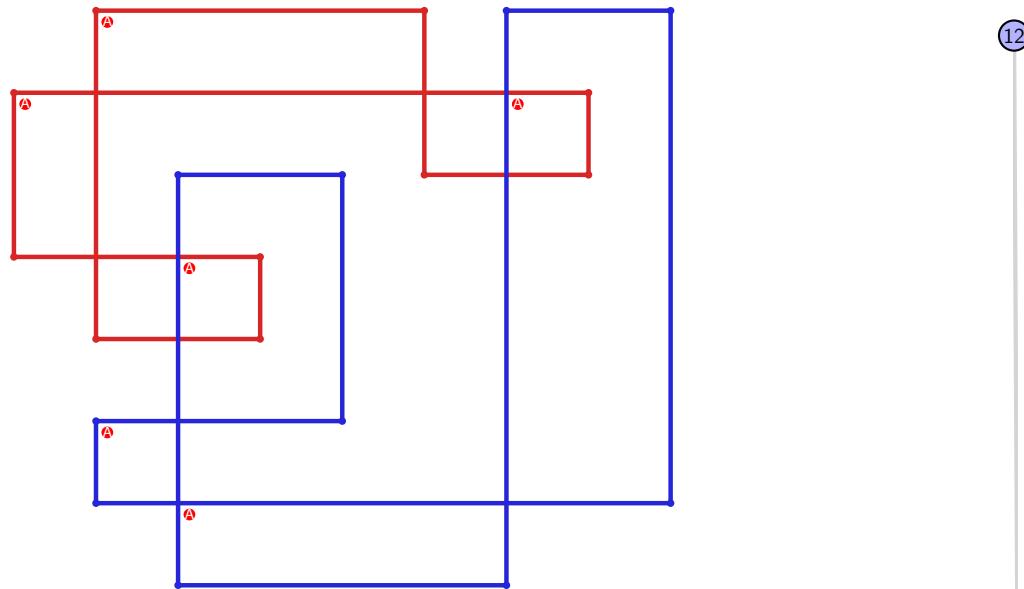


Figure 1125: SnapPy multiloop plot.

6

Figure 1126: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.266 $[[3, 8, 4, 1], [2, 14, 3, 9], [7, 20, 8, 15], [4, 18, 5, 17], [1, 10, 2, 9], [10, 13, 11, 14], [15, 11, 16, 12], [19, 6, 20, 7], [18, 6, 19, 5], [12, 16, 13, 17]]$

PD code drawn by SnapPy: $[(8, 9, 1, 10), (10, 1, 11, 2), (6, 3, 7, 4), (12, 17, 13, 18), (16, 19, 17, 20), (5, 20, 6, 15), (15, 4, 16, 5), (14, 7, 9, 8), (2, 11, 3, 12), (18, 13, 19, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 8, 8, 9], [0, 5, 1, 1], [1, 4, 9, 6], [2, 5, 9, 9], [2, 8, 8, 2], [3, 7, 7, 3], [3, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 562: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

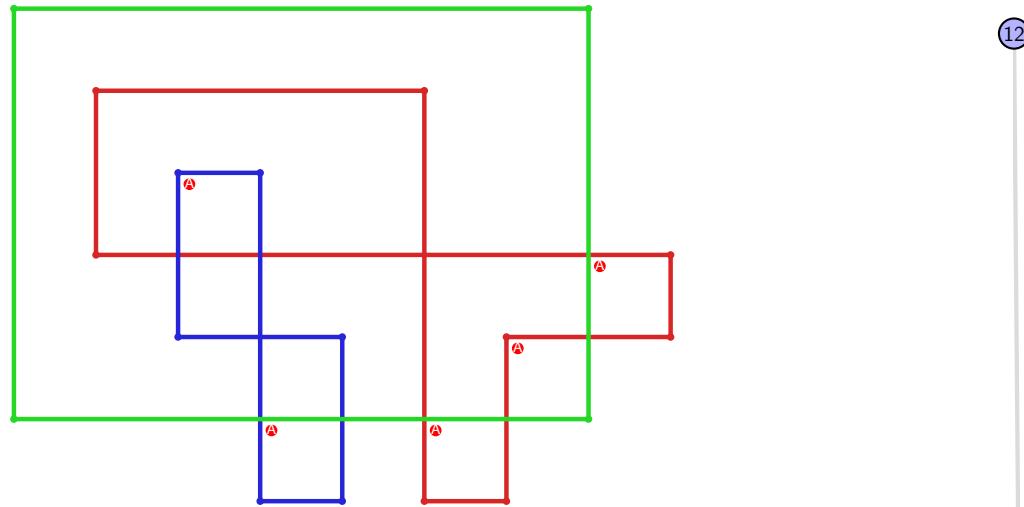


Figure 1127: SnapPy multiloop plot.

5

Figure 1128: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.267 $[[3, 14, 4, 1], [2, 20, 3, 15], [13, 6, 14, 7], [4, 9, 5, 10], [1, 16, 2, 15], [16, 19, 17, 20], [7, 12, 8, 13], [8, 5, 9, 6], [10, 18, 11, 19], [17, 11, 18, 12]]$

PD code drawn by `SnapPy`: $[(6, 3, 7, 4), (11, 4, 12, 5), (2, 7, 3, 8), (18, 9, 19, 10), (5, 10, 6, 11), (1, 12, 2, 13), (8, 19, 9, 20), (17, 20, 18, 15), (14, 15, 1, 16), (16, 13, 17, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 7, 8], [0, 5, 1, 1], [1, 4, 8, 9], [2, 9, 7, 2], [2, 6, 3, 3], [3, 9, 9, 5], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 563: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

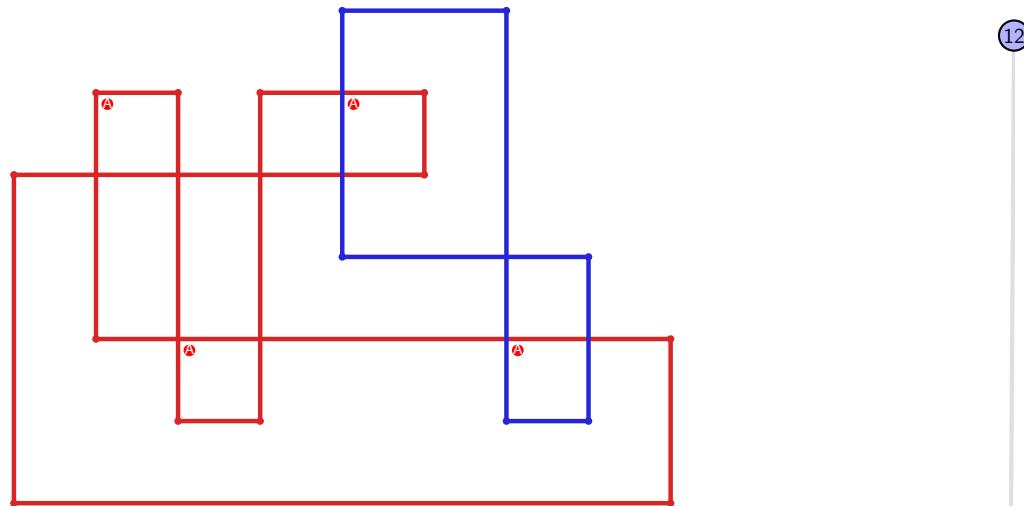


Figure 1129: `SnapPy` multiloop plot.

12
4

Figure 1130: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.268 $[[3, 20, 4, 1], [11, 2, 12, 3], [19, 6, 20, 7], [4, 18, 5, 17], [1, 10, 2, 11], [12, 10, 13, 9], [7, 15, 8, 14], [5, 18, 6, 19], [16, 13, 17, 14], [8, 15, 9, 16]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (17, 4, 18, 5), (7, 10, 8, 11), (19, 8, 20, 9), (14, 11, 15, 12), (12, 5, 13, 6), (6, 13, 7, 14), (15, 2, 16, 3), (3, 16, 4, 17), (1, 18, 2, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 7, 8], [0, 5, 1, 1], [1, 4, 8, 9], [2, 9, 9, 8], [2, 3, 3, 2], [3, 6, 9, 5], [5, 8, 6, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 564: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

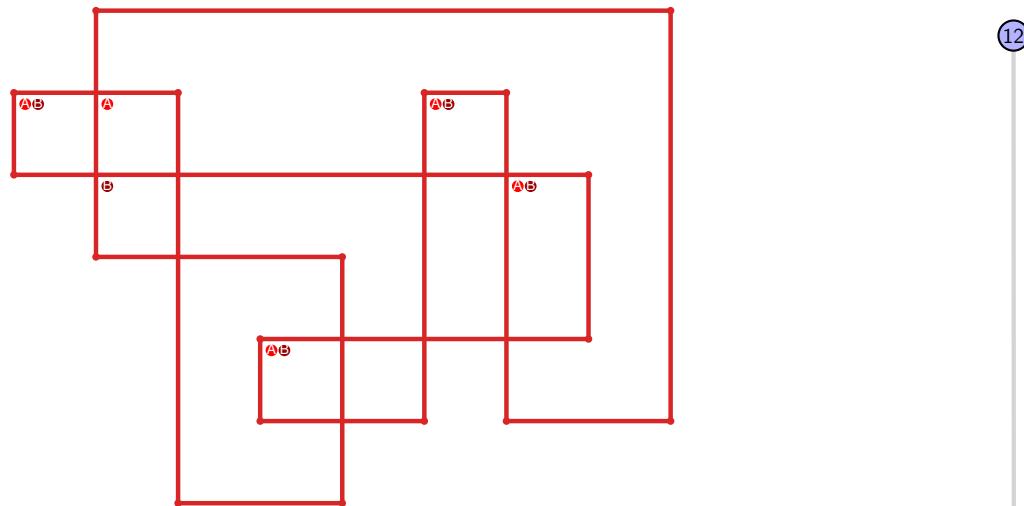


Figure 1131: `SnapPy` multiloop plot.

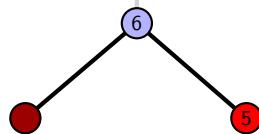


Figure 1132: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.269 $[[3, 14, 4, 1], [2, 20, 3, 15], [13, 4, 14, 5], [1, 16, 2, 15], [16, 19, 17, 20], [5, 10, 6, 11], [7, 12, 8, 13], [8, 18, 9, 19], [17, 9, 18, 10], [6, 12, 7, 11]]$

PD code drawn by SnapPy: $[(11, 2, 12, 3), (18, 7, 19, 8), (3, 8, 4, 9), (9, 4, 10, 5), (5, 10, 6, 11), (1, 12, 2, 13), (6, 19, 7, 20), (17, 20, 18, 15), (14, 15, 1, 16), (16, 13, 17, 14)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 8], [2, 8, 9, 9], [2, 9, 9, 7], [4, 6, 8, 8], [4, 7, 7, 5], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 565: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

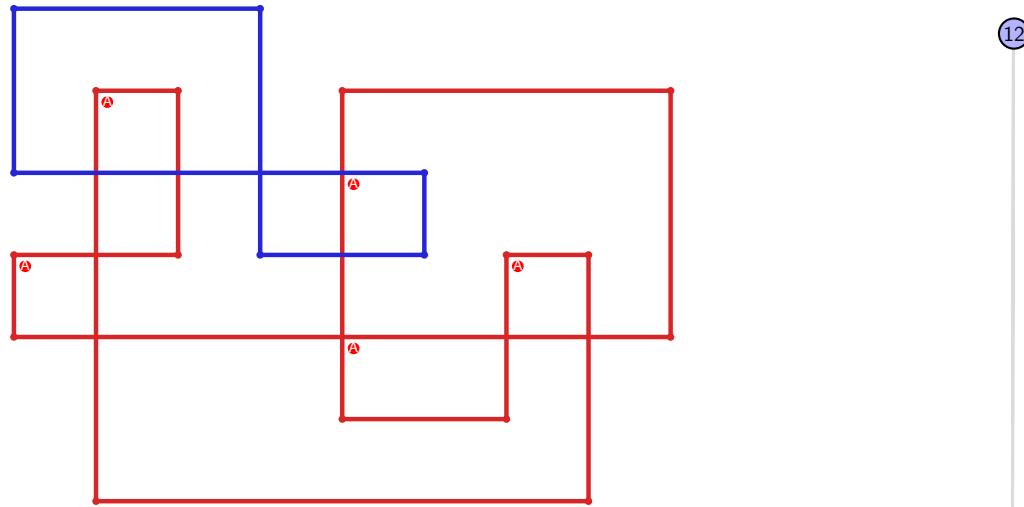


Figure 1133: SnapPy multiloop plot.

(12)

5

Figure 1134: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.270 $[[3, 20, 4, 1], [2, 11, 3, 12], [19, 6, 20, 7], [4, 18, 5, 17], [1, 13, 2, 12], [13, 10, 14, 11], [7, 14, 8, 15], [5, 18, 6, 19], [9, 16, 10, 17], [8, 16, 9, 15]]$

PD code drawn by `SnapPy`: $[(16, 3, 17, 4), (10, 7, 11, 8), (19, 8, 20, 9), (9, 18, 10, 19), (4, 11, 5, 12), (12, 5, 13, 6), (6, 13, 7, 14), (14, 1, 15, 2), (2, 15, 3, 16), (20, 17, 1, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 7, 8], [0, 5, 1, 1], [1, 4, 8, 6], [2, 5, 9, 9], [2, 3, 3, 2], [3, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 566: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

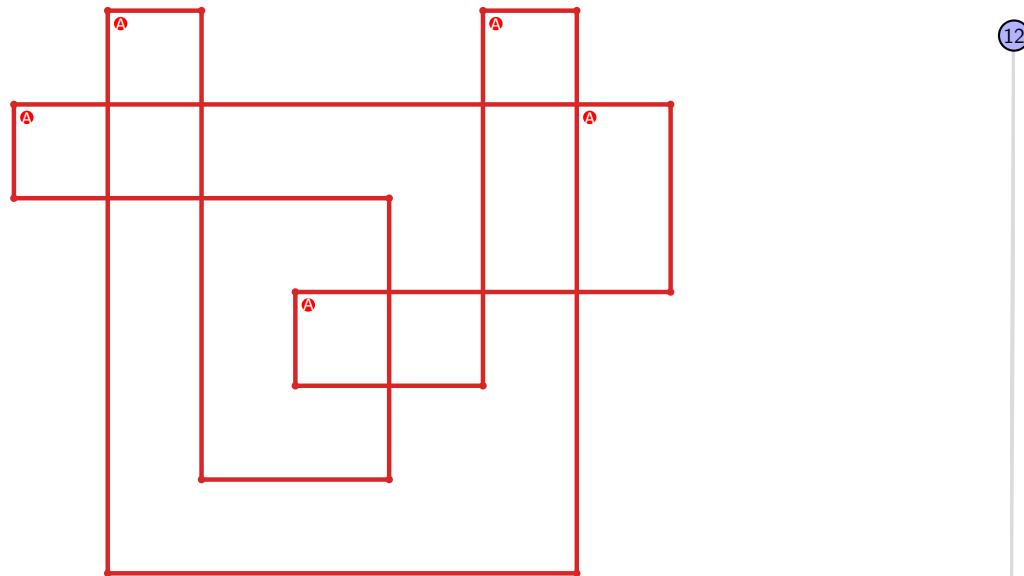


Figure 1135: `SnapPy` multiloop plot.



Figure 1136: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.271 $[[11, 20, 12, 1], [10, 7, 11, 8], [19, 14, 20, 15], [12, 18, 13, 17], [1, 9, 2, 8], [2, 9, 3, 10], [3, 6, 4, 7], [15, 4, 16, 5], [13, 18, 14, 19], [5, 16, 6, 17]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (20, 3, 1, 4), (7, 4, 8, 5), (5, 18, 6, 19), (19, 6, 20, 7), (16, 11, 17, 12), (2, 13, 3, 14), (14, 9, 15, 10), (10, 15, 11, 16), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 8, 8], [0, 8, 8, 9], [0, 5, 5, 1], [1, 4, 4, 6], [1, 5, 9, 7], [2, 6, 9, 9], [2, 3, 3, 2], [3, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 567: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

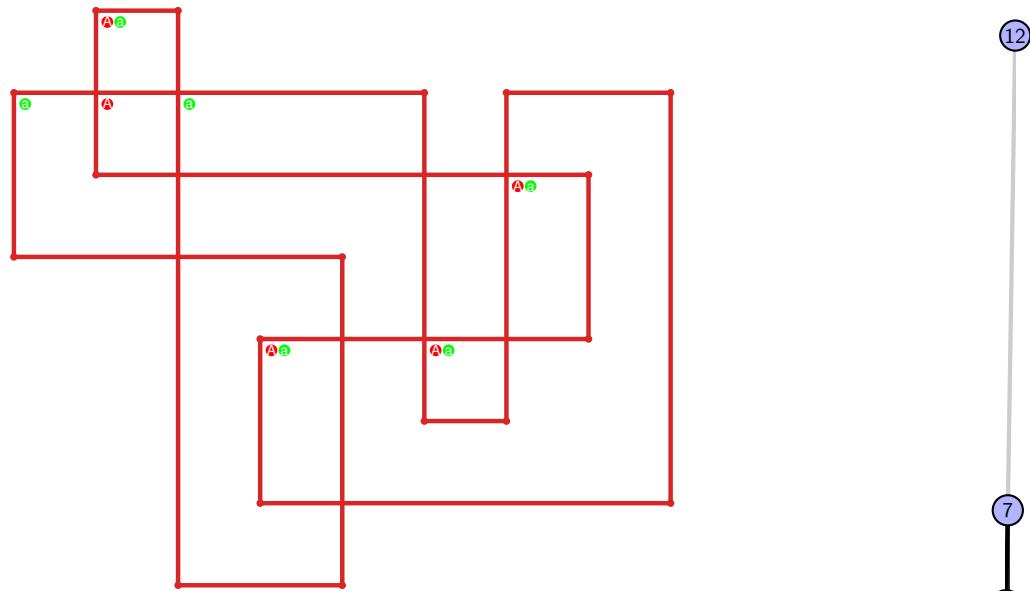


Figure 1137: SnapPy multiloop plot.



Figure 1138: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.272 $[[3, 12, 4, 1], [2, 20, 3, 13], [11, 6, 12, 7], [4, 10, 5, 9], [1, 14, 2, 13], [14, 19, 15, 20], [7, 18, 8, 17], [5, 10, 6, 11], [8, 16, 9, 17], [18, 15, 19, 16]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (4, 11, 5, 12), (12, 5, 1, 6), (10, 7, 11, 8), (14, 19, 15, 20), (3, 20, 4, 13), (13, 2, 14, 3), (18, 15, 19, 16), (9, 16, 10, 17), (17, 8, 18, 9)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 7, 7], [0, 7, 7, 8], [0, 5, 1, 1], [1, 4, 9, 9], [2, 9, 8, 8], [2, 3, 3, 2], [3, 6, 6, 9], [5, 8, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 568: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

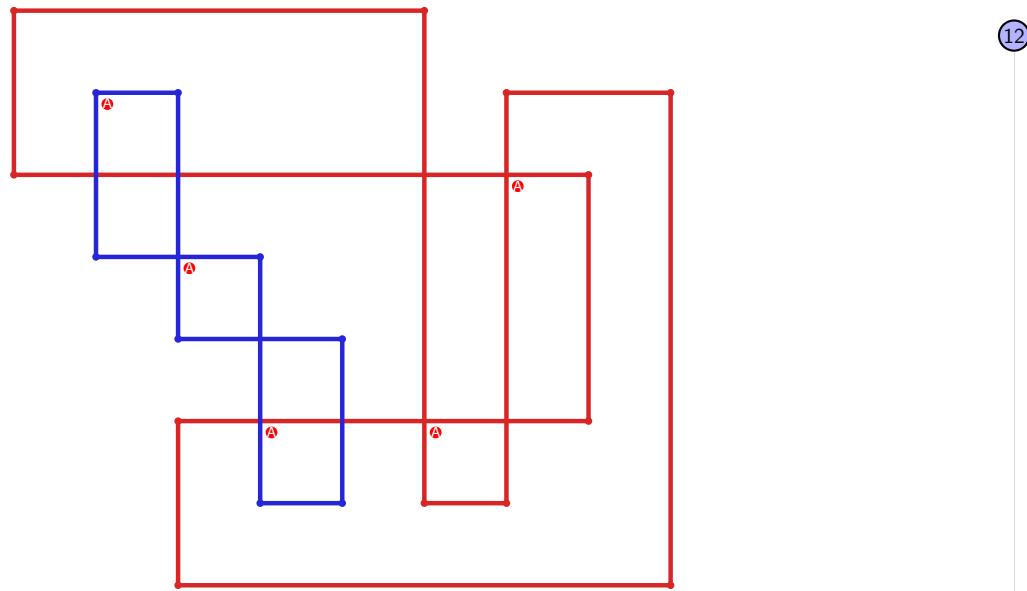


Figure 1139: SnapPy multiloop plot.



Figure 1140: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.273 $[[3, 14, 4, 1], [2, 20, 3, 15], [13, 4, 14, 5], [1, 16, 2, 15], [16, 19, 17, 20], [5, 11, 6, 10], [12, 9, 13, 10], [18, 8, 19, 9], [17, 8, 18, 7], [11, 7, 12, 6]]$

PD code drawn by SnapPy: $[(11, 2, 12, 3), (4, 9, 5, 10), (5, 18, 6, 19), (19, 6, 20, 7), (10, 7, 11, 8), (8, 3, 9, 4), (1, 12, 2, 13), (17, 20, 18, 15), (14, 15, 1, 16), (16, 13, 17, 14)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 8], [2, 9, 9, 6], [2, 5, 9, 7], [4, 6, 8, 8], [4, 7, 7, 9], [5, 8, 6, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 569: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

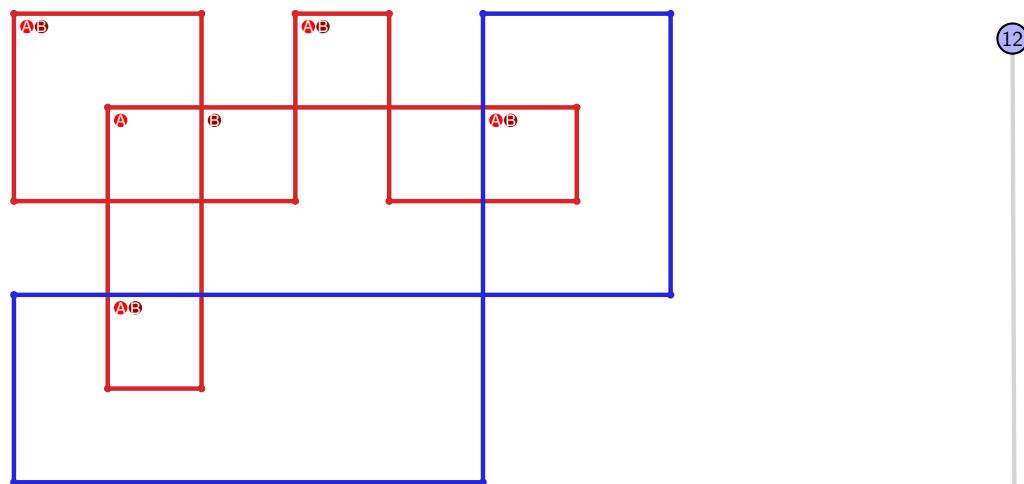


Figure 1141: SnapPy multiloop plot.

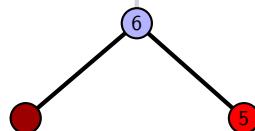


Figure 1142: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.274 $[[3, 12, 4, 1], [2, 20, 3, 13], [6, 11, 7, 12], [4, 7, 5, 8], [1, 14, 2, 13], [14, 19, 15, 20], [10, 5, 11, 6], [8, 17, 9, 16], [18, 15, 19, 16], [9, 17, 10, 18]]$

PD code drawn by SnapPy: $[(8, 3, 9, 4), (2, 5, 3, 6), (4, 9, 5, 10), (1, 10, 2, 11), (19, 16, 20, 17), (17, 6, 18, 7), (7, 18, 8, 19), (15, 20, 16, 13), (12, 13, 1, 14), (14, 11, 15, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 8, 8], [2, 9, 3, 2], [3, 9, 9, 8], [5, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 570: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

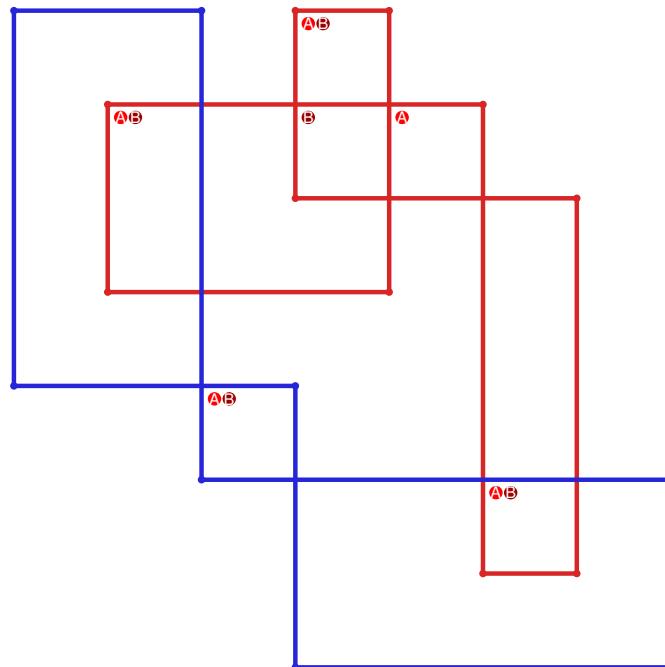


Figure 1143: SnapPy multiloop plot.

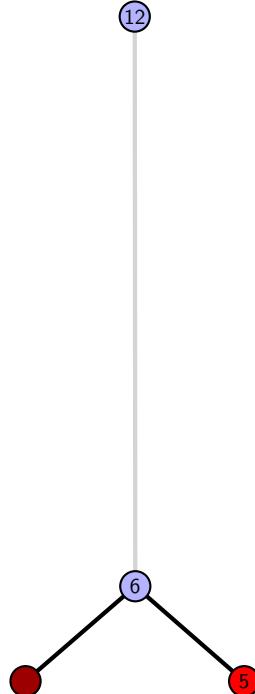


Figure 1144: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.275 $[[3, 10, 4, 1], [2, 16, 3, 11], [9, 20, 10, 17], [4, 20, 5, 19], [1, 12, 2, 11], [12, 15, 13, 16], [17, 8, 18, 9], [5, 18, 6, 19], [6, 14, 7, 15], [13, 7, 14, 8]]$

PD code drawn by SnapPy: $[(14, 5, 15, 6), (19, 6, 20, 7), (1, 8, 2, 9), (4, 15, 5, 16), (13, 16, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10), (17, 2, 18, 3), (7, 18, 8, 19), (3, 20, 4, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 7], [0, 5, 1, 1], [1, 4, 8, 9], [2, 9, 7, 2], [3, 6, 8, 3], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 571: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

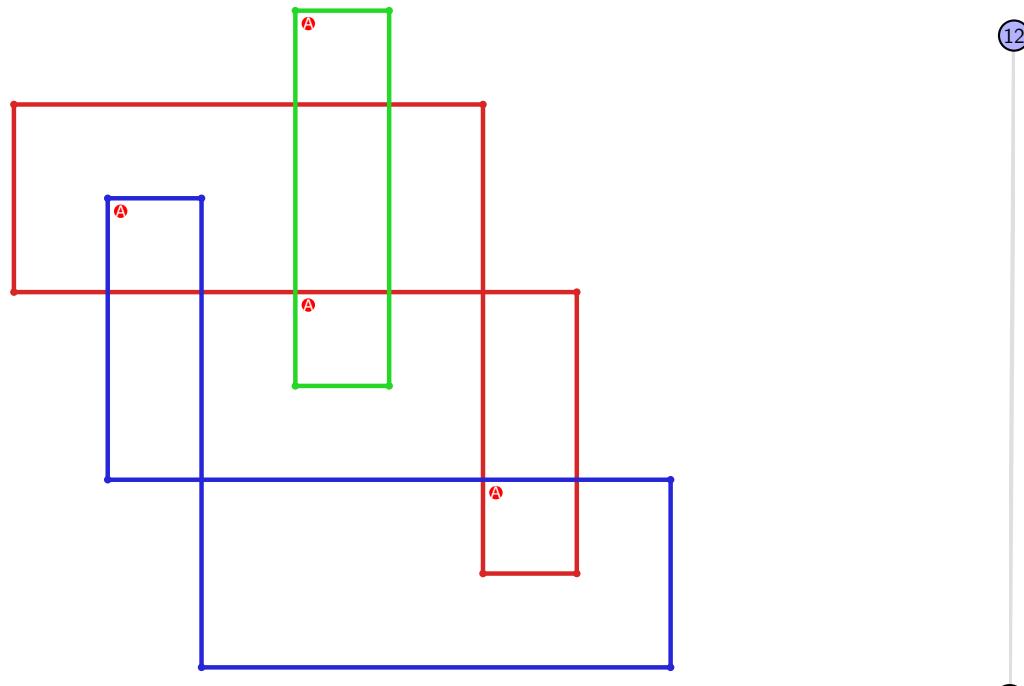


Figure 1145: SnapPy multiloop plot.

4

Figure 1146: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.276 $[[3, 8, 4, 1], [2, 14, 3, 9], [7, 20, 8, 15], [4, 20, 5, 19], [1, 10, 2, 9], [10, 13, 11, 14], [15, 6, 16, 7], [5, 16, 6, 17], [12, 18, 13, 19], [11, 18, 12, 17]]$

PD code drawn by SnapPy: $[(17, 4, 18, 5), (1, 6, 2, 7), (11, 14, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8), (19, 12, 20, 13), (13, 20, 14, 15), (15, 2, 16, 3), (5, 16, 6, 17), (3, 18, 4, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 8], [0, 5, 1, 1], [1, 4, 8, 9], [2, 7, 7, 2], [3, 6, 6, 9], [3, 9, 9, 5], [5, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 572: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

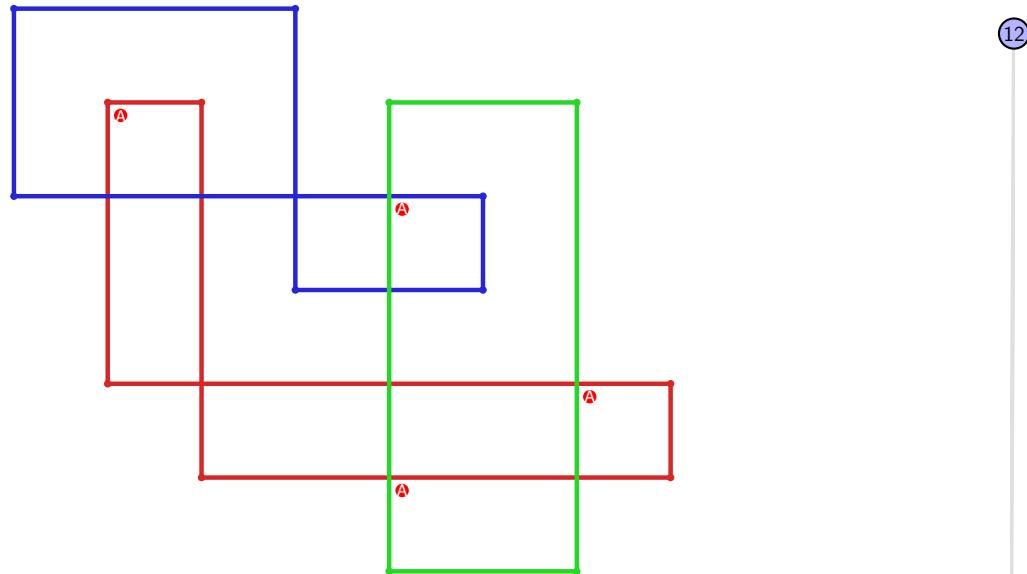


Figure 1147: SnapPy multiloop plot.

4

Figure 1148: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.277 $[[3, 20, 4, 1], [2, 13, 3, 14], [6, 19, 7, 20], [4, 7, 5, 8], [1, 15, 2, 14], [15, 12, 16, 13], [18, 5, 19, 6], [8, 11, 9, 12], [16, 9, 17, 10], [10, 17, 11, 18]]$

PD code drawn by SnapPy: $[(16, 3, 17, 4), (2, 5, 3, 6), (14, 7, 15, 8), (6, 9, 7, 10), (13, 10, 14, 11), (20, 11, 1, 12), (12, 19, 13, 20), (8, 15, 9, 16), (4, 17, 5, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 7, 8], [2, 9, 3, 2], [3, 9, 8, 5], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 272
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 3.04

Table 573: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

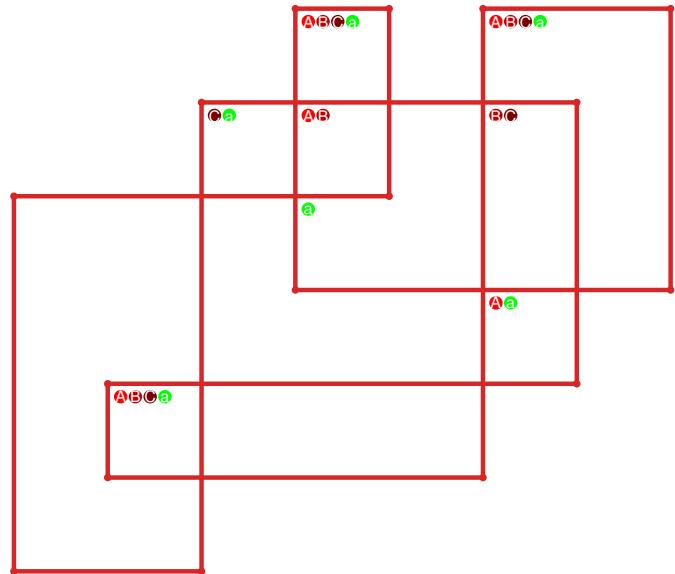


Figure 1149: SnapPy multiloop plot.

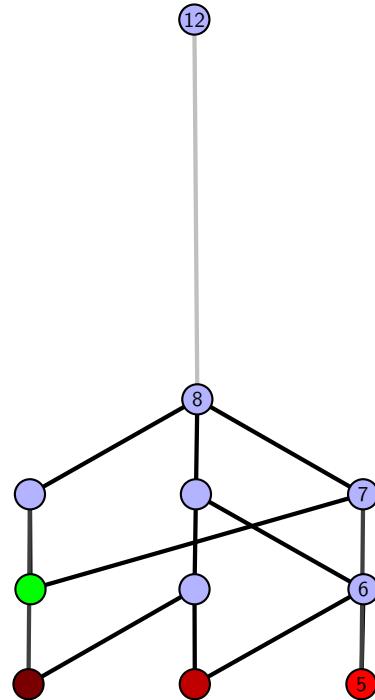


Figure 1150: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.278 $[[3, 20, 4, 1], [2, 11, 3, 12], [6, 19, 7, 20], [4, 7, 5, 8], [1, 13, 2, 12], [13, 10, 14, 11], [18, 5, 19, 6], [8, 15, 9, 16], [16, 9, 17, 10], [14, 17, 15, 18]]$

PD code drawn by SnapPy: $[(16, 3, 17, 4), (2, 5, 3, 6), (14, 7, 15, 8), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (6, 13, 7, 14), (12, 15, 13, 16), (4, 17, 5, 18), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 6, 7], [0, 5, 1, 1], [1, 4, 8, 9], [2, 9, 3, 2], [3, 9, 8, 8], [5, 7, 7, 9], [5, 8, 7, 6]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 4

Total pinning sets: 272

Pinning number: 5

Average optimal degree: 2.4
Average minimal degree: 2.47

Average overall degree: 3.04

Table 574: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

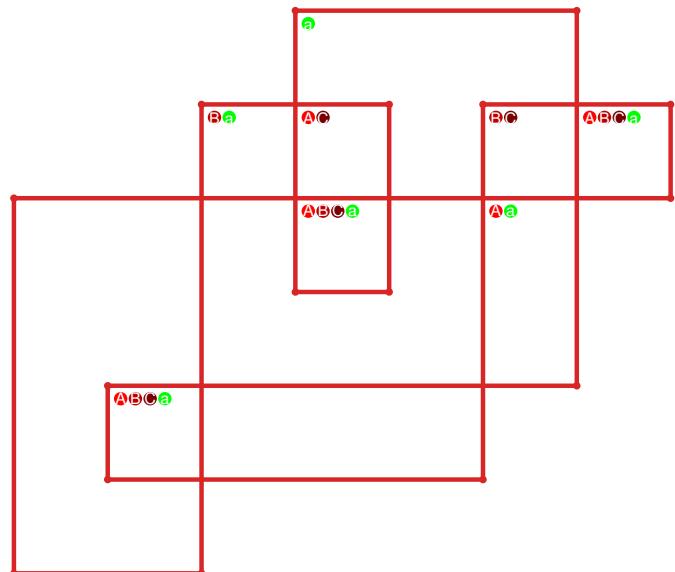


Figure 1151: SnapPy multiloop plot.

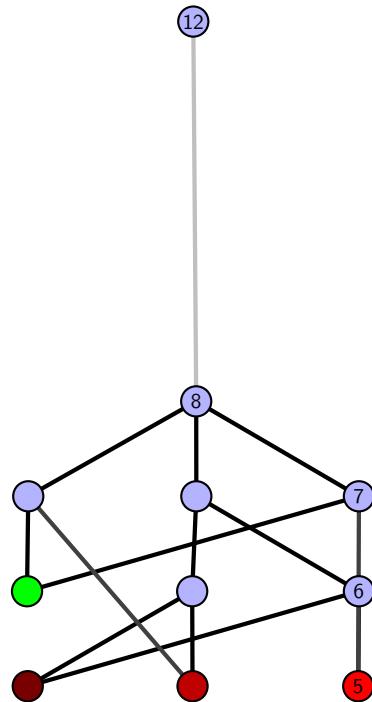


Figure 1152: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.279 $[[3, 10, 4, 1], [2, 16, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [12, 15, 13, 16], [5, 8, 6, 9], [14, 20, 15, 17], [13, 20, 14, 19], [7, 18, 8, 19], [6, 18, 7, 17]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (3, 6, 4, 7), (1, 8, 2, 9), (13, 16, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10), (5, 18, 6, 19), (19, 14, 20, 15), (15, 20, 16, 17), (17, 4, 18, 5)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 4, 1, 1], [1, 3, 6, 7], [2, 8, 9, 2], [4, 9, 7, 7], [4, 6, 6, 8], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 575: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

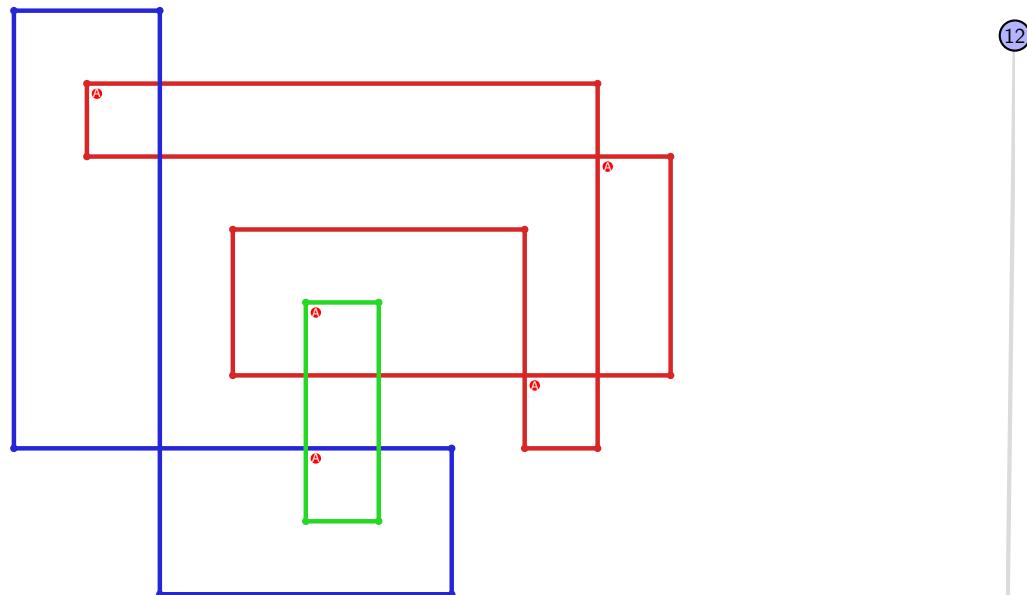


Figure 1153: SnapPy multiloop plot.

(5)

Figure 1154: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.280 $[[6, 10, 1, 7], [7, 11, 8, 16], [5, 2, 6, 3], [9, 1, 10, 2], [11, 9, 12, 8], [12, 15, 13, 16], [3, 17, 4, 20], [4, 19, 5, 20], [14, 18, 15, 19], [13, 18, 14, 17]]$

PD code drawn by SnapPy: $[(20, 3, 17, 4), (1, 4, 2, 5), (19, 14, 20, 15), (2, 17, 3, 18), (15, 12, 16, 13), (13, 18, 14, 19), (9, 16, 10, 11), (11, 10, 12, 7), (6, 7, 1, 8), (8, 5, 9, 6)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 7, 3], [0, 2, 4, 0], [1, 3, 5, 1], [1, 4, 8, 9], [2, 9, 7, 7], [2, 6, 6, 8], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 256

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.97

Table 576: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

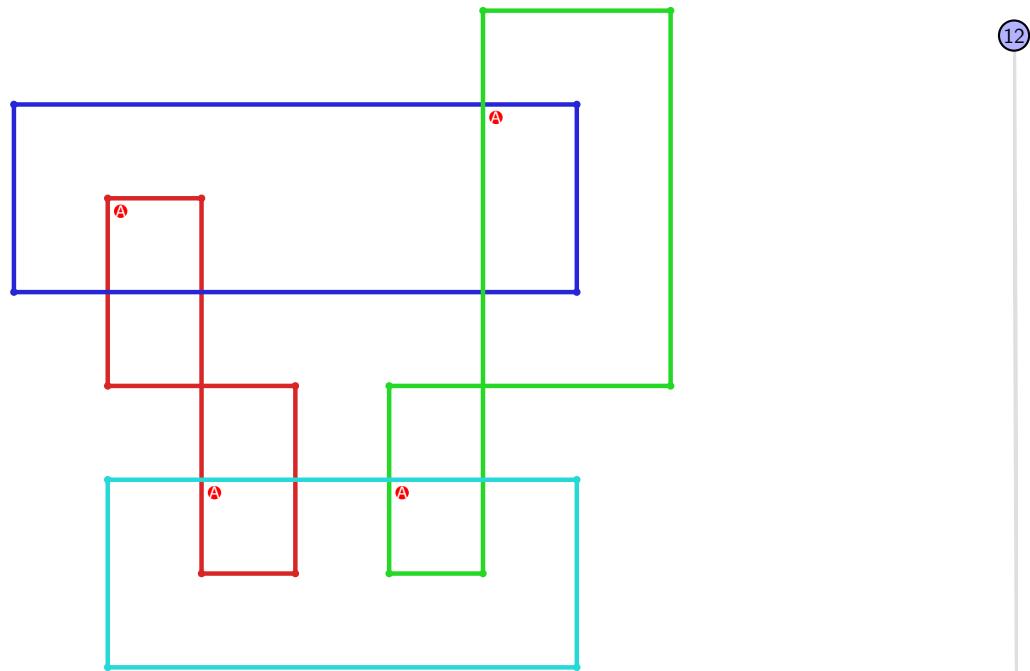


Figure 1155: SnapPy multiloop plot.

Figure 1156: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.281 $[[3, 8, 4, 1], [2, 16, 3, 9], [7, 4, 8, 5], [1, 10, 2, 9], [10, 15, 11, 16], [5, 17, 6, 20], [6, 19, 7, 20], [14, 11, 15, 12], [17, 14, 18, 13], [18, 12, 19, 13]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (1, 6, 2, 7), (15, 12, 16, 13), (20, 13, 17, 14), (14, 19, 15, 20), (11, 16, 12, 9), (8, 9, 1, 10), (10, 7, 11, 8), (4, 17, 5, 18), (18, 3, 19, 4)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 4, 1, 1], [1, 3, 7, 7], [2, 8, 6, 6], [2, 5, 5, 9], [4, 9, 8, 4], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 577: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

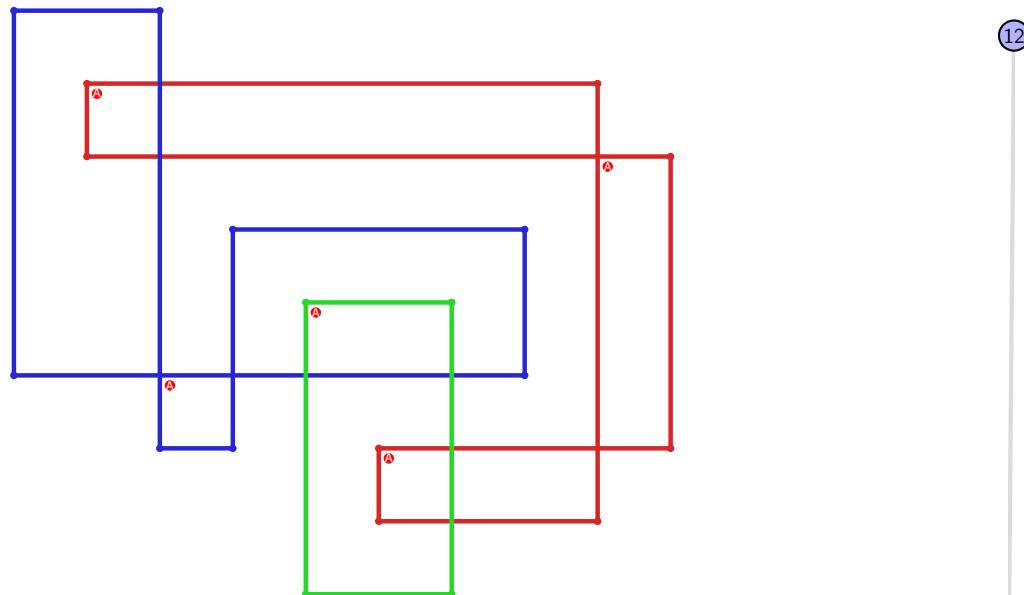


Figure 1157: SnapPy multiloop plot.



Figure 1158: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.282 $[[5, 10, 6, 1], [4, 16, 5, 11], [9, 20, 10, 17], [6, 2, 7, 1], [11, 3, 12, 4], [12, 15, 13, 16], [17, 13, 18, 14], [19, 8, 20, 9], [2, 8, 3, 7], [14, 18, 15, 19]]$

PD code drawn by `SnapPy`: $[(11, 10, 12, 1), (4, 9, 5, 10), (20, 5, 17, 6), (2, 7, 3, 8), (8, 3, 9, 4), (18, 13, 19, 14), (12, 15, 13, 16), (1, 16, 2, 11), (6, 17, 7, 18), (14, 19, 15, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 7, 7], [0, 8, 8, 0], [1, 8, 5, 1], [1, 4, 9, 6], [2, 5, 9, 9], [2, 9, 8, 2], [3, 7, 4, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 578: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

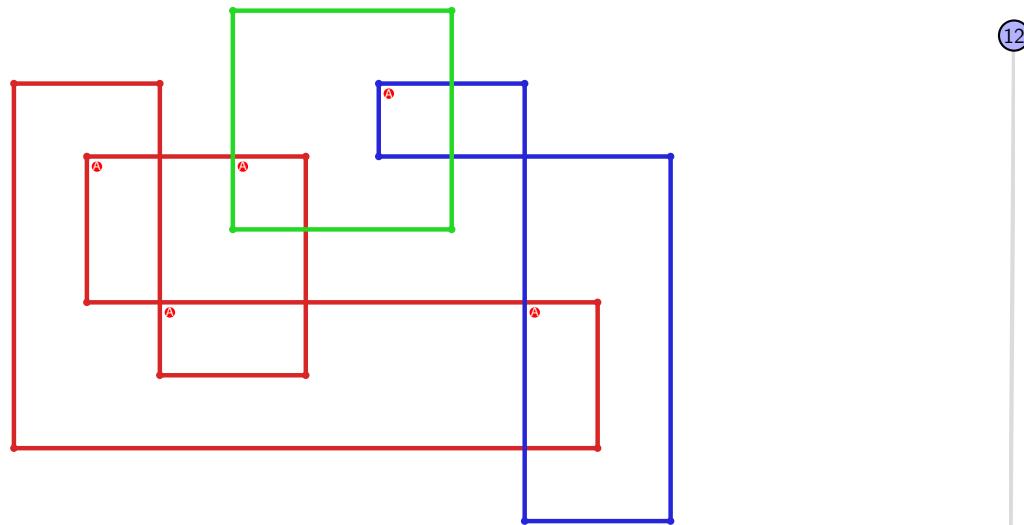


Figure 1159: `SnapPy` multiloop plot.

12
5

Figure 1160: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.283 [[10, 7, 1, 8], [8, 3, 9, 4], [4, 9, 5, 10], [6, 14, 7, 11], [1, 15, 2, 20], [2, 19, 3, 20], [5, 12, 6, 11], [17, 13, 18, 14], [15, 18, 16, 19], [12, 16, 13, 17]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (8, 5, 9, 6), (2, 7, 3, 8), (15, 20, 16, 17), (4, 17, 5, 18), (18, 3, 19, 4), (13, 16, 14, 11), (10, 11, 1, 12), (12, 9, 13, 10), (19, 14, 20, 15)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 2, 2], [0, 1, 1, 6], [0, 6, 6, 7], [0, 8, 5, 5], [1, 4, 4, 8], [2, 9, 3, 3], [3, 9, 9, 8], [4, 7, 9, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 579: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

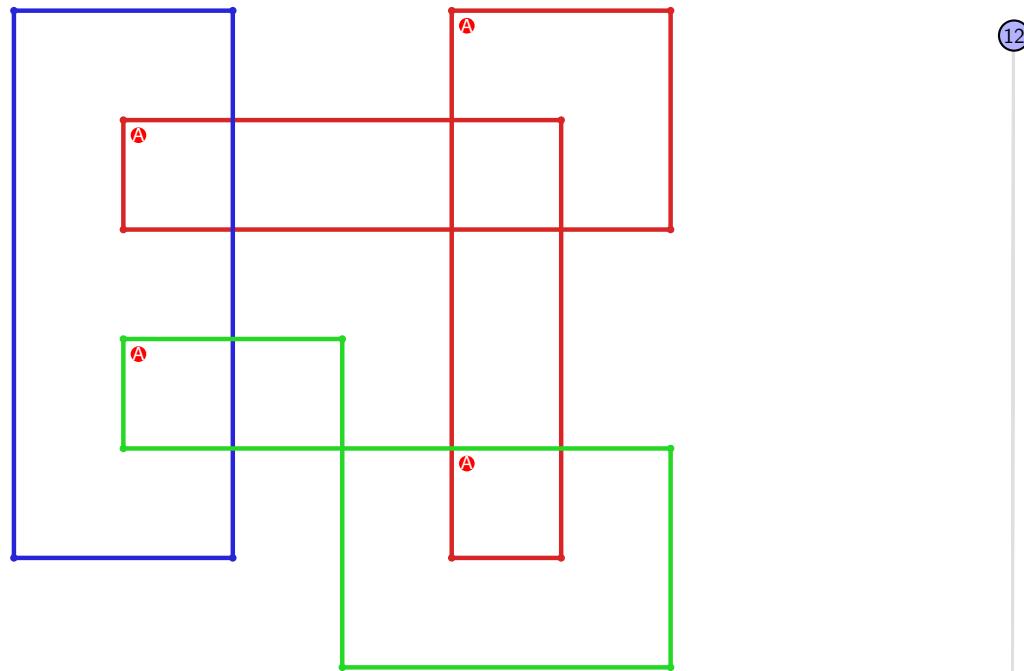


Figure 1161: SnapPy multiloop plot.

Figure 1162: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.284 [[12, 16, 1, 13], [13, 11, 14, 12], [15, 20, 16, 17], [1, 9, 2, 8], [10, 7, 11, 8], [14, 18, 15, 17], [5, 19, 6, 20], [9, 3, 10, 2], [3, 6, 4, 7], [18, 4, 19, 5]]

PD code drawn by SnapPy: [(12, 7, 1, 8), (13, 2, 14, 3), (1, 4, 2, 5), (8, 5, 9, 6), (6, 11, 7, 12), (18, 9, 19, 10), (10, 17, 11, 18), (3, 14, 4, 15), (20, 15, 17, 16), (16, 19, 13, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 7, 7, 4], [1, 3, 7, 8], [1, 9, 2, 2], [2, 9, 9, 8], [3, 8, 4, 3], [4, 7, 6, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 580: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

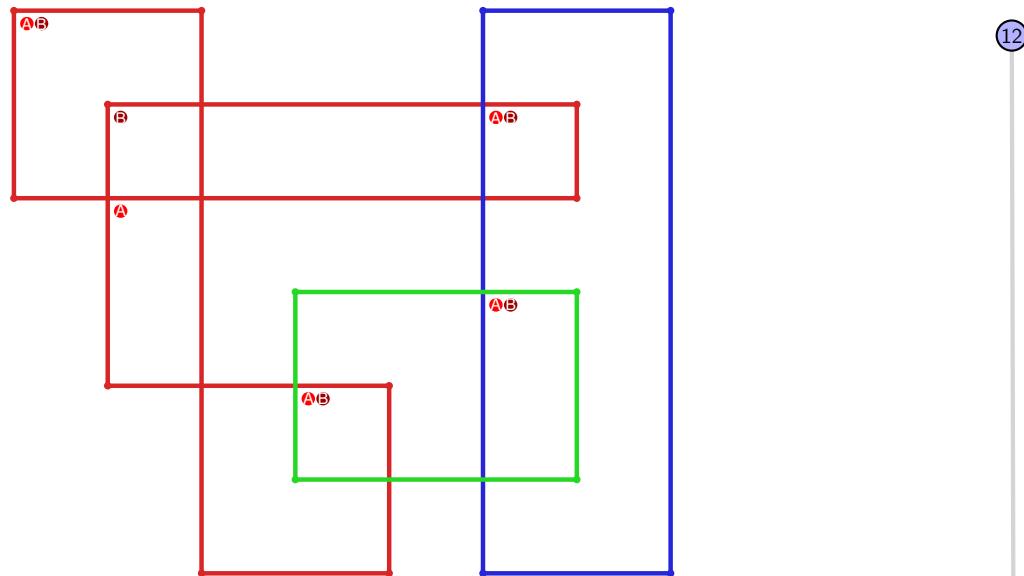


Figure 1163: SnapPy multiloop plot.

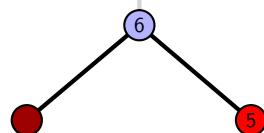


Figure 1164: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.285 $[[4, 8, 1, 5], [5, 3, 6, 4], [7, 12, 8, 9], [1, 13, 2, 16], [2, 15, 3, 16], [6, 10, 7, 9], [11, 20, 12, 17], [13, 20, 14, 19], [14, 18, 15, 19], [10, 18, 11, 17]]$

PD code drawn by `SnapPy`: $[(18, 1, 19, 2), (2, 17, 3, 18), (20, 15, 17, 16), (16, 19, 13, 20), (4, 5, 1, 6), (6, 3, 7, 4), (8, 9, 5, 10), (10, 7, 11, 8), (14, 11, 15, 12), (12, 13, 9, 14)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 7, 4, 4], [1, 3, 3, 8], [1, 9, 2, 2], [2, 9, 9, 7], [3, 6, 8, 8], [4, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 581: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

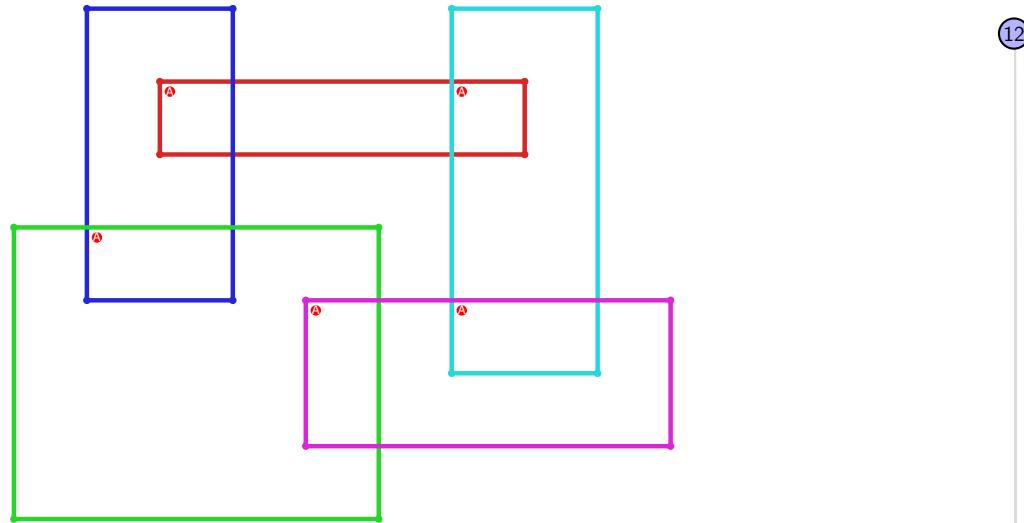


Figure 1165: `SnapPy` multiloop plot.

5

Figure 1166: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.286 $[[4, 12, 1, 5], [5, 3, 6, 4], [6, 11, 7, 12], [1, 13, 2, 16], [2, 15, 3, 16], [10, 7, 11, 8], [13, 17, 14, 20], [14, 19, 15, 20], [8, 19, 9, 18], [9, 17, 10, 18]]$

PD code drawn by `SnapPy`: $[(14, 1, 15, 2), (19, 16, 20, 17), (15, 20, 16, 13), (2, 13, 3, 14), (4, 5, 1, 6), (6, 3, 7, 4), (12, 17, 9, 18), (8, 9, 5, 10), (10, 7, 11, 8), (18, 11, 19, 12)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 4, 4], [1, 3, 3, 7], [2, 8, 9, 2], [3, 9, 7, 7], [4, 6, 6, 8], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 582: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

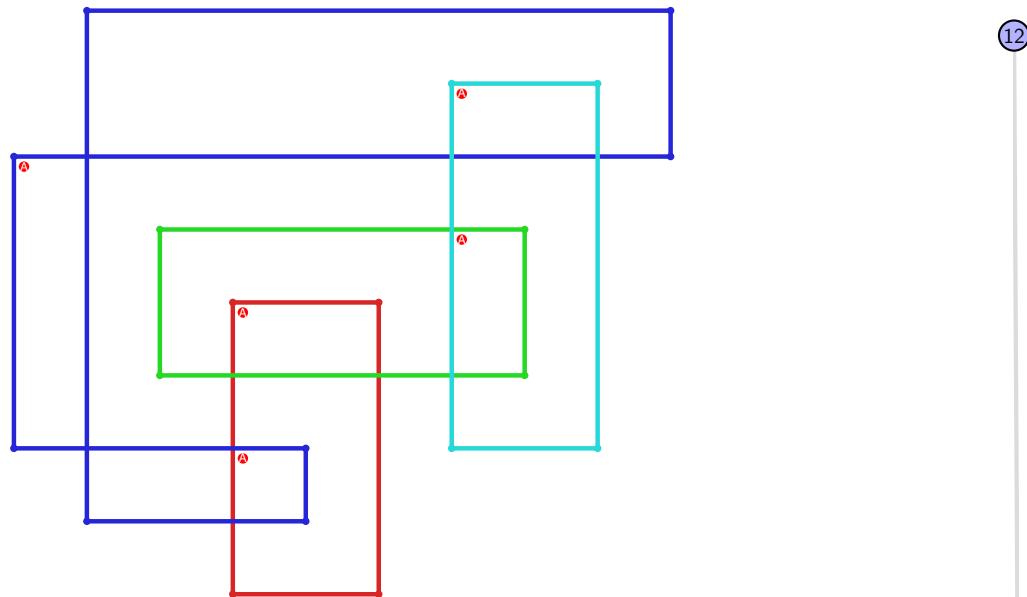


Figure 1167: `SnapPy` multiloop plot.

5

Figure 1168: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.287 $[[8, 16, 1, 9], [9, 7, 10, 8], [15, 1, 16, 2], [3, 6, 4, 7], [10, 13, 11, 14], [2, 14, 3, 15], [5, 20, 6, 17], [4, 20, 5, 19], [12, 18, 13, 19], [11, 18, 12, 17]]$

PD code drawn by SnapPy: $[(1, 4, 2, 5), (12, 5, 13, 6), (10, 7, 11, 8), (13, 16, 14, 9), (8, 9, 1, 10), (6, 11, 7, 12), (17, 2, 18, 3), (3, 18, 4, 19), (19, 14, 20, 15), (15, 20, 16, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 5, 6, 7], [1, 8, 9, 5], [2, 4, 3, 2], [3, 9, 7, 7], [3, 6, 6, 8], [4, 7, 9, 9], [4, 8, 8, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 583: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

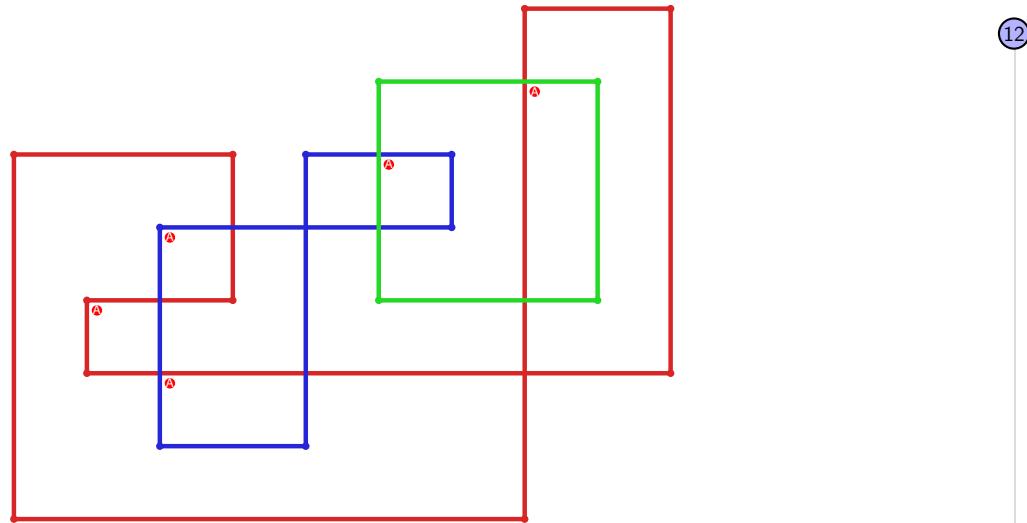


Figure 1169: SnapPy multiloop plot.

5

Figure 1170: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.288 $[[7, 16, 8, 1], [6, 9, 7, 10], [15, 8, 16, 9], [1, 4, 2, 5], [10, 5, 11, 6], [11, 14, 12, 15], [3, 20, 4, 17], [2, 20, 3, 19], [13, 18, 14, 19], [12, 18, 13, 17]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (7, 2, 8, 3), (12, 5, 13, 6), (3, 6, 4, 7), (8, 11, 9, 12), (4, 13, 5, 14), (18, 9, 19, 10), (10, 19, 11, 20), (20, 15, 17, 16), (16, 17, 1, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 2], [0, 1, 5, 0], [0, 6, 7, 4], [1, 3, 5, 1], [2, 4, 8, 9], [3, 9, 7, 7], [3, 6, 6, 8], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 256

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.97

Table 584: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

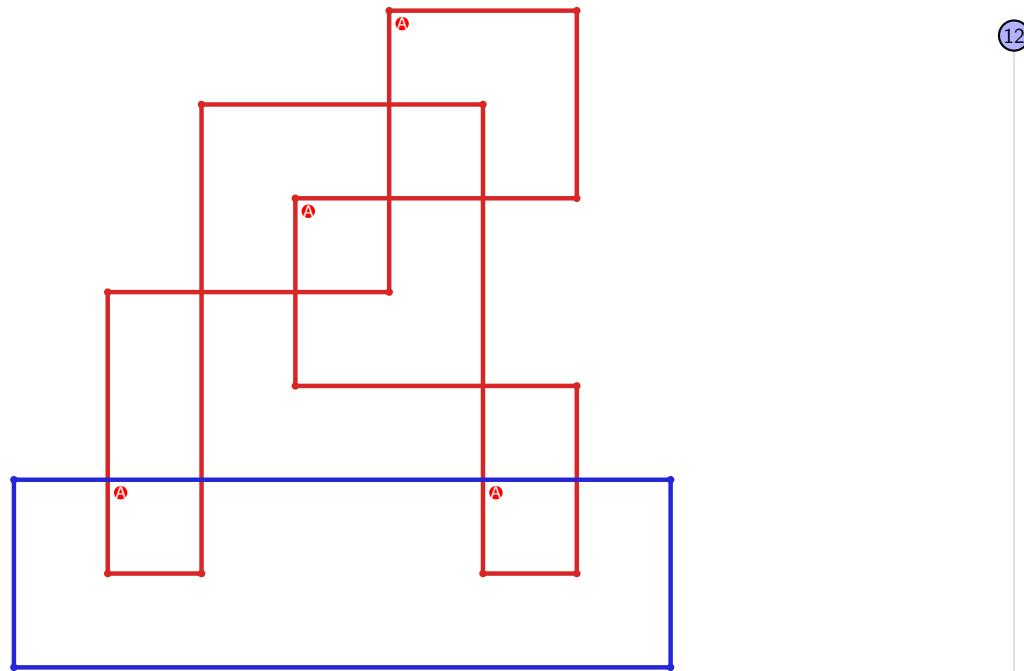


Figure 1171: SnapPy multiloop plot.

Figure 1172: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.289 $[[9, 16, 10, 1], [15, 8, 16, 9], [10, 14, 11, 13], [1, 6, 2, 7], [7, 14, 8, 15], [11, 17, 12, 20], [12, 19, 13, 20], [5, 2, 6, 3], [17, 5, 18, 4], [18, 3, 19, 4]]$

PD code drawn by SnapPy: $[(17, 16, 18, 1), (1, 20, 2, 17), (14, 3, 15, 4), (12, 5, 13, 6), (10, 7, 11, 8), (4, 11, 5, 12), (6, 13, 7, 14), (2, 15, 3, 16), (9, 18, 10, 19), (19, 8, 20, 9)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 6], [0, 7, 7, 4], [1, 3, 2, 1], [2, 8, 6, 6], [2, 5, 5, 9], [3, 9, 8, 3], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 585: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

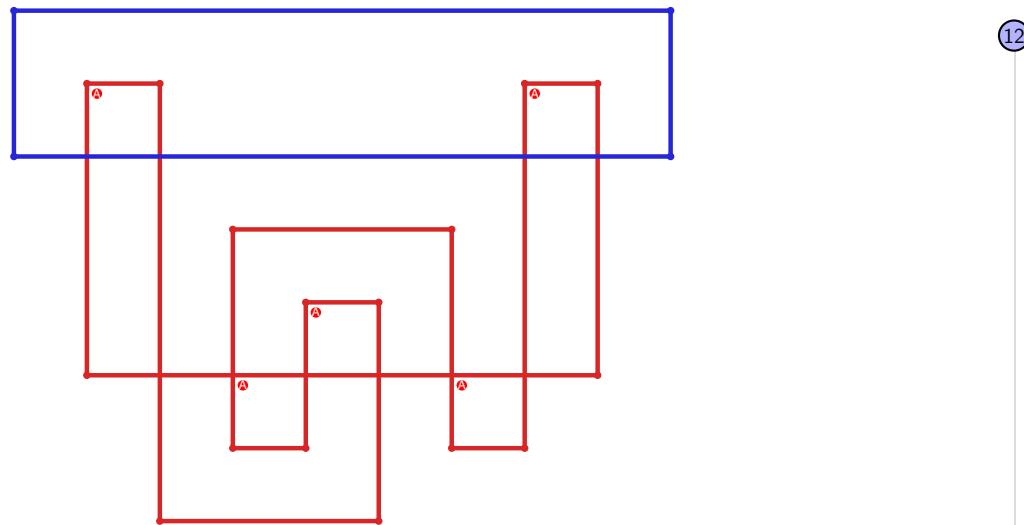


Figure 1173: SnapPy multiloop plot.

Figure 1174: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.290 $[[7, 12, 8, 1], [11, 6, 12, 7], [8, 13, 9, 16], [1, 4, 2, 5], [5, 10, 6, 11], [13, 10, 14, 9], [15, 20, 16, 17], [3, 19, 4, 20], [2, 19, 3, 18], [14, 18, 15, 17]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (8, 3, 9, 4), (6, 17, 7, 18), (2, 7, 3, 8), (4, 9, 5, 10), (20, 5, 17, 6), (16, 11, 13, 12), (12, 13, 1, 14), (19, 14, 20, 15), (15, 18, 16, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 6], [0, 7, 8, 4], [1, 3, 5, 1], [2, 4, 9, 2], [2, 9, 9, 7], [3, 6, 8, 8], [3, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 128
 Pinning number: 5

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.91

Table 586: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

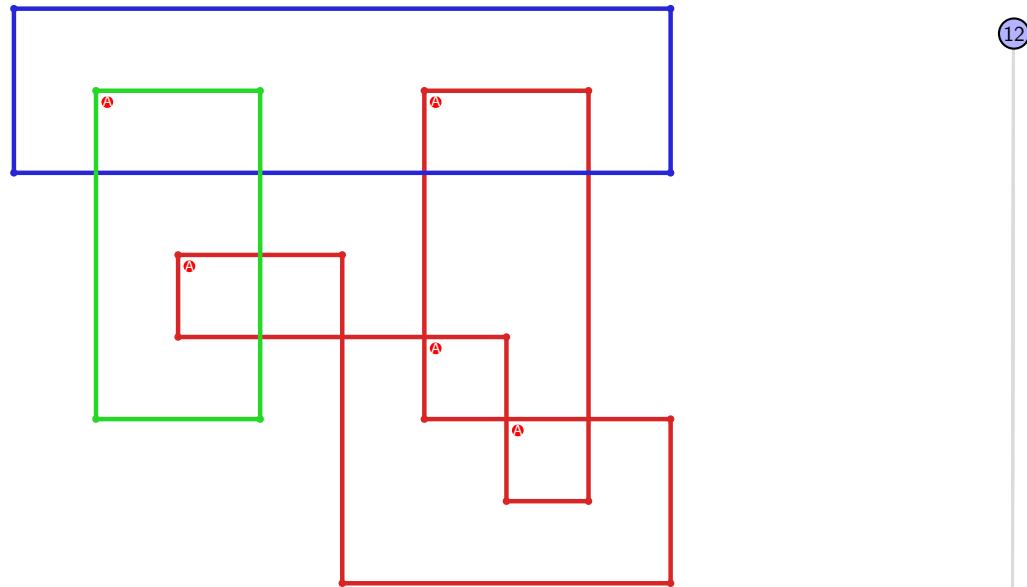


Figure 1175: SnapPy multiloop plot.



Figure 1176: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.291 $[[7, 20, 8, 1], [19, 6, 20, 7], [8, 18, 9, 17], [1, 4, 2, 5], [5, 18, 6, 19], [9, 14, 10, 15], [11, 16, 12, 17], [12, 3, 13, 4], [2, 13, 3, 14], [10, 16, 11, 15]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (18, 1, 19, 2), (16, 3, 17, 4), (19, 10, 20, 11), (6, 11, 7, 12), (12, 7, 13, 8), (8, 13, 9, 14), (14, 5, 15, 6), (2, 15, 3, 16), (4, 17, 5, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 6], [0, 7, 8, 4], [1, 3, 2, 1], [2, 8, 9, 9], [2, 9, 9, 7], [3, 6, 8, 8], [3, 7, 7, 5], [5, 6, 6, 5]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 587: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

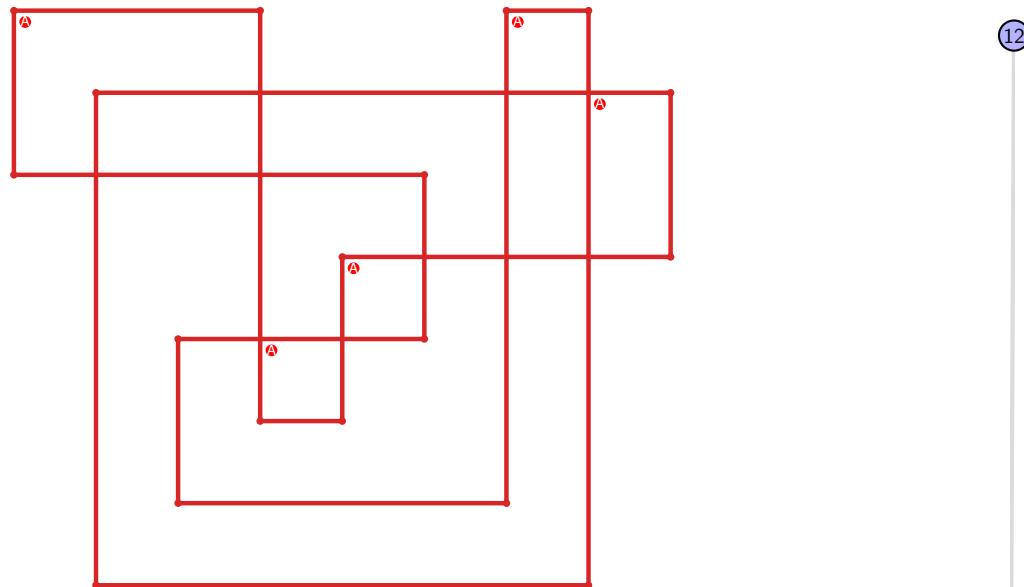


Figure 1177: SnapPy multiloop plot.

5

Figure 1178: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.292 $[[7, 20, 8, 1], [19, 6, 20, 7], [8, 18, 9, 17], [1, 4, 2, 5], [5, 18, 6, 19], [9, 15, 10, 14], [16, 13, 17, 14], [3, 12, 4, 13], [2, 12, 3, 11], [15, 11, 16, 10]]$

PD code drawn by SnapPy: $[(19, 2, 20, 3), (17, 4, 18, 5), (8, 13, 9, 14), (9, 20, 10, 1), (1, 10, 2, 11), (14, 11, 15, 12), (12, 7, 13, 8), (15, 6, 16, 7), (3, 16, 4, 17), (5, 18, 6, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 6], [0, 7, 8, 4], [1, 3, 2, 1], [2, 9, 9, 6], [2, 5, 9, 7], [3, 6, 8, 8], [3, 7, 7, 9], [5, 8, 6, 5]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 588: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

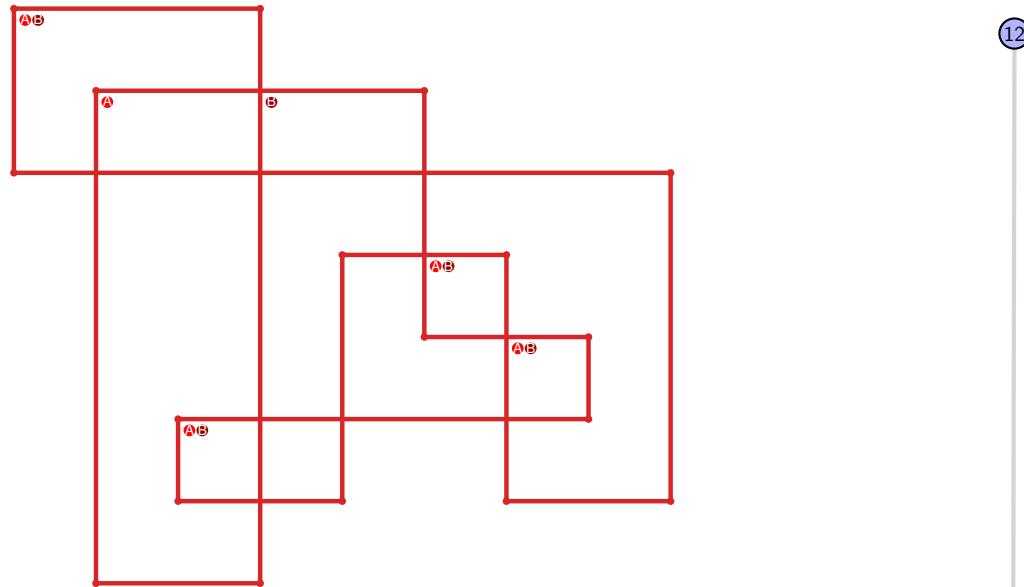


Figure 1179: SnapPy multiloop plot.

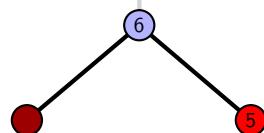


Figure 1180: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.293 $[[8, 16, 1, 9], [9, 5, 10, 6], [11, 7, 12, 8], [12, 15, 13, 16], [1, 4, 2, 5], [10, 7, 11, 6], [14, 20, 15, 17], [13, 20, 14, 19], [3, 18, 4, 19], [2, 18, 3, 17]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (13, 2, 14, 3), (3, 14, 4, 15), (15, 4, 16, 5), (16, 19, 17, 20), (5, 20, 6, 13), (12, 7, 9, 8), (8, 9, 1, 10), (10, 17, 11, 18), (18, 11, 19, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 5, 5, 3], [0, 2, 6, 7], [0, 8, 9, 1], [1, 2, 2, 1], [3, 9, 7, 7], [3, 6, 6, 8], [4, 7, 9, 9], [4, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 589: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

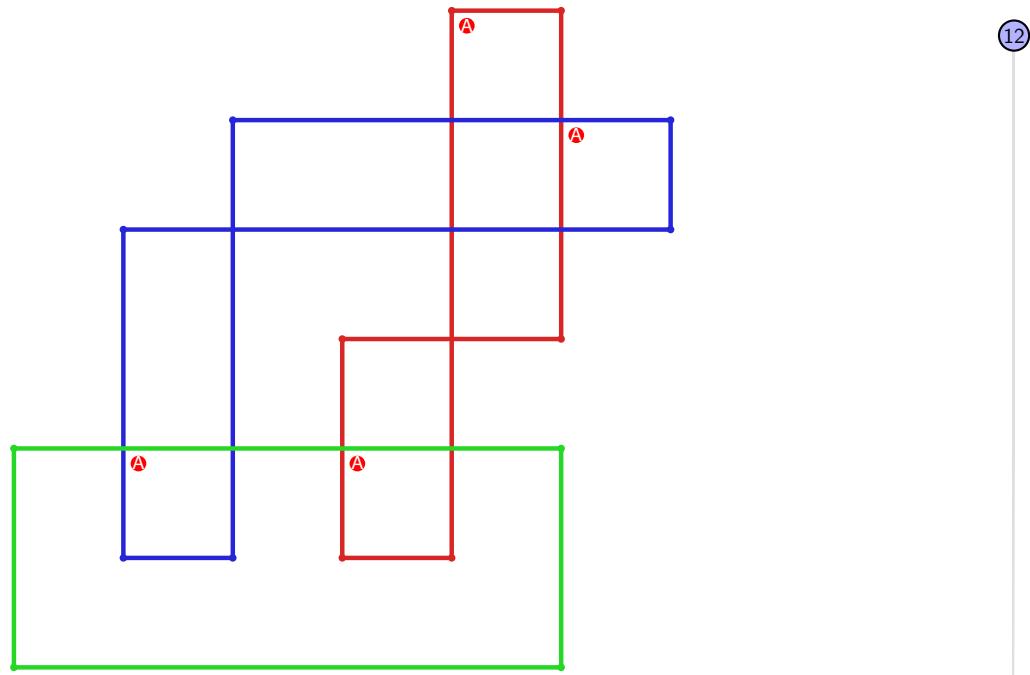


Figure 1181: SnapPy multiloop plot.

Figure 1182: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.294 $[[4, 16, 1, 5], [5, 9, 6, 8], [15, 3, 16, 4], [1, 10, 2, 9], [6, 17, 7, 20], [7, 19, 8, 20], [14, 11, 15, 12], [2, 10, 3, 11], [17, 14, 18, 13], [18, 12, 19, 13]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (15, 12, 16, 13), (16, 3, 5, 4), (4, 5, 1, 6), (9, 6, 10, 7), (18, 7, 19, 8), (8, 17, 9, 18), (2, 11, 3, 12), (14, 19, 15, 20), (20, 13, 17, 14)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 7, 7, 1], [1, 8, 5, 5], [1, 4, 4, 9], [2, 9, 8, 7], [2, 6, 3, 3], [4, 6, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 590: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

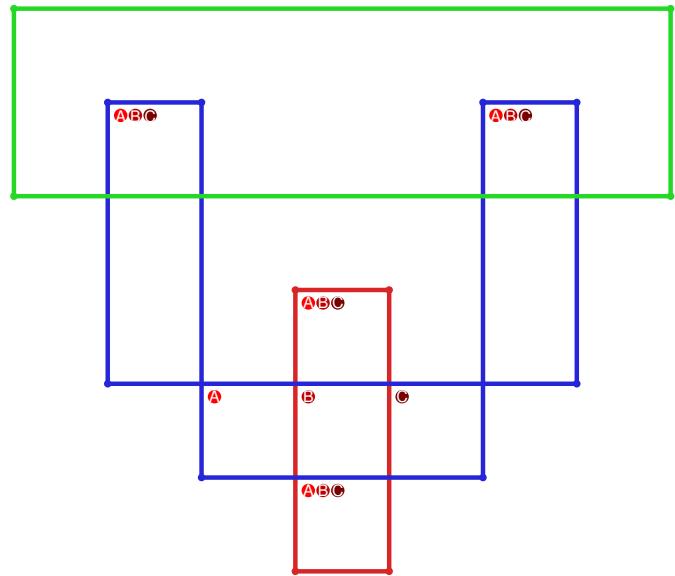


Figure 1183: SnapPy multiloop plot.

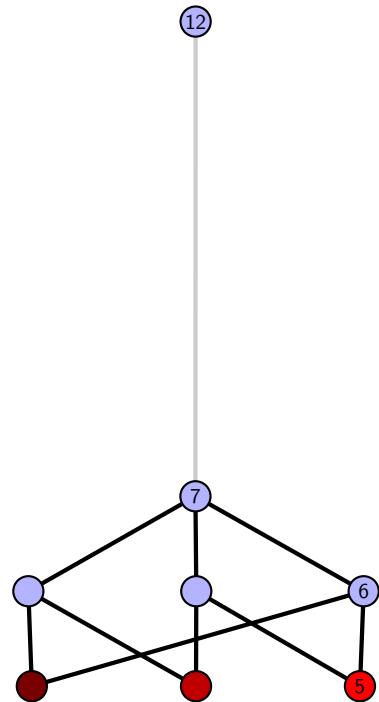


Figure 1184: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.295 [[16, 7, 1, 8], [8, 14, 9, 13], [6, 15, 7, 16], [1, 15, 2, 14], [9, 12, 10, 13], [5, 2, 6, 3], [11, 20, 12, 17], [10, 20, 11, 19], [3, 19, 4, 18], [4, 17, 5, 18]]

PD code drawn by SnapPy: [(13, 4, 14, 5), (6, 9, 7, 10), (10, 5, 11, 6), (11, 14, 12, 15), (3, 12, 4, 13), (2, 15, 3, 16), (17, 16, 18, 1), (18, 7, 19, 8), (8, 19, 9, 20), (1, 20, 2, 17)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 4], [0, 5, 3, 0], [0, 2, 5, 1], [1, 6, 7, 1], [2, 8, 9, 3], [4, 9, 7, 7], [4, 6, 6, 8], [5, 7, 9, 9], [5, 8, 8, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.97

Table 591: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

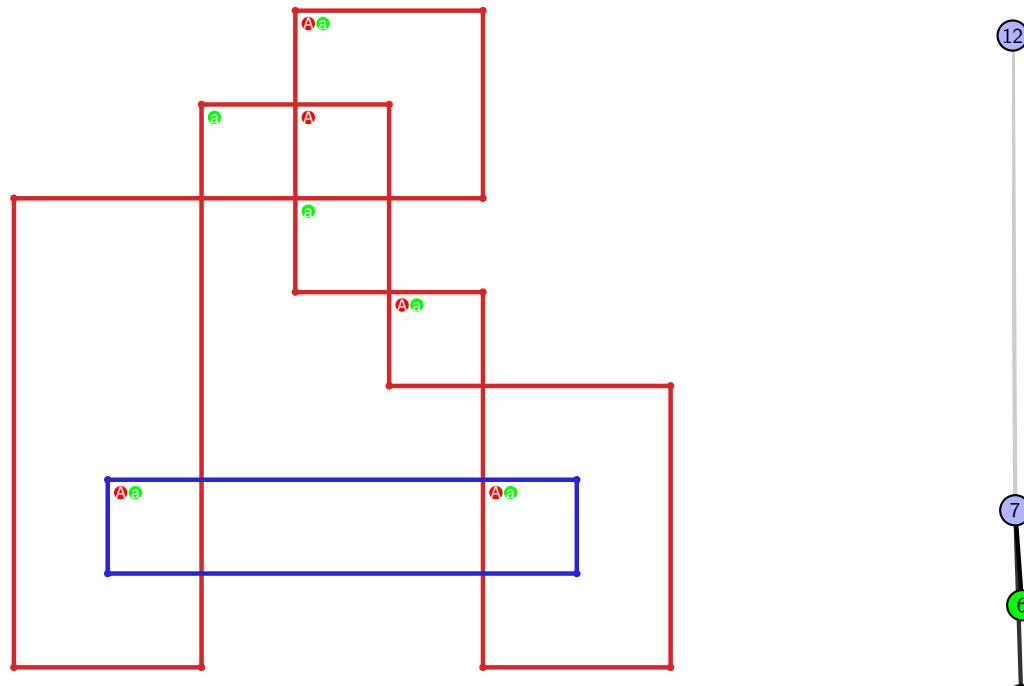


Figure 1185: SnapPy multiloop plot.

Figure 1186: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.296 $[[20, 7, 1, 8], [8, 18, 9, 17], [6, 19, 7, 20], [1, 19, 2, 18], [9, 15, 10, 14], [16, 13, 17, 14], [5, 2, 6, 3], [15, 11, 16, 10], [12, 3, 13, 4], [4, 11, 5, 12]]$

PD code drawn by `SnapPy`: $[(3, 20, 4, 1), (10, 1, 11, 2), (18, 5, 19, 6), (8, 13, 9, 14), (2, 9, 3, 10), (14, 11, 15, 12), (12, 7, 13, 8), (15, 6, 16, 7), (16, 19, 17, 20), (4, 17, 5, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 6, 1], [1, 7, 7, 5], [1, 4, 7, 8], [2, 8, 9, 3], [4, 9, 5, 4], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 592: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

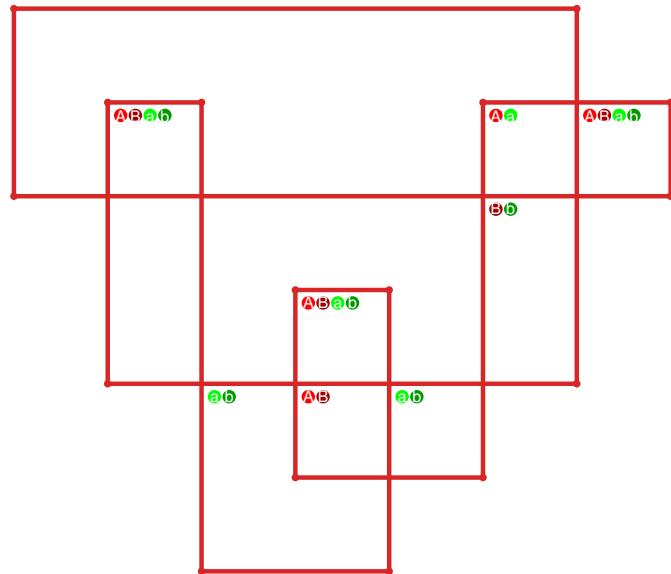


Figure 1187: `SnapPy` multiloop plot.

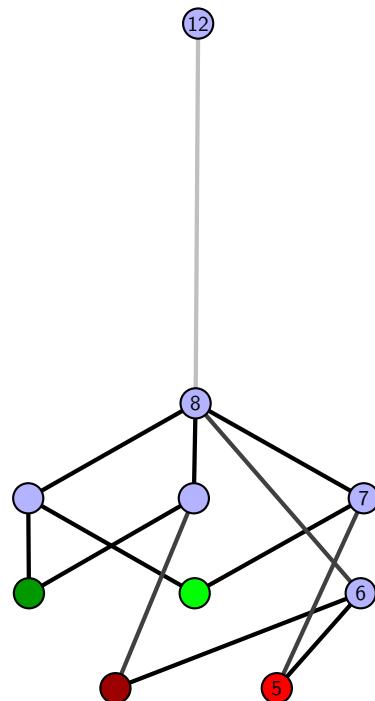


Figure 1188: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.297 [[20, 7, 1, 8], [8, 18, 9, 17], [6, 19, 7, 20], [1, 19, 2, 18], [9, 13, 10, 12], [16, 11, 17, 12], [5, 2, 6, 3], [13, 5, 14, 4], [10, 15, 11, 16], [3, 15, 4, 14]]

PD code drawn by SnapPy: [(1, 10, 2, 11), (17, 4, 18, 5), (13, 8, 14, 9), (9, 6, 10, 7), (11, 20, 12, 1), (7, 12, 8, 13), (14, 5, 15, 6), (15, 18, 16, 19), (3, 16, 4, 17), (2, 19, 3, 20)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 6, 1], [1, 7, 8, 5], [1, 4, 8, 8], [2, 9, 7, 3], [4, 6, 9, 9], [4, 9, 5, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 593: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

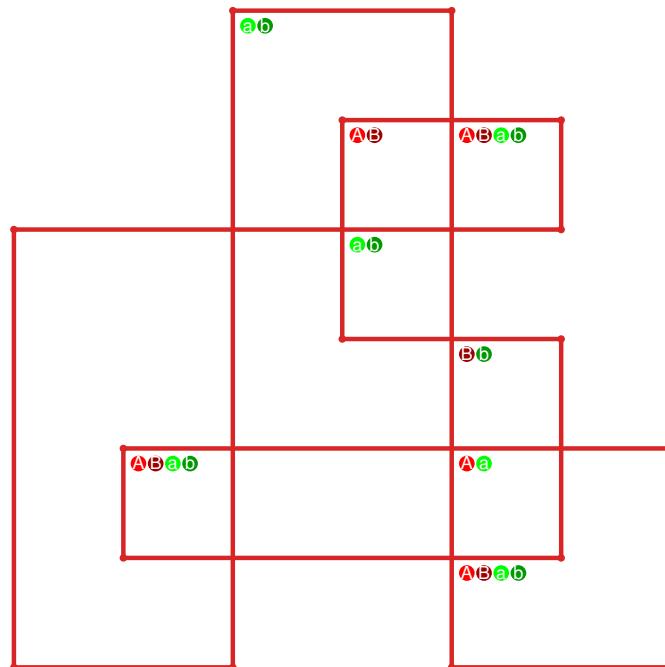


Figure 1189: SnapPy multiloop plot.

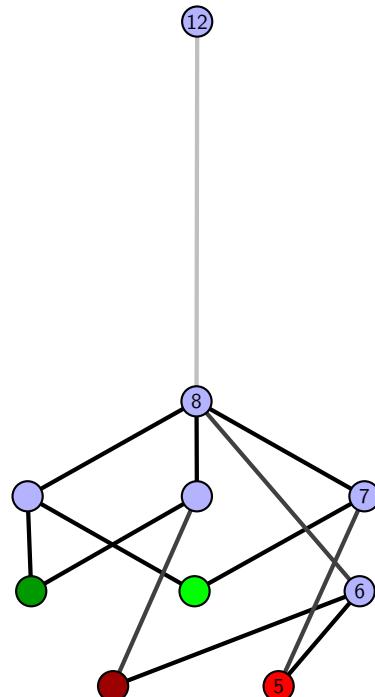


Figure 1190: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.298 [[14, 20, 1, 15], [15, 19, 16, 18], [13, 6, 14, 7], [19, 1, 20, 2], [16, 9, 17, 8], [17, 7, 18, 8], [5, 12, 6, 13], [2, 10, 3, 9], [11, 4, 12, 5], [10, 4, 11, 3]]

PD code drawn by SnapPy: [(14, 7, 1, 8), (8, 1, 9, 2), (10, 3, 11, 4), (15, 4, 16, 5), (5, 20, 6, 15), (6, 13, 7, 14), (2, 9, 3, 10), (17, 12, 18, 13), (16, 19, 17, 20), (11, 18, 12, 19)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 5, 6, 6], [0, 7, 1, 0], [1, 7, 5, 5], [1, 4, 4, 2], [2, 8, 8, 2], [3, 9, 9, 4], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 4
Total minimal pinning sets: 4
Total pinning sets: 60
Pinning number: 7

Average optimal degree: 2.21
Average minimal degree: 2.21
Average overall degree: 2.87

Table 594: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	14	20	15	6	1	56
Average degree	2.21	2.62	2.89	3.07	3.21	3.33	

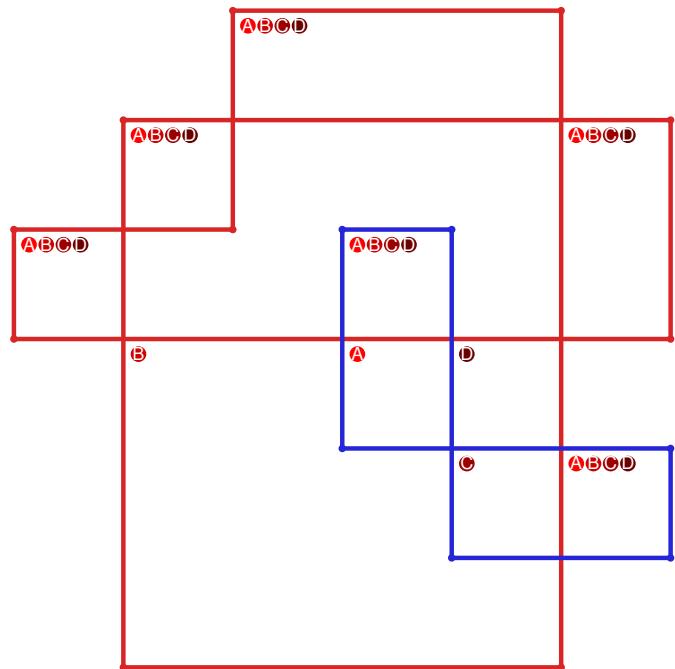


Figure 1191: SnapPy multiloop plot.

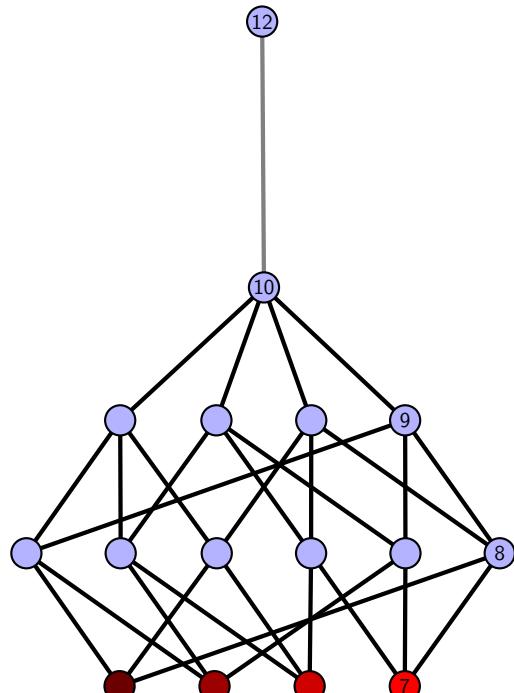


Figure 1192: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.299 `[[14, 20, 1, 15], [15, 19, 16, 18], [6, 13, 7, 14], [19, 1, 20, 2], [16, 8, 17, 9], [9, 17, 10, 18], [12, 5, 13, 6], [7, 3, 8, 2], [10, 3, 11, 4], [4, 11, 5, 12]]`

PD code drawn by `SnapPy`: `[(8, 1, 9, 2), (15, 4, 16, 5), (14, 7, 1, 8), (2, 9, 3, 10), (18, 11, 19, 12), (12, 3, 13, 4), (6, 13, 7, 14), (5, 16, 6, 17), (17, 20, 18, 15), (10, 19, 11, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 7, 1, 0], [1, 7, 5, 5], [1, 4, 4, 8], [2, 9, 9, 2], [2, 8, 4, 3], [5, 7, 9, 9], [6, 8, 8, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 595: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

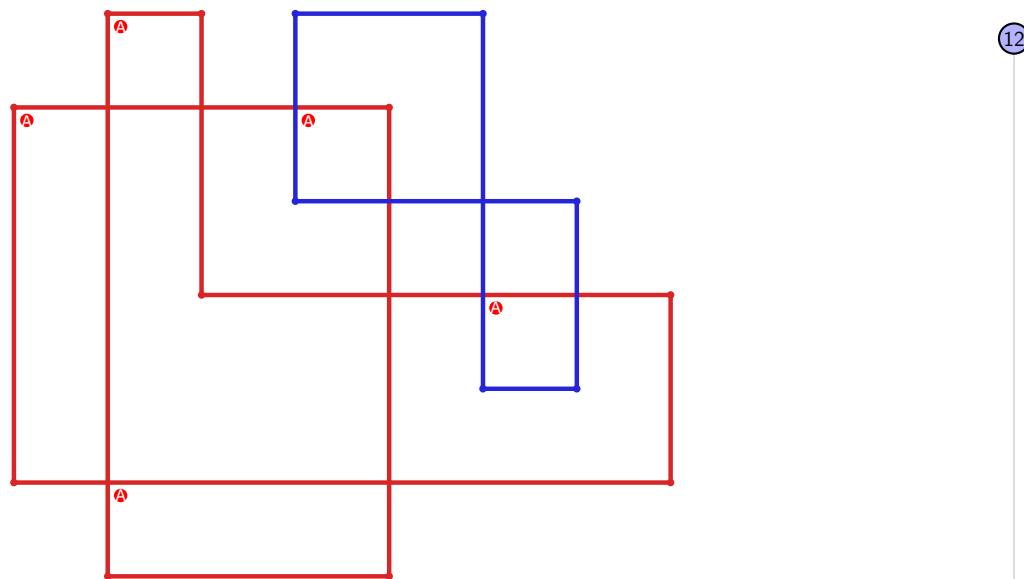


Figure 1193: `SnapPy` multiloop plot.

5

Figure 1194: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.300 [[6, 14, 1, 7], [7, 13, 8, 12], [5, 20, 6, 15], [13, 1, 14, 2], [8, 11, 9, 12], [15, 4, 16, 5], [19, 2, 20, 3], [10, 18, 11, 19], [9, 18, 10, 17], [3, 16, 4, 17]]

PD code drawn by `SnapPy`: [(7, 6, 8, 1), (20, 3, 13, 4), (11, 4, 12, 5), (15, 18, 16, 19), (19, 14, 20, 15), (2, 13, 3, 14), (9, 16, 10, 17), (17, 10, 18, 11), (1, 12, 2, 7), (5, 8, 6, 9)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 5, 6], [0, 6, 1, 0], [1, 7, 8, 1], [2, 9, 9, 2], [2, 9, 7, 3], [4, 6, 8, 8], [4, 7, 7, 9], [5, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 596: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

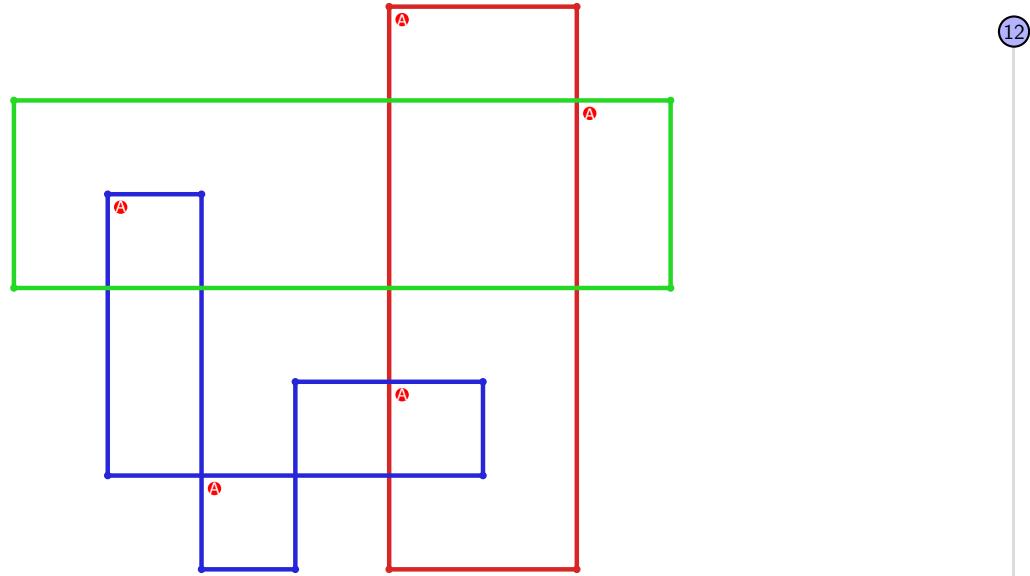


Figure 1195: `SnapPy` multiloop plot.



Figure 1196: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.301 $[[7, 20, 8, 1], [3, 6, 4, 7], [19, 8, 20, 9], [1, 19, 2, 18], [2, 17, 3, 18], [5, 12, 6, 13], [4, 12, 5, 11], [9, 15, 10, 14], [16, 13, 17, 14], [10, 15, 11, 16]]$

PD code drawn by SnapPy: $[(19, 2, 20, 3), (15, 4, 16, 5), (7, 20, 8, 1), (1, 8, 2, 9), (12, 9, 13, 10), (10, 5, 11, 6), (6, 11, 7, 12), (18, 13, 19, 14), (14, 17, 15, 18), (3, 16, 4, 17)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 3, 0], [0, 2, 4, 4], [1, 3, 3, 8], [1, 8, 6, 6], [1, 5, 5, 9], [2, 9, 9, 8], [4, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 597: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

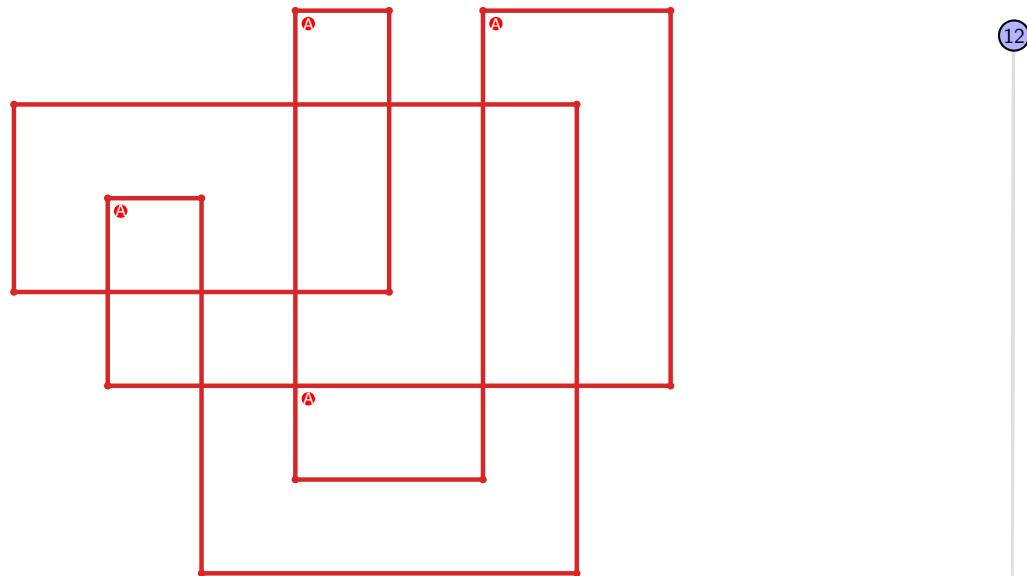


Figure 1197: SnapPy multiloop plot.

4

Figure 1198: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.302 $[[9, 20, 10, 1], [3, 8, 4, 9], [14, 19, 15, 20], [10, 2, 11, 1], [11, 2, 12, 3], [7, 4, 8, 5], [18, 13, 19, 14], [15, 13, 16, 12], [5, 16, 6, 17], [17, 6, 18, 7]]$

PD code drawn by SnapPy: $[(3, 20, 4, 1), (13, 2, 14, 3), (19, 4, 20, 5), (8, 11, 9, 12), (14, 9, 15, 10), (1, 12, 2, 13), (10, 15, 11, 16), (5, 16, 6, 17), (17, 6, 18, 7), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 7], [0, 4, 4, 0], [1, 3, 3, 7], [1, 8, 9, 1], [2, 9, 7, 2], [2, 6, 8, 4], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 598: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

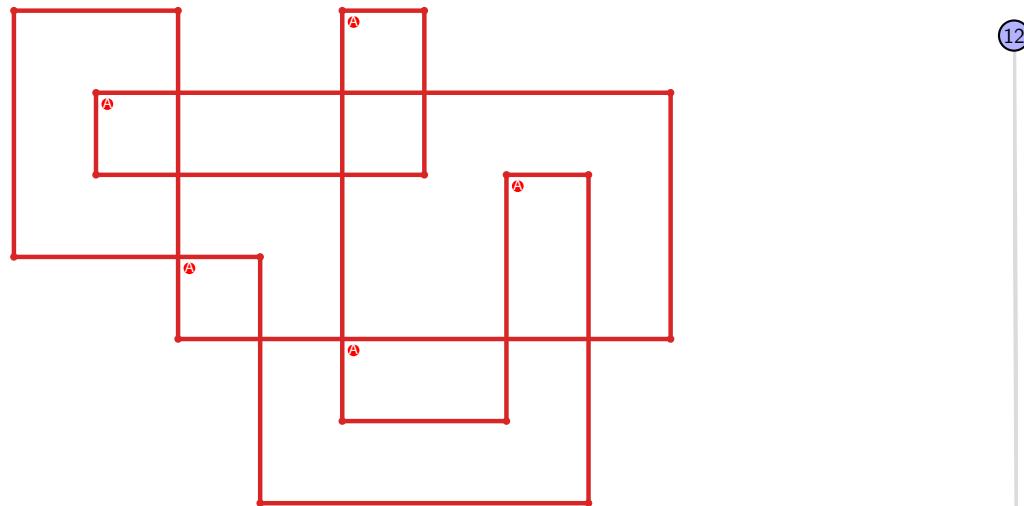


Figure 1199: SnapPy multiloop plot.

5

Figure 1200: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.303 $[[7, 14, 8, 1], [13, 6, 14, 7], [8, 15, 9, 20], [1, 4, 2, 5], [5, 12, 6, 13], [15, 12, 16, 11], [9, 17, 10, 18], [3, 19, 4, 20], [2, 19, 3, 18], [16, 10, 17, 11]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (11, 4, 12, 5), (19, 8, 20, 9), (9, 18, 10, 19), (3, 10, 4, 11), (5, 12, 6, 13), (7, 20, 8, 15), (15, 14, 16, 1), (1, 16, 2, 17), (17, 6, 18, 7)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 7], [0, 7, 8, 4], [1, 3, 5, 1], [2, 4, 9, 9], [2, 9, 9, 8], [2, 8, 8, 3], [3, 7, 7, 6], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 599: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

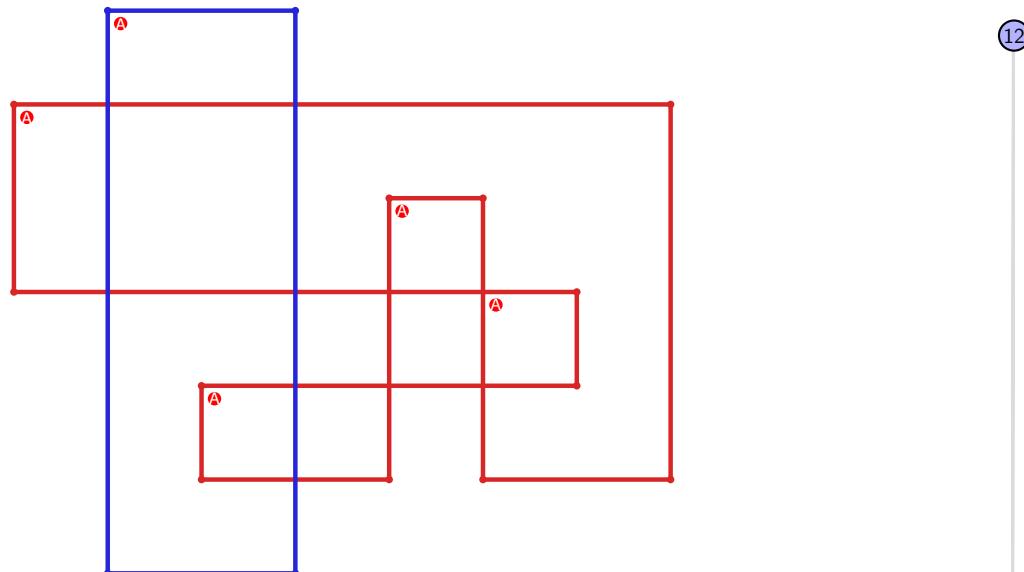


Figure 1201: SnapPy multiloop plot.



Figure 1202: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.304 $[[7, 16, 8, 1], [15, 6, 16, 7], [8, 17, 9, 20], [1, 4, 2, 5], [5, 14, 6, 15], [17, 14, 18, 13], [9, 19, 10, 20], [10, 3, 11, 4], [2, 11, 3, 12], [18, 12, 19, 13]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (15, 2, 16, 3), (13, 4, 14, 5), (16, 9, 1, 10), (19, 10, 20, 11), (11, 18, 12, 19), (3, 12, 4, 13), (5, 14, 6, 15), (7, 20, 8, 17), (17, 6, 18, 7)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 6], [0, 7, 8, 4], [1, 3, 5, 1], [2, 4, 9, 9], [2, 9, 7, 2], [3, 6, 8, 8], [3, 7, 7, 9], [5, 8, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 600: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

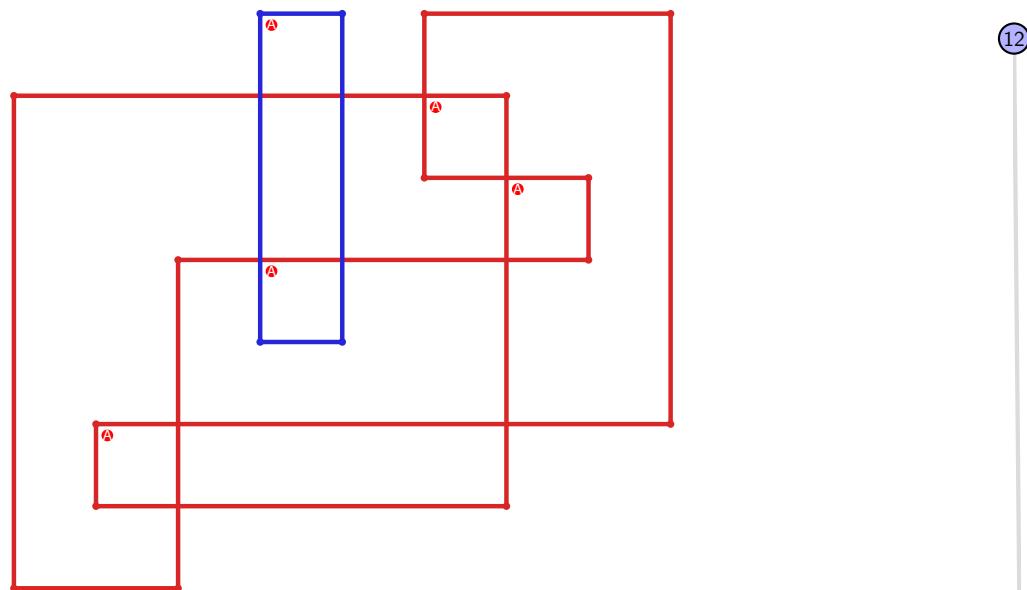


Figure 1203: `SnapPy` multiloop plot.



Figure 1204: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.305 $[[8, 20, 1, 9], [9, 7, 10, 8], [19, 16, 20, 17], [1, 4, 2, 5], [6, 10, 7, 11], [17, 12, 18, 13], [13, 18, 14, 19], [3, 15, 4, 16], [2, 15, 3, 14], [5, 12, 6, 11]]$

PD code drawn by SnapPy: $[(5, 8, 6, 1), (20, 3, 9, 4), (2, 9, 3, 10), (10, 1, 11, 2), (16, 11, 17, 12), (13, 6, 14, 7), (7, 14, 8, 15), (18, 15, 19, 16), (12, 17, 13, 18), (4, 19, 5, 20)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 7], [0, 7, 8, 9], [1, 9, 9, 1], [2, 9, 6, 6], [2, 5, 5, 8], [2, 8, 8, 3], [3, 7, 7, 6], [3, 5, 4, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 601: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

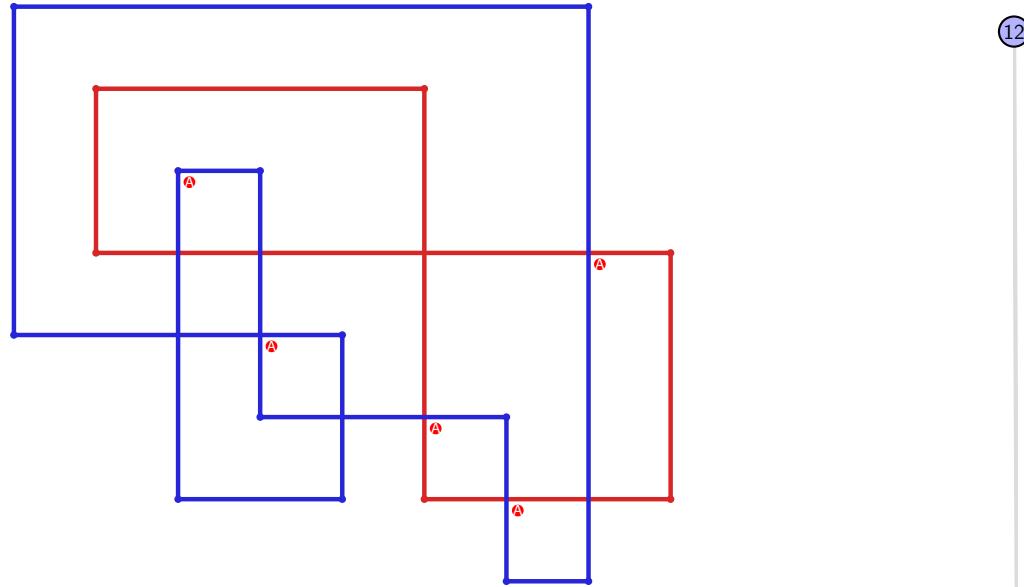


Figure 1205: SnapPy multiloop plot.

12
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Figure 1206: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.306 [[20, 13, 1, 14], [14, 3, 15, 4], [19, 8, 20, 9], [12, 1, 13, 2], [2, 11, 3, 12], [15, 7, 16, 6], [4, 17, 5, 18], [9, 18, 10, 19], [10, 7, 11, 8], [16, 5, 17, 6]]

PD code drawn by `SnapPy`: [(12, 1, 13, 2), (14, 3, 15, 4), (4, 13, 5, 14), (8, 5, 9, 6), (17, 6, 18, 7), (20, 9, 1, 10), (18, 11, 19, 12), (2, 15, 3, 16), (7, 16, 8, 17), (10, 19, 11, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 7, 7, 8], [0, 4, 4, 0], [1, 3, 3, 8], [1, 8, 9, 9], [1, 9, 9, 7], [2, 6, 8, 2], [2, 7, 5, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 602: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

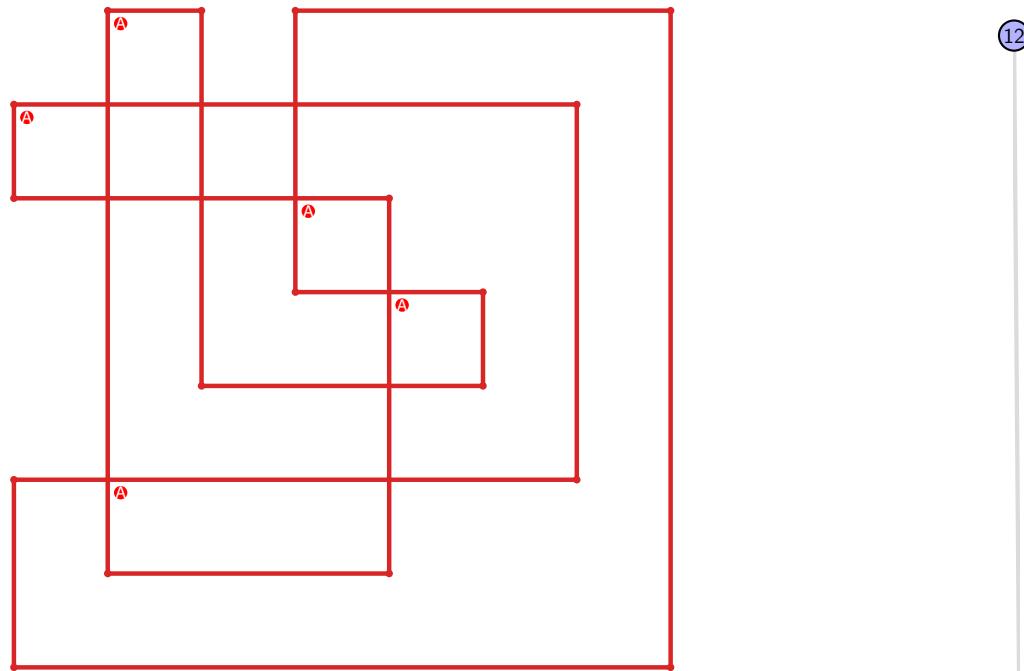


Figure 1207: `SnapPy` multiloop plot.

Figure 1208: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.307 [[7, 20, 8, 1], [3, 6, 4, 7], [19, 12, 20, 13], [8, 2, 9, 1], [9, 2, 10, 3], [16, 5, 17, 6], [4, 17, 5, 18], [13, 18, 14, 19], [14, 11, 15, 12], [10, 15, 11, 16]]

PD code drawn by `SnapPy`: [(7, 20, 8, 1), (14, 3, 15, 4), (1, 4, 2, 5), (12, 9, 13, 10), (17, 10, 18, 11), (8, 13, 9, 14), (2, 15, 3, 16), (11, 16, 12, 17), (5, 18, 6, 19), (19, 6, 20, 7)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 7, 7, 8], [0, 4, 4, 0], [1, 3, 3, 9], [1, 9, 6, 6], [1, 5, 5, 7], [2, 6, 8, 2], [2, 7, 9, 9], [4, 8, 8, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 603: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

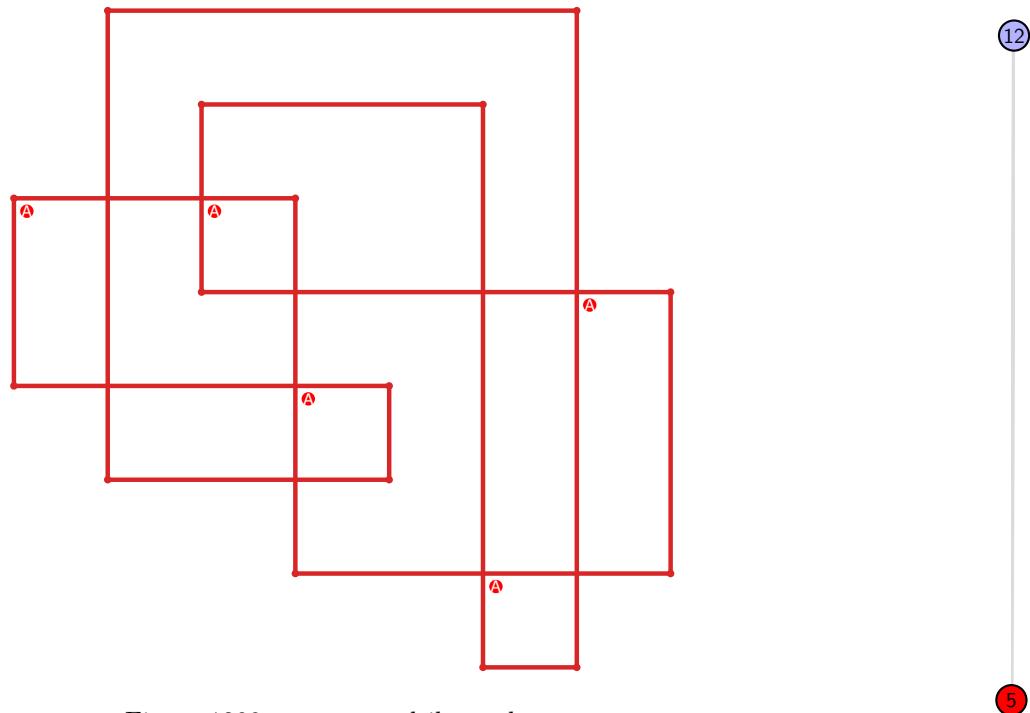


Figure 1209: `SnapPy` multiloop plot.

Figure 1210: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.308 [[14, 20, 1, 15], [15, 19, 16, 18], [6, 13, 7, 14], [19, 1, 20, 2], [16, 10, 17, 11], [11, 17, 12, 18], [12, 5, 13, 6], [7, 5, 8, 4], [2, 9, 3, 10], [8, 3, 9, 4]]

PD code drawn by SnapPy: [(14, 3, 1, 4), (8, 1, 9, 2), (12, 5, 13, 6), (15, 6, 16, 7), (2, 9, 3, 10), (18, 11, 19, 12), (4, 13, 5, 14), (7, 16, 8, 17), (17, 20, 18, 15), (10, 19, 11, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 8, 1, 0], [1, 8, 5, 5], [1, 4, 4, 6], [2, 5, 7, 2], [2, 6, 9, 9], [3, 9, 9, 4], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 604: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

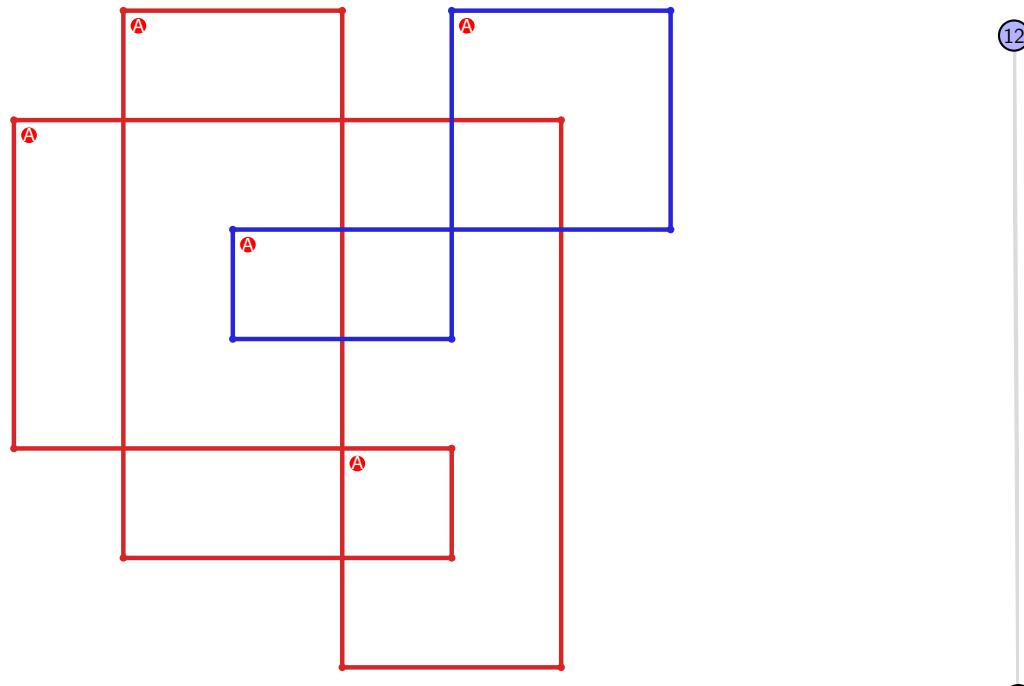


Figure 1211: SnapPy multiloop plot.

Figure 1212: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.309 $[[8, 14, 1, 9], [9, 13, 10, 12], [7, 20, 8, 15], [13, 1, 14, 2], [10, 4, 11, 5], [5, 11, 6, 12], [15, 6, 16, 7], [16, 19, 17, 20], [2, 17, 3, 18], [18, 3, 19, 4]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (15, 2, 16, 3), (12, 5, 13, 6), (18, 7, 19, 8), (1, 10, 2, 11), (11, 14, 12, 9), (4, 13, 5, 14), (6, 17, 7, 18), (16, 19, 17, 20), (3, 20, 4, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 8, 1, 0], [1, 9, 5, 5], [1, 4, 4, 6], [2, 5, 7, 2], [2, 6, 9, 8], [3, 7, 9, 9], [4, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 605: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

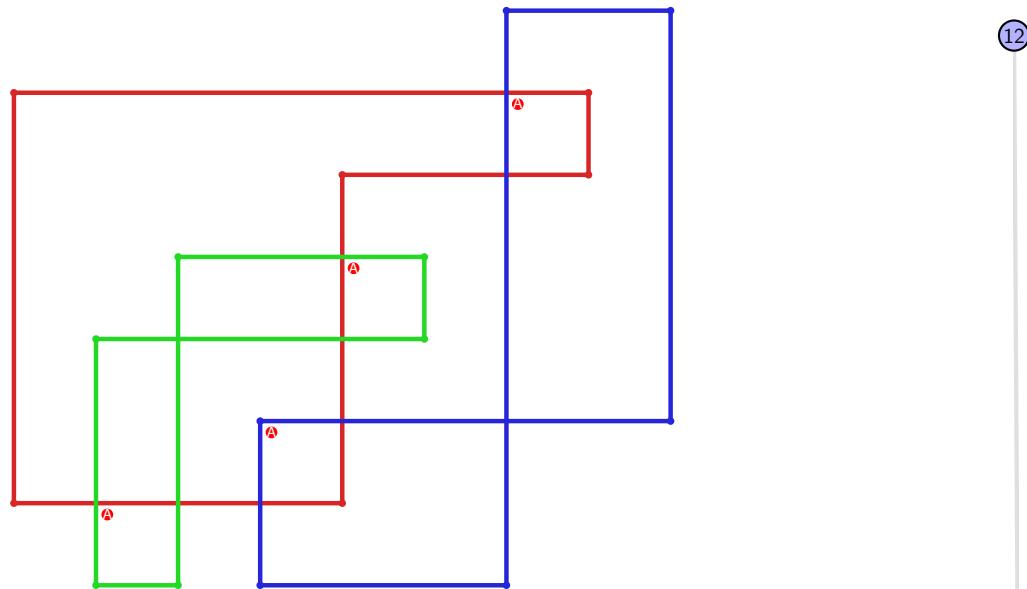


Figure 1213: `SnapPy` multiloop plot.

4

Figure 1214: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.310 `[[14, 20, 1, 15], [15, 19, 16, 18], [13, 4, 14, 5], [19, 1, 20, 2], [16, 9, 17, 8], [17, 7, 18, 8], [5, 12, 6, 13], [3, 10, 4, 11], [2, 10, 3, 9], [11, 6, 12, 7]]`

PD code drawn by `SnapPy`: `[(10, 1, 11, 2), (8, 3, 9, 4), (15, 4, 16, 5), (5, 20, 6, 15), (6, 13, 7, 14), (14, 7, 1, 8), (2, 9, 3, 10), (17, 12, 18, 13), (16, 19, 17, 20), (11, 18, 12, 19)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 8, 1, 0], [1, 8, 5, 5], [1, 4, 4, 9], [2, 9, 9, 2], [2, 9, 8, 8], [3, 7, 7, 4], [5, 7, 6, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 606: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

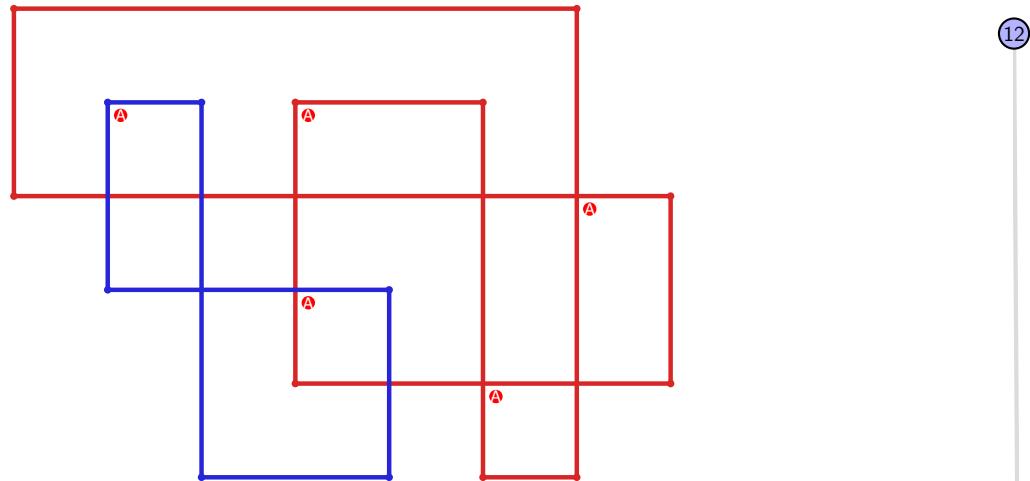


Figure 1215: `SnapPy` multiloop plot.

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Figure 1216: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.311 $[[12, 20, 1, 13], [13, 19, 14, 18], [11, 4, 12, 5], [19, 1, 20, 2], [14, 17, 15, 18], [5, 10, 6, 11], [6, 3, 7, 4], [2, 7, 3, 8], [8, 16, 9, 17], [15, 9, 16, 10]]$

PD code drawn by SnapPy: $[(9, 2, 10, 3), (13, 4, 14, 5), (12, 5, 1, 6), (17, 8, 18, 9), (1, 10, 2, 11), (6, 11, 7, 12), (3, 14, 4, 15), (20, 15, 13, 16), (16, 19, 17, 20), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 5, 6], [0, 7, 1, 0], [1, 8, 9, 1], [2, 9, 6, 2], [2, 5, 7, 7], [3, 6, 6, 8], [4, 7, 9, 9], [4, 8, 8, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 607: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

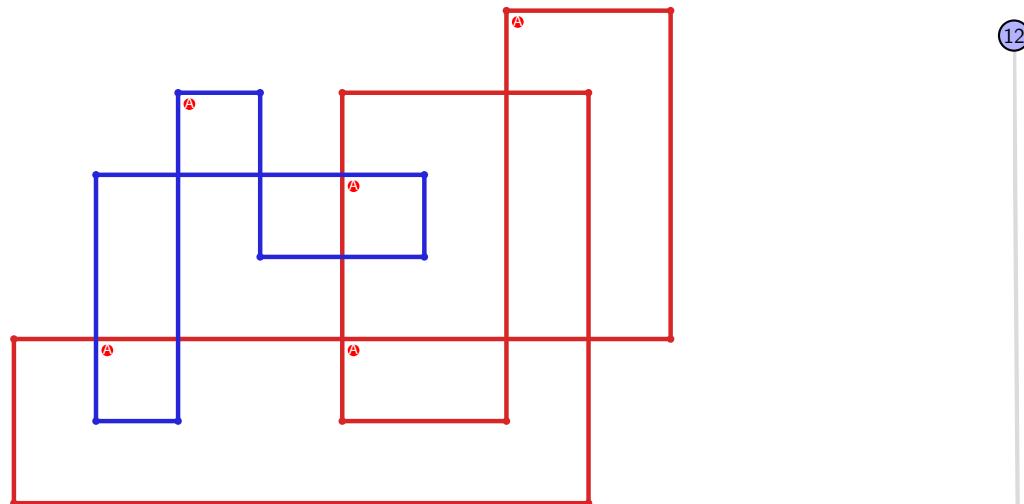


Figure 1217: SnapPy multiloop plot.

(12)

5

Figure 1218: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.312 [[14, 20, 1, 15], [15, 19, 16, 18], [6, 13, 7, 14], [19, 1, 20, 2], [16, 10, 17, 11], [11, 17, 12, 18], [12, 5, 13, 6], [7, 3, 8, 2], [4, 9, 5, 10], [3, 9, 4, 8]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (4, 13, 5, 14), (14, 5, 1, 6), (15, 6, 16, 7), (2, 9, 3, 10), (18, 11, 19, 12), (12, 3, 13, 4), (7, 16, 8, 17), (17, 20, 18, 15), (10, 19, 11, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 7, 1, 0], [1, 8, 5, 5], [1, 4, 4, 6], [2, 5, 8, 2], [2, 9, 9, 3], [4, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 608: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

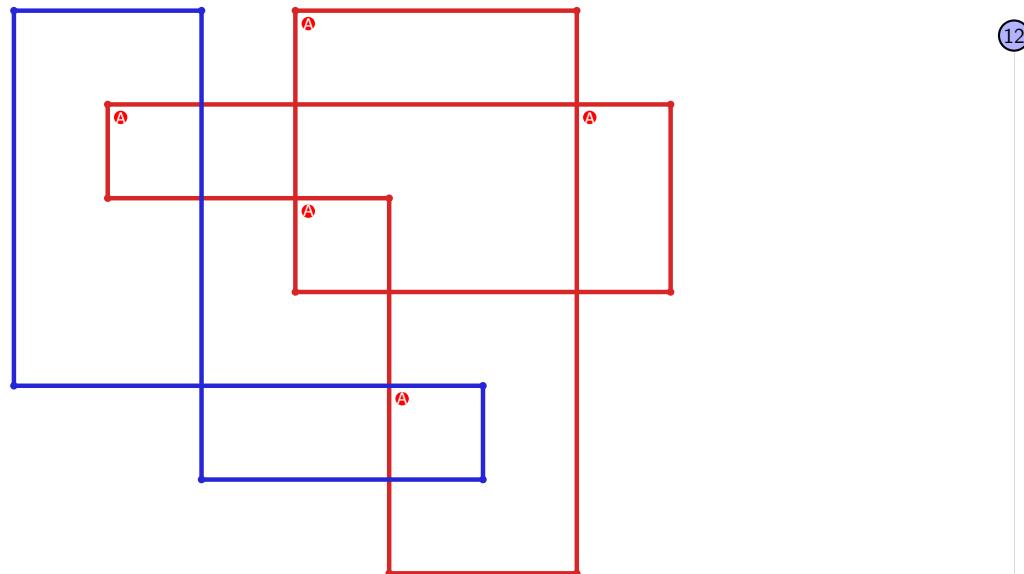


Figure 1219: `SnapPy` multiloop plot.



Figure 1220: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.313 [[8, 16, 1, 9], [9, 15, 10, 14], [7, 20, 8, 17], [15, 1, 16, 2], [10, 13, 11, 14], [17, 6, 18, 7], [19, 2, 20, 3], [4, 12, 5, 13], [11, 5, 12, 6], [18, 4, 19, 3]]

PD code drawn by `SnapPy`: [(9, 8, 10, 1), (1, 12, 2, 9), (20, 3, 13, 4), (11, 4, 12, 5), (16, 7, 17, 8), (2, 13, 3, 14), (19, 14, 20, 15), (15, 18, 16, 19), (6, 17, 7, 18), (5, 10, 6, 11)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 5, 6], [0, 6, 1, 0], [1, 7, 8, 1], [2, 8, 9, 2], [2, 9, 9, 3], [4, 9, 8, 8], [4, 7, 7, 5], [5, 7, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 609: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

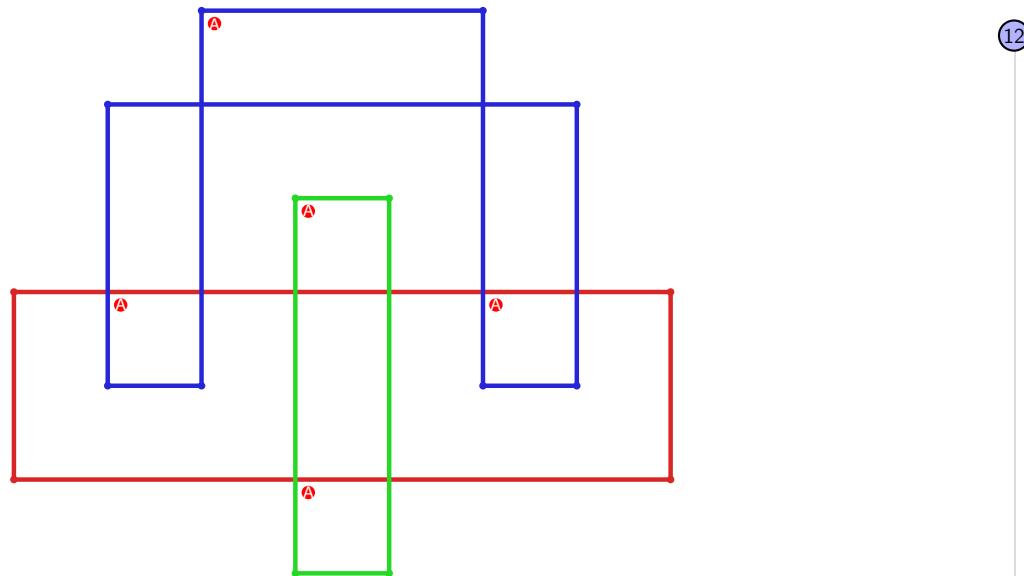


Figure 1221: `SnapPy` multiloop plot.



Figure 1222: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.314 [[10, 20, 1, 11], [11, 19, 12, 18], [4, 9, 5, 10], [19, 1, 20, 2], [12, 17, 13, 18], [8, 3, 9, 4], [5, 3, 6, 2], [16, 13, 17, 14], [7, 15, 8, 16], [6, 15, 7, 14]]

PD code drawn by `SnapPy`: [(10, 3, 1, 4), (6, 1, 7, 2), (2, 7, 3, 8), (16, 9, 17, 10), (13, 20, 14, 11), (11, 4, 12, 5), (5, 12, 6, 13), (19, 14, 20, 15), (15, 18, 16, 19), (8, 17, 9, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 5, 6], [0, 6, 1, 0], [1, 7, 7, 1], [2, 8, 6, 2], [2, 5, 9, 3], [4, 9, 8, 4], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 610: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

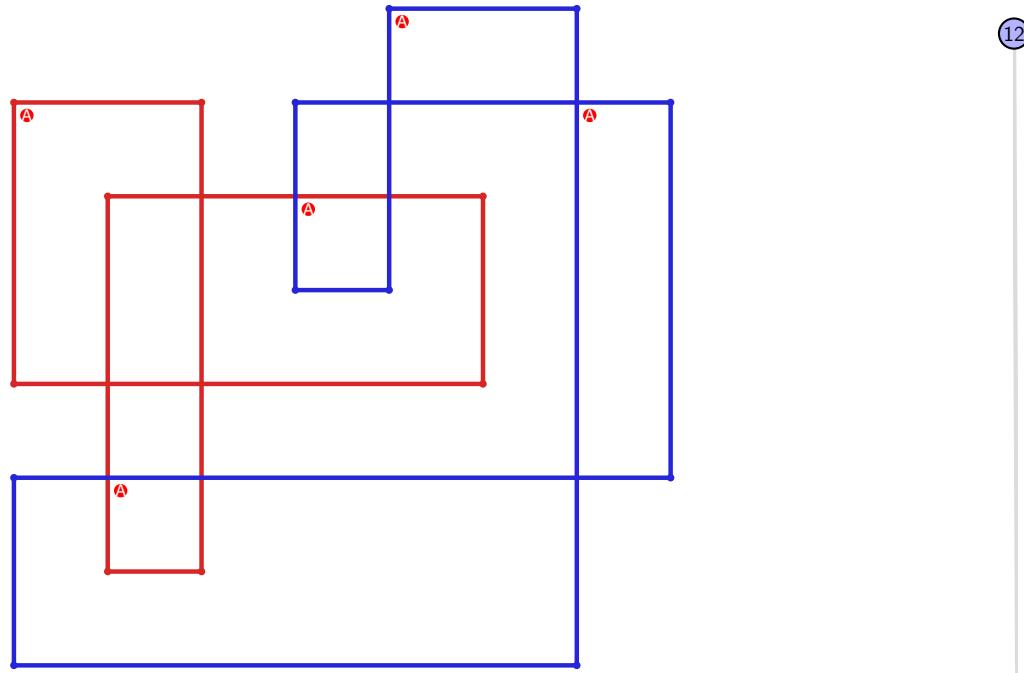


Figure 1223: `SnapPy` multiloop plot.

Figure 1224: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.315 $[[14, 5, 1, 6], [6, 12, 7, 11], [4, 13, 5, 14], [1, 13, 2, 12], [7, 15, 8, 20], [10, 19, 11, 20], [3, 16, 4, 17], [2, 16, 3, 15], [8, 17, 9, 18], [18, 9, 19, 10]]$

PD code drawn by SnapPy: $[(11, 2, 12, 3), (17, 6, 18, 7), (8, 3, 9, 4), (9, 12, 10, 13), (1, 10, 2, 11), (5, 16, 6, 17), (7, 18, 8, 19), (19, 4, 20, 5), (20, 13, 15, 14), (14, 15, 1, 16)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 7, 1], [1, 7, 8, 5], [1, 4, 9, 9], [2, 8, 7, 7], [3, 6, 6, 4], [4, 6, 9, 9], [5, 8, 8, 5]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 611: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

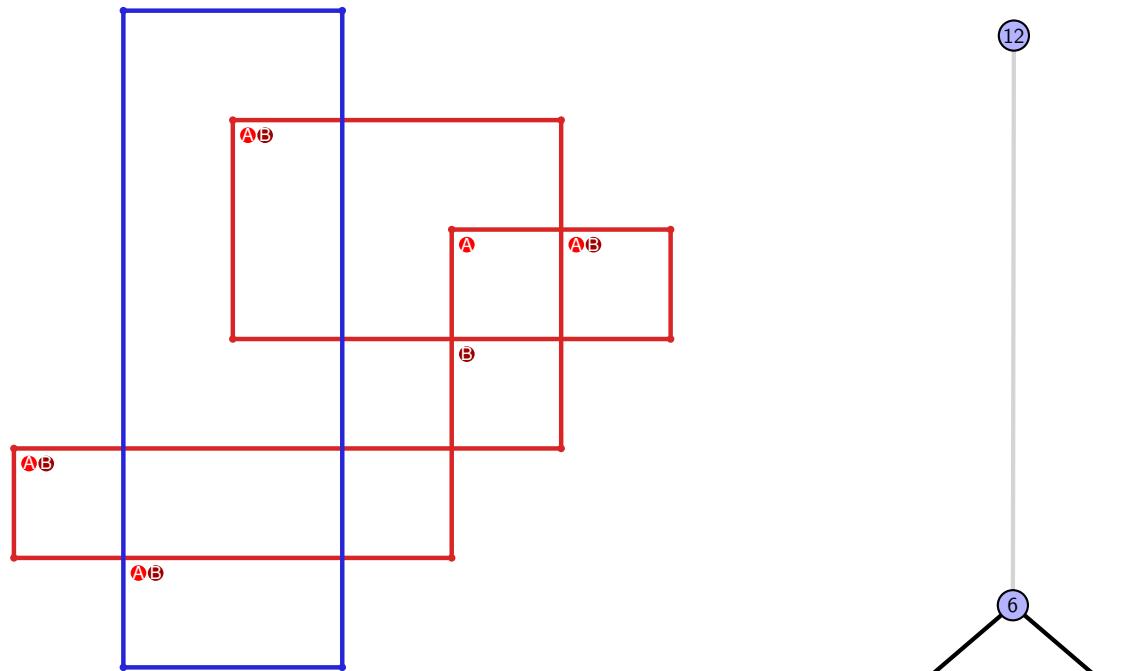


Figure 1225: SnapPy multiloop plot.

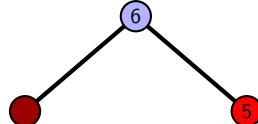


Figure 1226: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.316 [[11, 20, 12, 1], [10, 17, 11, 18], [19, 12, 20, 13], [1, 19, 2, 18], [6, 9, 7, 10], [7, 16, 8, 17], [13, 4, 14, 5], [2, 5, 3, 6], [15, 8, 16, 9], [3, 14, 4, 15]]

PD code drawn by `SnapPy`: [(10, 1, 11, 2), (19, 2, 20, 3), (12, 5, 13, 6), (3, 6, 4, 7), (16, 9, 17, 10), (20, 11, 1, 12), (4, 13, 5, 14), (7, 14, 8, 15), (15, 18, 16, 19), (8, 17, 9, 18)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 7, 1], [1, 7, 8, 5], [1, 4, 8, 8], [2, 9, 9, 7], [3, 6, 9, 4], [4, 9, 5, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 1
Total minimal pinning sets: 7

Total pinning sets: 244

Pinning number: 5

Average optimal degree: 2.4

Average minimal degree: 2.58

Average overall degree: 3.05

Table 612: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	1	0	0	0	0	0	6
Nonminimal pinning sets	0	7	43	75	68	34	9	1	237
Average degree	2.4	2.63	2.85	3.02	3.15	3.24	3.29	3.33	

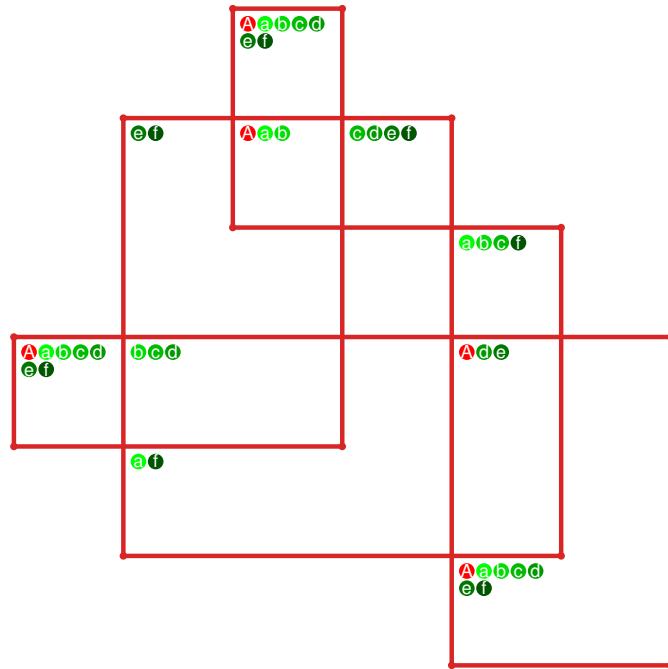


Figure 1227: `SnapPy` multiloop plot.

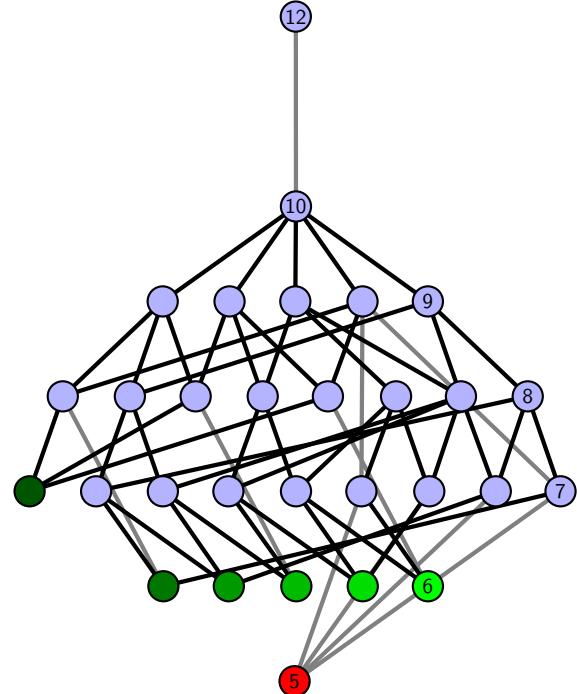


Figure 1228: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.317 $[[20, 5, 1, 6], [6, 18, 7, 17], [4, 19, 5, 20], [1, 19, 2, 18], [7, 16, 8, 17], [10, 3, 11, 4], [2, 11, 3, 12], [12, 15, 13, 16], [8, 13, 9, 14], [14, 9, 15, 10]]$

PD code drawn by SnapPy: [(7, 20, 8, 1), (17, 2, 18, 3), (11, 6, 12, 7), (19, 8, 20, 9), (5, 10, 6, 11), (9, 12, 10, 13), (4, 13, 5, 14), (14, 3, 15, 4), (15, 18, 16, 19), (1, 16, 2, 17)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 4], [0, 5, 3, 0], [0, 2, 6, 1], [1, 7, 8, 1], [2, 9, 6, 6], [3, 5, 5, 7], [4, 6, 9, 8], [4, 7, 9, 9], [5, 8, 8, 7]]

Total optimal pinning sets: 4
Total pinning pinning sets: 4

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.33

Total pinning sets: 144

• 11-1 • 2-65

Pinning number: 6

Average overall degree: 2.97

Table 613: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

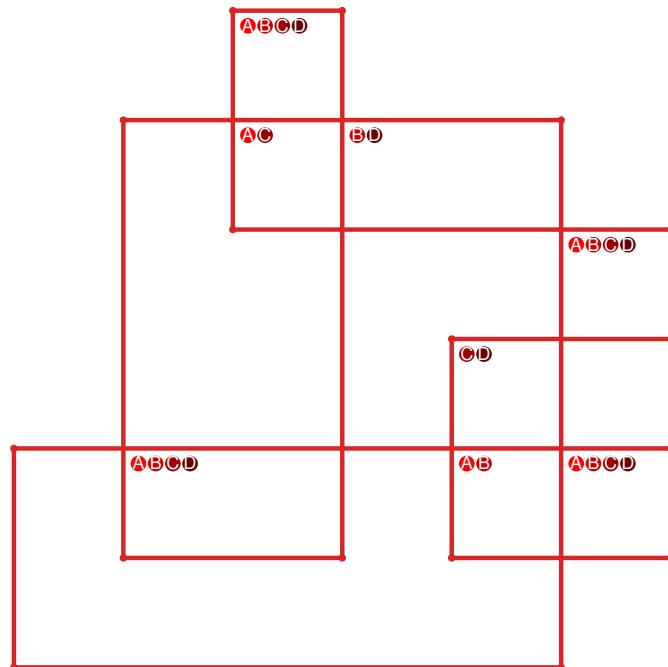


Figure 1229: SnapPy multiloop plot.

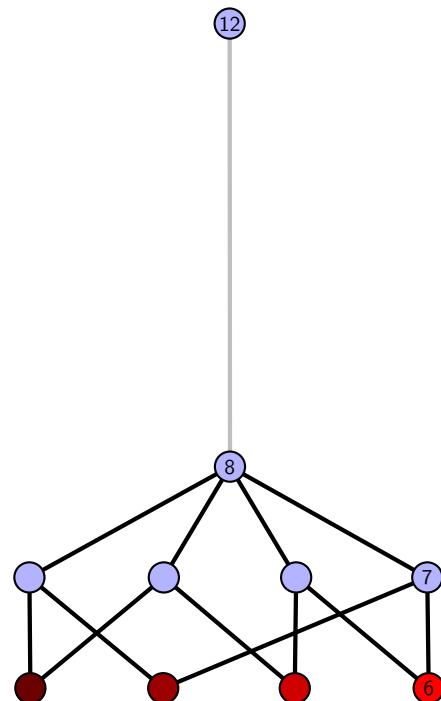


Figure 1230: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.318 $[[6, 20, 1, 7], [7, 17, 8, 16], [5, 13, 6, 14], [19, 3, 20, 4], [1, 18, 2, 17], [8, 12, 9, 11], [15, 10, 16, 11], [14, 10, 15, 9], [12, 4, 13, 5], [2, 18, 3, 19]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (15, 2, 16, 3), (12, 17, 13, 18), (18, 13, 19, 14), (14, 11, 15, 12), (3, 16, 4, 17), (19, 10, 20, 11), (20, 5, 7, 6), (6, 7, 1, 8), (4, 9, 5, 10)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 8, 8], [0, 8, 9, 9], [0, 9, 9, 1], [1, 8, 7, 6], [1, 5, 7, 7], [2, 6, 6, 5], [2, 5, 3, 2], [3, 4, 4, 3]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 614: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

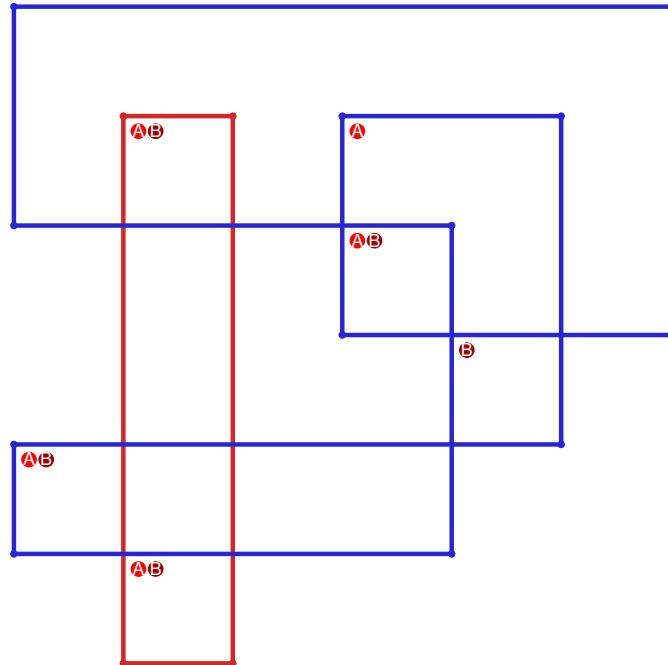


Figure 1231: SnapPy multiloop plot.

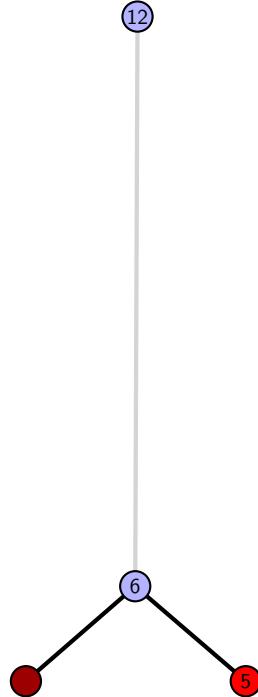


Figure 1232: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.319 $[[12, 3, 1, 4], [4, 13, 5, 20], [11, 17, 12, 18], [2, 14, 3, 15], [1, 14, 2, 13], [5, 9, 6, 8], [19, 7, 20, 8], [18, 7, 19, 6], [16, 10, 17, 11], [15, 10, 16, 9]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (4, 17, 5, 18), (18, 5, 19, 6), (6, 3, 7, 4), (7, 14, 8, 15), (15, 8, 16, 9), (9, 16, 10, 17), (19, 2, 20, 3), (20, 11, 13, 12), (12, 13, 1, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 8, 8], [0, 9, 4, 4], [0, 3, 3, 1], [1, 9, 7, 6], [1, 5, 7, 7], [2, 6, 6, 5], [2, 9, 9, 2], [3, 8, 8, 5]]$

Total optimal pinning sets: 4

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.33

Total pinning sets: 144

Average overall degree: 2.97

Pinning number: 6

Table 615: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

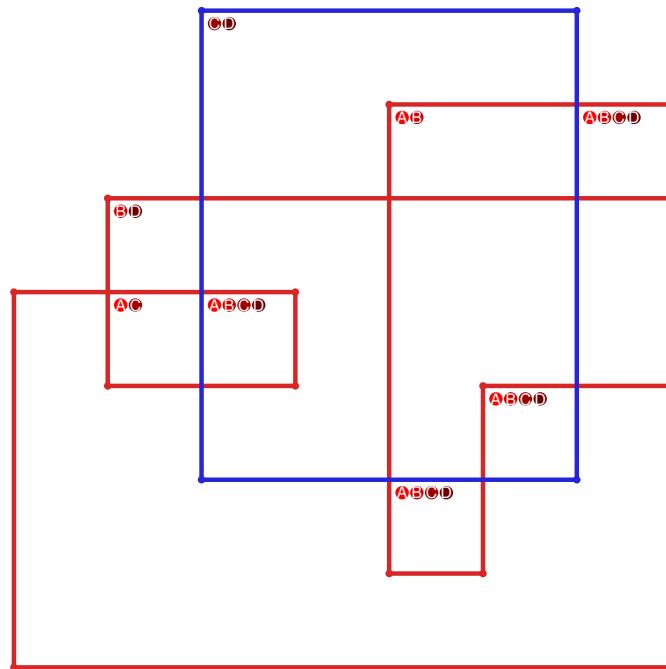


Figure 1233: SnapPy multiloop plot.

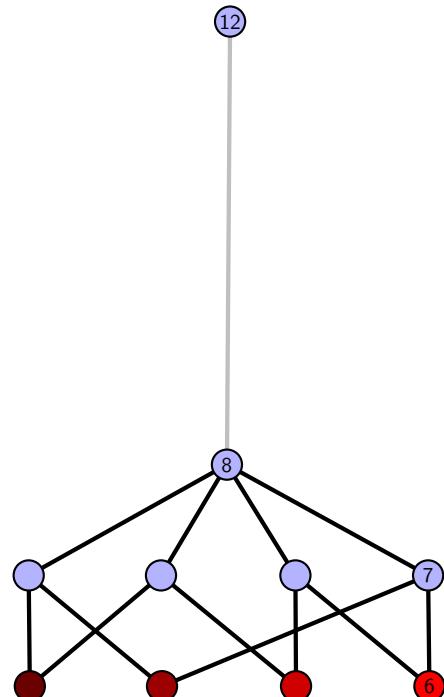


Figure 1234: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.320 `[[16, 20, 1, 17], [17, 11, 18, 12], [19, 15, 20, 16], [1, 10, 2, 11], [18, 13, 19, 12], [5, 14, 6, 15], [6, 9, 7, 10], [2, 7, 3, 8], [13, 4, 14, 5], [8, 3, 9, 4]]`

PD code drawn by `SnapPy`: `[(6, 1, 7, 2), (11, 2, 12, 3), (16, 5, 1, 6), (4, 7, 5, 8), (15, 8, 16, 9), (20, 9, 17, 10), (10, 17, 11, 18), (3, 12, 4, 13), (18, 13, 19, 14), (14, 19, 15, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 3, 4, 4], [0, 4, 5, 0], [0, 6, 7, 1], [1, 8, 2, 1], [2, 8, 8, 6], [3, 5, 9, 7], [3, 6, 9, 9], [4, 9, 5, 5], [6, 8, 7, 7]]`

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 616: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

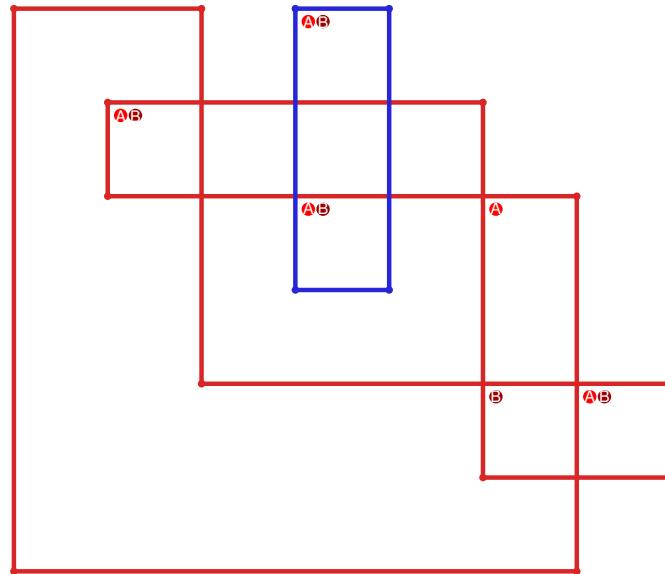


Figure 1235: `SnapPy` multiloop plot.

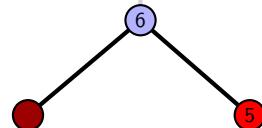


Figure 1236: Minimal join sub-semi-lattice of minimal pinning sets.

$$4.9.321 \quad [[7, 20, 8, 1], [6, 9, 7, 10], [19, 8, 20, 9], [1, 11, 2, 10], [5, 16, 6, 17], [18, 15, 19, 16], [11, 15, 12, 14], [2, 14, 3, 13], [17, 4, 18, 5], [12, 4, 13, 3]]$$

PD code drawn by SnapPy: $[(1, 10, 2, 11), (15, 2, 16, 3), (17, 6, 18, 7), (4, 7, 5, 8), (8, 19, 9, 20), (11, 20, 12, 1), (12, 9, 13, 10), (16, 13, 17, 14), (3, 14, 4, 15), (5, 18, 6, 19)]$

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 5, 0], [0, 6, 7, 1], [1, 8, 8, 5], [2, 4, 8, 6], [3, 5, 9, 7], [3, 6, 9, 9], [4, 9, 5, 4], [6, 8, 7, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 7
Total pinning sets: 244
Pinning number: 5

Average optimal degree: 2.4
Average minimal degree: 2.58
Average overall degree: 3.05

Table 617: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	1	0	0	0	0	0	6
Nonminimal pinning sets	0	7	43	75	68	34	9	1	237
Average degree	2.4	2.63	2.85	3.02	3.15	3.24	3.29	3.33	

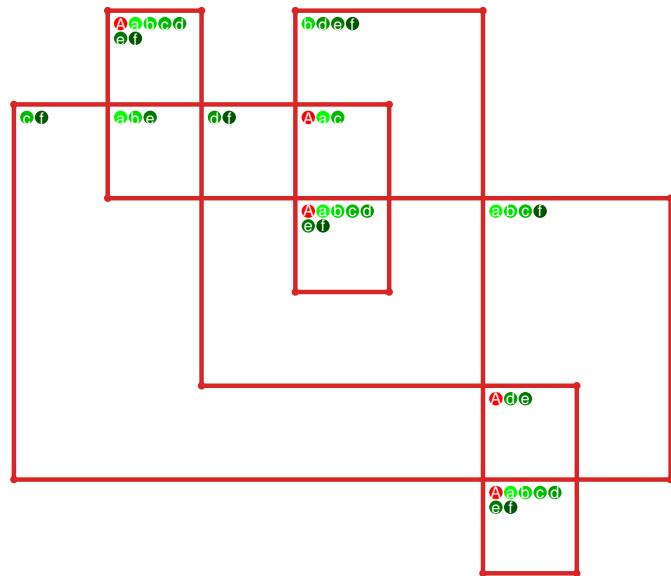


Figure 1237: SnapPy multiloop plot.

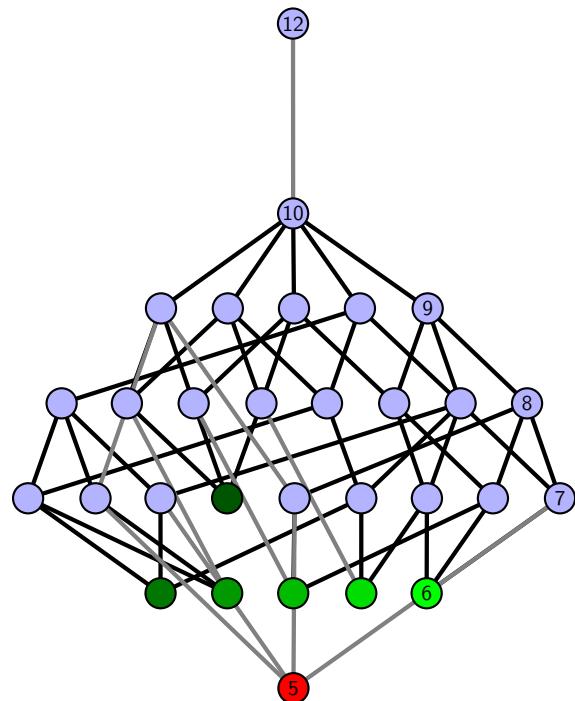


Figure 1238: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.322 $[[20, 15, 1, 16], [16, 13, 17, 14], [14, 19, 15, 20], [1, 12, 2, 13], [17, 9, 18, 8], [18, 7, 19, 8], [11, 2, 12, 3], [9, 5, 10, 4], [6, 3, 7, 4], [10, 5, 11, 6]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (4, 1, 5, 2), (2, 7, 3, 8), (8, 3, 9, 4), (16, 5, 17, 6), (6, 15, 7, 16), (19, 10, 20, 11), (14, 11, 15, 12), (18, 13, 19, 14), (12, 17, 13, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 2], [0, 1, 5, 0], [0, 6, 6, 1], [1, 7, 5, 5], [2, 4, 4, 8], [3, 8, 9, 3], [4, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 4

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.33

Total pinning sets: 144

Average overall degree: 2.97

Pinning number: 6

Table 618: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

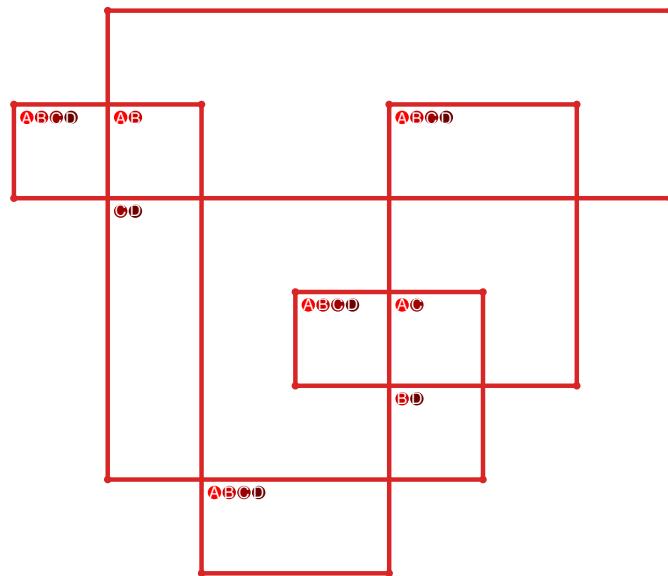


Figure 1239: `SnapPy` multiloop plot.

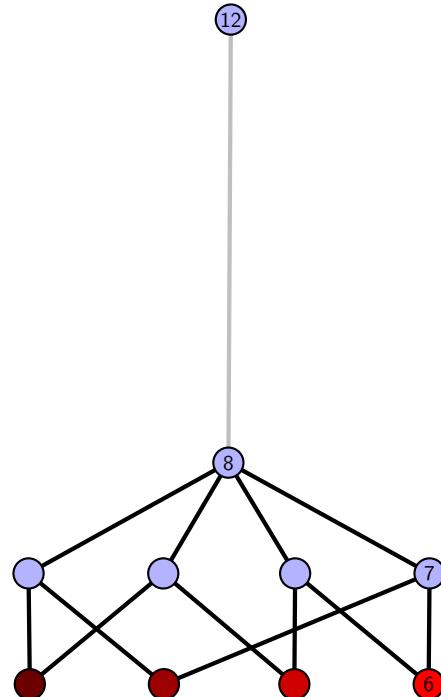


Figure 1240: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.323 $[[3, 16, 4, 1], [2, 20, 3, 17], [15, 4, 16, 5], [1, 18, 2, 17], [9, 19, 10, 20], [5, 14, 6, 15], [18, 8, 19, 9], [10, 13, 11, 14], [6, 11, 7, 12], [12, 7, 13, 8]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (10, 5, 11, 6), (19, 6, 20, 7), (4, 9, 5, 10), (8, 11, 9, 12), (3, 12, 4, 13), (1, 14, 2, 15), (7, 20, 8, 17), (16, 17, 1, 18), (18, 15, 19, 16)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 6, 1, 1], [1, 6, 6, 7], [2, 7, 8, 2], [3, 9, 4, 4], [4, 9, 8, 5], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 619: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

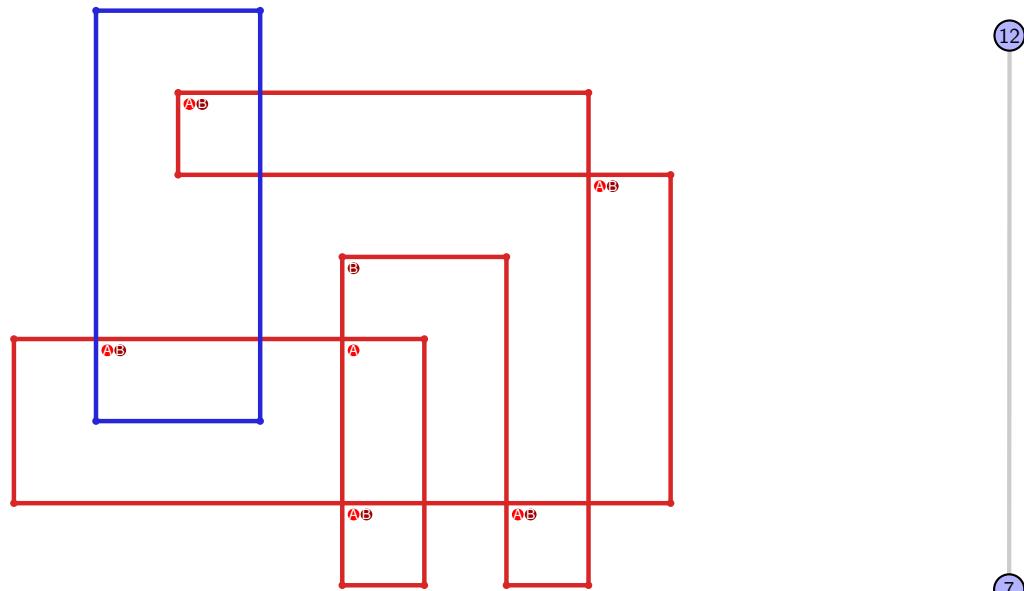


Figure 1241: SnapPy multiloop plot.

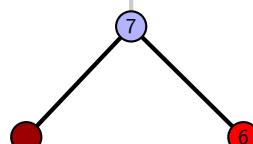


Figure 1242: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.324 [[20, 9, 1, 10], [10, 19, 11, 20], [8, 13, 9, 14], [1, 18, 2, 19], [11, 15, 12, 14], [12, 7, 13, 8], [17, 2, 18, 3], [15, 5, 16, 4], [6, 3, 7, 4], [16, 5, 17, 6]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (4, 1, 5, 2), (2, 13, 3, 14), (14, 3, 15, 4), (10, 5, 11, 6), (18, 7, 19, 8), (6, 11, 7, 12), (12, 9, 13, 10), (19, 16, 20, 17), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 3, 4, 0], [0, 4, 5, 5], [0, 6, 6, 1], [1, 7, 5, 2], [2, 4, 8, 2], [3, 8, 9, 3], [4, 9, 9, 8], [5, 7, 9, 6], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 3

Average minimal degree: 2.34

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 5

Table 620: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

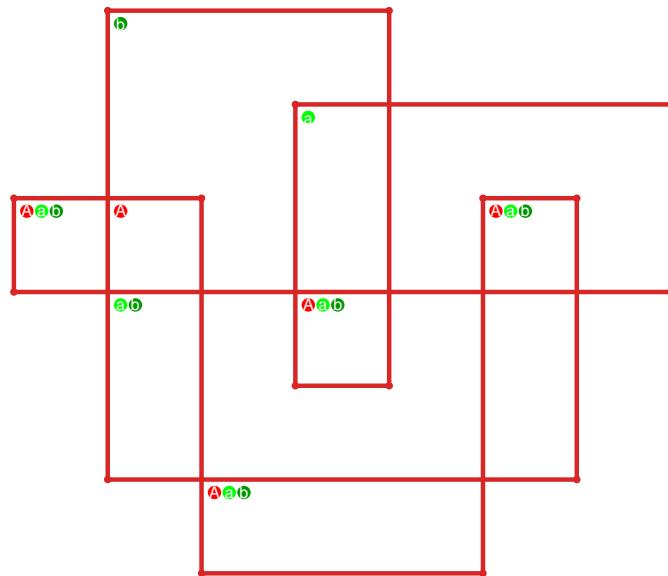


Figure 1243: SnapPy multiloop plot.

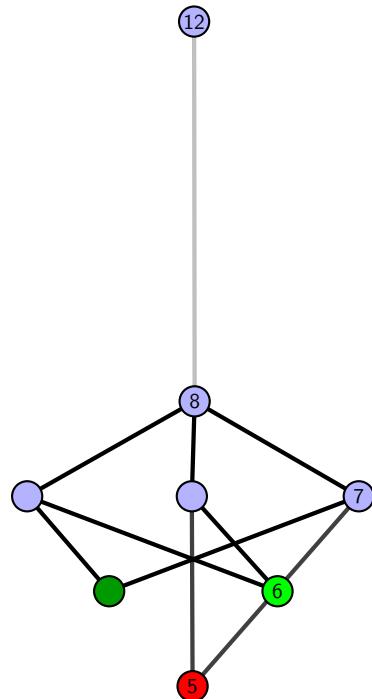


Figure 1244: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.325 [[20, 17, 1, 18], [18, 10, 19, 9], [19, 8, 20, 9], [5, 16, 6, 17], [1, 11, 2, 10], [4, 7, 5, 8], [15, 6, 16, 7], [11, 15, 12, 14], [2, 14, 3, 13], [3, 12, 4, 13]]

PD code drawn by `SnapPy`: [(13, 4, 14, 5), (2, 5, 3, 6), (17, 6, 18, 7), (7, 16, 8, 17), (8, 19, 9, 20), (1, 10, 2, 11), (11, 20, 12, 1), (12, 9, 13, 10), (3, 14, 4, 15), (18, 15, 19, 16)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 2, 2], [0, 1, 1, 5], [0, 5, 6, 6], [0, 7, 8, 1], [2, 9, 6, 3], [3, 5, 7, 3], [4, 6, 9, 8], [4, 7, 9, 9], [5, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 7
 Total pinning sets: 244
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.58
 Average overall degree: 3.05

Table 621: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	1	0	0	0	0	0	6
Nonminimal pinning sets	0	7	43	75	68	34	9	1	237
Average degree	2.4	2.62	2.85	3.02	3.15	3.24	3.29	3.33	

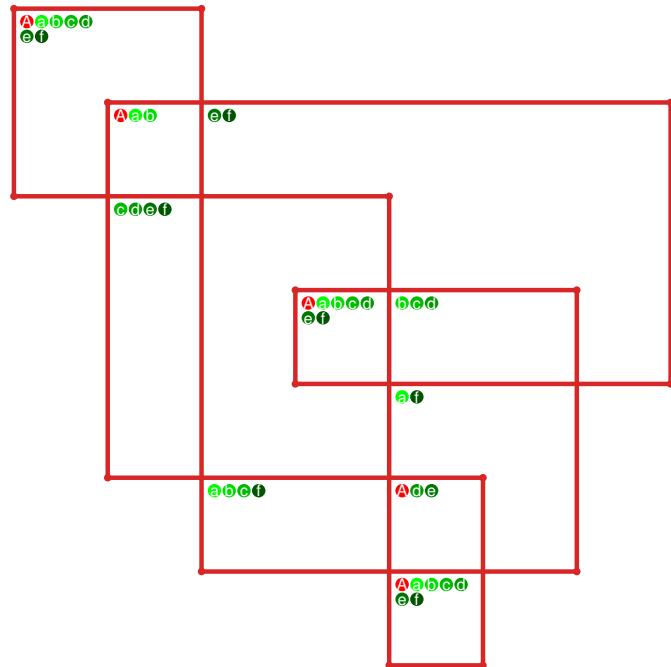


Figure 1245: `SnapPy` multiloop plot.

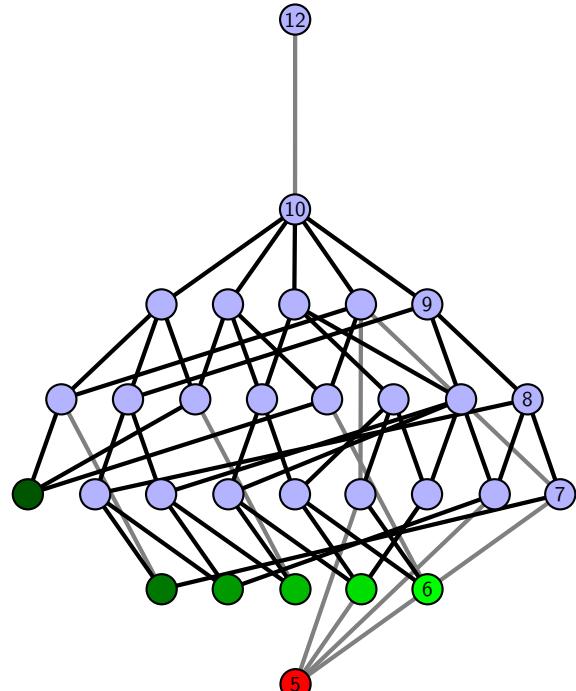


Figure 1246: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.326 [[10, 20, 1, 11], [11, 9, 12, 10], [5, 19, 6, 20], [1, 14, 2, 13], [8, 12, 9, 13], [4, 7, 5, 8], [18, 6, 19, 7], [14, 18, 15, 17], [2, 17, 3, 16], [3, 15, 4, 16]]

PD code drawn by SnapPy: [(13, 4, 14, 5), (2, 5, 3, 6), (16, 7, 17, 8), (18, 9, 19, 10), (1, 20, 2, 11), (11, 10, 12, 1), (12, 19, 13, 20), (3, 14, 4, 15), (8, 15, 9, 16), (6, 17, 7, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 6], [0, 7, 8, 4], [1, 3, 5, 1], [2, 4, 9, 6], [2, 5, 7, 2], [3, 6, 9, 8], [3, 7, 9, 9], [5, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.98

Table 622: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

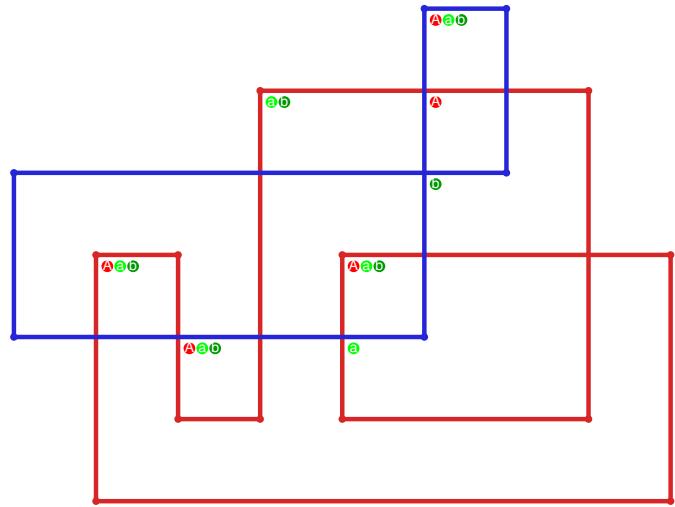


Figure 1247: SnapPy multiloop plot.

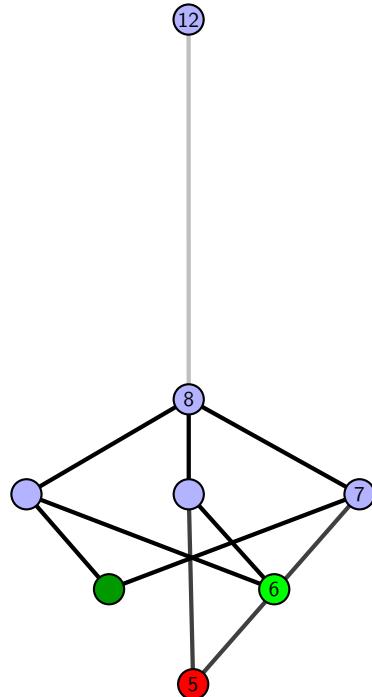


Figure 1248: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.327 $[[9, 16, 10, 1], [11, 8, 12, 9], [15, 20, 16, 17], [10, 2, 11, 1], [4, 7, 5, 8], [12, 5, 13, 6], [17, 14, 18, 15], [19, 2, 20, 3], [3, 18, 4, 19], [6, 13, 7, 14]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (16, 3, 1, 4), (7, 4, 8, 5), (2, 9, 3, 10), (17, 10, 18, 11), (5, 12, 6, 13), (13, 6, 14, 7), (19, 14, 20, 15), (11, 20, 12, 17), (15, 18, 16, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 7, 1, 0], [1, 8, 9, 5], [1, 4, 9, 9], [2, 9, 8, 2], [2, 8, 8, 3], [4, 7, 7, 6], [4, 6, 5, 5]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 623: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

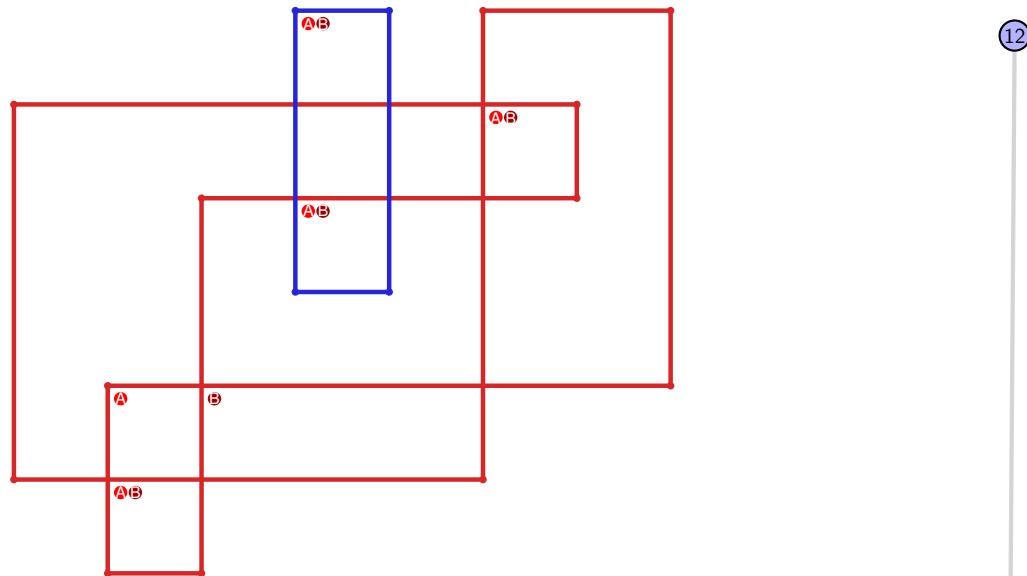


Figure 1249: `SnapPy` multiloop plot.

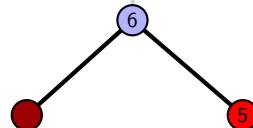


Figure 1250: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.328 $[[6, 20, 1, 7], [7, 19, 8, 18], [5, 15, 6, 16], [19, 1, 20, 2], [8, 12, 9, 11], [17, 10, 18, 11], [16, 10, 17, 9], [12, 4, 13, 5], [14, 2, 15, 3], [3, 13, 4, 14]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (19, 2, 20, 3), (12, 5, 13, 6), (16, 9, 17, 10), (10, 17, 11, 18), (18, 15, 19, 16), (1, 20, 2, 7), (3, 8, 4, 9), (11, 14, 12, 15), (4, 13, 5, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 8], [0, 8, 1, 0], [1, 7, 6, 5], [1, 4, 6, 6], [2, 5, 5, 4], [2, 4, 9, 9], [2, 9, 9, 3], [7, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 624: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

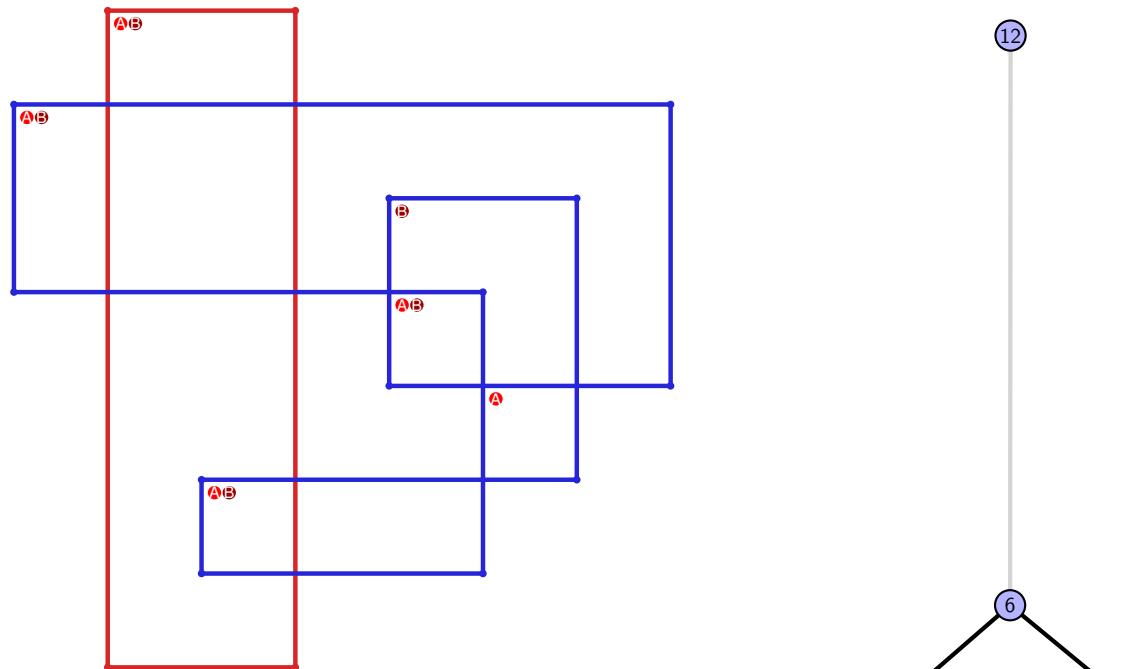


Figure 1251: SnapPy multiloop plot.

Figure 1252: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.329 $[[9, 20, 10, 1], [11, 8, 12, 9], [14, 19, 15, 20], [10, 2, 11, 1], [4, 7, 5, 8], [12, 5, 13, 6], [6, 13, 7, 14], [18, 15, 19, 16], [2, 18, 3, 17], [3, 16, 4, 17]]$

PD code drawn by `SnapPy`: $[(10, 3, 11, 4), (2, 5, 3, 6), (9, 6, 10, 7), (4, 11, 5, 12), (16, 13, 17, 14), (1, 14, 2, 15), (15, 20, 16, 1), (12, 17, 13, 18), (7, 18, 8, 19), (19, 8, 20, 9)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 7], [0, 8, 1, 0], [1, 9, 6, 5], [1, 4, 6, 6], [2, 5, 5, 4], [2, 9, 8, 2], [3, 7, 9, 9], [4, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 625: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

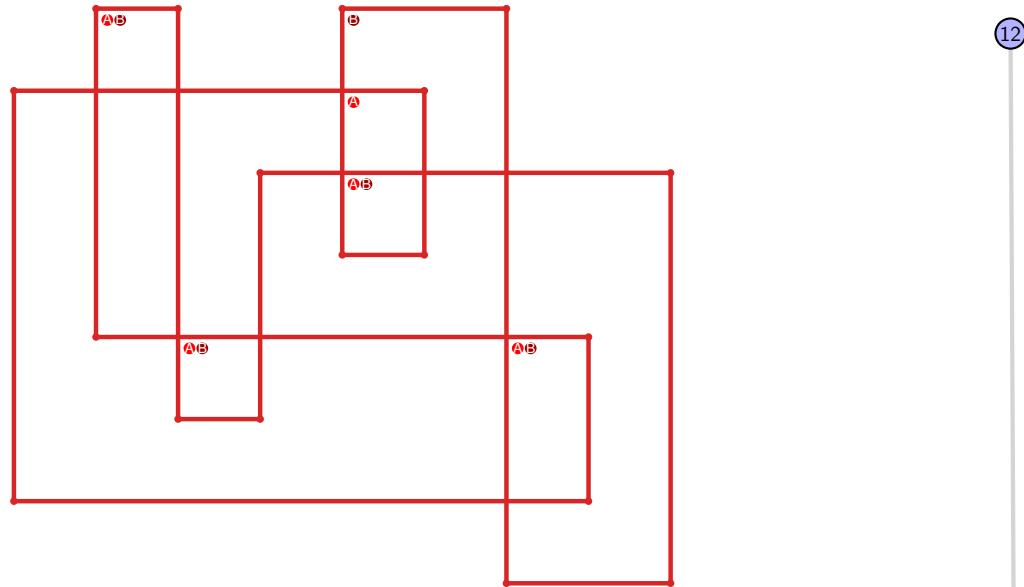


Figure 1253: `SnapPy` multiloop plot.

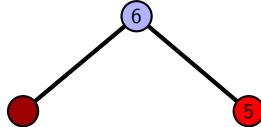


Figure 1254: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.330 $[[20, 11, 1, 12], [12, 10, 13, 9], [19, 6, 20, 7], [10, 1, 11, 2], [13, 17, 14, 16], [8, 15, 9, 16], [7, 15, 8, 14], [18, 3, 19, 4], [5, 2, 6, 3], [17, 5, 18, 4]]$

PD code drawn by `SnapPy`: $[(3, 20, 4, 1), (16, 1, 17, 2), (2, 15, 3, 16), (17, 4, 18, 5), (7, 10, 8, 11), (18, 9, 19, 10), (12, 5, 13, 6), (6, 13, 7, 14), (14, 11, 15, 12), (8, 19, 9, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 8], [0, 8, 1, 0], [1, 9, 6, 5], [1, 4, 6, 6], [2, 5, 5, 4], [2, 9, 9, 8], [2, 7, 9, 3], [4, 8, 7, 7]]$

Total optimal pinning sets: 4

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.4

Total pinning sets: 288

Average overall degree: 3.03

Pinning number: 5

Table 626: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

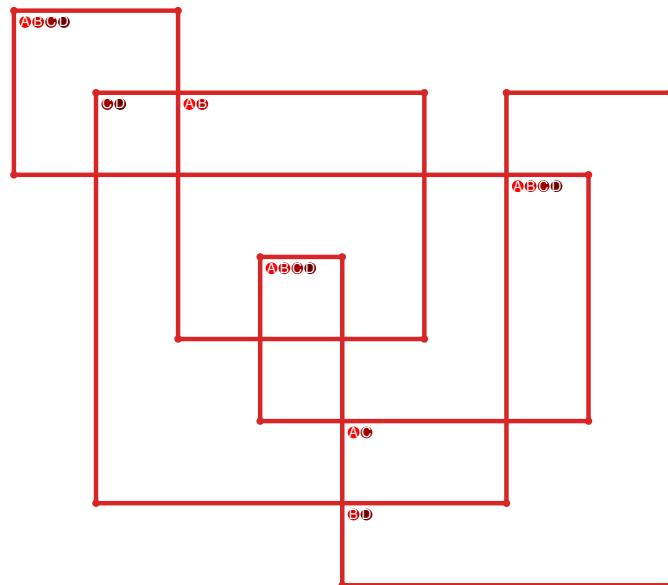


Figure 1255: `SnapPy` multiloop plot.

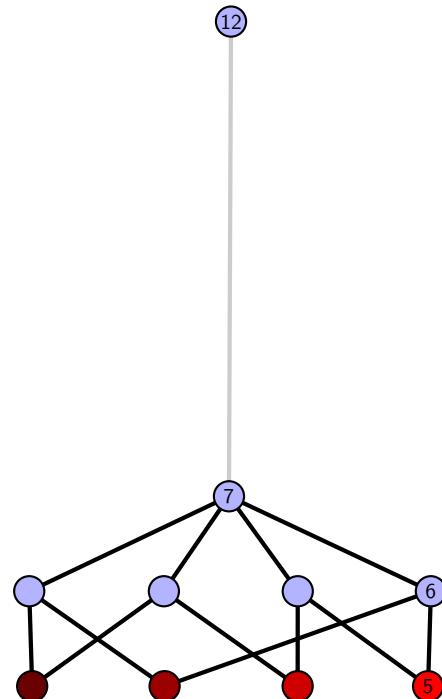


Figure 1256: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.331 [[11, 20, 12, 1], [13, 10, 14, 11], [16, 19, 17, 20], [12, 2, 13, 1], [4, 9, 5, 10], [14, 8, 15, 7], [15, 6, 16, 7], [18, 3, 19, 4], [17, 3, 18, 2], [8, 5, 9, 6]]

PD code drawn by `SnapPy`: [(4, 1, 5, 2), (11, 2, 12, 3), (3, 10, 4, 11), (20, 5, 1, 6), (9, 6, 10, 7), (12, 15, 13, 16), (7, 16, 8, 17), (17, 8, 18, 9), (18, 13, 19, 14), (14, 19, 15, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 8], [0, 8, 1, 0], [1, 7, 9, 9], [1, 9, 6, 6], [2, 5, 5, 9], [2, 4, 8, 8], [2, 7, 7, 3], [4, 6, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 627: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

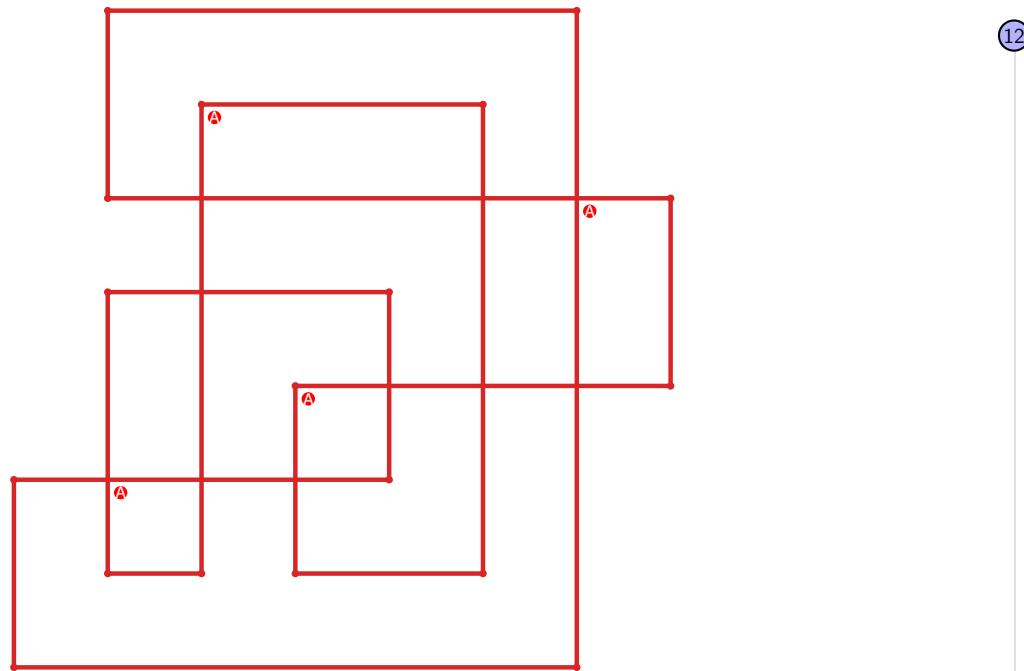


Figure 1257: `SnapPy` multiloop plot.

Figure 1258: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.332 $[[7, 16, 8, 1], [9, 6, 10, 7], [12, 15, 13, 16], [8, 2, 9, 1], [5, 20, 6, 17], [10, 20, 11, 19], [11, 18, 12, 19], [14, 3, 15, 4], [13, 3, 14, 2], [17, 4, 18, 5]]$

PD code drawn by `SnapPy`: $[(16, 11, 1, 12), (12, 1, 13, 2), (17, 2, 18, 3), (7, 4, 8, 5), (10, 13, 11, 14), (5, 14, 6, 15), (15, 6, 16, 7), (19, 8, 20, 9), (3, 20, 4, 17), (9, 18, 10, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 8], [0, 8, 1, 0], [1, 9, 9, 5], [1, 4, 6, 6], [2, 5, 5, 9], [2, 9, 8, 8], [2, 7, 7, 3], [4, 7, 6, 4]]$

Total optimal pinning sets: 4

Average optimal degree: 2.3

Total minimal pinning sets: 4

Average minimal degree: 2.3

Total pinning sets: 240

Average overall degree: 2.98

Pinning number: 5

Table 628: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.3	2.62	2.84	3.0	3.11	3.2	3.27	3.33	

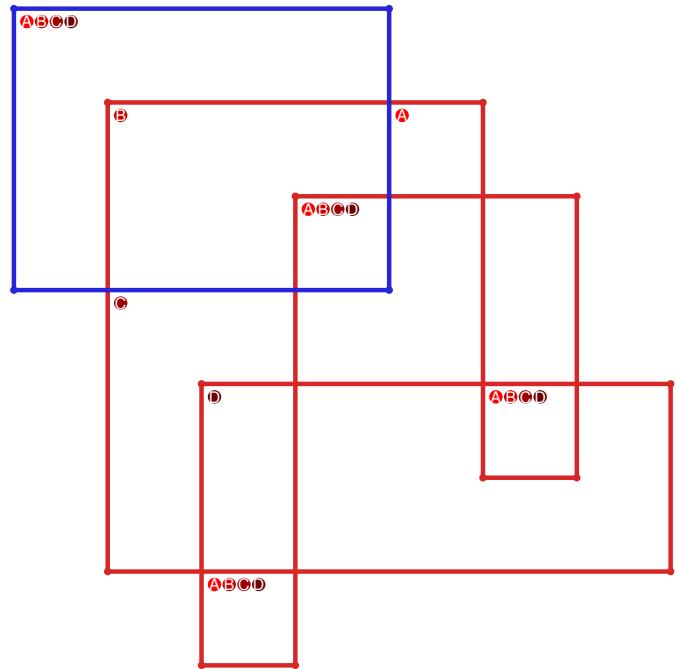


Figure 1259: `SnapPy` multiloop plot.

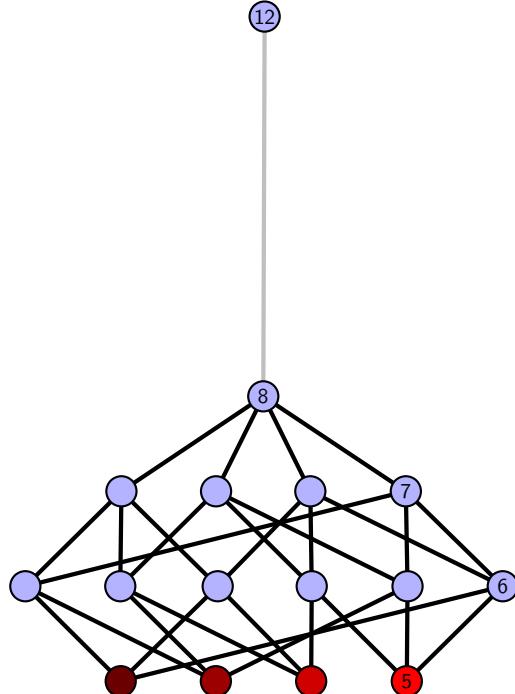


Figure 1260: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.333 [[12, 20, 1, 13], [13, 19, 14, 18], [8, 11, 9, 12], [19, 1, 20, 2], [14, 4, 15, 5], [5, 17, 6, 18], [7, 15, 8, 16], [10, 3, 11, 4], [9, 3, 10, 2], [16, 6, 17, 7]]

PD code drawn by `SnapPy`: [(7, 12, 8, 1), (18, 1, 19, 2), (20, 3, 13, 4), (5, 8, 6, 9), (15, 10, 16, 11), (11, 6, 12, 7), (2, 13, 3, 14), (14, 17, 15, 18), (9, 16, 10, 17), (4, 19, 5, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 8], [0, 8, 1, 0], [1, 7, 6, 5], [1, 4, 9, 9], [2, 9, 9, 4], [2, 4, 8, 8], [2, 7, 7, 3], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 629: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

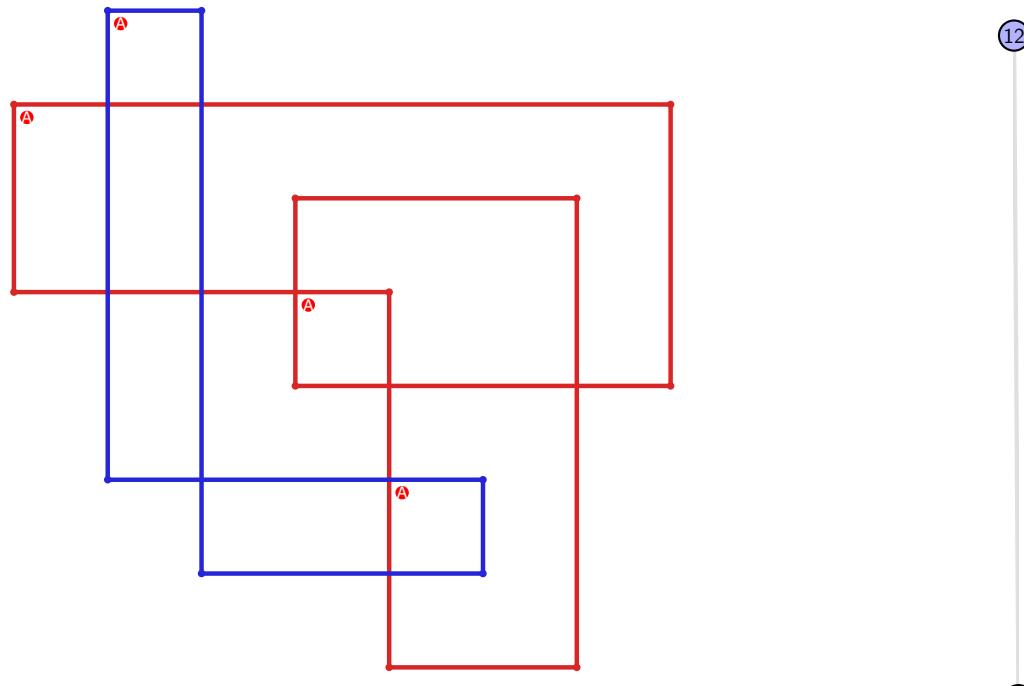


Figure 1261: `SnapPy` multiloop plot.

Figure 1262: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.334 [[20, 13, 1, 14], [14, 12, 15, 11], [4, 19, 5, 20], [12, 1, 13, 2], [15, 10, 16, 11], [18, 3, 19, 4], [5, 3, 6, 2], [6, 9, 7, 10], [16, 7, 17, 8], [8, 17, 9, 18]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (13, 4, 14, 5), (3, 6, 4, 7), (12, 7, 13, 8), (8, 11, 9, 12), (17, 10, 18, 11), (5, 14, 6, 15), (1, 16, 2, 17), (9, 18, 10, 19), (19, 2, 20, 3)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 5, 6], [0, 6, 1, 0], [1, 7, 8, 1], [2, 9, 6, 2], [2, 5, 7, 3], [4, 6, 9, 8], [4, 7, 9, 9], [5, 8, 8, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 3
Total pinning sets: 176
Pinning number: 5

Average optimal degree: 2.2
Average minimal degree: 2.34
Average overall degree: 2.98

Table 630: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

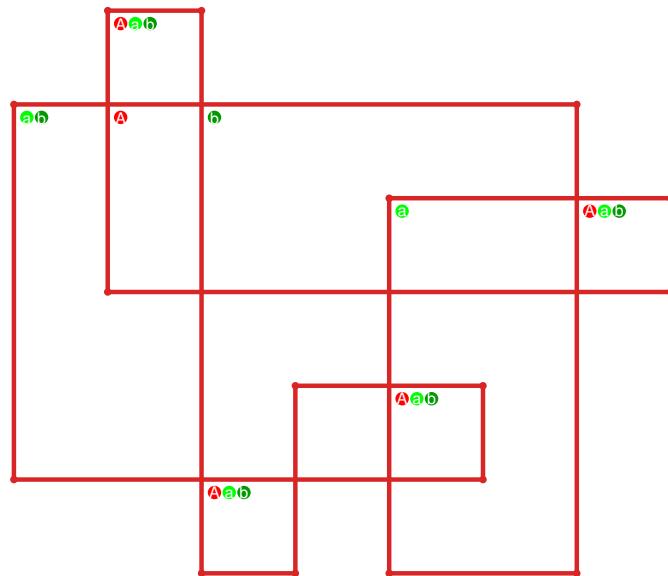


Figure 1263: SnapPy multiloop plot.

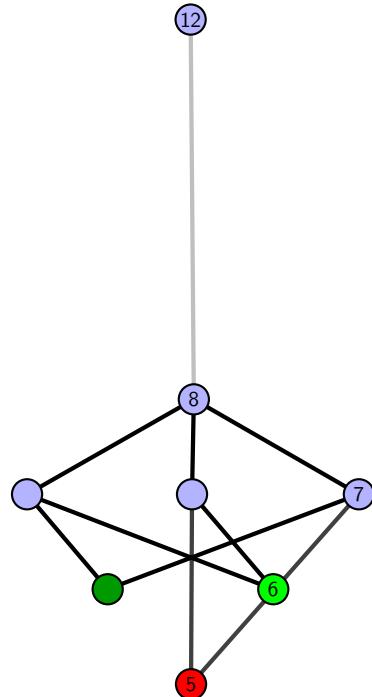


Figure 1264: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.335 $[[6, 20, 1, 7], [7, 19, 8, 18], [5, 13, 6, 14], [19, 1, 20, 2], [8, 12, 9, 11], [17, 10, 18, 11], [14, 4, 15, 5], [12, 2, 13, 3], [9, 16, 10, 17], [3, 15, 4, 16]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (12, 3, 13, 4), (19, 4, 20, 5), (10, 17, 11, 18), (18, 15, 19, 16), (1, 20, 2, 7), (5, 8, 6, 9), (16, 9, 17, 10), (11, 14, 12, 15), (2, 13, 3, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 7, 1, 0], [1, 7, 8, 5], [1, 4, 8, 8], [2, 9, 9, 2], [2, 9, 4, 3], [4, 9, 5, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 631: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

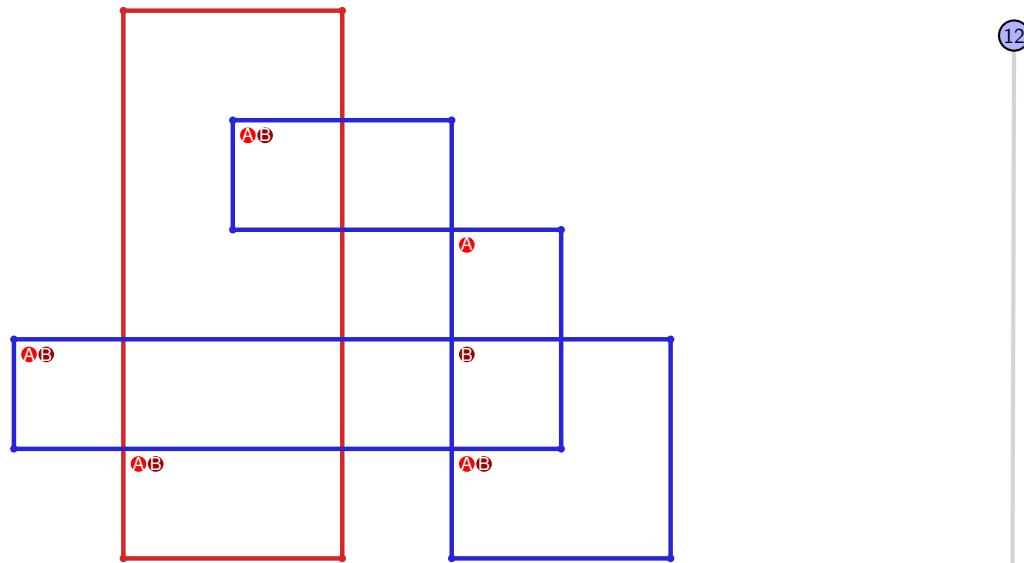


Figure 1265: `SnapPy` multiloop plot.

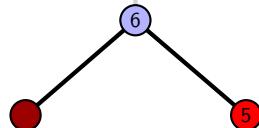


Figure 1266: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.336 [[12, 20, 1, 13], [13, 19, 14, 18], [4, 11, 5, 12], [19, 1, 20, 2], [14, 6, 15, 7], [7, 17, 8, 18], [10, 3, 11, 4], [5, 3, 6, 2], [15, 10, 16, 9], [16, 8, 17, 9]]

PD code drawn by `SnapPy`: [(7, 12, 8, 1), (18, 3, 19, 4), (20, 5, 13, 6), (6, 19, 7, 20), (1, 8, 2, 9), (15, 10, 16, 11), (11, 2, 12, 3), (4, 13, 5, 14), (14, 17, 15, 18), (9, 16, 10, 17)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 7, 1, 0], [1, 7, 8, 5], [1, 4, 9, 9], [2, 8, 7, 2], [2, 6, 4, 3], [4, 6, 9, 9], [5, 8, 8, 5]]

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 252
 Pinning number: 5

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 632: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	27	56	70	56	28	8	1	246
Average degree	2.33	2.65	2.86	3.0	3.11	3.2	3.27	3.33	

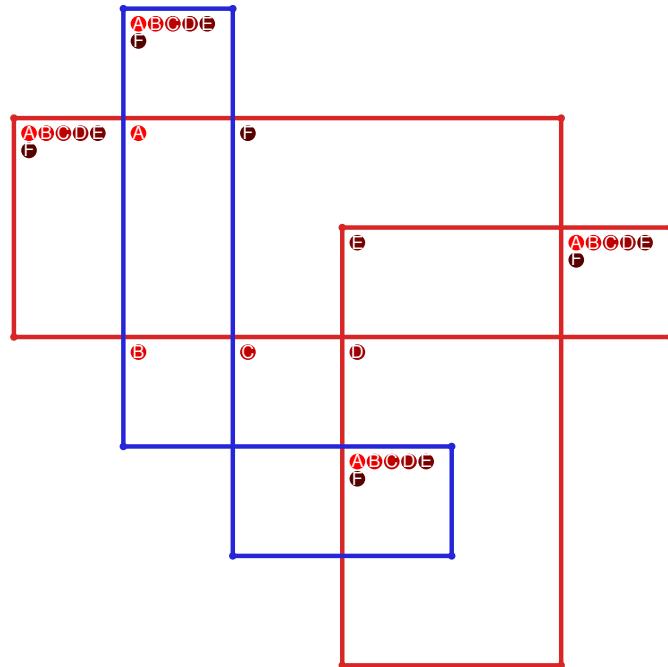


Figure 1267: `SnapPy` multiloop plot.

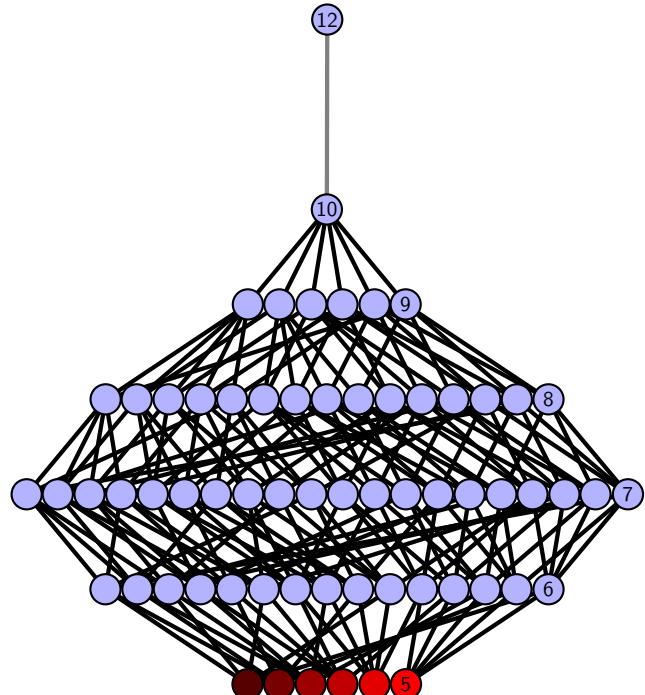


Figure 1268: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.337 [[10, 20, 1, 11], [11, 8, 12, 7], [19, 9, 20, 10], [1, 9, 2, 8], [12, 16, 13, 15], [6, 14, 7, 15], [18, 4, 19, 5], [2, 17, 3, 16], [13, 5, 14, 6], [3, 17, 4, 18]]

PD code drawn by `SnapPy`: [(11, 10, 12, 1), (2, 19, 3, 20), (3, 6, 4, 7), (17, 4, 18, 5), (16, 9, 17, 10), (1, 12, 2, 13), (13, 20, 14, 11), (14, 7, 15, 8), (8, 15, 9, 16), (5, 18, 6, 19)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 3, 0], [0, 2, 7, 1], [1, 7, 8, 5], [1, 4, 8, 8], [2, 8, 9, 9], [3, 9, 9, 4], [4, 6, 5, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 4

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.33

Total pinning sets: 144

Average overall degree: 2.97

Pinning number: 6

Table 633: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

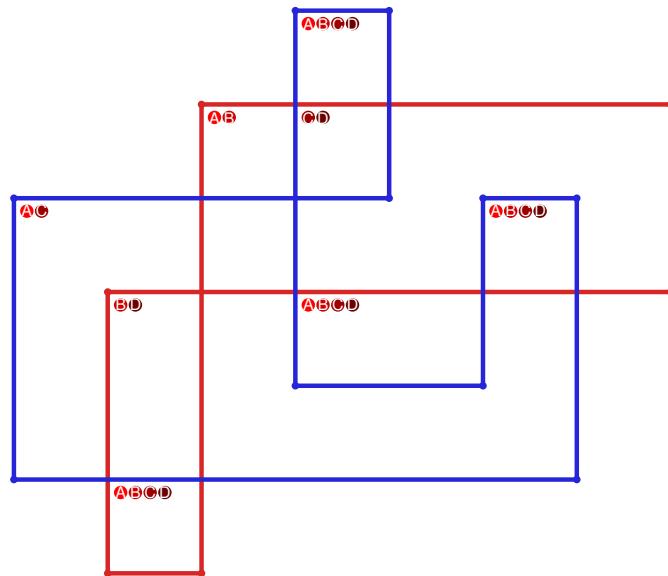


Figure 1269: `SnapPy` multiloop plot.

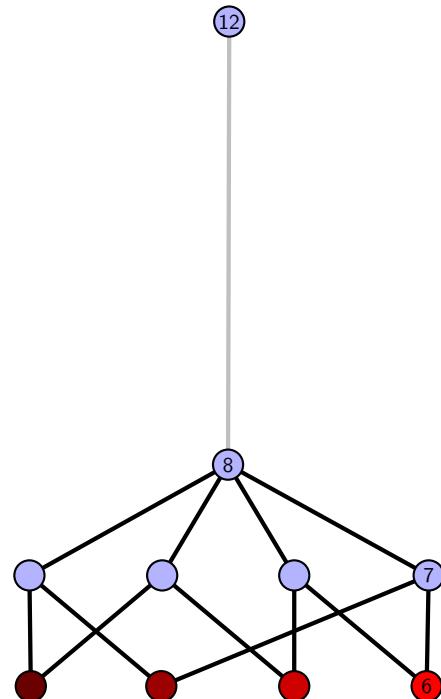


Figure 1270: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.338 $[[9, 20, 10, 1], [11, 8, 12, 9], [19, 4, 20, 5], [10, 2, 11, 1], [7, 12, 8, 13], [5, 15, 6, 14], [3, 18, 4, 19], [2, 18, 3, 17], [13, 17, 14, 16], [6, 15, 7, 16]]$

PD code drawn by `SnapPy`: $[(16, 1, 17, 2), (8, 5, 9, 6), (4, 9, 5, 10), (11, 2, 12, 3), (3, 12, 4, 13), (13, 10, 14, 11), (14, 19, 15, 20), (20, 15, 1, 16), (6, 17, 7, 18), (18, 7, 19, 8)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 6, 6], [0, 7, 1, 0], [1, 8, 9, 1], [2, 9, 9, 8], [2, 7, 7, 2], [3, 6, 6, 8], [4, 7, 5, 9], [4, 8, 5, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 634: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

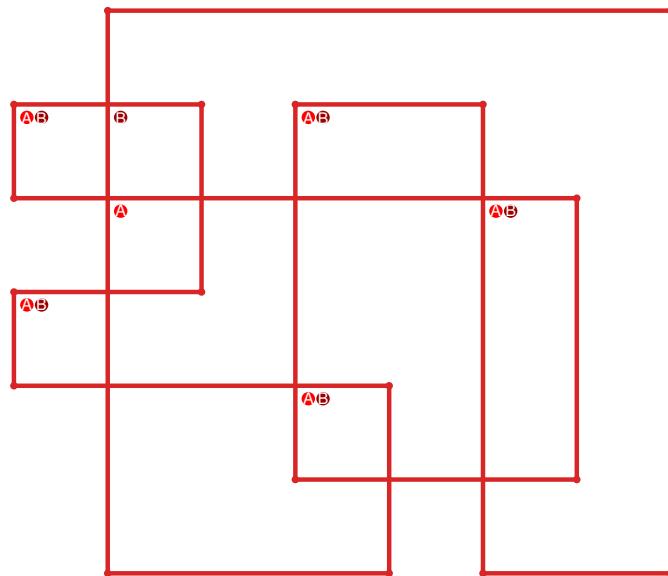


Figure 1271: `SnapPy` multiloop plot.

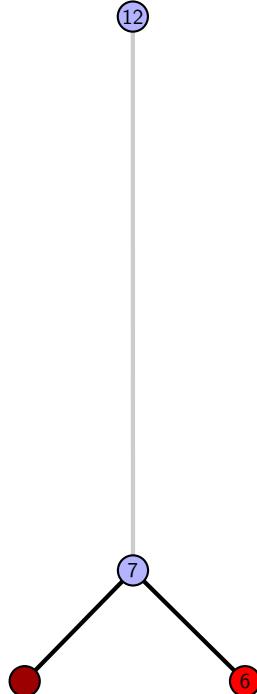


Figure 1272: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.339 `[[13, 20, 14, 1], [15, 12, 16, 13], [19, 4, 20, 5], [14, 2, 15, 1], [8, 11, 9, 12], [16, 9, 17, 10], [5, 18, 6, 19], [6, 3, 7, 4], [2, 7, 3, 8], [10, 17, 11, 18]]`

PD code drawn by `SnapPy`: `[(3, 20, 4, 1), (16, 1, 17, 2), (19, 4, 20, 5), (13, 6, 14, 7), (5, 8, 6, 9), (12, 9, 13, 10), (7, 14, 8, 15), (2, 15, 3, 16), (10, 17, 11, 18), (18, 11, 19, 12)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 6, 7], [0, 8, 1, 0], [1, 8, 9, 5], [1, 4, 9, 9], [2, 9, 7, 2], [2, 6, 8, 8], [3, 7, 7, 4], [4, 6, 5, 5]]`

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 635: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

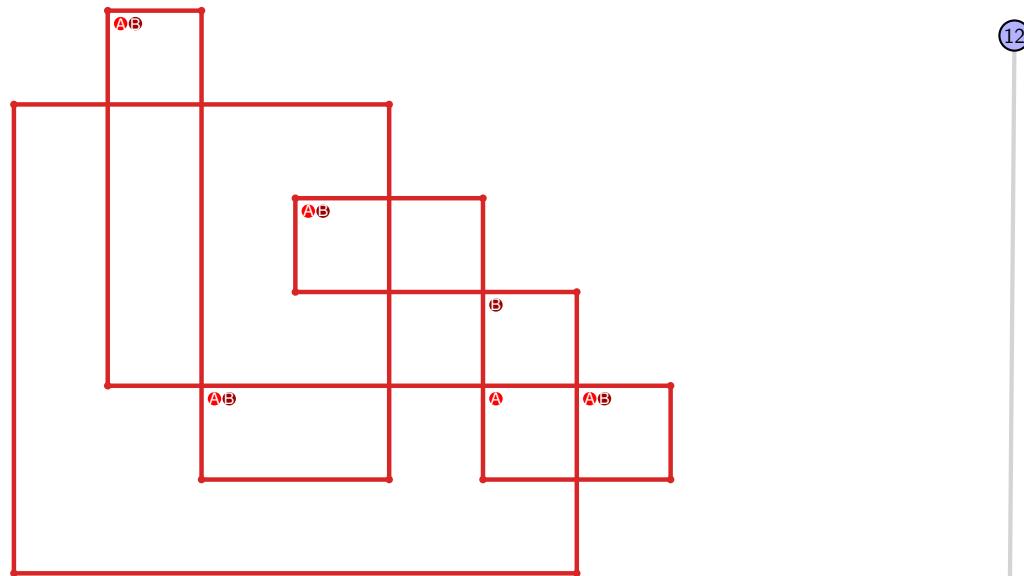


Figure 1273: `SnapPy` multiloop plot.

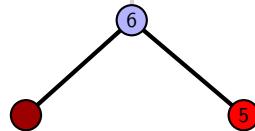


Figure 1274: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.340 $[[6, 20, 1, 7], [7, 19, 8, 18], [5, 15, 6, 16], [19, 1, 20, 2], [8, 12, 9, 11], [17, 10, 18, 11], [16, 10, 17, 9], [14, 4, 15, 5], [2, 13, 3, 12], [3, 13, 4, 14]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (13, 4, 14, 5), (17, 10, 18, 11), (11, 18, 12, 19), (19, 16, 20, 17), (20, 5, 7, 6), (6, 7, 1, 8), (2, 9, 3, 10), (12, 15, 13, 16), (3, 14, 4, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 7], [0, 8, 1, 0], [1, 8, 6, 5], [1, 4, 6, 6], [2, 5, 5, 4], [2, 9, 9, 2], [3, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 636: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

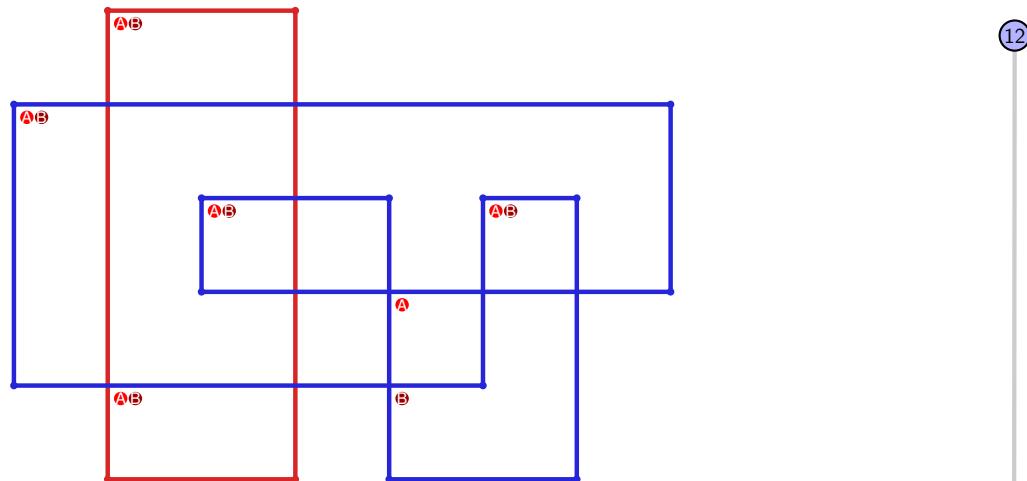


Figure 1275: `SnapPy` multiloop plot.

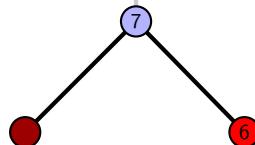


Figure 1276: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.341 [[12, 20, 1, 13], [13, 19, 14, 18], [11, 4, 12, 5], [19, 1, 20, 2], [14, 9, 15, 8], [17, 7, 18, 8], [5, 16, 6, 15], [3, 10, 4, 11], [2, 10, 3, 9], [6, 16, 7, 17]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (15, 4, 16, 5), (5, 20, 6, 13), (6, 11, 7, 12), (12, 7, 1, 8), (17, 10, 18, 11), (3, 14, 4, 15), (16, 19, 17, 20), (9, 18, 10, 19), (13, 2, 14, 3)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 7], [0, 8, 1, 0], [1, 8, 6, 5], [1, 4, 9, 9], [2, 9, 9, 4], [2, 8, 8, 2], [3, 7, 7, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 637: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

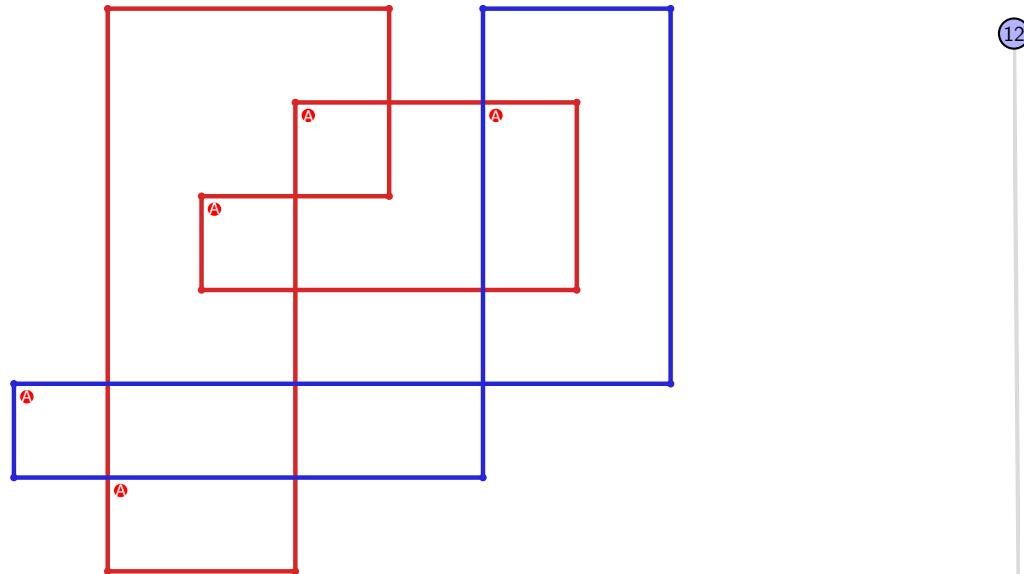


Figure 1277: SnapPy multiloop plot.

5

Figure 1278: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.342 $[[4, 20, 1, 5], [5, 19, 6, 18], [3, 9, 4, 10], [19, 1, 20, 2], [6, 14, 7, 13], [17, 12, 18, 13], [10, 16, 11, 15], [8, 2, 9, 3], [14, 8, 15, 7], [11, 16, 12, 17]]$

PD code drawn by `SnapPy`: $[(15, 2, 16, 3), (20, 3, 5, 4), (19, 10, 20, 11), (4, 5, 1, 6), (13, 8, 14, 9), (9, 18, 10, 19), (11, 6, 12, 7), (7, 12, 8, 13), (14, 17, 15, 18), (1, 16, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 7], [0, 7, 1, 0], [1, 8, 8, 5], [1, 4, 9, 9], [2, 9, 9, 8], [2, 8, 3, 2], [4, 7, 6, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 638: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

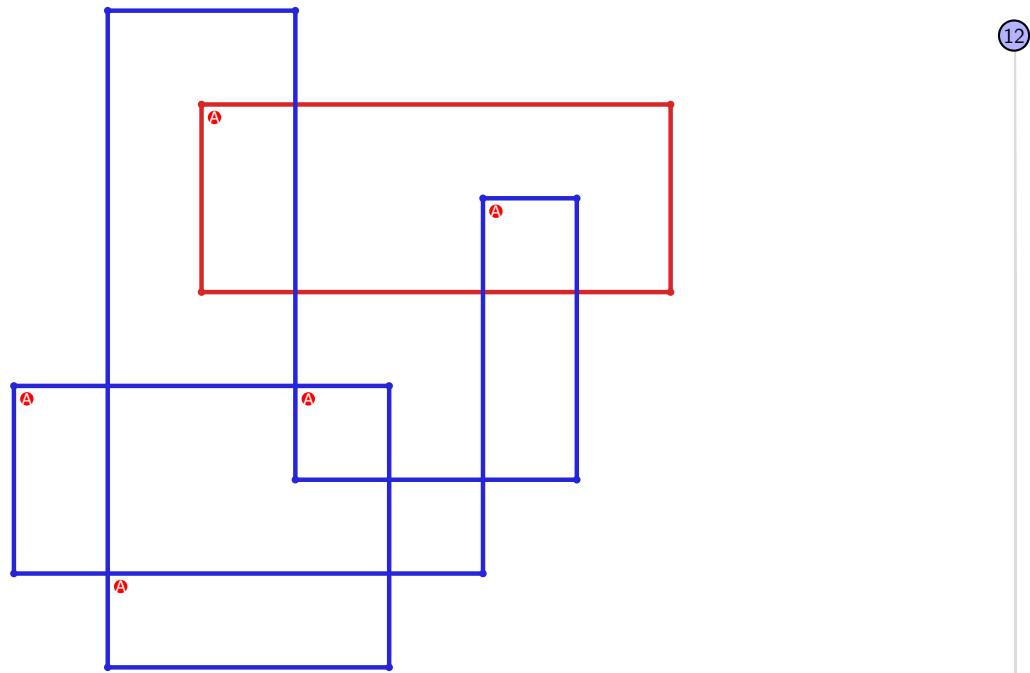


Figure 1279: `SnapPy` multiloop plot.

Figure 1280: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.343 [[16, 9, 1, 10], [10, 8, 11, 7], [15, 4, 16, 5], [8, 1, 9, 2], [11, 17, 12, 20], [6, 19, 7, 20], [5, 19, 6, 18], [3, 14, 4, 15], [2, 14, 3, 13], [17, 13, 18, 12]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (4, 7, 5, 8), (13, 6, 14, 7), (9, 20, 10, 17), (10, 15, 11, 16), (16, 11, 1, 12), (5, 14, 6, 15), (17, 2, 18, 3), (3, 18, 4, 19), (19, 8, 20, 9)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 7], [0, 8, 1, 0], [1, 9, 9, 5], [1, 4, 6, 6], [2, 5, 5, 9], [2, 8, 8, 2], [3, 7, 7, 9], [4, 8, 6, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 639: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

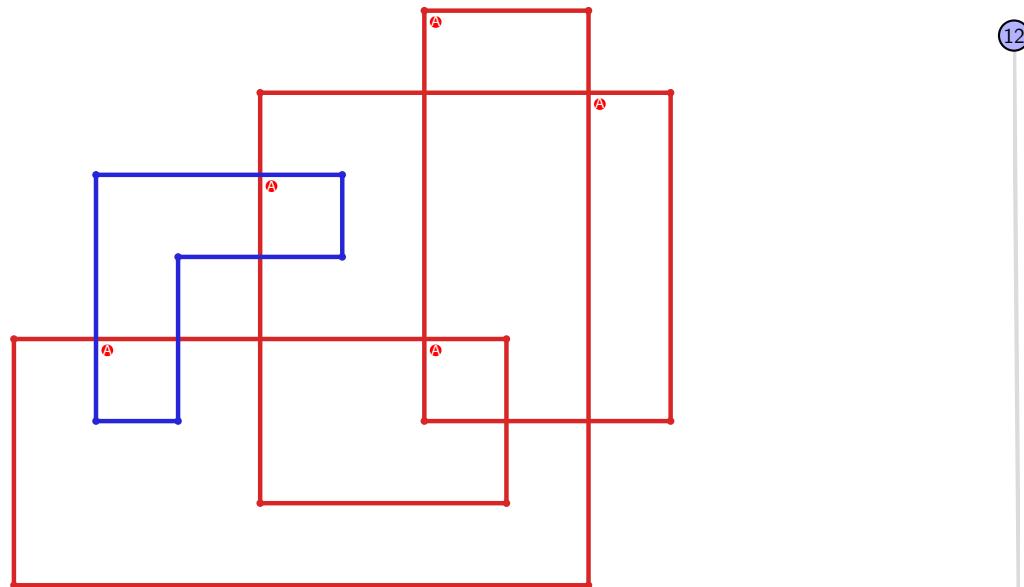


Figure 1281: SnapPy multiloop plot.



Figure 1282: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.344 $[[4, 16, 1, 5], [5, 15, 6, 14], [9, 3, 10, 4], [15, 1, 16, 2], [6, 13, 7, 14], [8, 20, 9, 17], [2, 10, 3, 11], [12, 18, 13, 19], [7, 18, 8, 17], [19, 11, 20, 12]]$

PD code drawn by SnapPy: $[(16, 1, 5, 2), (10, 3, 11, 4), (4, 5, 1, 6), (17, 6, 18, 7), (13, 8, 14, 9), (9, 12, 10, 13), (2, 11, 3, 12), (15, 18, 16, 19), (19, 14, 20, 15), (7, 20, 8, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 6, 6], [0, 6, 1, 0], [1, 7, 8, 1], [2, 8, 8, 9], [2, 9, 3, 2], [4, 9, 9, 8], [4, 7, 5, 5], [5, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 640: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

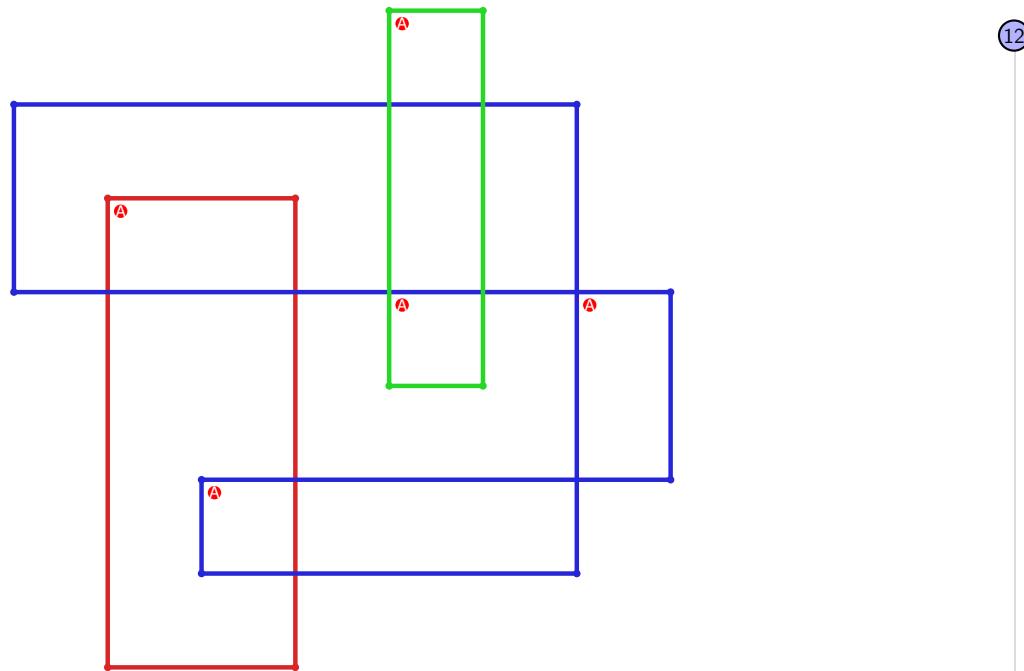


Figure 1283: SnapPy multiloop plot.

Figure 1284: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.345 $[[4, 14, 1, 5], [5, 13, 6, 12], [3, 20, 4, 15], [13, 1, 14, 2], [6, 11, 7, 12], [15, 9, 16, 10], [19, 2, 20, 3], [10, 18, 11, 19], [7, 18, 8, 17], [8, 16, 9, 17]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (10, 3, 5, 4), (6, 17, 7, 18), (14, 19, 15, 20), (20, 13, 11, 14), (1, 12, 2, 13), (8, 15, 9, 16), (18, 9, 19, 10), (4, 5, 1, 6), (16, 7, 17, 8)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 4], [0, 5, 6, 6], [0, 6, 1, 0], [1, 7, 8, 1], [2, 9, 9, 7], [2, 7, 3, 2], [4, 6, 5, 8], [4, 7, 9, 9], [5, 8, 8, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 641: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

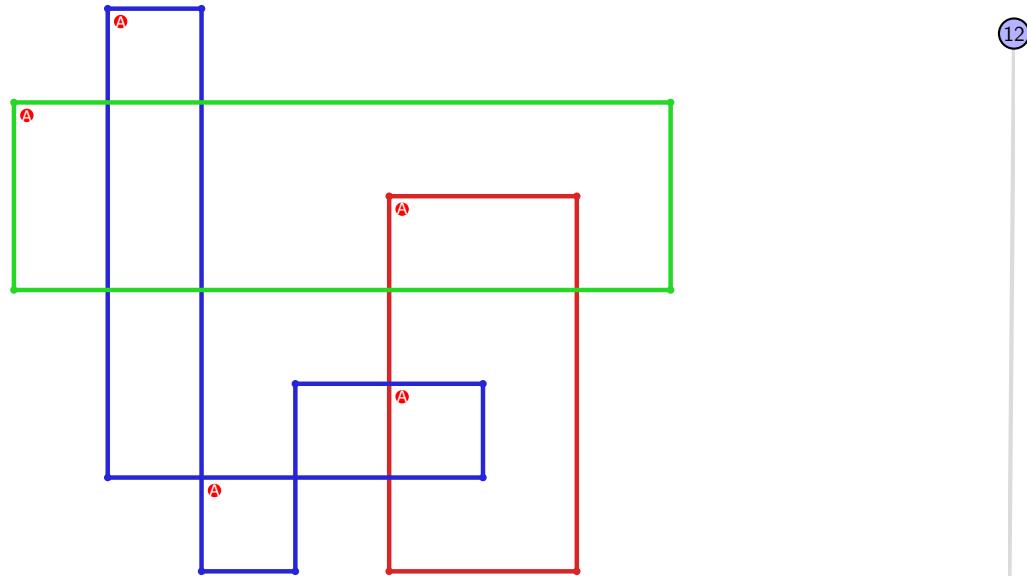


Figure 1285: `SnapPy` multiloop plot.



Figure 1286: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.346 $[[4, 20, 1, 5], [5, 19, 6, 18], [3, 13, 4, 14], [19, 1, 20, 2], [6, 12, 7, 11], [17, 10, 18, 11], [14, 8, 15, 7], [12, 2, 13, 3], [9, 16, 10, 17], [8, 16, 9, 15]]$

PD code drawn by `SnapPy`: $[(20, 1, 5, 2), (13, 2, 14, 3), (18, 11, 19, 12), (12, 7, 13, 8), (3, 14, 4, 15), (16, 9, 17, 10), (10, 17, 11, 18), (19, 6, 20, 7), (4, 5, 1, 6), (8, 15, 9, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 3, 4, 5], [0, 6, 7, 7], [0, 7, 1, 0], [1, 7, 6, 5], [1, 4, 8, 8], [2, 9, 9, 4], [2, 4, 3, 2], [5, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 642: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

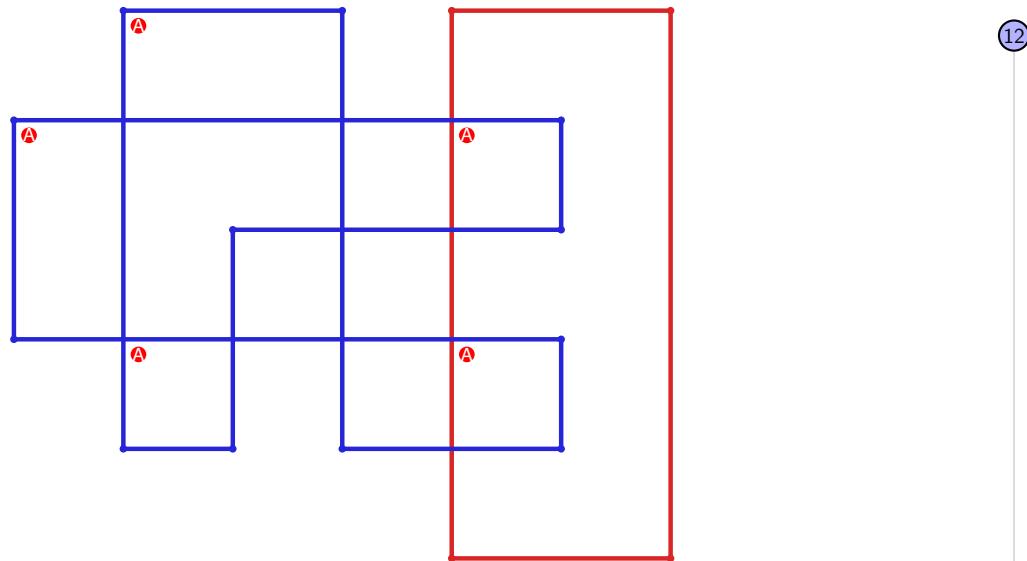


Figure 1287: `SnapPy` multiloop plot.

5

Figure 1288: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.347 `[[6, 12, 1, 7], [7, 5, 8, 6], [11, 1, 12, 2], [4, 8, 5, 9], [2, 13, 3, 16], [10, 20, 11, 17], [9, 20, 10, 19], [3, 13, 4, 14], [15, 17, 16, 18], [18, 14, 19, 15]]`

PD code drawn by `SnapPy`: `[(12, 1, 7, 2), (10, 3, 11, 4), (6, 7, 1, 8), (2, 11, 3, 12), (17, 4, 18, 5), (5, 18, 6, 19), (16, 19, 13, 20), (13, 8, 14, 9), (9, 14, 10, 15), (20, 15, 17, 16)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 6, 7, 1], [2, 7, 7, 8], [2, 8, 6, 6], [3, 5, 5, 9], [3, 9, 4, 4], [4, 9, 9, 5], [6, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 643: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

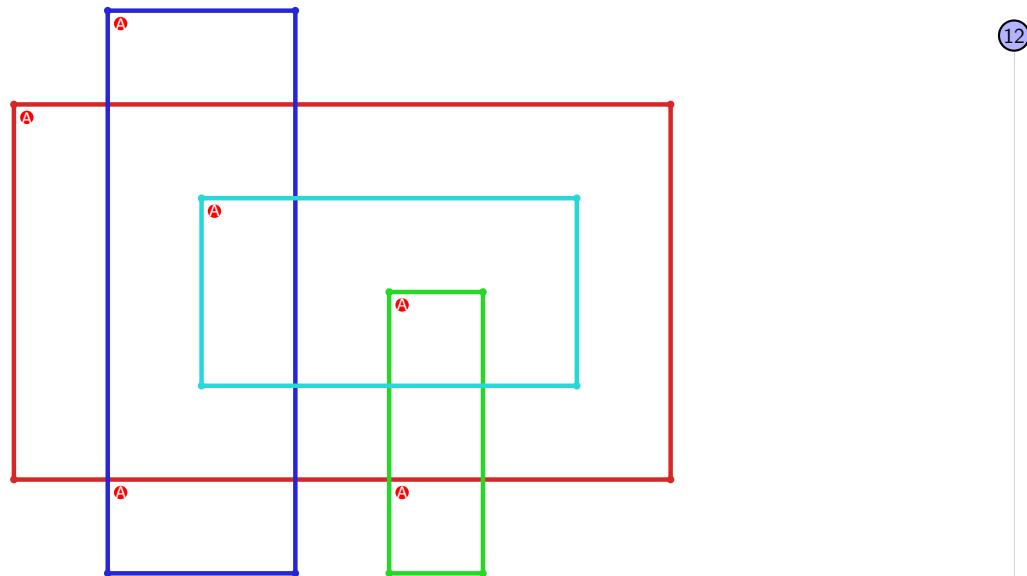


Figure 1289: `SnapPy` multiloop plot.



Figure 1290: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.348 [[11, 16, 12, 1], [5, 10, 6, 11], [15, 20, 16, 17], [12, 2, 13, 1], [9, 4, 10, 5], [6, 18, 7, 17], [19, 14, 20, 15], [2, 14, 3, 13], [3, 8, 4, 9], [18, 8, 19, 7]]

PD code drawn by `SnapPy`: [(6, 1, 7, 2), (4, 17, 5, 18), (16, 5, 1, 6), (2, 7, 3, 8), (10, 15, 11, 16), (18, 11, 19, 12), (8, 13, 9, 14), (14, 9, 15, 10), (12, 19, 13, 20), (20, 3, 17, 4)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 6], [0, 7, 7, 0], [1, 8, 8, 1], [1, 9, 9, 2], [2, 9, 7, 2], [3, 6, 8, 3], [4, 7, 9, 4], [5, 8, 6, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 64
 Pinning number: 6

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.85

Table 644: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

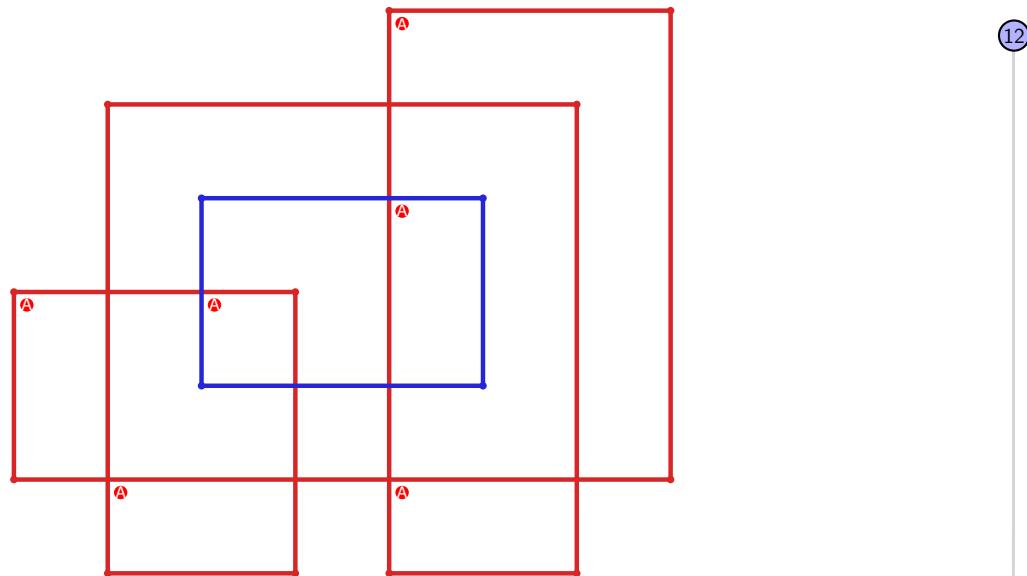


Figure 1291: `SnapPy` multiloop plot.

6

Figure 1292: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.349 $[[6, 12, 1, 7], [7, 13, 8, 16], [5, 20, 6, 17], [11, 3, 12, 4], [1, 10, 2, 9], [13, 9, 14, 8], [15, 17, 16, 18], [19, 4, 20, 5], [2, 10, 3, 11], [14, 19, 15, 18]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (17, 2, 18, 3), (11, 14, 12, 15), (12, 5, 7, 6), (6, 7, 1, 8), (4, 9, 5, 10), (13, 10, 14, 11), (20, 15, 17, 16), (3, 18, 4, 19), (16, 19, 13, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 7, 8, 8], [0, 8, 8, 5], [1, 4, 9, 1], [1, 9, 9, 2], [2, 9, 3, 2], [3, 4, 4, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 645: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

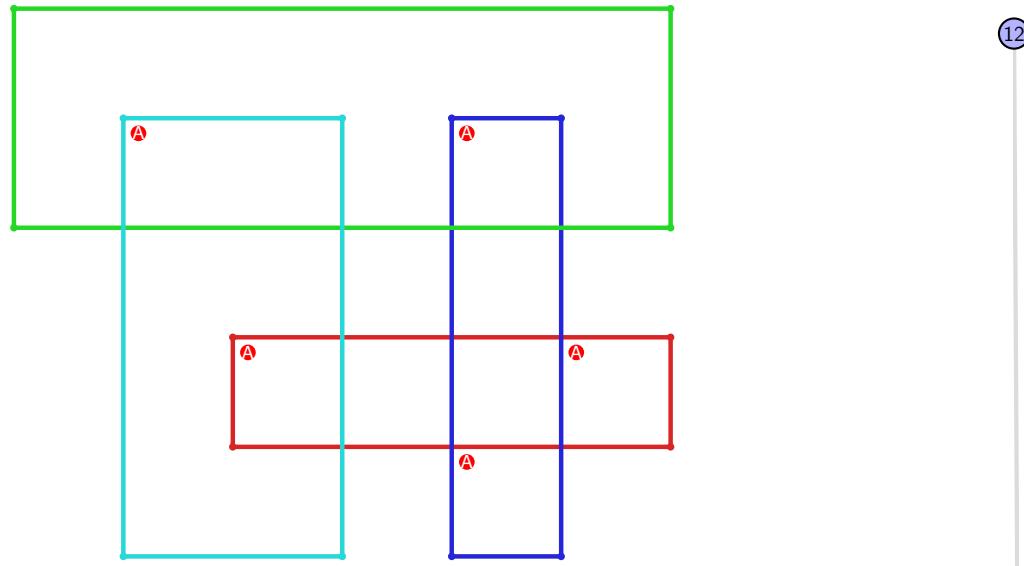


Figure 1293: `SnapPy` multiloop plot.

(5)

Figure 1294: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.350 `[[16, 3, 1, 4], [4, 17, 5, 20], [15, 10, 16, 11], [2, 7, 3, 8], [1, 7, 2, 6], [17, 6, 18, 5], [19, 11, 20, 12], [9, 14, 10, 15], [8, 14, 9, 13], [18, 13, 19, 12]]`

PD code drawn by `SnapPy`: `[(14, 1, 15, 2), (3, 18, 4, 19), (4, 15, 5, 16), (16, 5, 1, 6), (13, 8, 14, 9), (20, 9, 17, 10), (10, 19, 11, 20), (11, 6, 12, 7), (7, 12, 8, 13), (17, 2, 18, 3)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 8, 4, 4], [0, 3, 3, 5], [1, 4, 9, 1], [1, 9, 9, 2], [2, 8, 8, 2], [3, 7, 7, 9], [5, 8, 6, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 646: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

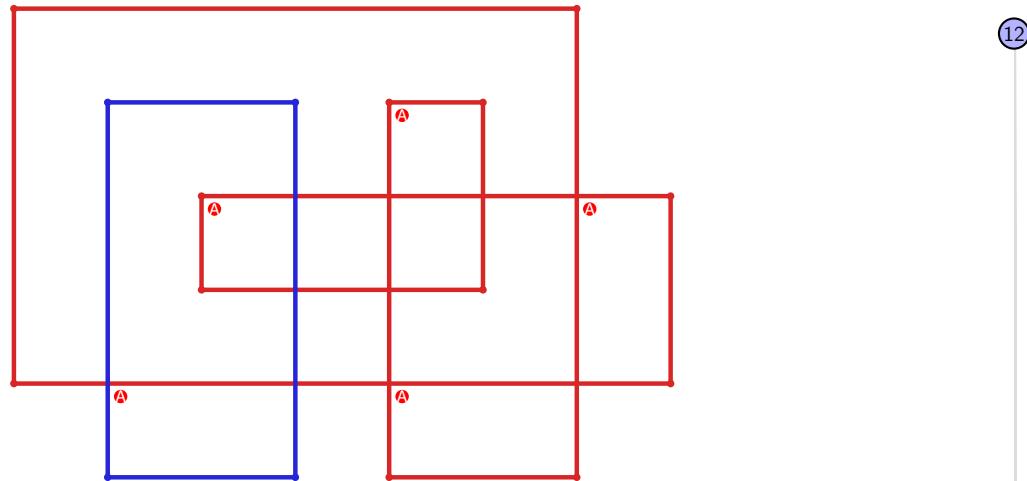


Figure 1295: `SnapPy` multiloop plot.

(5)

Figure 1296: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.351 $[[10, 3, 1, 4], [4, 11, 5, 20], [15, 9, 16, 10], [2, 7, 3, 8], [1, 7, 2, 6], [11, 6, 12, 5], [14, 19, 15, 20], [8, 16, 9, 17], [12, 17, 13, 18], [18, 13, 19, 14]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (3, 12, 4, 13), (4, 9, 5, 10), (10, 5, 1, 6), (16, 7, 17, 8), (19, 14, 20, 15), (6, 17, 7, 18), (13, 18, 14, 19), (15, 20, 16, 11), (11, 2, 12, 3)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 7, 4, 4], [0, 3, 3, 5], [1, 4, 8, 1], [1, 9, 9, 2], [2, 8, 3, 2], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 647: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

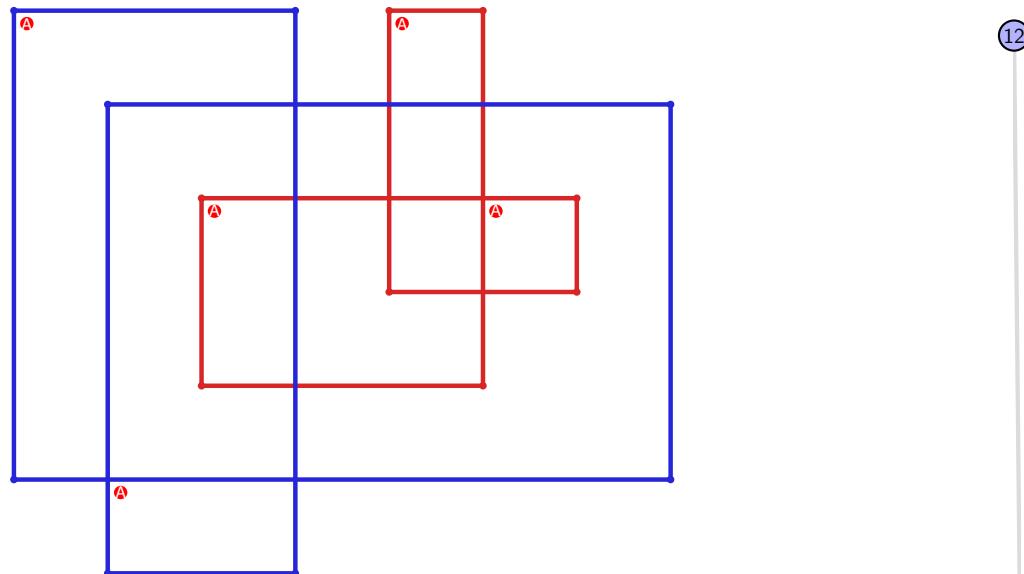


Figure 1297: SnapPy multiloop plot.



Figure 1298: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.352 [[12, 5, 1, 6], [6, 13, 7, 16], [11, 20, 12, 17], [4, 1, 5, 2], [13, 8, 14, 7], [15, 17, 16, 18], [19, 10, 20, 11], [2, 10, 3, 9], [3, 8, 4, 9], [14, 19, 15, 18]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (4, 13, 5, 14), (12, 5, 1, 6), (6, 11, 7, 12), (20, 7, 17, 8), (1, 10, 2, 11), (16, 3, 13, 4), (19, 14, 20, 15), (8, 17, 9, 18), (15, 18, 16, 19)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 6, 6], [0, 7, 8, 0], [1, 8, 9, 1], [1, 9, 9, 2], [2, 9, 7, 2], [3, 6, 8, 8], [3, 7, 7, 4], [4, 6, 5, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 648: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

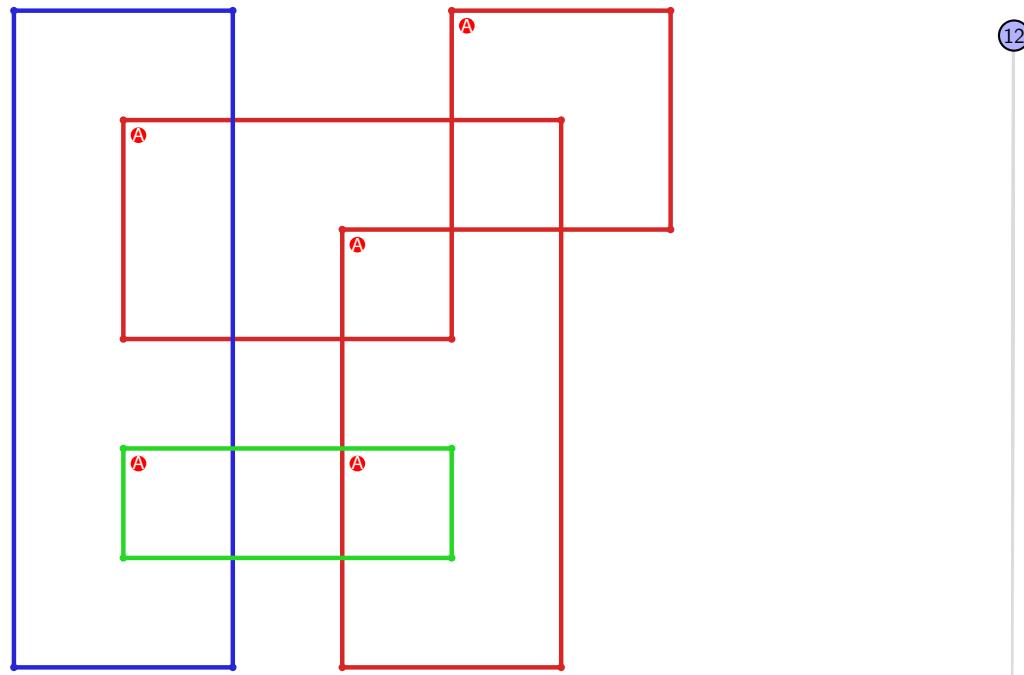


Figure 1299: SnapPy multiloop plot.

Figure 1300: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.353 $[[4, 12, 1, 5], [5, 13, 6, 16], [11, 3, 12, 4], [1, 8, 2, 7], [13, 7, 14, 6], [15, 20, 16, 17], [10, 19, 11, 20], [2, 8, 3, 9], [14, 18, 15, 17], [18, 9, 19, 10]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (11, 18, 12, 19), (12, 3, 5, 4), (4, 5, 1, 6), (13, 6, 14, 7), (2, 9, 3, 10), (17, 10, 18, 11), (7, 14, 8, 15), (20, 15, 17, 16), (16, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 7, 0], [0, 7, 7, 4], [1, 3, 8, 1], [1, 8, 8, 6], [2, 5, 9, 9], [2, 9, 3, 3], [4, 9, 5, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 649: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

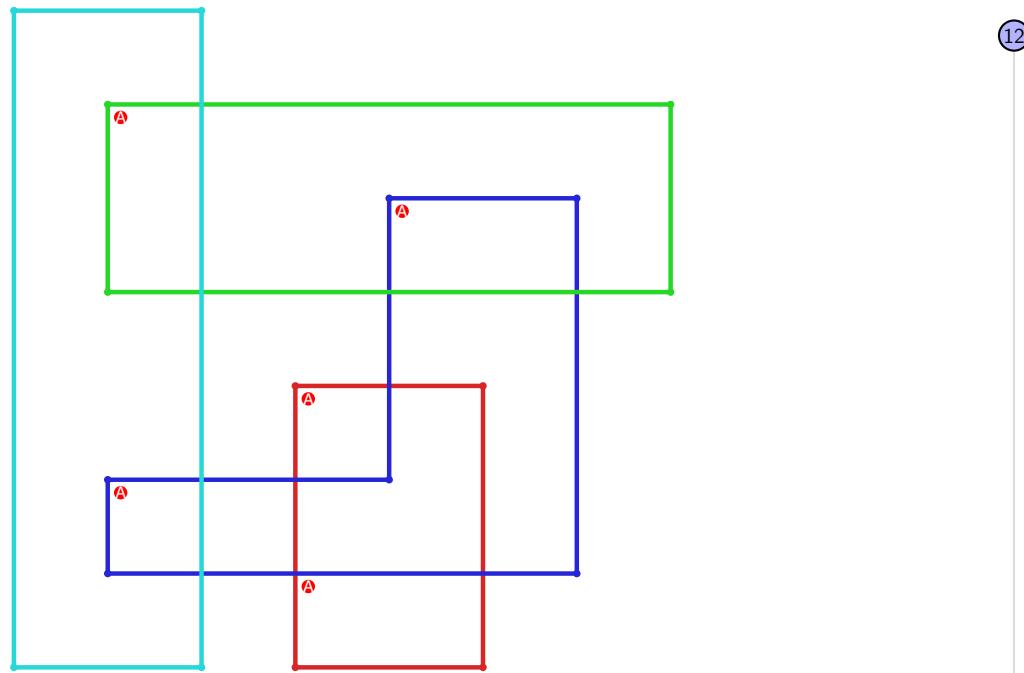


Figure 1301: SnapPy multiloop plot.

Figure 1302: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.354 [[16, 3, 1, 4], [4, 17, 5, 20], [10, 15, 11, 16], [2, 7, 3, 8], [1, 7, 2, 6], [17, 6, 18, 5], [13, 19, 14, 20], [14, 9, 15, 10], [11, 9, 12, 8], [18, 12, 19, 13]]

PD code drawn by SnapPy: [(14, 1, 15, 2), (3, 18, 4, 19), (4, 15, 5, 16), (16, 5, 1, 6), (6, 9, 7, 10), (12, 7, 13, 8), (19, 10, 20, 11), (8, 13, 9, 14), (11, 20, 12, 17), (17, 2, 18, 3)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 8], [0, 8, 4, 4], [0, 3, 3, 5], [1, 4, 9, 1], [1, 9, 9, 7], [2, 6, 8, 2], [2, 7, 9, 3], [5, 8, 6, 6]]

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 650: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

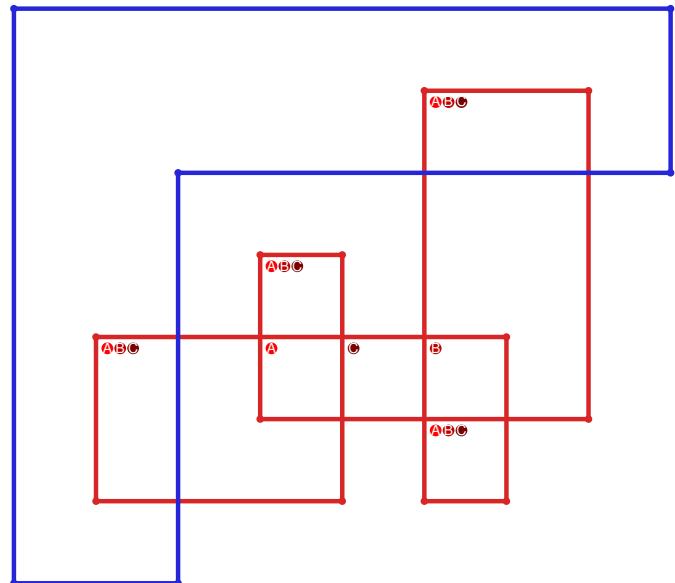


Figure 1303: SnapPy multiloop plot.

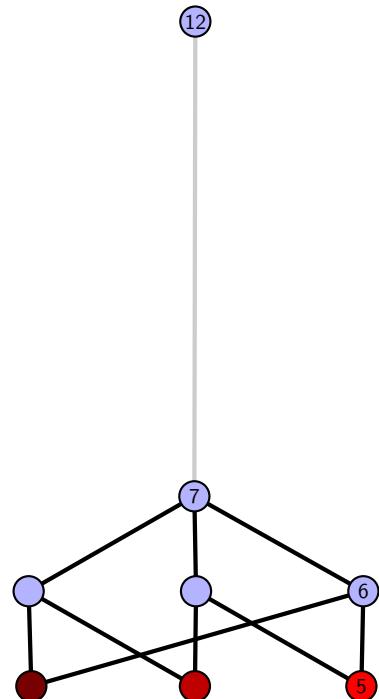


Figure 1304: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.355 $[[16, 3, 1, 4], [4, 17, 5, 20], [12, 15, 13, 16], [2, 7, 3, 8], [1, 7, 2, 6], [17, 6, 18, 5], [11, 19, 12, 20], [14, 9, 15, 10], [13, 9, 14, 8], [18, 10, 19, 11]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (3, 18, 4, 19), (4, 15, 5, 16), (16, 5, 1, 6), (6, 11, 7, 12), (12, 7, 13, 8), (19, 8, 20, 9), (10, 13, 11, 14), (9, 20, 10, 17), (17, 2, 18, 3)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 8], [0, 8, 4, 4], [0, 3, 3, 5], [1, 4, 9, 1], [1, 9, 9, 2], [2, 9, 8, 8], [2, 7, 7, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 224

Pinning number: 5

Average optimal degree: 2.27

Average minimal degree: 2.27

Average overall degree: 2.98

Table 651: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

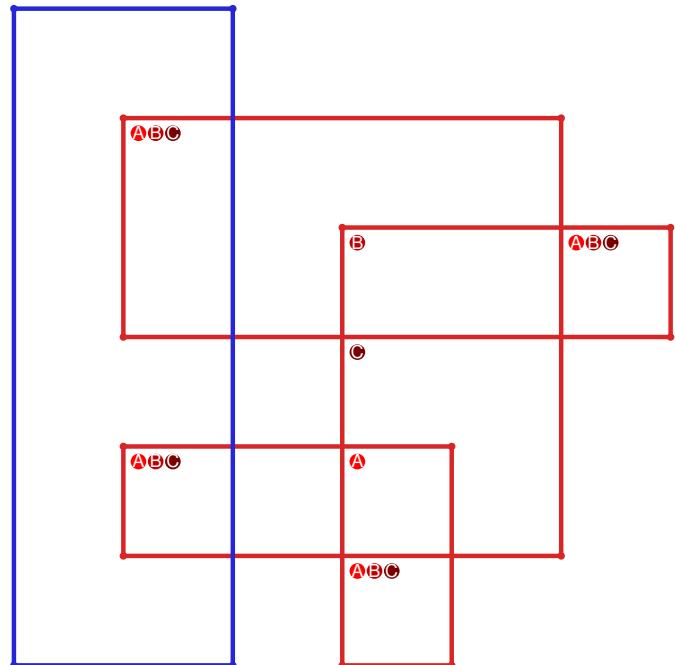


Figure 1305: SnapPy multiloop plot.

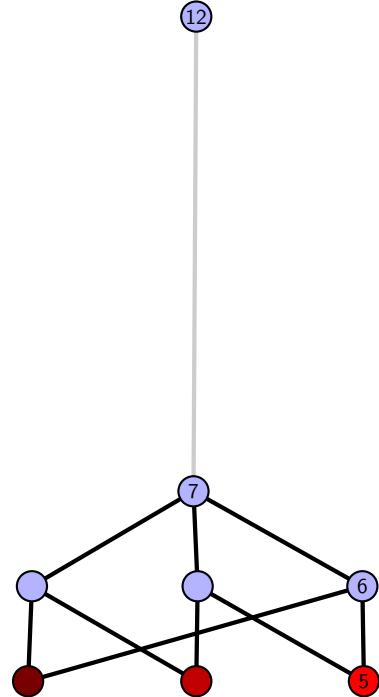


Figure 1306: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.356 `[[10, 3, 1, 4], [4, 11, 5, 20], [9, 17, 10, 18], [2, 7, 3, 8], [1, 7, 2, 6], [11, 6, 12, 5], [19, 14, 20, 15], [18, 14, 19, 13], [16, 8, 17, 9], [12, 16, 13, 15]]`

PD code drawn by `SnapPy`: `[(8, 1, 9, 2), (3, 12, 4, 13), (4, 9, 5, 10), (10, 5, 1, 6), (17, 6, 18, 7), (14, 19, 15, 20), (20, 15, 11, 16), (16, 13, 17, 14), (7, 18, 8, 19), (11, 2, 12, 3)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 8, 8], [0, 8, 4, 4], [0, 3, 3, 5], [1, 4, 9, 1], [1, 9, 7, 7], [2, 6, 6, 9], [2, 9, 3, 2], [5, 8, 7, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 652: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

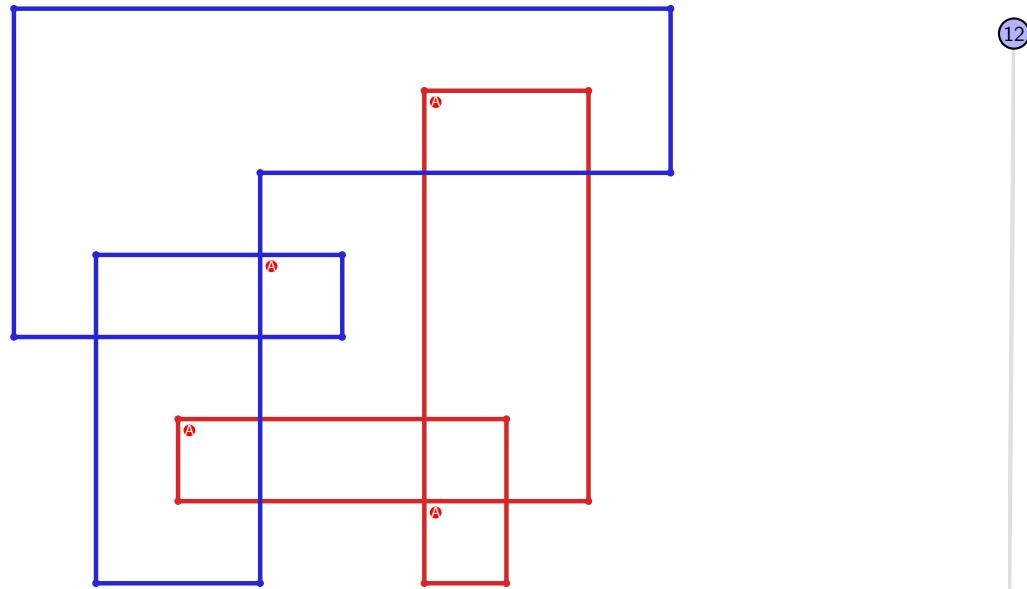


Figure 1307: `SnapPy` multiloop plot.



Figure 1308: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.357 `[[10, 3, 1, 4], [4, 11, 5, 20], [9, 15, 10, 16], [2, 7, 3, 8], [1, 7, 2, 6], [11, 6, 12, 5], [19, 16, 20, 17], [14, 8, 15, 9], [12, 18, 13, 17], [13, 18, 14, 19]]`

PD code drawn by `SnapPy`: `[(8, 1, 9, 2), (3, 12, 4, 13), (4, 9, 5, 10), (10, 5, 1, 6), (15, 6, 16, 7), (7, 16, 8, 17), (20, 17, 11, 18), (18, 13, 19, 14), (14, 19, 15, 20), (11, 2, 12, 3)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 7, 4, 4], [0, 3, 3, 5], [1, 4, 8, 1], [1, 8, 9, 2], [2, 9, 3, 2], [5, 9, 9, 6], [6, 8, 8, 7]]`

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 256

Pinning number: 4

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.97

Table 653: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

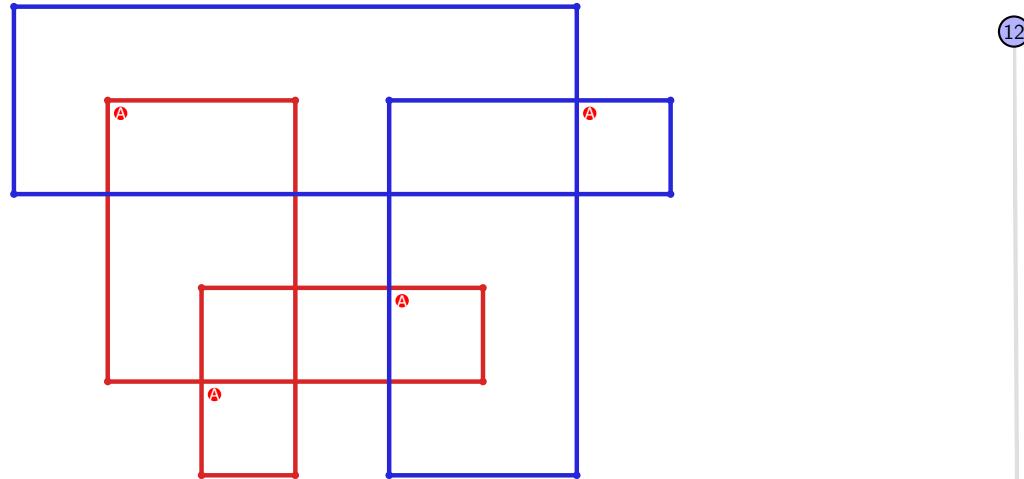


Figure 1309: `SnapPy` multiloop plot.

(4)

Figure 1310: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.358 $[[3, 12, 4, 1], [2, 16, 3, 13], [11, 4, 12, 5], [1, 14, 2, 13], [15, 20, 16, 17], [5, 10, 6, 11], [14, 18, 15, 17], [19, 7, 20, 8], [9, 6, 10, 7], [18, 9, 19, 8]]$

PD code drawn by `SnapPy`: $[(9, 2, 10, 3), (7, 4, 8, 5), (18, 5, 19, 6), (6, 17, 7, 18), (3, 8, 4, 9), (1, 10, 2, 11), (12, 13, 1, 14), (14, 11, 15, 12), (16, 19, 13, 20), (20, 15, 17, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 6, 1, 1], [1, 6, 6, 7], [2, 8, 8, 2], [3, 9, 4, 4], [4, 9, 9, 8], [5, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 654: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

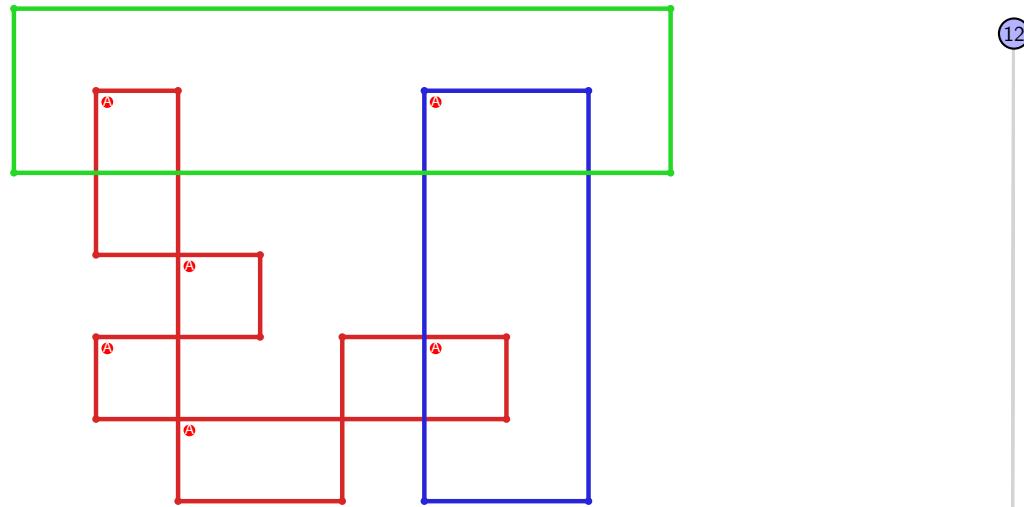


Figure 1311: `SnapPy` multiloop plot.

6

Figure 1312: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.359 $[[3, 8, 4, 1], [2, 14, 3, 9], [7, 4, 8, 5], [1, 10, 2, 9], [13, 20, 14, 15], [5, 20, 6, 19], [6, 18, 7, 19], [10, 18, 11, 17], [15, 12, 16, 13], [11, 16, 12, 17]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (1, 6, 2, 7), (18, 13, 19, 14), (8, 9, 1, 10), (10, 7, 11, 8), (20, 11, 15, 12), (4, 15, 5, 16), (16, 3, 17, 4), (14, 17, 9, 18), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 6, 0], [0, 7, 1, 1], [1, 8, 8, 5], [2, 4, 6, 6], [2, 5, 5, 7], [3, 6, 9, 9], [4, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 655: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

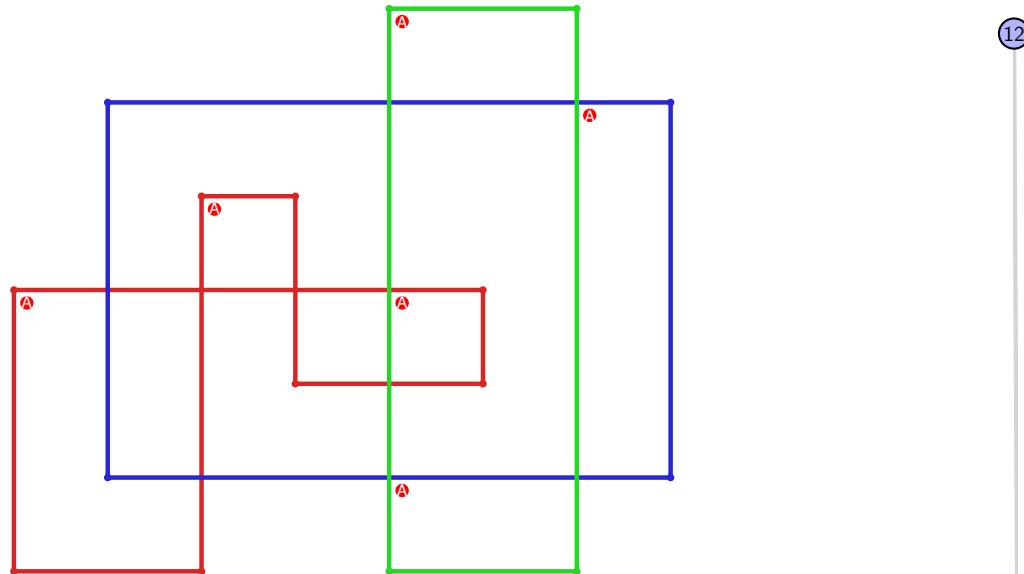


Figure 1313: SnapPy multiloop plot.

6

Figure 1314: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.360 `[[3, 10, 4, 1], [2, 20, 3, 11], [9, 4, 10, 5], [1, 12, 2, 11], [14, 19, 15, 20], [5, 8, 6, 9], [12, 17, 13, 18], [18, 13, 19, 14], [15, 7, 16, 8], [6, 16, 7, 17]]`

PD code drawn by `SnapPy`: `[(7, 2, 8, 3), (16, 5, 17, 6), (3, 6, 4, 7), (1, 8, 2, 9), (19, 14, 20, 15), (4, 17, 5, 18), (13, 18, 14, 19), (15, 20, 16, 11), (10, 11, 1, 12), (12, 9, 13, 10)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 3, 3, 4], [0, 5, 5, 0], [0, 6, 1, 1], [1, 7, 7, 8], [2, 8, 9, 2], [3, 9, 7, 7], [4, 6, 6, 4], [4, 9, 9, 5], [5, 8, 8, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 656: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

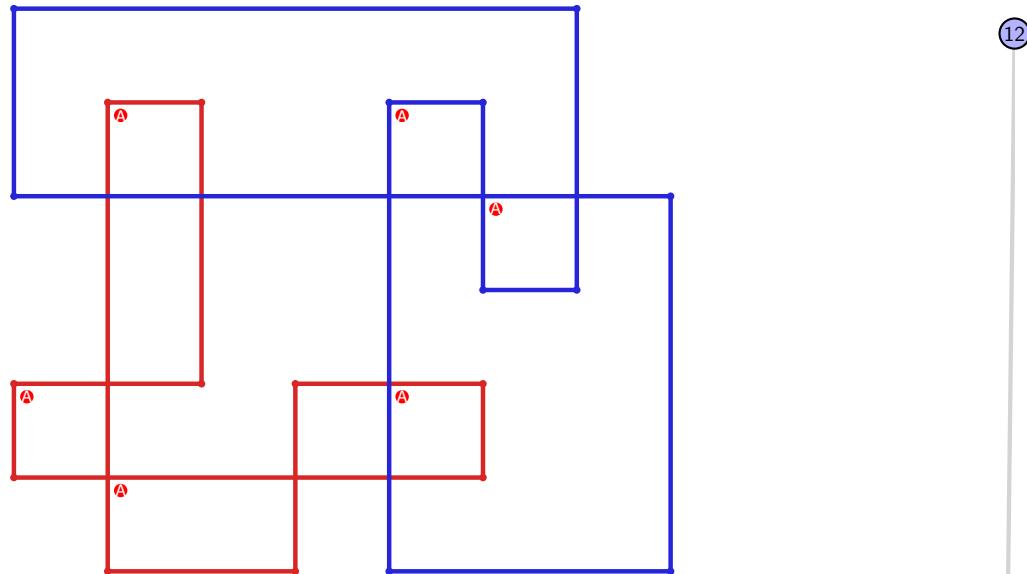


Figure 1315: `SnapPy` multiloop plot.

12

Figure 1316: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.361 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 2, 11, 1], [7, 18, 8, 19], [2, 12, 3, 11], [17, 6, 18, 7], [12, 16, 13, 15], [3, 15, 4, 14], [5, 16, 6, 17], [13, 5, 14, 4]]$

PD code drawn by `SnapPy`: $[(1, 10, 2, 11), (14, 3, 15, 4), (16, 5, 17, 6), (8, 19, 9, 20), (11, 20, 12, 1), (12, 9, 13, 10), (2, 13, 3, 14), (4, 15, 5, 16), (6, 17, 7, 18), (18, 7, 19, 8)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 7, 2], [3, 8, 8, 3], [4, 8, 9, 7], [4, 6, 9, 9], [5, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.12

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 20

Average overall degree: 2.82

Pinning number: 8

Table 657: Pinning sets/average degree by cardinal

Cardinal	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	1
Nonminimal pinning sets	0	4	8	5	1	18
Average degree	2.12	2.47	2.85	3.16	3.33	

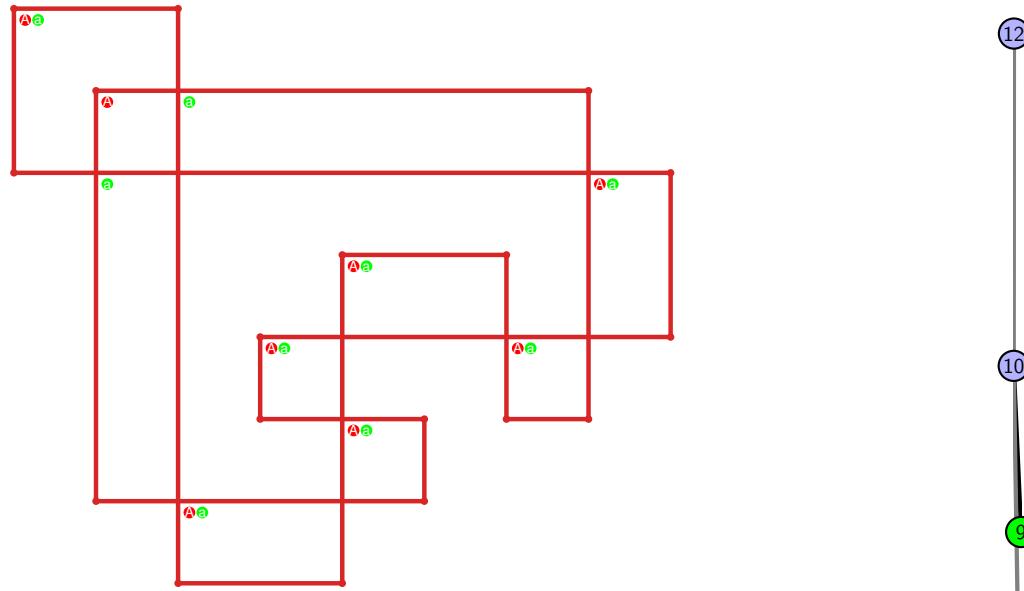


Figure 1317: `SnapPy` multiloop plot.

Figure 1318: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.362 [[20, 9, 1, 10], [10, 19, 11, 20], [8, 1, 9, 2], [18, 11, 19, 12], [2, 7, 3, 8], [12, 17, 13, 18], [13, 6, 14, 7], [3, 14, 4, 15], [5, 16, 6, 17], [4, 16, 5, 15]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (17, 2, 18, 3), (15, 4, 16, 5), (13, 6, 14, 7), (18, 9, 19, 10), (10, 19, 11, 20), (20, 11, 1, 12), (7, 12, 8, 13), (5, 14, 6, 15), (3, 16, 4, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 7, 2], [3, 8, 6, 3], [4, 5, 8, 7], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 658: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

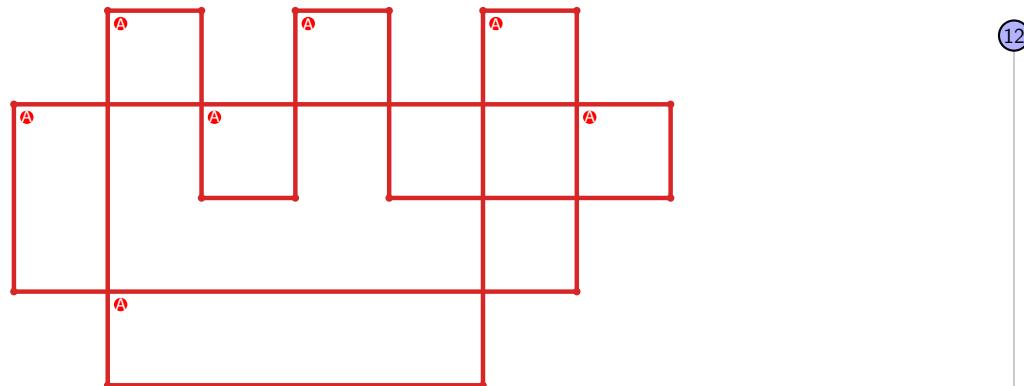


Figure 1319: `SnapPy` multiloop plot.

Figure 1320: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.363 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 2, 11, 1], [7, 18, 8, 19], [2, 12, 3, 11], [6, 13, 7, 14], [17, 12, 18, 13], [3, 17, 4, 16], [14, 5, 15, 6], [4, 15, 5, 16]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (16, 5, 17, 6), (8, 19, 9, 20), (14, 9, 15, 10), (3, 10, 4, 11), (1, 12, 2, 13), (13, 20, 14, 1), (4, 15, 5, 16), (6, 17, 7, 18), (18, 7, 19, 8)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 7, 2], [3, 8, 8, 6], [3, 5, 7, 4], [4, 6, 9, 9], [5, 9, 9, 5], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 659: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

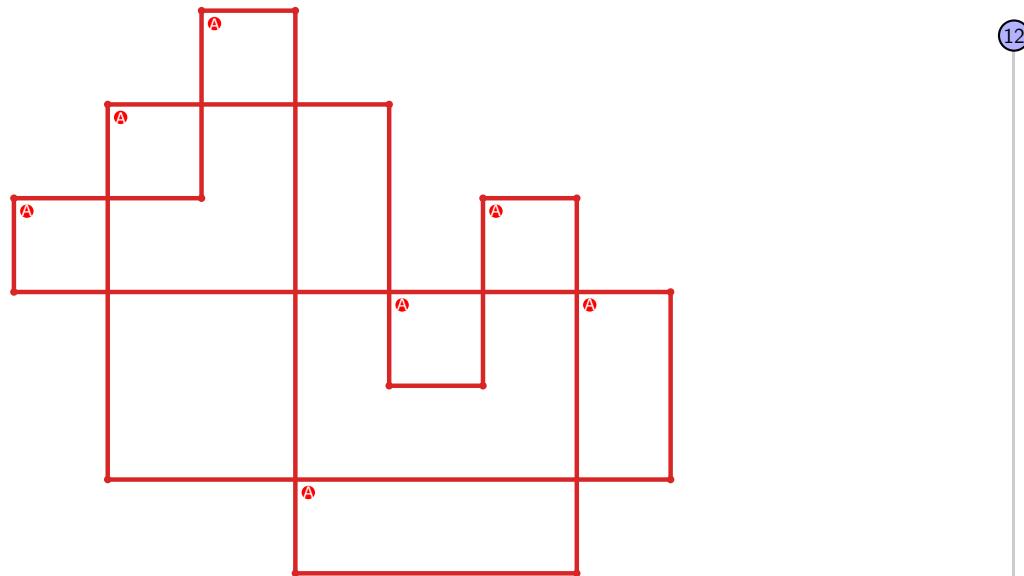


Figure 1321: `SnapPy` multiloop plot.

12

7

Figure 1322: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.364 [[20, 7, 1, 8], [8, 18, 9, 17], [19, 16, 20, 17], [6, 15, 7, 16], [1, 11, 2, 10], [18, 10, 19, 9], [14, 5, 15, 6], [11, 3, 12, 2], [4, 13, 5, 14], [3, 13, 4, 12]]

PD code drawn by SnapPy: [(20, 9, 1, 10), (12, 3, 13, 4), (18, 5, 19, 6), (7, 16, 8, 17), (8, 19, 9, 20), (10, 1, 11, 2), (2, 11, 3, 12), (4, 13, 5, 14), (17, 14, 18, 15), (15, 6, 16, 7)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 7, 5], [1, 4, 2, 1], [3, 8, 8, 3], [4, 9, 9, 4], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.14

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 40

Average overall degree: 2.86

Pinning number: 7

Table 660: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	5	13	13	6	1	38
Average degree	2.14	2.46	2.76	3.02	3.21	3.33	

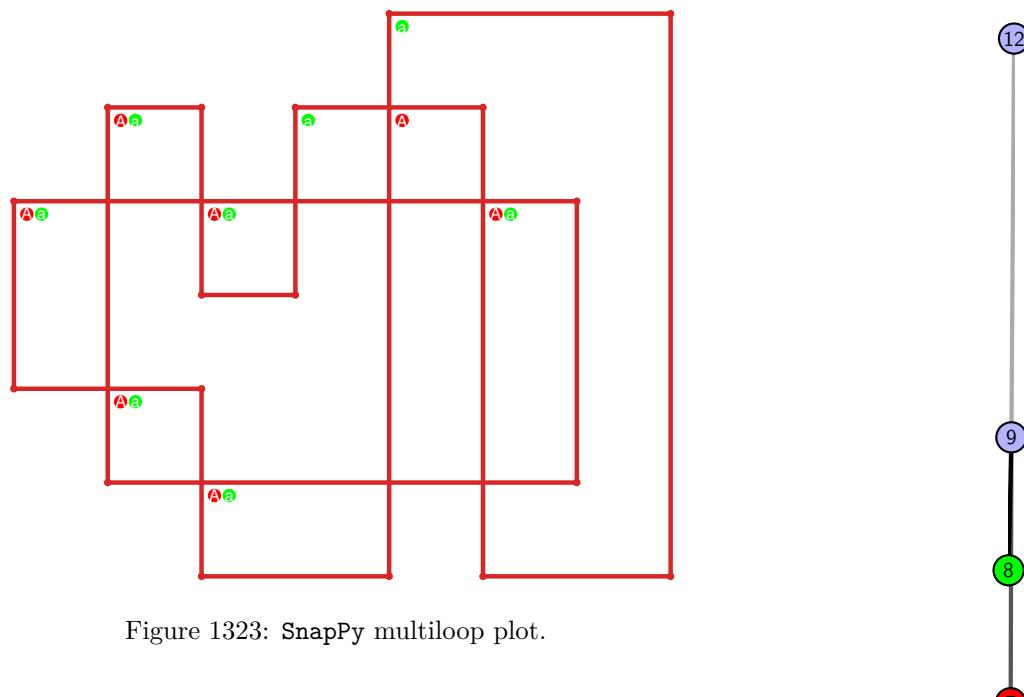


Figure 1323: SnapPy multiloop plot.

Figure 1324: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.365 [[20, 9, 1, 10], [10, 5, 11, 6], [8, 19, 9, 20], [1, 12, 2, 13], [15, 4, 16, 5], [11, 16, 12, 17], [6, 17, 7, 18], [18, 7, 19, 8], [2, 14, 3, 13], [3, 14, 4, 15]]

PD code drawn by SnapPy: [(13, 2, 14, 3), (8, 3, 9, 4), (16, 5, 17, 6), (18, 7, 19, 8), (19, 10, 20, 11), (11, 20, 12, 1), (1, 12, 2, 13), (9, 14, 10, 15), (4, 15, 5, 16), (6, 17, 7, 18)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 7, 0], [0, 5, 8, 8], [1, 9, 9, 5], [1, 4, 3, 6], [1, 5, 7, 7], [2, 6, 6, 2], [3, 9, 9, 3], [4, 8, 8, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.14

Total minimal pinning sets: 2

Average minimal degree: 2.14

Total pinning sets: 48

Average overall degree: 2.86

Pinning number: 7

Table 661: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.14	2.53	2.82	3.04	3.21	3.33	

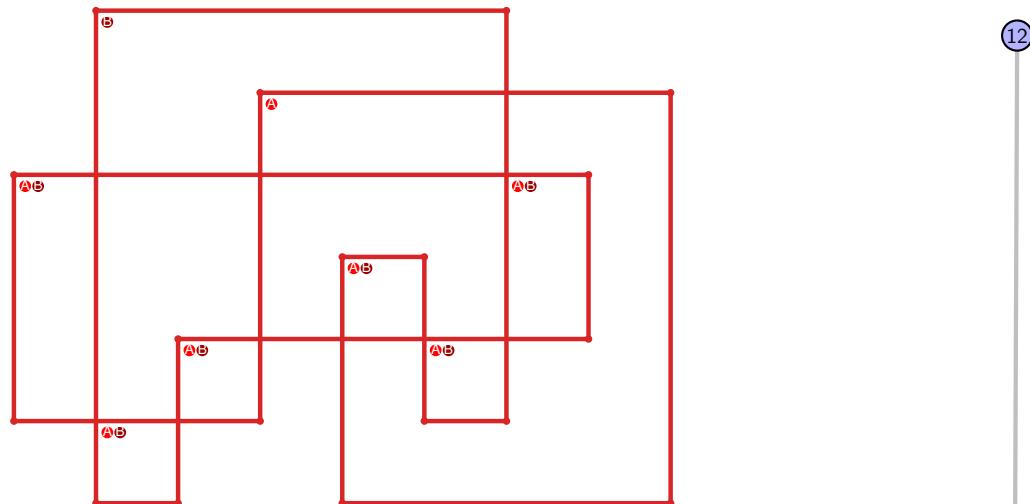


Figure 1325: SnapPy multiloop plot.

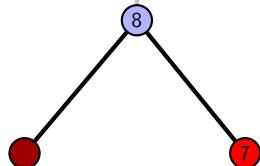


Figure 1326: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.366 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 16, 11, 15], [1, 15, 2, 14], [7, 18, 8, 19], [16, 6, 17, 5], [11, 3, 12, 2], [4, 13, 5, 14], [17, 6, 18, 7], [3, 13, 4, 12]]$

PD code drawn by SnapPy: $[(20, 9, 1, 10), (3, 14, 4, 15), (15, 4, 16, 5), (17, 6, 18, 7), (10, 1, 11, 2), (2, 11, 3, 12), (12, 19, 13, 20), (13, 8, 14, 9), (5, 16, 6, 17), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 6, 7], [1, 8, 8, 1], [2, 8, 8, 7], [2, 9, 9, 3], [3, 9, 9, 5], [4, 5, 5, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 48
 Pinning number: 7

Average optimal degree: 2.14
 Average minimal degree: 2.14
 Average overall degree: 2.86

Table 662: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.14	2.53	2.82	3.04	3.21	3.33	

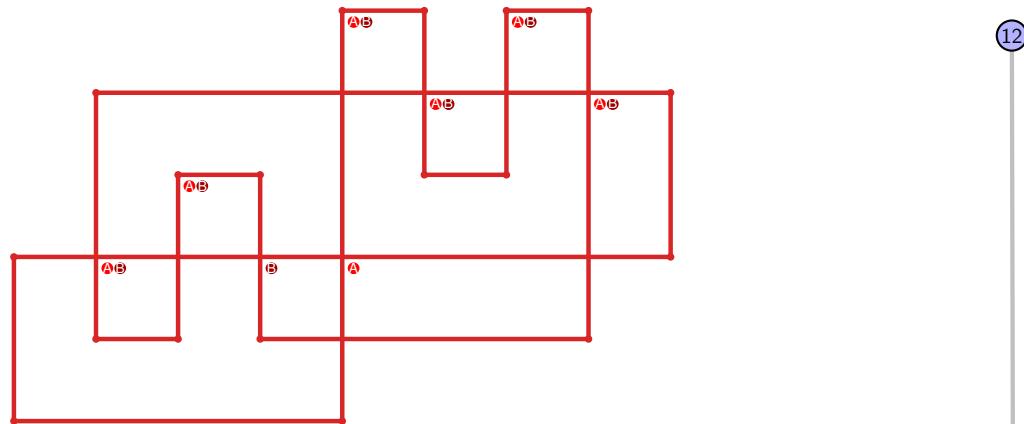


Figure 1327: SnapPy multiloop plot.

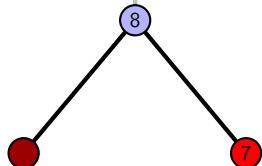


Figure 1328: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.367 $[[20, 5, 1, 6], [6, 16, 7, 15], [19, 14, 20, 15], [4, 11, 5, 12], [1, 11, 2, 10], [16, 8, 17, 7], [9, 18, 10, 19], [2, 13, 3, 14], [12, 3, 13, 4], [8, 18, 9, 17]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (18, 3, 19, 4), (5, 14, 6, 15), (8, 19, 9, 20), (2, 9, 3, 10), (20, 11, 1, 12), (17, 12, 18, 13), (13, 4, 14, 5), (15, 6, 16, 7), (7, 16, 8, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 8, 8, 4], [0, 3, 7, 6], [1, 9, 9, 1], [2, 9, 9, 4], [2, 4, 8, 8], [3, 7, 7, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 663: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

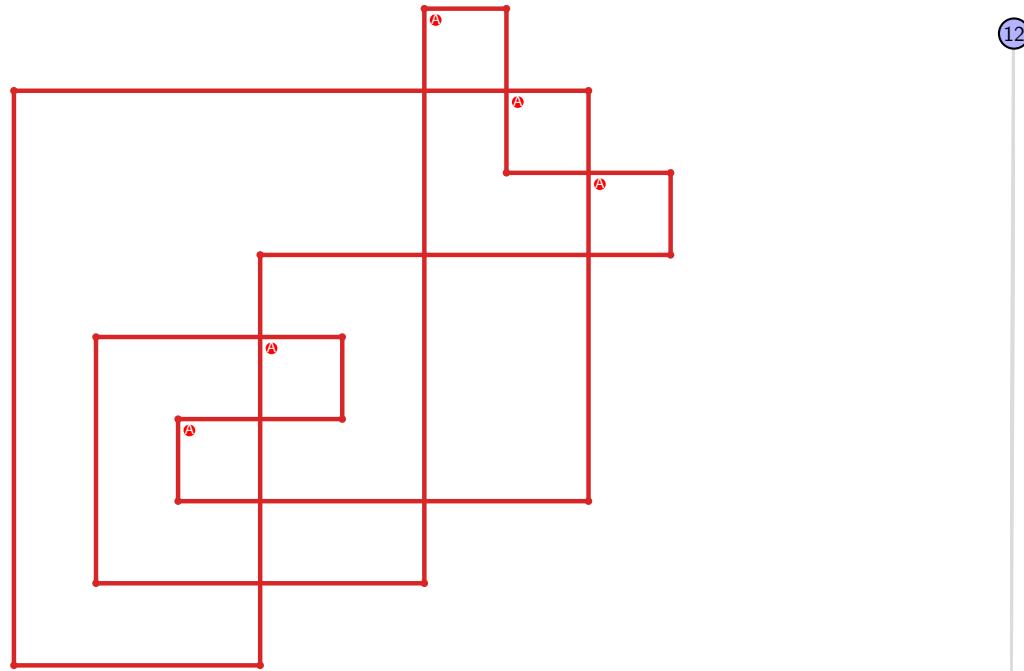


Figure 1329: SnapPy multiloop plot.

Figure 1330: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.368 [[11, 20, 12, 1], [19, 10, 20, 11], [12, 2, 13, 1], [18, 7, 19, 8], [9, 2, 10, 3], [13, 9, 14, 8], [6, 17, 7, 18], [3, 17, 4, 16], [14, 5, 15, 6], [4, 15, 5, 16]]

PD code drawn by `SnapPy`: [(11, 2, 12, 3), (15, 4, 16, 5), (5, 10, 6, 11), (16, 7, 17, 8), (1, 12, 2, 13), (13, 20, 14, 1), (3, 14, 4, 15), (8, 17, 9, 18), (18, 9, 19, 10), (6, 19, 7, 20)]

Planar representation generated by `plantri`: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 4, 5, 0], [1, 5, 6, 6], [1, 7, 5, 2], [2, 4, 8, 3], [3, 8, 7, 3], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 664: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

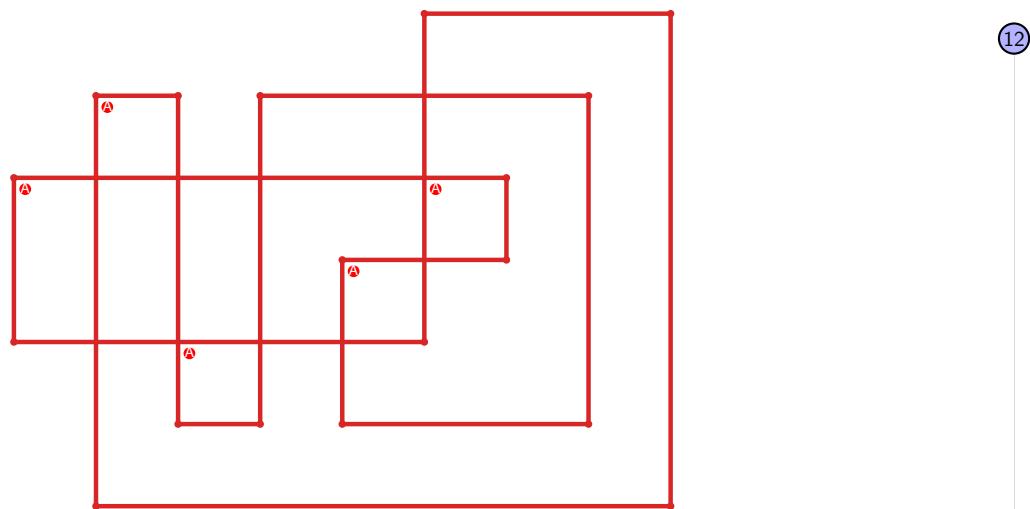


Figure 1331: `SnapPy` multiloop plot.

5

Figure 1332: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.369 $[[20, 13, 1, 14], [14, 19, 15, 20], [12, 1, 13, 2], [7, 18, 8, 19], [15, 3, 16, 2], [16, 11, 17, 12], [17, 6, 18, 7], [8, 4, 9, 3], [5, 10, 6, 11], [4, 10, 5, 9]]$

PD code drawn by `SnapPy`: $[(13, 2, 14, 3), (5, 20, 6, 1), (1, 6, 2, 7), (12, 7, 13, 8), (16, 9, 17, 10), (3, 14, 4, 15), (10, 15, 11, 16), (8, 17, 9, 18), (18, 11, 19, 12), (19, 4, 20, 5)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 4, 5, 0], [1, 6, 6, 7], [1, 7, 5, 2], [2, 4, 8, 6], [3, 5, 8, 3], [3, 9, 9, 4], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 665: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

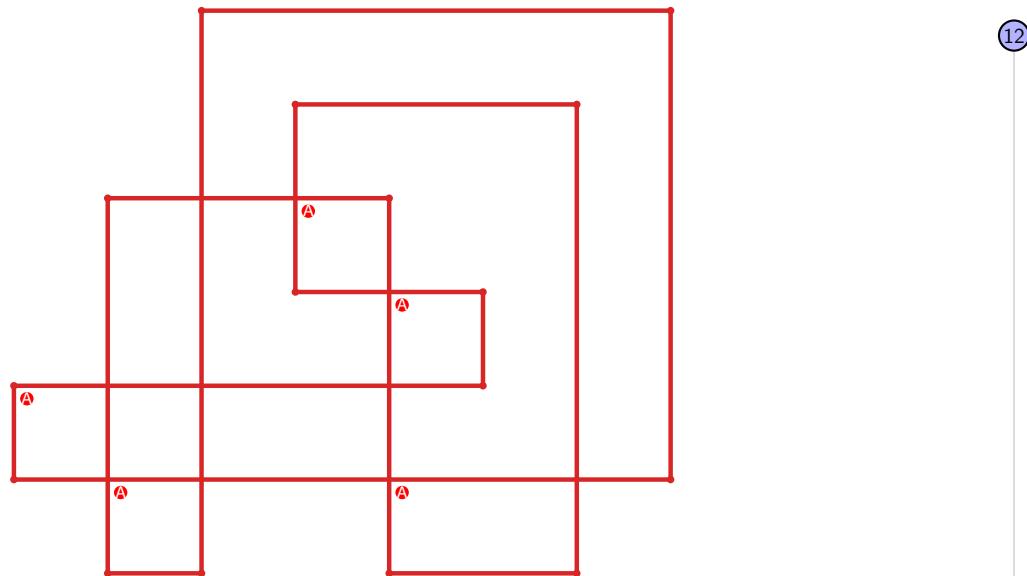


Figure 1333: `SnapPy` multiloop plot.



Figure 1334: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.370 $[[8, 20, 1, 9], [9, 16, 10, 17], [17, 7, 18, 8], [19, 5, 20, 6], [1, 14, 2, 13], [15, 10, 16, 11], [6, 18, 7, 19], [4, 14, 5, 15], [2, 12, 3, 13], [11, 3, 12, 4]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (17, 2, 18, 3), (15, 4, 16, 5), (7, 10, 8, 11), (11, 6, 12, 7), (1, 12, 2, 13), (19, 14, 20, 15), (3, 16, 4, 17), (5, 18, 6, 19), (13, 20, 14, 9)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 6, 6, 7], [0, 7, 8, 8], [1, 9, 7, 1], [2, 3, 3, 2], [3, 5, 9, 4], [4, 9, 9, 4], [5, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 666: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

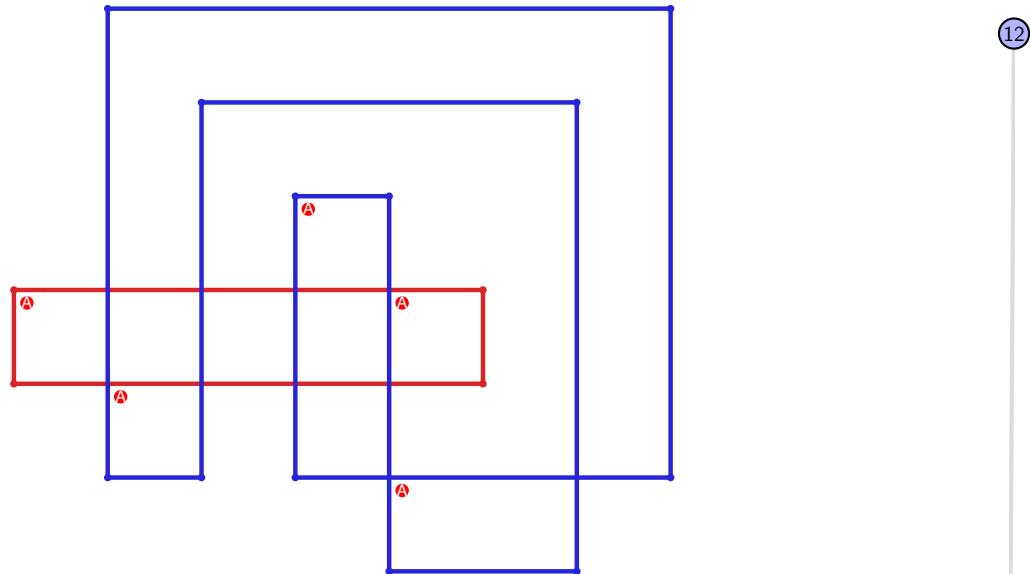


Figure 1335: `SnapPy` multiloop plot.



Figure 1336: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.371 $[[13, 20, 14, 1], [19, 12, 20, 13], [14, 12, 15, 11], [1, 16, 2, 17], [18, 5, 19, 6], [15, 10, 16, 11], [2, 8, 3, 7], [17, 7, 18, 6], [9, 4, 10, 5], [8, 4, 9, 3]]$

PD code drawn by SnapPy: $[(20, 5, 1, 6), (6, 1, 7, 2), (15, 2, 16, 3), (3, 14, 4, 15), (4, 19, 5, 20), (12, 7, 13, 8), (8, 11, 9, 12), (16, 9, 17, 10), (18, 13, 19, 14), (10, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 7], [1, 7, 7, 8], [2, 8, 3, 2], [3, 9, 9, 7], [3, 6, 4, 4], [4, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 667: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

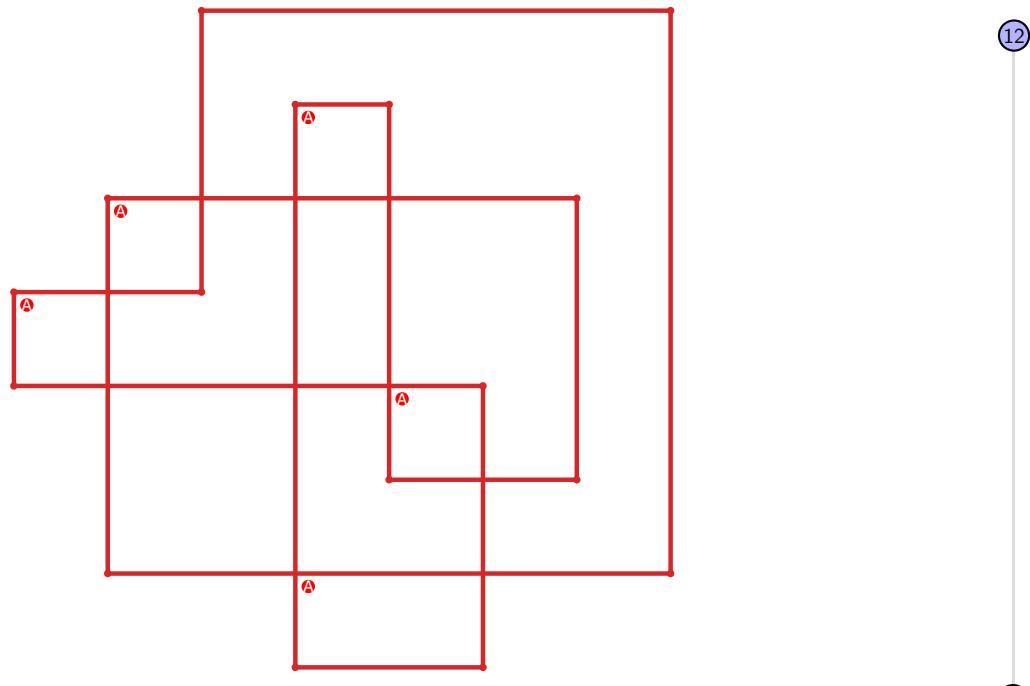


Figure 1337: SnapPy multiloop plot.

Figure 1338: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.372 `[[15, 20, 16, 1], [3, 14, 4, 15], [4, 19, 5, 20], [16, 7, 17, 8], [1, 10, 2, 11], [11, 2, 12, 3], [13, 8, 14, 9], [18, 5, 19, 6], [6, 17, 7, 18], [9, 12, 10, 13]]`

PD code drawn by `SnapPy`: `[(15, 2, 16, 3), (13, 4, 14, 5), (10, 5, 11, 6), (18, 7, 19, 8), (6, 9, 7, 10), (20, 11, 1, 12), (3, 14, 4, 15), (1, 16, 2, 17), (12, 17, 13, 18), (8, 19, 9, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 7], [0, 8, 8, 6], [0, 9, 5, 5], [1, 4, 4, 9], [1, 9, 9, 3], [2, 8, 8, 2], [3, 7, 7, 3], [4, 6, 6, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 668: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

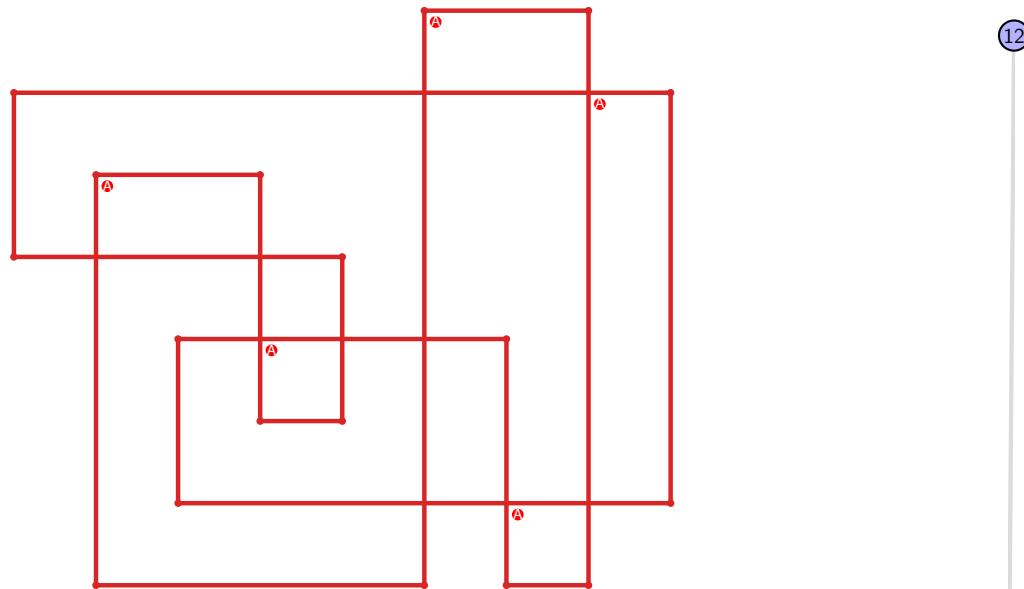


Figure 1339: `SnapPy` multiloop plot.

12
5

Figure 1340: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.373 $[[5, 20, 6, 1], [4, 9, 5, 10], [19, 8, 20, 9], [6, 18, 7, 17], [1, 15, 2, 14], [10, 3, 11, 4], [7, 18, 8, 19], [11, 16, 12, 17], [15, 12, 16, 13], [2, 13, 3, 14]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (17, 6, 18, 7), (2, 7, 3, 8), (13, 10, 14, 11), (20, 11, 1, 12), (12, 19, 13, 20), (9, 14, 10, 15), (15, 4, 16, 5), (5, 16, 6, 17), (3, 18, 4, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 6, 6, 7], [0, 8, 9, 9], [1, 9, 7, 1], [2, 3, 3, 2], [3, 5, 8, 8], [4, 7, 7, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 669: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

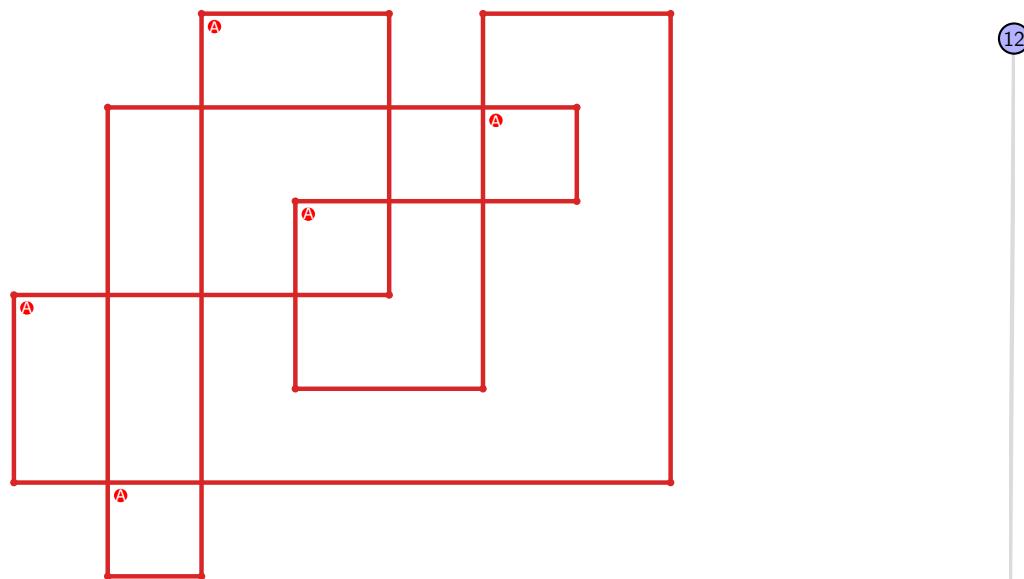


Figure 1341: SnapPy multiloop plot.

(12)

5

Figure 1342: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.374 [[20, 5, 1, 6], [6, 16, 7, 15], [19, 12, 20, 13], [4, 9, 5, 10], [1, 9, 2, 8], [16, 8, 17, 7], [17, 14, 18, 15], [13, 18, 14, 19], [2, 11, 3, 12], [10, 3, 11, 4]]

PD code drawn by SnapPy: [(7, 20, 8, 1), (17, 2, 18, 3), (4, 13, 5, 14), (5, 18, 6, 19), (1, 6, 2, 7), (19, 8, 20, 9), (16, 9, 17, 10), (14, 11, 15, 12), (12, 3, 13, 4), (10, 15, 11, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 8], [0, 9, 9, 4], [0, 3, 8, 5], [1, 4, 6, 1], [1, 5, 7, 7], [2, 6, 6, 2], [2, 4, 9, 9], [3, 8, 8, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 670: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

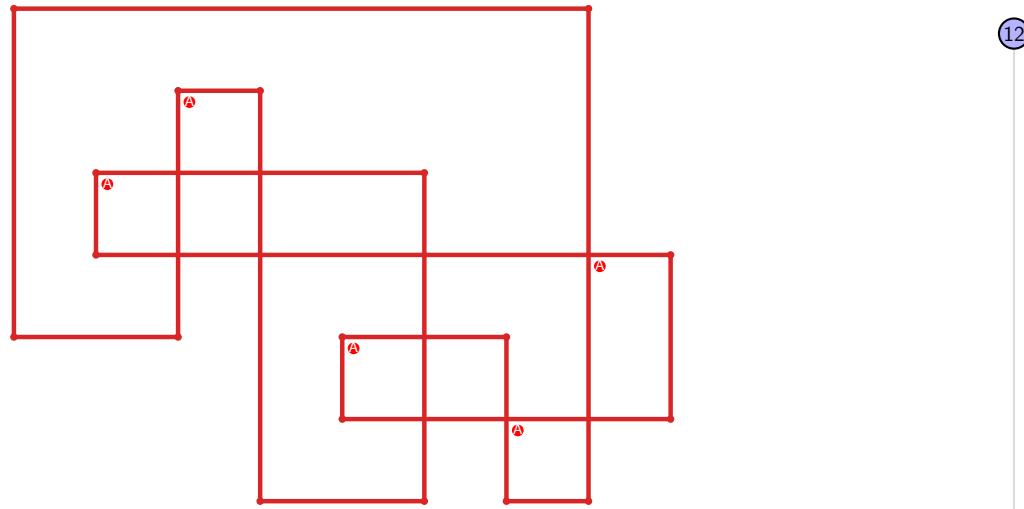


Figure 1343: SnapPy multiloop plot.

5

Figure 1344: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.375 $[[20, 7, 1, 8], [8, 18, 9, 17], [19, 16, 20, 17], [6, 11, 7, 12], [1, 11, 2, 10], [18, 10, 19, 9], [2, 15, 3, 16], [12, 5, 13, 6], [14, 3, 15, 4], [4, 13, 5, 14]]$

PD code drawn by SnapPy: $[(11, 20, 12, 1), (9, 2, 10, 3), (17, 4, 18, 5), (6, 15, 7, 16), (7, 18, 8, 19), (3, 8, 4, 9), (1, 10, 2, 11), (19, 12, 20, 13), (16, 13, 17, 14), (14, 5, 15, 6)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 6, 5], [1, 4, 2, 1], [2, 4, 8, 8], [3, 9, 9, 3], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 671: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

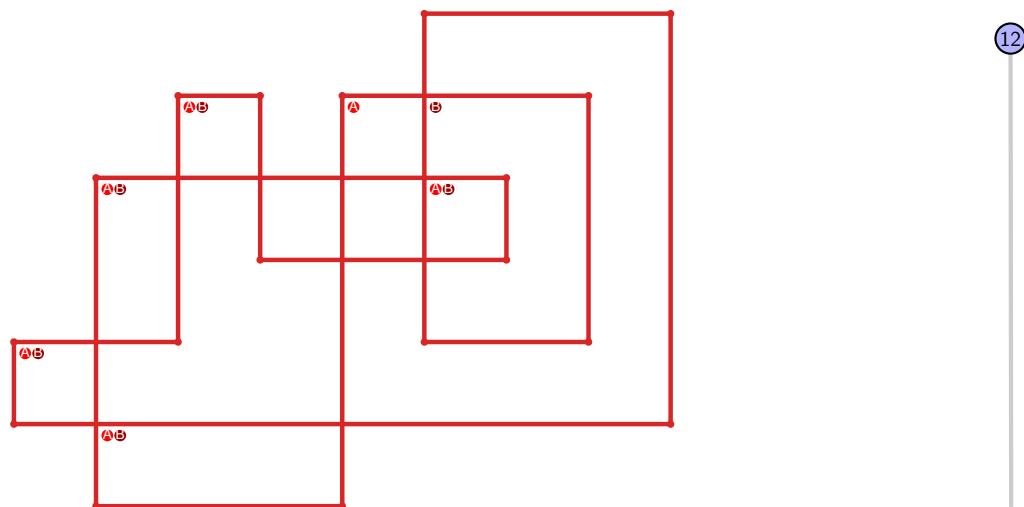


Figure 1345: SnapPy multiloop plot.

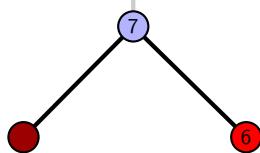


Figure 1346: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.376 $[[9, 16, 10, 1], [8, 20, 9, 17], [15, 19, 16, 20], [10, 5, 11, 6], [1, 6, 2, 7], [17, 7, 18, 8], [18, 14, 19, 15], [4, 11, 5, 12], [2, 13, 3, 14], [12, 3, 13, 4]]$

PD code drawn by `SnapPy`: $[(9, 16, 10, 1), (7, 2, 8, 3), (14, 3, 15, 4), (17, 4, 18, 5), (1, 8, 2, 9), (15, 10, 16, 11), (18, 11, 19, 12), (6, 13, 7, 14), (12, 19, 13, 20), (5, 20, 6, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 7, 4], [0, 3, 8, 5], [1, 4, 6, 1], [2, 5, 8, 2], [3, 9, 9, 3], [4, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 672: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

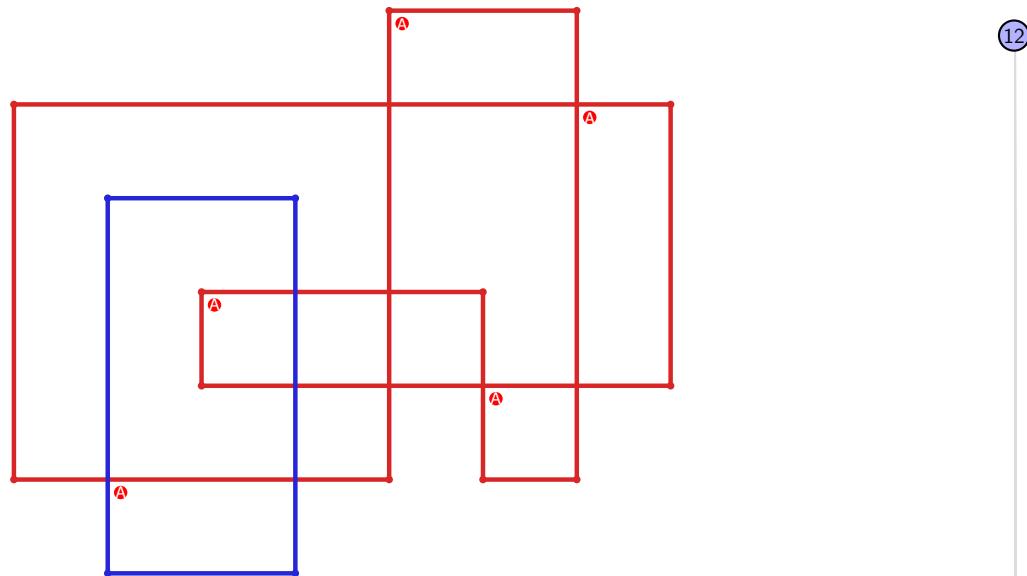


Figure 1347: `SnapPy` multiloop plot.

Figure 1348: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.377 `[[20, 5, 1, 6], [6, 16, 7, 15], [19, 14, 20, 15], [4, 9, 5, 10], [1, 9, 2, 8], [16, 8, 17, 7], [13, 18, 14, 19], [10, 3, 11, 4], [2, 11, 3, 12], [17, 12, 18, 13]]`

PD code drawn by `SnapPy`: `[(7, 20, 8, 1), (17, 2, 18, 3), (4, 13, 5, 14), (5, 18, 6, 19), (1, 6, 2, 7), (19, 8, 20, 9), (14, 9, 15, 10), (16, 11, 17, 12), (12, 3, 13, 4), (10, 15, 11, 16)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 7, 4], [0, 3, 8, 5], [1, 4, 9, 1], [2, 9, 9, 2], [3, 8, 8, 3], [4, 7, 7, 9], [5, 8, 6, 6]]`

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 673: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

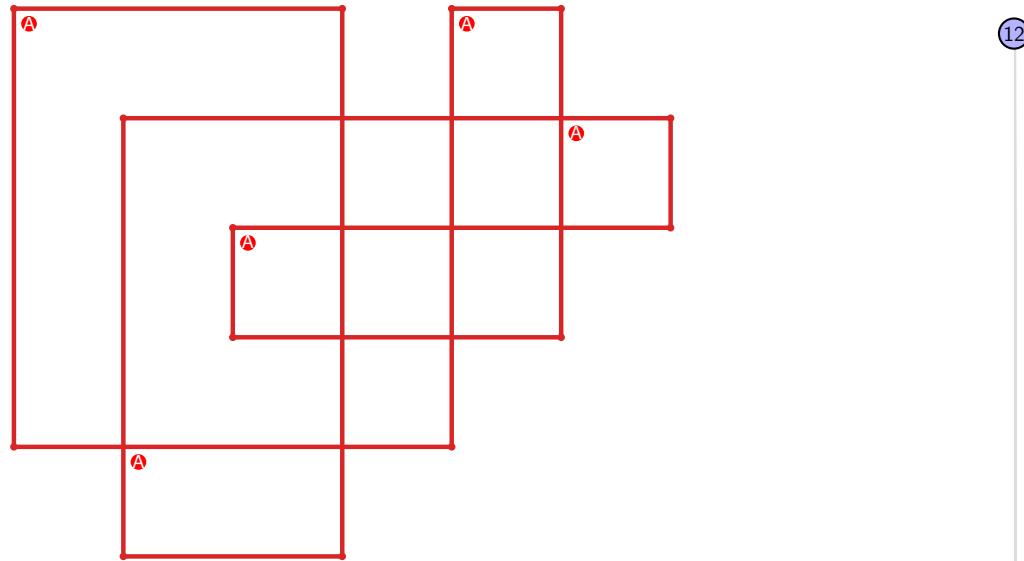


Figure 1349: `SnapPy` multiloop plot.

5

Figure 1350: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.378 [[16, 7, 1, 8], [8, 17, 9, 20], [15, 19, 16, 20], [6, 1, 7, 2], [17, 10, 18, 9], [18, 14, 19, 15], [2, 12, 3, 11], [5, 10, 6, 11], [13, 4, 14, 5], [12, 4, 13, 3]]

PD code drawn by SnapPy: [(1, 10, 2, 11), (11, 2, 12, 3), (14, 5, 15, 6), (7, 18, 8, 19), (3, 8, 4, 9), (9, 16, 10, 1), (19, 12, 20, 13), (4, 15, 5, 16), (13, 20, 14, 17), (17, 6, 18, 7)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 7, 0], [1, 7, 5, 1], [2, 4, 8, 2], [3, 9, 9, 7], [3, 6, 8, 4], [5, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 674: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

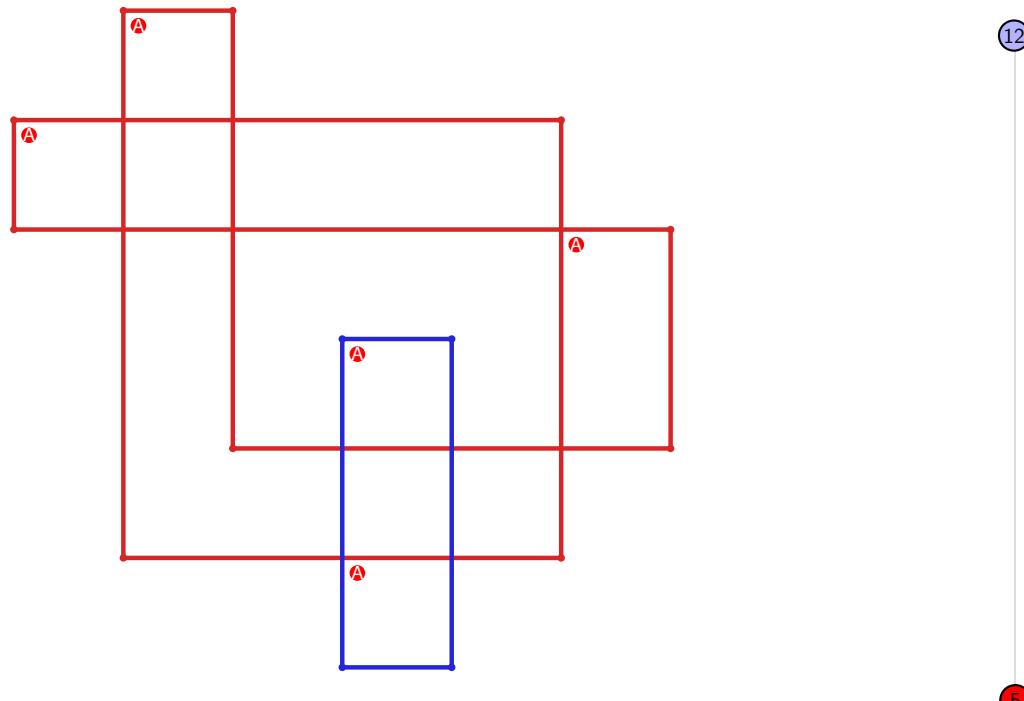


Figure 1351: SnapPy multiloop plot.

Figure 1352: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.379 $[[20, 7, 1, 8], [8, 18, 9, 17], [19, 16, 20, 17], [6, 13, 7, 14], [1, 13, 2, 12], [18, 10, 19, 9], [4, 15, 5, 16], [14, 5, 15, 6], [2, 11, 3, 12], [10, 3, 11, 4]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (12, 3, 13, 4), (18, 5, 19, 6), (7, 16, 8, 17), (20, 9, 1, 10), (10, 19, 11, 20), (4, 11, 5, 12), (2, 13, 3, 14), (17, 14, 18, 15), (15, 6, 16, 7)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 8, 8], [1, 9, 2, 1], [2, 9, 7, 7], [3, 6, 6, 3], [4, 9, 9, 4], [5, 8, 8, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 675: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

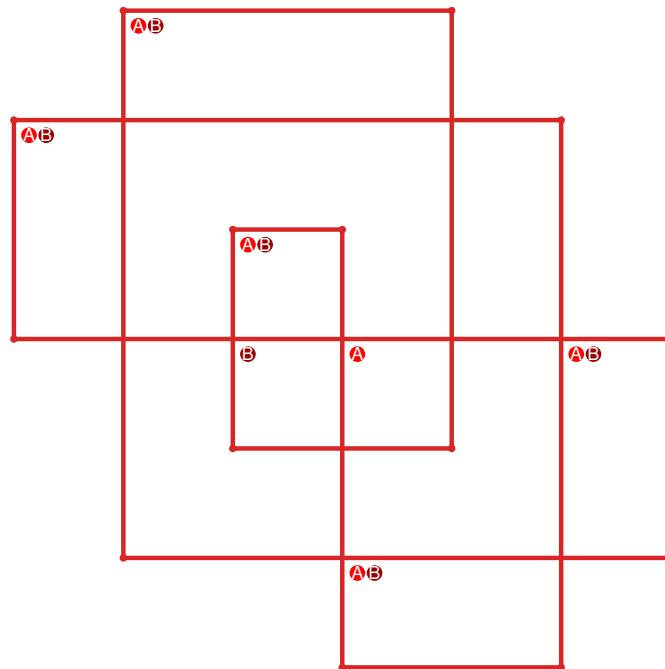


Figure 1353: SnapPy multiloop plot.

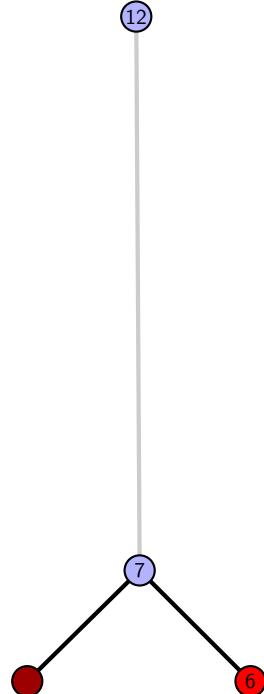


Figure 1354: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.380 `[[14, 20, 1, 15], [15, 13, 16, 14], [7, 19, 8, 20], [1, 11, 2, 10], [3, 12, 4, 13], [16, 4, 17, 5], [18, 6, 19, 7], [8, 12, 9, 11], [2, 9, 3, 10], [17, 6, 18, 5]]`

PD code drawn by `SnapPy`: `[(14, 15, 1, 16), (16, 1, 17, 2), (11, 4, 12, 5), (5, 10, 6, 11), (6, 3, 7, 4), (12, 7, 13, 8), (19, 8, 20, 9), (20, 13, 15, 14), (2, 17, 3, 18), (9, 18, 10, 19)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 7, 8, 8], [1, 8, 7, 5], [1, 4, 9, 9], [2, 9, 9, 2], [2, 4, 8, 3], [3, 7, 4, 3], [5, 6, 6, 5]]`

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 676: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

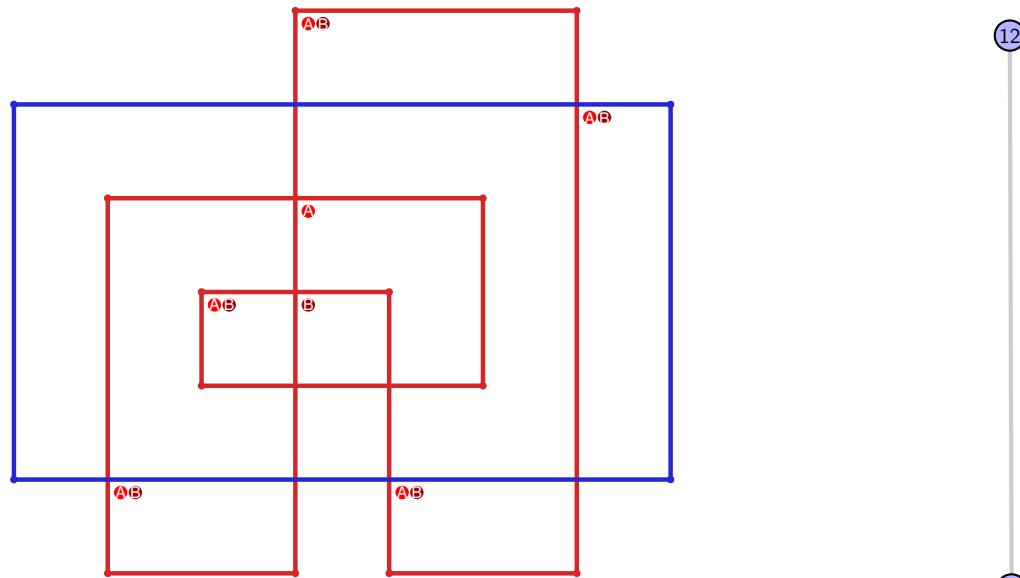


Figure 1355: `SnapPy` multiloop plot.

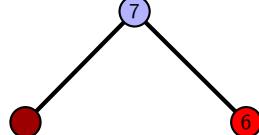


Figure 1356: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.381 $[[6, 20, 1, 7], [7, 5, 8, 6], [10, 19, 11, 20], [1, 14, 2, 13], [16, 4, 17, 5], [8, 17, 9, 18], [18, 9, 19, 10], [11, 15, 12, 14], [2, 12, 3, 13], [3, 15, 4, 16]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (13, 2, 14, 3), (10, 15, 11, 16), (5, 18, 6, 19), (19, 4, 20, 5), (20, 17, 7, 18), (6, 7, 1, 8), (14, 9, 15, 10), (16, 11, 17, 12), (3, 12, 4, 13)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 7, 8, 8], [1, 9, 9, 5], [1, 4, 6, 6], [2, 5, 5, 2], [2, 9, 8, 3], [3, 7, 9, 3], [4, 8, 7, 4]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 677: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

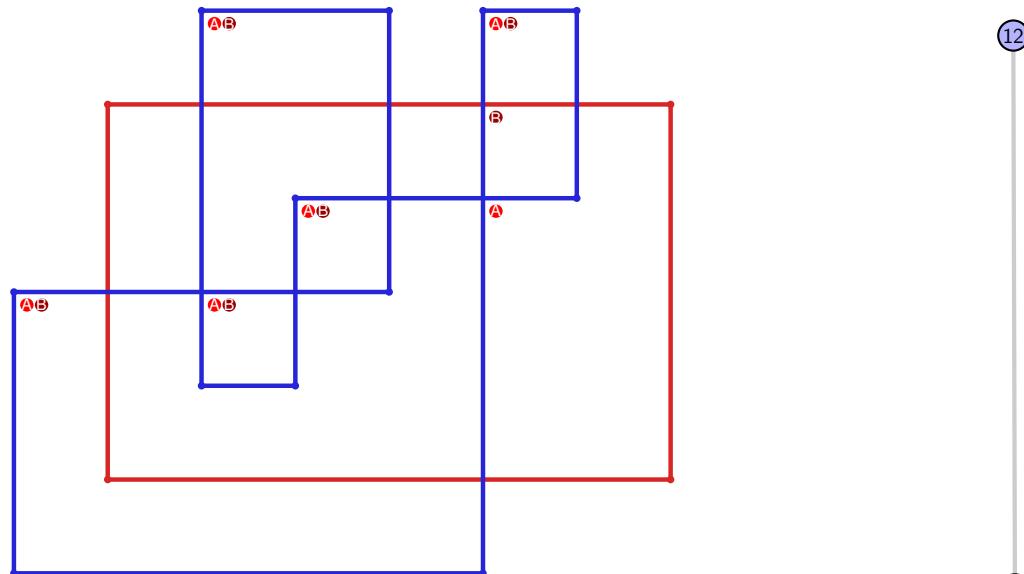


Figure 1357: SnapPy multiloop plot.

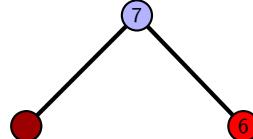


Figure 1358: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.382 $[[5, 10, 6, 1], [4, 20, 5, 11], [9, 19, 10, 20], [6, 17, 7, 16], [1, 13, 2, 14], [11, 3, 12, 4], [18, 8, 19, 9], [17, 8, 18, 7], [12, 15, 13, 16], [2, 15, 3, 14]]$

PD code drawn by `SnapPy`: $[(3, 18, 4, 19), (19, 4, 20, 5), (1, 6, 2, 7), (12, 9, 13, 10), (7, 14, 8, 15), (15, 8, 16, 9), (13, 16, 14, 17), (17, 2, 18, 3), (5, 20, 6, 11), (10, 11, 1, 12)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 7, 8], [0, 8, 9, 9], [1, 9, 8, 1], [2, 7, 7, 2], [3, 6, 6, 3], [3, 5, 9, 4], [4, 8, 5, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 678: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

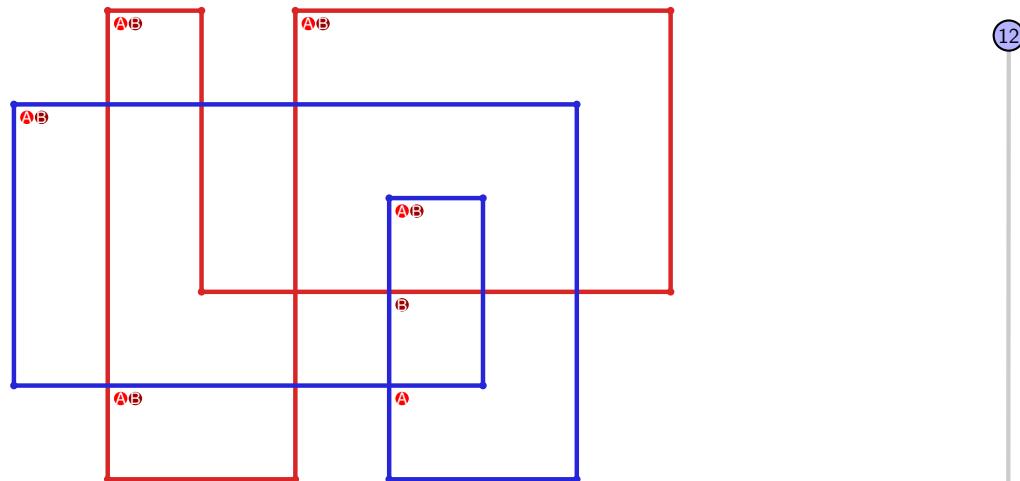


Figure 1359: `SnapPy` multiloop plot.

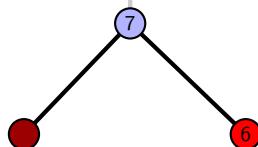


Figure 1360: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.383 $[[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [8, 1, 9, 2], [18, 12, 19, 11], [4, 15, 5, 16], [2, 7, 3, 8], [12, 3, 13, 4], [14, 5, 15, 6], [6, 13, 7, 14]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (12, 3, 13, 4), (20, 5, 1, 6), (18, 7, 19, 8), (9, 16, 10, 17), (4, 11, 5, 12), (2, 13, 3, 14), (17, 14, 18, 15), (15, 8, 16, 9), (6, 19, 7, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 7, 8, 8], [3, 9, 7, 3], [4, 6, 9, 5], [5, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 679: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

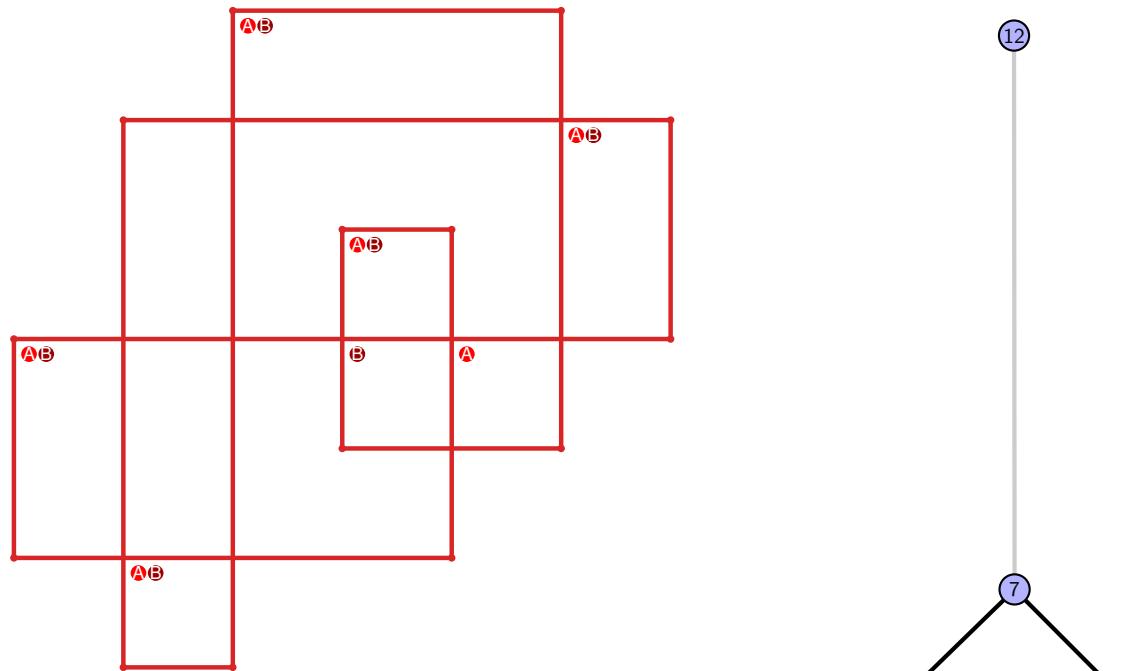


Figure 1361: SnapPy multiloop plot.

Figure 1362: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.384 $[[9, 20, 10, 1], [13, 8, 14, 9], [19, 10, 20, 11], [1, 6, 2, 7], [7, 12, 8, 13], [14, 12, 15, 11], [3, 18, 4, 19], [5, 16, 6, 17], [2, 16, 3, 15], [17, 4, 18, 5]]$

PD code drawn by `SnapPy`: $[(13, 20, 14, 1), (17, 2, 18, 3), (9, 4, 10, 5), (15, 6, 16, 7), (7, 10, 8, 11), (3, 8, 4, 9), (11, 18, 12, 19), (1, 12, 2, 13), (19, 14, 20, 15), (5, 16, 6, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 7, 8, 4], [1, 3, 5, 1], [1, 4, 8, 2], [2, 8, 9, 9], [3, 9, 9, 8], [3, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 680: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

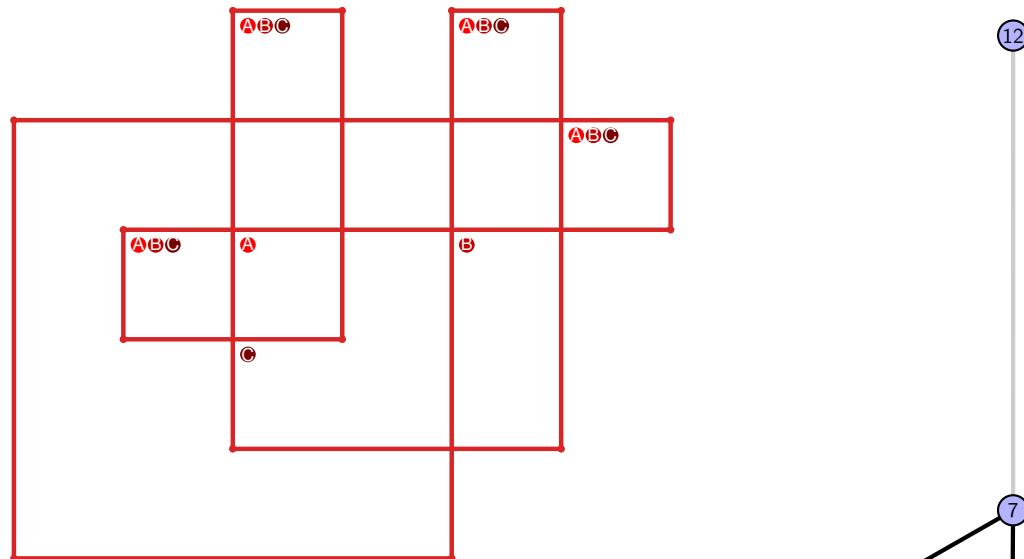


Figure 1363: `SnapPy` multiloop plot.

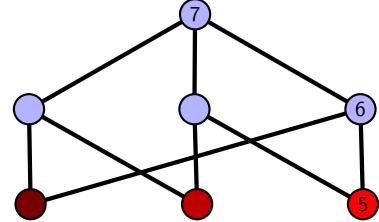


Figure 1364: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.385 $[[11, 20, 12, 1], [10, 17, 11, 18], [19, 16, 20, 17], [12, 6, 13, 5], [1, 8, 2, 9], [18, 9, 19, 10], [15, 6, 16, 7], [13, 4, 14, 5], [7, 2, 8, 3], [3, 14, 4, 15]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (2, 9, 3, 10), (12, 3, 13, 4), (18, 5, 19, 6), (15, 6, 16, 7), (20, 11, 1, 12), (16, 13, 17, 14), (7, 14, 8, 15), (8, 17, 9, 18), (4, 19, 5, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 8, 5], [1, 4, 2, 1], [2, 8, 9, 3], [3, 9, 9, 3], [4, 9, 6, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 681: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

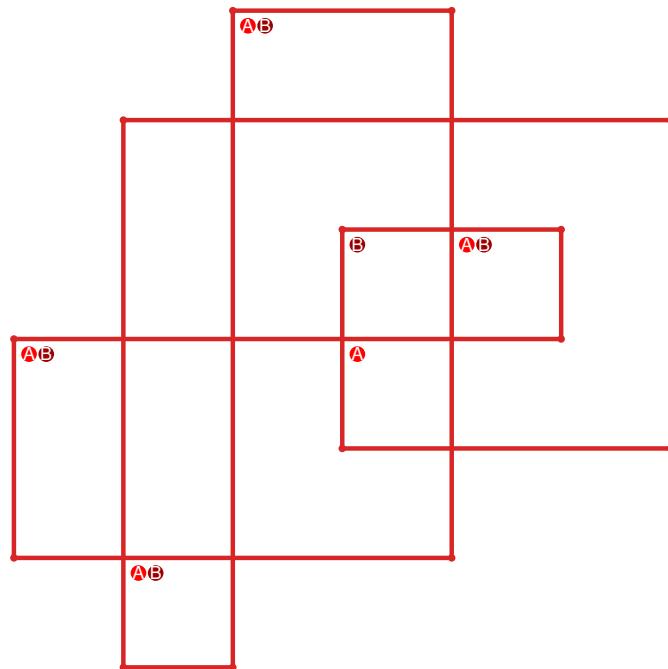


Figure 1365: SnapPy multiloop plot.

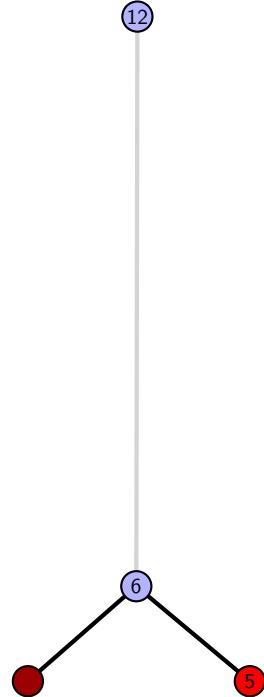


Figure 1366: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.386 [[20, 15, 1, 16], [16, 9, 17, 10], [10, 19, 11, 20], [3, 14, 4, 15], [1, 6, 2, 7], [8, 17, 9, 18], [18, 7, 19, 8], [11, 2, 12, 3], [13, 4, 14, 5], [5, 12, 6, 13]]

PD code drawn by SnapPy: [(9, 20, 10, 1), (17, 2, 18, 3), (14, 3, 15, 4), (12, 5, 13, 6), (1, 8, 2, 9), (19, 10, 20, 11), (16, 11, 17, 12), (4, 13, 5, 14), (6, 15, 7, 16), (7, 18, 8, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 8, 8], [0, 9, 7, 6], [1, 6, 6, 1], [2, 5, 5, 4], [2, 4, 9, 3], [3, 9, 9, 3], [4, 8, 8, 7]]

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 252
 Pinning number: 5

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 682: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	27	56	70	56	28	8	1	246
Average degree	2.33	2.65	2.86	3.0	3.11	3.2	3.27	3.33	

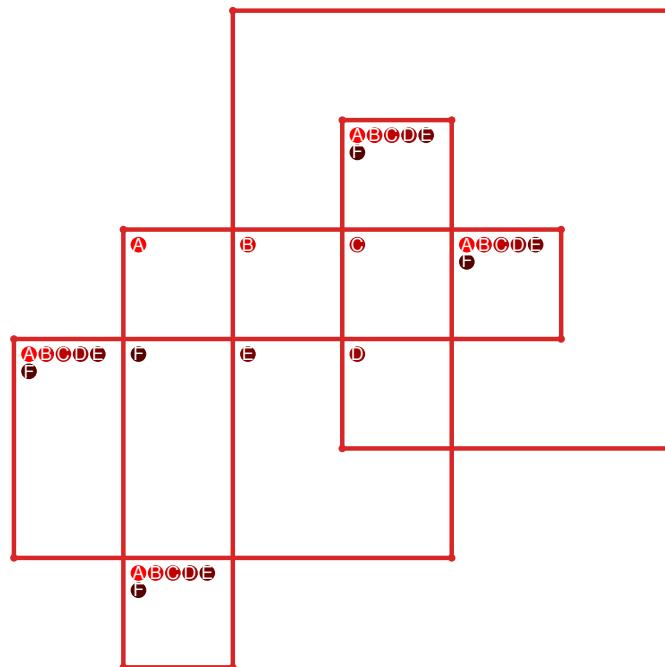


Figure 1367: SnapPy multiloop plot.

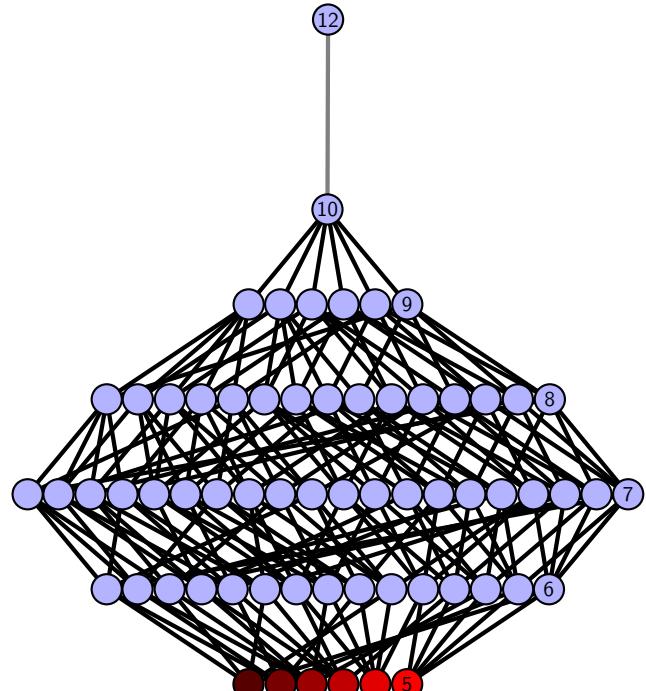


Figure 1368: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.387 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 8, 11, 7], [1, 12, 2, 13], [13, 18, 14, 19], [11, 6, 12, 7], [2, 15, 3, 16], [4, 17, 5, 18], [14, 5, 15, 6], [3, 17, 4, 16]]$

PD code drawn by `SnapPy`: $[(12, 3, 13, 4), (9, 4, 10, 5), (5, 8, 6, 9), (17, 6, 18, 7), (19, 10, 20, 11), (20, 13, 1, 14), (14, 1, 15, 2), (2, 15, 3, 16), (11, 16, 12, 17), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 7, 8], [2, 8, 3, 2], [3, 8, 9, 9], [4, 9, 9, 8], [4, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 683: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

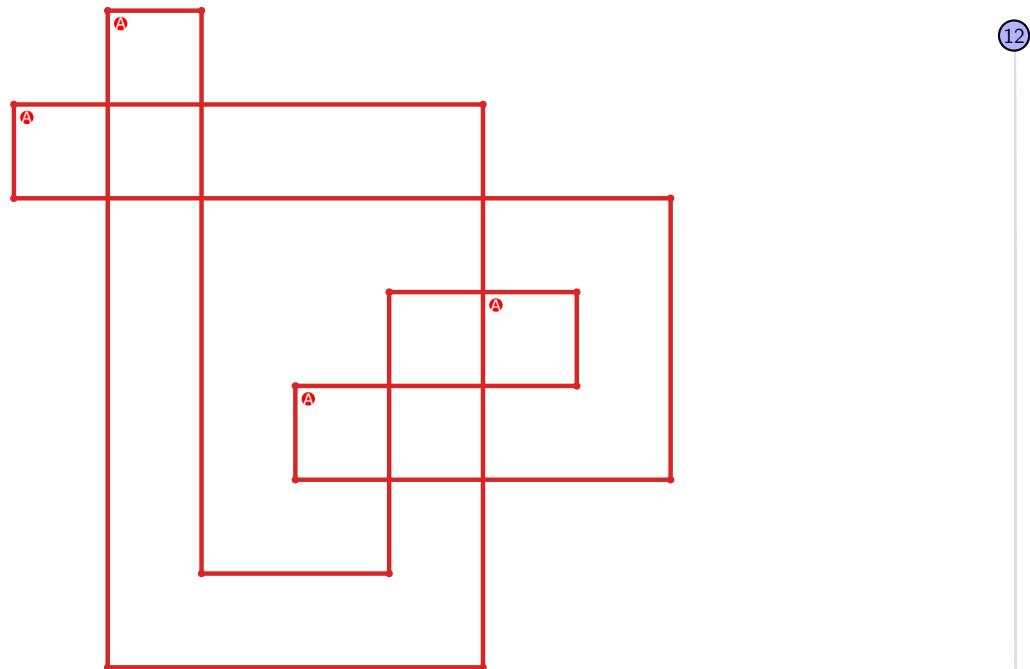


Figure 1369: `SnapPy` multiloop plot.

Figure 1370: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.388 [[14, 7, 1, 8], [8, 13, 9, 14], [9, 6, 10, 7], [1, 10, 2, 11], [12, 20, 13, 15], [5, 19, 6, 20], [2, 19, 3, 18], [11, 16, 12, 15], [16, 4, 17, 5], [3, 17, 4, 18]]

PD code drawn by SnapPy: [(15, 14, 16, 1), (5, 2, 6, 3), (10, 3, 11, 4), (11, 6, 12, 7), (4, 9, 5, 10), (13, 16, 14, 17), (17, 12, 18, 13), (1, 18, 2, 19), (8, 19, 9, 20), (20, 7, 15, 8)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 5], [2, 4, 8, 6], [3, 5, 9, 9], [3, 8, 4, 4], [5, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 684: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

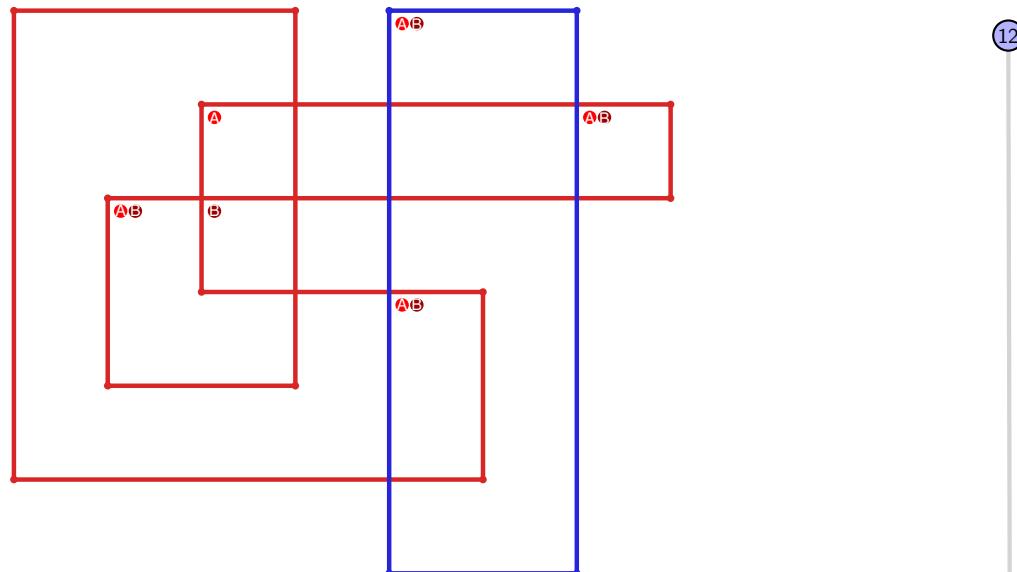


Figure 1371: SnapPy multiloop plot.

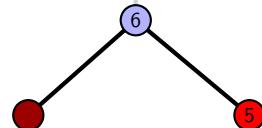


Figure 1372: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.389 $[[5, 10, 6, 1], [4, 20, 5, 11], [9, 17, 10, 18], [6, 17, 7, 16], [1, 13, 2, 14], [11, 3, 12, 4], [7, 19, 8, 20], [18, 8, 19, 9], [12, 15, 13, 16], [2, 15, 3, 14]]$

PD code drawn by SnapPy: $[(18, 1, 19, 2), (15, 6, 16, 7), (3, 8, 4, 9), (11, 10, 12, 1), (19, 12, 20, 13), (13, 4, 14, 5), (7, 14, 8, 15), (5, 16, 6, 17), (2, 17, 3, 18), (9, 20, 10, 11)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 3], [0, 2, 6, 8], [0, 8, 9, 9], [1, 9, 8, 1], [1, 3, 7, 7], [2, 6, 6, 2], [3, 5, 9, 4], [4, 8, 5, 4]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.98

Table 685: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

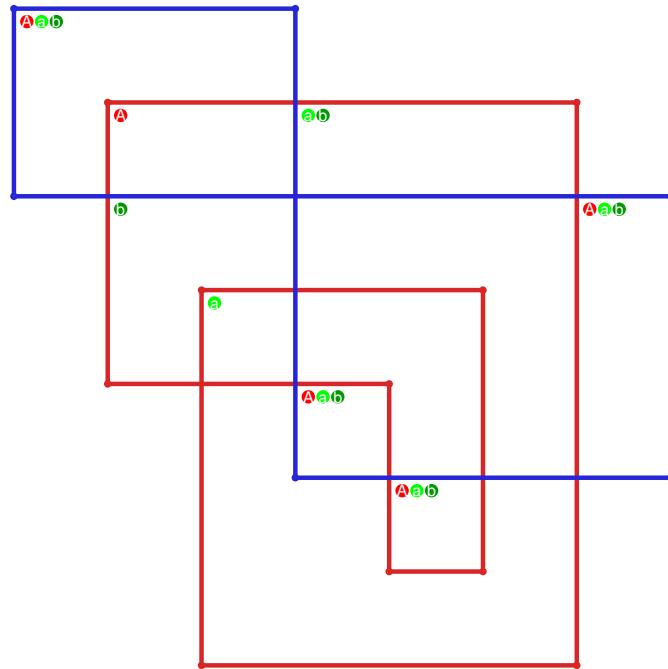


Figure 1373: SnapPy multiloop plot.

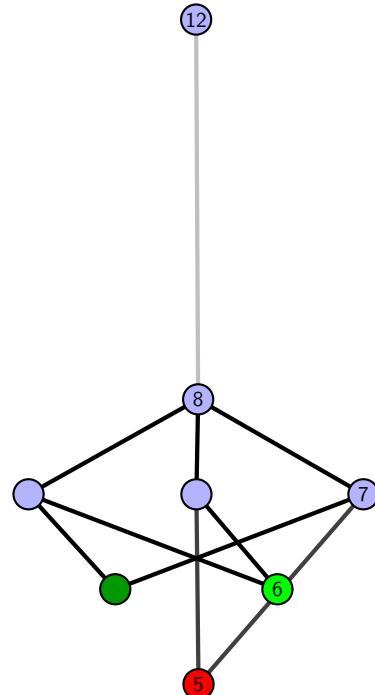


Figure 1374: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.390 $[[12, 20, 1, 13], [13, 10, 14, 9], [11, 8, 12, 9], [3, 19, 4, 20], [1, 16, 2, 15], [10, 15, 11, 14], [2, 7, 3, 8], [18, 4, 19, 5], [16, 6, 17, 7], [5, 17, 6, 18]]$

PD code drawn by SnapPy: $[(13, 12, 14, 1), (19, 2, 20, 3), (10, 3, 11, 4), (7, 4, 8, 5), (5, 16, 6, 17), (1, 20, 2, 13), (11, 14, 12, 15), (8, 15, 9, 16), (17, 6, 18, 7), (18, 9, 19, 10)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 8, 3], [3, 9, 9, 3], [4, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.98

Table 686: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

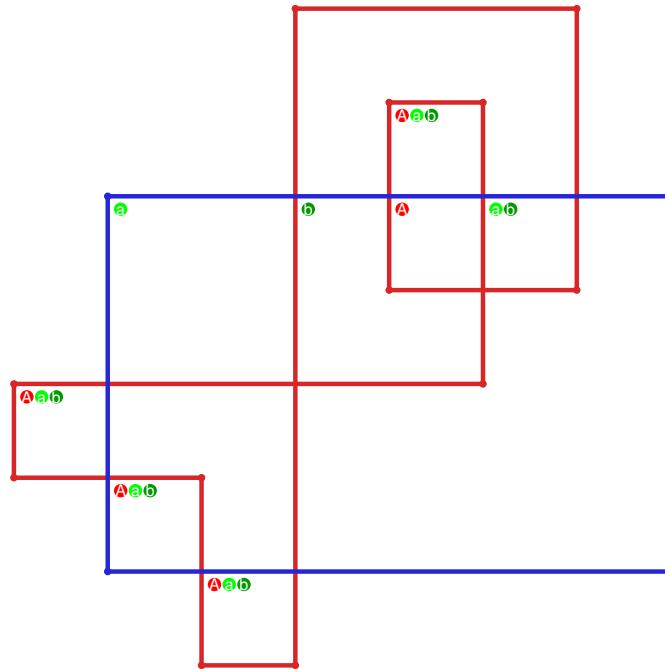


Figure 1375: SnapPy multiloop plot.

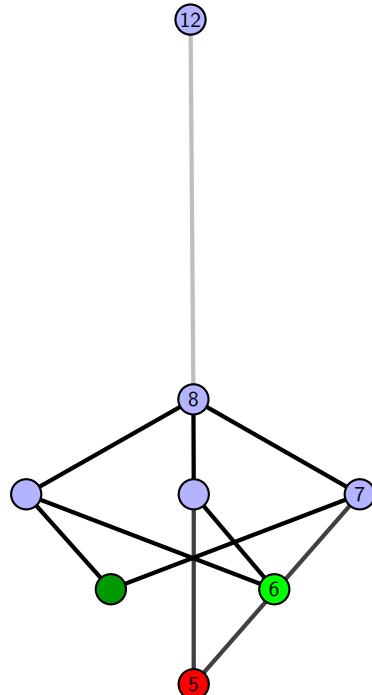


Figure 1376: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.391 $[[8, 20, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [19, 14, 20, 15], [1, 12, 2, 11], [6, 11, 7, 10], [3, 15, 4, 16], [13, 18, 14, 19], [12, 18, 13, 17], [2, 17, 3, 16]]$

PD code drawn by SnapPy: $[(5, 2, 6, 3), (3, 14, 4, 15), (15, 4, 16, 5), (16, 7, 17, 8), (12, 19, 13, 20), (1, 20, 2, 9), (9, 8, 10, 1), (10, 17, 11, 18), (18, 11, 19, 12), (6, 13, 7, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 9, 5], [1, 4, 2, 1], [2, 9, 9, 3], [3, 8, 8, 3], [4, 7, 7, 9], [4, 8, 6, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 687: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

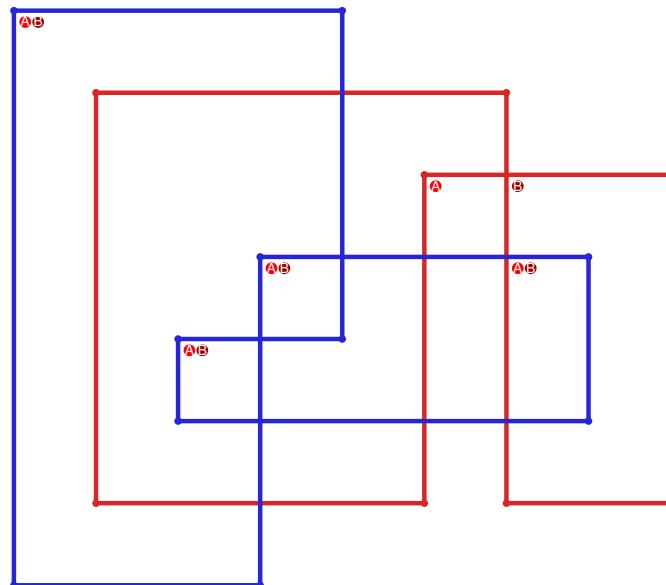


Figure 1377: SnapPy multiloop plot.

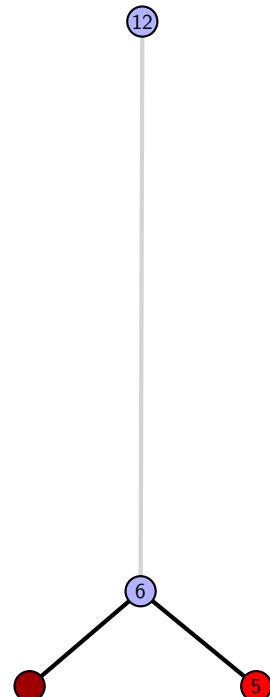


Figure 1378: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.392 $[[12, 20, 1, 13], [13, 10, 14, 9], [11, 8, 12, 9], [3, 19, 4, 20], [1, 16, 2, 15], [10, 15, 11, 14], [2, 7, 3, 8], [18, 6, 19, 7], [4, 17, 5, 16], [5, 17, 6, 18]]$

PD code drawn by SnapPy: $[(15, 4, 16, 5), (12, 5, 1, 6), (9, 6, 10, 7), (7, 18, 8, 19), (19, 8, 20, 9), (20, 11, 13, 12), (13, 2, 14, 3), (3, 14, 4, 15), (1, 16, 2, 17), (10, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 7, 3], [3, 6, 9, 9], [3, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 352
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.42
 Average overall degree: 3.04

Table 688: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	39	81	100	76	35	9	1	349
Average degree	2.25	2.56	2.79	2.95	3.08	3.17	3.24	3.29	3.33	

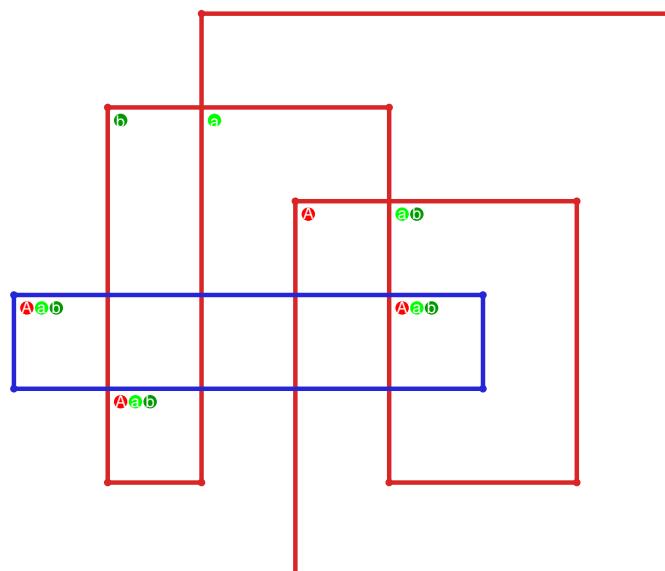


Figure 1379: SnapPy multiloop plot.

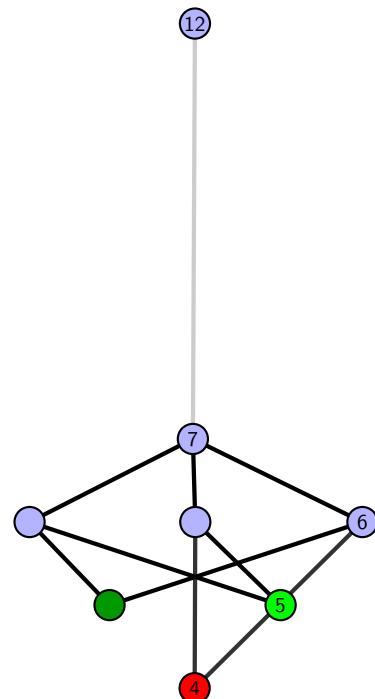


Figure 1380: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.393 [[11, 20, 12, 1], [10, 17, 11, 18], [19, 16, 20, 17], [12, 3, 13, 4], [1, 8, 2, 9], [18, 9, 19, 10], [2, 15, 3, 16], [13, 6, 14, 7], [4, 7, 5, 8], [5, 14, 6, 15]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (11, 4, 12, 5), (2, 5, 3, 6), (19, 6, 20, 7), (16, 7, 17, 8), (3, 12, 4, 13), (20, 13, 1, 14), (17, 14, 18, 15), (8, 15, 9, 16), (9, 18, 10, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 9, 3], [3, 9, 9, 8], [3, 7, 9, 4], [6, 8, 7, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 8
 Total pinning sets: 556
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.73
 Average overall degree: 3.11

Table 689: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	0	6
Nonminimal pinning sets	0	16	78	142	154	104	43	10	1	548
Average degree	2.5	2.76	2.94	3.07	3.16	3.23	3.27	3.31	3.33	

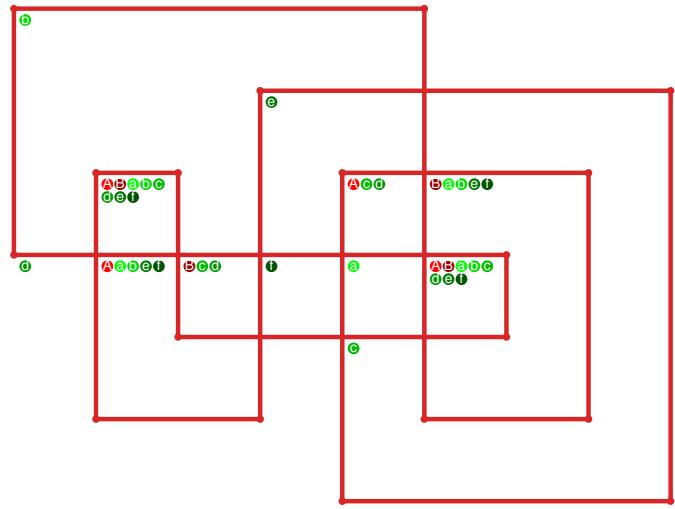


Figure 1381: SnapPy multiloop plot.

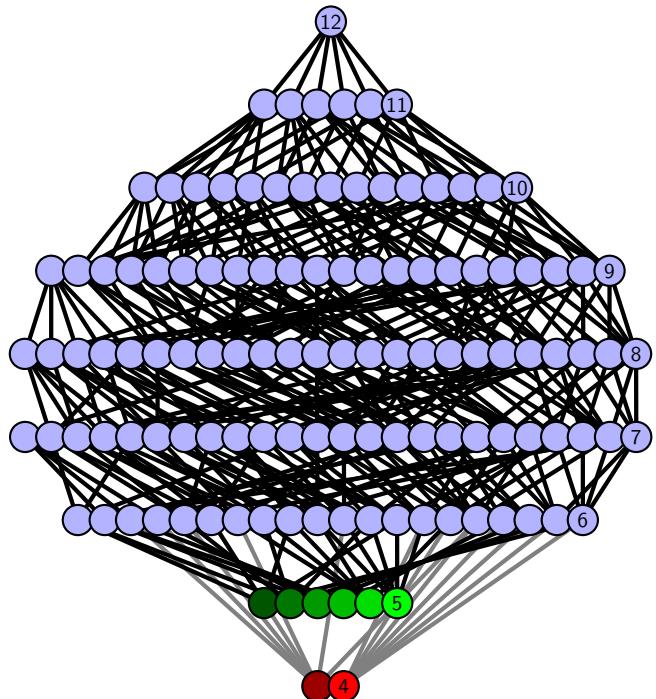


Figure 1382: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.394 $[[9, 20, 10, 1], [8, 17, 9, 18], [19, 16, 20, 17], [10, 3, 11, 4], [1, 6, 2, 7], [18, 7, 19, 8], [2, 15, 3, 16], [11, 15, 12, 14], [4, 14, 5, 13], [5, 12, 6, 13]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (19, 4, 20, 5), (16, 5, 17, 6), (3, 10, 4, 11), (11, 2, 12, 3), (12, 9, 13, 10), (20, 13, 1, 14), (17, 14, 18, 15), (6, 15, 7, 16), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 9, 6, 5], [1, 4, 2, 1], [2, 4, 7, 3], [3, 6, 9, 8], [3, 7, 9, 9], [4, 8, 8, 7]]$

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 432
 Pinning number: 5

Average optimal degree: 2.68
 Average minimal degree: 2.68
 Average overall degree: 3.11

Table 690: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	44	102	129	96	42	10	1	424
Average degree	2.68	2.89	3.03	3.14	3.22	3.27	3.31	3.33	

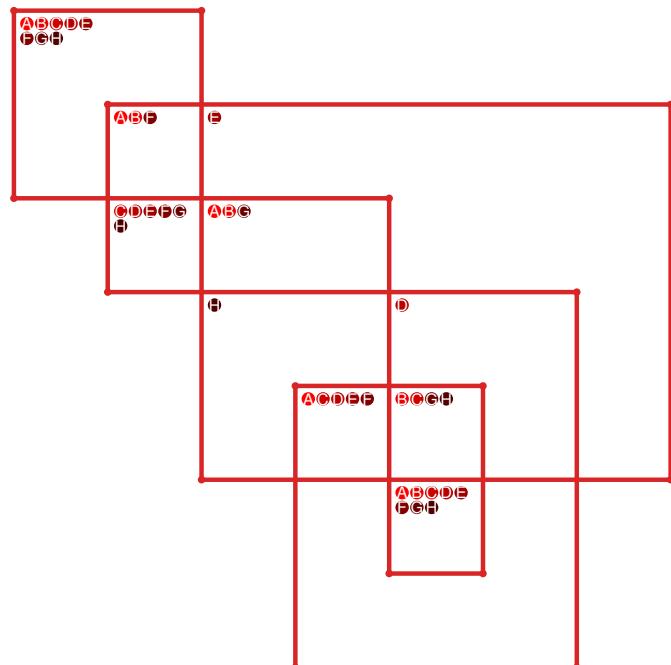


Figure 1383: `SnapPy` multiloop plot.

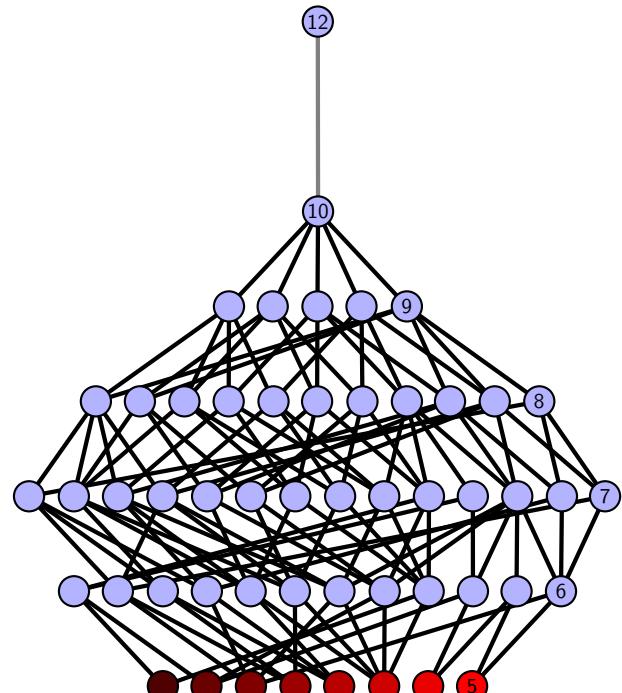


Figure 1384: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.395 `[[10, 20, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [16, 19, 17, 20], [1, 14, 2, 13], [8, 13, 9, 12], [15, 5, 16, 6], [18, 4, 19, 5], [17, 4, 18, 3], [14, 3, 15, 2]]`

PD code drawn by `SnapPy`: `[(10, 11, 1, 12), (1, 14, 2, 15), (15, 2, 16, 3), (12, 3, 13, 4), (7, 4, 8, 5), (5, 18, 6, 19), (19, 6, 20, 7), (20, 9, 11, 10), (13, 16, 14, 17), (8, 17, 9, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 9, 9, 5], [1, 4, 2, 1], [2, 9, 7, 3], [3, 6, 8, 8], [3, 7, 7, 9], [4, 8, 6, 4]]`

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.47

Total pinning sets: 272

Average overall degree: 3.04

Pinning number: 5

Table 691: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

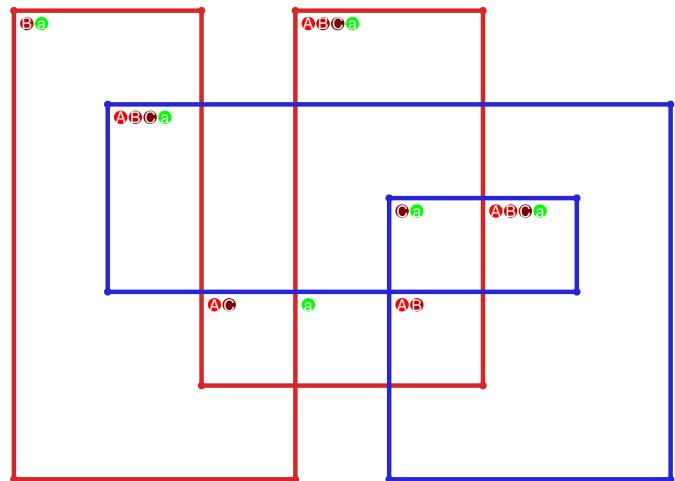


Figure 1385: `SnapPy` multiloop plot.

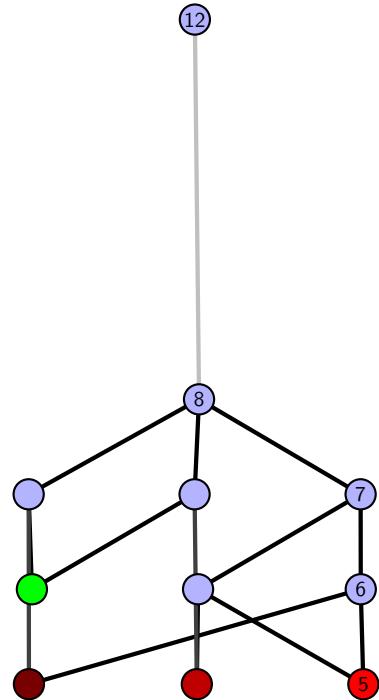


Figure 1386: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.396 $[[8, 20, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [16, 19, 17, 20], [1, 12, 2, 11], [6, 11, 7, 10], [15, 3, 16, 4], [18, 13, 19, 14], [17, 13, 18, 12], [2, 14, 3, 15]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (5, 2, 6, 3), (3, 16, 4, 17), (17, 4, 18, 5), (18, 7, 19, 8), (19, 12, 20, 13), (13, 20, 14, 9), (8, 9, 1, 10), (11, 14, 12, 15), (6, 15, 7, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 8, 9, 5], [1, 4, 2, 1], [2, 9, 9, 3], [3, 9, 8, 8], [3, 7, 7, 4], [4, 7, 6, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 6
 Total pinning sets: 380
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.51
 Average overall degree: 3.04

Table 692: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	0	5
Nonminimal pinning sets	0	8	48	91	105	77	35	9	1	374
Average degree	2.25	2.57	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

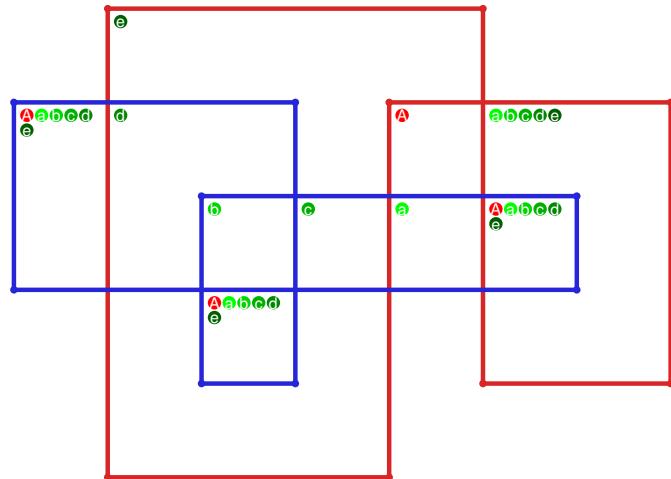


Figure 1387: SnapPy multiloop plot.

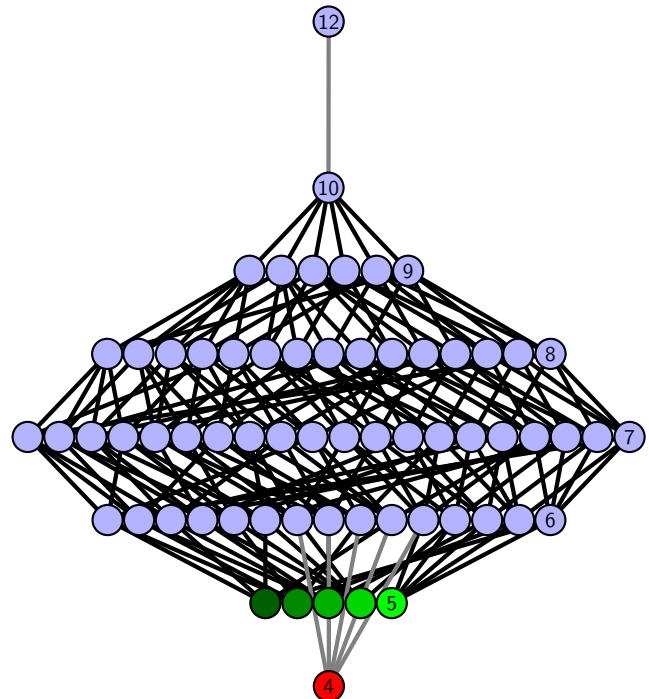


Figure 1388: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.397 [[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [3, 8, 4, 9], [1, 13, 2, 12], [18, 12, 19, 11], [2, 15, 3, 16], [7, 4, 8, 5], [13, 7, 14, 6], [14, 5, 15, 6]]

PD code drawn by `SnapPy`: [(3, 20, 4, 1), (10, 1, 11, 2), (2, 9, 3, 10), (19, 4, 20, 5), (16, 5, 17, 6), (7, 14, 8, 15), (8, 17, 9, 18), (18, 11, 19, 12), (15, 12, 16, 13), (13, 6, 14, 7)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 9, 3], [3, 9, 8, 3], [4, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 368
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.46
 Average overall degree: 3.04

Table 693: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	43	87	104	77	35	9	1	364
Average degree	2.25	2.56	2.79	2.96	3.08	3.17	3.24	3.29	3.33	

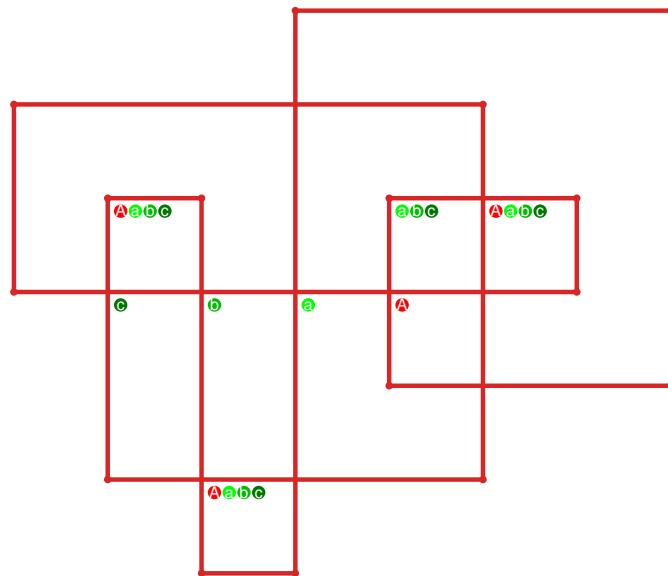


Figure 1389: `SnapPy` multiloop plot.

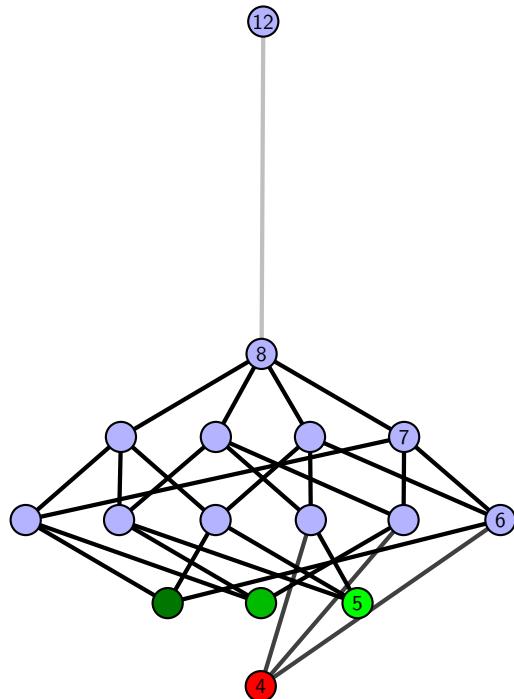


Figure 1390: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.398 $[[5, 20, 6, 1], [4, 17, 5, 18], [19, 16, 20, 17], [6, 10, 7, 9], [1, 13, 2, 12], [18, 3, 19, 4], [15, 10, 16, 11], [7, 15, 8, 14], [8, 13, 9, 14], [2, 11, 3, 12]]$

PD code drawn by `SnapPy`: $[(16, 1, 17, 2), (7, 4, 8, 5), (13, 8, 14, 9), (20, 9, 1, 10), (10, 19, 11, 20), (6, 11, 7, 12), (12, 5, 13, 6), (17, 14, 18, 15), (2, 15, 3, 16), (3, 18, 4, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 8, 9, 9], [1, 9, 2, 1], [2, 9, 7, 3], [3, 6, 8, 8], [3, 7, 7, 4], [4, 6, 5, 4]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 272
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 3.04

Table 694: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

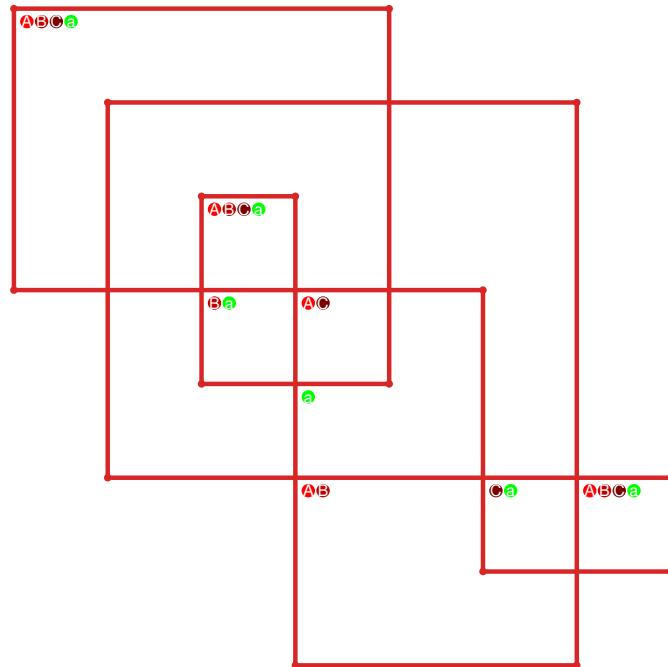


Figure 1391: `SnapPy` multiloop plot.

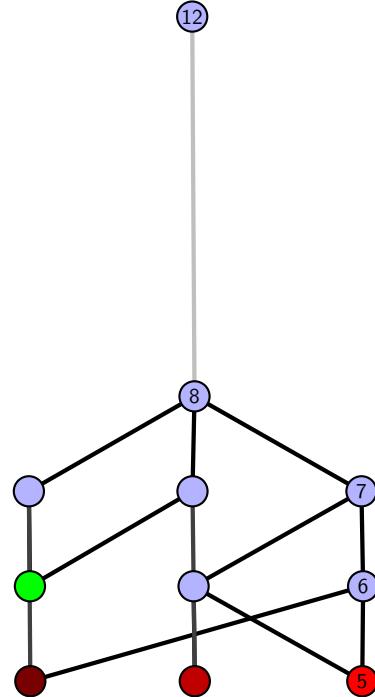


Figure 1392: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.399 $[[16, 7, 1, 8], [8, 3, 9, 4], [15, 20, 16, 17], [6, 13, 7, 14], [1, 10, 2, 11], [11, 2, 12, 3], [9, 12, 10, 13], [4, 18, 5, 17], [19, 14, 20, 15], [5, 18, 6, 19]]$

PD code drawn by `SnapPy`: $[(9, 16, 10, 1), (6, 1, 7, 2), (14, 5, 15, 6), (15, 8, 16, 9), (7, 10, 8, 11), (4, 11, 5, 12), (19, 12, 20, 13), (3, 18, 4, 19), (13, 20, 14, 17), (17, 2, 18, 3)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 8, 8], [0, 8, 9, 6], [0, 6, 5, 5], [1, 4, 4, 6], [1, 5, 4, 3], [1, 9, 9, 2], [2, 9, 3, 2], [3, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 7

Average minimal degree: 2.55

Total pinning sets: 382

Average overall degree: 3.04

Pinning number: 4

Table 695: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	0	6
Nonminimal pinning sets	0	8	49	91	105	77	35	9	1	375
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

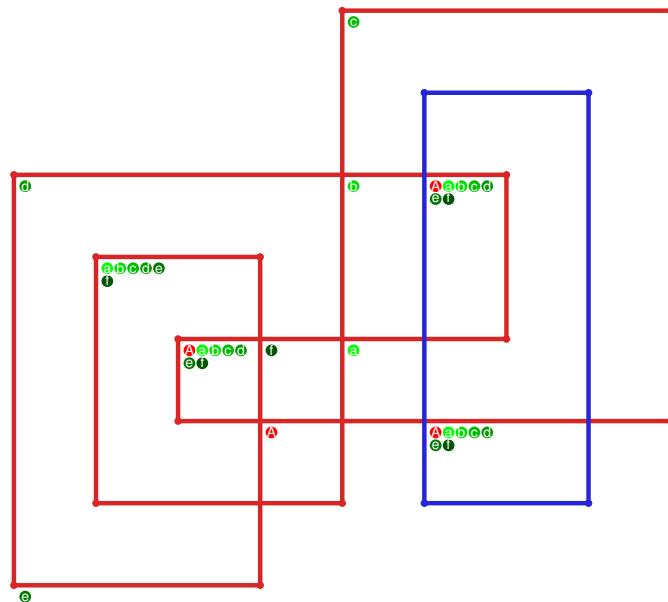


Figure 1393: `SnapPy` multiloop plot.

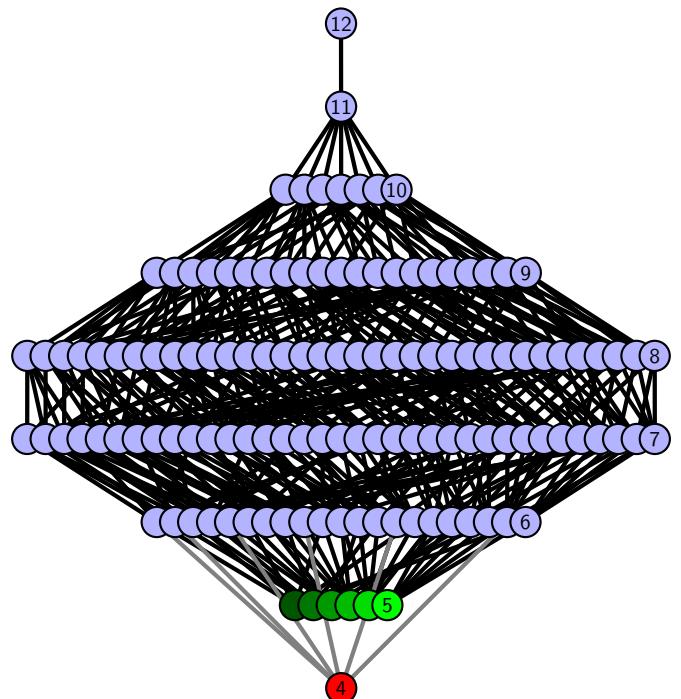


Figure 1394: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.400 $[[5, 20, 6, 1], [4, 11, 5, 12], [8, 19, 9, 20], [6, 18, 7, 17], [1, 14, 2, 15], [12, 3, 13, 4], [7, 10, 8, 11], [18, 9, 19, 10], [13, 16, 14, 17], [2, 16, 3, 15]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (15, 6, 16, 7), (4, 7, 5, 8), (1, 8, 2, 9), (18, 11, 19, 12), (12, 19, 13, 20), (10, 13, 11, 14), (14, 3, 15, 4), (5, 16, 6, 17), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 7, 6, 8], [0, 8, 9, 9], [1, 9, 8, 1], [1, 3, 7, 2], [2, 6, 3, 2], [3, 5, 9, 4], [4, 8, 5, 4]]$

Total optimal pinning sets: 4

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.4

Total pinning sets: 288

Average overall degree: 3.03

Pinning number: 5

Table 696: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

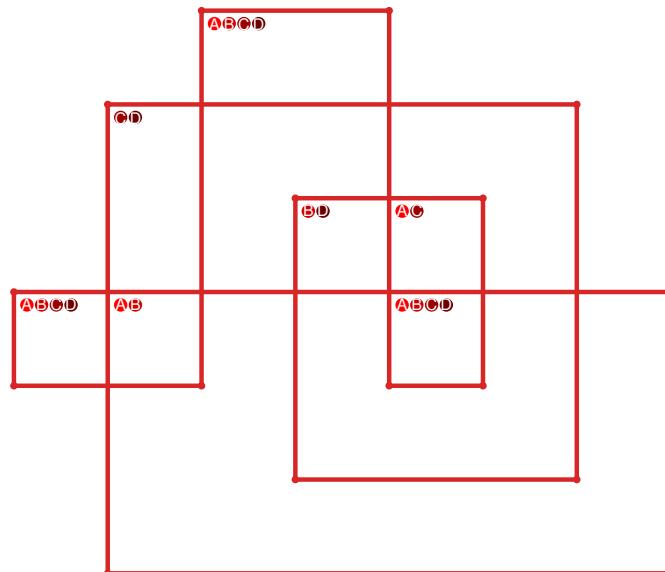


Figure 1395: SnapPy multiloop plot.

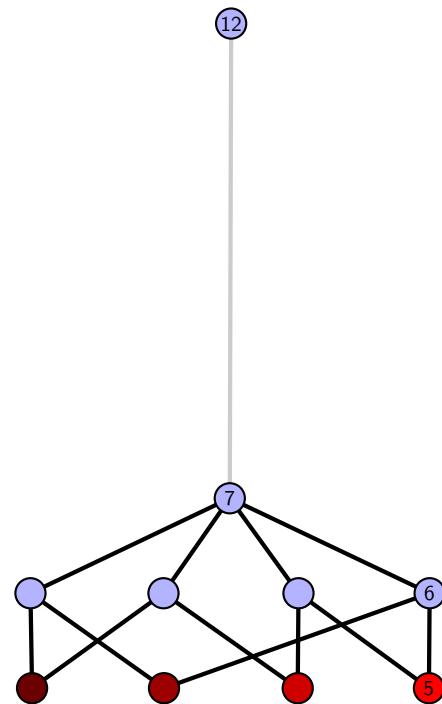


Figure 1396: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.401 $[[6, 20, 1, 7], [7, 17, 8, 16], [19, 5, 20, 6], [1, 10, 2, 9], [17, 9, 18, 8], [18, 15, 19, 16], [12, 4, 13, 5], [10, 13, 11, 14], [2, 14, 3, 15], [3, 11, 4, 12]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (15, 2, 16, 3), (20, 9, 7, 10), (5, 10, 6, 11), (14, 11, 15, 12), (12, 17, 13, 18), (3, 16, 4, 17), (18, 13, 19, 14), (19, 4, 20, 5), (6, 7, 1, 8)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 7, 8, 4], [1, 3, 5, 1], [1, 4, 8, 2], [2, 9, 9, 7], [3, 6, 9, 8], [3, 7, 9, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 288
 Pinning number: 5

Average optimal degree: 2.45
 Average minimal degree: 2.45
 Average overall degree: 3.04

Table 697: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.45	2.72	2.91	3.05	3.16	3.24	3.29	3.33	

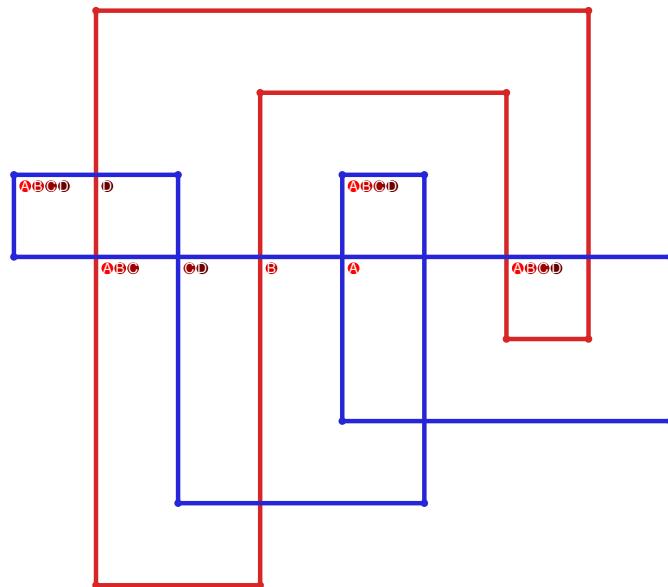


Figure 1397: SnapPy multiloop plot.

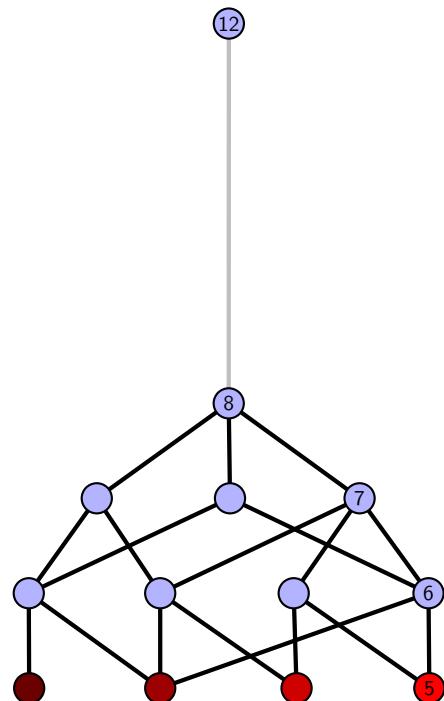


Figure 1398: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.402 [[12, 20, 1, 13], [13, 10, 14, 9], [11, 8, 12, 9], [5, 19, 6, 20], [1, 16, 2, 15], [10, 15, 11, 14], [17, 7, 18, 8], [18, 4, 19, 5], [6, 4, 7, 3], [16, 3, 17, 2]]

PD code drawn by SnapPy: [(12, 13, 1, 14), (1, 4, 2, 5), (15, 2, 16, 3), (14, 5, 15, 6), (9, 6, 10, 7), (7, 18, 8, 19), (19, 8, 20, 9), (20, 11, 13, 12), (3, 16, 4, 17), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 9, 9, 5], [1, 4, 2, 1], [2, 9, 8, 7], [3, 6, 8, 3], [3, 7, 6, 9], [4, 8, 6, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 698: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

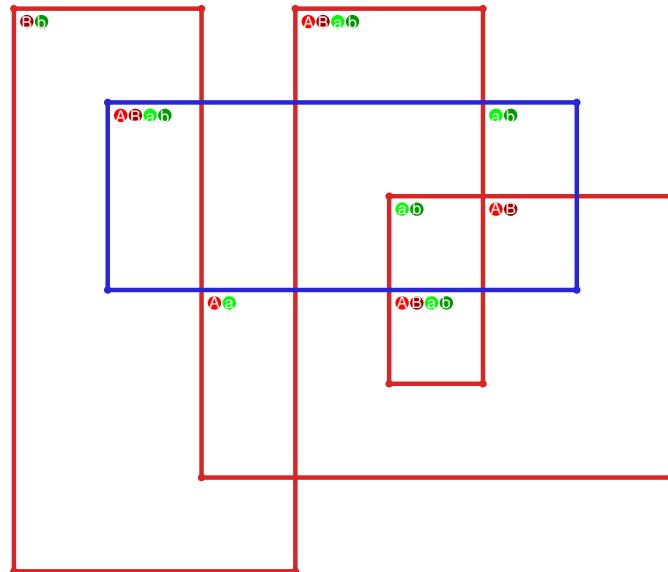


Figure 1399: SnapPy multiloop plot.

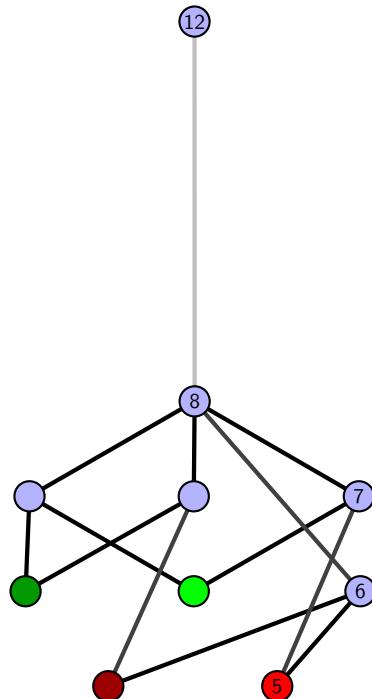


Figure 1400: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.403 [[20, 5, 1, 6], [6, 9, 7, 10], [10, 19, 11, 20], [4, 13, 5, 14], [1, 16, 2, 17], [17, 8, 18, 9], [7, 18, 8, 19], [11, 2, 12, 3], [14, 3, 15, 4], [15, 12, 16, 13]]

PD code drawn by `SnapPy`: [(9, 20, 10, 1), (12, 1, 13, 2), (18, 3, 19, 4), (15, 6, 16, 7), (4, 7, 5, 8), (13, 10, 14, 11), (2, 11, 3, 12), (19, 14, 20, 15), (5, 16, 6, 17), (8, 17, 9, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 8, 8, 9], [0, 9, 7, 5], [1, 4, 6, 6], [1, 5, 5, 2], [2, 4, 9, 8], [3, 7, 9, 3], [3, 8, 7, 4]]

Total optimal pinning sets: 6
 Total minimal pinning sets: 7
 Total pinning sets: 384
 Pinning number: 5

Average optimal degree: 2.67
 Average minimal degree: 2.67
 Average overall degree: 3.11

Table 699: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	34	86	115	90	41	10	1	377
Average degree	2.67	2.87	3.01	3.12	3.21	3.27	3.31	3.33	

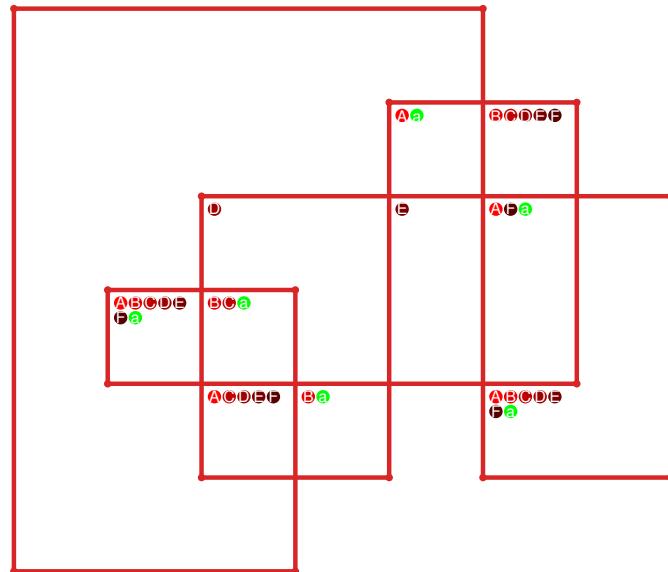


Figure 1401: `SnapPy` multiloop plot.

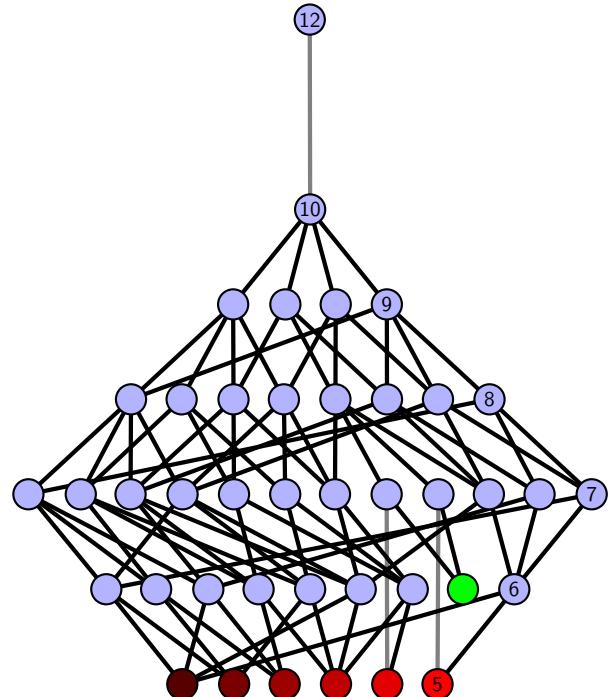


Figure 1402: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.404 [[10, 5, 1, 6], [6, 11, 7, 20], [9, 19, 10, 20], [16, 4, 17, 5], [1, 14, 2, 13], [11, 8, 12, 7], [12, 8, 13, 9], [2, 18, 3, 19], [3, 15, 4, 16], [17, 15, 18, 14]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (7, 2, 8, 3), (4, 17, 5, 18), (18, 5, 19, 6), (19, 8, 20, 9), (20, 13, 11, 14), (10, 11, 1, 12), (9, 14, 10, 15), (6, 15, 7, 16), (16, 3, 17, 4)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 8, 8, 9], [0, 9, 7, 6], [1, 6, 6, 1], [2, 5, 5, 4], [2, 4, 9, 8], [3, 7, 9, 3], [3, 8, 7, 4]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 320
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.33
 Average overall degree: 3.03

Table 700: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

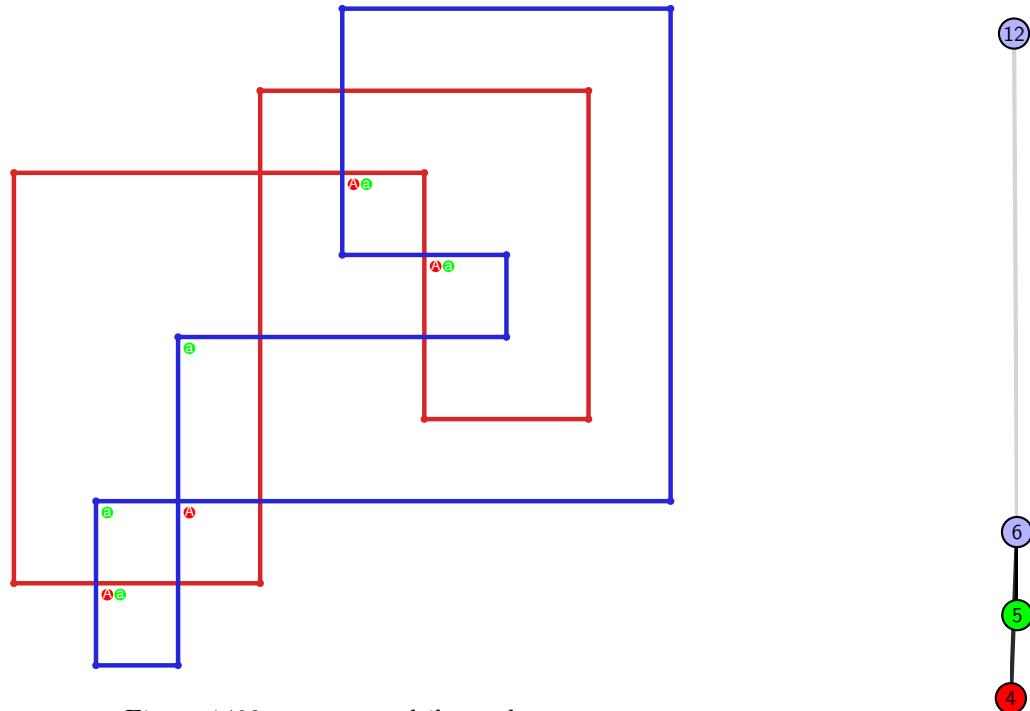


Figure 1403: SnapPy multiloop plot.

Figure 1404: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.405 $[[20, 9, 1, 10], [10, 19, 11, 20], [11, 8, 12, 9], [1, 7, 2, 6], [18, 5, 19, 6], [7, 12, 8, 13], [2, 16, 3, 15], [17, 14, 18, 15], [4, 13, 5, 14], [16, 4, 17, 3]]$

PD code drawn by SnapPy: $[(20, 13, 1, 14), (15, 2, 16, 3), (3, 18, 4, 19), (8, 5, 9, 6), (17, 6, 18, 7), (4, 9, 5, 10), (1, 10, 2, 11), (14, 11, 15, 12), (12, 19, 13, 20), (7, 16, 8, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 7, 8], [2, 8, 3, 2], [3, 9, 9, 7], [4, 6, 9, 8], [4, 7, 9, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 701: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

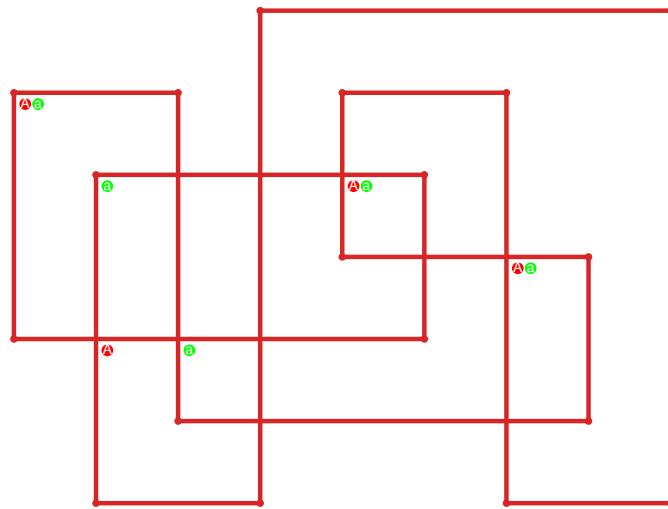


Figure 1405: SnapPy multiloop plot.



Figure 1406: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.406 [[20, 7, 1, 8], [8, 19, 9, 20], [9, 6, 10, 7], [1, 10, 2, 11], [11, 18, 12, 19], [12, 5, 13, 6], [2, 16, 3, 15], [17, 14, 18, 15], [4, 13, 5, 14], [16, 4, 17, 3]]

PD code drawn by `SnapPy`: [(1, 14, 2, 15), (10, 3, 11, 4), (7, 4, 8, 5), (18, 5, 19, 6), (19, 8, 20, 9), (2, 11, 3, 12), (15, 12, 16, 13), (13, 20, 14, 1), (9, 16, 10, 17), (6, 17, 7, 18)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 7, 5], [2, 4, 8, 8], [3, 9, 9, 7], [4, 6, 9, 8], [5, 7, 9, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.51

Total pinning sets: 280

Average overall degree: 3.04

Pinning number: 5

Table 702: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	19	58	84	70	34	9	1	275
Average degree	2.4	2.68	2.89	3.04	3.16	3.24	3.29	3.33	

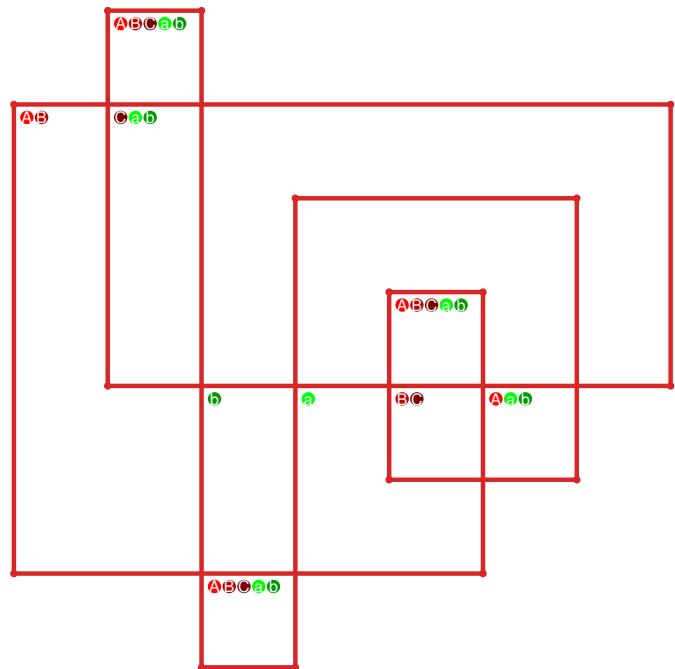


Figure 1407: `SnapPy` multiloop plot.

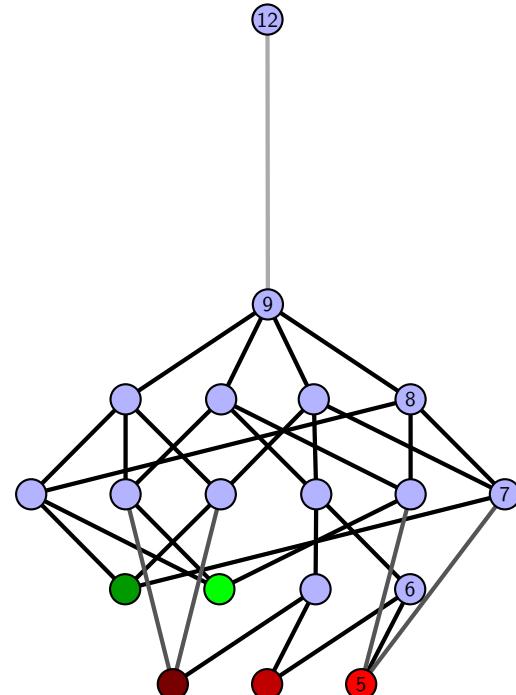


Figure 1408: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.407 `[[16, 20, 1, 17], [17, 15, 18, 16], [19, 7, 20, 8], [1, 7, 2, 6], [14, 5, 15, 6], [18, 9, 19, 8], [2, 12, 3, 11], [13, 10, 14, 11], [4, 9, 5, 10], [12, 4, 13, 3]]`

PD code drawn by `SnapPy`: `[(10, 1, 11, 2), (2, 13, 3, 14), (18, 3, 19, 4), (4, 17, 5, 18), (16, 5, 1, 6), (9, 6, 10, 7), (7, 14, 8, 15), (20, 11, 17, 12), (15, 8, 16, 9), (12, 19, 13, 20)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 7, 8], [1, 8, 2, 2], [3, 9, 9, 7], [4, 6, 9, 8], [4, 7, 9, 5], [6, 8, 7, 6]]`

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 304
 Pinning number: 5

Average optimal degree: 2.48
 Average minimal degree: 2.48
 Average overall degree: 3.04

Table 703: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	28	67	89	71	34	9	1	299
Average degree	2.48	2.74	2.93	3.06	3.16	3.24	3.29	3.33	

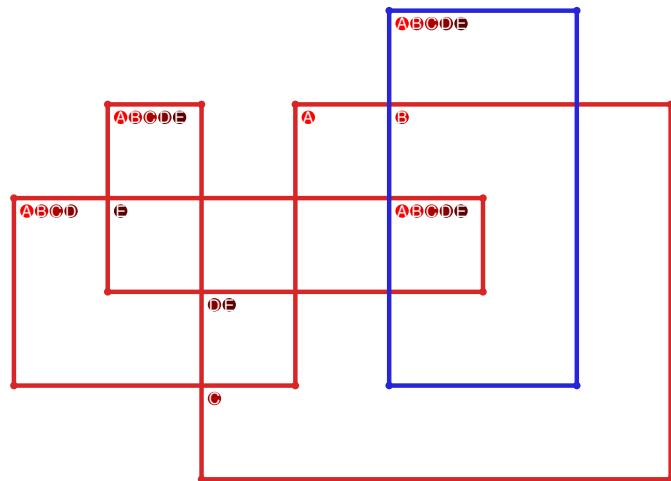


Figure 1409: `SnapPy` multiloop plot.

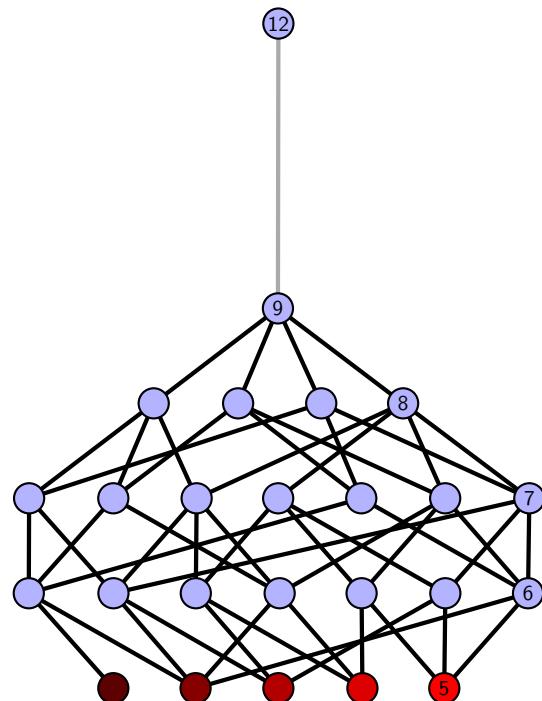


Figure 1410: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.408 [[20, 13, 1, 14], [14, 19, 15, 20], [15, 12, 16, 13], [1, 16, 2, 17], [18, 5, 19, 6], [11, 4, 12, 5], [2, 9, 3, 10], [17, 7, 18, 6], [7, 10, 8, 11], [8, 3, 9, 4]]

PD code drawn by SnapPy: [(7, 20, 8, 1), (14, 1, 15, 2), (2, 13, 3, 14), (18, 5, 19, 6), (3, 6, 4, 7), (11, 8, 12, 9), (16, 9, 17, 10), (17, 12, 18, 13), (10, 15, 11, 16), (4, 19, 5, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 5], [2, 4, 8, 9], [3, 9, 9, 8], [3, 8, 4, 4], [5, 7, 6, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 4
Total minimal pinning sets: 4
Total pinning sets: 288
Pinning number: 5

Average optimal degree: 2.4
Average minimal degree: 2.4
Average overall degree: 3.03

Table 704: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

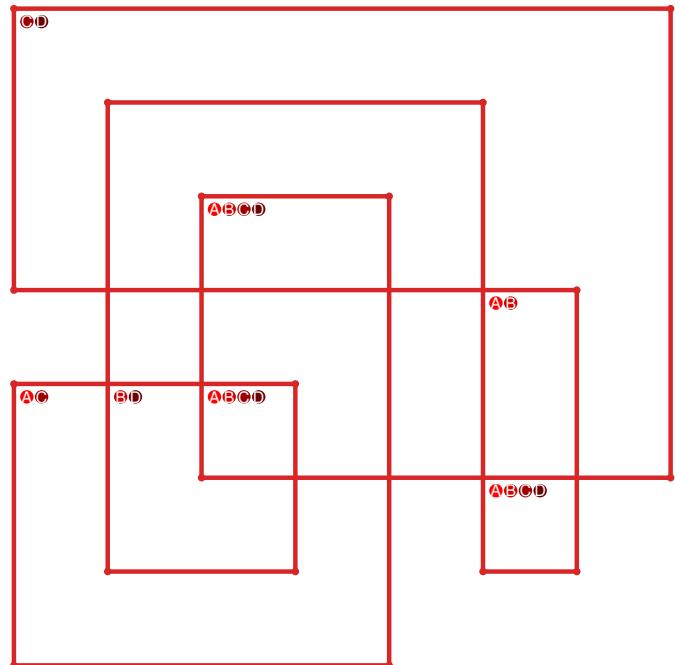


Figure 1411: SnapPy multiloop plot.

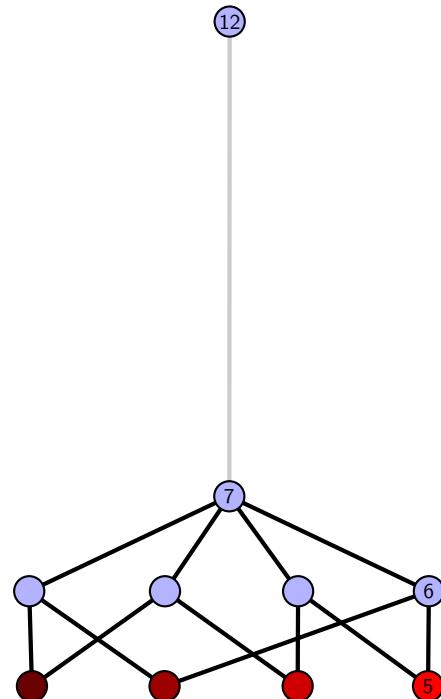


Figure 1412: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.409 $[[5, 20, 6, 1], [4, 9, 5, 10], [19, 16, 20, 17], [6, 16, 7, 15], [1, 12, 2, 13], [10, 3, 11, 4], [8, 17, 9, 18], [18, 7, 19, 8], [11, 14, 12, 15], [2, 14, 3, 13]]$

PD code drawn by `SnapPy`: $[(7, 20, 8, 1), (15, 4, 16, 5), (1, 6, 2, 7), (18, 9, 19, 10), (10, 19, 11, 20), (8, 11, 9, 12), (12, 3, 13, 4), (16, 13, 17, 14), (5, 14, 6, 15), (2, 17, 3, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 3], [0, 2, 7, 8], [0, 8, 9, 9], [1, 9, 8, 1], [1, 7, 7, 2], [2, 6, 6, 3], [3, 5, 9, 4], [4, 8, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.51

Total pinning sets: 224

Average overall degree: 3.04

Pinning number: 5

Table 705: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	7	39	67	63	33	9	1	219
Average degree	2.4	2.62	2.84	3.01	3.14	3.23	3.29	3.33	

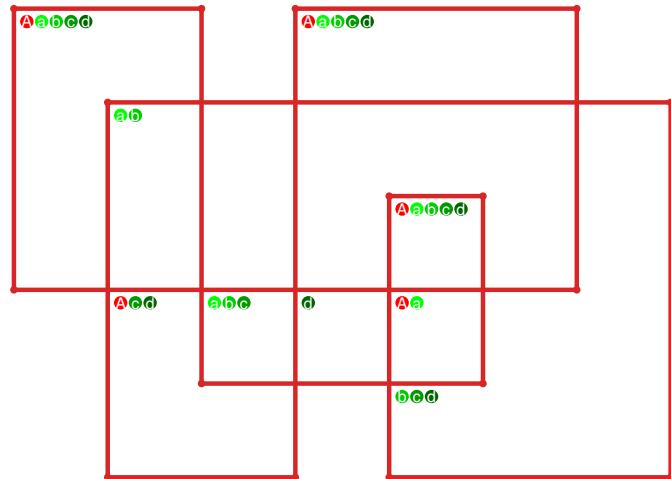


Figure 1413: `SnapPy` multiloop plot.

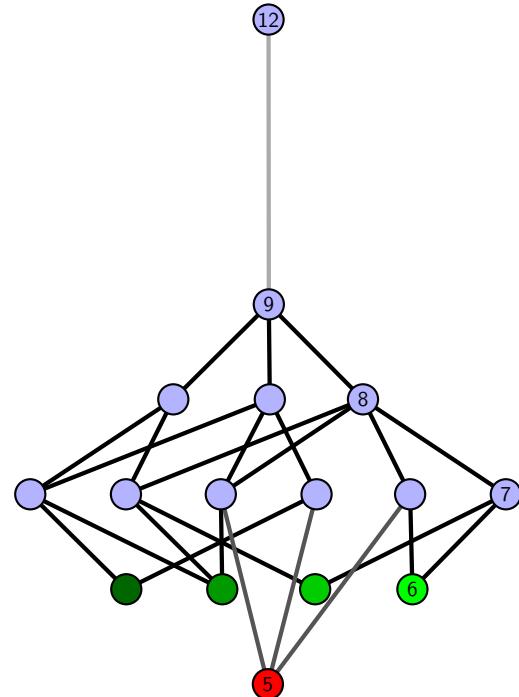


Figure 1414: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.410 $[[8, 20, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [14, 19, 15, 20], [1, 12, 2, 11], [6, 11, 7, 10], [17, 3, 18, 4], [18, 13, 19, 14], [15, 13, 16, 12], [2, 16, 3, 17]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (5, 2, 6, 3), (3, 14, 4, 15), (15, 4, 16, 5), (16, 7, 17, 8), (17, 20, 18, 9), (11, 18, 12, 19), (8, 9, 1, 10), (19, 12, 20, 13), (6, 13, 7, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 8, 9, 5], [1, 4, 2, 1], [2, 9, 9, 7], [3, 6, 8, 3], [3, 7, 9, 4], [4, 8, 6, 6]]$

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 360
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.05

Table 706: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	40	86	104	77	35	9	1	352
Average degree	2.5	2.77	2.96	3.08	3.17	3.24	3.29	3.33	

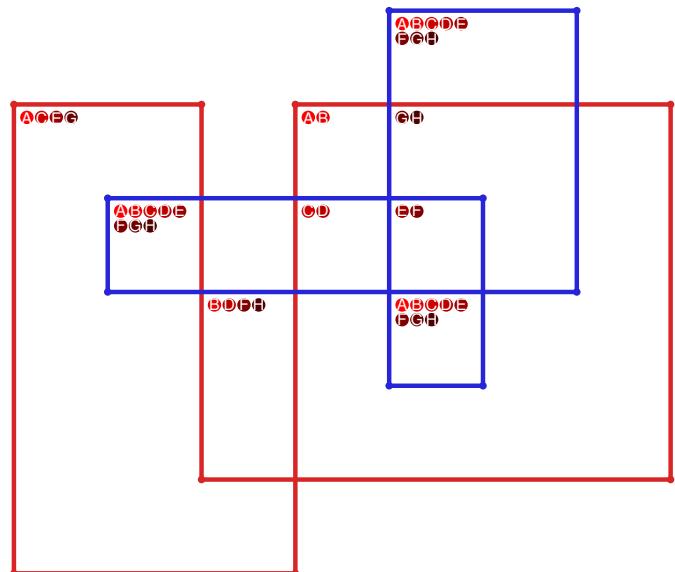


Figure 1415: SnapPy multiloop plot.

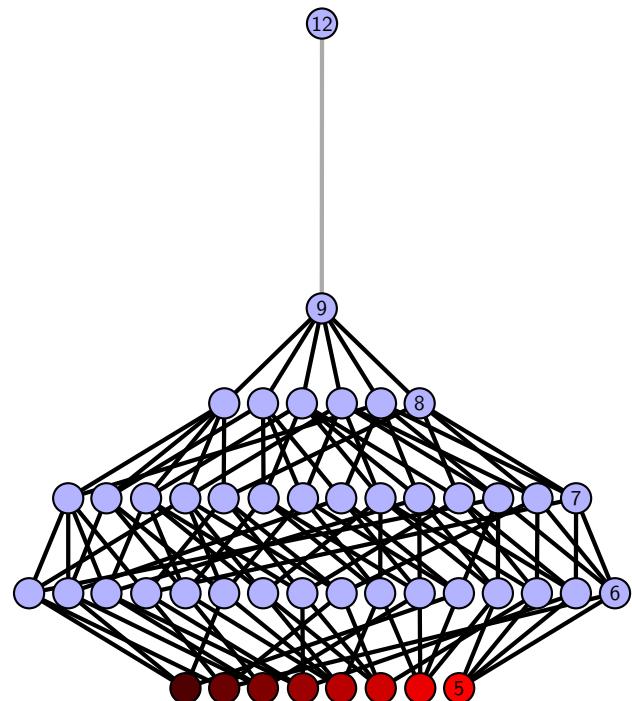


Figure 1416: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.411 $[[9, 20, 10, 1], [8, 17, 9, 18], [19, 16, 20, 17], [10, 13, 11, 14], [1, 6, 2, 7], [18, 7, 19, 8], [2, 15, 3, 16], [3, 12, 4, 13], [11, 4, 12, 5], [14, 5, 15, 6]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (11, 2, 12, 3), (18, 3, 19, 4), (15, 4, 16, 5), (20, 9, 1, 10), (7, 10, 8, 11), (19, 12, 20, 13), (16, 13, 17, 14), (5, 14, 6, 15), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 9], [0, 9, 6, 5], [1, 4, 2, 1], [2, 4, 9, 7], [3, 6, 8, 8], [3, 7, 7, 9], [3, 8, 6, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 9

Average minimal degree: 2.74

Total pinning sets: 500

Average overall degree: 3.12

Pinning number: 4

Table 707: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	2	0	0	0	0	0	0	8
Nonminimal pinning sets	0	8	59	127	148	103	43	10	1	499
Average degree	2.5	2.73	2.92	3.06	3.16	3.23	3.27	3.31	3.33	

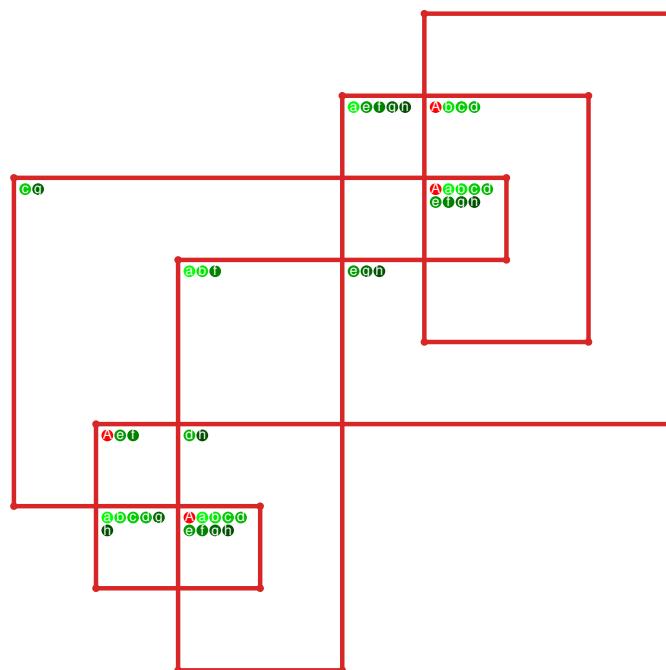


Figure 1417: `SnapPy` multiloop plot.

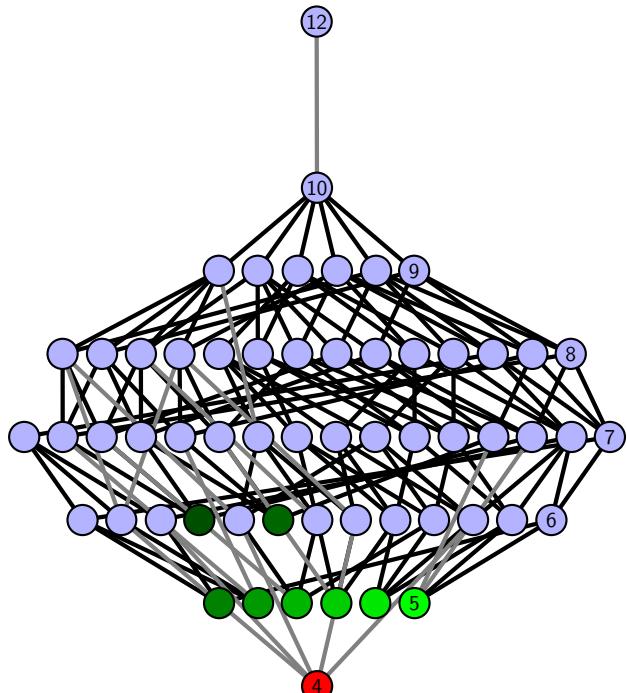


Figure 1418: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.412 [[11, 20, 12, 1], [10, 17, 11, 18], [19, 16, 20, 17], [12, 6, 13, 5], [1, 8, 2, 9], [18, 9, 19, 10], [2, 15, 3, 16], [6, 3, 7, 4], [13, 4, 14, 5], [14, 7, 15, 8]]

PD code drawn by `SnapPy`: [(20, 7, 1, 8), (9, 2, 10, 3), (16, 3, 17, 4), (13, 4, 14, 5), (17, 10, 18, 11), (14, 11, 15, 12), (5, 12, 6, 13), (6, 15, 7, 16), (1, 18, 2, 19), (8, 19, 9, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 8], [0, 9, 6, 5], [1, 4, 2, 1], [2, 4, 9, 7], [3, 6, 9, 8], [3, 7, 9, 3], [4, 8, 7, 6]]

Total optimal pinning sets: 4

Average optimal degree: 2.6

Total minimal pinning sets: 7

Average minimal degree: 2.68

Total pinning sets: 360

Average overall degree: 3.11

Pinning number: 5

Table 708: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	25	77	110	89	41	10	1	353
Average degree	2.6	2.82	2.99	3.12	3.21	3.27	3.31	3.33	

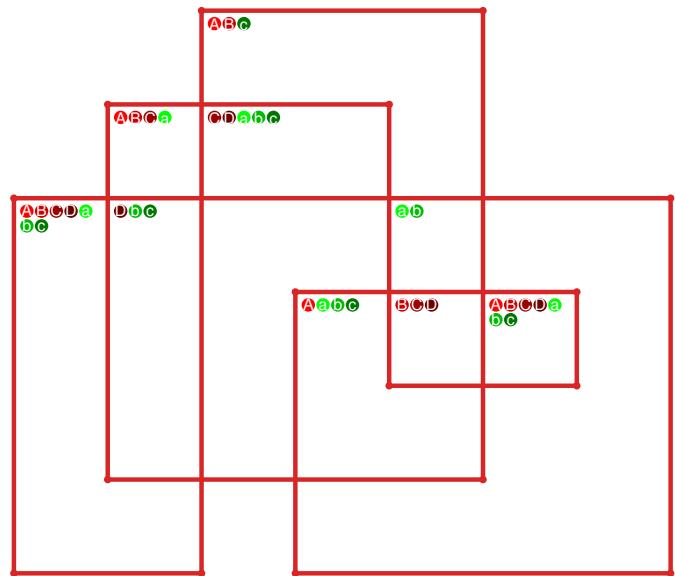


Figure 1419: `SnapPy` multiloop plot.

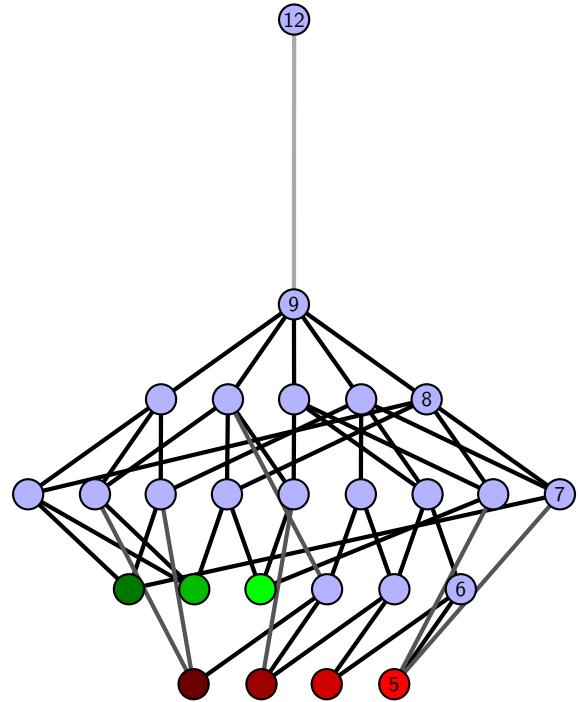


Figure 1420: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.413 $[[12, 20, 1, 13], [13, 10, 14, 9], [11, 8, 12, 9], [5, 19, 6, 20], [1, 16, 2, 15], [10, 15, 11, 14], [2, 7, 3, 8], [18, 4, 19, 5], [6, 17, 7, 16], [3, 17, 4, 18]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (11, 4, 12, 5), (8, 5, 9, 6), (6, 17, 7, 18), (18, 7, 19, 8), (19, 10, 20, 11), (20, 3, 13, 4), (12, 13, 1, 14), (2, 15, 3, 16), (9, 16, 10, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 8, 6, 5], [1, 4, 2, 1], [2, 4, 8, 9], [3, 9, 9, 3], [3, 9, 6, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 272
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 3.04

Table 709: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

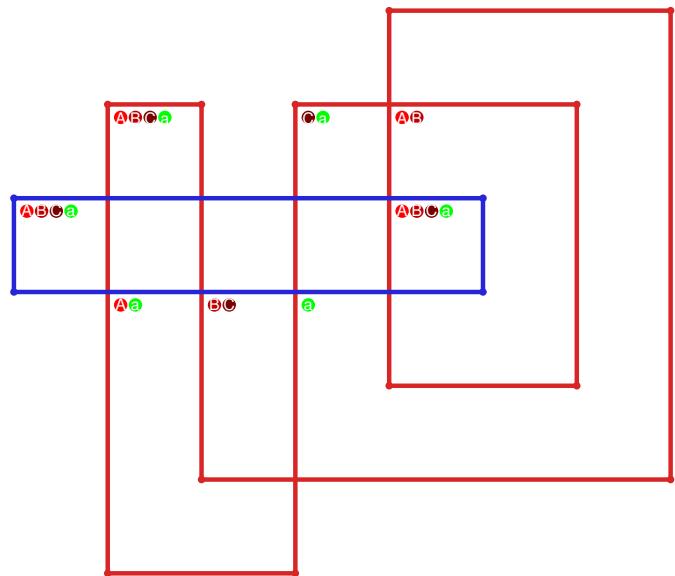


Figure 1421: SnapPy multiloop plot.

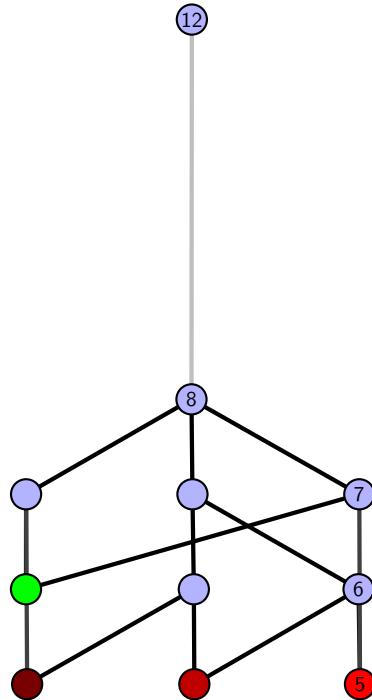


Figure 1422: Minimal join sub-semi-lattice of minimal pinning sets.

$$4.9.414 \quad [[20, 5, 1, 6], [6, 18, 7, 17], [19, 16, 20, 17], [4, 11, 5, 12], [1, 9, 2, 8], [18, 8, 19, 7], [2, 15, 3, 16], [12, 3, 13, 4], [13, 10, 14, 11], [9, 14, 10, 15]]$$

PD code drawn by SnapPy: [(16, 1, 17, 2), (3, 14, 4, 15), (4, 17, 5, 18), (9, 6, 10, 7), (20, 7, 1, 8), (5, 10, 6, 11), (18, 11, 19, 12), (15, 12, 16, 13), (13, 2, 14, 3), (8, 19, 9, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 9, 6, 5], [1, 4, 2, 1], [2, 4, 9, 7], [3, 6, 8, 3], [3, 7, 9, 9], [4, 8, 8, 6]]

Total optimal pinning sets: 4
Total pinning pinning sets: 6

Average optimal degree: 2.45

Total minimal pinning sets: 6

Average minimal degree: 2.55

Total pinning sets: 312

Average minimal degree: 2.3

Pinning number: 5

Average overall degree: 3.05

Table 710: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	24	68	94	75	35	9	1	306
Average degree	2.45	2.72	2.92	3.07	3.17	3.24	3.29	3.33	

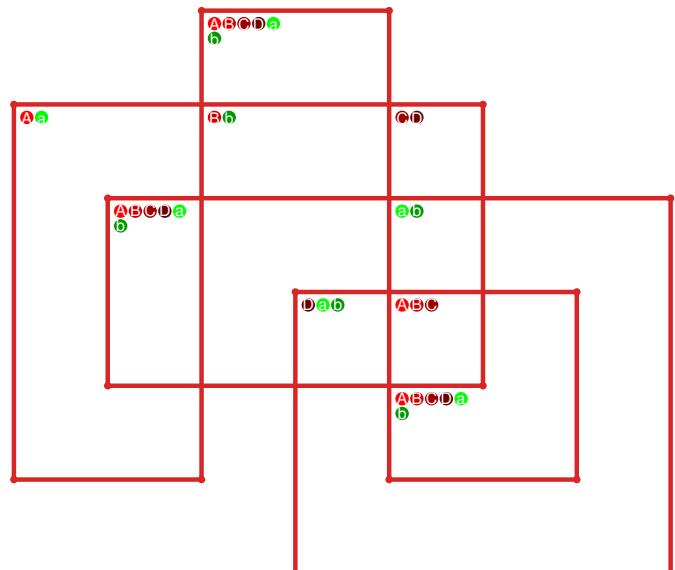


Figure 1423: SnapPy multiloop plot.

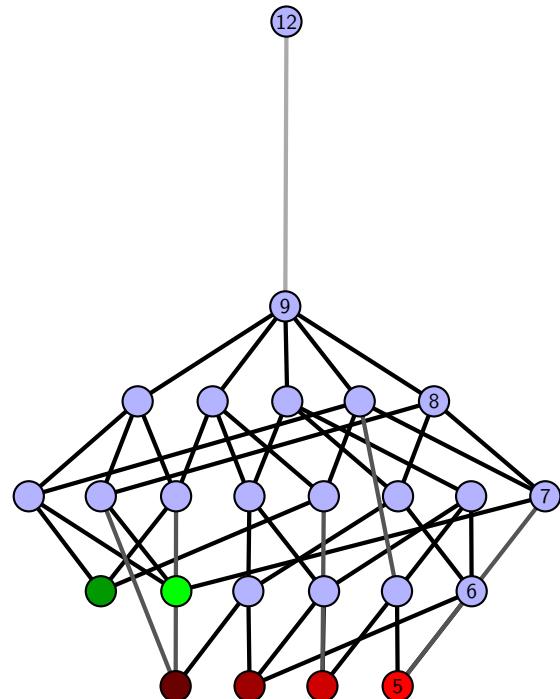


Figure 1424: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.415 $[[20, 3, 1, 4], [4, 18, 5, 17], [19, 16, 20, 17], [9, 2, 10, 3], [1, 10, 2, 11], [18, 6, 19, 5], [12, 15, 13, 16], [13, 8, 14, 9], [11, 7, 12, 6], [7, 14, 8, 15]]$

PD code drawn by `SnapPy`: $[(7, 20, 8, 1), (18, 1, 19, 2), (3, 16, 4, 17), (4, 9, 5, 10), (11, 6, 12, 7), (19, 8, 20, 9), (5, 12, 6, 13), (10, 13, 11, 14), (17, 14, 18, 15), (15, 2, 16, 3)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 4, 4], [0, 3, 3, 8], [1, 8, 2, 1], [2, 8, 9, 7], [3, 6, 9, 9], [4, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.47

Total pinning sets: 272

Average overall degree: 3.04

Pinning number: 5

Table 711: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

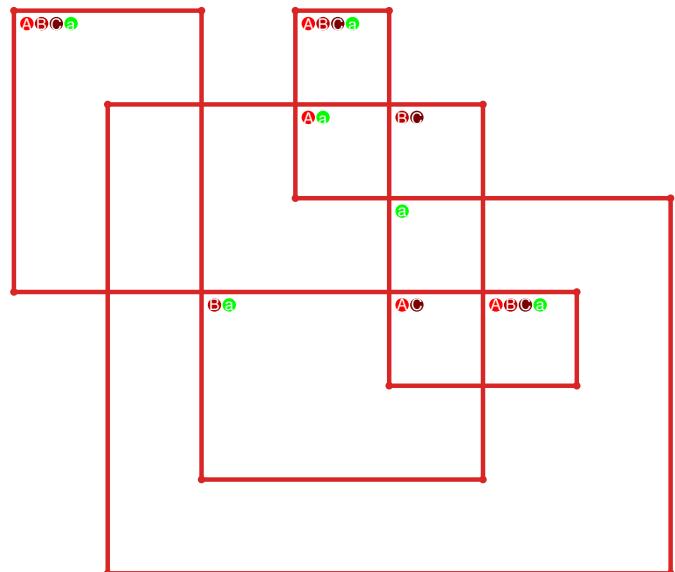


Figure 1425: `SnapPy` multiloop plot.

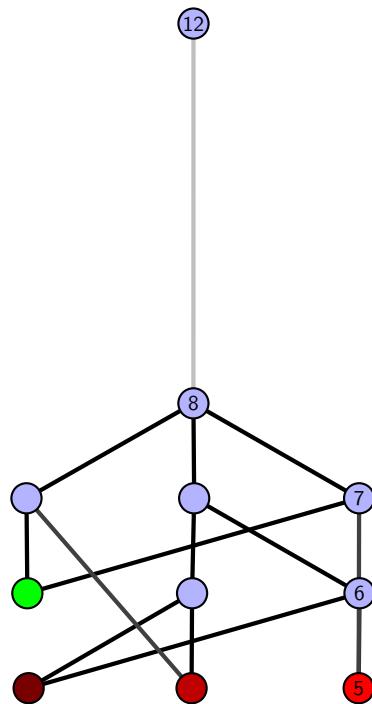


Figure 1426: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.416 $[[20, 7, 1, 8], [8, 18, 9, 17], [19, 16, 20, 17], [6, 1, 7, 2], [18, 10, 19, 9], [12, 15, 13, 16], [2, 13, 3, 14], [5, 10, 6, 11], [11, 4, 12, 5], [14, 3, 15, 4]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (9, 2, 10, 3), (18, 5, 19, 6), (7, 16, 8, 17), (3, 8, 4, 9), (20, 11, 1, 12), (10, 13, 11, 14), (17, 14, 18, 15), (15, 6, 16, 7), (4, 19, 5, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 7, 0], [1, 7, 2, 1], [2, 8, 9, 6], [3, 5, 9, 9], [3, 8, 8, 4], [5, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 144
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 712: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

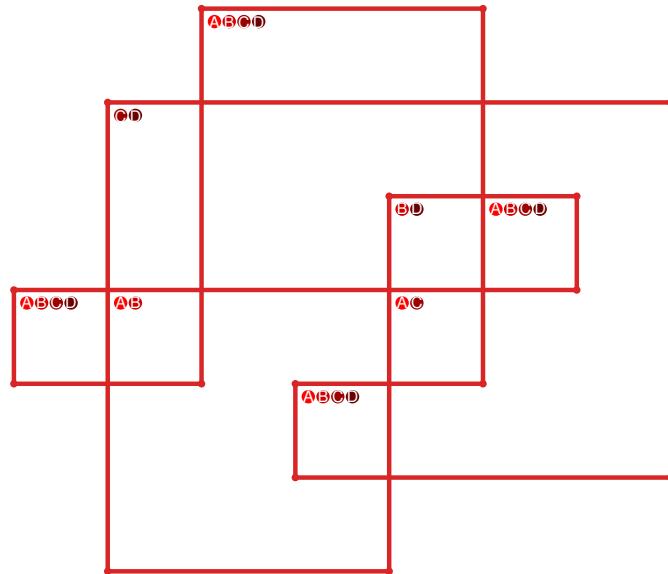


Figure 1427: SnapPy multiloop plot.

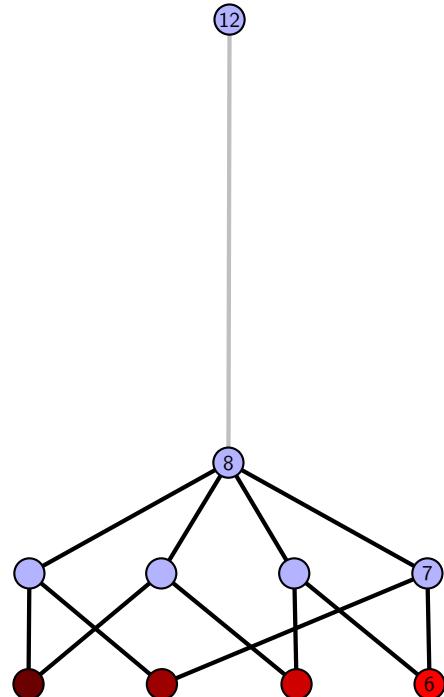


Figure 1428: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.417 `[[12, 20, 1, 13], [13, 10, 14, 9], [11, 8, 12, 9], [19, 1, 20, 2], [10, 15, 11, 14], [4, 7, 5, 8], [2, 18, 3, 19], [15, 3, 16, 4], [16, 6, 17, 7], [5, 17, 6, 18]]`

PD code drawn by `SnapPy`: `[(18, 1, 19, 2), (19, 4, 20, 5), (2, 5, 3, 6), (9, 6, 10, 7), (7, 16, 8, 17), (14, 11, 15, 12), (3, 20, 4, 13), (12, 13, 1, 14), (10, 15, 11, 16), (17, 8, 18, 9)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 7, 8, 9], [3, 9, 7, 3], [4, 6, 8, 5], [5, 7, 9, 9], [5, 8, 8, 6]]`

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 136
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.39
 Average overall degree: 2.98

Table 713: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	16	38	43	26	8	1	132
Average degree	2.33	2.64	2.88	3.05	3.18	3.27	3.33	

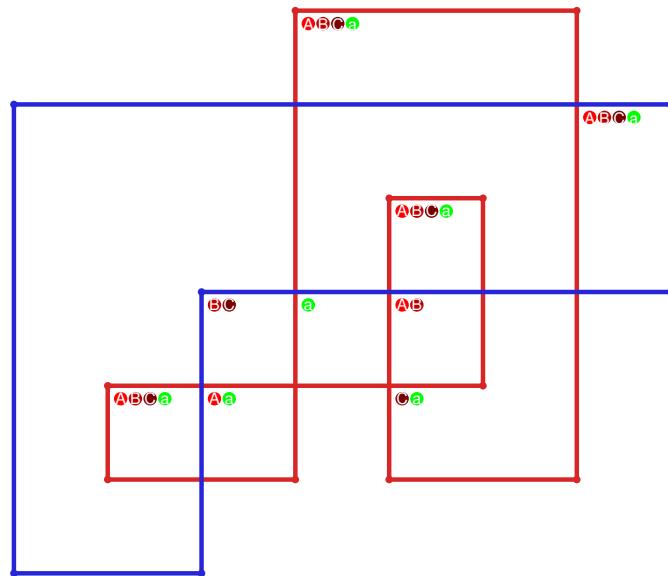


Figure 1429: `SnapPy` multiloop plot.

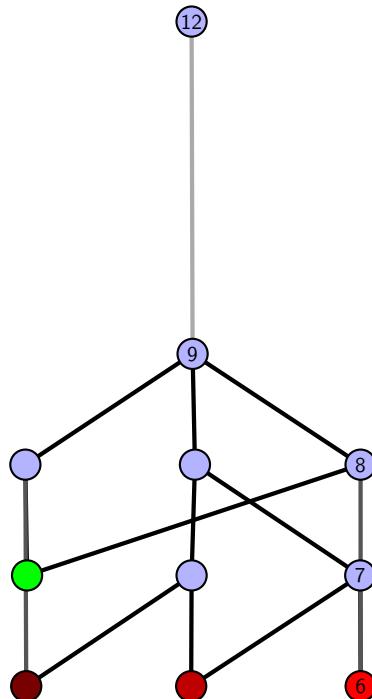


Figure 1430: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.418 $[[5, 20, 6, 1], [9, 4, 10, 5], [19, 6, 20, 7], [1, 17, 2, 16], [3, 8, 4, 9], [10, 8, 11, 7], [18, 13, 19, 14], [17, 13, 18, 12], [2, 15, 3, 16], [11, 15, 12, 14]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (16, 3, 17, 4), (4, 7, 5, 8), (20, 5, 1, 6), (9, 14, 10, 15), (15, 10, 16, 11), (11, 8, 12, 9), (19, 12, 20, 13), (13, 18, 14, 19), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 7, 8, 8], [1, 8, 5, 1], [1, 4, 9, 2], [2, 9, 7, 7], [3, 6, 6, 9], [3, 9, 4, 3], [5, 8, 7, 6]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 252
 Pinning number: 5

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 714: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	27	56	70	56	28	8	1	246
Average degree	2.33	2.65	2.86	3.0	3.11	3.2	3.27	3.33	

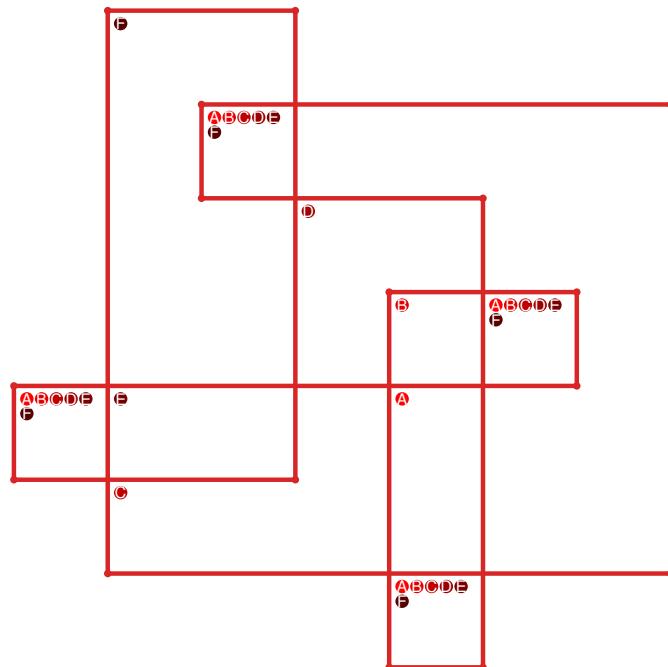


Figure 1431: SnapPy multiloop plot.

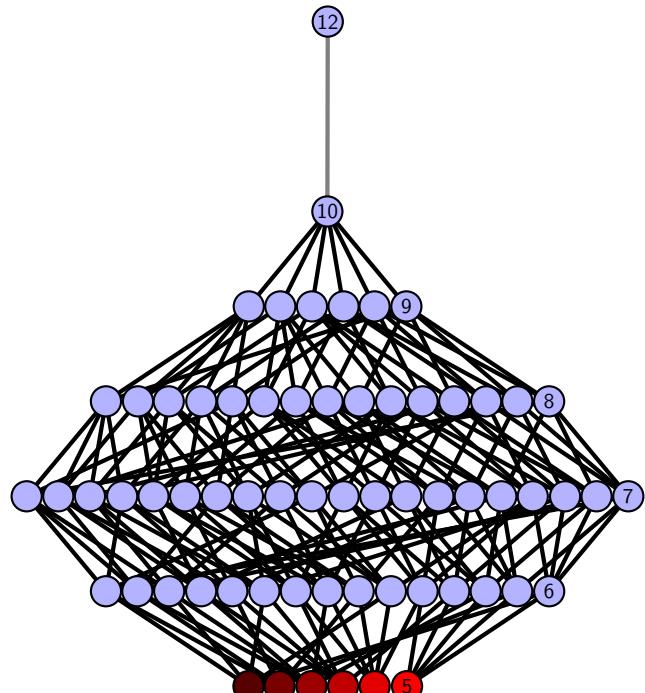


Figure 1432: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.419 $[[20, 5, 1, 6], [6, 18, 7, 17], [19, 16, 20, 17], [13, 4, 14, 5], [1, 10, 2, 11], [18, 8, 19, 7], [12, 15, 13, 16], [3, 14, 4, 15], [9, 2, 10, 3], [11, 9, 12, 8]]$

PD code drawn by SnapPy: $[(7, 20, 8, 1), (11, 2, 12, 3), (18, 3, 19, 4), (5, 16, 6, 17), (6, 9, 7, 10), (19, 8, 20, 9), (1, 12, 2, 13), (10, 13, 11, 14), (17, 14, 18, 15), (15, 4, 16, 5)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 8, 9], [1, 9, 2, 1], [2, 9, 7, 3], [3, 6, 8, 3], [4, 7, 9, 4], [4, 8, 6, 5]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 6
 Total pinning sets: 312
 Pinning number: 5

Average optimal degree: 2.45
 Average minimal degree: 2.55
 Average overall degree: 3.05

Table 715: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	24	68	94	75	35	9	1	306
Average degree	2.45	2.72	2.92	3.07	3.17	3.24	3.29	3.33	

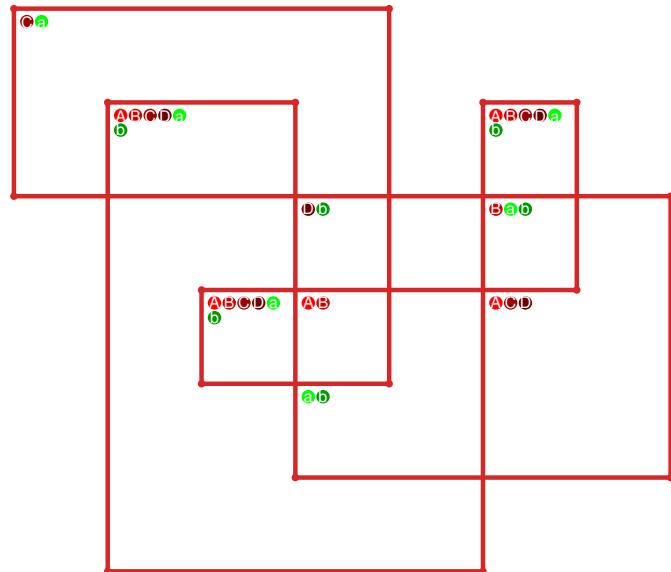


Figure 1433: SnapPy multiloop plot.

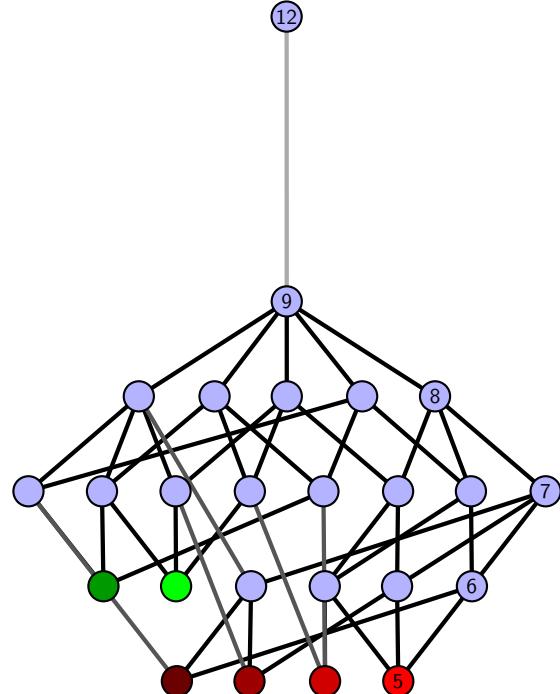


Figure 1434: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.420 $[[20, 7, 1, 8], [8, 18, 9, 17], [19, 16, 20, 17], [13, 6, 14, 7], [1, 5, 2, 4], [18, 10, 19, 9], [12, 15, 13, 16], [5, 14, 6, 15], [2, 12, 3, 11], [3, 10, 4, 11]]$

PD code drawn by `SnapPy`: $[(1, 18, 2, 19), (10, 3, 11, 4), (17, 4, 18, 5), (6, 15, 7, 16), (20, 7, 1, 8), (8, 19, 9, 20), (2, 11, 3, 12), (9, 12, 10, 13), (16, 13, 17, 14), (14, 5, 15, 6)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 7, 8, 9], [1, 9, 2, 1], [2, 8, 7, 3], [3, 6, 4, 3], [4, 6, 9, 9], [4, 8, 8, 5]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 6
 Total pinning sets: 312
 Pinning number: 5

Average optimal degree: 2.45
 Average minimal degree: 2.55
 Average overall degree: 3.05

Table 716: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	24	68	94	75	35	9	1	306
Average degree	2.45	2.72	2.92	3.07	3.17	3.24	3.29	3.33	

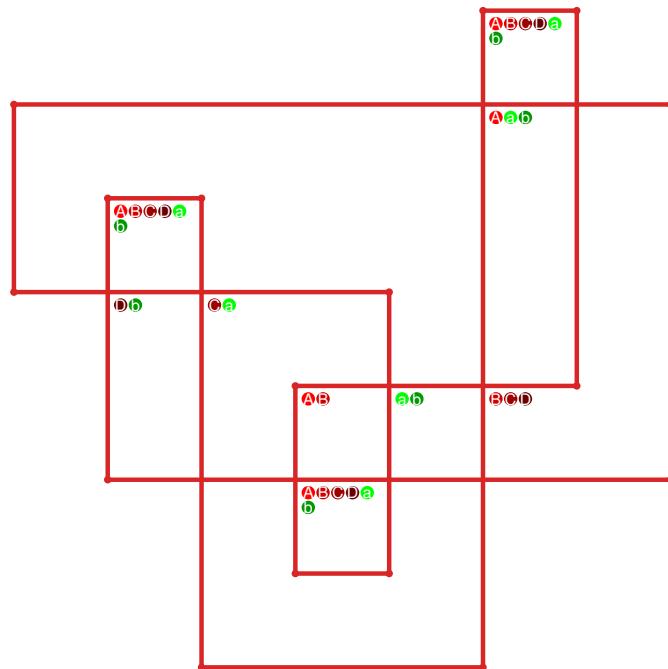


Figure 1435: `SnapPy` multiloop plot.

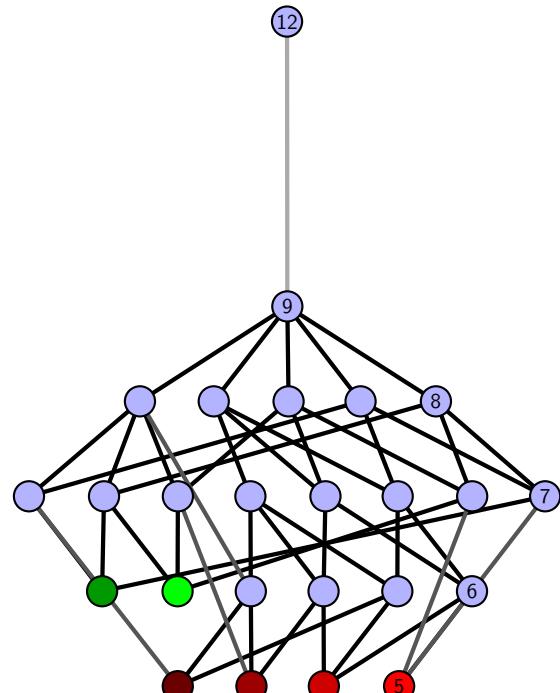


Figure 1436: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.421 $[[8, 20, 1, 9], [9, 7, 10, 8], [10, 19, 11, 20], [1, 11, 2, 12], [14, 6, 15, 7], [15, 18, 16, 19], [2, 16, 3, 17], [12, 4, 13, 5], [5, 13, 6, 14], [17, 3, 18, 4]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (17, 2, 18, 3), (13, 6, 14, 7), (20, 7, 9, 8), (8, 9, 1, 10), (5, 12, 6, 13), (11, 14, 12, 15), (18, 15, 19, 16), (3, 16, 4, 17), (4, 19, 5, 20)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 8, 8, 5], [2, 4, 9, 6], [3, 5, 9, 9], [3, 9, 8, 8], [4, 7, 7, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.98

Table 717: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

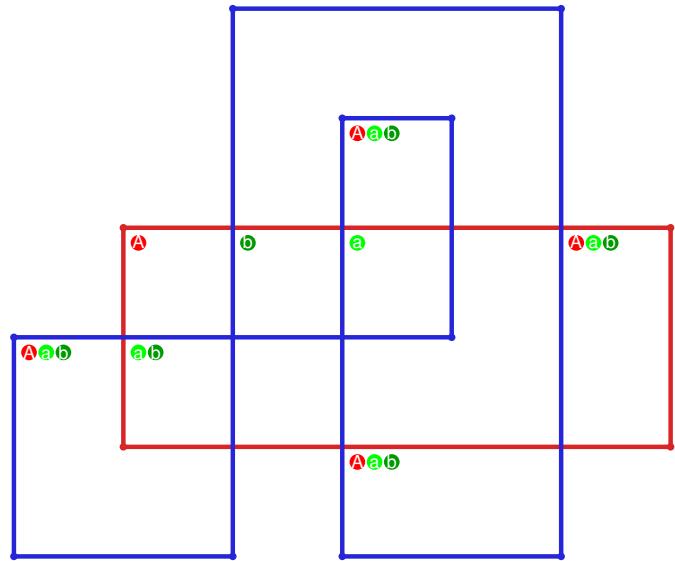


Figure 1437: SnapPy multiloop plot.

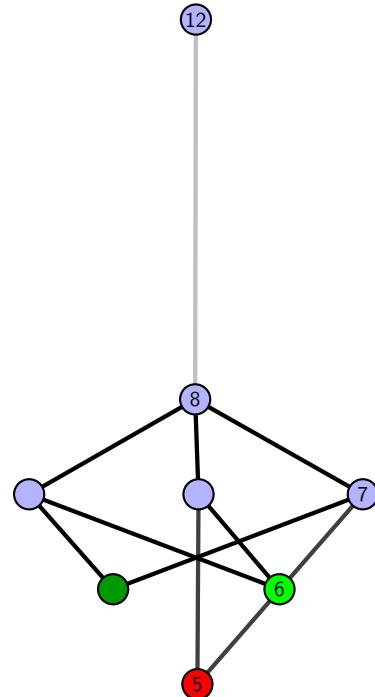


Figure 1438: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.422 $[[6, 20, 1, 7], [7, 5, 8, 6], [19, 16, 20, 17], [1, 13, 2, 14], [4, 10, 5, 11], [8, 18, 9, 17], [9, 18, 10, 19], [12, 15, 13, 16], [2, 15, 3, 14], [11, 3, 12, 4]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (17, 2, 18, 3), (4, 9, 5, 10), (10, 5, 11, 6), (8, 11, 9, 12), (15, 12, 16, 13), (13, 18, 14, 19), (19, 14, 20, 15), (3, 16, 4, 17), (1, 20, 2, 7)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 7], [0, 7, 8, 8], [1, 9, 9, 6], [1, 6, 6, 2], [2, 5, 5, 4], [2, 9, 8, 3], [3, 7, 9, 3], [4, 8, 7, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 718: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

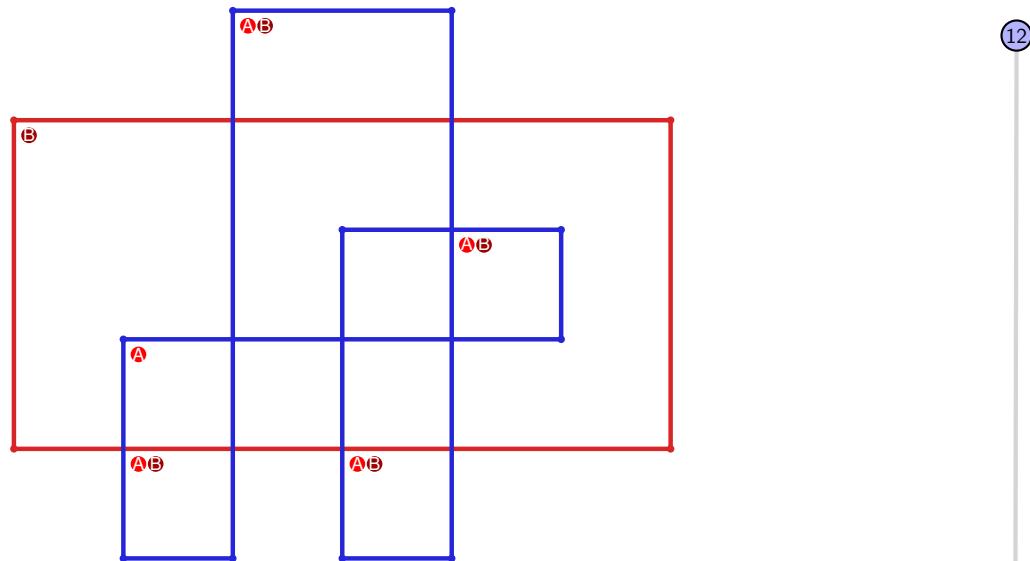


Figure 1439: SnapPy multiloop plot.

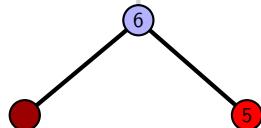


Figure 1440: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.423 $[[20, 7, 1, 8], [8, 3, 9, 4], [6, 19, 7, 20], [1, 10, 2, 11], [11, 2, 12, 3], [9, 12, 10, 13], [4, 15, 5, 16], [16, 5, 17, 6], [18, 13, 19, 14], [14, 17, 15, 18]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (16, 3, 17, 4), (17, 6, 18, 7), (5, 8, 6, 9), (14, 9, 15, 10), (20, 11, 1, 12), (10, 13, 11, 14), (2, 15, 3, 16), (7, 18, 8, 19), (4, 19, 5, 20)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 8, 0], [0, 5, 4, 4], [1, 3, 3, 5], [1, 4, 3, 8], [1, 9, 7, 7], [2, 6, 6, 9], [2, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 719: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

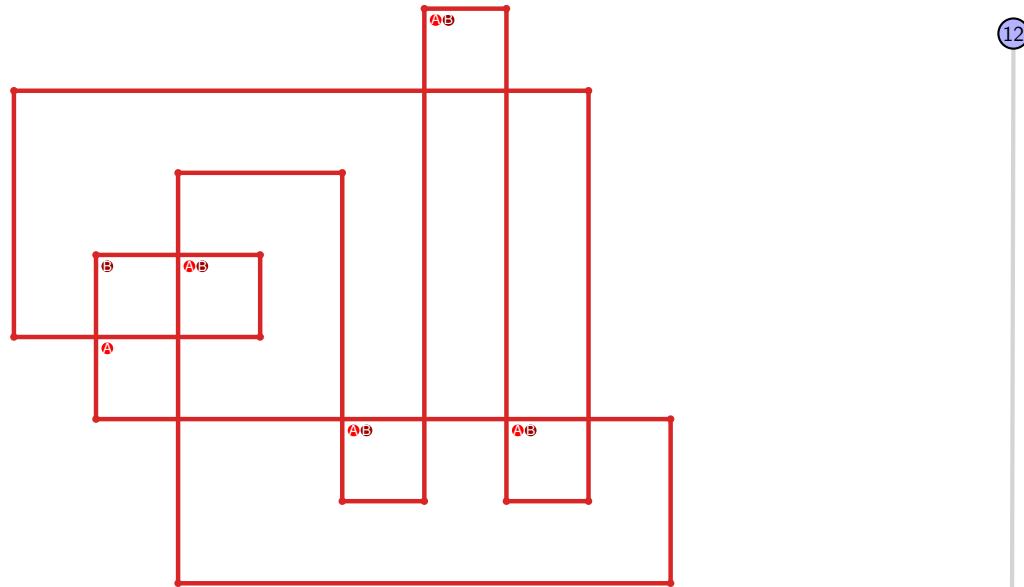


Figure 1441: SnapPy multiloop plot.

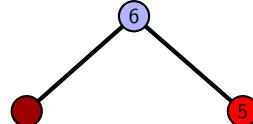


Figure 1442: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.424 [[20, 15, 1, 16], [16, 3, 17, 4], [12, 19, 13, 20], [14, 9, 15, 10], [1, 6, 2, 7], [7, 2, 8, 3], [17, 5, 18, 4], [18, 11, 19, 12], [13, 11, 14, 10], [5, 8, 6, 9]]

PD code drawn by SnapPy: [(5, 20, 6, 1), (14, 1, 15, 2), (2, 15, 3, 16), (19, 4, 20, 5), (3, 6, 4, 7), (12, 7, 13, 8), (8, 11, 9, 12), (16, 9, 17, 10), (18, 13, 19, 14), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 7, 7, 8], [0, 8, 8, 9], [0, 9, 5, 5], [1, 4, 4, 9], [1, 9, 7, 1], [2, 6, 8, 2], [2, 7, 3, 3], [3, 6, 5, 4]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 240
 Pinning number: 5

Average optimal degree: 2.3
 Average minimal degree: 2.3
 Average overall degree: 2.98

Table 720: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.3	2.62	2.84	3.0	3.11	3.2	3.27	3.33	

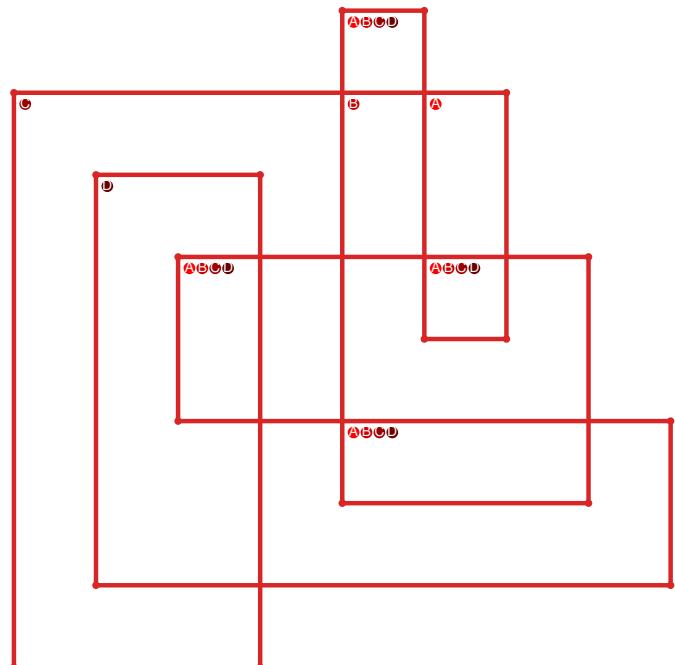


Figure 1443: SnapPy multiloop plot.

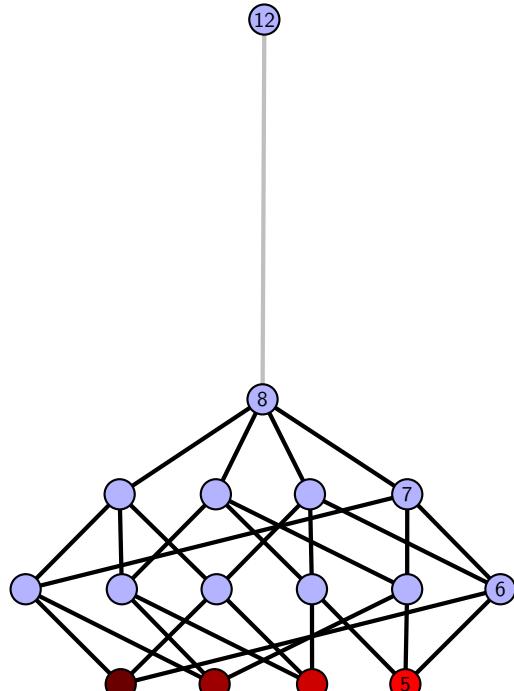


Figure 1444: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.425 $[[6, 20, 1, 7], [7, 5, 8, 6], [8, 19, 9, 20], [1, 18, 2, 17], [4, 16, 5, 17], [18, 9, 19, 10], [2, 12, 3, 13], [13, 3, 14, 4], [15, 10, 16, 11], [11, 14, 12, 15]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (15, 2, 16, 3), (12, 17, 13, 18), (9, 18, 10, 19), (5, 20, 6, 7), (19, 8, 20, 9), (1, 10, 2, 11), (11, 4, 12, 5), (16, 13, 17, 14), (3, 14, 4, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 7, 8], [2, 8, 3, 2], [3, 9, 7, 7], [4, 6, 6, 9], [4, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 721: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

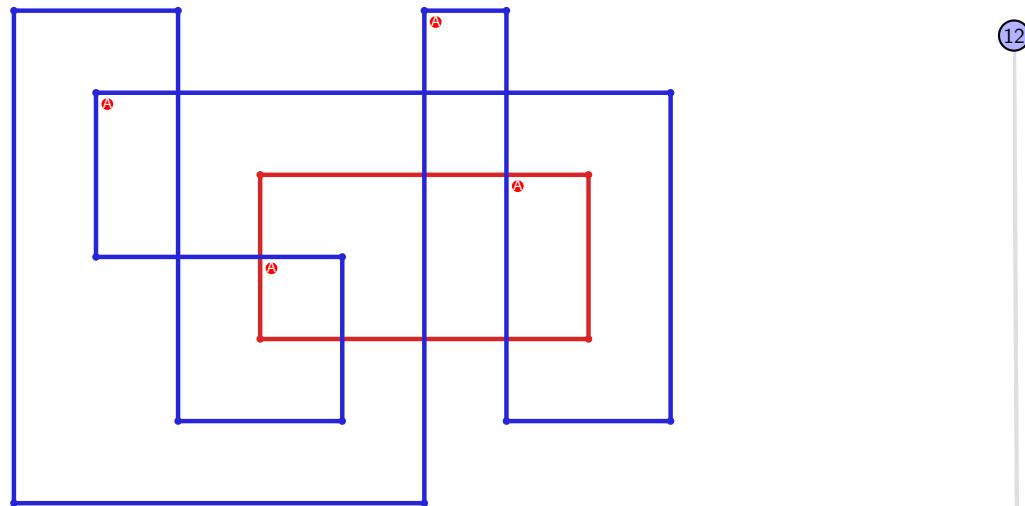


Figure 1445: SnapPy multiloop plot.



Figure 1446: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.426 $[[6, 20, 1, 7], [7, 5, 8, 6], [8, 19, 9, 20], [1, 9, 2, 10], [10, 4, 11, 5], [11, 18, 12, 19], [2, 14, 3, 15], [15, 3, 16, 4], [17, 12, 18, 13], [13, 16, 14, 17]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (17, 2, 18, 3), (14, 3, 15, 4), (5, 16, 6, 17), (10, 19, 11, 20), (6, 7, 1, 8), (20, 9, 7, 10), (18, 11, 19, 12), (15, 12, 16, 13), (4, 13, 5, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 7, 5], [2, 4, 8, 8], [3, 9, 7, 7], [4, 6, 6, 9], [5, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 722: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

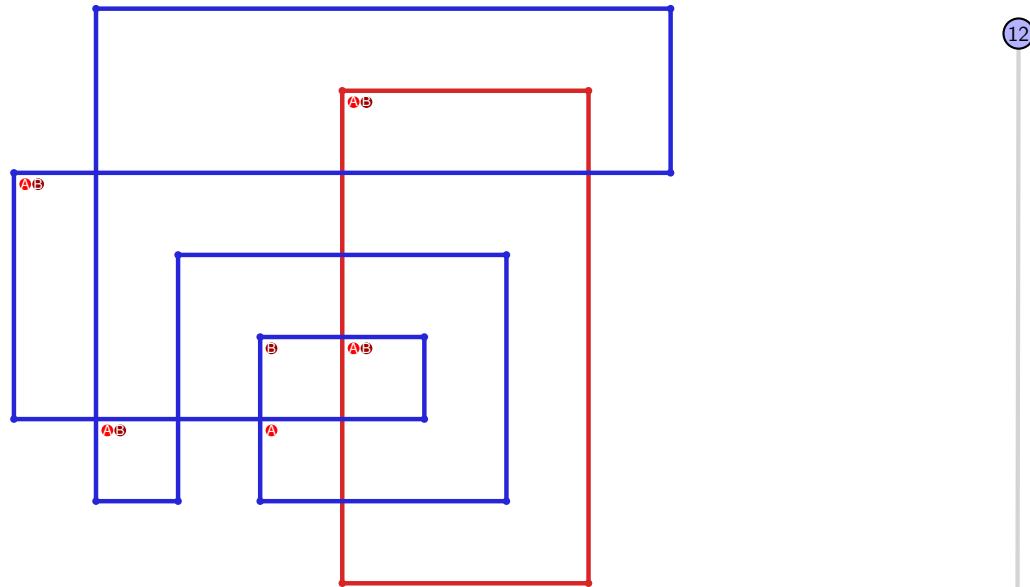


Figure 1447: SnapPy multiloop plot.

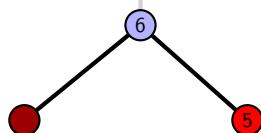


Figure 1448: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.427 [[20, 13, 1, 14], [14, 19, 15, 20], [15, 12, 16, 13], [1, 16, 2, 17], [5, 18, 6, 19], [6, 11, 7, 12], [2, 10, 3, 9], [17, 4, 18, 5], [10, 7, 11, 8], [3, 8, 4, 9]]

PD code drawn by SnapPy: [(14, 1, 15, 2), (7, 4, 8, 5), (20, 5, 1, 6), (6, 19, 7, 20), (3, 8, 4, 9), (12, 9, 13, 10), (17, 10, 18, 11), (18, 13, 19, 14), (2, 15, 3, 16), (11, 16, 12, 17)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 5], [2, 4, 8, 8], [3, 8, 9, 9], [3, 9, 4, 4], [5, 9, 6, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 723: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

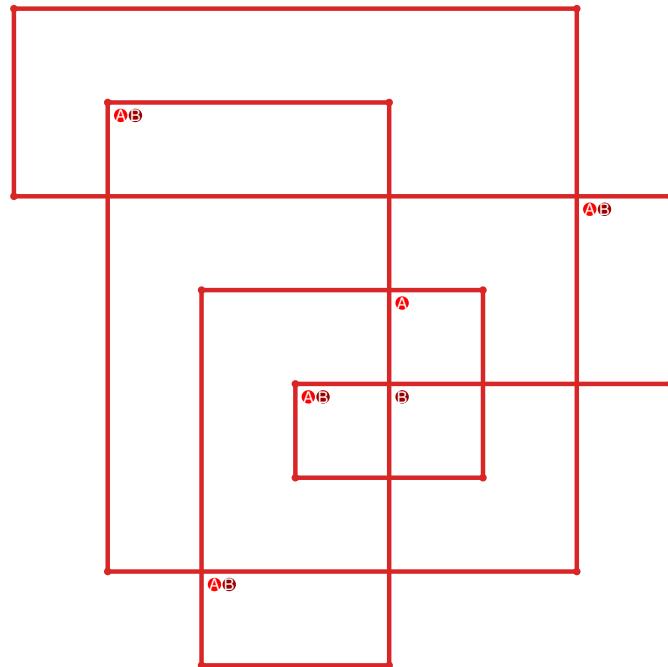


Figure 1449: SnapPy multiloop plot.

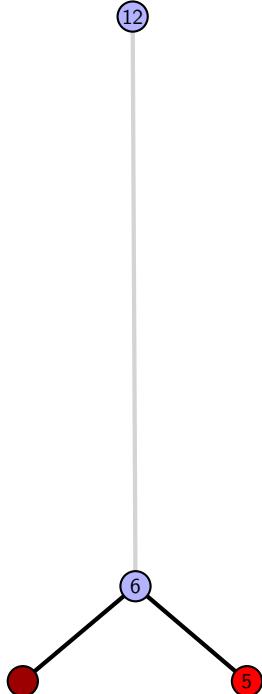


Figure 1450: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.428 [[5, 20, 6, 1], [17, 4, 18, 5], [19, 8, 20, 9], [6, 11, 7, 12], [1, 15, 2, 14], [3, 16, 4, 17], [18, 10, 19, 9], [10, 7, 11, 8], [12, 16, 13, 15], [2, 13, 3, 14]]

PD code drawn by SnapPy: [(13, 20, 14, 1), (6, 3, 7, 4), (15, 4, 16, 5), (5, 14, 6, 15), (2, 7, 3, 8), (18, 9, 19, 10), (10, 17, 11, 18), (11, 8, 12, 9), (19, 12, 20, 13), (1, 16, 2, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 7], [0, 7, 7, 8], [0, 8, 9, 9], [1, 9, 8, 1], [1, 7, 2, 2], [2, 6, 3, 3], [3, 5, 9, 4], [4, 8, 5, 4]]

Total optimal pinning sets: 1
Total minimal pinning sets: 4
Total pinning sets: 184
Pinning number: 5

Average optimal degree: 2.2
Average minimal degree: 2.38
Average overall degree: 2.98

Table 724: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.2	2.5	2.76	2.95	3.09	3.19	3.27	3.33	

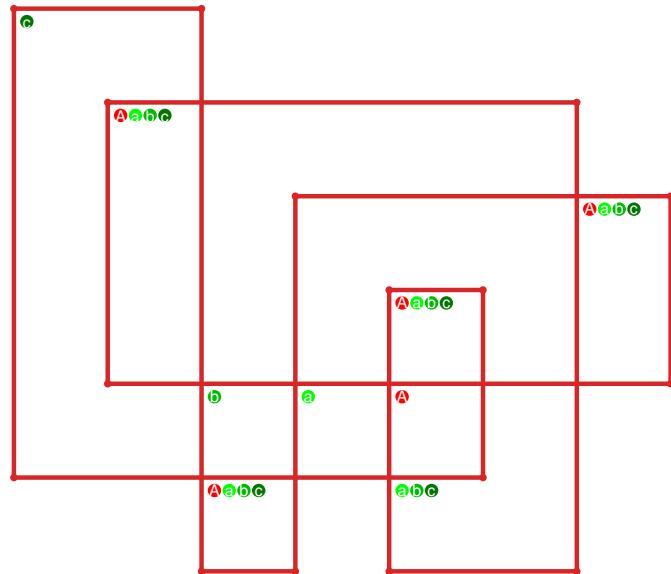


Figure 1451: SnapPy multiloop plot.

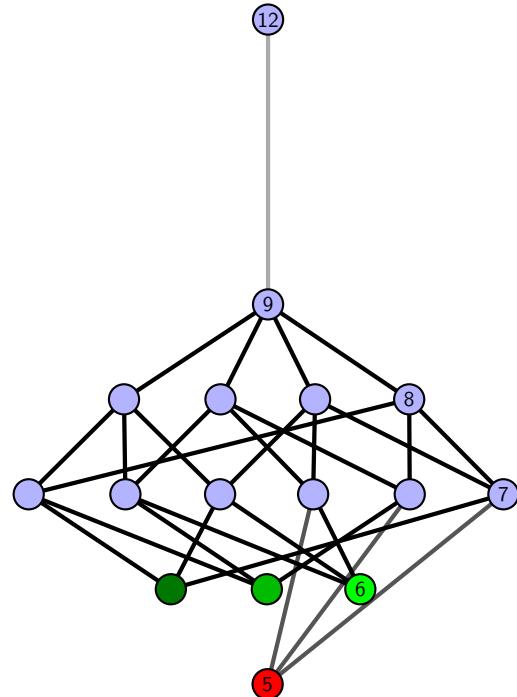


Figure 1452: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.429 $[[8, 14, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [13, 20, 14, 15], [1, 12, 2, 11], [6, 11, 7, 10], [17, 3, 18, 4], [15, 18, 16, 19], [19, 12, 20, 13], [2, 16, 3, 17]]$

PD code drawn by `SnapPy`: $[(10, 1, 11, 2), (5, 2, 6, 3), (3, 20, 4, 15), (15, 4, 16, 5), (16, 7, 17, 8), (12, 17, 13, 18), (6, 19, 7, 20), (14, 11, 9, 12), (18, 13, 19, 14), (8, 9, 1, 10)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 8], [0, 8, 9, 5], [1, 4, 2, 1], [2, 9, 9, 7], [3, 6, 9, 8], [3, 7, 4, 3], [4, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 5

Average minimal degree: 2.49

Total pinning sets: 376

Average overall degree: 3.04

Pinning number: 4

Table 725: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	8	46	90	105	77	35	9	1	371
Average degree	2.25	2.57	2.8	2.97	3.08	3.17	3.24	3.29	3.33	

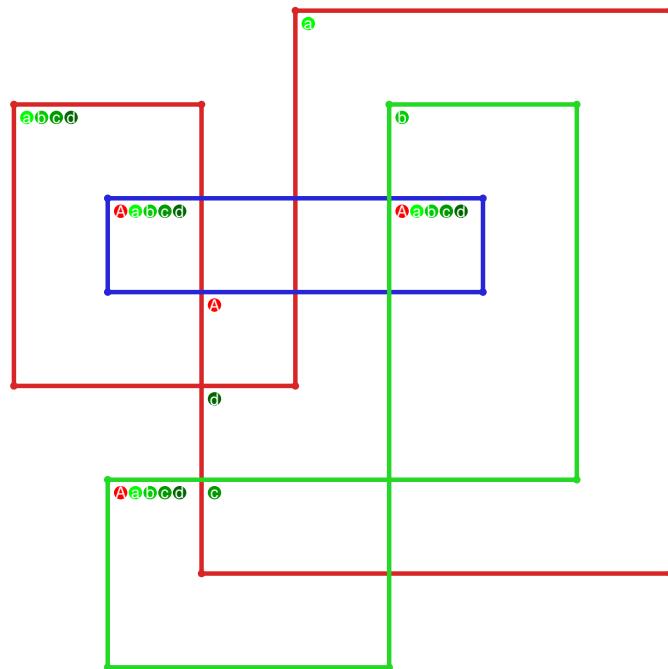


Figure 1453: `SnapPy` multiloop plot.

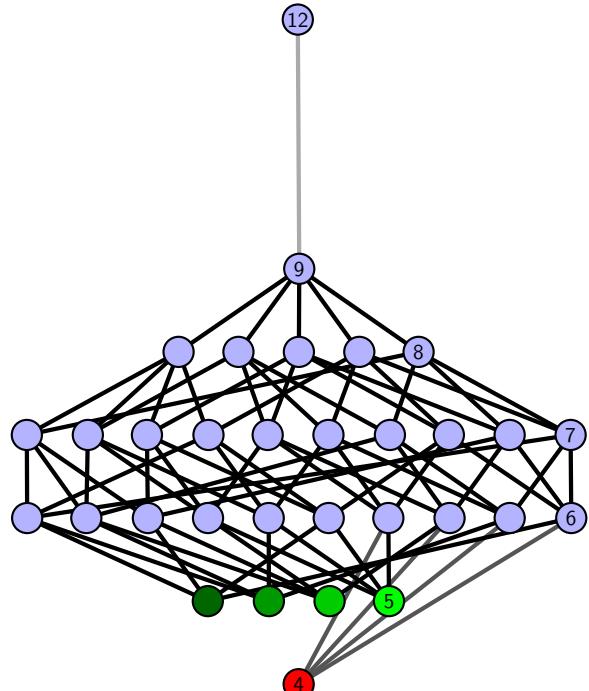


Figure 1454: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.430 [[20, 7, 1, 8], [8, 18, 9, 17], [19, 16, 20, 17], [6, 13, 7, 14], [1, 11, 2, 10], [18, 10, 19, 9], [2, 15, 3, 16], [14, 3, 15, 4], [12, 5, 13, 6], [11, 5, 12, 4]]

PD code drawn by `SnapPy`: [(7, 20, 8, 1), (15, 2, 16, 3), (4, 13, 5, 14), (5, 16, 6, 17), (1, 8, 2, 9), (17, 10, 18, 11), (14, 11, 15, 12), (12, 3, 13, 4), (9, 18, 10, 19), (19, 6, 20, 7)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 8], [0, 9, 6, 5], [1, 4, 2, 1], [2, 4, 7, 7], [3, 6, 6, 9], [3, 9, 9, 3], [4, 8, 8, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 726: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

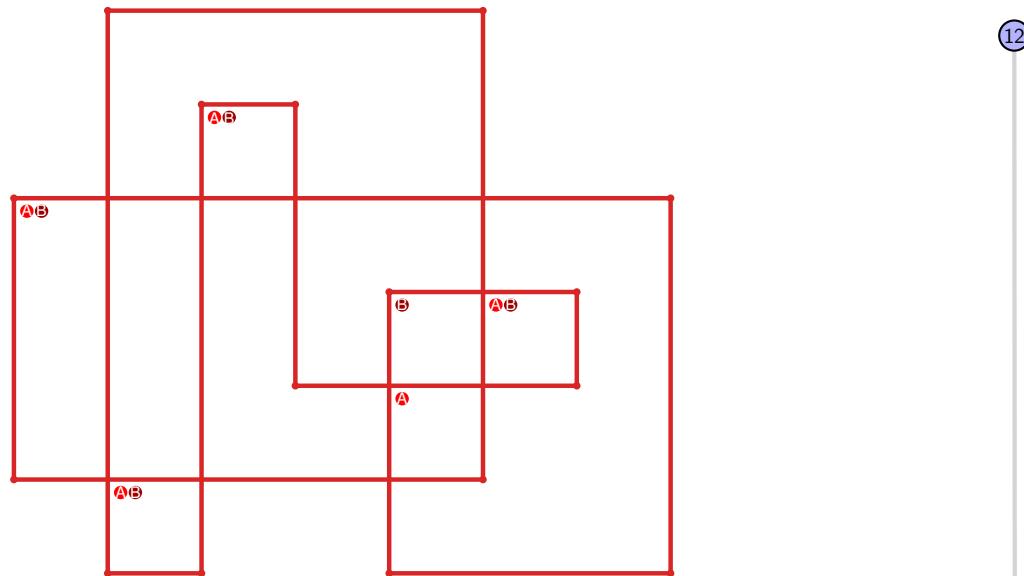


Figure 1455: `SnapPy` multiloop plot.

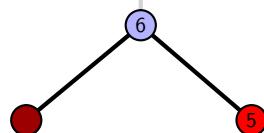


Figure 1456: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.431 [[16, 9, 1, 10], [10, 6, 11, 5], [8, 15, 9, 16], [1, 13, 2, 12], [6, 12, 7, 11], [7, 4, 8, 5], [14, 20, 15, 17], [13, 20, 14, 19], [2, 19, 3, 18], [3, 17, 4, 18]]

PD code drawn by SnapPy: [(5, 2, 6, 3), (3, 8, 4, 9), (14, 7, 15, 8), (9, 4, 10, 5), (10, 15, 11, 16), (6, 13, 7, 14), (17, 16, 18, 1), (18, 11, 19, 12), (12, 19, 13, 20), (1, 20, 2, 17)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 7, 8, 4], [1, 3, 5, 1], [1, 4, 9, 2], [2, 9, 7, 7], [3, 6, 6, 8], [3, 7, 9, 9], [5, 8, 8, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 727: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

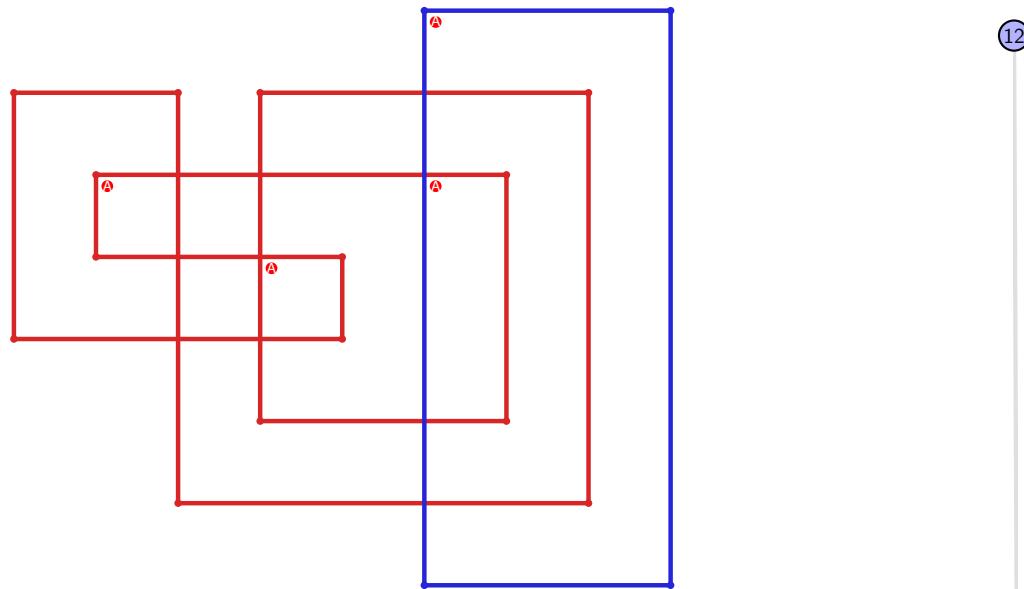


Figure 1457: SnapPy multiloop plot.

4

Figure 1458: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.432 $[[16, 5, 1, 6], [6, 14, 7, 13], [15, 12, 16, 13], [4, 20, 5, 17], [1, 9, 2, 8], [14, 8, 15, 7], [11, 17, 12, 18], [19, 3, 20, 4], [9, 3, 10, 2], [18, 10, 19, 11]]$

PD code drawn by `SnapPy`: $[(16, 7, 1, 8), (20, 1, 17, 2), (14, 3, 15, 4), (5, 12, 6, 13), (6, 15, 7, 16), (19, 8, 20, 9), (13, 10, 14, 11), (11, 4, 12, 5), (2, 17, 3, 18), (9, 18, 10, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 8, 5], [1, 4, 2, 1], [2, 9, 9, 3], [3, 9, 8, 3], [4, 7, 9, 4], [6, 8, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 4
Total pinning sets: 184
Pinning number: 5

Average optimal degree: 2.2
Average minimal degree: 2.38
Average overall degree: 2.98

Table 728: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.2	2.5	2.76	2.95	3.09	3.19	3.27	3.33	

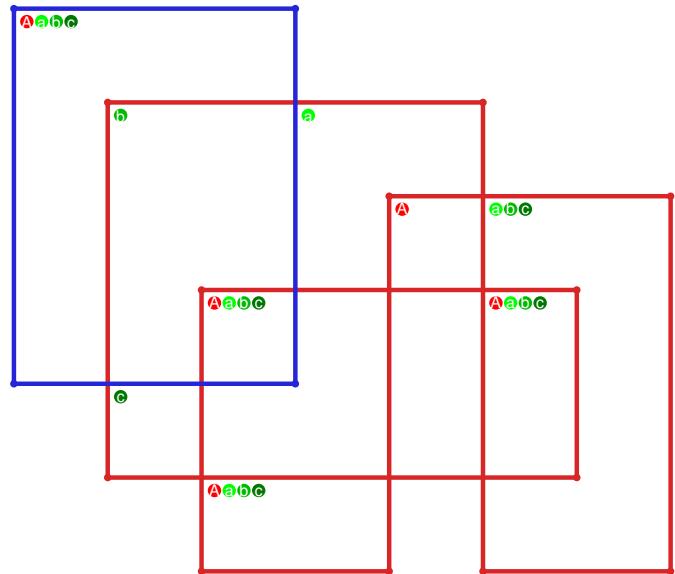


Figure 1459: `SnapPy` multiloop plot.

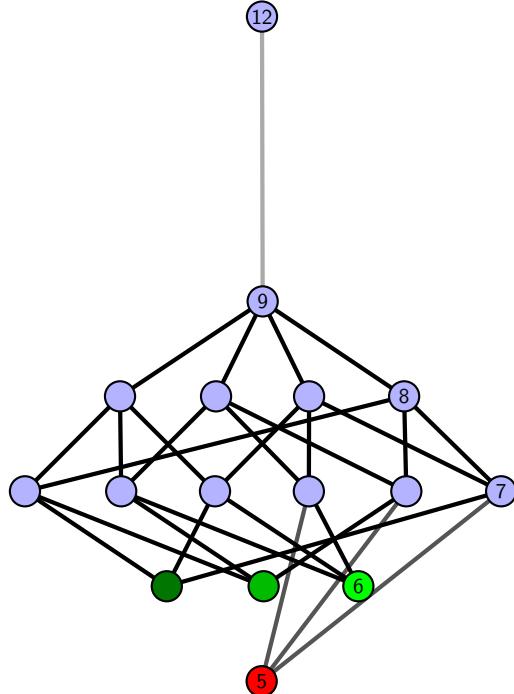


Figure 1460: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.433 [[16, 11, 1, 12], [12, 6, 13, 5], [15, 4, 16, 5], [10, 20, 11, 17], [1, 9, 2, 8], [6, 14, 7, 13], [7, 14, 8, 15], [3, 17, 4, 18], [19, 9, 20, 10], [2, 19, 3, 18]]

PD code drawn by `SnapPy`: [(13, 2, 14, 3), (3, 10, 4, 11), (6, 15, 7, 16), (18, 7, 19, 8), (14, 9, 15, 10), (11, 4, 12, 5), (5, 12, 6, 13), (17, 16, 18, 1), (8, 19, 9, 20), (1, 20, 2, 17)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 8, 8], [0, 8, 9, 6], [1, 6, 6, 1], [2, 5, 5, 4], [2, 9, 9, 3], [3, 9, 4, 3], [4, 8, 7, 7]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 240
 Pinning number: 5

Average optimal degree: 2.3
 Average minimal degree: 2.3
 Average overall degree: 2.98

Table 729: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.3	2.62	2.84	3.0	3.11	3.2	3.27	3.33	

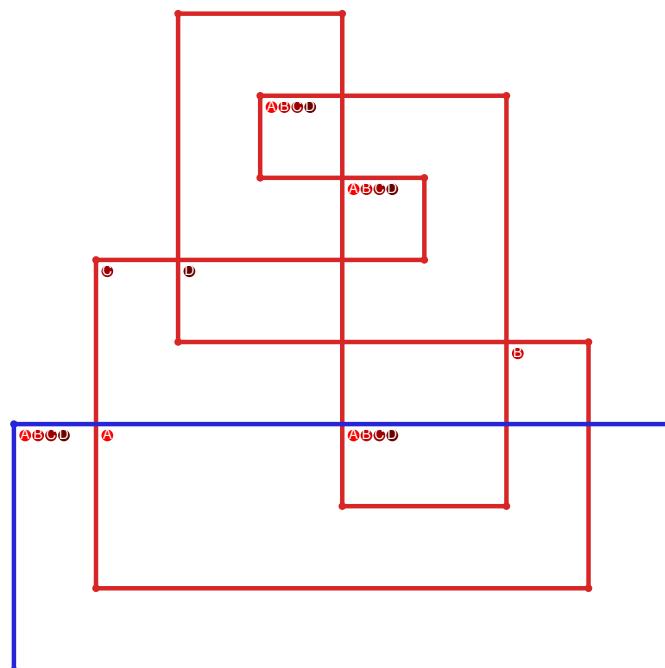


Figure 1461: `SnapPy` multiloop plot.

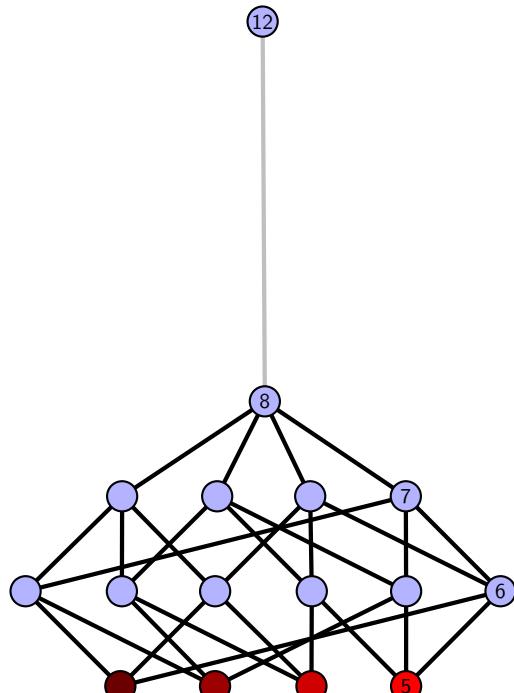


Figure 1462: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.434 $[[6, 16, 1, 7], [7, 5, 8, 6], [8, 15, 9, 16], [1, 14, 2, 13], [4, 12, 5, 13], [14, 9, 15, 10], [2, 17, 3, 20], [3, 19, 4, 20], [11, 18, 12, 19], [10, 18, 11, 17]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (18, 13, 19, 14), (1, 16, 2, 17), (17, 4, 18, 5), (12, 19, 13, 20), (3, 20, 4, 11), (15, 10, 16, 7), (6, 7, 1, 8), (8, 5, 9, 6), (9, 14, 10, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 7, 8], [2, 9, 3, 2], [3, 9, 7, 7], [4, 6, 6, 8], [4, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 248
 Pinning number: 5

Average optimal degree: 2.32
 Average minimal degree: 2.32
 Average overall degree: 2.97

Table 730: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	25	55	70	56	28	8	1	243
Average degree	2.32	2.64	2.85	3.0	3.11	3.2	3.27	3.33	

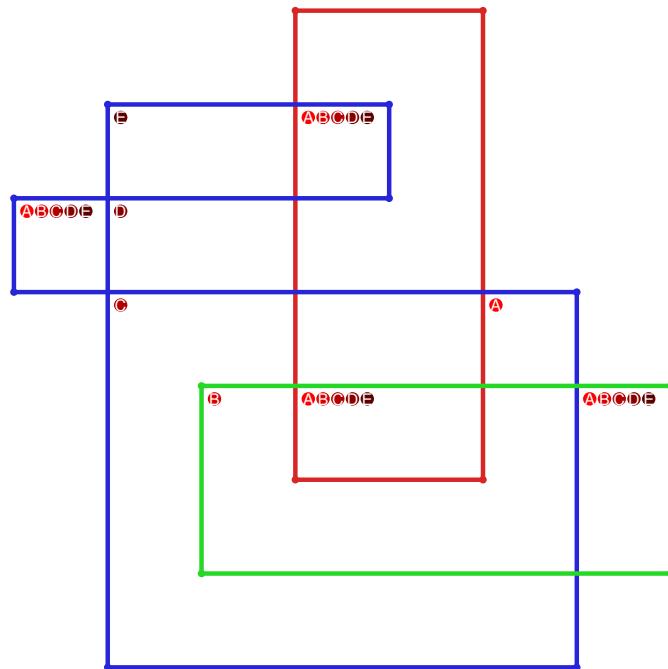


Figure 1463: `SnapPy` multiloop plot.

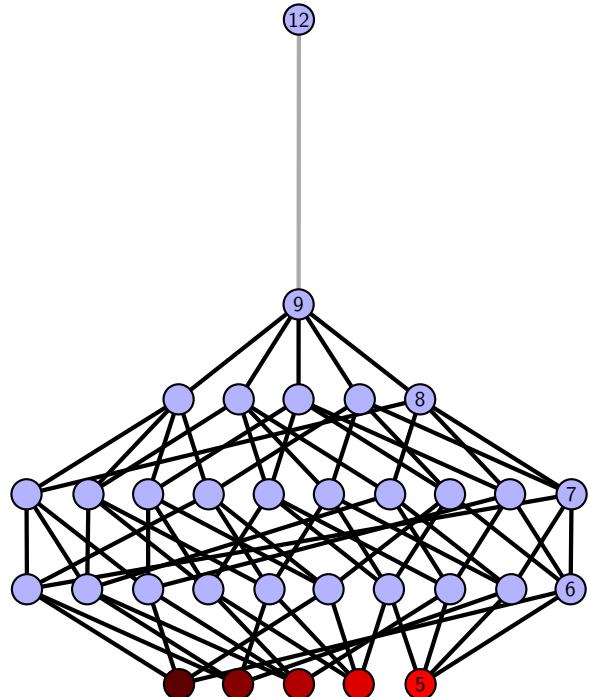


Figure 1464: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.435 $[[6, 20, 1, 7], [7, 5, 8, 6], [8, 19, 9, 20], [1, 9, 2, 10], [10, 4, 11, 5], [18, 13, 19, 14], [2, 17, 3, 16], [3, 15, 4, 16], [11, 15, 12, 14], [12, 17, 13, 18]]$

PD code drawn by SnapPy: $[(15, 2, 16, 3), (12, 3, 13, 4), (5, 14, 6, 15), (9, 18, 10, 19), (19, 16, 20, 17), (1, 20, 2, 7), (7, 6, 8, 1), (17, 8, 18, 9), (13, 10, 14, 11), (4, 11, 5, 12)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 7, 8], [2, 8, 9, 9], [3, 9, 7, 7], [4, 6, 6, 8], [4, 7, 9, 5], [5, 8, 6, 5]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 5
 Total pinning sets: 376
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.49
 Average overall degree: 3.04

Table 731: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	8	46	90	105	77	35	9	1	371
Average degree	2.25	2.57	2.8	2.97	3.08	3.17	3.24	3.29	3.33	

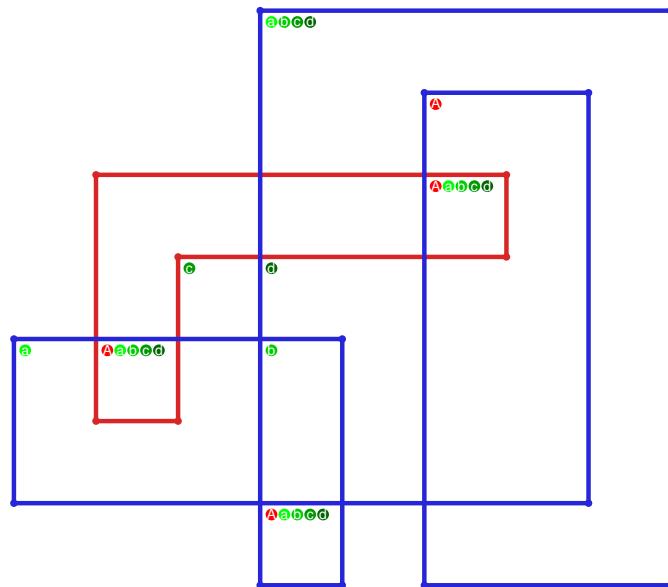


Figure 1465: SnapPy multiloop plot.

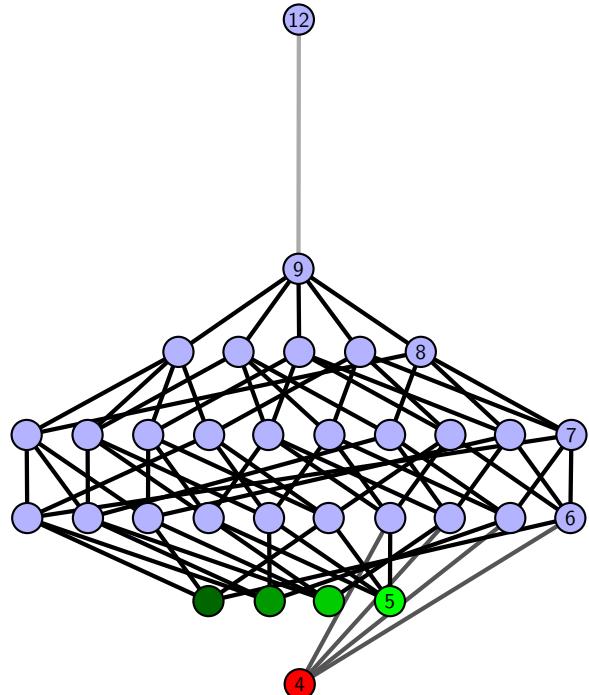


Figure 1466: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.436 $[[6, 10, 1, 7], [7, 5, 8, 6], [9, 16, 10, 11], [1, 16, 2, 15], [4, 14, 5, 15], [8, 12, 9, 11], [2, 17, 3, 20], [3, 19, 4, 20], [13, 18, 14, 19], [12, 18, 13, 17]]$

PD code drawn by SnapPy: $[(17, 2, 18, 3), (3, 20, 4, 17), (1, 16, 2, 11), (11, 4, 12, 5), (19, 12, 20, 13), (13, 18, 14, 19), (15, 10, 16, 7), (6, 7, 1, 8), (8, 5, 9, 6), (9, 14, 10, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 7, 8], [1, 9, 2, 2], [3, 9, 7, 7], [4, 6, 6, 8], [4, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 732: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

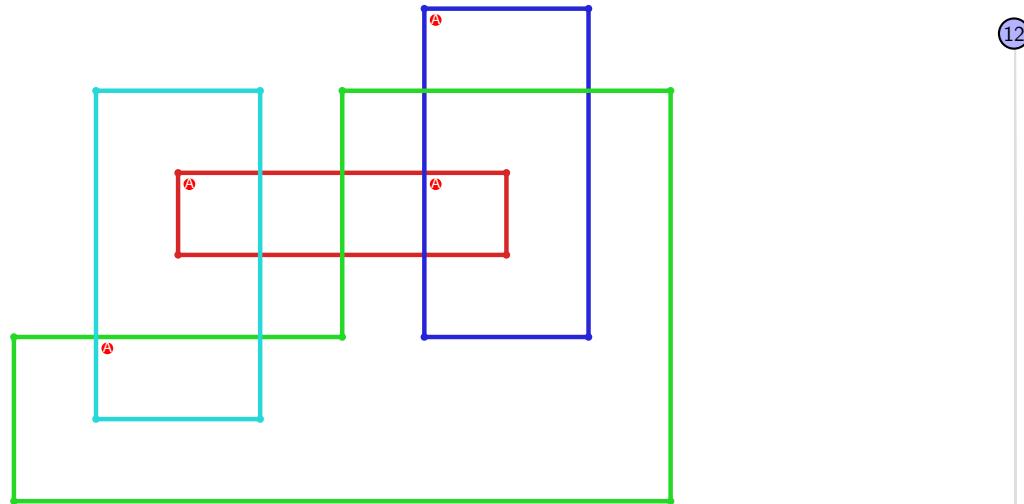


Figure 1467: SnapPy multiloop plot.

4

Figure 1468: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.437 `[[16, 9, 1, 10], [10, 15, 11, 16], [11, 8, 12, 9], [1, 12, 2, 13], [5, 14, 6, 15], [7, 20, 8, 17], [2, 20, 3, 19], [13, 4, 14, 5], [6, 18, 7, 17], [3, 18, 4, 19]]`

PD code drawn by `SnapPy`: `[(10, 1, 11, 2), (8, 5, 9, 6), (13, 6, 14, 7), (14, 9, 15, 10), (2, 11, 3, 12), (7, 12, 8, 13), (20, 3, 17, 4), (16, 17, 1, 18), (18, 15, 19, 16), (4, 19, 5, 20)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 8], [2, 8, 8, 6], [3, 5, 9, 9], [3, 9, 4, 4], [4, 9, 5, 5], [6, 8, 7, 6]]`

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 733: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

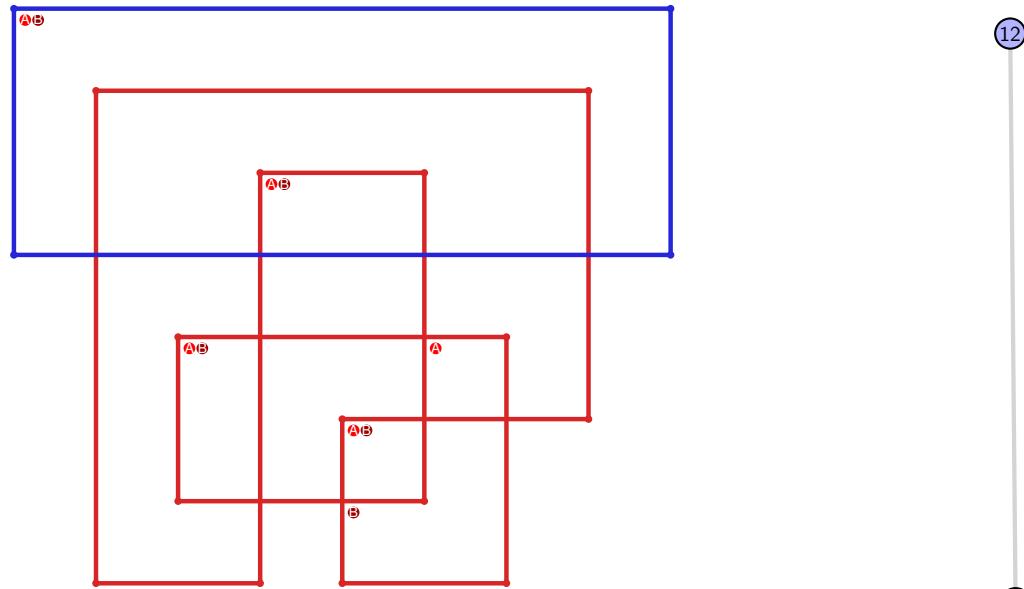


Figure 1469: `SnapPy` multiloop plot.

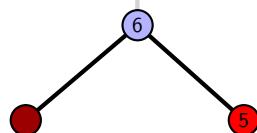


Figure 1470: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.438 [[5, 16, 6, 1], [13, 4, 14, 5], [15, 20, 16, 17], [6, 20, 7, 19], [1, 11, 2, 10], [3, 12, 4, 13], [14, 18, 15, 17], [7, 18, 8, 19], [11, 8, 12, 9], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(11, 2, 12, 3), (9, 6, 10, 7), (16, 7, 1, 8), (8, 15, 9, 16), (1, 10, 2, 11), (3, 14, 4, 15), (5, 20, 6, 17), (17, 4, 18, 5), (13, 18, 14, 19), (19, 12, 20, 13)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 3], [0, 2, 7, 7], [0, 8, 9, 9], [1, 9, 8, 1], [1, 7, 2, 2], [3, 6, 8, 3], [4, 7, 5, 9], [4, 8, 5, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 734: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

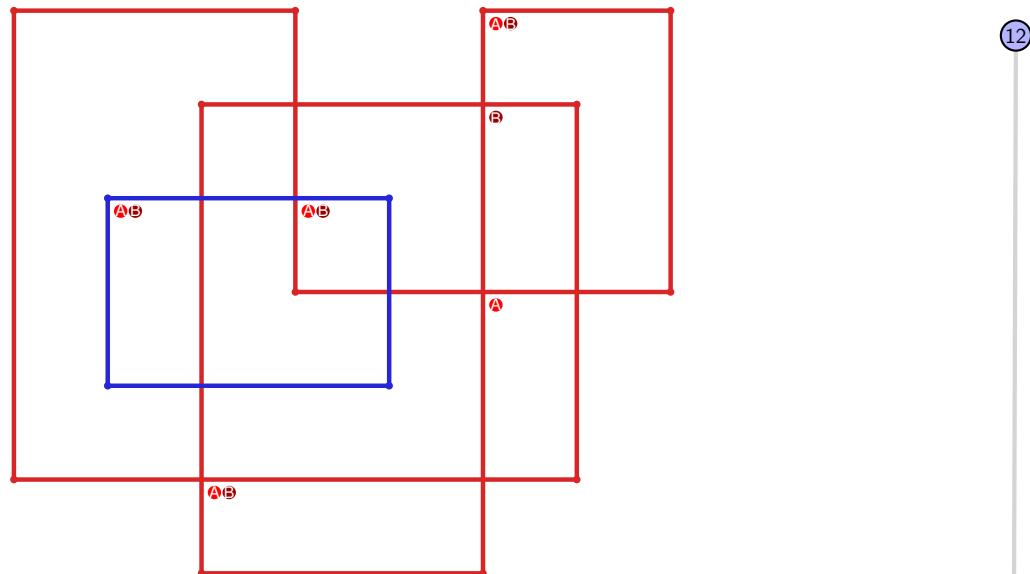


Figure 1471: SnapPy multiloop plot.

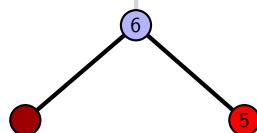


Figure 1472: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.439 [[14, 20, 1, 15], [15, 12, 16, 11], [13, 10, 14, 11], [5, 19, 6, 20], [1, 18, 2, 17], [12, 17, 13, 16], [4, 9, 5, 10], [18, 6, 19, 7], [2, 7, 3, 8], [8, 3, 9, 4]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (15, 4, 16, 5), (14, 5, 1, 6), (2, 7, 3, 8), (11, 8, 12, 9), (9, 18, 10, 19), (19, 10, 20, 11), (20, 13, 15, 14), (3, 16, 4, 17), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 7, 8, 5], [1, 4, 2, 1], [2, 9, 9, 3], [3, 8, 4, 3], [4, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 735: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

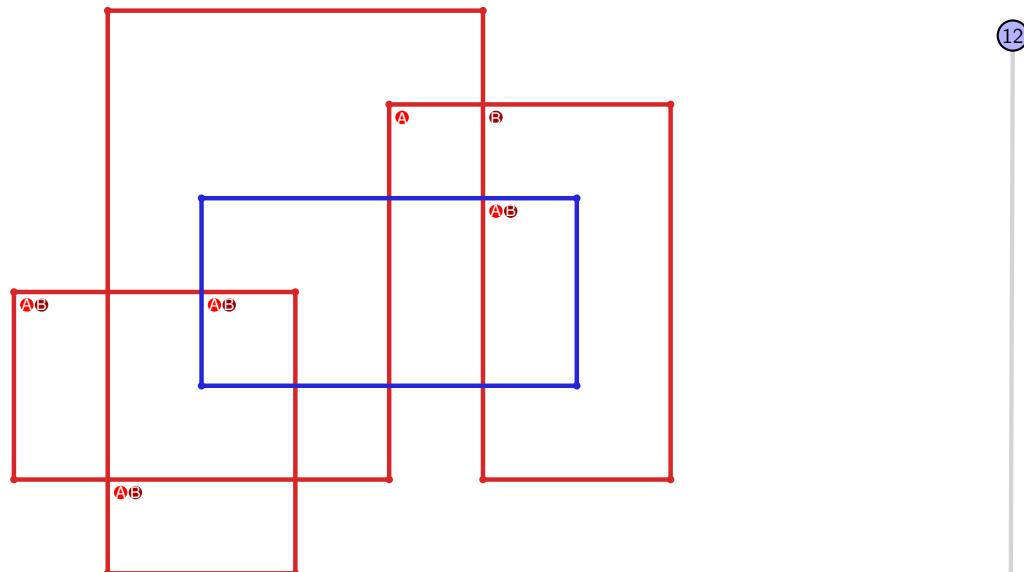


Figure 1473: SnapPy multiloop plot.

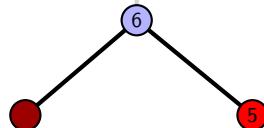


Figure 1474: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.440 $[[10, 20, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [19, 16, 20, 17], [1, 14, 2, 13], [8, 13, 9, 12], [5, 17, 6, 18], [18, 4, 19, 5], [15, 3, 16, 4], [14, 3, 15, 2]]$

PD code drawn by `SnapPy`: $[(10, 11, 1, 12), (12, 1, 13, 2), (15, 2, 16, 3), (7, 4, 8, 5), (5, 18, 6, 19), (19, 6, 20, 7), (20, 9, 11, 10), (16, 13, 17, 14), (3, 14, 4, 15), (8, 17, 9, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 9, 9, 5], [1, 4, 2, 1], [2, 7, 7, 3], [3, 6, 6, 8], [3, 7, 9, 9], [4, 8, 8, 4]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 136
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.39
 Average overall degree: 2.98

Table 736: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	16	38	43	26	8	1	132
Average degree	2.33	2.64	2.88	3.05	3.18	3.27	3.33	

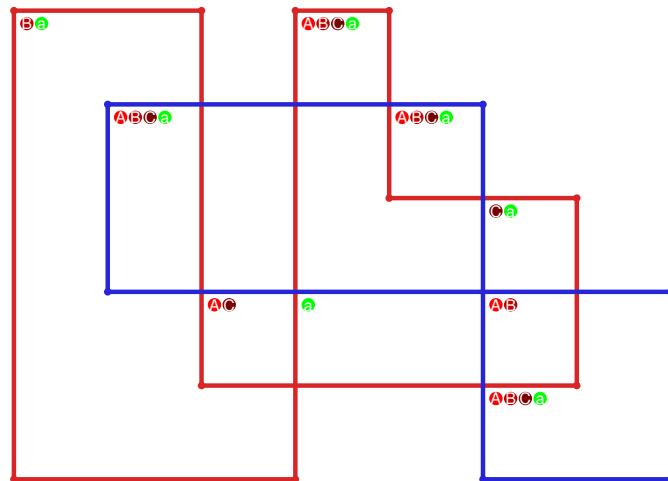


Figure 1475: `SnapPy` multiloop plot.

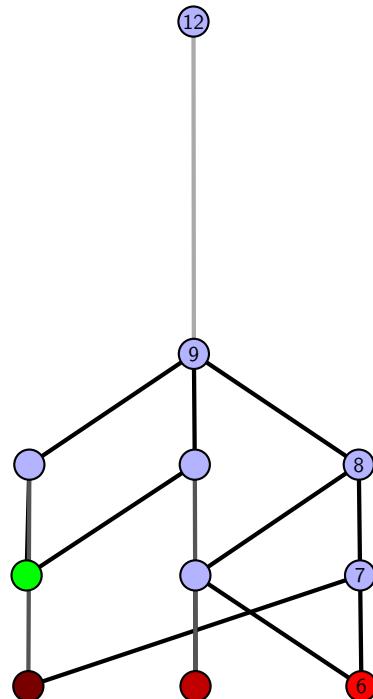


Figure 1476: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.441 $[[20, 7, 1, 8], [8, 17, 9, 18], [19, 14, 20, 15], [6, 3, 7, 4], [1, 11, 2, 10], [16, 9, 17, 10], [18, 16, 19, 15], [13, 4, 14, 5], [5, 12, 6, 13], [2, 11, 3, 12]]$

PD code drawn by `SnapPy`: $[(4, 1, 5, 2), (11, 2, 12, 3), (18, 5, 19, 6), (14, 7, 15, 8), (8, 19, 9, 20), (20, 9, 1, 10), (3, 10, 4, 11), (17, 12, 18, 13), (13, 16, 14, 17), (6, 15, 7, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 7], [0, 7, 8, 9], [0, 9, 9, 5], [1, 4, 6, 1], [1, 5, 2, 2], [2, 8, 8, 3], [3, 7, 7, 9], [3, 8, 4, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 4

Average minimal degree: 2.38

Total pinning sets: 184

Average overall degree: 2.98

Pinning number: 5

Table 737: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.2	2.5	2.76	2.95	3.09	3.19	3.27	3.33	

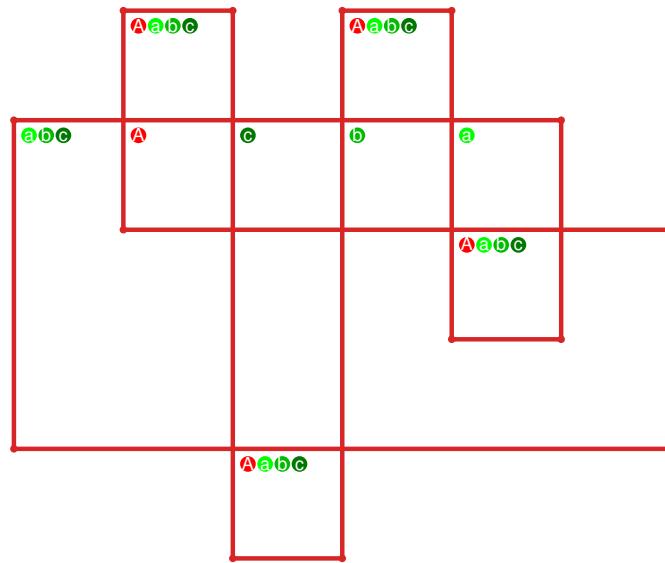


Figure 1477: `SnapPy` multiloop plot.

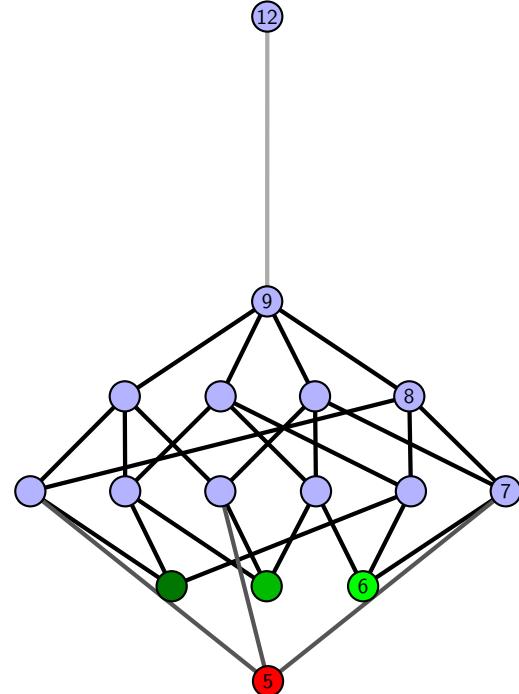


Figure 1478: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.442 $[[10, 20, 1, 11], [11, 5, 12, 6], [6, 9, 7, 10], [7, 19, 8, 20], [1, 15, 2, 16], [16, 4, 17, 5], [12, 17, 13, 18], [18, 8, 19, 9], [14, 2, 15, 3], [3, 13, 4, 14]]$

PD code drawn by `SnapPy`: $[(14, 1, 15, 2), (19, 2, 20, 3), (16, 5, 17, 6), (3, 6, 4, 7), (12, 9, 13, 10), (10, 11, 1, 12), (8, 13, 9, 14), (20, 15, 11, 16), (4, 17, 5, 18), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 3], [0, 2, 7, 7], [0, 8, 8, 5], [1, 4, 9, 6], [1, 5, 9, 7], [2, 6, 3, 3], [4, 9, 9, 4], [5, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 5

Average minimal degree: 2.56

Total pinning sets: 220

Average overall degree: 3.04

Pinning number: 5

Table 738: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	1	0	0	0	0	0	4
Nonminimal pinning sets	0	7	36	66	63	33	9	1	215
Average degree	2.4	2.63	2.83	3.01	3.14	3.23	3.29	3.33	

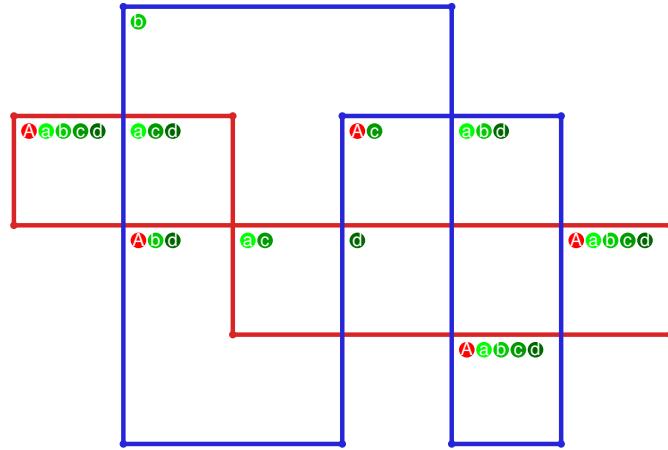


Figure 1479: `SnapPy` multiloop plot.

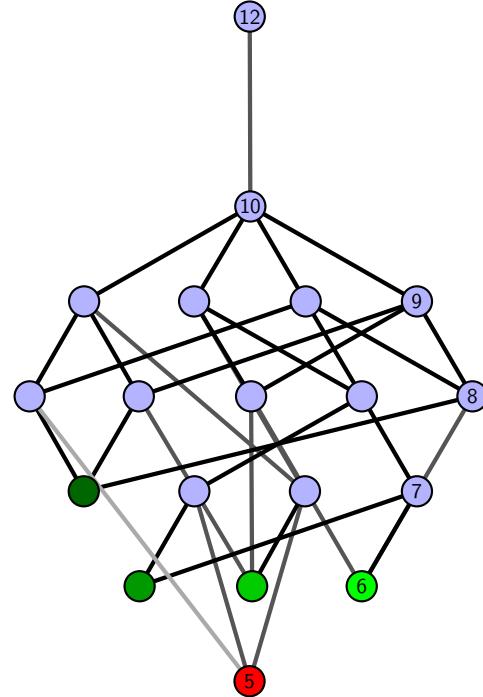


Figure 1480: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.443 $[[7, 20, 8, 1], [11, 6, 12, 7], [19, 8, 20, 9], [1, 19, 2, 18], [10, 17, 11, 18], [5, 12, 6, 13], [9, 3, 10, 2], [16, 13, 17, 14], [4, 15, 5, 16], [3, 15, 4, 14]]$

PD code drawn by `SnapPy`: $[(8, 3, 9, 4), (16, 5, 17, 6), (2, 9, 3, 10), (13, 10, 14, 11), (11, 20, 12, 1), (1, 12, 2, 13), (7, 14, 8, 15), (15, 18, 16, 19), (4, 17, 5, 18), (19, 6, 20, 7)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 3, 0], [0, 2, 6, 4], [1, 3, 6, 7], [1, 7, 8, 1], [2, 9, 4, 3], [4, 9, 8, 5], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 8
Total minimal pinning sets: 8
Total pinning sets: 216
Pinning number: 6

Average optimal degree: 2.56
Average minimal degree: 2.56
Average overall degree: 3.04

Table 739: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	36	66	63	33	9	1	208
Average degree	2.56	2.82	3.01	3.14	3.23	3.29	3.33	

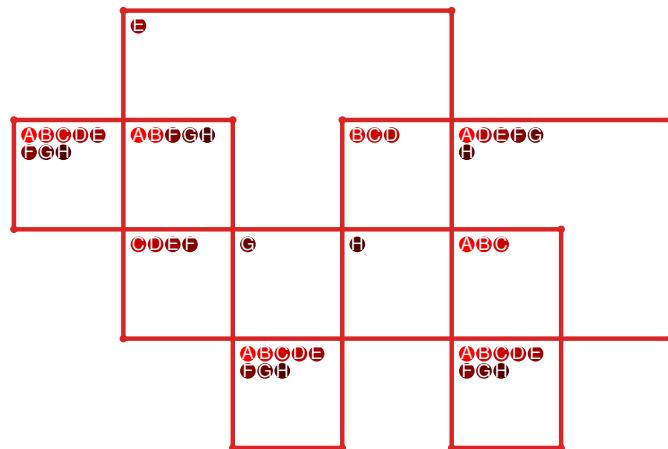


Figure 1481: `SnapPy` multiloop plot.

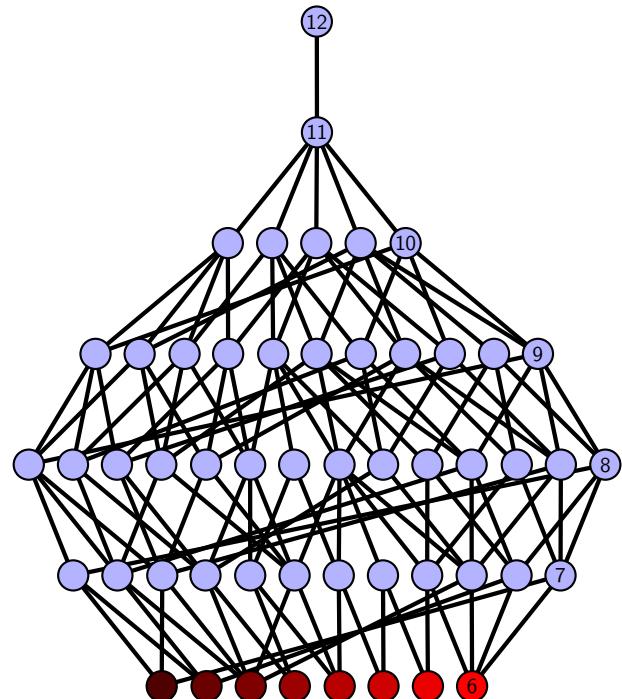


Figure 1482: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.444 $[[9, 20, 10, 1], [13, 8, 14, 9], [19, 10, 20, 11], [1, 19, 2, 18], [3, 12, 4, 13], [4, 7, 5, 8], [14, 5, 15, 6], [11, 16, 12, 17], [2, 17, 3, 18], [6, 15, 7, 16]]$

PD code drawn by SnapPy: $[(11, 2, 12, 3), (1, 4, 2, 5), (10, 5, 11, 6), (16, 7, 17, 8), (20, 9, 1, 10), (3, 12, 4, 13), (8, 13, 9, 14), (19, 14, 20, 15), (15, 18, 16, 19), (6, 17, 7, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 3, 0], [0, 2, 8, 8], [1, 8, 7, 5], [1, 4, 9, 6], [1, 5, 9, 9], [2, 9, 4, 8], [3, 7, 4, 3], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 8

Average minimal degree: 2.63

Total pinning sets: 254

Average overall degree: 3.05

Pinning number: 5

Table 740: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	1	0	0	0	0	0	7
Nonminimal pinning sets	0	7	47	79	69	34	9	1	246
Average degree	2.4	2.64	2.87	3.04	3.15	3.24	3.29	3.33	

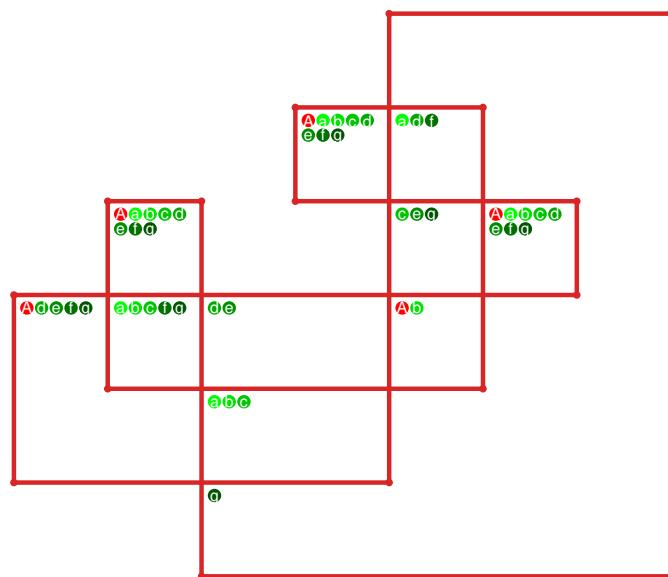


Figure 1483: SnapPy multiloop plot.

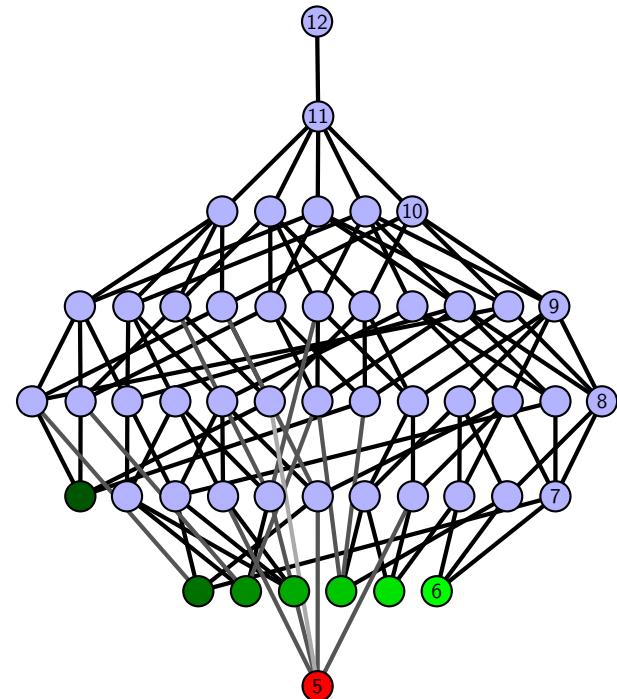


Figure 1484: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.445 $[[12, 20, 1, 13], [13, 10, 14, 9], [17, 11, 18, 12], [19, 1, 20, 2], [10, 3, 11, 4], [14, 8, 15, 9], [6, 16, 7, 17], [18, 3, 19, 2], [4, 7, 5, 8], [15, 5, 16, 6]]$

PD code drawn by SnapPy: $[(12, 13, 1, 14), (8, 1, 9, 2), (18, 3, 19, 4), (2, 5, 3, 6), (17, 6, 18, 7), (7, 16, 8, 17), (20, 9, 13, 10), (14, 11, 15, 12), (4, 19, 5, 20), (10, 15, 11, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 4, 7], [0, 7, 7, 0], [1, 7, 2, 8], [1, 8, 9, 1], [2, 9, 9, 8], [2, 4, 3, 3], [4, 6, 9, 5], [5, 8, 6, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.98

Table 741: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

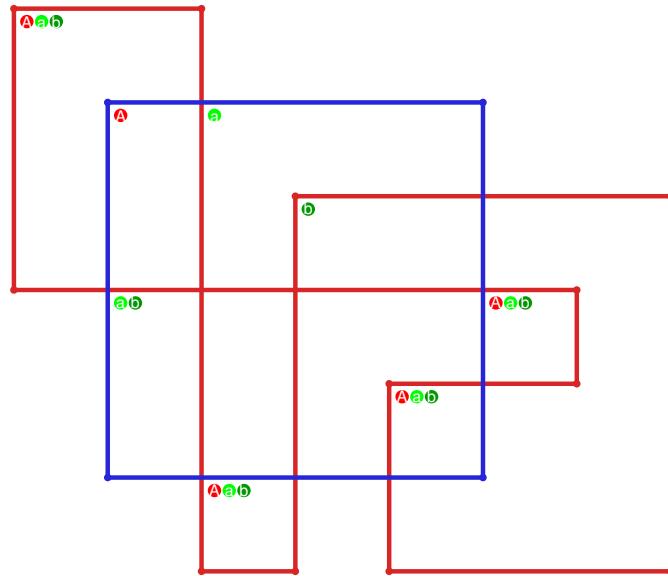


Figure 1485: SnapPy multiloop plot.

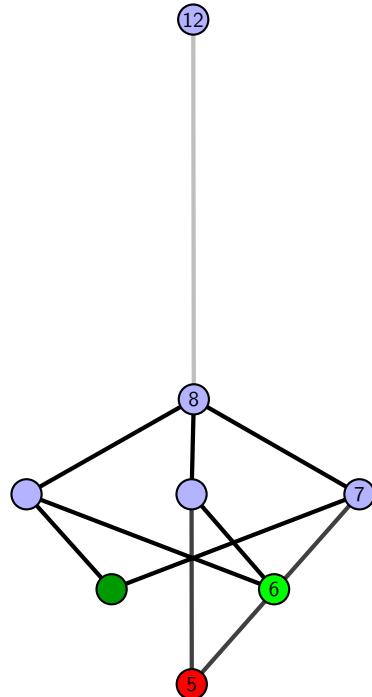


Figure 1486: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.446 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 18, 11, 17], [1, 12, 2, 13], [7, 18, 8, 19], [11, 16, 12, 17], [2, 5, 3, 6], [13, 6, 14, 7], [4, 15, 5, 16], [3, 15, 4, 14]]$

PD code drawn by `SnapPy`: $[(19, 2, 20, 3), (10, 3, 11, 4), (16, 5, 17, 6), (18, 9, 19, 10), (11, 20, 12, 1), (1, 12, 2, 13), (8, 13, 9, 14), (14, 7, 15, 8), (4, 15, 5, 16), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 5, 6, 7], [1, 7, 2, 1], [2, 8, 3, 2], [3, 8, 9, 7], [3, 6, 9, 4], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 742: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

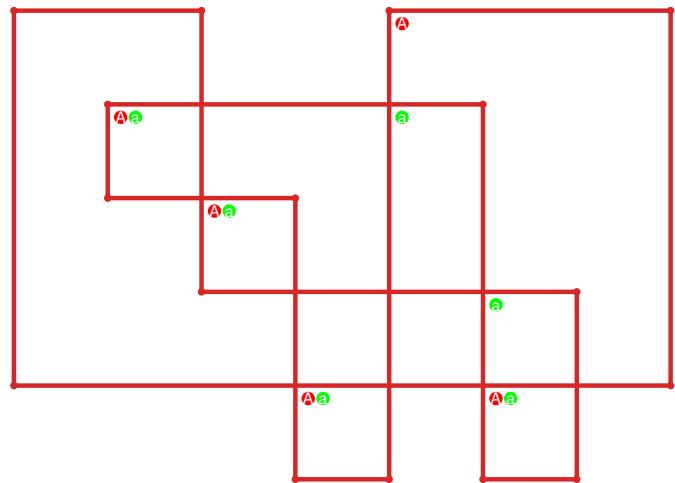


Figure 1487: `SnapPy` multiloop plot.



Figure 1488: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.447 `[[10, 20, 1, 11], [11, 9, 12, 10], [14, 19, 15, 20], [1, 15, 2, 16], [8, 12, 9, 13], [13, 7, 14, 8], [4, 18, 5, 19], [2, 5, 3, 6], [16, 6, 17, 7], [17, 3, 18, 4]]`

PD code drawn by `SnapPy`: `[(20, 1, 11, 2), (10, 3, 1, 4), (19, 4, 20, 5), (16, 5, 17, 6), (14, 7, 15, 8), (9, 18, 10, 19), (2, 11, 3, 12), (17, 12, 18, 13), (8, 13, 9, 14), (6, 15, 7, 16)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 8], [1, 5, 5, 1], [2, 4, 4, 8], [2, 9, 9, 7], [3, 6, 9, 8], [3, 7, 9, 5], [6, 8, 7, 6]]`

Total optimal pinning sets: 4

Average optimal degree: 2.38

Total minimal pinning sets: 4

Average minimal degree: 2.38

Total pinning sets: 144

Average overall degree: 2.98

Pinning number: 6

Table 743: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.38	2.68	2.9	3.06	3.18	3.27	3.33	

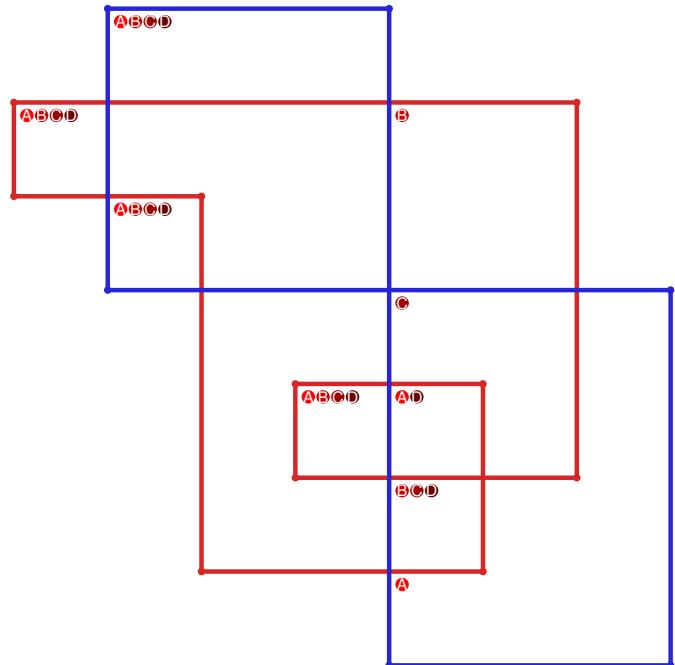


Figure 1489: `SnapPy` multiloop plot.

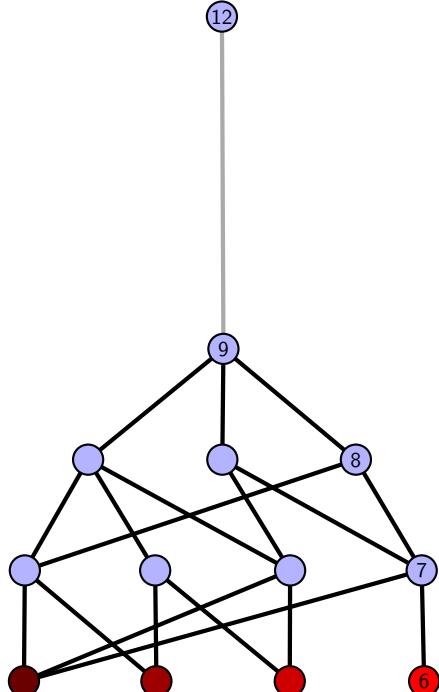


Figure 1490: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.448 [[20, 15, 1, 16], [16, 9, 17, 10], [12, 19, 13, 20], [14, 1, 15, 2], [8, 17, 9, 18], [10, 5, 11, 6], [6, 11, 7, 12], [18, 3, 19, 4], [13, 3, 14, 2], [4, 7, 5, 8]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (7, 2, 8, 3), (1, 4, 2, 5), (13, 6, 14, 7), (3, 8, 4, 9), (17, 12, 18, 13), (5, 14, 6, 15), (9, 16, 10, 17), (11, 18, 12, 19), (19, 10, 20, 11)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 7, 8], [0, 8, 8, 0], [1, 7, 9, 1], [1, 9, 6, 6], [2, 5, 5, 9], [2, 9, 4, 8], [2, 7, 3, 3], [4, 7, 6, 5]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 4
 Total pinning sets: 216
 Pinning number: 5

Average optimal degree: 2.3
 Average minimal degree: 2.36
 Average overall degree: 2.98

Table 744: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	43	64	55	28	8	1	212
Average degree	2.3	2.58	2.81	2.98	3.11	3.2	3.27	3.33	

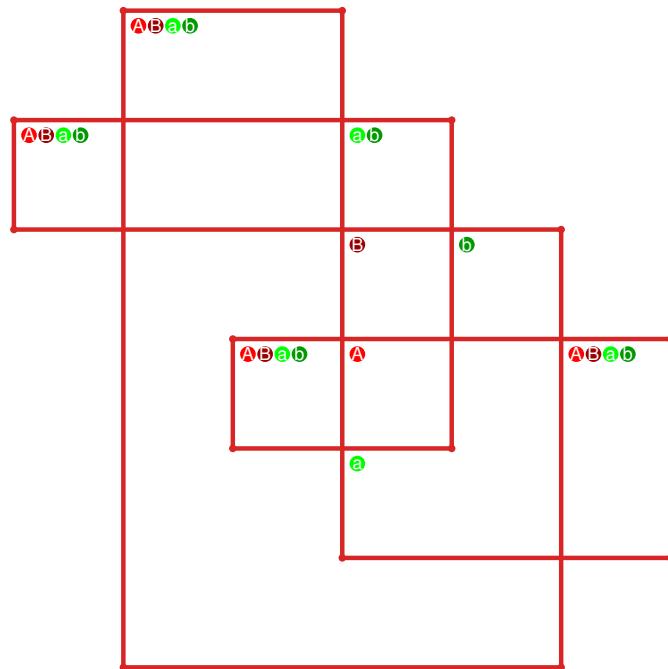


Figure 1491: SnapPy multiloop plot.

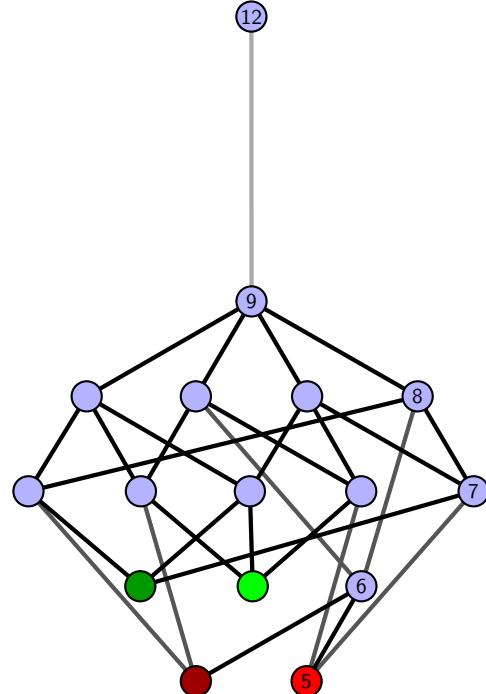


Figure 1492: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.449 [[14, 20, 1, 15], [15, 9, 16, 10], [10, 13, 11, 14], [11, 19, 12, 20], [1, 6, 2, 7], [3, 8, 4, 9], [16, 4, 17, 5], [18, 12, 19, 13], [5, 17, 6, 18], [2, 8, 3, 7]]

PD code drawn by `SnapPy`: [(15, 2, 16, 3), (13, 4, 14, 5), (5, 14, 6, 1), (1, 6, 2, 7), (20, 7, 15, 8), (17, 10, 18, 11), (8, 11, 9, 12), (3, 16, 4, 17), (9, 18, 10, 19), (12, 19, 13, 20)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 3], [0, 2, 7, 7], [0, 8, 9, 9], [1, 9, 9, 6], [1, 5, 8, 8], [2, 8, 3, 3], [4, 7, 6, 6], [4, 5, 5, 4]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.97

Table 745: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

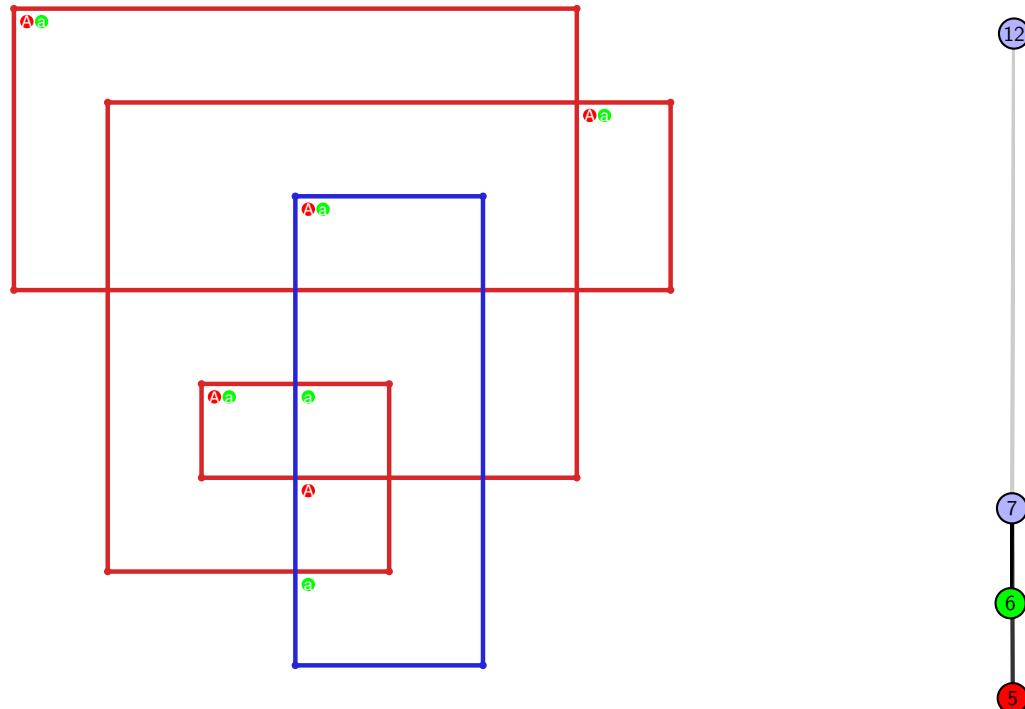


Figure 1493: `SnapPy` multiloop plot.

Figure 1494: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.450 $[[20, 7, 1, 8], [8, 15, 9, 16], [16, 19, 17, 20], [17, 6, 18, 7], [1, 13, 2, 12], [14, 9, 15, 10], [5, 18, 6, 19], [13, 5, 14, 4], [2, 11, 3, 12], [10, 3, 11, 4]]$

PD code drawn by `SnapPy`: $[(7, 20, 8, 1), (1, 10, 2, 11), (14, 3, 15, 4), (17, 4, 18, 5), (11, 6, 12, 7), (19, 8, 20, 9), (9, 18, 10, 19), (5, 12, 6, 13), (2, 15, 3, 16), (13, 16, 14, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 6, 6], [0, 7, 8, 8], [1, 9, 7, 1], [2, 7, 3, 3], [4, 6, 5, 9], [4, 9, 9, 4], [5, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 746: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

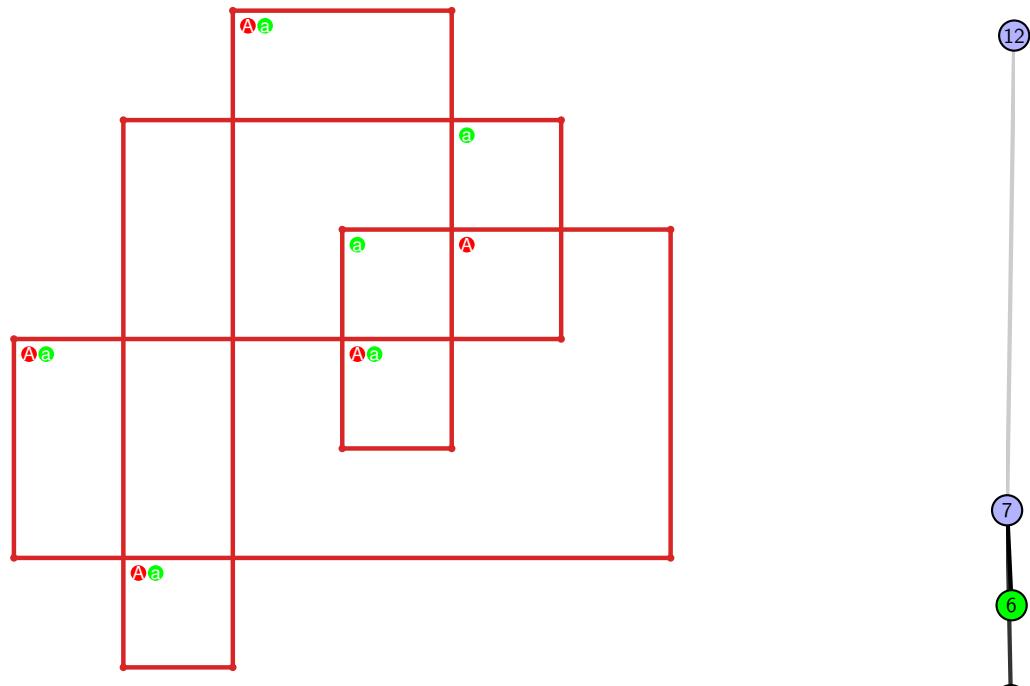


Figure 1495: `SnapPy` multiloop plot.

Figure 1496: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.451 [[20, 15, 1, 16], [16, 9, 17, 10], [10, 19, 11, 20], [5, 14, 6, 15], [1, 6, 2, 7], [8, 17, 9, 18], [18, 7, 19, 8], [11, 4, 12, 5], [13, 2, 14, 3], [3, 12, 4, 13]]

PD code drawn by SnapPy: [(11, 20, 12, 1), (9, 2, 10, 3), (19, 4, 20, 5), (16, 5, 17, 6), (14, 7, 15, 8), (1, 10, 2, 11), (3, 12, 4, 13), (18, 13, 19, 14), (6, 15, 7, 16), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 8, 4], [0, 3, 8, 6], [1, 6, 6, 1], [2, 5, 5, 4], [2, 9, 9, 3], [3, 9, 9, 4], [7, 8, 8, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 747: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

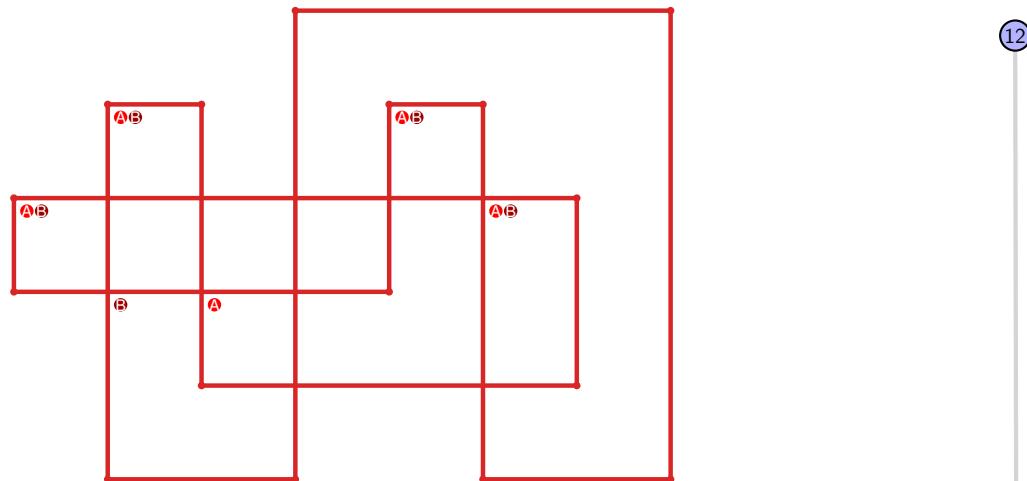


Figure 1497: SnapPy multiloop plot.

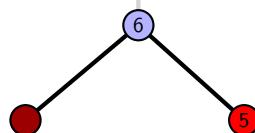


Figure 1498: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.452 `[[8, 20, 1, 9], [9, 7, 10, 8], [10, 19, 11, 20], [1, 13, 2, 14], [14, 6, 15, 7], [18, 11, 19, 12], [12, 17, 13, 18], [2, 5, 3, 6], [15, 3, 16, 4], [4, 16, 5, 17]]`

PD code drawn by `SnapPy`: `[(20, 1, 9, 2), (8, 3, 1, 4), (19, 4, 20, 5), (14, 5, 15, 6), (11, 16, 12, 17), (7, 18, 8, 19), (2, 9, 3, 10), (17, 10, 18, 11), (15, 12, 16, 13), (6, 13, 7, 14)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 4], [1, 3, 7, 8], [2, 6, 6, 2], [3, 5, 5, 9], [3, 9, 8, 4], [4, 7, 9, 9], [6, 8, 8, 7]]`

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 160
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.27
 Average overall degree: 2.97

Table 748: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

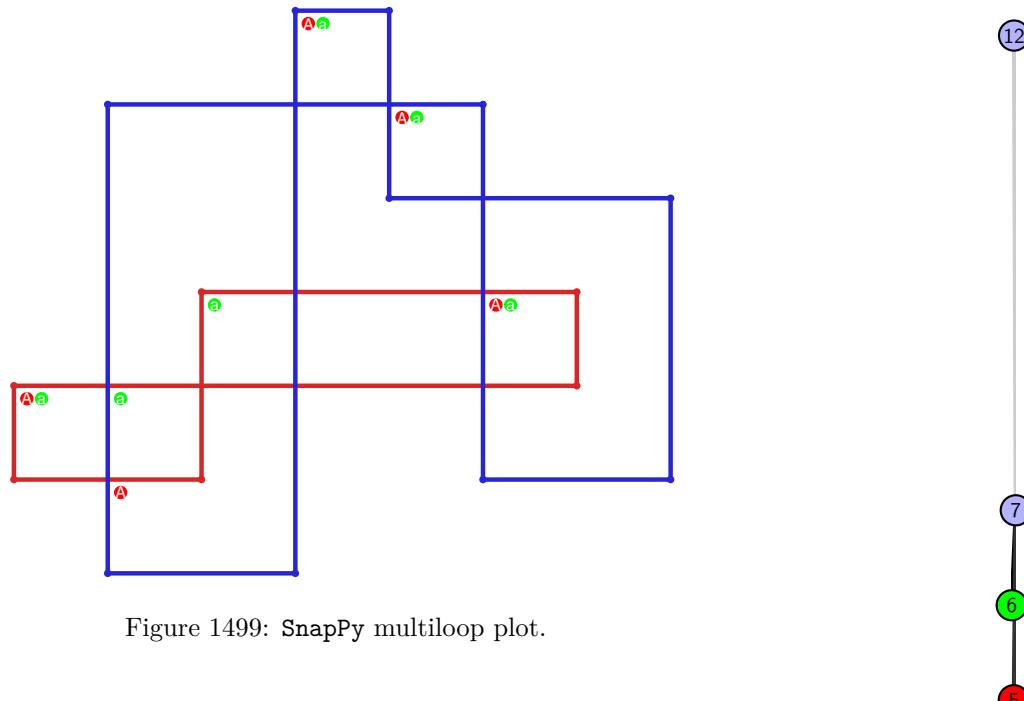


Figure 1499: `SnapPy` multiloop plot.

Figure 1500: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.453 [[10, 20, 1, 11], [11, 9, 12, 10], [12, 19, 13, 20], [1, 13, 2, 14], [14, 8, 15, 9], [6, 18, 7, 19], [2, 7, 3, 8], [15, 5, 16, 6], [17, 3, 18, 4], [4, 16, 5, 17]]

PD code drawn by `SnapPy`: [(11, 10, 12, 1), (19, 2, 20, 3), (9, 4, 10, 5), (18, 5, 19, 6), (15, 6, 16, 7), (8, 17, 9, 18), (1, 20, 2, 11), (3, 12, 4, 13), (16, 13, 17, 14), (7, 14, 8, 15)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [2, 7, 8, 6], [3, 5, 8, 4], [4, 9, 9, 5], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 4

Average minimal degree: 2.5

Total pinning sets: 344

Average overall degree: 3.04

Pinning number: 4

Table 749: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	2	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	34	78	99	76	35	9	1	340
Average degree	2.25	2.58	2.79	2.95	3.07	3.17	3.24	3.29	3.33	

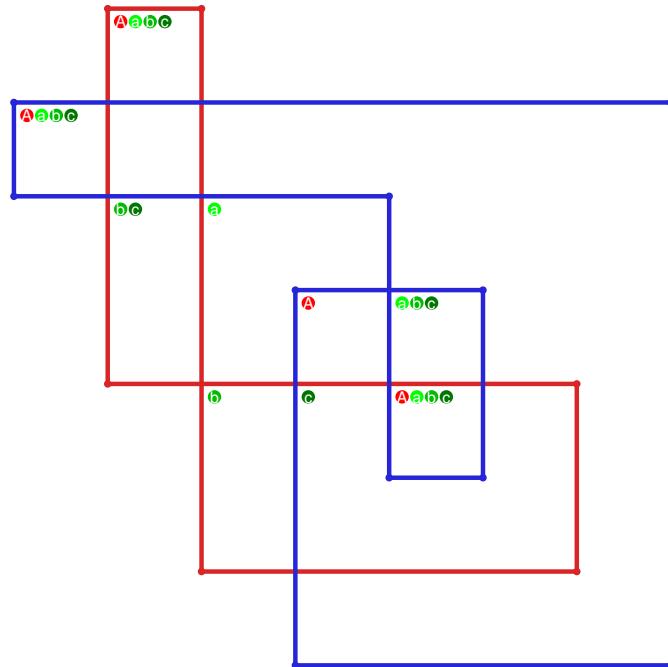


Figure 1501: `SnapPy` multiloop plot.

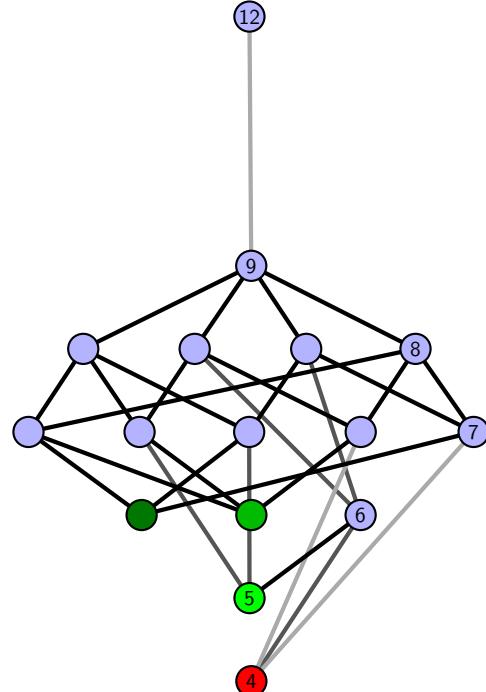


Figure 1502: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.454 [[20, 9, 1, 10], [10, 19, 11, 20], [11, 8, 12, 9], [1, 12, 2, 13], [13, 18, 14, 19], [16, 7, 17, 8], [2, 17, 3, 18], [14, 6, 15, 5], [15, 4, 16, 5], [6, 3, 7, 4]]

PD code drawn by SnapPy: [(11, 20, 12, 1), (1, 10, 2, 11), (12, 3, 13, 4), (7, 4, 8, 5), (16, 5, 17, 6), (17, 8, 18, 9), (18, 13, 19, 14), (9, 14, 10, 15), (6, 15, 7, 16), (2, 19, 3, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [2, 8, 9, 6], [3, 5, 9, 4], [4, 9, 8, 8], [5, 7, 7, 9], [5, 8, 7, 6]]

Total optimal pinning sets: 3

Average optimal degree: 2.67

Total minimal pinning sets: 12

Average minimal degree: 2.79

Total pinning sets: 386

Average overall degree: 3.12

Pinning number: 5

Table 750: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	8	1	0	0	0	0	0	9
Nonminimal pinning sets	0	20	84	122	95	42	10	1	374
Average degree	2.67	2.85	3.01	3.13	3.22	3.27	3.31	3.33	

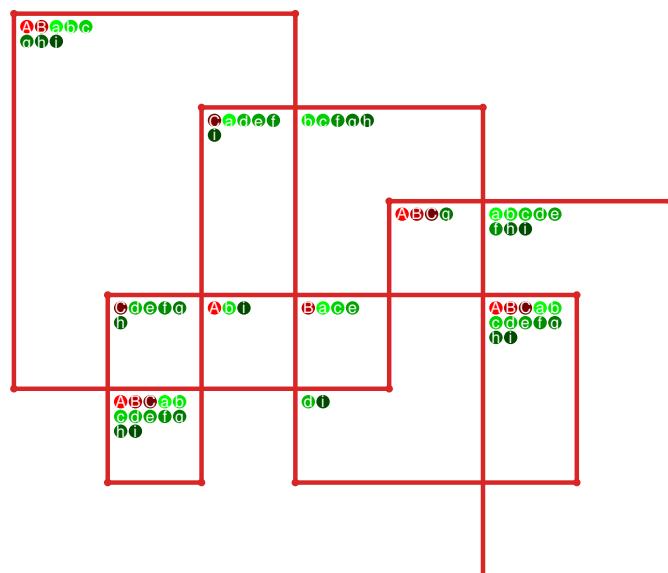


Figure 1503: SnapPy multiloop plot.

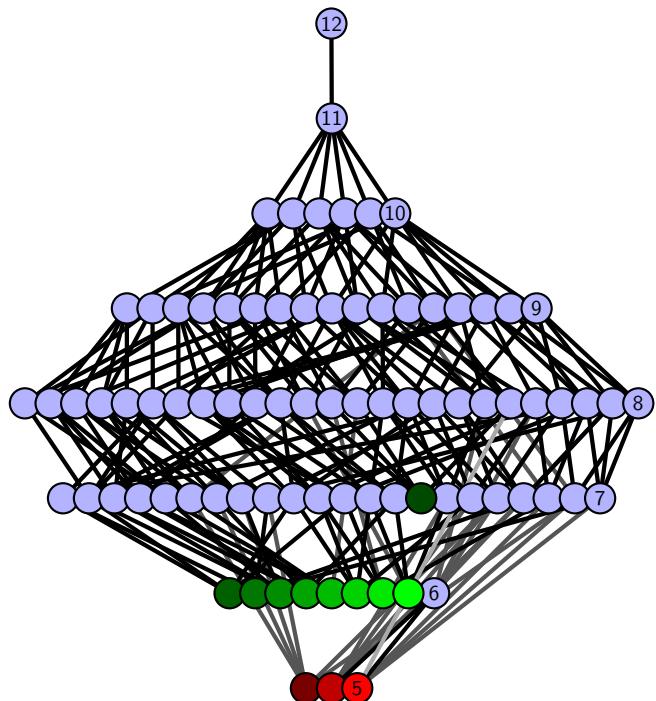


Figure 1504: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.455 $[[8, 20, 1, 9], [9, 7, 10, 8], [10, 19, 11, 20], [1, 11, 2, 12], [12, 6, 13, 7], [18, 15, 19, 16], [2, 15, 3, 14], [5, 13, 6, 14], [16, 5, 17, 4], [17, 3, 18, 4]]$

PD code drawn by SnapPy: $[(8, 9, 1, 10), (17, 2, 18, 3), (14, 3, 15, 4), (10, 7, 11, 8), (5, 16, 6, 17), (1, 18, 2, 19), (19, 6, 20, 7), (11, 20, 12, 9), (15, 12, 16, 13), (4, 13, 5, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 7, 7], [2, 8, 9, 6], [3, 5, 9, 7], [4, 6, 8, 4], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 272
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 3.04

Table 751: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

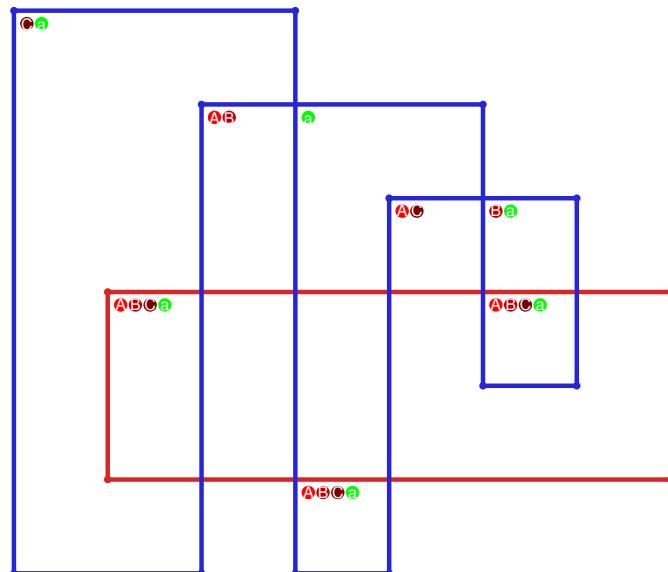


Figure 1505: SnapPy multiloop plot.

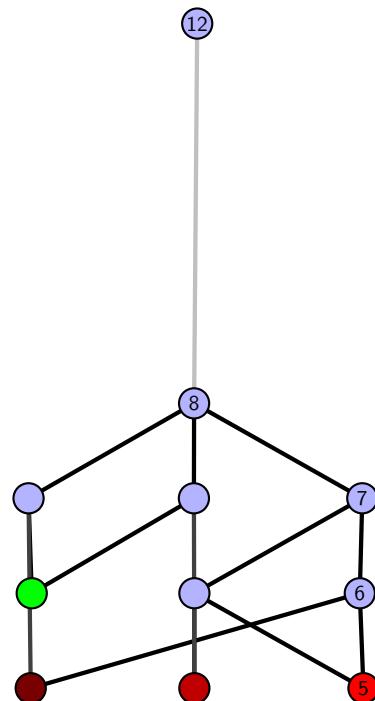


Figure 1506: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.456 $[[6, 20, 1, 7], [7, 5, 8, 6], [8, 19, 9, 20], [1, 9, 2, 10], [10, 4, 11, 5], [18, 15, 19, 16], [2, 15, 3, 14], [3, 13, 4, 14], [11, 17, 12, 16], [12, 17, 13, 18]]$

PD code drawn by `SnapPy`: $[(18, 1, 19, 2), (15, 2, 16, 3), (4, 17, 5, 18), (6, 7, 1, 8), (8, 5, 9, 6), (12, 9, 13, 10), (10, 19, 11, 20), (20, 11, 7, 12), (16, 13, 17, 14), (3, 14, 4, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 7, 8], [2, 8, 9, 6], [3, 5, 7, 7], [4, 6, 6, 9], [4, 9, 9, 5], [5, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 384
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.25
 Average overall degree: 3.03

Table 752: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

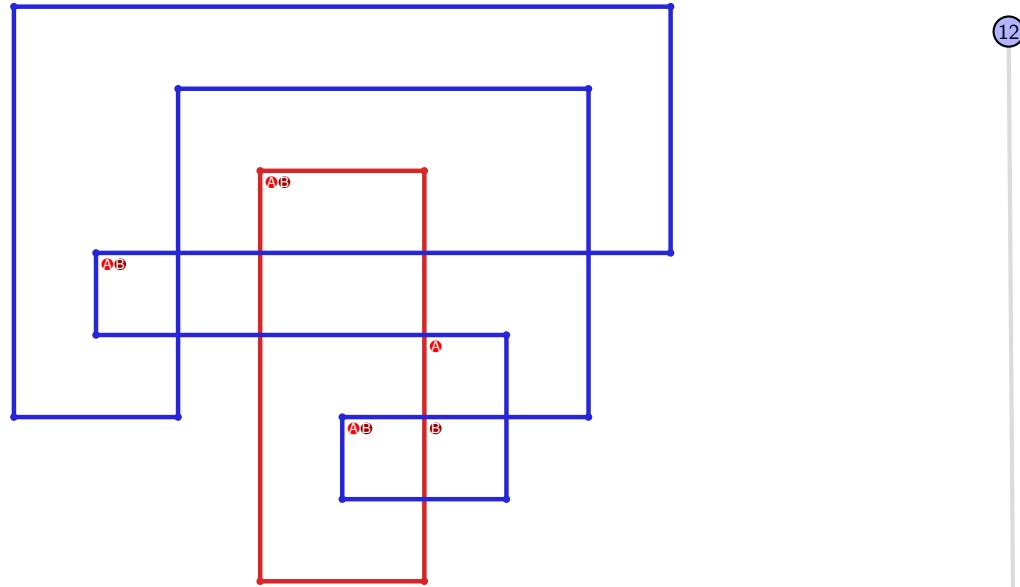


Figure 1507: `SnapPy` multiloop plot.

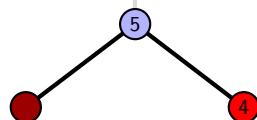


Figure 1508: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.457 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 8, 11, 7], [1, 7, 2, 6], [18, 5, 19, 6], [11, 16, 12, 17], [2, 17, 3, 18], [4, 13, 5, 14], [15, 12, 16, 13], [3, 15, 4, 14]]$

PD code drawn by SnapPy: $[(13, 20, 14, 1), (1, 16, 2, 17), (2, 5, 3, 6), (14, 3, 15, 4), (10, 7, 11, 8), (19, 8, 20, 9), (9, 18, 10, 19), (6, 11, 7, 12), (17, 12, 18, 13), (4, 15, 5, 16)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [2, 8, 8, 6], [3, 5, 9, 4], [4, 9, 9, 8], [5, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 6

Total pinning sets: 356

Pinning number: 4

Average optimal degree: 2.25

Average minimal degree: 2.59

Average overall degree: 3.05

Table 753: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	4	0	0	0	0	0	0	5
Nonminimal pinning sets	0	8	34	83	103	77	35	9	1	350
Average degree	2.25	2.58	2.79	2.95	3.08	3.17	3.24	3.29	3.33	

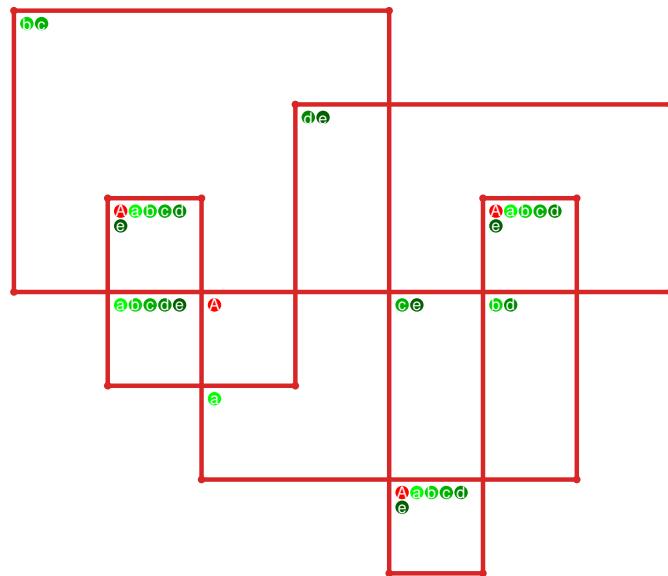


Figure 1509: SnapPy multiloop plot.

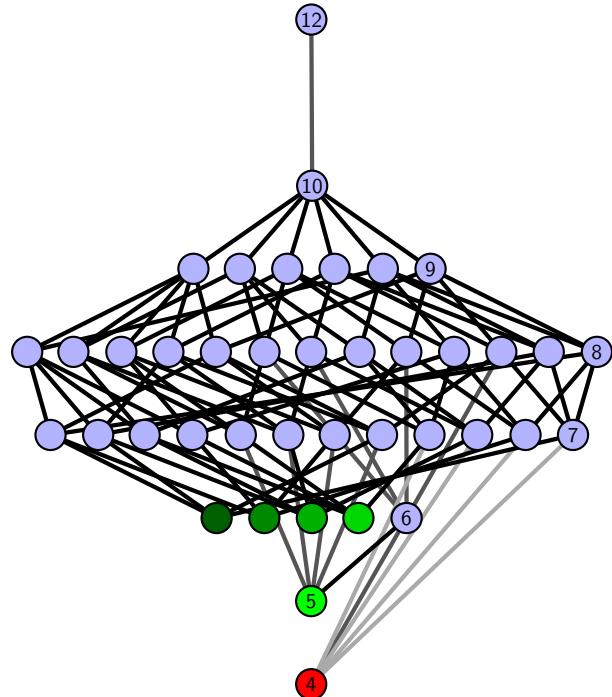


Figure 1510: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.458 $[[9, 16, 10, 1], [15, 8, 16, 9], [10, 8, 11, 7], [1, 7, 2, 6], [14, 5, 15, 6], [11, 17, 12, 20], [2, 13, 3, 14], [4, 17, 5, 18], [12, 19, 13, 20], [3, 19, 4, 18]]$

PD code drawn by SnapPy: $[(12, 3, 13, 4), (4, 15, 5, 16), (5, 8, 6, 9), (13, 6, 14, 7), (16, 11, 1, 12), (7, 14, 8, 15), (18, 1, 19, 2), (10, 19, 11, 20), (20, 9, 17, 10), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [2, 7, 8, 8], [3, 8, 9, 4], [4, 9, 9, 5], [5, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 7

Average minimal degree: 2.55

Total pinning sets: 382

Average overall degree: 3.04

Pinning number: 4

Table 754: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	0	6
Nonminimal pinning sets	0	8	49	91	105	77	35	9	1	375
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

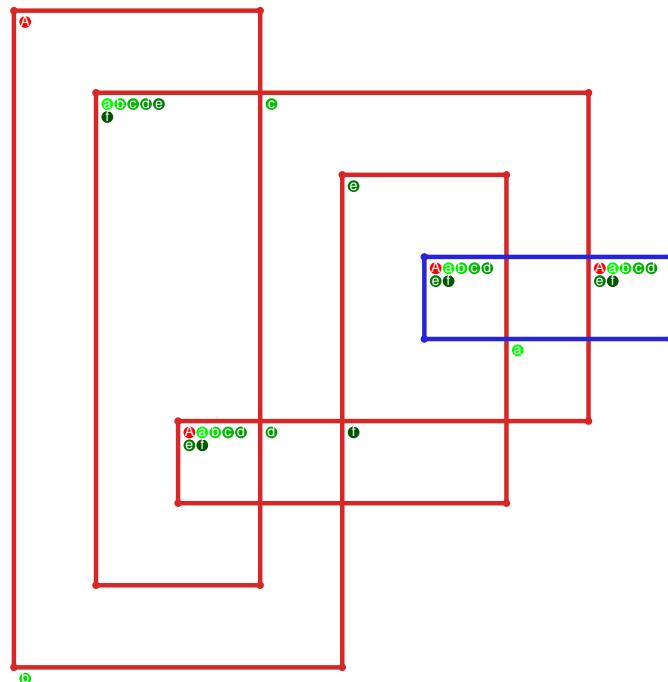


Figure 1511: SnapPy multiloop plot.

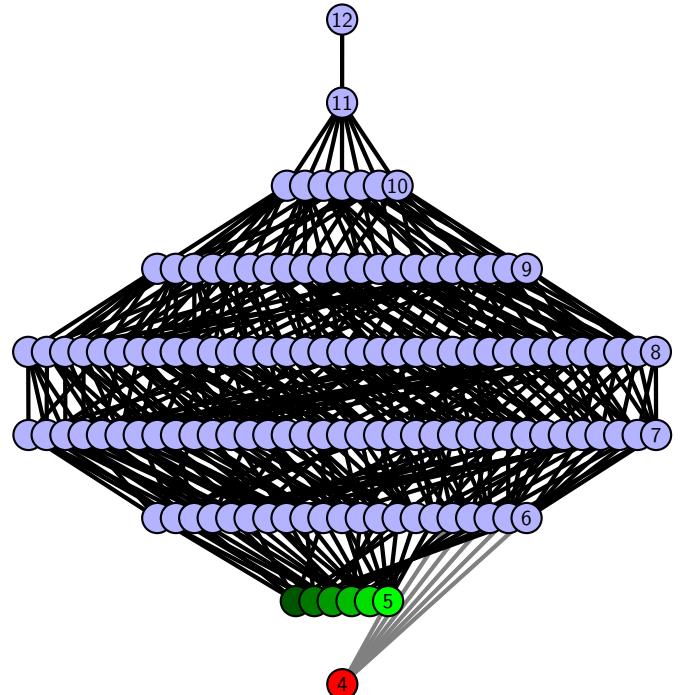


Figure 1512: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.459 $[[20, 13, 1, 14], [14, 19, 15, 20], [15, 12, 16, 13], [1, 16, 2, 17], [18, 5, 19, 6], [11, 8, 12, 9], [2, 8, 3, 7], [17, 7, 18, 6], [4, 9, 5, 10], [10, 3, 11, 4]]$

PD code drawn by SnapPy: $[(7, 20, 8, 1), (15, 2, 16, 3), (3, 14, 4, 15), (4, 19, 5, 20), (8, 5, 9, 6), (1, 6, 2, 7), (12, 9, 13, 10), (17, 10, 18, 11), (18, 13, 19, 14), (11, 16, 12, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 8], [2, 8, 9, 6], [3, 5, 9, 7], [3, 6, 4, 4], [4, 9, 9, 5], [5, 8, 8, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 272
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 3.04

Table 755: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

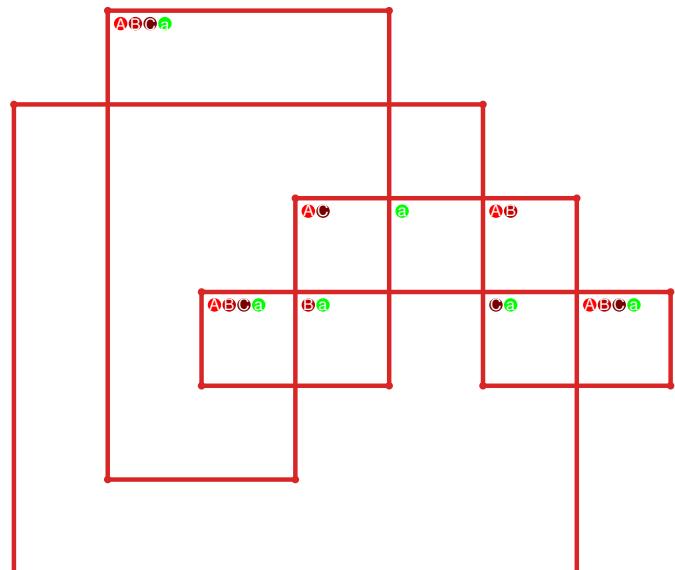


Figure 1513: SnapPy multiloop plot.

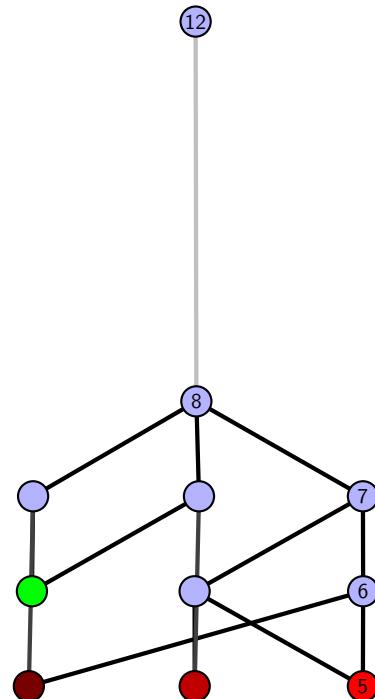


Figure 1514: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.460 $[[5, 20, 6, 1], [4, 9, 5, 10], [19, 8, 20, 9], [6, 17, 7, 18], [1, 12, 2, 13], [10, 3, 11, 4], [15, 18, 16, 19], [16, 7, 17, 8], [11, 14, 12, 15], [2, 14, 3, 13]]$

PD code drawn by `SnapPy`: $[(7, 20, 8, 1), (13, 4, 14, 5), (16, 5, 17, 6), (1, 6, 2, 7), (18, 9, 19, 10), (10, 19, 11, 20), (8, 11, 9, 12), (3, 14, 4, 15), (12, 15, 13, 16), (2, 17, 3, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 7, 6], [0, 8, 9, 9], [1, 9, 8, 1], [2, 8, 3, 7], [2, 6, 3, 3], [4, 6, 5, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 6

Average minimal degree: 2.53

Total pinning sets: 284

Average overall degree: 3.04

Pinning number: 5

Table 756: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	19	60	85	70	34	9	1	278
Average degree	2.4	2.68	2.9	3.05	3.16	3.24	3.29	3.33	

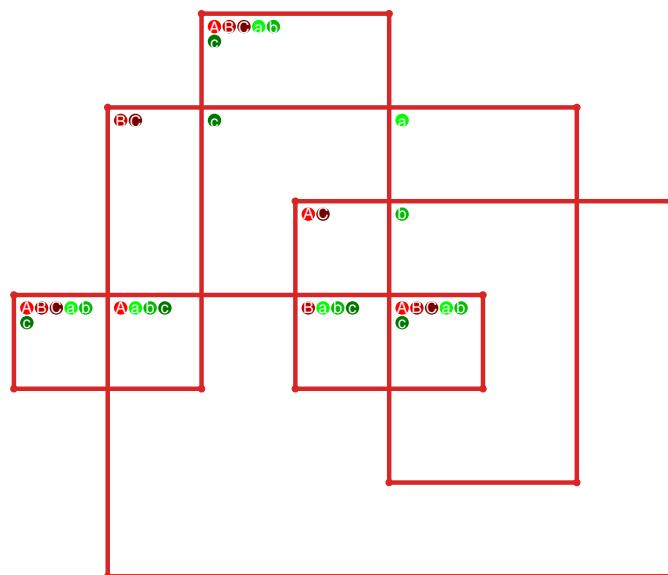


Figure 1515: `SnapPy` multiloop plot.

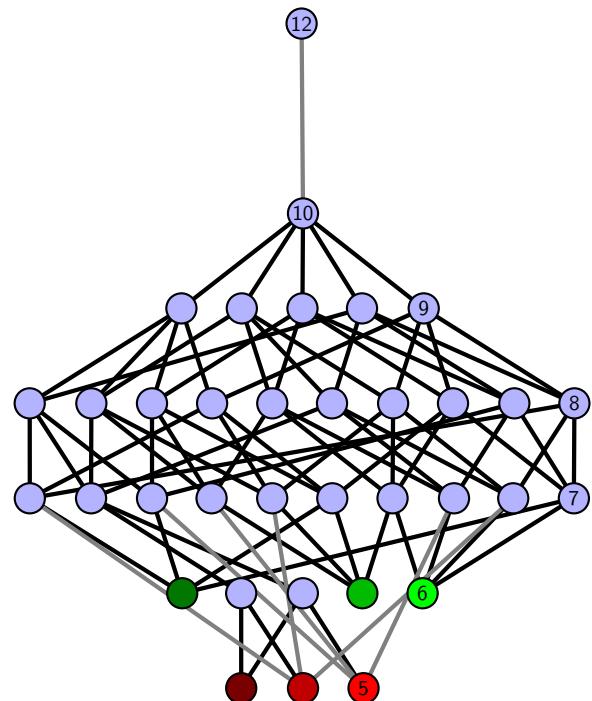


Figure 1516: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.461 [[10, 20, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [19, 3, 20, 4], [1, 14, 2, 13], [8, 13, 9, 12], [5, 17, 6, 18], [4, 17, 5, 16], [18, 15, 19, 16], [2, 14, 3, 15]]

PD code drawn by SnapPy: [(16, 1, 17, 2), (7, 4, 8, 5), (5, 18, 6, 19), (19, 6, 20, 7), (20, 9, 11, 10), (10, 11, 1, 12), (15, 12, 16, 13), (13, 2, 14, 3), (3, 14, 4, 15), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 9], [0, 9, 9, 5], [1, 4, 2, 1], [2, 8, 7, 7], [3, 6, 6, 8], [3, 7, 6, 9], [3, 8, 4, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.45

Total pinning sets: 240

Average overall degree: 3.03

Pinning number: 5

Table 757: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

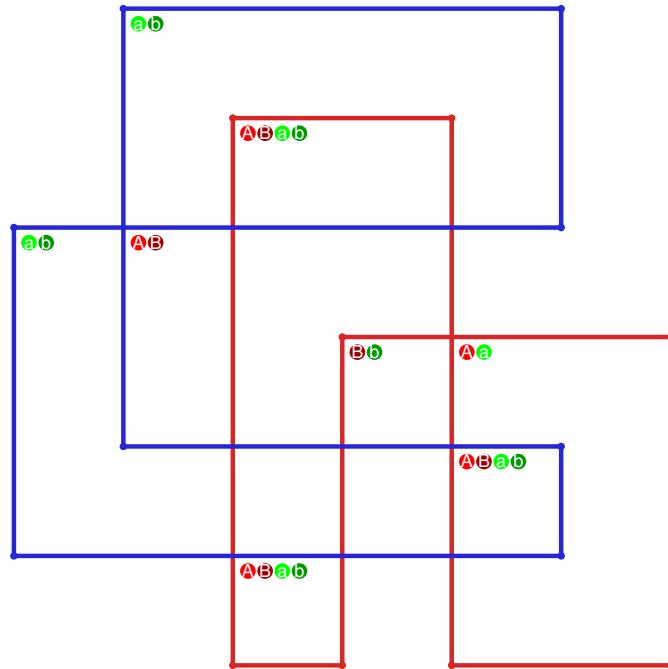


Figure 1517: SnapPy multiloop plot.

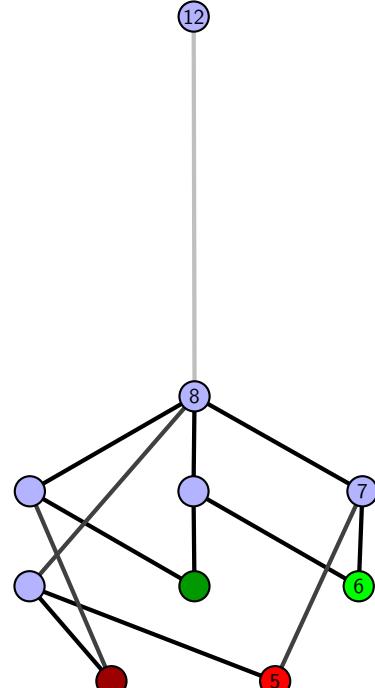


Figure 1518: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.462 [[20, 7, 1, 8], [8, 11, 9, 12], [12, 19, 13, 20], [15, 6, 16, 7], [1, 16, 2, 17], [17, 10, 18, 11], [9, 18, 10, 19], [13, 5, 14, 4], [14, 3, 15, 4], [5, 2, 6, 3]]

PD code drawn by SnapPy: [(3, 20, 4, 1), (12, 1, 13, 2), (2, 11, 3, 12), (13, 4, 14, 5), (18, 5, 19, 6), (15, 8, 16, 9), (6, 9, 7, 10), (19, 14, 20, 15), (7, 16, 8, 17), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 8, 9, 4], [0, 3, 9, 5], [1, 4, 6, 6], [1, 5, 5, 2], [2, 9, 8, 8], [3, 7, 7, 9], [3, 8, 7, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.6

Total minimal pinning sets: 9

Average minimal degree: 2.7

Total pinning sets: 296

Average overall degree: 3.11

Pinning number: 5

Table 758: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	8	0	0	0	0	0	0	8
Nonminimal pinning sets	0	7	55	92	82	40	10	1	287
Average degree	2.6	2.76	2.95	3.09	3.19	3.27	3.31	3.33	

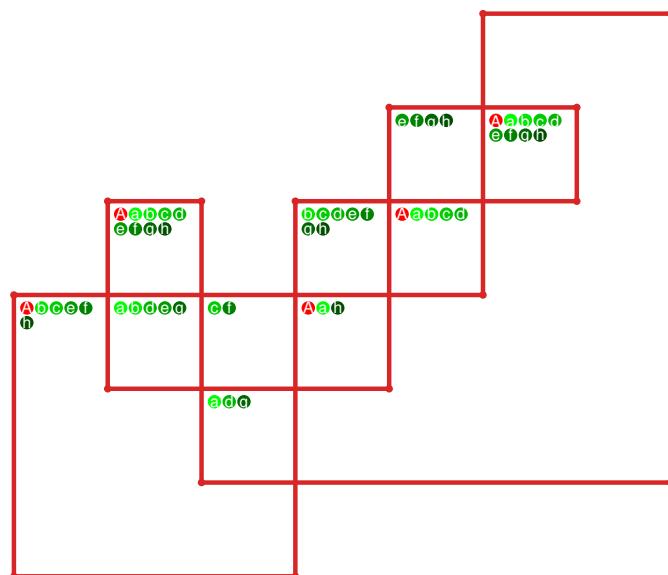


Figure 1519: SnapPy multiloop plot.

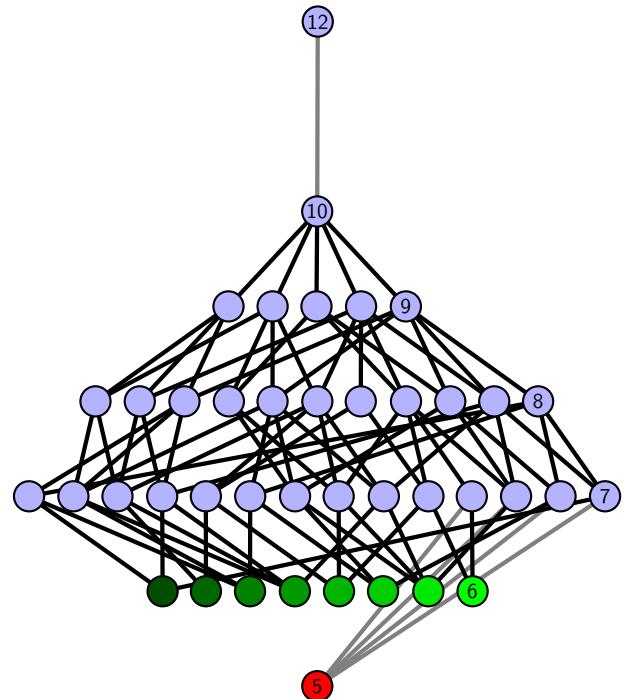


Figure 1520: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.463 $[[12, 7, 1, 8], [8, 13, 9, 20], [11, 19, 12, 20], [6, 16, 7, 17], [1, 16, 2, 15], [13, 10, 14, 9], [14, 10, 15, 11], [18, 4, 19, 5], [17, 4, 18, 3], [5, 2, 6, 3]]$

PD code drawn by SnapPy: $[(3, 12, 4, 1), (1, 20, 2, 13), (13, 2, 14, 3), (10, 5, 11, 6), (7, 16, 8, 17), (17, 8, 18, 9), (18, 11, 19, 12), (4, 19, 5, 20), (9, 14, 10, 15), (15, 6, 16, 7)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 8, 9, 4], [0, 3, 9, 6], [1, 6, 6, 1], [2, 5, 5, 4], [2, 9, 8, 8], [3, 7, 7, 9], [3, 8, 7, 4]]$

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 3

Average minimal degree: 2.4

Total pinning sets: 256

Average overall degree: 3.03

Pinning number: 5

Table 759: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

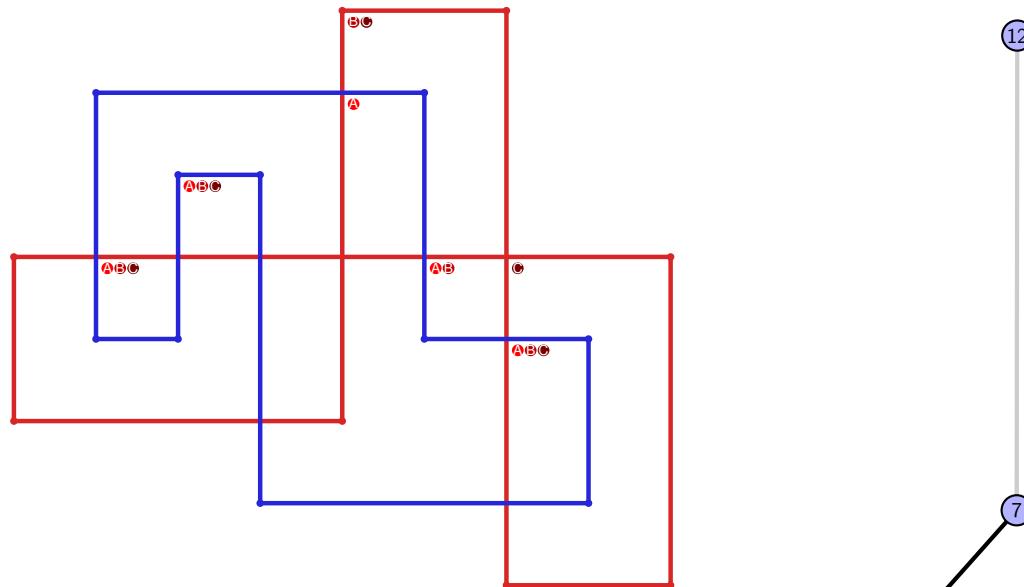


Figure 1521: SnapPy multiloop plot.

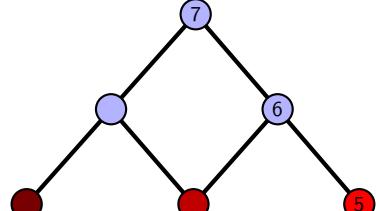


Figure 1522: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.464 $[[20, 11, 1, 12], [12, 19, 13, 20], [13, 10, 14, 11], [1, 9, 2, 8], [18, 7, 19, 8], [9, 14, 10, 15], [2, 17, 3, 18], [3, 6, 4, 7], [15, 4, 16, 5], [5, 16, 6, 17]]$

PD code drawn by SnapPy: $[(11, 20, 12, 1), (19, 2, 20, 3), (14, 3, 15, 4), (4, 17, 5, 18), (9, 6, 10, 7), (16, 7, 17, 8), (5, 10, 6, 11), (1, 12, 2, 13), (18, 13, 19, 14), (8, 15, 9, 16)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 6, 7], [2, 8, 3, 2], [3, 9, 7, 4], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 256
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 3.03

Table 760: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

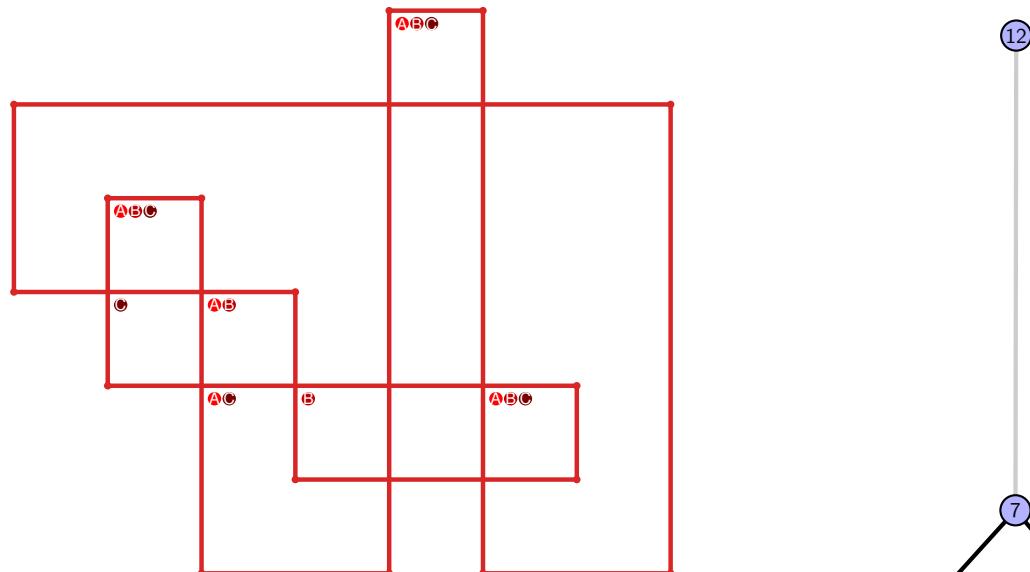


Figure 1523: SnapPy multiloop plot.

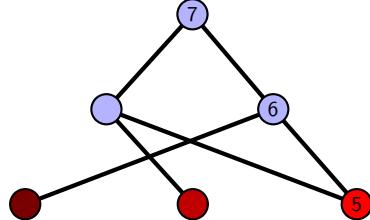


Figure 1524: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.465 $[[10, 20, 1, 11], [11, 9, 12, 10], [12, 19, 13, 20], [1, 13, 2, 14], [14, 8, 15, 9], [4, 18, 5, 19], [2, 7, 3, 8], [15, 3, 16, 4], [17, 5, 18, 6], [6, 16, 7, 17]]$

PD code drawn by SnapPy: $[(18, 1, 19, 2), (20, 3, 11, 4), (10, 5, 1, 6), (17, 6, 18, 7), (14, 7, 15, 8), (9, 16, 10, 17), (4, 19, 5, 20), (2, 11, 3, 12), (15, 12, 16, 13), (8, 13, 9, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [2, 7, 8, 8], [3, 9, 7, 4], [4, 6, 9, 5], [5, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 4
 Total pinning sets: 240
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.45
 Average overall degree: 3.03

Table 761: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	13	45	71	64	33	9	1	236
Average degree	2.4	2.66	2.86	3.02	3.14	3.23	3.29	3.33	

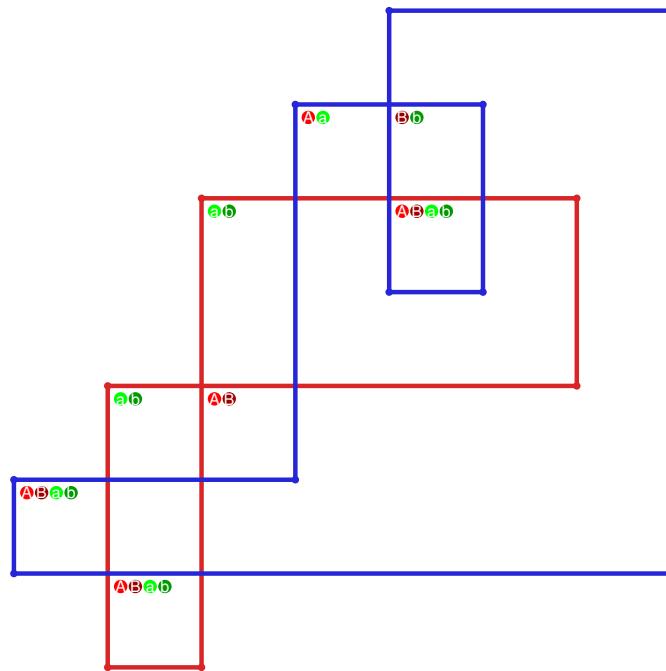


Figure 1525: SnapPy multiloop plot.

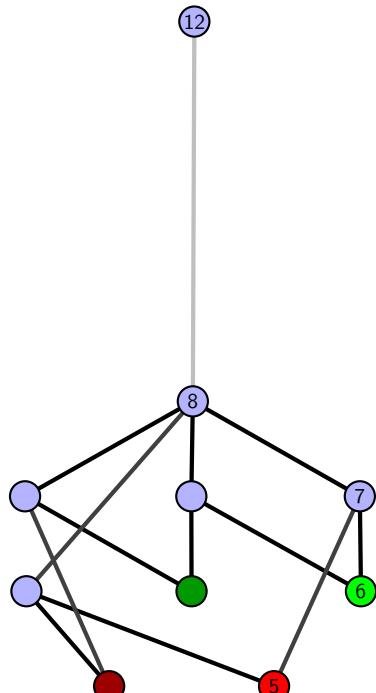


Figure 1526: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.466 $[[16, 20, 1, 17], [17, 15, 18, 16], [19, 9, 20, 10], [1, 9, 2, 8], [14, 7, 15, 8], [18, 11, 19, 10], [2, 13, 3, 14], [3, 6, 4, 7], [11, 4, 12, 5], [5, 12, 6, 13]]$

PD code drawn by `SnapPy`: $[(9, 2, 10, 3), (1, 4, 2, 5), (12, 5, 13, 6), (6, 15, 7, 16), (18, 7, 19, 8), (8, 17, 9, 18), (3, 10, 4, 11), (16, 11, 1, 12), (20, 13, 17, 14), (14, 19, 15, 20)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [1, 8, 2, 2], [3, 9, 7, 4], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 3
Total minimal pinning sets: 3

Total pinning sets: 256

Pinning number: 5

Average optimal degree: 2.4

Average minimal degree: 2.4

Average overall degree: 3.03

Table 762: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

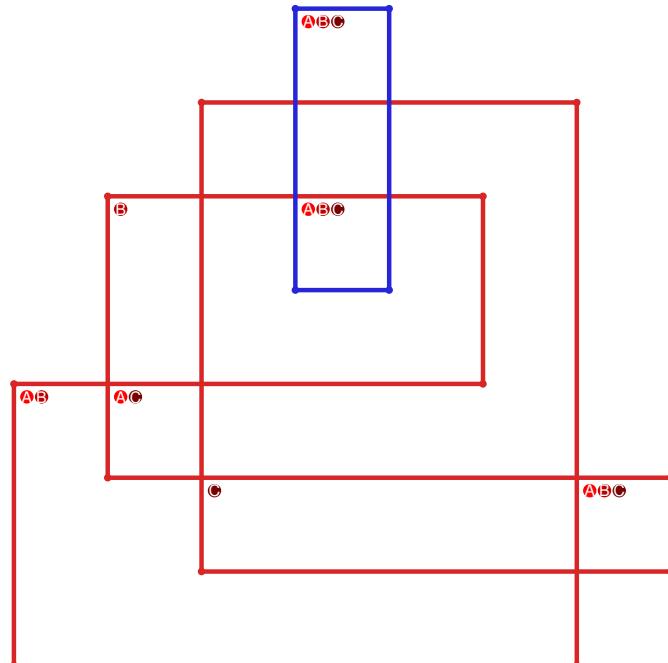


Figure 1527: `SnapPy` multiloop plot.

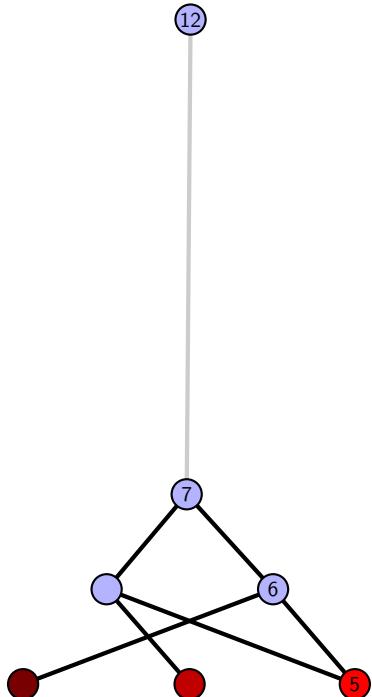


Figure 1528: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.467 $[[20, 13, 1, 14], [14, 19, 15, 20], [15, 12, 16, 13], [1, 16, 2, 17], [18, 7, 19, 8], [4, 11, 5, 12], [2, 10, 3, 9], [17, 9, 18, 8], [3, 6, 4, 7], [10, 5, 11, 6]]$

PD code drawn by `SnapPy`: $[(8, 3, 9, 4), (1, 4, 2, 5), (16, 5, 17, 6), (6, 15, 7, 16), (7, 20, 8, 1), (2, 9, 3, 10), (13, 10, 14, 11), (18, 11, 19, 12), (19, 14, 20, 15), (12, 17, 13, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 8], [2, 8, 9, 9], [3, 9, 8, 7], [3, 6, 4, 4], [4, 6, 9, 5], [5, 8, 6, 5]]$

Total optimal pinning sets: 4

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.4

Total pinning sets: 288

Average overall degree: 3.03

Pinning number: 5

Table 763: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

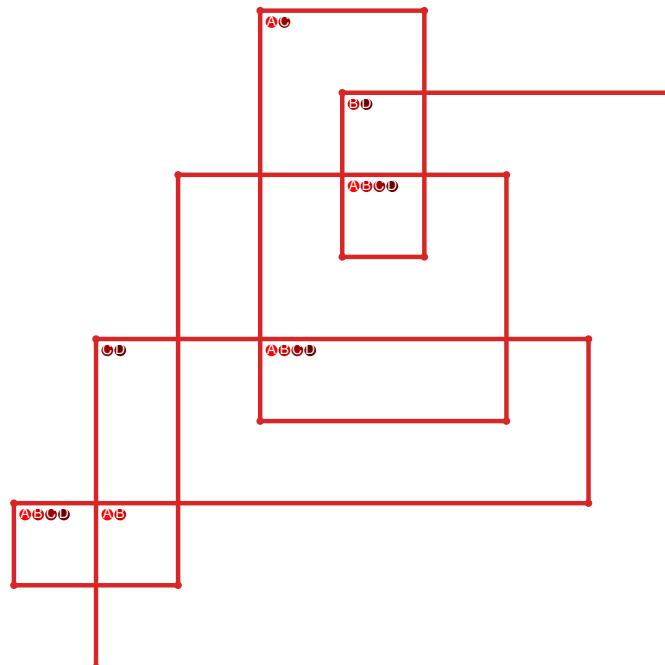


Figure 1529: `SnapPy` multiloop plot.

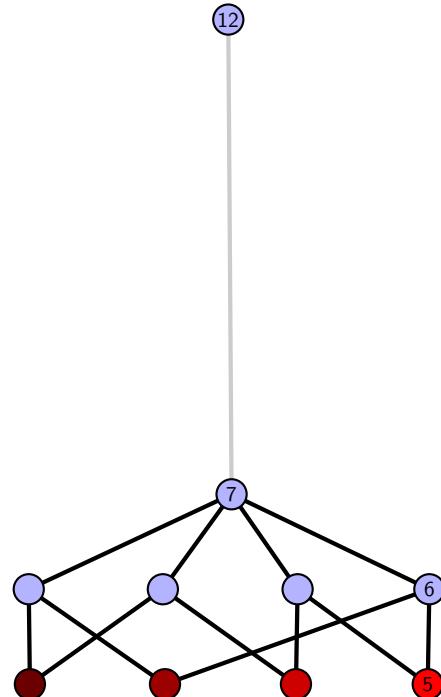


Figure 1530: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.468 $[[5, 20, 6, 1], [4, 11, 5, 12], [19, 10, 20, 11], [6, 10, 7, 9], [1, 14, 2, 15], [12, 3, 13, 4], [18, 7, 19, 8], [8, 17, 9, 18], [13, 16, 14, 17], [2, 16, 3, 15]]$

PD code drawn by SnapPy: $[(14, 3, 15, 4), (5, 2, 6, 3), (15, 6, 16, 7), (20, 7, 1, 8), (17, 10, 18, 11), (11, 18, 12, 19), (9, 12, 10, 13), (4, 13, 5, 14), (1, 16, 2, 17), (8, 19, 9, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 6, 7], [0, 8, 9, 9], [1, 9, 8, 1], [2, 7, 7, 3], [3, 6, 6, 8], [4, 7, 5, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 192
 Pinning number: 6

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.03

Table 764: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	29	57	58	32	9	1	186
Average degree	2.5	2.78	2.98	3.12	3.23	3.29	3.33	

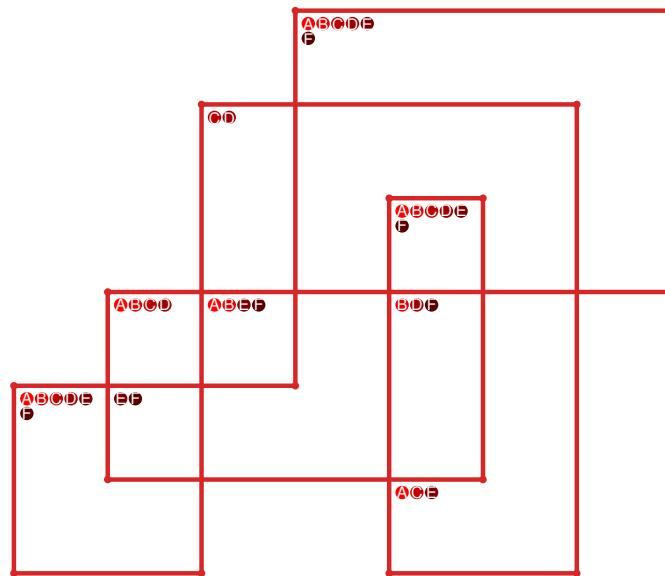


Figure 1531: SnapPy multiloop plot.

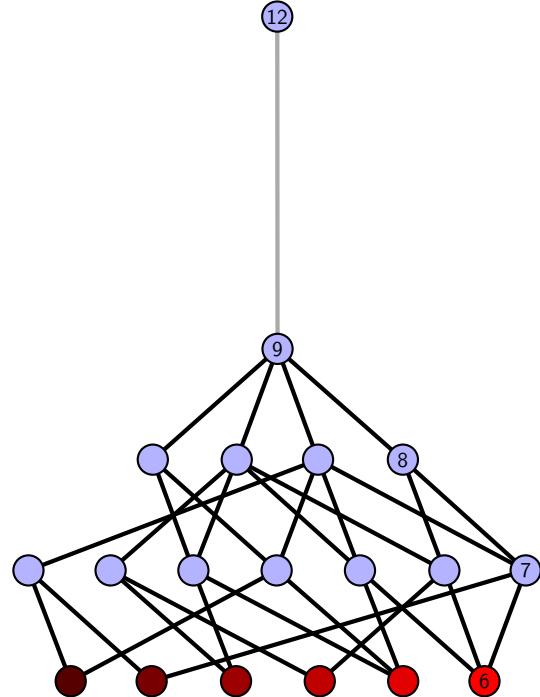


Figure 1532: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.469 $[[11, 20, 12, 1], [10, 17, 11, 18], [19, 16, 20, 17], [12, 7, 13, 8], [1, 8, 2, 9], [18, 9, 19, 10], [15, 4, 16, 5], [6, 3, 7, 4], [13, 3, 14, 2], [5, 14, 6, 15]]$

PD code drawn by SnapPy: $[(20, 11, 1, 12), (4, 1, 5, 2), (13, 2, 14, 3), (10, 5, 11, 6), (19, 6, 20, 7), (16, 7, 17, 8), (3, 12, 4, 13), (17, 14, 18, 15), (8, 15, 9, 16), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 4], [0, 3, 8, 5], [1, 4, 2, 1], [2, 9, 9, 7], [3, 6, 9, 8], [3, 7, 9, 4], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.6

Total minimal pinning sets: 11

Average minimal degree: 2.71

Total pinning sets: 308

Average overall degree: 3.1

Pinning number: 5

Table 765: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	10	0	0	0	0	0	0	10
Nonminimal pinning sets	0	7	60	96	83	40	10	1	297
Average degree	2.6	2.75	2.95	3.09	3.2	3.27	3.31	3.33	

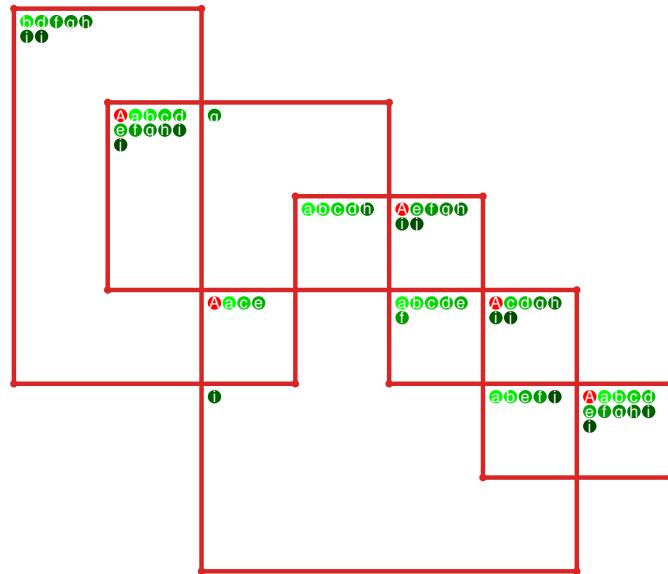


Figure 1533: SnapPy multiloop plot.

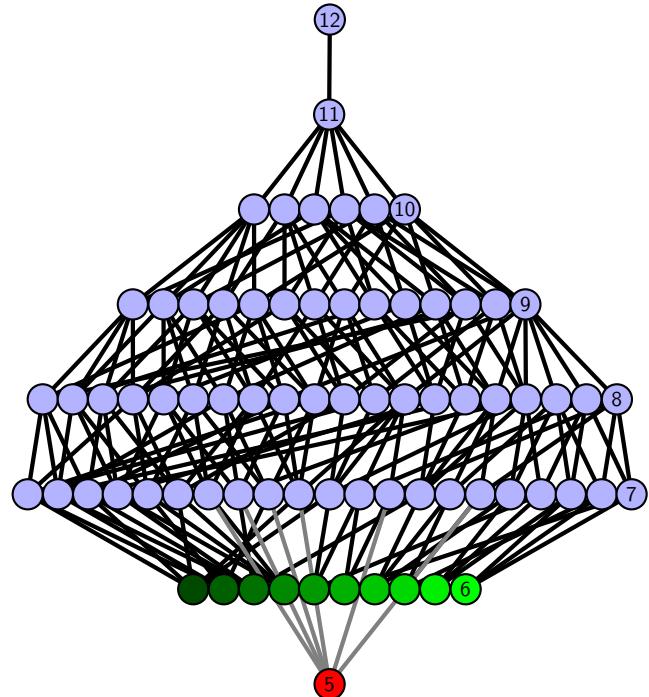


Figure 1534: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.470 $[[9, 20, 10, 1], [8, 17, 9, 18], [19, 16, 20, 17], [10, 5, 11, 6], [1, 6, 2, 7], [18, 7, 19, 8], [12, 15, 13, 16], [13, 4, 14, 5], [11, 3, 12, 2], [3, 14, 4, 15]]$

PD code drawn by `SnapPy`: $[(20, 9, 1, 10), (11, 2, 12, 3), (8, 3, 9, 4), (19, 4, 20, 5), (16, 5, 17, 6), (1, 12, 2, 13), (10, 13, 11, 14), (17, 14, 18, 15), (6, 15, 7, 16), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 4], [0, 3, 8, 5], [1, 4, 2, 1], [2, 8, 9, 7], [3, 6, 9, 9], [3, 9, 6, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 6

Average optimal degree: 2.6

Total minimal pinning sets: 10

Average minimal degree: 2.73

Total pinning sets: 424

Average overall degree: 3.11

Pinning number: 5

Table 766: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	36	100	129	96	42	10	1	414
Average degree	2.6	2.84	3.01	3.13	3.22	3.27	3.31	3.33	

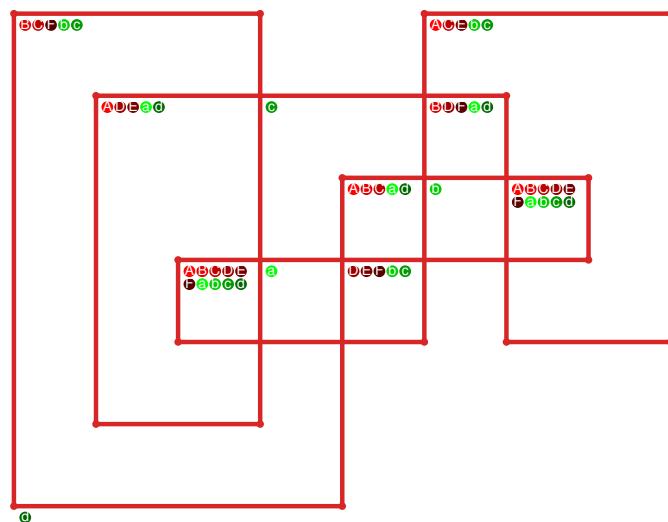


Figure 1535: `SnapPy` multiloop plot.

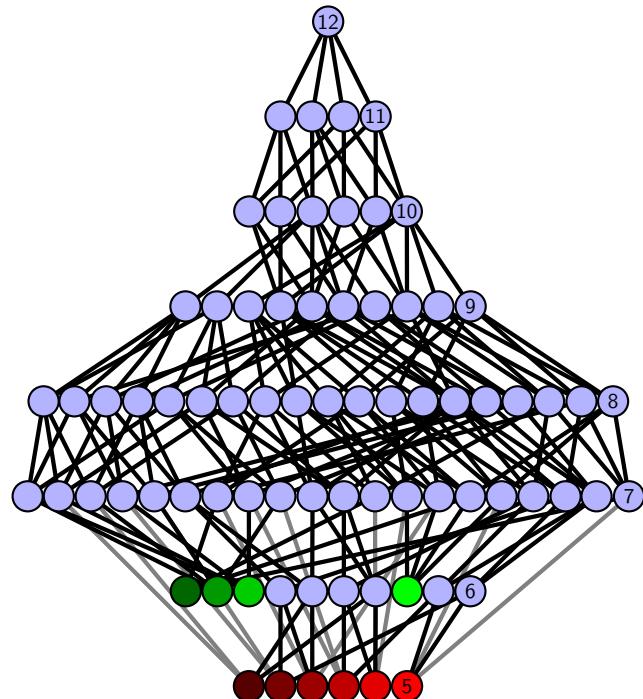


Figure 1536: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.471 $[[11, 20, 12, 1], [10, 17, 11, 18], [19, 16, 20, 17], [12, 7, 13, 8], [1, 8, 2, 9], [18, 9, 19, 10], [15, 4, 16, 5], [6, 13, 7, 14], [2, 6, 3, 5], [3, 14, 4, 15]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (1, 18, 2, 19), (8, 3, 9, 4), (17, 4, 18, 5), (14, 5, 15, 6), (2, 9, 3, 10), (19, 10, 20, 11), (15, 12, 16, 13), (6, 13, 7, 14), (7, 16, 8, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 8, 5], [1, 4, 2, 1], [2, 8, 9, 9], [3, 9, 8, 3], [4, 7, 9, 6], [6, 8, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 6

Average minimal degree: 2.52

Total pinning sets: 264

Average overall degree: 3.04

Pinning number: 5

Table 767: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	13	52	80	69	34	9	1	258
Average degree	2.4	2.66	2.87	3.04	3.15	3.24	3.29	3.33	

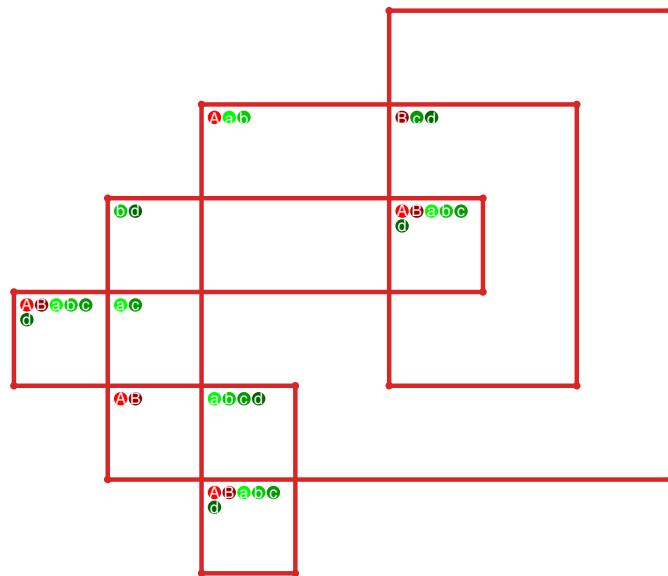


Figure 1537: `SnapPy` multiloop plot.

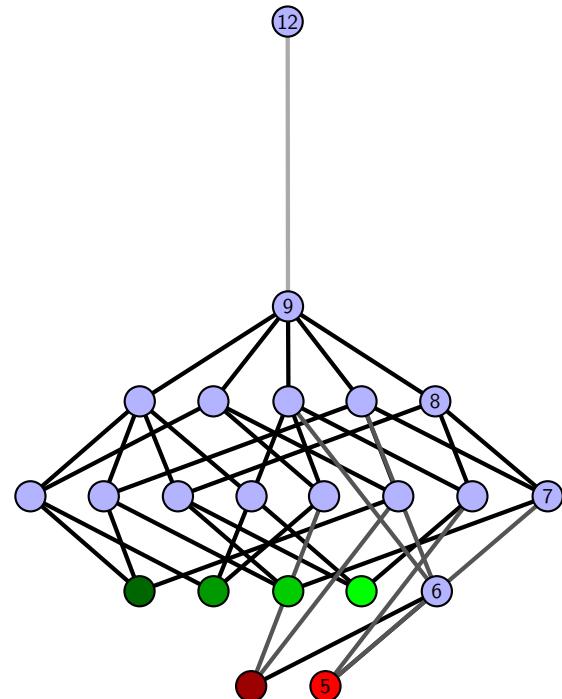


Figure 1538: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.472 [[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [8, 13, 9, 14], [1, 13, 2, 12], [18, 12, 19, 11], [4, 15, 5, 16], [14, 5, 15, 6], [7, 2, 8, 3], [3, 6, 4, 7]]

PD code drawn by `SnapPy`: [(5, 20, 6, 1), (12, 3, 13, 4), (1, 4, 2, 5), (18, 7, 19, 8), (9, 16, 10, 17), (10, 19, 11, 20), (6, 11, 7, 12), (2, 13, 3, 14), (17, 14, 18, 15), (15, 8, 16, 9)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 8, 4], [0, 3, 8, 5], [1, 4, 2, 1], [2, 9, 7, 7], [3, 6, 6, 9], [3, 9, 9, 4], [6, 8, 8, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 6
 Total pinning sets: 264
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.52
 Average overall degree: 3.04

Table 768: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	13	52	80	69	34	9	1	258
Average degree	2.4	2.66	2.87	3.04	3.15	3.24	3.29	3.33	

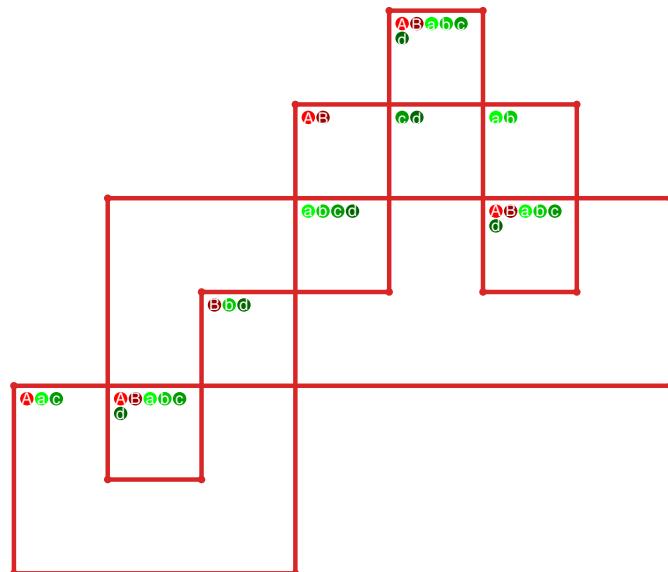


Figure 1539: `SnapPy` multiloop plot.

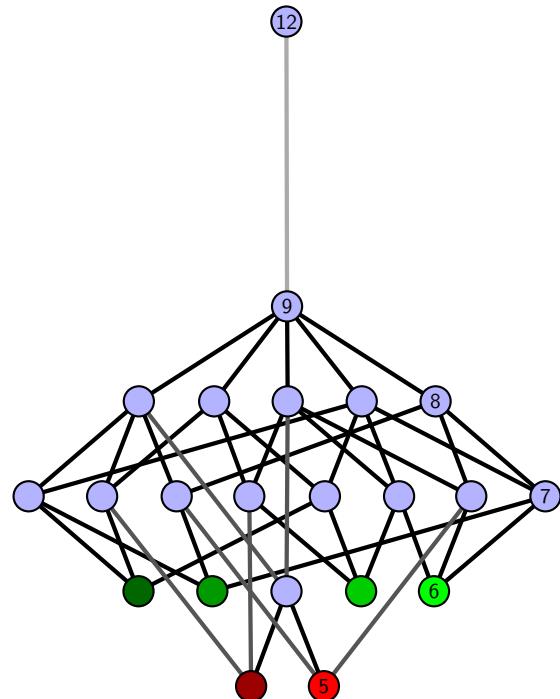


Figure 1540: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.473 `[[16, 7, 1, 8], [8, 17, 9, 20], [15, 19, 16, 20], [6, 3, 7, 4], [1, 11, 2, 10], [17, 10, 18, 9], [18, 14, 19, 15], [4, 14, 5, 13], [5, 12, 6, 13], [2, 11, 3, 12]]`

PD code drawn by `SnapPy`: `[(4, 1, 5, 2), (14, 5, 15, 6), (7, 18, 8, 19), (8, 15, 9, 16), (16, 9, 1, 10), (3, 10, 4, 11), (11, 2, 12, 3), (19, 12, 20, 13), (13, 20, 14, 17), (17, 6, 18, 7)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 8, 9], [0, 9, 9, 5], [1, 4, 6, 1], [2, 5, 7, 2], [3, 6, 8, 8], [3, 7, 7, 9], [3, 8, 4, 4]]`

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 769: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

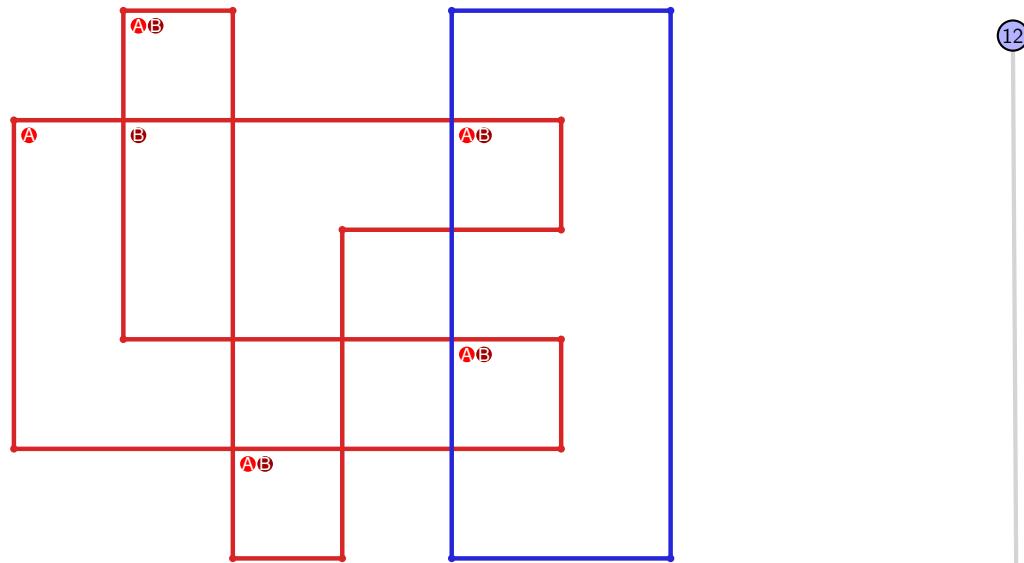


Figure 1541: `SnapPy` multiloop plot.

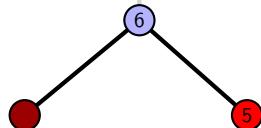


Figure 1542: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.474 $[[8, 20, 1, 9], [9, 7, 10, 8], [19, 16, 20, 17], [1, 16, 2, 15], [6, 14, 7, 15], [10, 18, 11, 17], [11, 18, 12, 19], [2, 5, 3, 6], [3, 13, 4, 14], [12, 4, 13, 5]]$

PD code drawn by SnapPy: $[(20, 1, 9, 2), (7, 2, 8, 3), (17, 4, 18, 5), (8, 9, 1, 10), (3, 10, 4, 11), (11, 6, 12, 7), (15, 12, 16, 13), (13, 18, 14, 19), (19, 14, 20, 15), (5, 16, 6, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 3], [0, 2, 7, 4], [1, 3, 7, 8], [1, 6, 6, 2], [2, 5, 5, 9], [3, 9, 8, 4], [4, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 312
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.04

Table 770: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	31	70	90	71	34	9	1	306
Average degree	2.5	2.76	2.93	3.06	3.16	3.24	3.29	3.33	

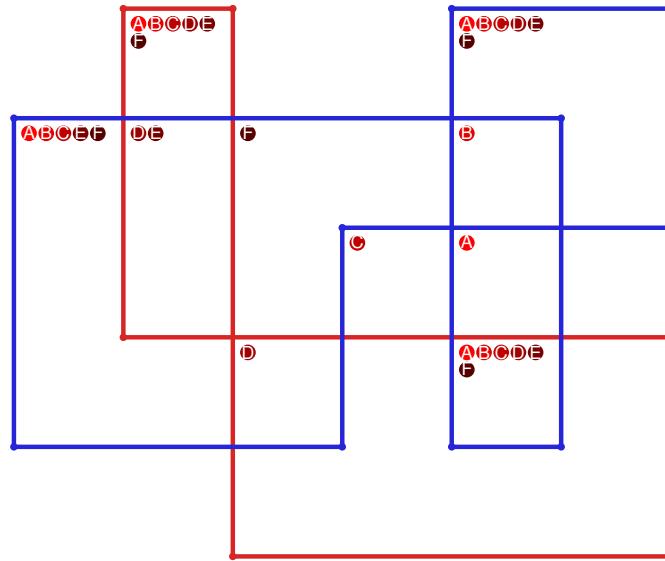


Figure 1543: SnapPy multiloop plot.

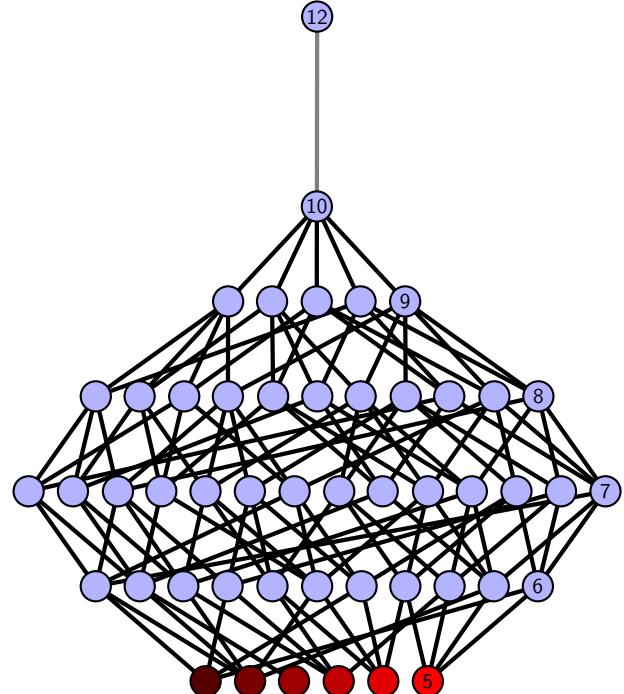


Figure 1544: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.475 $[[8, 20, 1, 9], [9, 7, 10, 8], [12, 19, 13, 20], [1, 13, 2, 14], [14, 6, 15, 7], [10, 17, 11, 18], [18, 11, 19, 12], [2, 5, 3, 6], [15, 3, 16, 4], [4, 16, 5, 17]]$

PD code drawn by `SnapPy`: $[(20, 1, 9, 2), (8, 3, 1, 4), (19, 4, 20, 5), (14, 5, 15, 6), (11, 16, 12, 17), (7, 18, 8, 19), (2, 9, 3, 10), (15, 10, 16, 11), (17, 12, 18, 13), (6, 13, 7, 14)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 3], [0, 2, 7, 4], [1, 3, 7, 8], [1, 9, 6, 6], [2, 5, 5, 2], [3, 9, 8, 4], [4, 7, 9, 9], [5, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 771: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

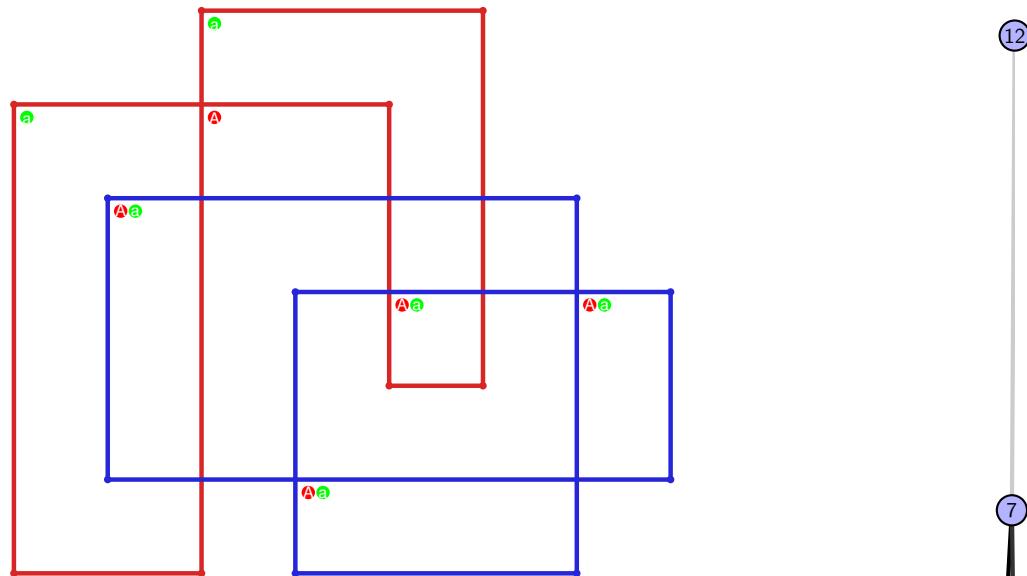


Figure 1545: `SnapPy` multiloop plot.



Figure 1546: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.476 `[[5, 16, 6, 1], [11, 4, 12, 5], [12, 15, 13, 16], [6, 13, 7, 14], [1, 17, 2, 20], [3, 10, 4, 11], [14, 7, 15, 8], [17, 8, 18, 9], [2, 19, 3, 20], [9, 18, 10, 19]]`

PD code drawn by `SnapPy`: `[(7, 16, 8, 1), (10, 3, 11, 4), (17, 4, 18, 5), (15, 6, 16, 7), (2, 9, 3, 10), (8, 11, 9, 12), (1, 12, 2, 13), (5, 18, 6, 19), (14, 19, 15, 20), (20, 13, 17, 14)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 6, 6], [0, 7, 8, 8], [1, 8, 9, 1], [2, 7, 3, 3], [4, 6, 9, 9], [4, 9, 5, 4], [5, 8, 7, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 772: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

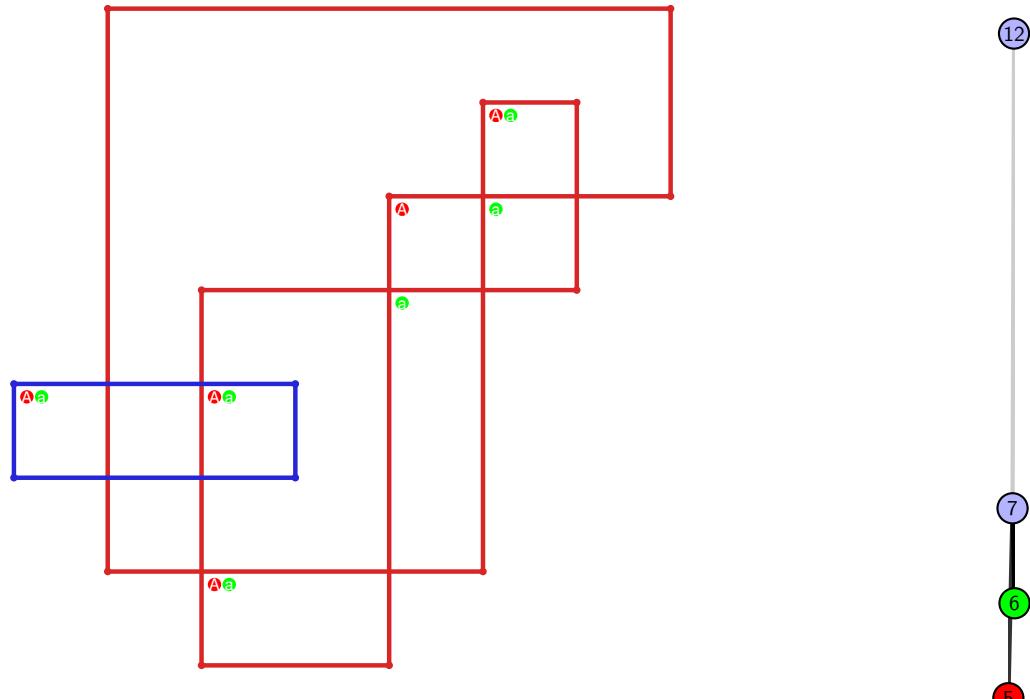


Figure 1547: `SnapPy` multiloop plot.

Figure 1548: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.477 $[[9, 16, 10, 1], [8, 20, 9, 17], [15, 19, 16, 20], [10, 5, 11, 6], [1, 6, 2, 7], [17, 7, 18, 8], [18, 14, 19, 15], [4, 13, 5, 14], [11, 3, 12, 2], [12, 3, 13, 4]]$

PD code drawn by `SnapPy`: $[(16, 9, 1, 10), (10, 1, 11, 2), (8, 3, 9, 4), (15, 4, 16, 5), (18, 5, 19, 6), (2, 11, 3, 12), (19, 12, 20, 13), (7, 14, 8, 15), (13, 20, 14, 17), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 8, 4], [0, 3, 8, 5], [1, 4, 6, 1], [2, 5, 7, 2], [3, 6, 9, 9], [3, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 773: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

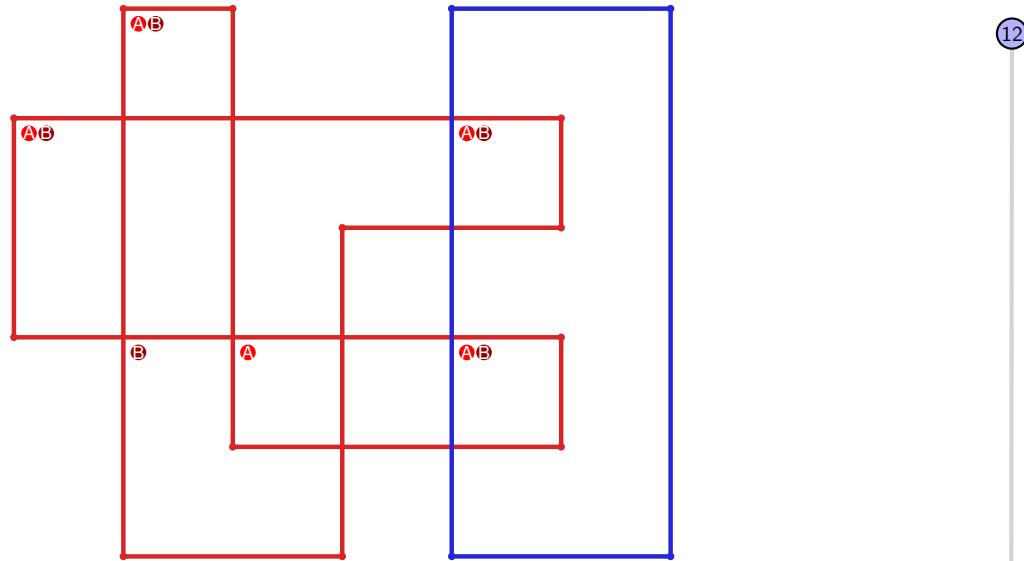


Figure 1549: `SnapPy` multiloop plot.

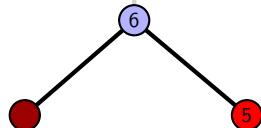


Figure 1550: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.478 [[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [8, 5, 9, 6], [1, 5, 2, 4], [18, 12, 19, 11], [15, 6, 16, 7], [7, 14, 8, 15], [2, 14, 3, 13], [3, 12, 4, 13]]

PD code drawn by `SnapPy`: [(1, 18, 2, 19), (5, 2, 6, 3), (12, 3, 13, 4), (17, 6, 18, 7), (8, 15, 9, 16), (20, 9, 1, 10), (10, 19, 11, 20), (4, 11, 5, 12), (16, 13, 17, 14), (14, 7, 15, 8)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 4], [0, 3, 8, 9], [1, 9, 2, 1], [2, 7, 7, 3], [3, 6, 6, 8], [4, 7, 9, 9], [4, 8, 8, 5]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 7
 Total pinning sets: 304
 Pinning number: 5

Average optimal degree: 2.47
 Average minimal degree: 2.58
 Average overall degree: 3.05

Table 774: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	19	65	93	75	35	9	1	297
Average degree	2.47	2.72	2.92	3.06	3.17	3.24	3.29	3.33	

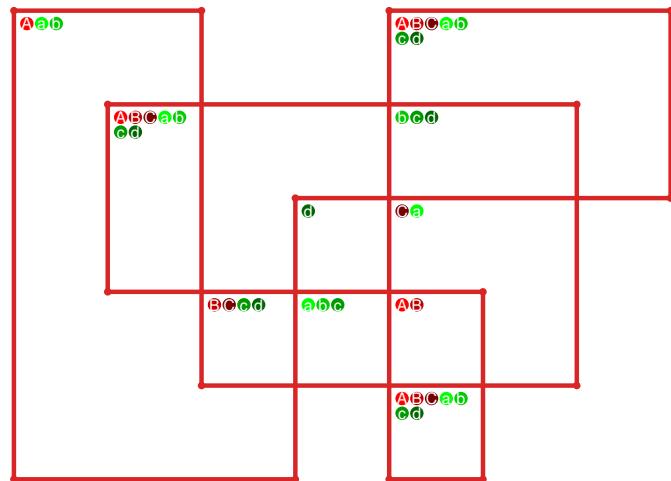


Figure 1551: `SnapPy` multiloop plot.

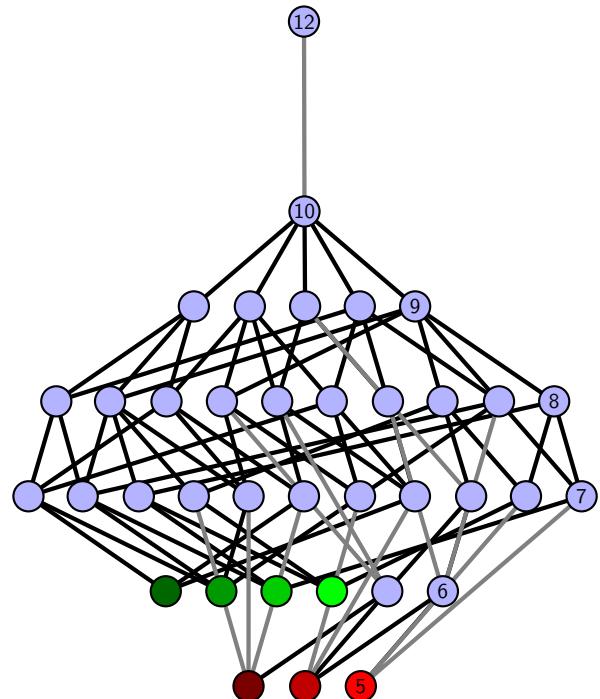


Figure 1552: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.479 $[[6, 20, 1, 7], [7, 10, 8, 11], [11, 5, 12, 6], [19, 16, 20, 17], [1, 16, 2, 15], [3, 9, 4, 10], [8, 4, 9, 5], [12, 18, 13, 17], [13, 18, 14, 19], [2, 14, 3, 15]]$

PD code drawn by `SnapPy`: $[(20, 1, 7, 2), (9, 2, 10, 3), (6, 7, 1, 8), (19, 8, 20, 9), (5, 12, 6, 13), (13, 4, 14, 5), (17, 14, 18, 15), (15, 10, 16, 11), (11, 16, 12, 17), (3, 18, 4, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 7, 8, 4], [0, 3, 9, 9], [1, 9, 6, 6], [1, 5, 5, 2], [2, 8, 8, 3], [3, 7, 7, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 8

Average minimal degree: 2.56

Total pinning sets: 276

Average overall degree: 3.05

Pinning number: 5

Table 775: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	6
Nonminimal pinning sets	0	13	57	84	70	34	9	1	268
Average degree	2.5	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

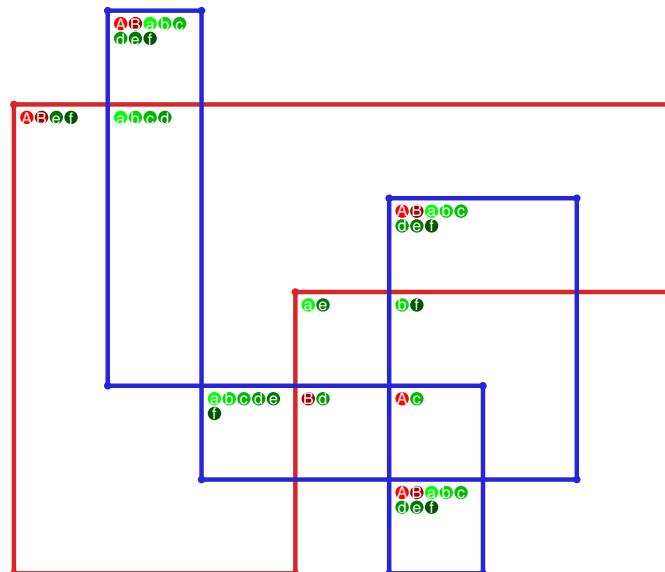


Figure 1553: `SnapPy` multiloop plot.

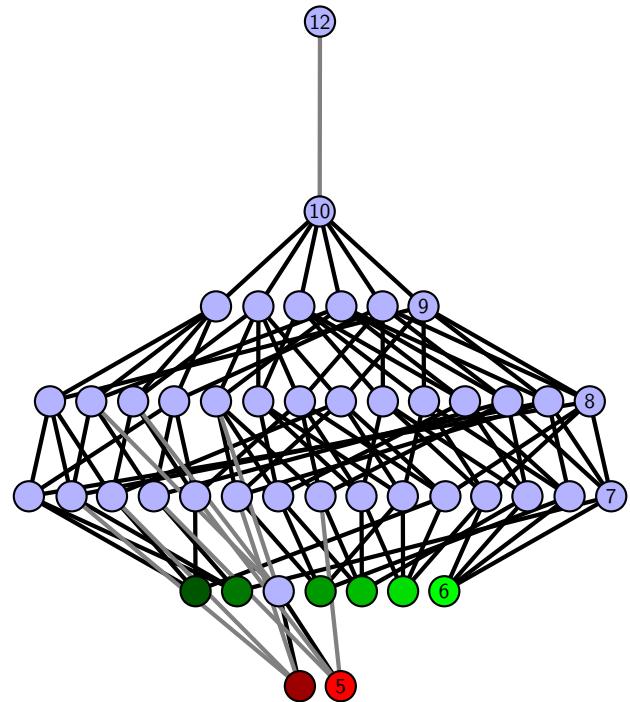


Figure 1554: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.480 [[13, 20, 14, 1], [19, 12, 20, 13], [14, 12, 15, 11], [1, 16, 2, 17], [7, 18, 8, 19], [15, 10, 16, 11], [2, 5, 3, 6], [17, 6, 18, 7], [8, 3, 9, 4], [4, 9, 5, 10]]

PD code drawn by SnapPy: [(18, 1, 19, 2), (13, 2, 14, 3), (20, 5, 1, 6), (11, 6, 12, 7), (7, 10, 8, 11), (15, 8, 16, 9), (17, 12, 18, 13), (3, 14, 4, 15), (9, 16, 10, 17), (4, 19, 5, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 7], [1, 7, 7, 8], [2, 9, 3, 2], [3, 9, 8, 7], [3, 6, 4, 4], [4, 6, 9, 9], [5, 8, 8, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.3

Total minimal pinning sets: 6

Average minimal degree: 2.43

Total pinning sets: 228

Average overall degree: 2.99

Pinning number: 5

Table 776: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	13	48	68	56	28	8	1	222
Average degree	2.3	2.58	2.82	2.99	3.11	3.2	3.27	3.33	

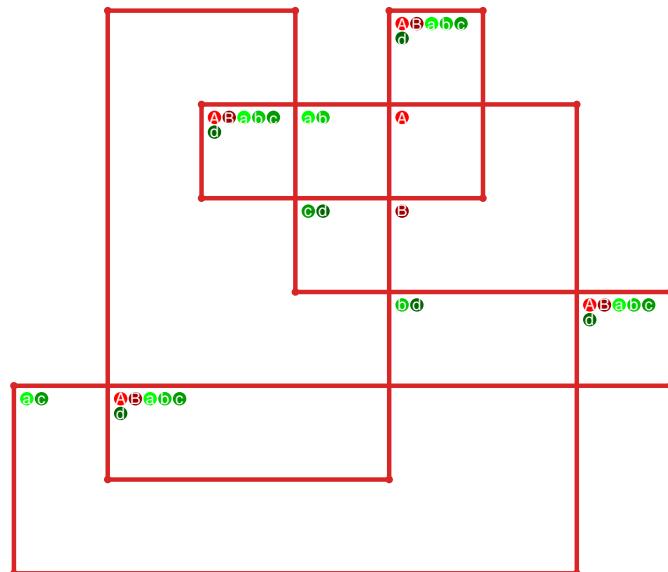


Figure 1555: SnapPy multiloop plot.

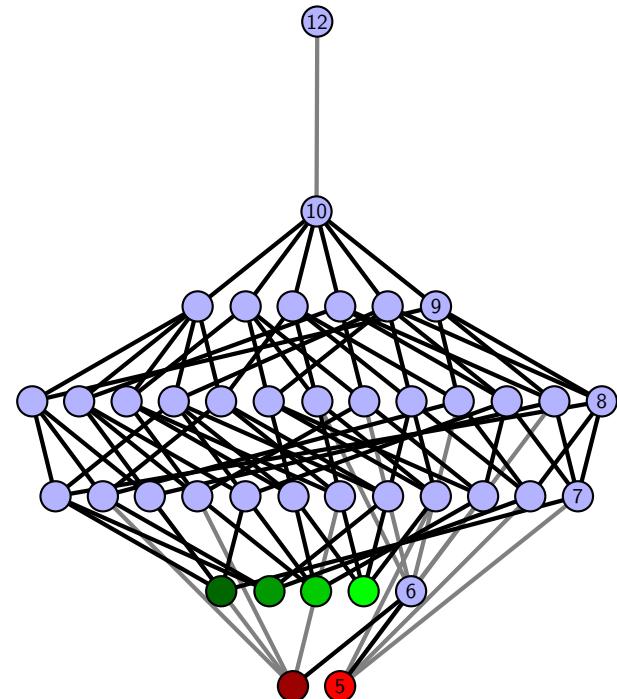


Figure 1556: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.481 $[[10, 20, 1, 11], [11, 9, 12, 10], [12, 19, 13, 20], [1, 13, 2, 14], [16, 8, 17, 9], [4, 18, 5, 19], [2, 5, 3, 6], [14, 6, 15, 7], [7, 15, 8, 16], [17, 3, 18, 4]]$

PD code drawn by `SnapPy`: $[(11, 10, 12, 1), (9, 2, 10, 3), (18, 3, 19, 4), (20, 5, 11, 6), (15, 6, 16, 7), (4, 19, 5, 20), (1, 12, 2, 13), (16, 13, 17, 14), (7, 14, 8, 15), (8, 17, 9, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 8, 8, 9], [2, 9, 9, 6], [3, 5, 9, 7], [3, 6, 8, 8], [4, 7, 7, 4], [4, 6, 5, 5]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.98

Table 777: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

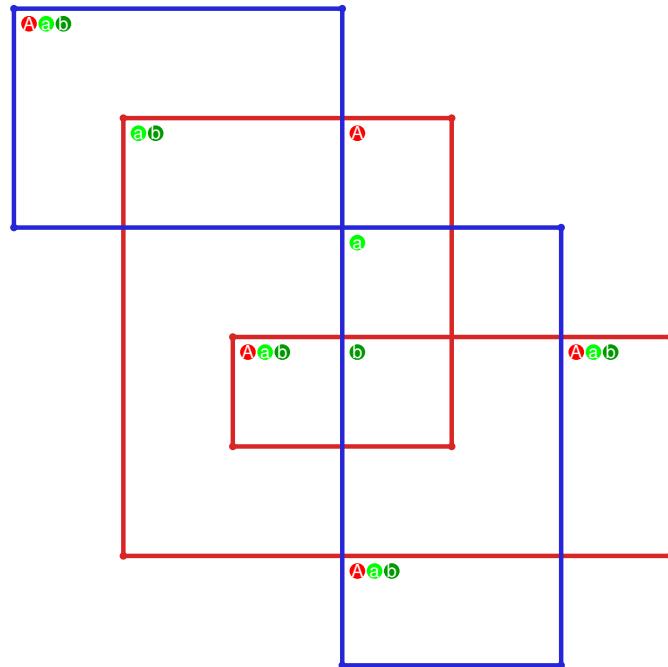


Figure 1557: `SnapPy` multiloop plot.

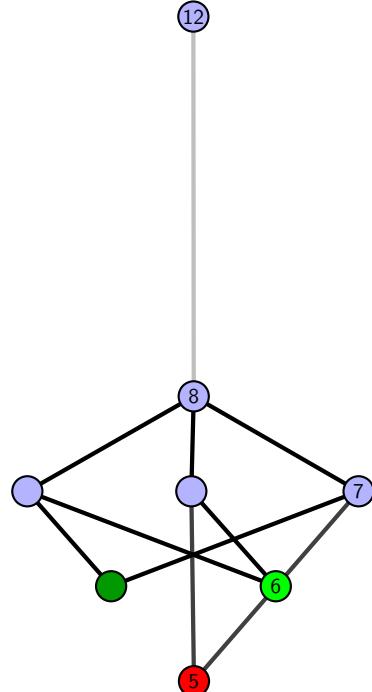


Figure 1558: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.482 $[[6, 20, 1, 7], [7, 5, 8, 6], [19, 10, 20, 11], [1, 15, 2, 16], [4, 12, 5, 13], [8, 12, 9, 11], [9, 18, 10, 19], [14, 17, 15, 18], [2, 17, 3, 16], [13, 3, 14, 4]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (15, 2, 16, 3), (13, 18, 14, 19), (19, 16, 20, 17), (1, 20, 2, 7), (4, 9, 5, 10), (10, 5, 11, 6), (8, 11, 9, 12), (17, 12, 18, 13), (3, 14, 4, 15)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 6], [0, 7, 8, 8], [1, 9, 9, 5], [1, 4, 6, 2], [2, 5, 7, 2], [3, 6, 9, 8], [3, 7, 9, 3], [4, 8, 7, 4]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 5
 Total pinning sets: 188
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.41
 Average overall degree: 2.97

Table 778: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	7	35	55	50	27	8	1	183
Average degree	2.2	2.5	2.77	2.95	3.09	3.19	3.27	3.33	

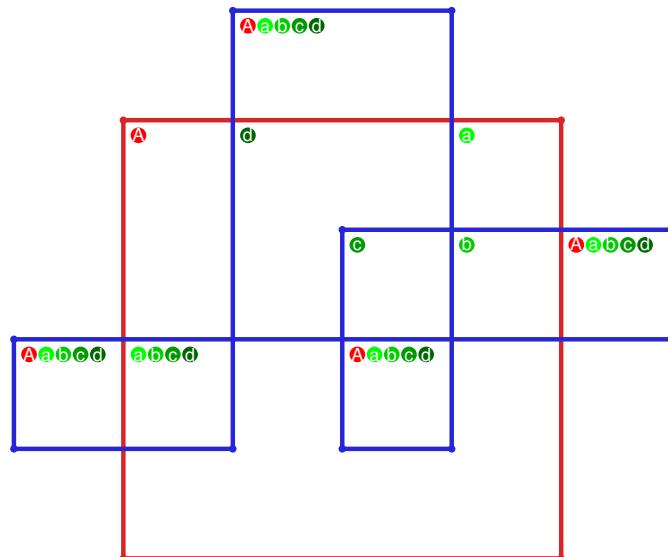


Figure 1559: `SnapPy` multiloop plot.

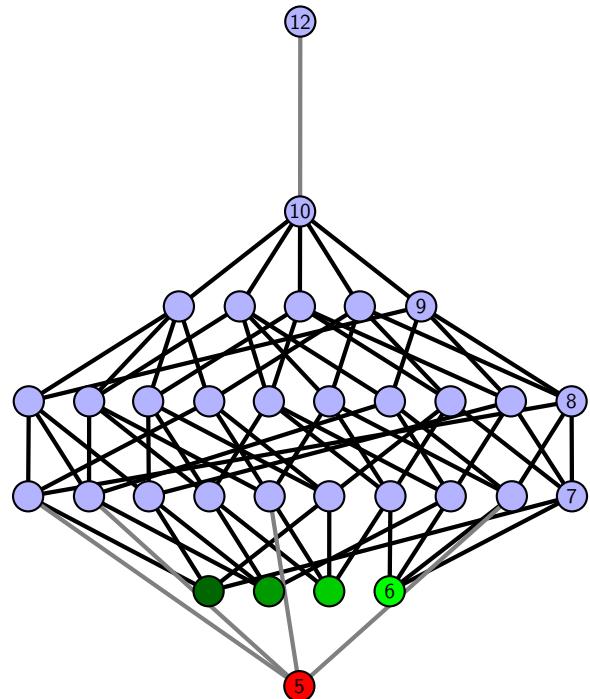


Figure 1560: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.483 $[[5, 14, 6, 1], [4, 11, 5, 12], [13, 10, 14, 11], [6, 15, 7, 20], [1, 20, 2, 19], [12, 3, 13, 4], [9, 15, 10, 16], [7, 17, 8, 18], [2, 18, 3, 19], [16, 8, 17, 9]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (19, 6, 20, 7), (11, 8, 12, 9), (2, 9, 3, 10), (3, 12, 4, 13), (5, 20, 6, 15), (14, 15, 1, 16), (16, 13, 17, 14), (17, 4, 18, 5), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 4], [0, 3, 8, 8], [1, 8, 2, 1], [2, 9, 9, 3], [3, 9, 9, 8], [4, 7, 5, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 779: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

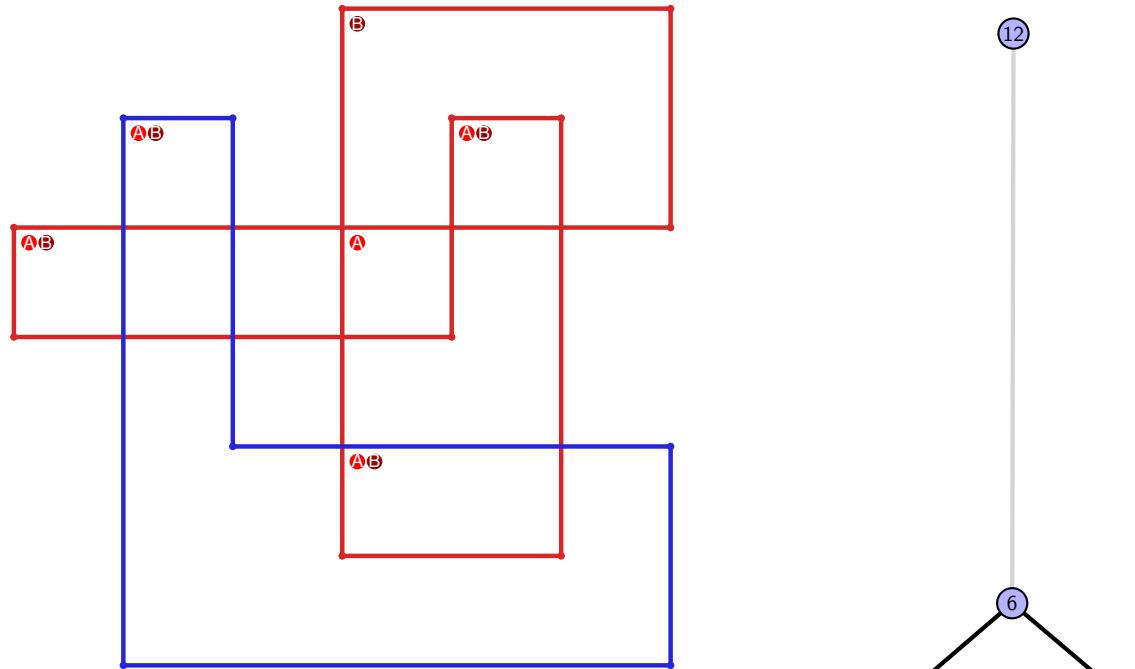


Figure 1561: SnapPy multiloop plot.

Figure 1562: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.484 [[5, 20, 6, 1], [4, 11, 5, 12], [19, 6, 20, 7], [1, 14, 2, 15], [12, 3, 13, 4], [10, 7, 11, 8], [18, 9, 19, 10], [13, 16, 14, 17], [2, 16, 3, 15], [8, 17, 9, 18]]

PD code drawn by SnapPy: [(15, 2, 16, 3), (6, 3, 7, 4), (14, 5, 15, 6), (20, 7, 1, 8), (17, 10, 18, 11), (11, 18, 12, 19), (9, 12, 10, 13), (4, 13, 5, 14), (1, 16, 2, 17), (8, 19, 9, 20)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 7, 8, 8], [1, 8, 7, 1], [1, 9, 6, 2], [2, 5, 9, 9], [3, 9, 4, 8], [3, 7, 4, 3], [5, 7, 6, 6]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 144
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 780: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

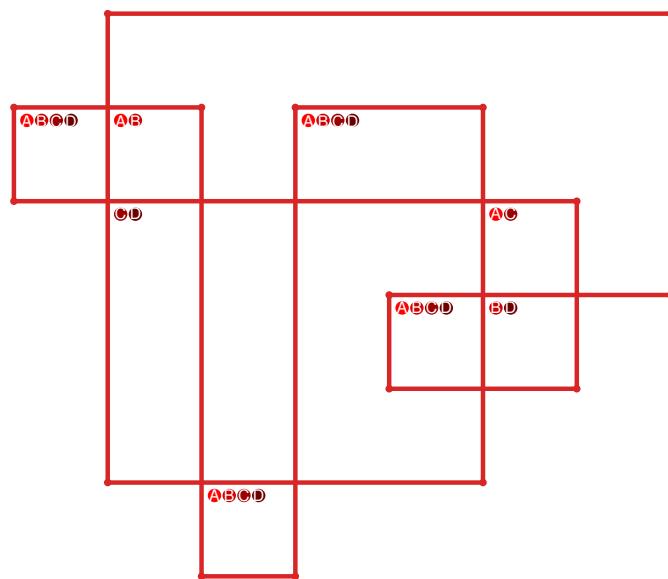


Figure 1563: SnapPy multiloop plot.

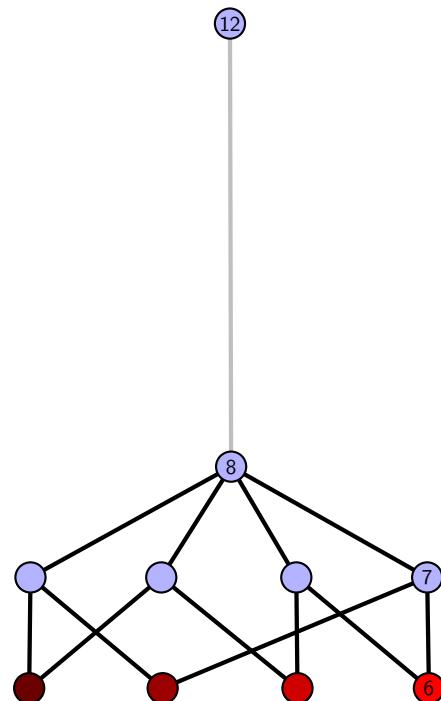


Figure 1564: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.485 [[10, 20, 1, 11], [11, 5, 12, 6], [6, 9, 7, 10], [7, 19, 8, 20], [1, 15, 2, 16], [4, 12, 5, 13], [18, 8, 19, 9], [14, 2, 15, 3], [16, 14, 17, 13], [17, 3, 18, 4]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (15, 2, 16, 3), (12, 5, 13, 6), (3, 6, 4, 7), (18, 9, 19, 10), (1, 16, 2, 17), (17, 20, 18, 11), (8, 19, 9, 20), (4, 13, 5, 14), (7, 14, 8, 15)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 6, 6], [0, 7, 7, 8], [1, 8, 9, 1], [2, 9, 3, 3], [4, 9, 8, 4], [4, 7, 9, 5], [5, 8, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.49

Total pinning sets: 200

Average overall degree: 3.03

Pinning number: 5

Table 781: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	3
Nonminimal pinning sets	0	7	31	58	58	32	9	1	196
Average degree	2.4	2.63	2.82	2.99	3.12	3.23	3.29	3.33	

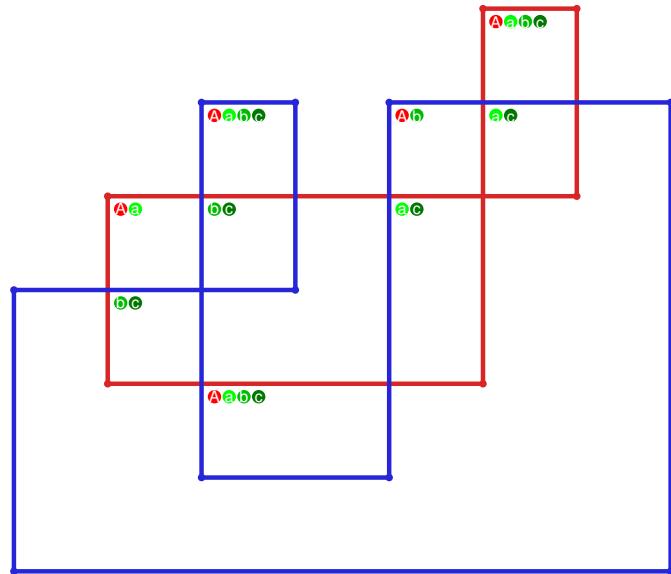


Figure 1565: SnapPy multiloop plot.

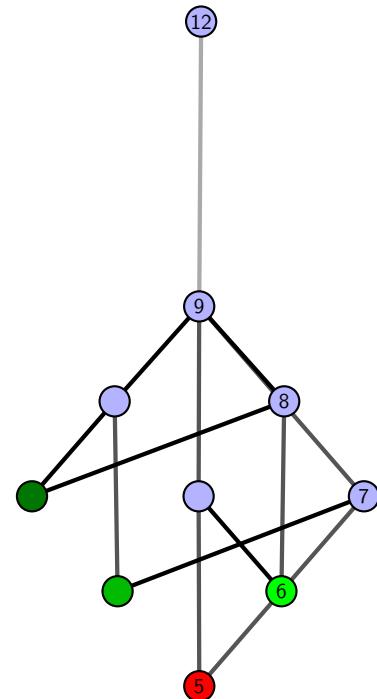


Figure 1566: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.486 $[[5, 20, 6, 1], [15, 4, 16, 5], [16, 19, 17, 20], [6, 17, 7, 18], [1, 10, 2, 11], [3, 14, 4, 15], [18, 7, 19, 8], [9, 12, 10, 13], [2, 12, 3, 11], [13, 8, 14, 9]]$

PD code drawn by `SnapPy`: $[(13, 2, 14, 3), (16, 5, 17, 6), (11, 6, 12, 7), (19, 8, 20, 9), (9, 20, 10, 1), (7, 10, 8, 11), (1, 12, 2, 13), (4, 15, 5, 16), (14, 17, 15, 18), (3, 18, 4, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 6, 6], [0, 7, 8, 8], [1, 8, 9, 1], [2, 9, 3, 3], [4, 9, 9, 8], [4, 7, 5, 4], [5, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 782: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

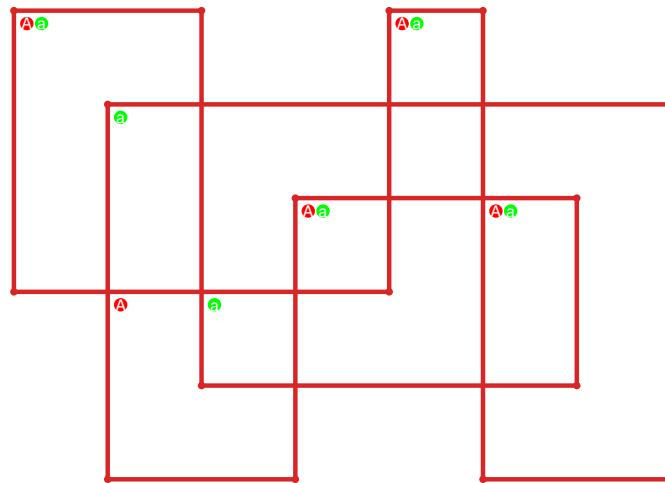


Figure 1567: `SnapPy` multiloop plot.



Figure 1568: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.487 [[10, 20, 1, 11], [11, 5, 12, 6], [6, 9, 7, 10], [7, 19, 8, 20], [1, 15, 2, 16], [4, 12, 5, 13], [18, 8, 19, 9], [14, 17, 15, 18], [2, 17, 3, 16], [13, 3, 14, 4]]

PD code drawn by SnapPy: [(20, 1, 11, 2), (17, 4, 18, 5), (2, 5, 3, 6), (12, 9, 13, 10), (10, 11, 1, 12), (7, 14, 8, 15), (15, 8, 16, 9), (13, 16, 14, 17), (3, 18, 4, 19), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 6, 6], [0, 7, 8, 8], [1, 9, 9, 1], [2, 7, 3, 3], [4, 6, 9, 8], [4, 7, 9, 4], [5, 8, 7, 5]]

Total optimal pinning sets: 2

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.38

Total pinning sets: 120

Average overall degree: 2.97

Pinning number: 6

Table 783: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	11	32	39	25	8	1	116
Average degree	2.33	2.6	2.84	3.03	3.18	3.27	3.33	

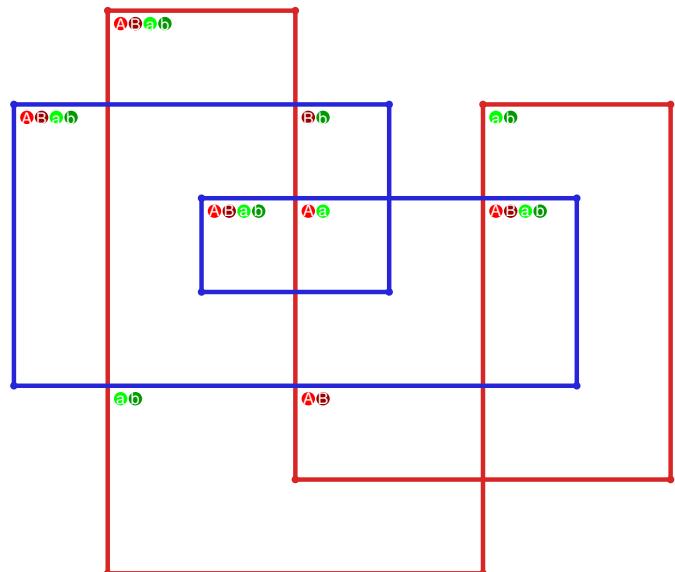


Figure 1569: SnapPy multiloop plot.

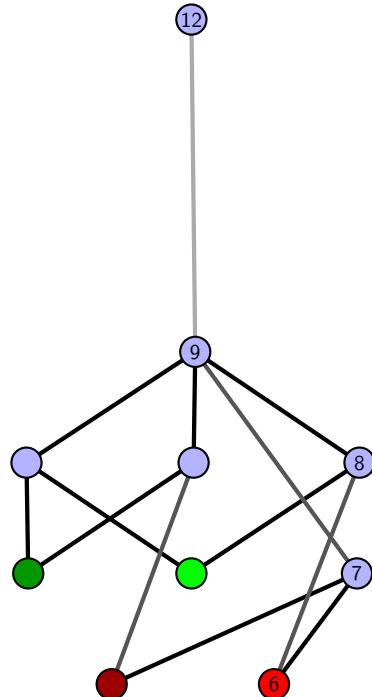


Figure 1570: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.488 [[10, 20, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [19, 1, 20, 2], [8, 13, 9, 12], [5, 15, 6, 16], [2, 15, 3, 14], [18, 13, 19, 14], [16, 4, 17, 5], [3, 17, 4, 18]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (5, 2, 6, 3), (3, 16, 4, 17), (14, 7, 15, 8), (17, 4, 18, 5), (13, 18, 14, 19), (19, 8, 20, 9), (1, 20, 2, 11), (9, 12, 10, 13), (6, 15, 7, 16)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 7, 0], [1, 7, 2, 1], [2, 8, 8, 6], [3, 5, 9, 7], [3, 6, 9, 4], [5, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 144
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 784: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

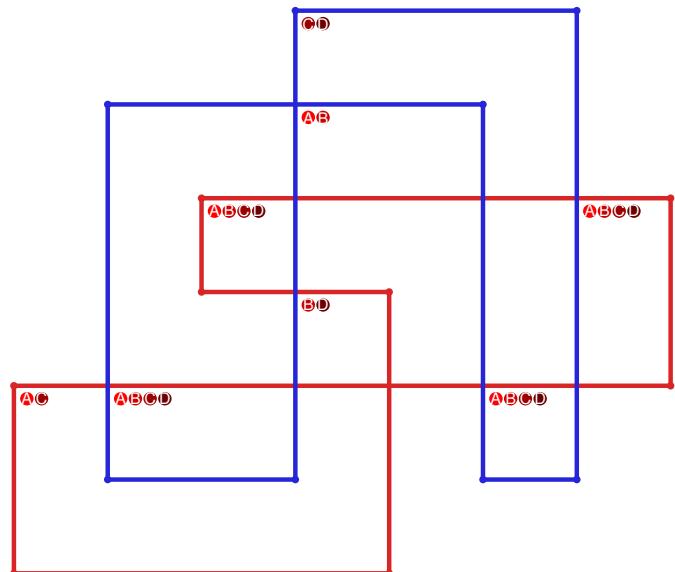


Figure 1571: SnapPy multiloop plot.

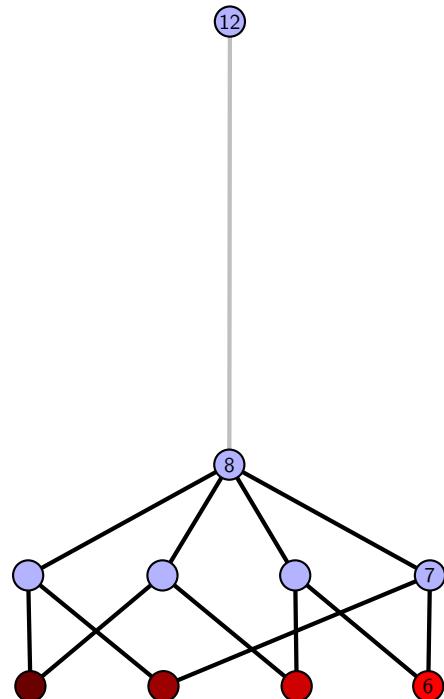


Figure 1572: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.489 $[[11, 20, 12, 1], [10, 17, 11, 18], [19, 16, 20, 17], [12, 4, 13, 3], [1, 8, 2, 9], [18, 9, 19, 10], [15, 4, 16, 5], [13, 6, 14, 7], [7, 2, 8, 3], [5, 14, 6, 15]]$

PD code drawn by `SnapPy`: $[(5, 20, 6, 1), (1, 10, 2, 11), (13, 2, 14, 3), (11, 4, 12, 5), (19, 6, 20, 7), (16, 7, 17, 8), (3, 12, 4, 13), (17, 14, 18, 15), (8, 15, 9, 16), (9, 18, 10, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 8, 8, 5], [1, 4, 2, 1], [2, 9, 9, 3], [3, 9, 9, 8], [3, 7, 4, 4], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 6

Average minimal degree: 2.42

Total pinning sets: 190

Average overall degree: 2.97

Pinning number: 5

Table 785: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	5
Nonminimal pinning sets	0	7	36	55	50	27	8	1	184
Average degree	2.2	2.5	2.78	2.95	3.09	3.19	3.27	3.33	

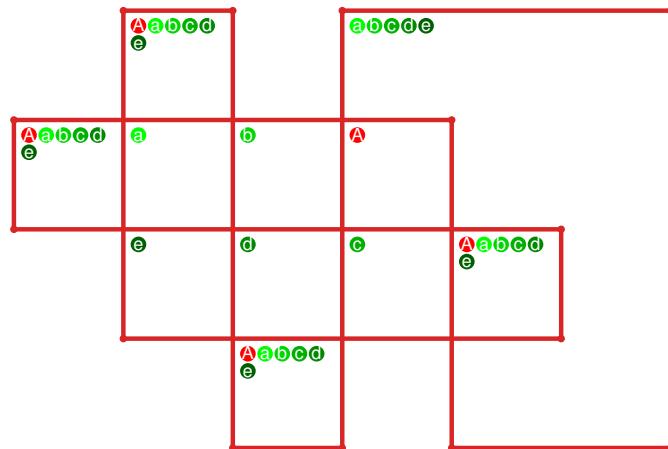


Figure 1573: `SnapPy` multiloop plot.

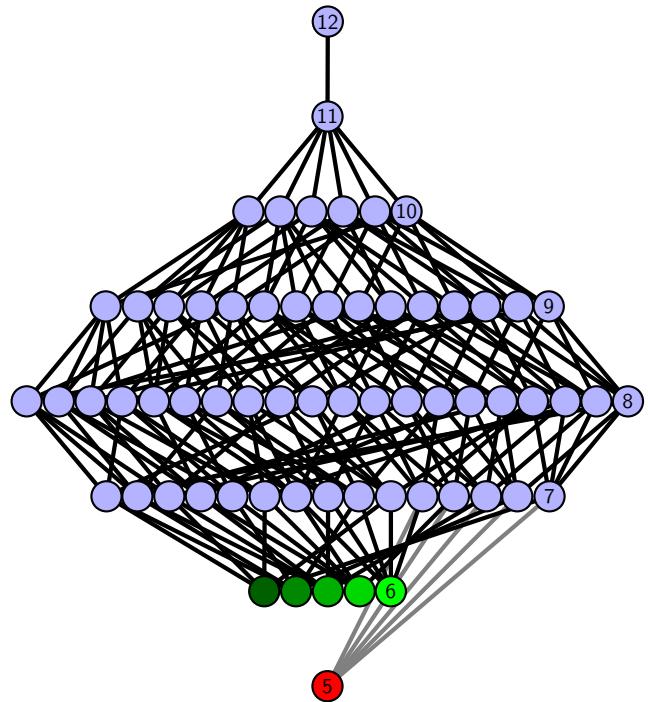


Figure 1574: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.490 $[[9, 20, 10, 1], [17, 8, 18, 9], [19, 14, 20, 15], [10, 5, 11, 6], [1, 6, 2, 7], [7, 16, 8, 17], [18, 16, 19, 15], [4, 13, 5, 14], [11, 3, 12, 2], [12, 3, 13, 4]]$

PD code drawn by `SnapPy`: $[(20, 9, 1, 10), (10, 1, 11, 2), (8, 3, 9, 4), (19, 4, 20, 5), (15, 6, 16, 7), (2, 11, 3, 12), (17, 12, 18, 13), (13, 16, 14, 17), (5, 14, 6, 15), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 7], [0, 7, 8, 4], [0, 3, 8, 5], [1, 4, 6, 1], [1, 5, 2, 2], [2, 9, 9, 3], [3, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 786: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

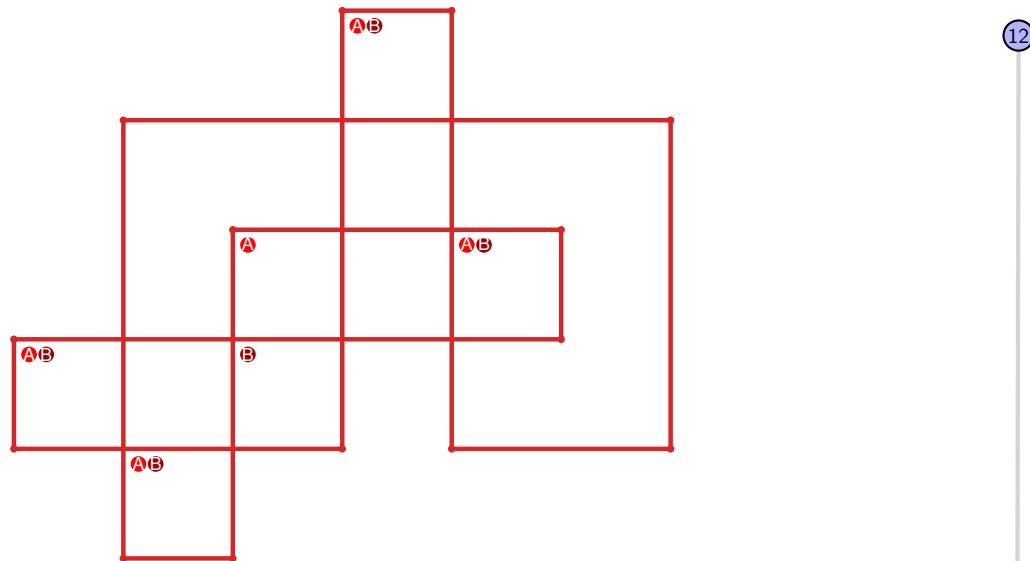


Figure 1575: `SnapPy` multiloop plot.

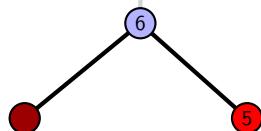


Figure 1576: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.491 [[10, 20, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [19, 14, 20, 15], [1, 14, 2, 13], [8, 13, 9, 12], [5, 15, 6, 16], [18, 2, 19, 3], [16, 4, 17, 5], [3, 17, 4, 18]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (19, 2, 20, 3), (7, 4, 8, 5), (5, 14, 6, 15), (15, 6, 16, 7), (16, 9, 17, 10), (12, 17, 13, 18), (3, 18, 4, 19), (1, 20, 2, 11), (8, 13, 9, 14)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 6, 7, 4], [0, 3, 7, 5], [1, 4, 2, 1], [2, 8, 8, 3], [3, 9, 9, 4], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 5
 Total pinning sets: 140
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.43
 Average overall degree: 2.98

Table 787: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	16	40	44	26	8	1	135
Average degree	2.33	2.63	2.88	3.06	3.18	3.27	3.33	

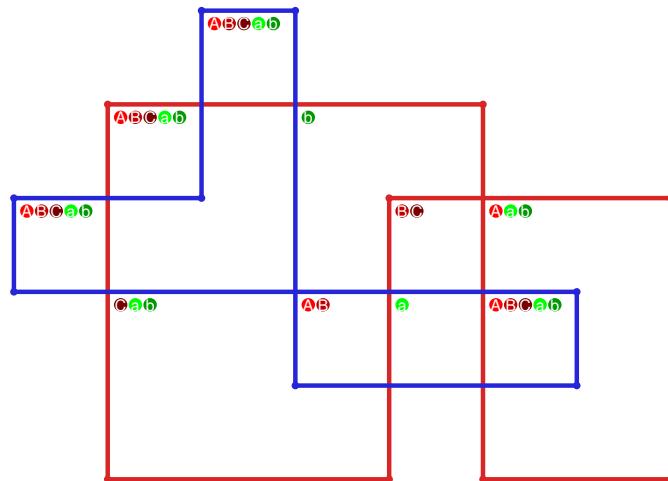


Figure 1577: SnapPy multiloop plot.

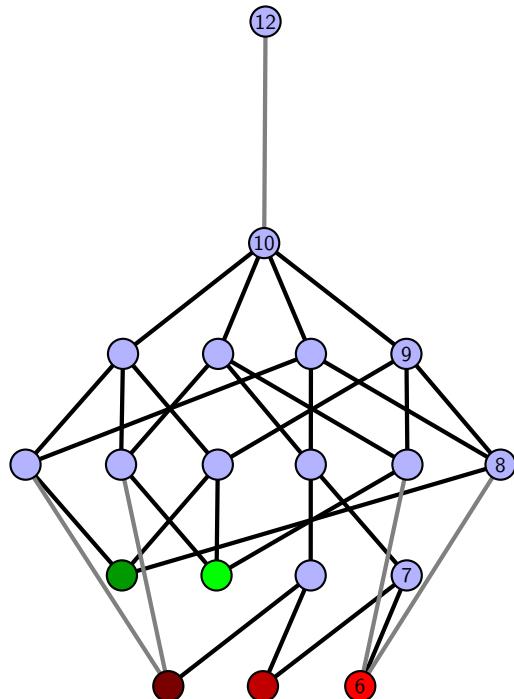


Figure 1578: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.492 [[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [8, 3, 9, 4], [1, 13, 2, 12], [18, 12, 19, 11], [6, 15, 7, 16], [4, 7, 5, 8], [2, 13, 3, 14], [14, 5, 15, 6]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (12, 3, 13, 4), (2, 5, 3, 6), (18, 7, 19, 8), (9, 16, 10, 17), (10, 19, 11, 20), (20, 11, 1, 12), (4, 13, 5, 14), (17, 14, 18, 15), (15, 8, 16, 9)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 8, 8, 5], [1, 4, 2, 1], [2, 9, 9, 7], [3, 6, 9, 3], [3, 9, 4, 4], [6, 8, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 788: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

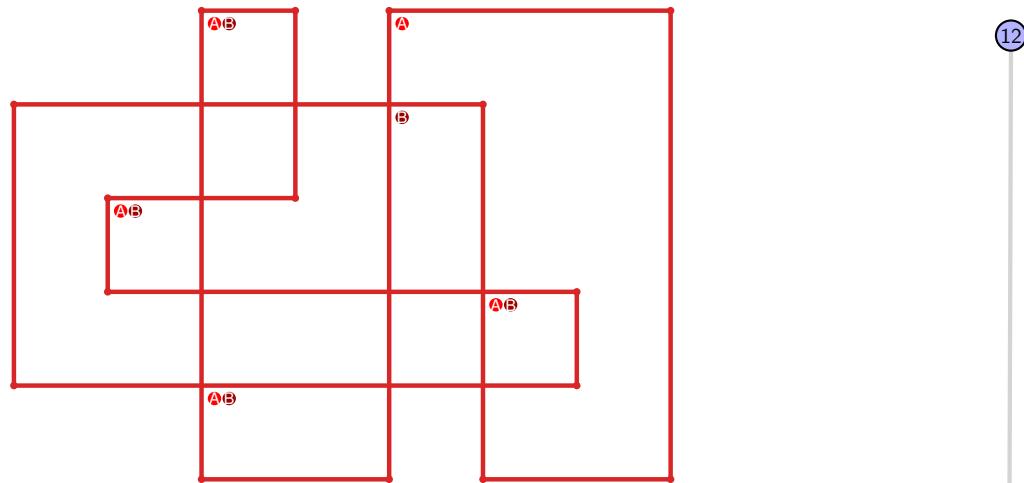


Figure 1579: SnapPy multiloop plot.

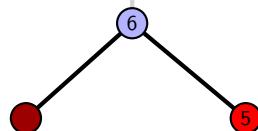


Figure 1580: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.493 [[20, 15, 1, 16], [16, 6, 17, 5], [19, 4, 20, 5], [14, 9, 15, 10], [1, 9, 2, 8], [6, 18, 7, 17], [7, 18, 8, 19], [12, 3, 13, 4], [10, 13, 11, 14], [2, 11, 3, 12]]

PD code drawn by `SnapPy`: [(10, 1, 11, 2), (17, 2, 18, 3), (3, 14, 4, 15), (6, 19, 7, 20), (12, 7, 13, 8), (20, 9, 1, 10), (8, 11, 9, 12), (18, 13, 19, 14), (15, 4, 16, 5), (5, 16, 6, 17)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 8, 8, 4], [0, 3, 9, 6], [1, 6, 6, 1], [2, 5, 5, 4], [2, 9, 9, 8], [3, 7, 9, 3], [4, 8, 7, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 789: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

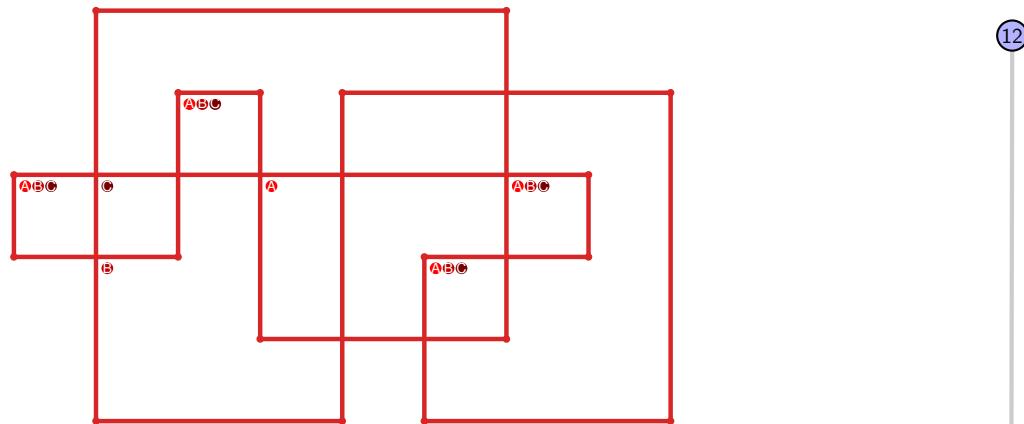


Figure 1581: `SnapPy` multiloop plot.

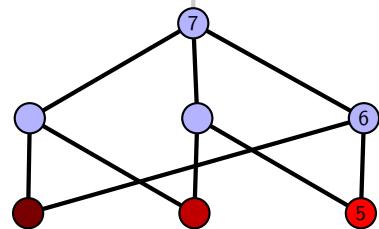


Figure 1582: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.494 [[10, 20, 1, 11], [11, 9, 12, 10], [12, 19, 13, 20], [1, 18, 2, 17], [8, 16, 9, 17], [18, 13, 19, 14], [2, 7, 3, 8], [15, 5, 16, 6], [14, 5, 15, 4], [6, 3, 7, 4]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (2, 11, 3, 12), (12, 3, 13, 4), (10, 5, 1, 6), (18, 7, 19, 8), (15, 20, 16, 11), (6, 13, 7, 14), (14, 9, 15, 10), (19, 16, 20, 17), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 4], [1, 3, 6, 7], [2, 8, 3, 2], [3, 9, 9, 4], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 790: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

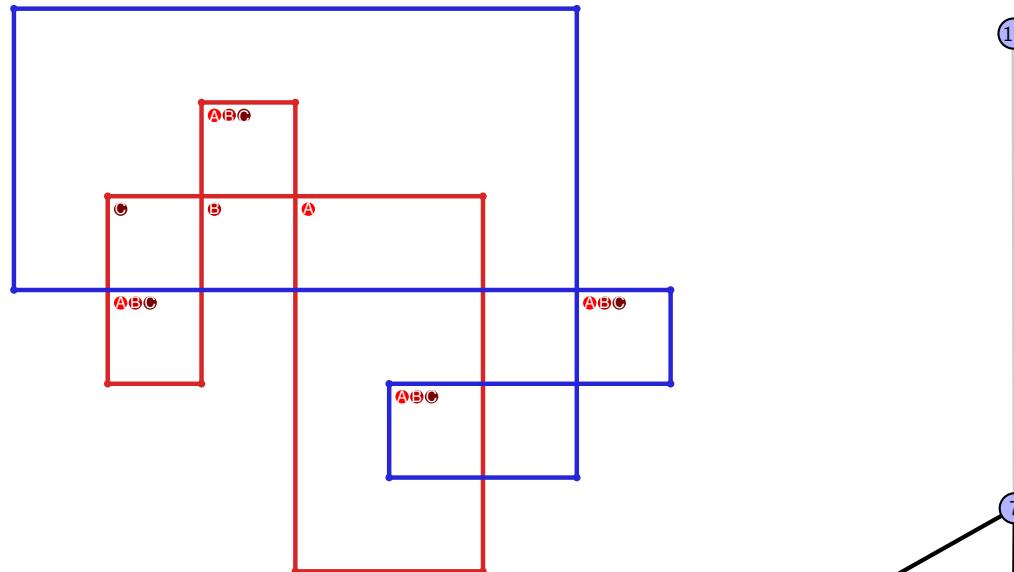


Figure 1583: SnapPy multiloop plot.

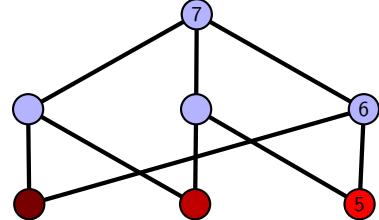


Figure 1584: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.495 $[[10, 14, 1, 11], [11, 9, 12, 10], [13, 20, 14, 15], [1, 20, 2, 19], [8, 18, 9, 19], [12, 16, 13, 15], [2, 7, 3, 8], [17, 5, 18, 6], [16, 5, 17, 4], [6, 3, 7, 4]]$

PD code drawn by SnapPy: $[(4, 1, 5, 2), (2, 11, 3, 12), (12, 3, 13, 4), (10, 5, 1, 6), (18, 7, 19, 8), (8, 17, 9, 18), (6, 13, 7, 14), (14, 9, 15, 10), (20, 15, 17, 16), (16, 19, 11, 20)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 6, 7], [1, 8, 2, 2], [3, 9, 9, 4], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 791: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

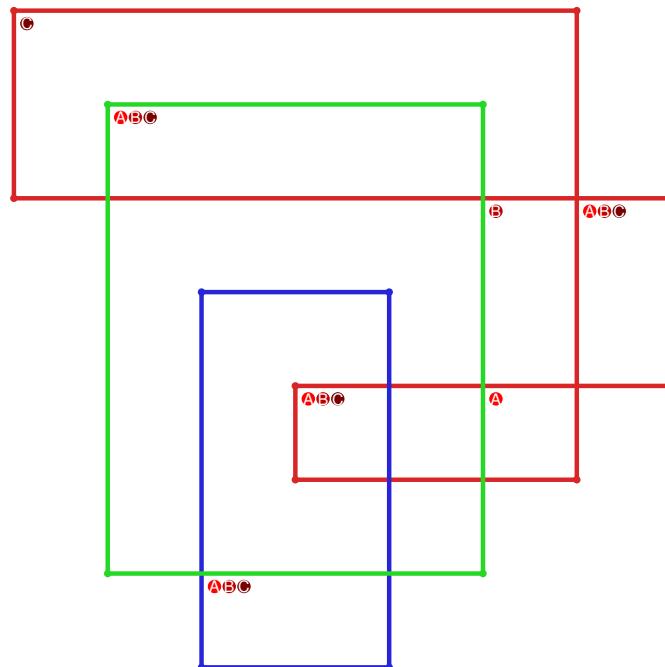


Figure 1585: SnapPy multiloop plot.

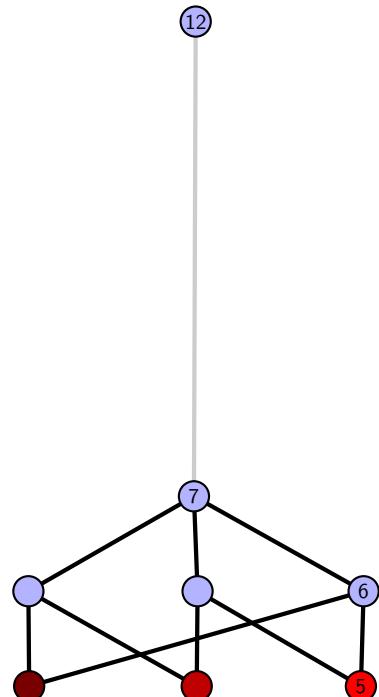


Figure 1586: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.496 $[[20, 13, 1, 14], [14, 19, 15, 20], [15, 12, 16, 13], [1, 16, 2, 17], [9, 18, 10, 19], [11, 4, 12, 5], [2, 7, 3, 8], [17, 8, 18, 9], [10, 6, 11, 5], [6, 3, 7, 4]]$

PD code drawn by SnapPy: $[(4, 1, 5, 2), (9, 2, 10, 3), (3, 8, 4, 9), (20, 5, 1, 6), (15, 6, 16, 7), (13, 10, 14, 11), (18, 11, 19, 12), (19, 14, 20, 15), (7, 16, 8, 17), (12, 17, 13, 18)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 7], [1, 7, 7, 8], [2, 8, 8, 9], [3, 9, 9, 7], [3, 6, 4, 4], [4, 9, 5, 5], [5, 8, 6, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 792: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

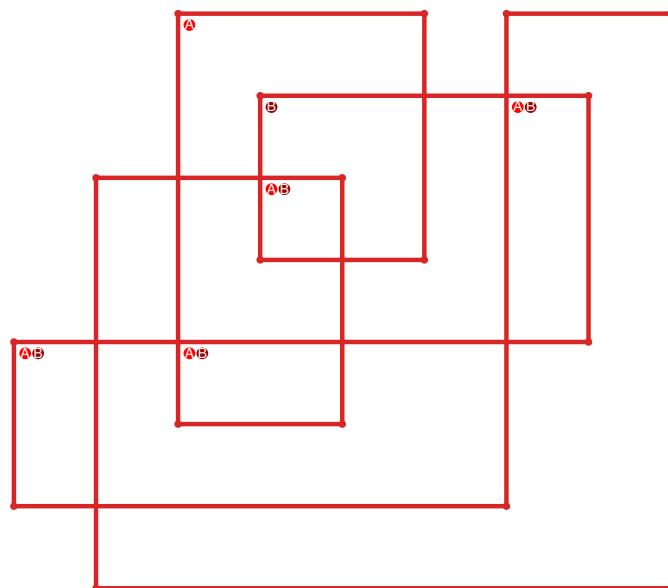


Figure 1587: SnapPy multiloop plot.

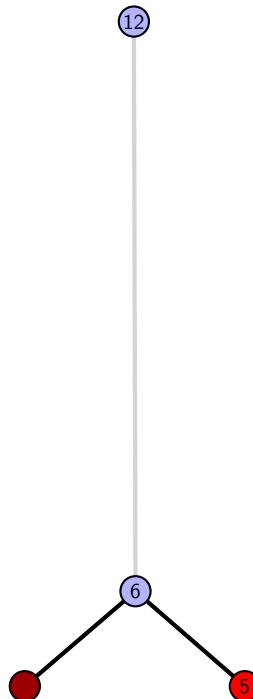


Figure 1588: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.497 $[[5, 20, 6, 1], [13, 4, 14, 5], [14, 19, 15, 20], [6, 18, 7, 17], [1, 11, 2, 10], [3, 12, 4, 13], [18, 15, 19, 16], [7, 16, 8, 17], [11, 8, 12, 9], [2, 9, 3, 10]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (7, 4, 8, 5), (18, 5, 19, 6), (6, 17, 7, 18), (19, 8, 20, 9), (14, 11, 15, 12), (3, 12, 4, 13), (13, 2, 14, 3), (10, 15, 11, 16), (1, 16, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 6, 7, 7], [0, 8, 9, 9], [1, 9, 8, 1], [2, 7, 3, 2], [3, 6, 8, 3], [4, 7, 5, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 168
 Pinning number: 6

Average optimal degree: 2.39
 Average minimal degree: 2.39
 Average overall degree: 2.98

Table 793: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	27	50	49	27	8	1	162
Average degree	2.39	2.71	2.93	3.08	3.19	3.27	3.33	

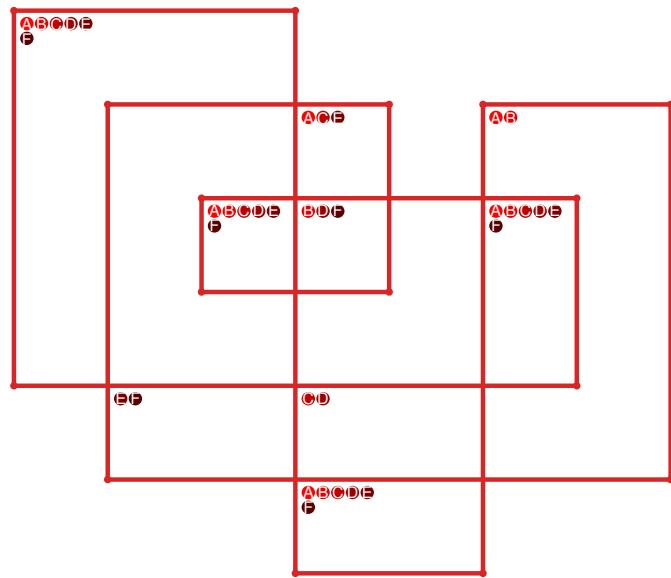


Figure 1589: `SnapPy` multiloop plot.

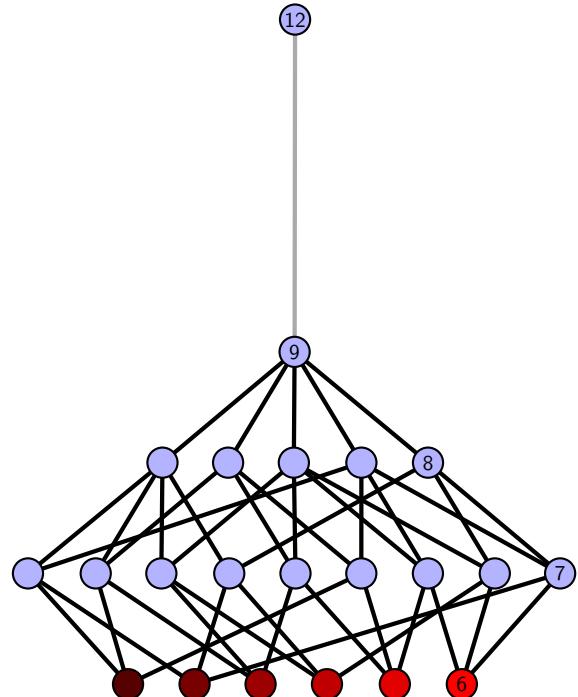


Figure 1590: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.498 [[20, 7, 1, 8], [8, 18, 9, 17], [19, 16, 20, 17], [6, 11, 7, 12], [1, 11, 2, 10], [18, 10, 19, 9], [4, 15, 5, 16], [12, 5, 13, 6], [2, 13, 3, 14], [14, 3, 15, 4]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (10, 3, 11, 4), (18, 5, 19, 6), (7, 16, 8, 17), (8, 19, 9, 20), (4, 9, 5, 10), (20, 11, 1, 12), (2, 13, 3, 14), (17, 14, 18, 15), (15, 6, 16, 7)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 8, 5], [1, 4, 2, 1], [2, 9, 9, 7], [3, 6, 8, 3], [4, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 794: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

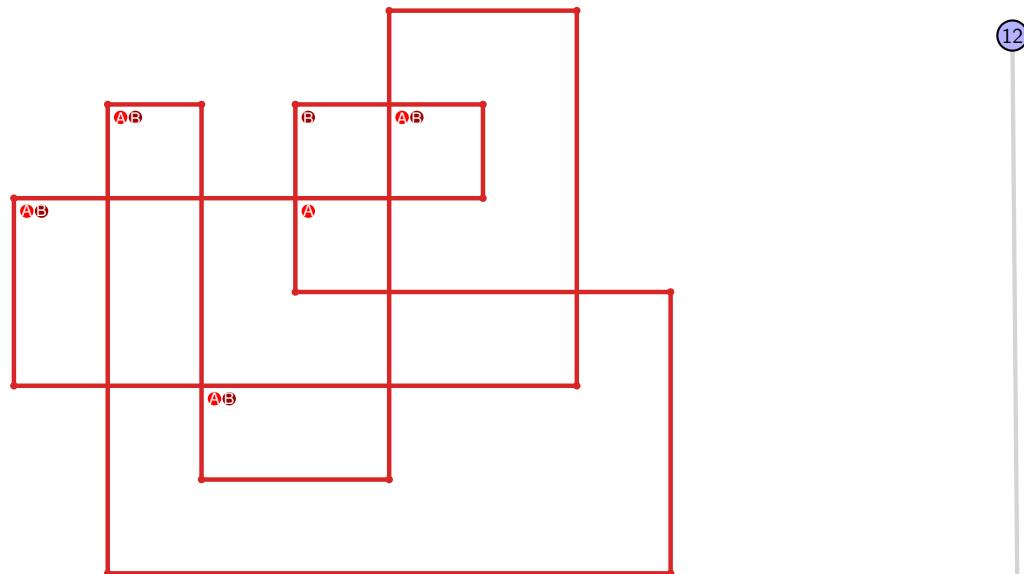


Figure 1591: SnapPy multiloop plot.

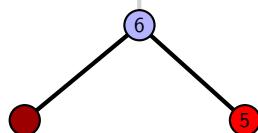


Figure 1592: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.499 $[[8, 20, 1, 9], [9, 6, 10, 5], [7, 4, 8, 5], [19, 12, 20, 13], [1, 12, 2, 11], [6, 11, 7, 10], [3, 15, 4, 16], [13, 18, 14, 19], [2, 17, 3, 16], [17, 14, 18, 15]]$

PD code drawn by SnapPy: $[(3, 8, 4, 1), (1, 20, 2, 9), (9, 2, 10, 3), (10, 5, 11, 6), (18, 11, 19, 12), (16, 13, 17, 14), (7, 14, 8, 15), (15, 6, 16, 7), (12, 17, 13, 18), (4, 19, 5, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 6], [0, 7, 7, 4], [0, 3, 8, 5], [1, 4, 2, 1], [2, 8, 8, 9], [3, 9, 9, 3], [4, 9, 6, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 795: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

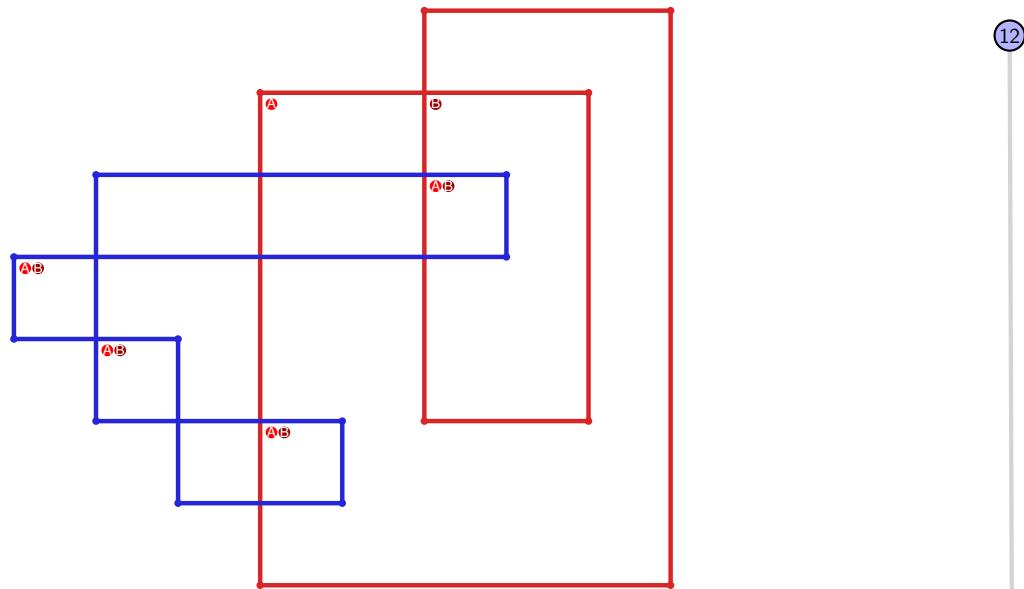


Figure 1593: SnapPy multiloop plot.

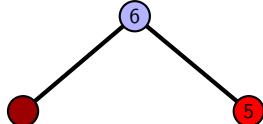


Figure 1594: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.500 [[11, 20, 12, 1], [17, 10, 18, 11], [19, 14, 20, 15], [12, 5, 13, 6], [1, 8, 2, 9], [9, 16, 10, 17], [18, 16, 19, 15], [4, 13, 5, 14], [6, 4, 7, 3], [7, 2, 8, 3]]

PD code drawn by SnapPy: [(5, 20, 6, 1), (1, 4, 2, 5), (10, 3, 11, 4), (19, 6, 20, 7), (15, 8, 16, 9), (2, 11, 3, 12), (17, 12, 18, 13), (13, 16, 14, 17), (7, 14, 8, 15), (9, 18, 10, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 6, 7], [0, 7, 7, 8], [0, 9, 9, 5], [1, 4, 6, 1], [1, 5, 2, 2], [2, 8, 3, 3], [3, 7, 9, 9], [4, 8, 8, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 796: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

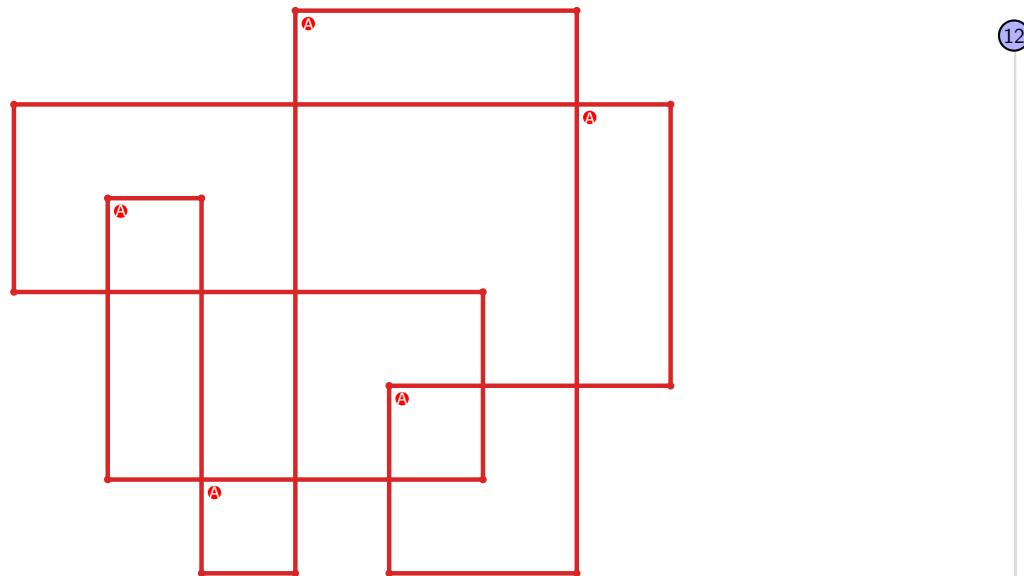


Figure 1595: SnapPy multiloop plot.



Figure 1596: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.501 $[[7, 12, 8, 1], [6, 20, 7, 13], [11, 8, 12, 9], [1, 16, 2, 15], [13, 3, 14, 4], [17, 5, 18, 6], [19, 9, 20, 10], [10, 18, 11, 19], [16, 5, 17, 4], [2, 14, 3, 15]]$

PD code drawn by SnapPy: $[(13, 12, 14, 1), (1, 16, 2, 17), (17, 2, 18, 3), (8, 5, 9, 6), (19, 6, 20, 7), (4, 9, 5, 10), (15, 10, 16, 11), (7, 18, 8, 19), (3, 20, 4, 13), (11, 14, 12, 15)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 7, 0], [0, 8, 9, 9], [1, 9, 9, 8], [1, 8, 8, 7], [1, 7, 7, 2], [2, 6, 6, 5], [3, 5, 5, 4], [3, 4, 4, 3]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 128
 Pinning number: 5

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.91

Table 797: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

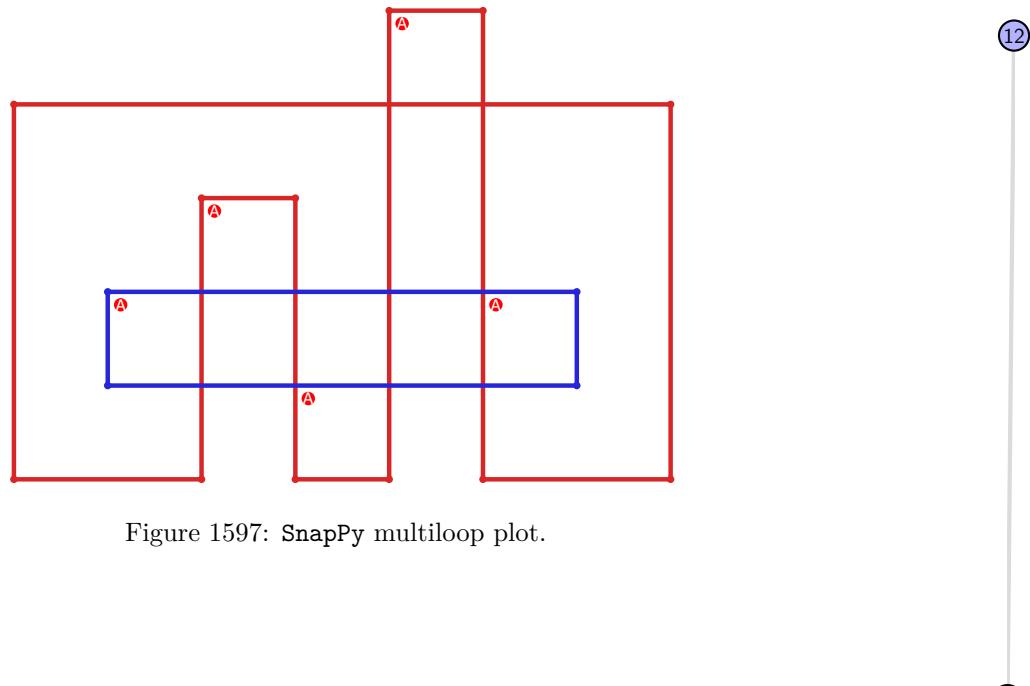


Figure 1597: SnapPy multiloop plot.

Figure 1598: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.502 $[[8, 16, 1, 9], [9, 7, 10, 8], [15, 5, 16, 6], [1, 14, 2, 13], [6, 10, 7, 11], [4, 14, 5, 15], [2, 17, 3, 20], [12, 19, 13, 20], [11, 19, 12, 18], [3, 17, 4, 18]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (15, 4, 16, 5), (19, 6, 20, 7), (1, 20, 2, 13), (5, 14, 6, 15), (3, 16, 4, 17), (10, 17, 11, 18), (18, 11, 19, 12), (12, 7, 9, 8), (8, 9, 1, 10)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 5, 6, 7], [1, 8, 2, 1], [2, 9, 3, 2], [3, 9, 9, 7], [3, 6, 8, 8], [4, 7, 7, 9], [5, 8, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 798: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

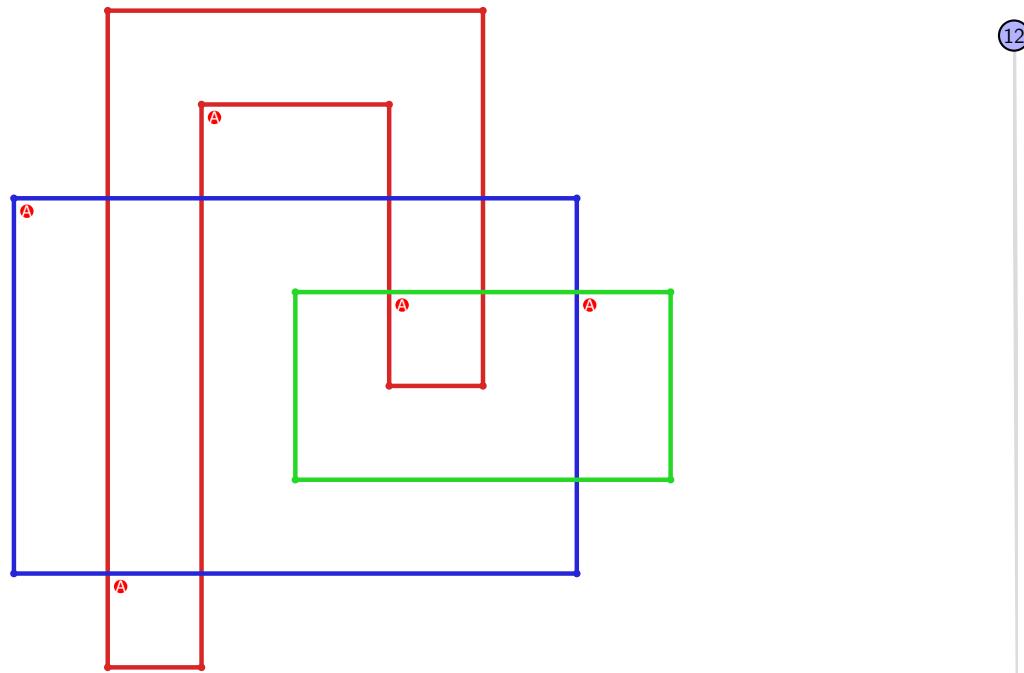


Figure 1599: SnapPy multiloop plot.

Figure 1600: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.503 [[17, 20, 18, 1], [5, 16, 6, 17], [6, 19, 7, 20], [18, 7, 19, 8], [1, 10, 2, 11], [13, 4, 14, 5], [15, 8, 16, 9], [9, 14, 10, 15], [2, 12, 3, 11], [3, 12, 4, 13]]

PD code drawn by SnapPy: [(11, 2, 12, 3), (16, 5, 17, 6), (13, 6, 14, 7), (19, 8, 20, 9), (9, 20, 10, 1), (1, 10, 2, 11), (7, 12, 8, 13), (3, 14, 4, 15), (4, 17, 5, 18), (15, 18, 16, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 3, 3], [0, 2, 2, 6], [0, 7, 8, 8], [1, 9, 9, 7], [1, 7, 7, 3], [4, 6, 6, 5], [4, 9, 9, 4], [5, 8, 8, 5]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 799: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

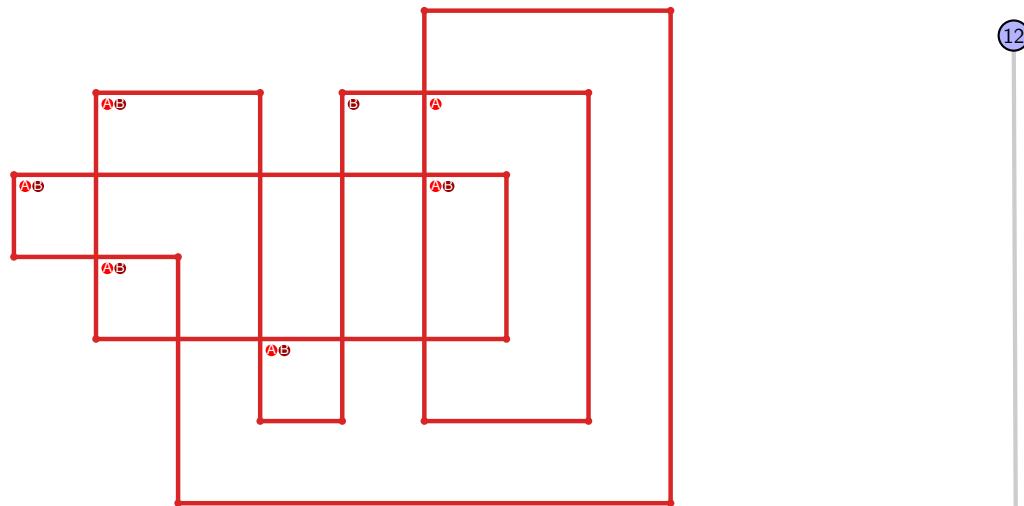


Figure 1601: SnapPy multiloop plot.

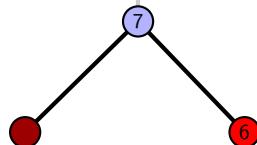


Figure 1602: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.504 $[[9, 20, 10, 1], [5, 8, 6, 9], [19, 12, 20, 13], [10, 2, 11, 1], [15, 4, 16, 5], [16, 7, 17, 8], [6, 17, 7, 18], [13, 18, 14, 19], [11, 2, 12, 3], [3, 14, 4, 15]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (13, 4, 14, 5), (2, 5, 3, 6), (16, 9, 17, 10), (20, 11, 1, 12), (3, 14, 4, 15), (10, 15, 11, 16), (6, 17, 7, 18), (18, 7, 19, 8), (8, 19, 9, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 6], [0, 7, 7, 8], [0, 8, 8, 0], [1, 9, 9, 5], [1, 4, 6, 6], [1, 5, 5, 7], [2, 6, 9, 2], [2, 9, 3, 3], [4, 8, 7, 4]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 800: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

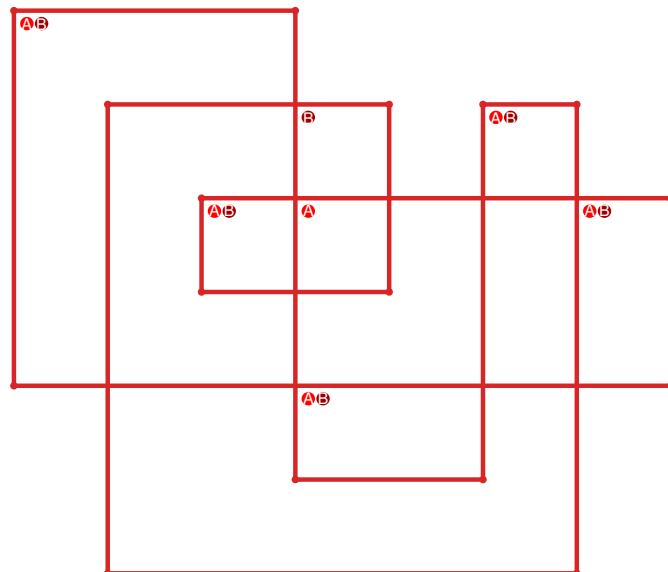


Figure 1603: SnapPy multiloop plot.

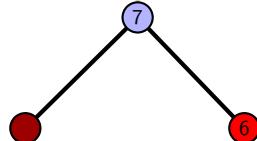


Figure 1604: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.505 $[[20, 13, 1, 14], [14, 7, 15, 8], [10, 19, 11, 20], [3, 12, 4, 13], [1, 4, 2, 5], [6, 15, 7, 16], [8, 17, 9, 18], [18, 9, 19, 10], [11, 2, 12, 3], [5, 17, 6, 16]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (19, 2, 20, 3), (12, 5, 13, 6), (16, 7, 17, 8), (1, 10, 2, 11), (18, 11, 19, 12), (4, 13, 5, 14), (14, 3, 15, 4), (6, 15, 7, 16), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 8], [0, 8, 8, 4], [0, 3, 8, 9], [1, 9, 9, 1], [1, 9, 7, 7], [2, 6, 6, 2], [2, 4, 3, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 801: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

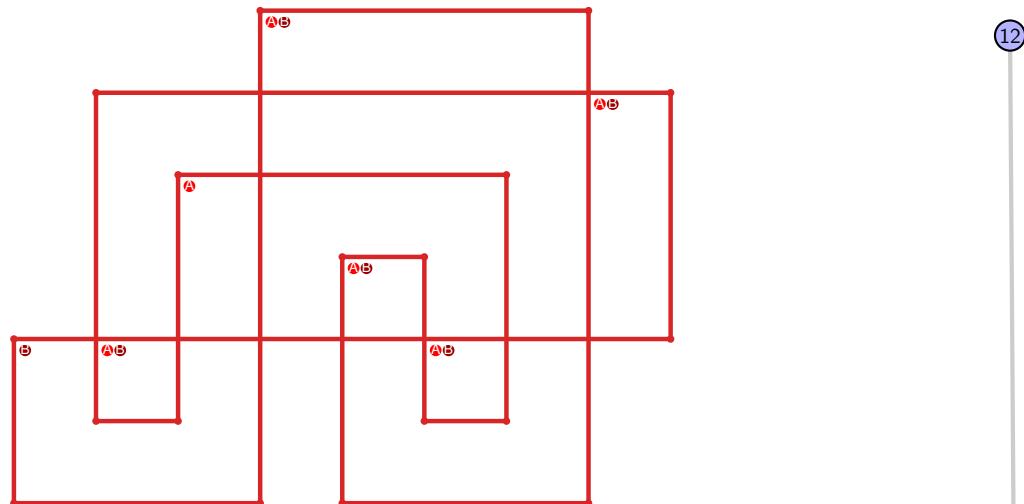


Figure 1605: SnapPy multiloop plot.

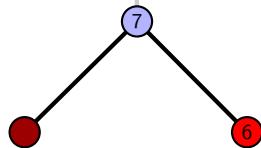


Figure 1606: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.506 [[14, 20, 1, 15], [15, 13, 16, 14], [16, 19, 17, 20], [1, 8, 2, 9], [9, 12, 10, 13], [18, 4, 19, 5], [17, 4, 18, 3], [7, 2, 8, 3], [11, 6, 12, 7], [10, 6, 11, 5]]

PD code drawn by `SnapPy`: [(14, 15, 1, 16), (16, 1, 17, 2), (2, 7, 3, 8), (8, 3, 9, 4), (12, 5, 13, 6), (6, 9, 7, 10), (19, 10, 20, 11), (4, 13, 5, 14), (20, 17, 15, 18), (11, 18, 12, 19)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 7, 7, 4], [1, 3, 8, 9], [2, 9, 6, 6], [2, 5, 5, 7], [3, 6, 8, 3], [4, 7, 9, 9], [4, 8, 8, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 802: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

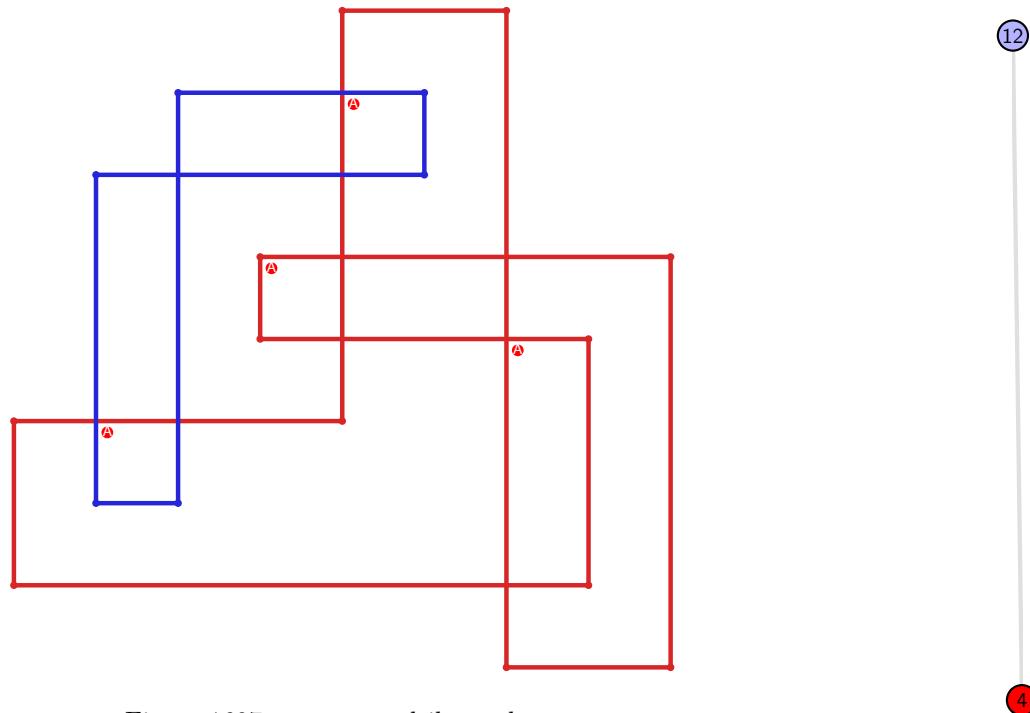


Figure 1607: `SnapPy` multiloop plot.

Figure 1608: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.507 `[[14, 20, 1, 15], [15, 13, 16, 14], [16, 19, 17, 20], [1, 6, 2, 7], [7, 12, 8, 13], [4, 18, 5, 19], [17, 5, 18, 6], [2, 10, 3, 9], [11, 8, 12, 9], [3, 10, 4, 11]]`

PD code drawn by `SnapPy`: `[(20, 1, 15, 2), (11, 2, 12, 3), (7, 4, 8, 5), (5, 12, 6, 13), (13, 6, 14, 7), (3, 8, 4, 9), (18, 9, 19, 10), (14, 15, 1, 16), (19, 16, 20, 17), (10, 17, 11, 18)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 7, 4], [1, 3, 8, 8], [2, 9, 6, 6], [2, 5, 5, 3], [3, 9, 9, 8], [4, 7, 9, 4], [5, 8, 7, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 803: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

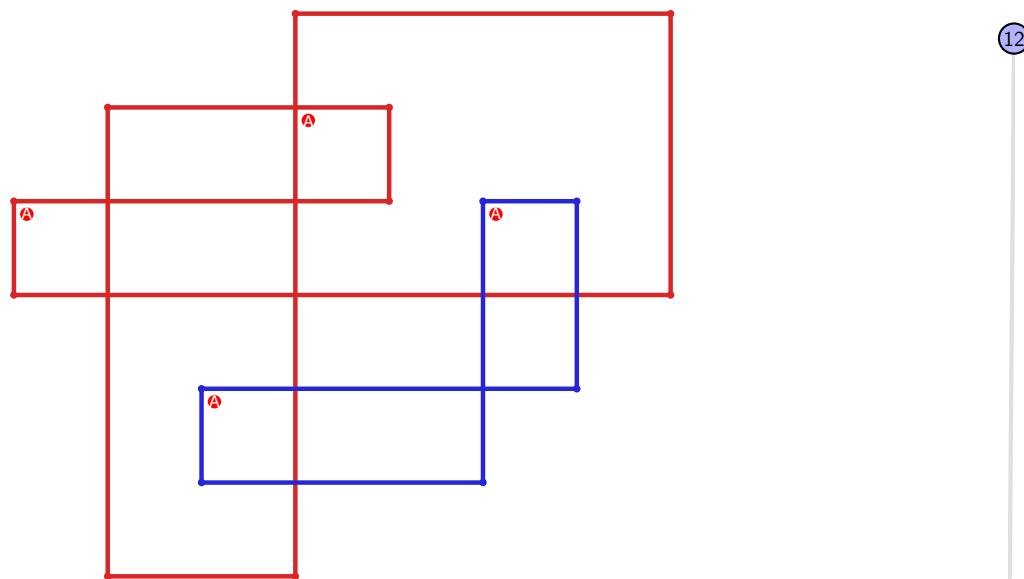


Figure 1609: `SnapPy` multiloop plot.



Figure 1610: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.508 [[20, 17, 1, 18], [18, 11, 19, 12], [12, 19, 13, 20], [13, 16, 14, 17], [1, 6, 2, 7], [7, 10, 8, 11], [4, 15, 5, 16], [14, 5, 15, 6], [2, 9, 3, 10], [8, 3, 9, 4]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (12, 3, 13, 4), (19, 4, 20, 5), (20, 7, 1, 8), (5, 8, 6, 9), (16, 9, 17, 10), (2, 13, 3, 14), (11, 14, 12, 15), (18, 15, 19, 16), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 2, 2], [0, 1, 1, 3], [0, 2, 6, 7], [0, 7, 8, 5], [1, 4, 8, 9], [3, 9, 7, 7], [3, 6, 6, 4], [4, 9, 9, 5], [5, 8, 8, 6]]

Total optimal pinning sets: 3
Total minimal pinning sets: 4
Total pinning sets: 272
Pinning number: 5

Average optimal degree: 2.4
Average minimal degree: 2.47
Average overall degree: 3.04

Table 804: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	19	55	81	69	34	9	1	268
Average degree	2.4	2.68	2.89	3.04	3.15	3.24	3.29	3.33	

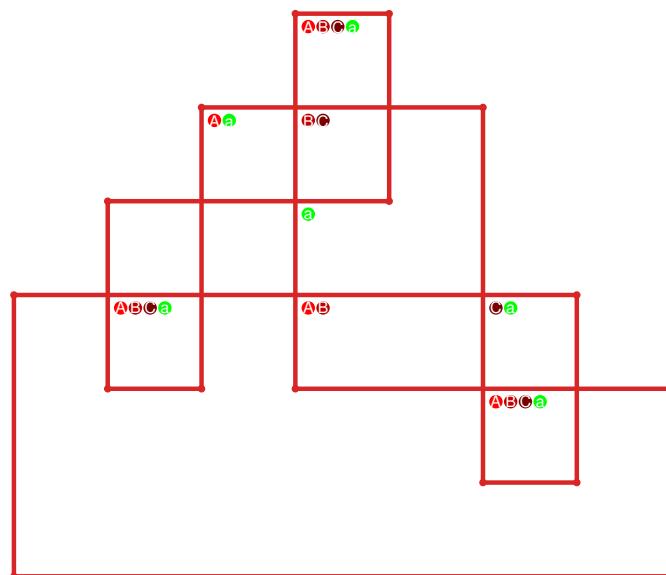


Figure 1611: SnapPy multiloop plot.

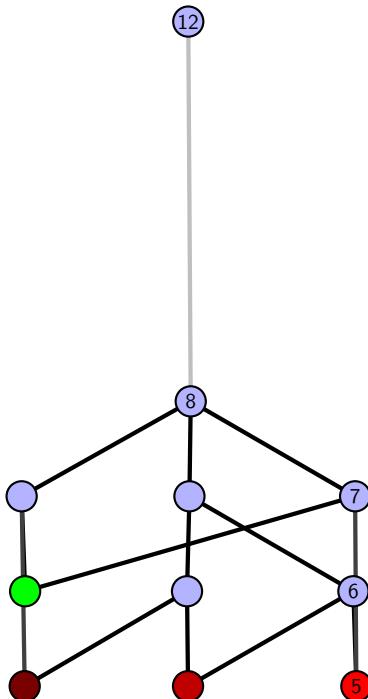


Figure 1612: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.509 $[[13, 20, 14, 1], [19, 12, 20, 13], [14, 18, 15, 17], [1, 6, 2, 7], [11, 18, 12, 19], [15, 4, 16, 5], [5, 16, 6, 17], [2, 9, 3, 10], [7, 10, 8, 11], [8, 3, 9, 4]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (13, 2, 14, 3), (19, 4, 20, 5), (20, 7, 1, 8), (5, 8, 6, 9), (17, 10, 18, 11), (3, 14, 4, 15), (15, 12, 16, 13), (9, 16, 10, 17), (11, 18, 12, 19)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 6], [0, 6, 7, 8], [1, 8, 2, 1], [2, 9, 6, 6], [2, 5, 5, 3], [3, 9, 9, 8], [3, 7, 9, 4], [5, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 805: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

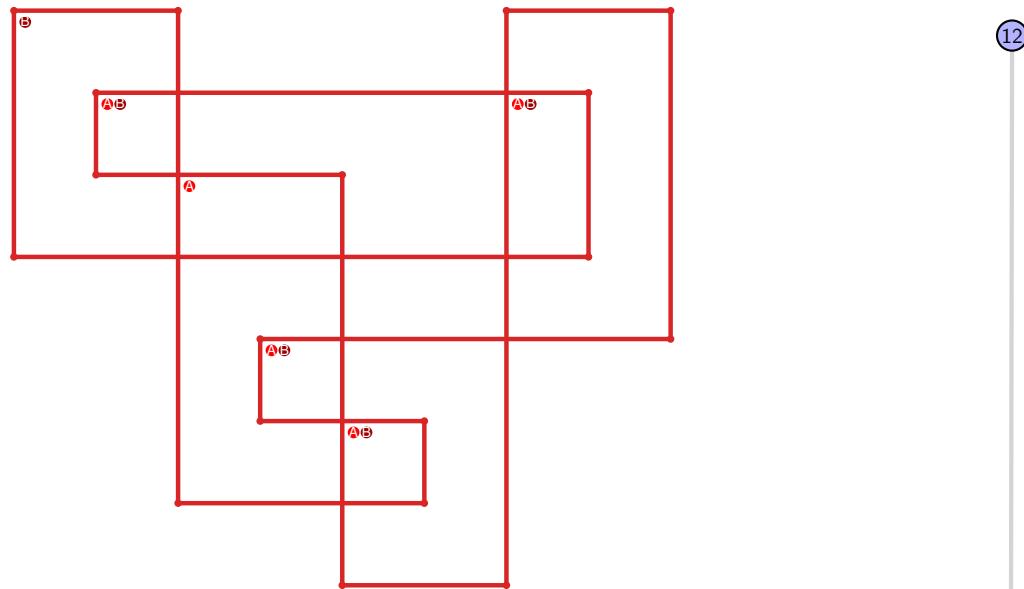


Figure 1613: `SnapPy` multiloop plot.

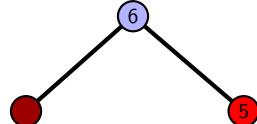


Figure 1614: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.510 `[[12, 20, 1, 13], [13, 11, 14, 12], [14, 19, 15, 20], [1, 6, 2, 7], [7, 10, 8, 11], [18, 15, 19, 16], [5, 17, 6, 18], [2, 9, 3, 10], [8, 3, 9, 4], [16, 4, 17, 5]]`

PD code drawn by `SnapPy`: `[(13, 12, 14, 1), (9, 2, 10, 3), (10, 5, 11, 6), (3, 6, 4, 7), (18, 7, 19, 8), (4, 11, 5, 12), (15, 20, 16, 13), (1, 14, 2, 15), (19, 16, 20, 17), (8, 17, 9, 18)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 4], [1, 3, 7, 8], [2, 9, 6, 2], [3, 5, 9, 9], [3, 8, 8, 4], [4, 7, 7, 9], [5, 8, 6, 6]]`

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 806: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

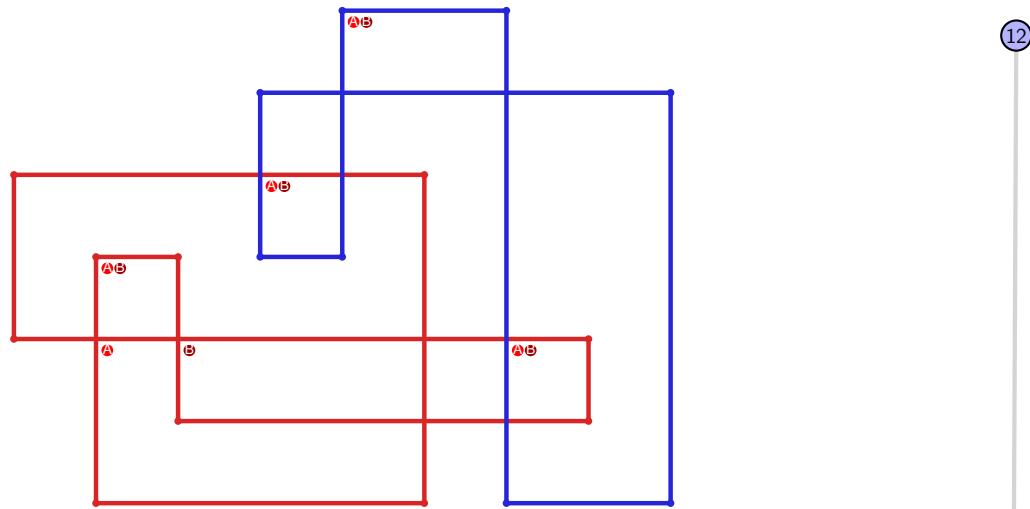


Figure 1615: `SnapPy` multiloop plot.

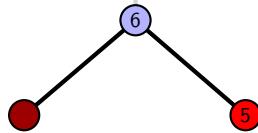


Figure 1616: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.511 [[10, 16, 1, 11], [11, 9, 12, 10], [12, 15, 13, 16], [1, 6, 2, 7], [8, 20, 9, 17], [4, 14, 5, 15], [13, 5, 14, 6], [2, 19, 3, 18], [7, 18, 8, 17], [3, 19, 4, 20]]

PD code drawn by SnapPy: [(15, 2, 16, 3), (8, 3, 9, 4), (19, 6, 20, 7), (1, 16, 2, 17), (20, 17, 15, 18), (7, 18, 8, 19), (14, 9, 11, 10), (10, 11, 1, 12), (5, 12, 6, 13), (13, 4, 14, 5)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 7, 8], [1, 8, 8, 9], [2, 9, 6, 6], [2, 5, 5, 3], [3, 9, 9, 8], [3, 7, 4, 4], [4, 7, 7, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 807: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

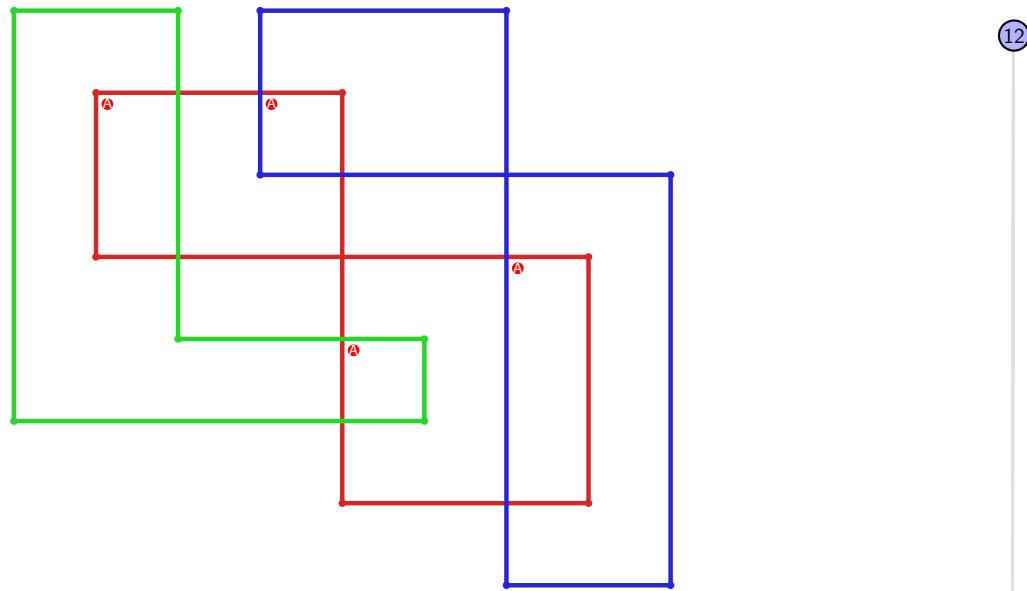


Figure 1617: SnapPy multiloop plot.



Figure 1618: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.512 $[[14, 7, 1, 8], [8, 3, 9, 4], [4, 13, 5, 14], [6, 11, 7, 12], [1, 15, 2, 20], [2, 19, 3, 20], [9, 16, 10, 17], [12, 5, 13, 6], [17, 10, 18, 11], [15, 18, 16, 19]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (10, 3, 11, 4), (12, 5, 13, 6), (19, 8, 20, 9), (4, 9, 5, 10), (2, 11, 3, 12), (7, 18, 8, 19), (17, 20, 18, 15), (14, 15, 1, 16), (16, 13, 17, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 7], [0, 7, 7, 8], [0, 9, 5, 5], [1, 4, 4, 9], [1, 9, 8, 8], [2, 3, 3, 2], [3, 6, 6, 9], [4, 8, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 808: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

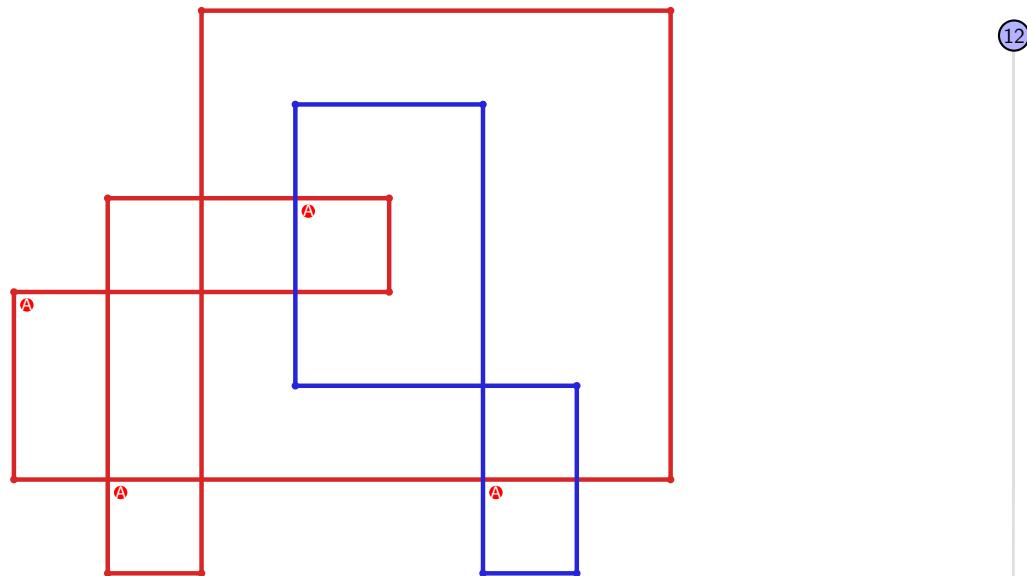


Figure 1619: `SnapPy` multiloop plot.

(12)

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Figure 1620: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.513 [[17, 20, 18, 1], [3, 16, 4, 17], [4, 19, 5, 20], [18, 5, 19, 6], [1, 10, 2, 11], [11, 2, 12, 3], [15, 8, 16, 9], [6, 14, 7, 13], [9, 12, 10, 13], [7, 14, 8, 15]]

PD code drawn by `SnapPy`: [(9, 20, 10, 1), (16, 3, 17, 4), (13, 6, 14, 7), (19, 8, 20, 9), (7, 10, 8, 11), (11, 4, 12, 5), (5, 12, 6, 13), (1, 14, 2, 15), (2, 17, 3, 18), (15, 18, 16, 19)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 3, 3], [0, 2, 2, 7], [0, 8, 5, 5], [1, 4, 4, 8], [1, 8, 9, 9], [3, 9, 9, 8], [4, 7, 6, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 809: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

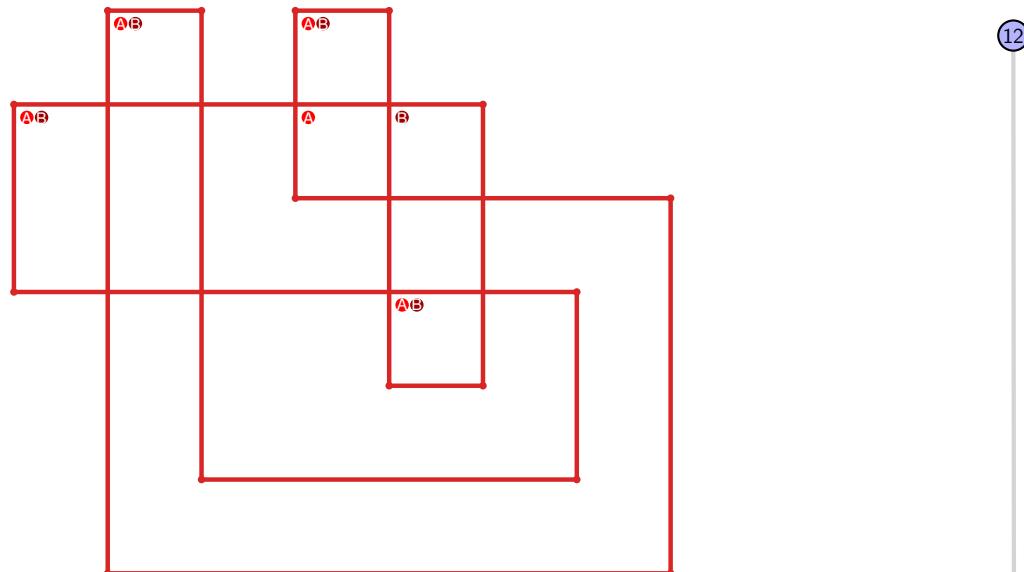


Figure 1621: `SnapPy` multiloop plot.

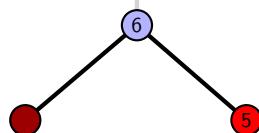


Figure 1622: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.514 [[5, 8, 6, 1], [4, 14, 5, 9], [7, 13, 8, 14], [6, 13, 7, 12], [1, 15, 2, 20], [9, 3, 10, 4], [17, 11, 18, 12], [15, 18, 16, 19], [2, 19, 3, 20], [10, 16, 11, 17]]

PD code drawn by SnapPy: [(9, 8, 10, 1), (2, 5, 3, 6), (18, 11, 19, 12), (12, 3, 13, 4), (4, 13, 5, 14), (1, 14, 2, 9), (16, 19, 17, 20), (7, 20, 8, 15), (15, 6, 16, 7), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 3, 3], [0, 2, 2, 6], [0, 7, 8, 8], [1, 8, 9, 1], [3, 9, 9, 7], [4, 6, 9, 8], [4, 7, 5, 4], [5, 7, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 5

Average minimal degree: 2.41

Total pinning sets: 188

Average overall degree: 2.97

Pinning number: 5

Table 810: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	7	35	55	50	27	8	1	183
Average degree	2.2	2.5	2.77	2.95	3.09	3.19	3.27	3.33	

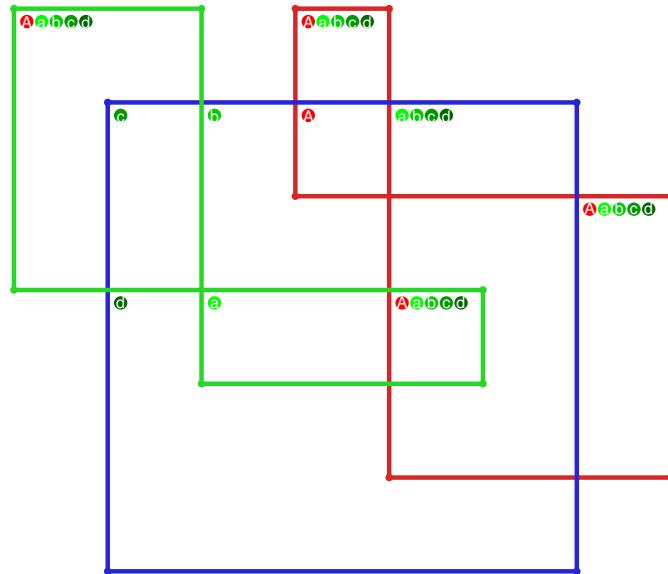


Figure 1623: SnapPy multiloop plot.

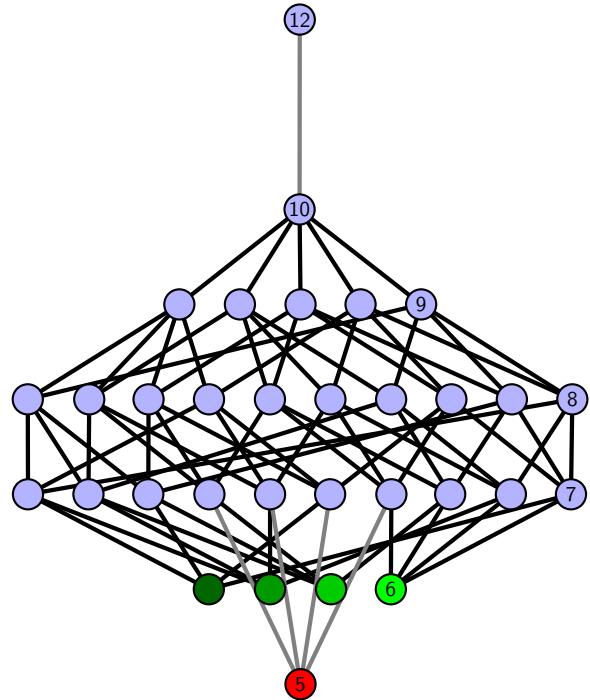


Figure 1624: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.515 $[[6, 14, 1, 7], [7, 15, 8, 20], [17, 5, 18, 6], [13, 10, 14, 11], [1, 10, 2, 9], [15, 9, 16, 8], [16, 19, 17, 20], [4, 18, 5, 19], [11, 4, 12, 3], [12, 2, 13, 3]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (1, 14, 2, 7), (20, 3, 15, 4), (11, 18, 12, 19), (12, 5, 13, 6), (8, 13, 9, 14), (4, 9, 5, 10), (2, 15, 3, 16), (19, 16, 20, 17), (17, 10, 18, 11)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 7], [0, 8, 9, 4], [0, 3, 9, 5], [1, 4, 6, 1], [1, 5, 7, 2], [2, 6, 8, 2], [3, 7, 9, 9], [3, 8, 8, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 811: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

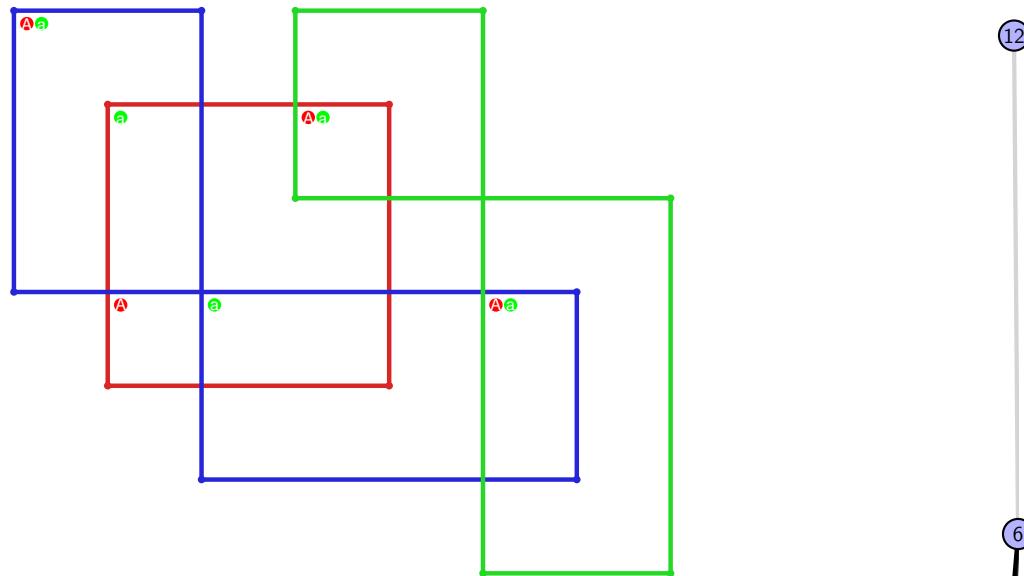


Figure 1625: SnapPy multiloop plot.



Figure 1626: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.516 $[[7, 20, 8, 1], [6, 13, 7, 14], [16, 19, 17, 20], [8, 3, 9, 4], [1, 4, 2, 5], [14, 5, 15, 6], [15, 12, 16, 13], [18, 11, 19, 12], [17, 11, 18, 10], [2, 9, 3, 10]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (19, 2, 20, 3), (12, 3, 13, 4), (20, 7, 1, 8), (8, 15, 9, 16), (16, 9, 17, 10), (13, 10, 14, 11), (4, 11, 5, 12), (14, 17, 15, 18), (5, 18, 6, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 8], [0, 9, 9, 4], [0, 3, 9, 5], [1, 4, 6, 1], [1, 5, 7, 2], [2, 6, 8, 8], [2, 7, 7, 9], [3, 8, 4, 3]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 288
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 3.03

Table 812: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

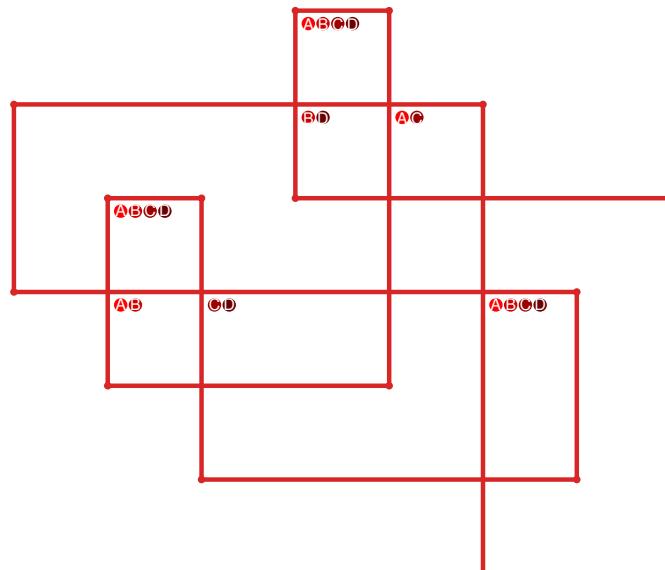


Figure 1627: SnapPy multiloop plot.

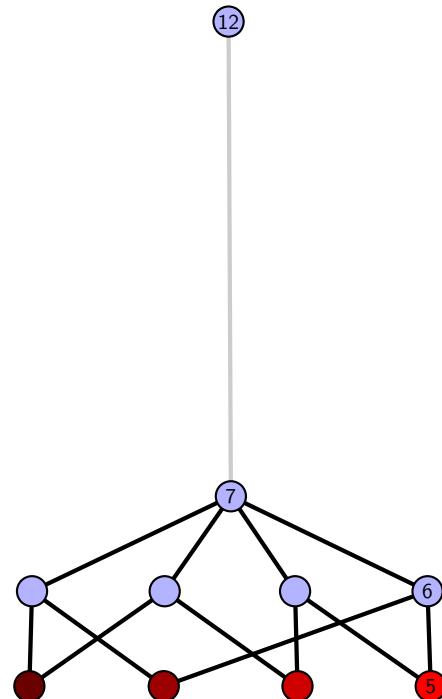


Figure 1628: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.517 $[[7, 20, 8, 1], [19, 6, 20, 7], [8, 6, 9, 5], [1, 10, 2, 11], [13, 18, 14, 19], [9, 4, 10, 5], [2, 15, 3, 16], [11, 16, 12, 17], [17, 12, 18, 13], [14, 3, 15, 4]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (6, 1, 7, 2), (2, 5, 3, 6), (16, 3, 17, 4), (18, 7, 19, 8), (14, 9, 15, 10), (19, 12, 20, 13), (8, 13, 9, 14), (10, 15, 11, 16), (4, 17, 5, 18)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 5, 6, 7], [1, 8, 8, 9], [2, 9, 3, 2], [3, 9, 9, 7], [3, 6, 8, 8], [4, 7, 7, 4], [4, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 813: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

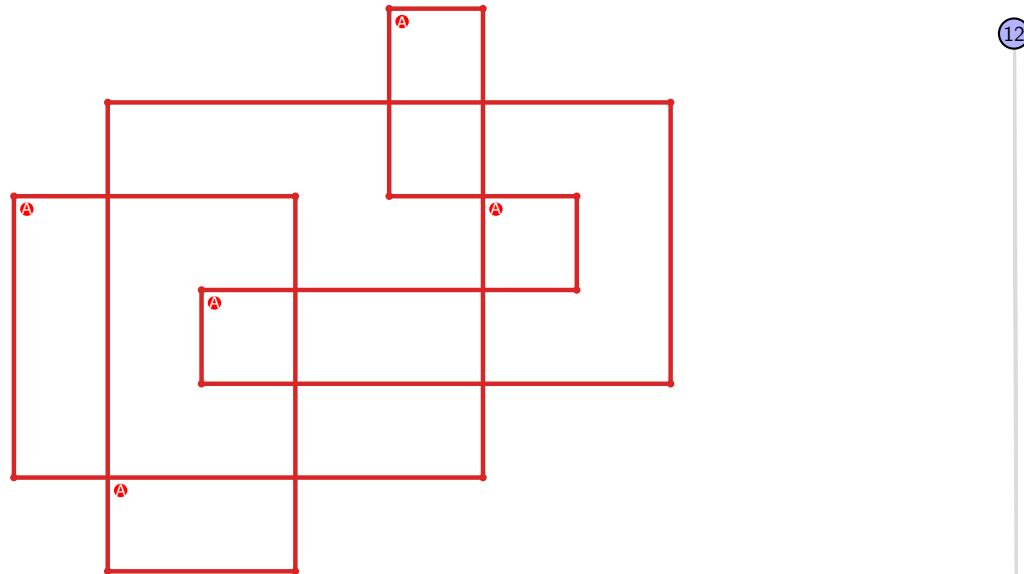


Figure 1629: `SnapPy` multiloop plot.



Figure 1630: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.518 $[[6, 10, 1, 7], [7, 5, 8, 6], [9, 20, 10, 11], [1, 18, 2, 17], [4, 12, 5, 13], [8, 12, 9, 11], [14, 19, 15, 20], [18, 15, 19, 16], [2, 16, 3, 17], [13, 3, 14, 4]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (18, 3, 19, 4), (4, 17, 5, 18), (9, 16, 10, 7), (6, 7, 1, 8), (8, 5, 9, 6), (15, 10, 16, 11), (20, 11, 17, 12), (12, 19, 13, 20), (2, 13, 3, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 7, 8, 8], [1, 9, 9, 5], [1, 4, 2, 2], [2, 9, 7, 7], [3, 6, 6, 8], [3, 7, 9, 3], [4, 8, 6, 4]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 814: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

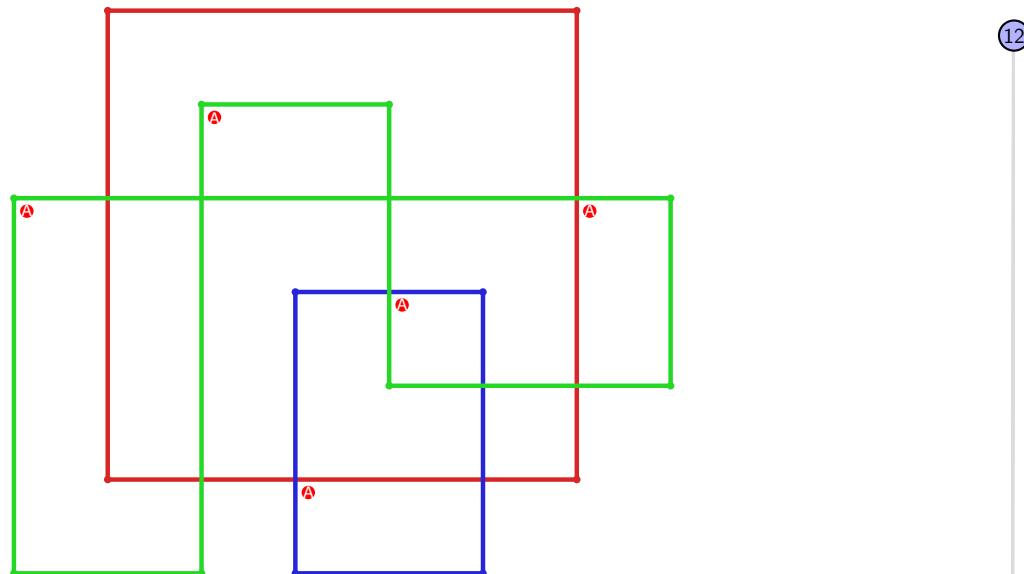


Figure 1631: SnapPy multiloop plot.

12
5

Figure 1632: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.519 $[[5, 16, 6, 1], [4, 11, 5, 12], [15, 8, 16, 9], [6, 17, 7, 20], [1, 20, 2, 19], [12, 3, 13, 4], [13, 10, 14, 11], [9, 14, 10, 15], [7, 17, 8, 18], [2, 18, 3, 19]]$

PD code drawn by `SnapPy`: $[(9, 16, 10, 1), (12, 5, 13, 6), (10, 7, 11, 8), (1, 8, 2, 9), (6, 11, 7, 12), (2, 13, 3, 14), (15, 18, 16, 19), (19, 14, 20, 15), (20, 3, 17, 4), (4, 17, 5, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 8], [0, 8, 8, 4], [0, 3, 9, 9], [1, 9, 6, 1], [1, 5, 7, 7], [2, 6, 6, 2], [2, 9, 3, 3], [4, 8, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 815: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

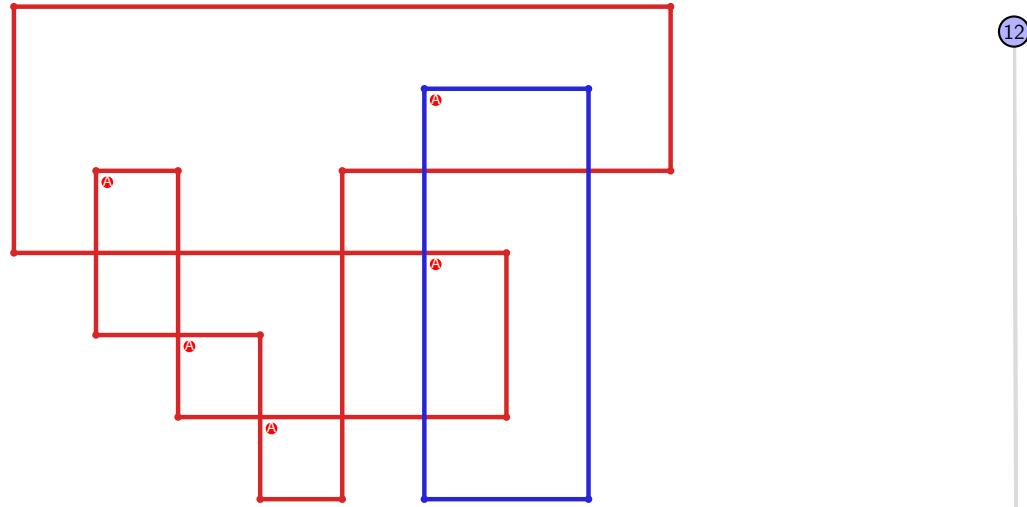


Figure 1633: `SnapPy` multiloop plot.

5

Figure 1634: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.520 $[[5, 10, 6, 1], [4, 20, 5, 11], [9, 6, 10, 7], [1, 16, 2, 15], [11, 3, 12, 4], [19, 7, 20, 8], [8, 18, 9, 19], [16, 13, 17, 14], [2, 14, 3, 15], [12, 17, 13, 18]]$

PD code drawn by `SnapPy`: $[(5, 2, 6, 3), (20, 3, 11, 4), (1, 6, 2, 7), (12, 9, 13, 10), (17, 14, 18, 15), (8, 15, 9, 16), (16, 7, 17, 8), (13, 18, 14, 19), (4, 19, 5, 20), (10, 11, 1, 12)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 7, 8, 8], [1, 8, 9, 1], [1, 6, 6, 2], [2, 5, 5, 9], [3, 9, 9, 8], [3, 7, 4, 3], [4, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 816: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

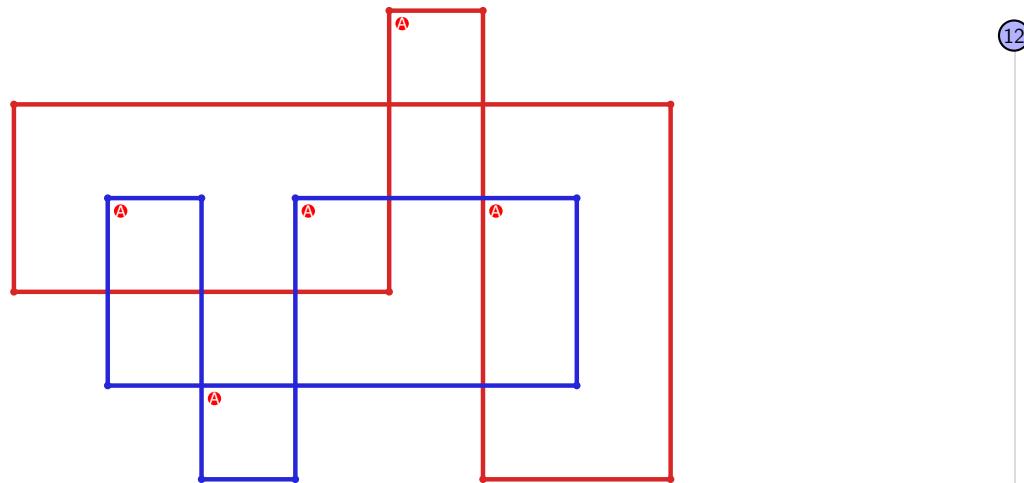


Figure 1635: `SnapPy` multiloop plot.

5

Figure 1636: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.521 [[17, 20, 18, 1], [5, 16, 6, 17], [6, 19, 7, 20], [18, 7, 19, 8], [1, 10, 2, 11], [15, 4, 16, 5], [8, 14, 9, 13], [9, 12, 10, 13], [2, 12, 3, 11], [3, 14, 4, 15]]

PD code drawn by SnapPy: [(13, 2, 14, 3), (16, 5, 17, 6), (6, 17, 7, 18), (4, 7, 5, 8), (8, 3, 9, 4), (18, 9, 19, 10), (20, 11, 1, 12), (1, 14, 2, 15), (12, 15, 13, 16), (10, 19, 11, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 3, 3], [0, 2, 2, 6], [0, 7, 8, 8], [1, 9, 9, 1], [3, 9, 7, 7], [4, 6, 6, 8], [4, 7, 9, 4], [5, 8, 6, 5]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 817: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

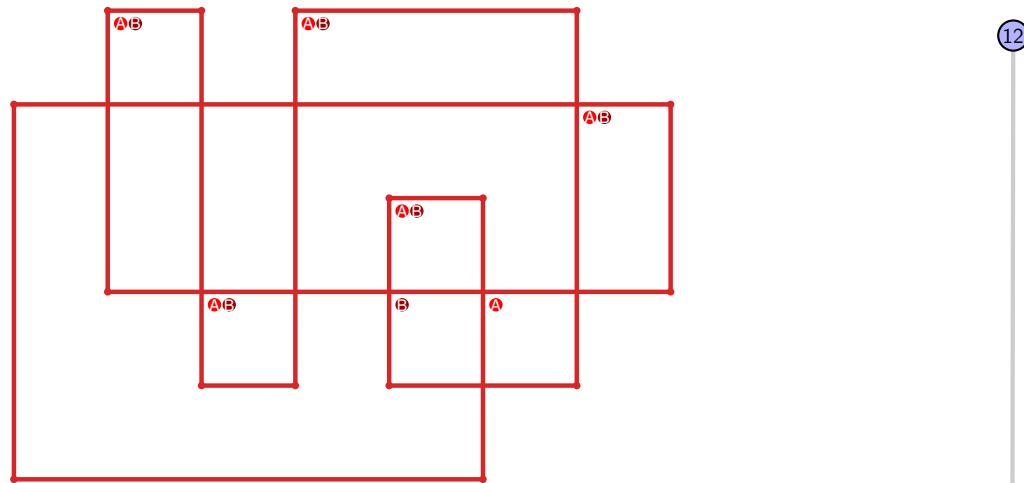


Figure 1637: SnapPy multiloop plot.

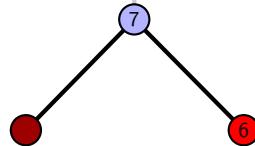


Figure 1638: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.522 [[12, 20, 1, 13], [13, 8, 14, 7], [11, 4, 12, 5], [19, 1, 20, 2], [8, 15, 9, 14], [9, 6, 10, 7], [5, 10, 6, 11], [3, 17, 4, 18], [2, 17, 3, 16], [18, 15, 19, 16]]

PD code drawn by SnapPy: [(7, 12, 8, 1), (5, 2, 6, 3), (3, 20, 4, 13), (1, 6, 2, 7), (18, 9, 19, 10), (13, 4, 14, 5), (17, 14, 18, 15), (15, 10, 16, 11), (11, 16, 12, 17), (8, 19, 9, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 8, 9, 0], [1, 9, 5, 1], [1, 4, 6, 6], [2, 5, 5, 2], [2, 9, 8, 8], [3, 7, 7, 9], [3, 8, 7, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 818: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

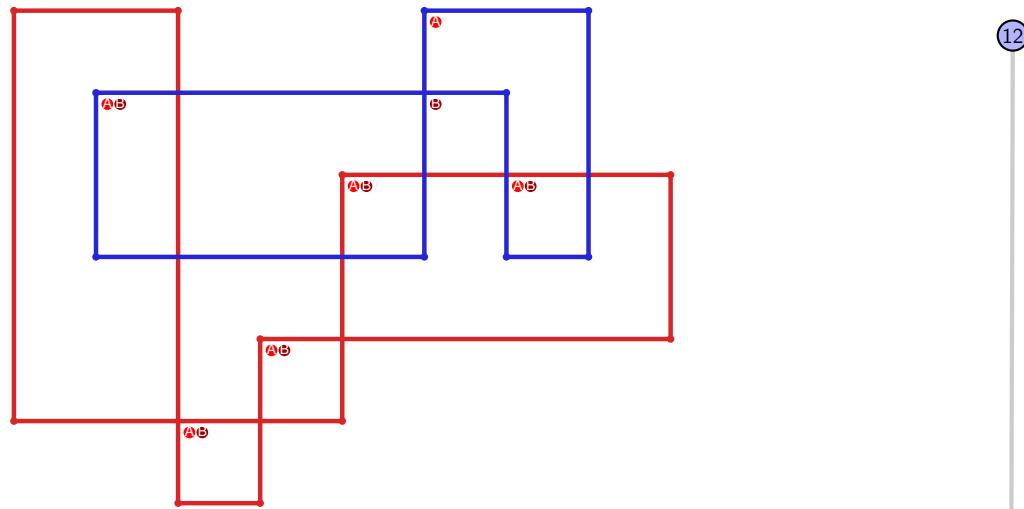


Figure 1639: SnapPy multiloop plot.

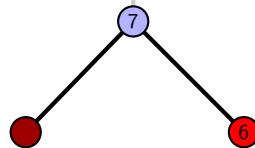


Figure 1640: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.523 $[[7, 20, 8, 1], [15, 6, 16, 7], [19, 10, 20, 11], [8, 3, 9, 4], [1, 4, 2, 5], [5, 14, 6, 15], [16, 14, 17, 13], [11, 18, 12, 19], [2, 9, 3, 10], [17, 12, 18, 13]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (19, 2, 20, 3), (13, 4, 14, 5), (20, 7, 1, 8), (17, 8, 18, 9), (15, 10, 16, 11), (11, 14, 12, 15), (3, 12, 4, 13), (9, 16, 10, 17), (5, 18, 6, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 8], [0, 8, 8, 4], [0, 3, 8, 5], [1, 4, 6, 1], [1, 5, 9, 9], [2, 9, 9, 2], [2, 4, 3, 3], [6, 7, 7, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 819: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

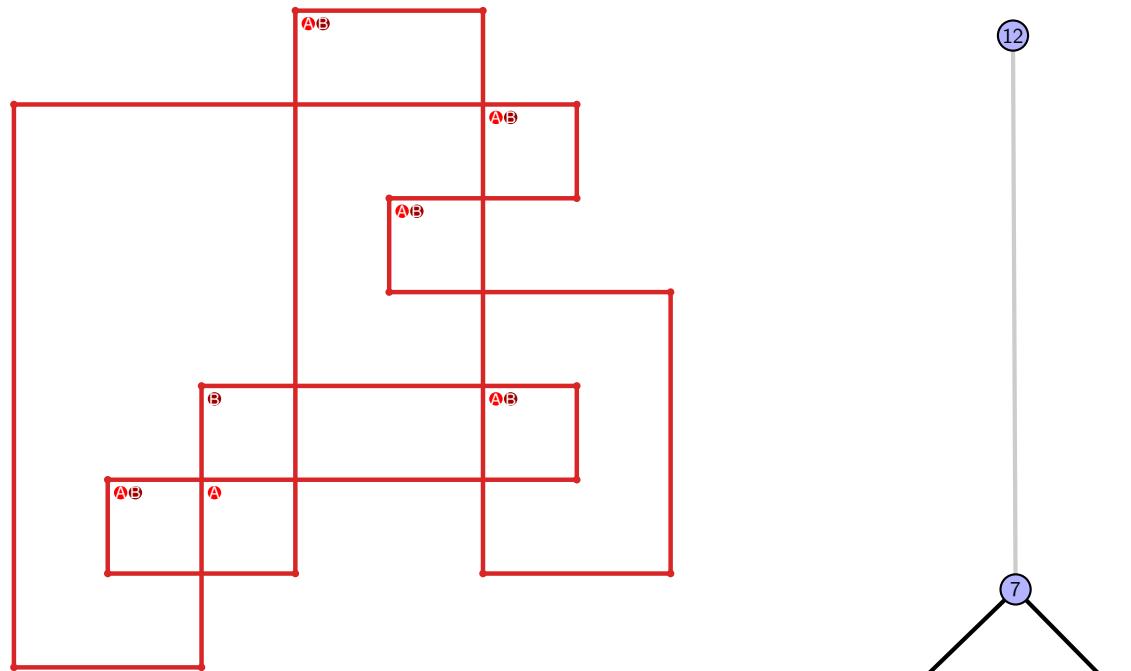


Figure 1641: SnapPy multiloop plot.

Figure 1642: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.524 $[[7, 20, 8, 1], [13, 6, 14, 7], [19, 8, 20, 9], [1, 4, 2, 5], [5, 12, 6, 13], [14, 12, 15, 11], [9, 18, 10, 19], [3, 16, 4, 17], [2, 16, 3, 15], [17, 10, 18, 11]]$

PD code drawn by SnapPy: $[(18, 1, 19, 2), (10, 3, 11, 4), (16, 5, 17, 6), (14, 7, 15, 8), (8, 11, 9, 12), (2, 9, 3, 10), (12, 19, 13, 20), (20, 13, 1, 14), (6, 15, 7, 16), (4, 17, 5, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 6, 0], [0, 7, 8, 4], [1, 3, 5, 1], [1, 4, 8, 9], [2, 9, 9, 2], [3, 9, 8, 8], [3, 7, 7, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 111
 Pinning number: 6

Average optimal degree: 2.22
 Average minimal degree: 2.22
 Average overall degree: 2.92

Table 820: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

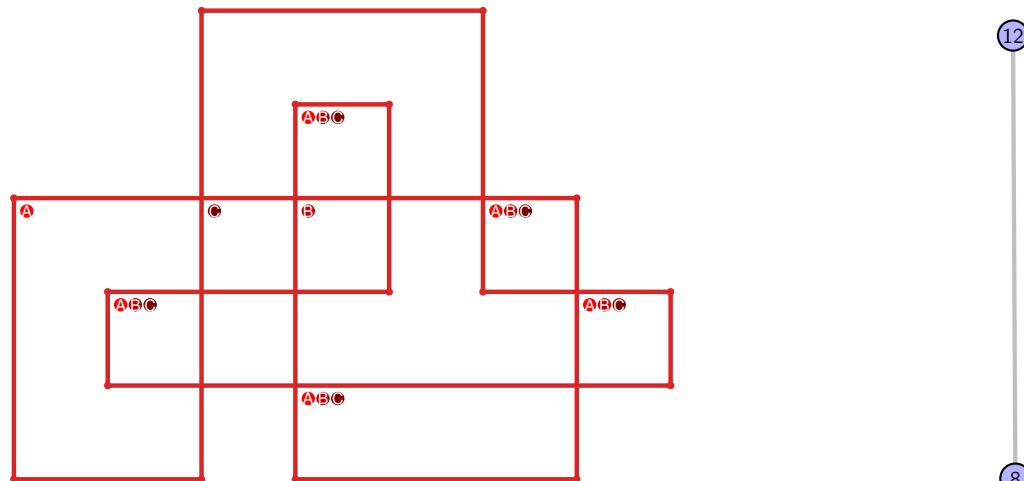


Figure 1643: SnapPy multiloop plot.

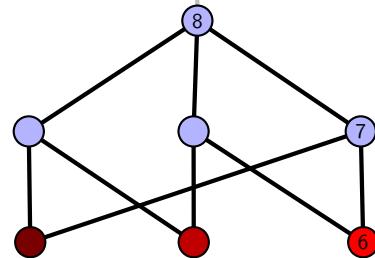


Figure 1644: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.525 $[[9, 20, 10, 1], [8, 15, 9, 16], [19, 10, 20, 11], [1, 6, 2, 7], [16, 7, 17, 8], [17, 14, 18, 15], [11, 18, 12, 19], [5, 2, 6, 3], [13, 4, 14, 5], [12, 4, 13, 3]]$

PD code drawn by `SnapPy`: $[(20, 9, 1, 10), (10, 1, 11, 2), (18, 3, 19, 4), (13, 4, 14, 5), (16, 7, 17, 8), (14, 11, 15, 12), (5, 12, 6, 13), (8, 15, 9, 16), (6, 17, 7, 18), (2, 19, 3, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 6, 0], [0, 7, 7, 4], [1, 3, 5, 1], [1, 4, 8, 6], [2, 5, 9, 2], [3, 9, 8, 3], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 821: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

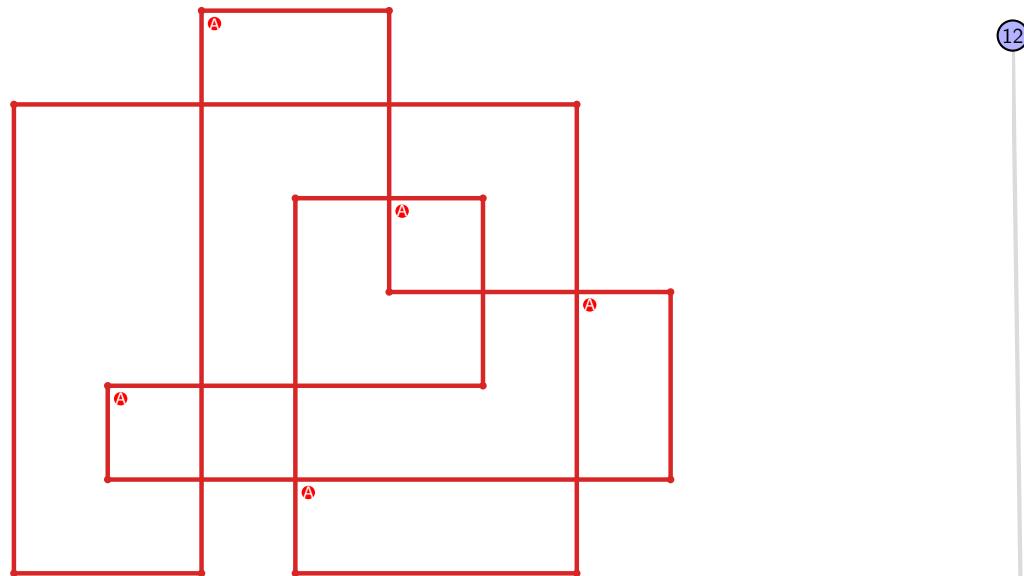


Figure 1645: `SnapPy` multiloop plot.



Figure 1646: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.526 `[[17, 20, 18, 1], [9, 16, 10, 17], [19, 6, 20, 7], [18, 6, 19, 5], [1, 14, 2, 15], [15, 8, 16, 9], [10, 8, 11, 7], [13, 4, 14, 5], [2, 12, 3, 11], [3, 12, 4, 13]]`

PD code drawn by `SnapPy`: `[(10, 1, 11, 2), (2, 15, 3, 16), (16, 3, 17, 4), (4, 7, 5, 8), (12, 5, 13, 6), (8, 19, 9, 20), (20, 9, 1, 10), (18, 11, 19, 12), (6, 13, 7, 14), (14, 17, 15, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 7, 8, 5], [1, 4, 6, 1], [1, 5, 8, 2], [3, 9, 9, 4], [4, 9, 9, 6], [7, 8, 8, 7]]`

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 822: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

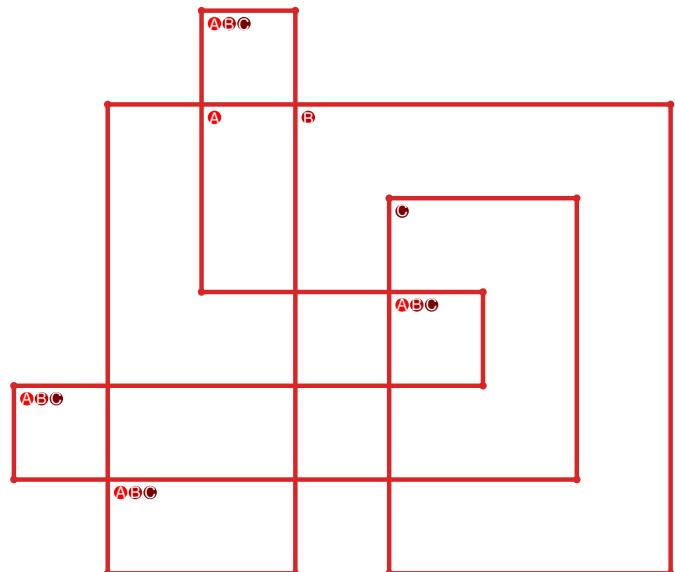


Figure 1647: `SnapPy` multiloop plot.

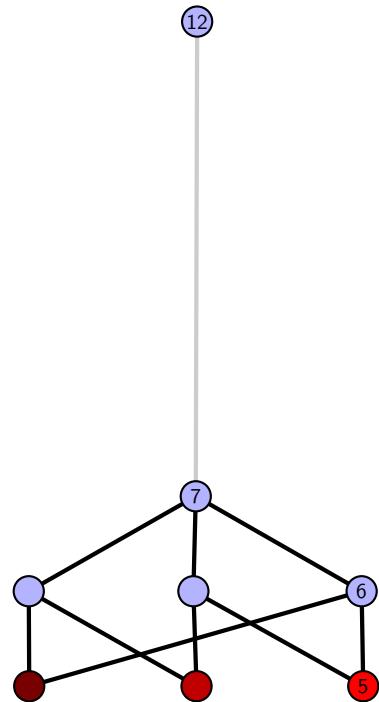


Figure 1648: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.527 $[[7, 20, 8, 1], [6, 15, 7, 16], [10, 19, 11, 20], [8, 11, 9, 12], [1, 4, 2, 5], [16, 5, 17, 6], [17, 14, 18, 15], [18, 9, 19, 10], [12, 3, 13, 4], [2, 13, 3, 14]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (19, 2, 20, 3), (14, 3, 15, 4), (16, 7, 17, 8), (6, 9, 7, 10), (20, 11, 1, 12), (15, 12, 16, 13), (4, 13, 5, 14), (8, 17, 9, 18), (5, 18, 6, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 7, 3], [0, 2, 7, 8], [0, 8, 9, 5], [1, 4, 6, 1], [1, 5, 9, 7], [2, 6, 3, 2], [3, 9, 9, 4], [4, 8, 8, 6]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 6
 Total pinning sets: 312
 Pinning number: 5

Average optimal degree: 2.45
 Average minimal degree: 2.55
 Average overall degree: 3.05

Table 823: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	24	68	94	75	35	9	1	306
Average degree	2.45	2.72	2.92	3.07	3.17	3.24	3.29	3.33	

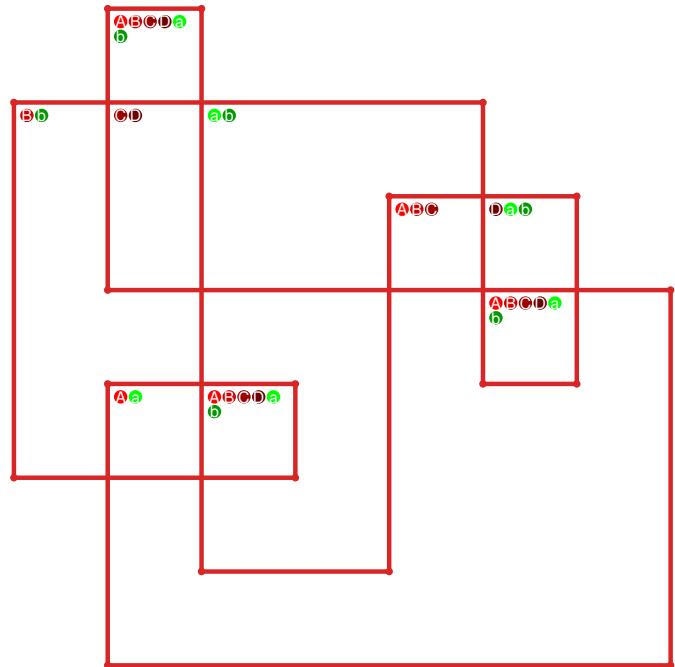


Figure 1649: SnapPy multiloop plot.

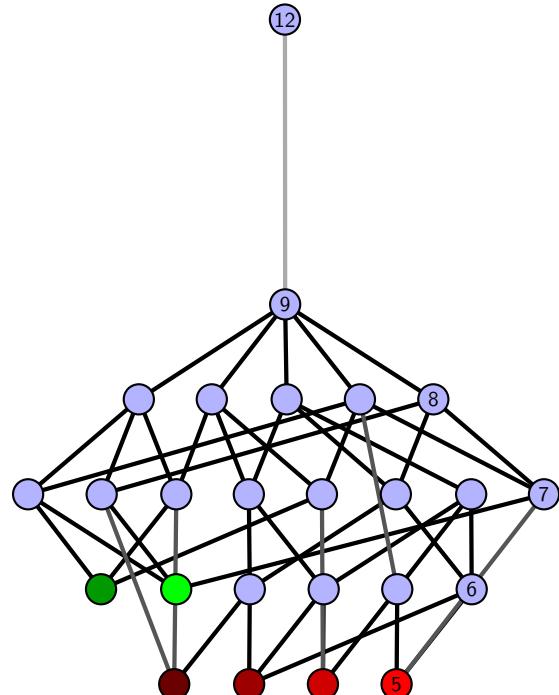


Figure 1650: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.528 [[7, 10, 8, 1], [6, 20, 7, 11], [9, 17, 10, 18], [8, 17, 9, 16], [1, 4, 2, 5], [11, 5, 12, 6], [12, 19, 13, 20], [18, 13, 19, 14], [3, 15, 4, 16], [2, 15, 3, 14]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (18, 3, 19, 4), (5, 8, 6, 9), (15, 20, 16, 11), (11, 10, 12, 1), (1, 12, 2, 13), (13, 6, 14, 7), (7, 14, 8, 15), (19, 16, 20, 17), (4, 17, 5, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 7, 3, 3], [0, 2, 2, 8], [0, 8, 9, 5], [1, 4, 6, 1], [1, 5, 7, 7], [2, 6, 6, 9], [3, 9, 9, 4], [4, 8, 8, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 824: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

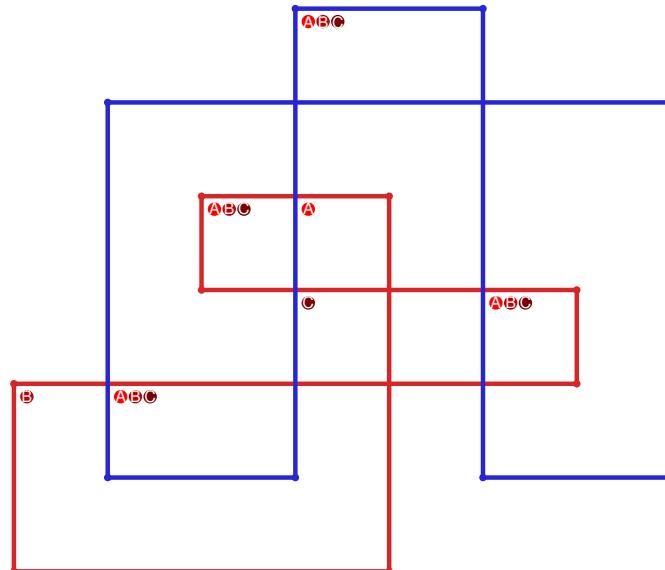


Figure 1651: SnapPy multiloop plot.

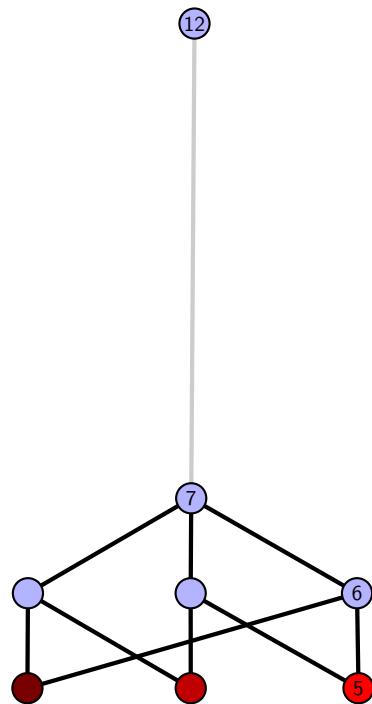


Figure 1652: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.529 $[[9, 12, 10, 1], [8, 20, 9, 13], [15, 11, 16, 12], [10, 16, 11, 17], [1, 6, 2, 7], [13, 7, 14, 8], [14, 19, 15, 20], [17, 4, 18, 3], [5, 2, 6, 3], [18, 4, 19, 5]]$

PD code drawn by `SnapPy`: $[(3, 12, 4, 1), (1, 20, 2, 13), (13, 2, 14, 3), (11, 4, 12, 5), (16, 5, 17, 6), (18, 9, 19, 10), (7, 10, 8, 11), (8, 19, 9, 20), (17, 14, 18, 15), (6, 15, 7, 16)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 8, 8, 5], [1, 4, 6, 1], [1, 5, 9, 2], [3, 9, 9, 8], [4, 7, 9, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 825: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

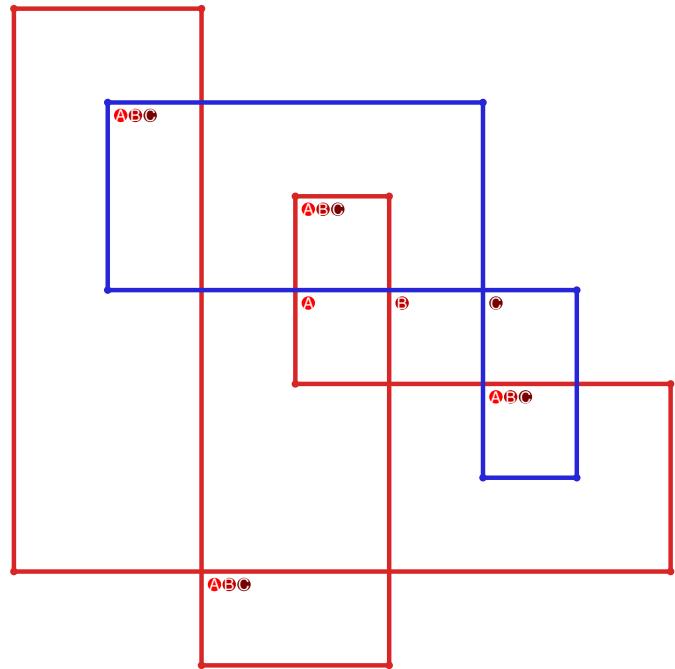


Figure 1653: `SnapPy` multiloop plot.

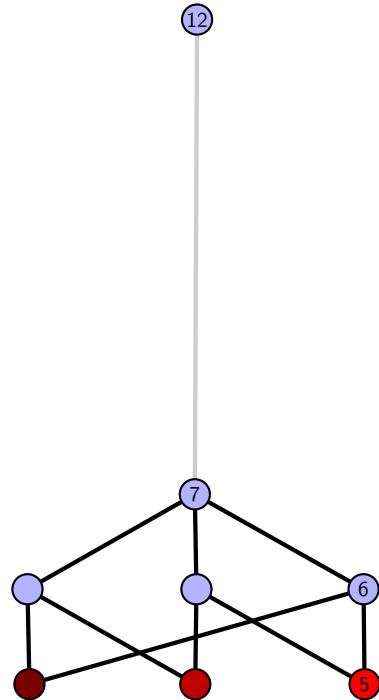


Figure 1654: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.530 $[[5, 8, 6, 1], [4, 16, 5, 9], [11, 7, 12, 8], [6, 12, 7, 13], [1, 17, 2, 20], [9, 3, 10, 4], [10, 15, 11, 16], [13, 18, 14, 17], [2, 19, 3, 20], [14, 18, 15, 19]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (11, 4, 12, 5), (2, 5, 3, 6), (3, 12, 4, 13), (10, 15, 11, 16), (1, 16, 2, 9), (14, 19, 15, 20), (7, 20, 8, 17), (17, 6, 18, 7), (18, 13, 19, 14)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 7, 8, 8], [1, 8, 6, 1], [1, 5, 9, 2], [3, 9, 9, 4], [4, 9, 5, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 5

Average minimal degree: 2.48

Total pinning sets: 220

Average overall degree: 2.98

Pinning number: 5

Table 826: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	13	45	65	55	28	8	1	215
Average degree	2.2	2.56	2.81	2.98	3.11	3.2	3.27	3.33	

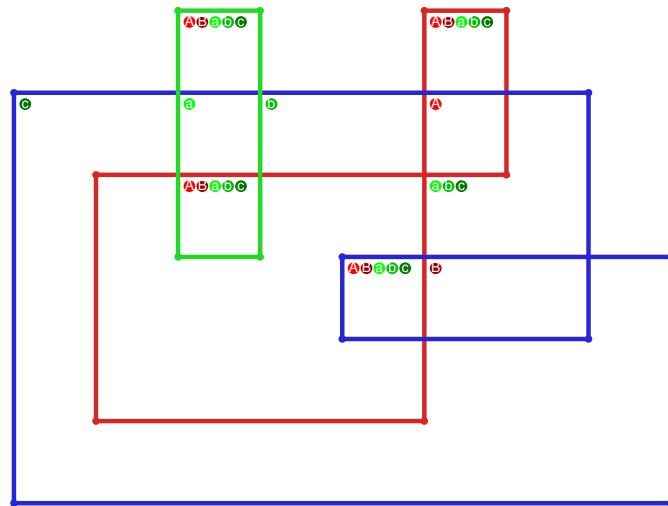


Figure 1655: `SnapPy` multiloop plot.

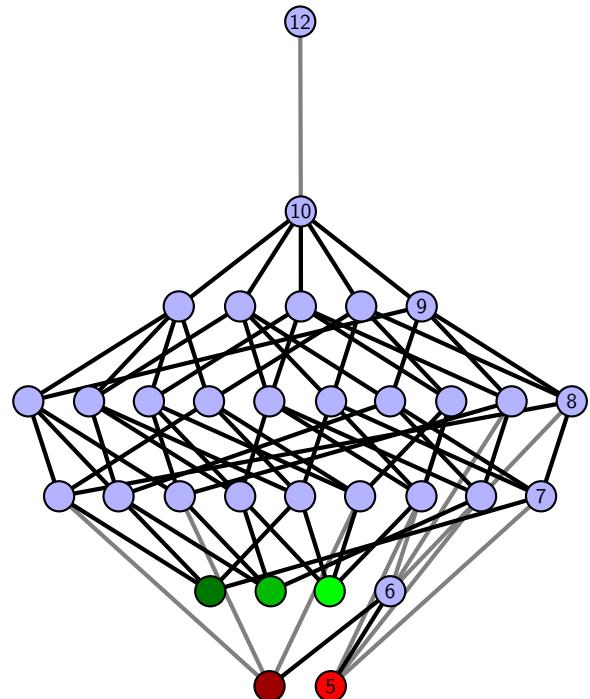


Figure 1656: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.531 [[17, 20, 18, 1], [13, 16, 14, 17], [19, 6, 20, 7], [18, 6, 19, 5], [1, 10, 2, 11], [3, 12, 4, 13], [15, 8, 16, 9], [14, 8, 15, 7], [9, 4, 10, 5], [2, 12, 3, 11]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (2, 15, 3, 16), (16, 3, 17, 4), (4, 11, 5, 12), (12, 5, 13, 6), (18, 7, 19, 8), (8, 19, 9, 20), (20, 9, 1, 10), (10, 13, 11, 14), (14, 17, 15, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 3, 3], [0, 2, 2, 8], [0, 8, 9, 9], [1, 9, 9, 8], [1, 8, 7, 7], [1, 6, 6, 2], [3, 6, 5, 4], [4, 5, 5, 4]]

Total optimal pinning sets: 3

Average optimal degree: 2.27

Total minimal pinning sets: 3

Average minimal degree: 2.27

Total pinning sets: 224

Average overall degree: 2.98

Pinning number: 5

Table 827: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

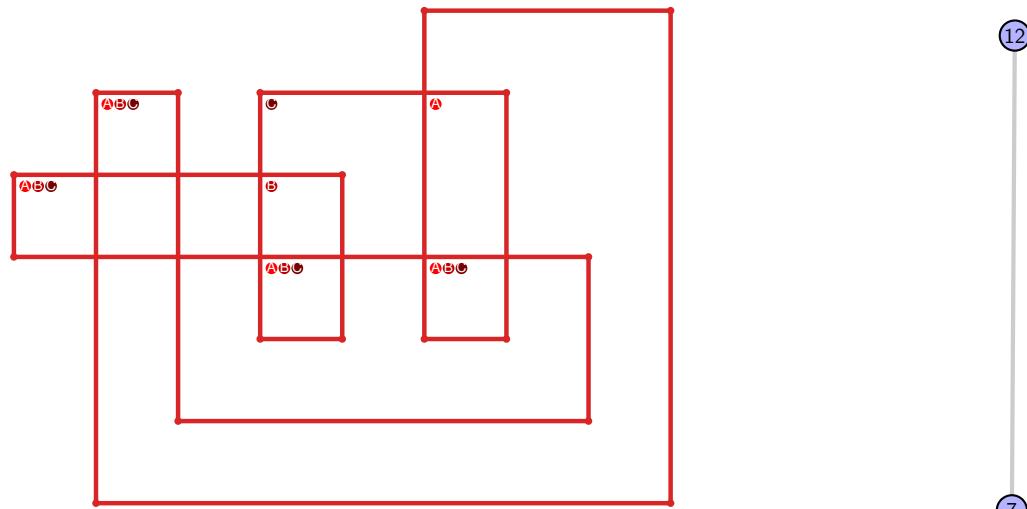


Figure 1657: SnapPy multiloop plot.

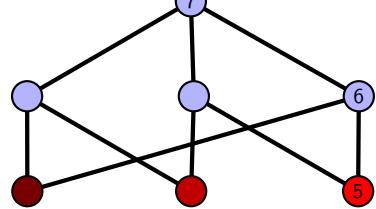


Figure 1658: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.532 [[10, 14, 1, 11], [11, 9, 12, 10], [13, 20, 14, 15], [1, 4, 2, 5], [5, 8, 6, 9], [12, 16, 13, 15], [3, 19, 4, 20], [2, 19, 3, 18], [7, 17, 8, 18], [6, 17, 7, 16]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (3, 6, 4, 7), (18, 7, 19, 8), (8, 17, 9, 18), (15, 4, 16, 5), (5, 16, 6, 11), (11, 10, 12, 1), (1, 12, 2, 13), (20, 13, 17, 14), (14, 19, 15, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 6, 7, 4], [1, 3, 8, 9], [1, 9, 2, 2], [2, 7, 7, 3], [3, 6, 6, 8], [4, 7, 9, 9], [4, 8, 8, 5]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 5
 Total pinning sets: 220
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.48
 Average overall degree: 2.98

Table 828: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	13	45	65	55	28	8	1	215
Average degree	2.2	2.56	2.81	2.98	3.11	3.2	3.27	3.33	

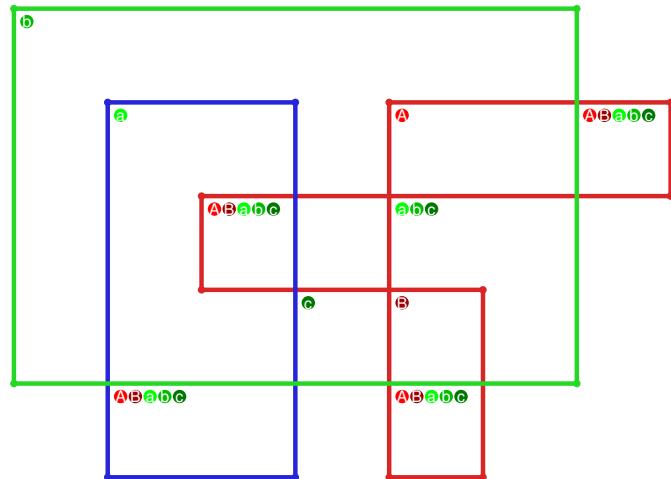


Figure 1659: SnapPy multiloop plot.

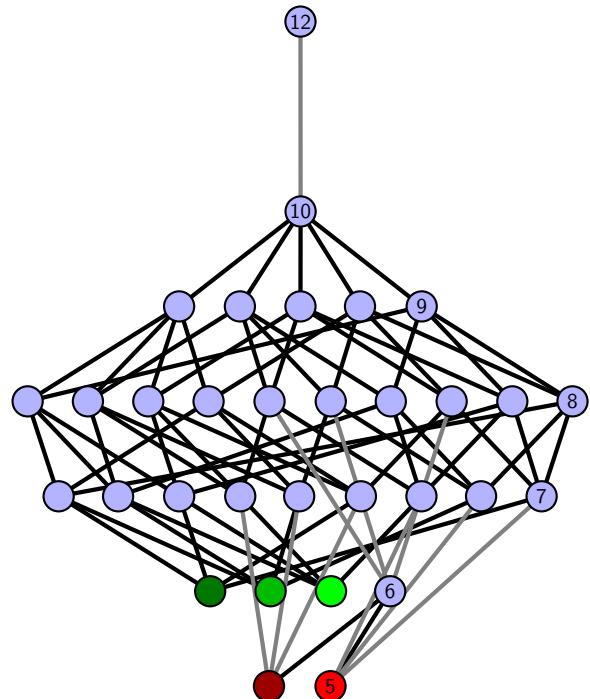


Figure 1660: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.533 [[16, 7, 1, 8], [8, 15, 9, 16], [9, 6, 10, 7], [1, 12, 2, 13], [14, 20, 15, 17], [5, 19, 6, 20], [10, 4, 11, 3], [11, 2, 12, 3], [13, 18, 14, 17], [18, 4, 19, 5]]

PD code drawn by SnapPy: [(9, 16, 10, 1), (1, 8, 2, 9), (17, 2, 18, 3), (7, 4, 8, 5), (14, 5, 15, 6), (15, 10, 16, 11), (6, 13, 7, 14), (3, 18, 4, 19), (12, 19, 13, 20), (20, 11, 17, 12)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 7, 7, 8], [1, 8, 8, 5], [2, 4, 9, 9], [2, 9, 7, 7], [3, 6, 6, 3], [3, 9, 4, 4], [5, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 829: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

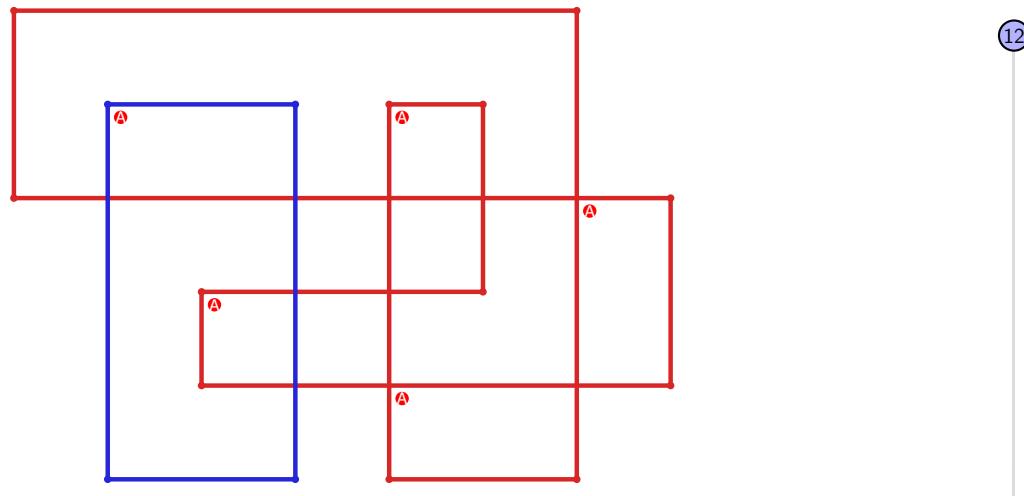


Figure 1661: SnapPy multiloop plot.

12
5

Figure 1662: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.534 $[[5, 20, 6, 1], [19, 4, 20, 5], [6, 4, 7, 3], [1, 10, 2, 11], [18, 13, 19, 14], [7, 17, 8, 16], [9, 2, 10, 3], [11, 15, 12, 14], [12, 17, 13, 18], [8, 15, 9, 16]]$

PD code drawn by `SnapPy`: $[(7, 20, 8, 1), (1, 4, 2, 5), (17, 2, 18, 3), (19, 8, 20, 9), (16, 11, 17, 12), (12, 9, 13, 10), (6, 13, 7, 14), (14, 5, 15, 6), (10, 15, 11, 16), (3, 18, 4, 19)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 6, 7], [1, 7, 8, 8], [2, 8, 9, 9], [2, 9, 3, 3], [3, 9, 8, 4], [4, 7, 5, 4], [5, 7, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 830: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

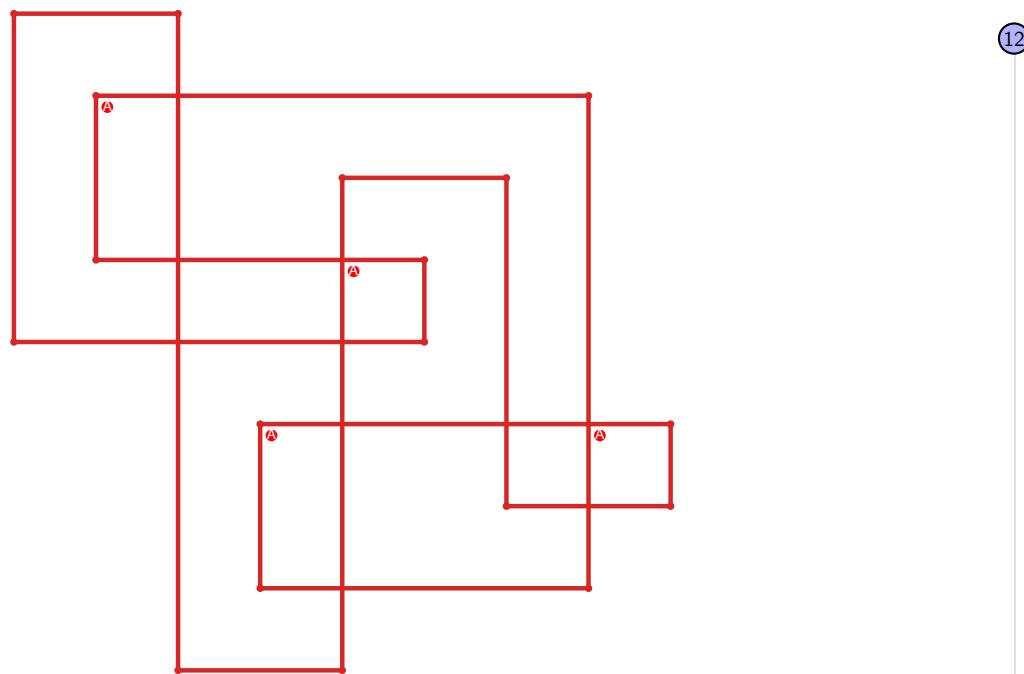


Figure 1663: `SnapPy` multiloop plot.

Figure 1664: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.535 $[[16, 5, 1, 6], [6, 15, 7, 16], [7, 4, 8, 5], [1, 12, 2, 13], [14, 20, 15, 17], [3, 8, 4, 9], [11, 2, 12, 3], [13, 18, 14, 17], [19, 9, 20, 10], [10, 18, 11, 19]]$

PD code drawn by SnapPy: $[(4, 1, 5, 2), (13, 2, 14, 3), (16, 5, 1, 6), (17, 6, 18, 7), (14, 9, 15, 10), (3, 12, 4, 13), (8, 15, 9, 16), (11, 18, 12, 19), (19, 10, 20, 11), (7, 20, 8, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 6, 7], [1, 7, 7, 8], [2, 8, 6, 2], [3, 5, 9, 3], [3, 9, 4, 4], [4, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 831: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

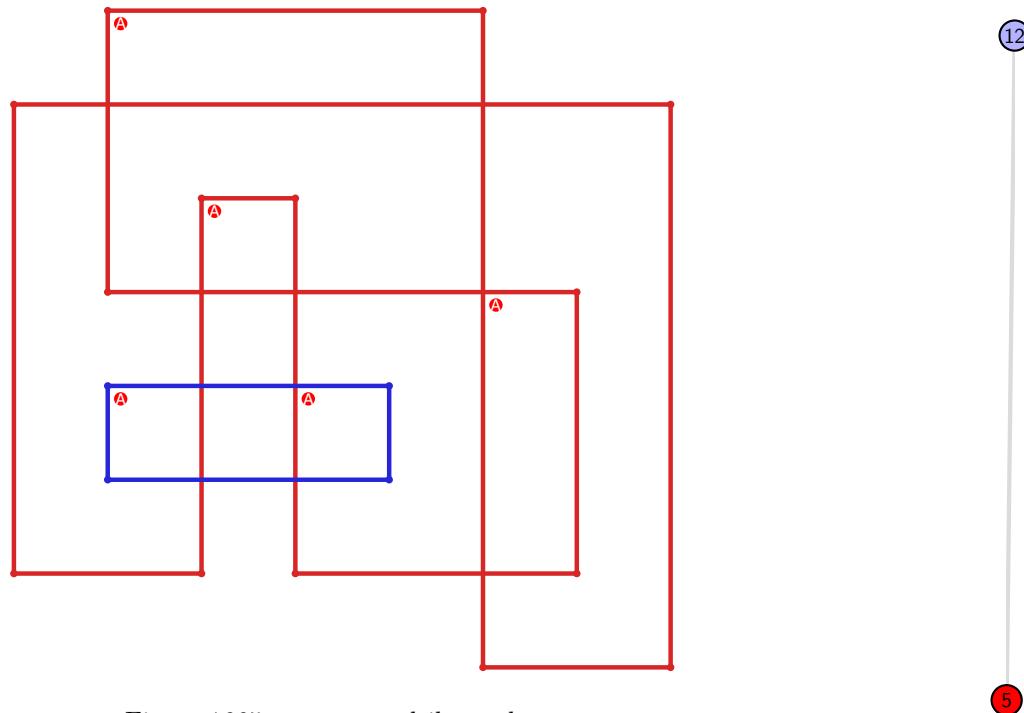


Figure 1665: SnapPy multiloop plot.

Figure 1666: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.536 $[[5, 20, 6, 1], [19, 4, 20, 5], [6, 4, 7, 3], [1, 10, 2, 11], [13, 18, 14, 19], [7, 14, 8, 15], [9, 2, 10, 3], [11, 16, 12, 17], [17, 12, 18, 13], [8, 16, 9, 15]]$

PD code drawn by SnapPy: $[(7, 20, 8, 1), (1, 4, 2, 5), (17, 2, 18, 3), (19, 8, 20, 9), (15, 10, 16, 11), (5, 12, 6, 13), (13, 6, 14, 7), (9, 14, 10, 15), (11, 16, 12, 17), (3, 18, 4, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 6, 7], [1, 8, 8, 5], [2, 4, 9, 9], [2, 9, 3, 3], [3, 9, 8, 8], [4, 7, 7, 4], [5, 7, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 832: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

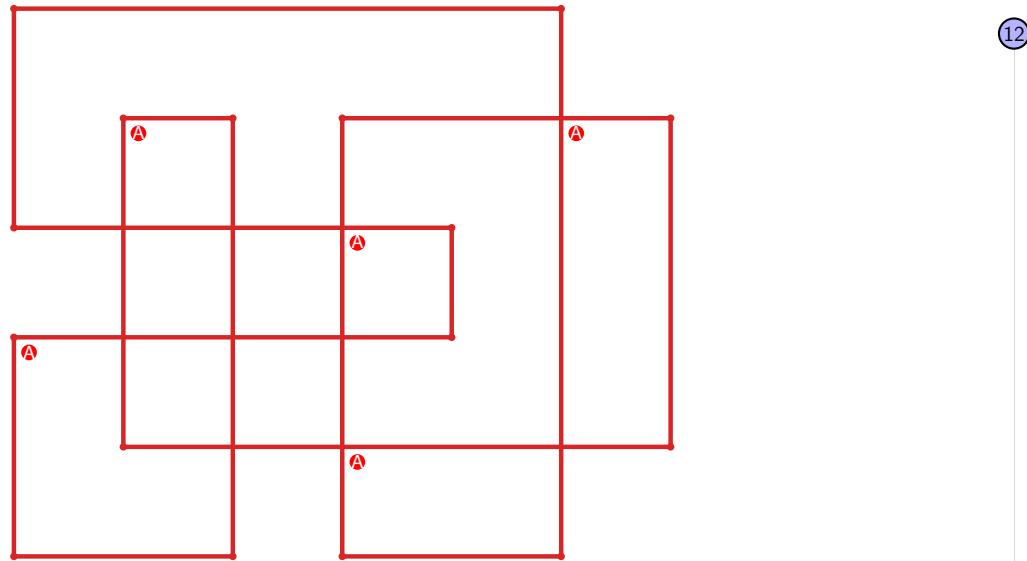


Figure 1667: SnapPy multiloop plot.



Figure 1668: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.537 [[12, 16, 1, 13], [13, 11, 14, 12], [15, 7, 16, 8], [1, 17, 2, 20], [3, 10, 4, 11], [14, 9, 15, 8], [6, 17, 7, 18], [2, 19, 3, 20], [9, 4, 10, 5], [18, 5, 19, 6]]

PD code drawn by SnapPy: [(7, 2, 8, 3), (16, 3, 13, 4), (18, 5, 19, 6), (6, 17, 7, 18), (1, 8, 2, 9), (20, 9, 17, 10), (10, 19, 11, 20), (12, 13, 1, 14), (14, 11, 15, 12), (4, 15, 5, 16)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 6, 7, 7], [1, 7, 8, 8], [1, 8, 2, 2], [2, 9, 9, 3], [3, 9, 4, 3], [4, 9, 5, 4], [6, 8, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 833: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

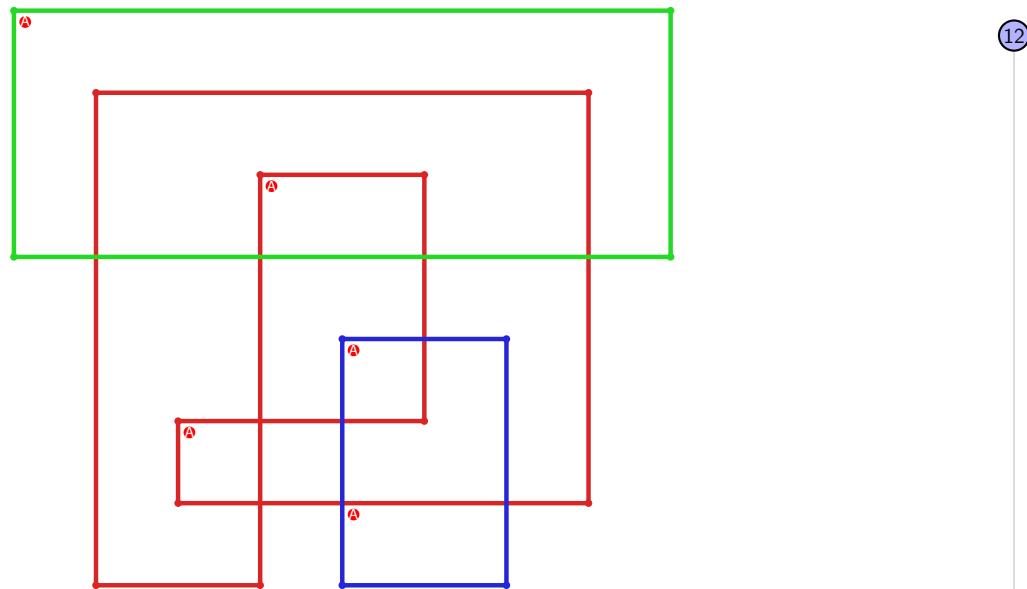


Figure 1669: SnapPy multiloop plot.



Figure 1670: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.538 [[20, 13, 1, 14], [14, 3, 15, 4], [12, 19, 13, 20], [1, 6, 2, 7], [7, 2, 8, 3], [15, 5, 16, 4], [16, 11, 17, 12], [18, 9, 19, 10], [5, 8, 6, 9], [10, 17, 11, 18]]

PD code drawn by SnapPy: [(5, 20, 6, 1), (12, 1, 13, 2), (2, 13, 3, 14), (19, 4, 20, 5), (3, 6, 4, 7), (16, 7, 17, 8), (14, 9, 15, 10), (18, 11, 19, 12), (8, 15, 9, 16), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 7, 0], [0, 8, 4, 4], [1, 3, 3, 8], [1, 8, 6, 1], [2, 5, 9, 9], [2, 9, 9, 8], [3, 7, 5, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 834: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

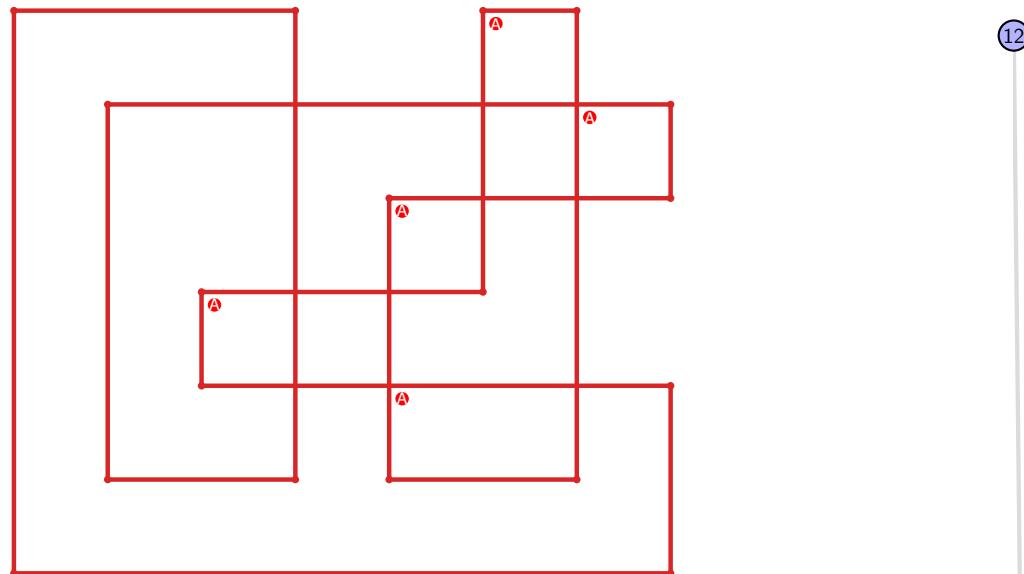


Figure 1671: SnapPy multiloop plot.

5

Figure 1672: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.539 $[[6, 14, 1, 7], [7, 15, 8, 20], [11, 5, 12, 6], [13, 1, 14, 2], [15, 3, 16, 4], [8, 17, 9, 18], [10, 19, 11, 20], [4, 16, 5, 17], [12, 3, 13, 2], [9, 19, 10, 18]]$

PD code drawn by `SnapPy`: $[(6, 7, 1, 8), (20, 1, 15, 2), (14, 3, 7, 4), (8, 5, 9, 6), (4, 9, 5, 10), (2, 15, 3, 16), (11, 16, 12, 17), (17, 12, 18, 13), (13, 18, 14, 19), (19, 10, 20, 11)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 5, 6], [0, 6, 7, 8], [0, 8, 8, 0], [1, 8, 7, 7], [1, 7, 9, 9], [1, 9, 9, 2], [2, 5, 4, 4], [2, 4, 3, 3], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 835: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

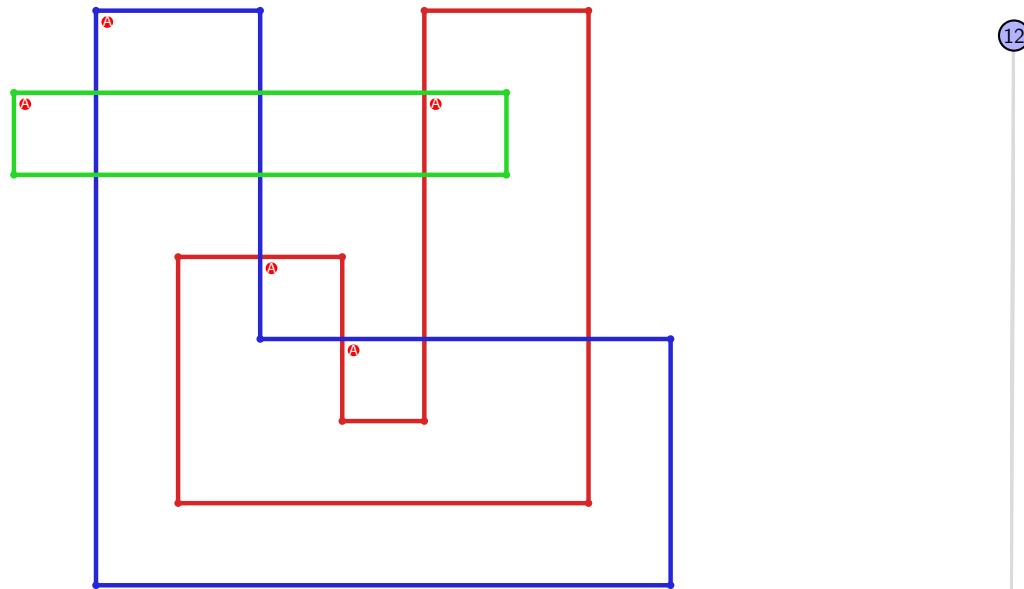


Figure 1673: `SnapPy` multiloop plot.



Figure 1674: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.540 `[[14, 5, 1, 6], [6, 13, 7, 14], [7, 4, 8, 5], [1, 15, 2, 20], [12, 19, 13, 20], [3, 8, 4, 9], [15, 3, 16, 2], [16, 11, 17, 12], [18, 9, 19, 10], [10, 17, 11, 18]]`

PD code drawn by `SnapPy`: `[(14, 15, 1, 16), (5, 2, 6, 3), (12, 3, 13, 4), (1, 6, 2, 7), (18, 7, 19, 8), (16, 9, 17, 10), (4, 11, 5, 12), (8, 17, 9, 18), (10, 19, 11, 20), (20, 13, 15, 14)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 6, 4], [1, 3, 7, 8], [2, 8, 6, 2], [3, 5, 7, 3], [4, 6, 9, 9], [4, 9, 9, 5], [7, 8, 8, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 836: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

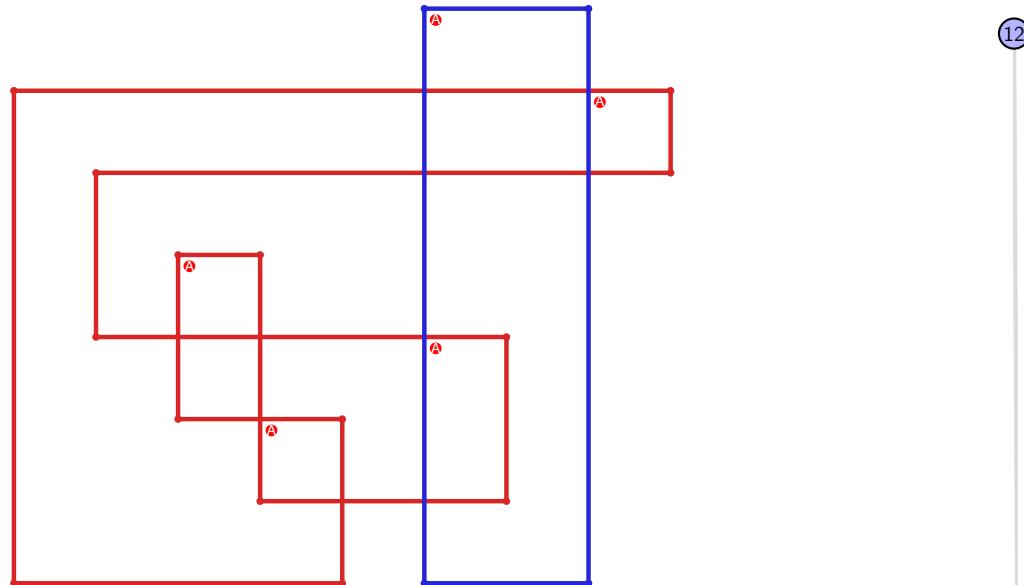


Figure 1675: `SnapPy` multiloop plot.



Figure 1676: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.541 [[10, 14, 1, 11], [11, 9, 12, 10], [13, 3, 14, 4], [1, 15, 2, 20], [8, 19, 9, 20], [12, 5, 13, 4], [2, 15, 3, 16], [16, 7, 17, 8], [18, 5, 19, 6], [6, 17, 7, 18]]

PD code drawn by SnapPy: [(18, 1, 19, 2), (2, 17, 3, 18), (14, 3, 15, 4), (12, 5, 13, 6), (20, 7, 17, 8), (8, 19, 9, 20), (4, 13, 5, 14), (6, 15, 7, 16), (16, 9, 11, 10), (10, 11, 1, 12)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 6, 6, 4], [1, 3, 7, 8], [1, 8, 2, 2], [2, 7, 3, 3], [4, 6, 9, 9], [4, 9, 9, 5], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 837: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

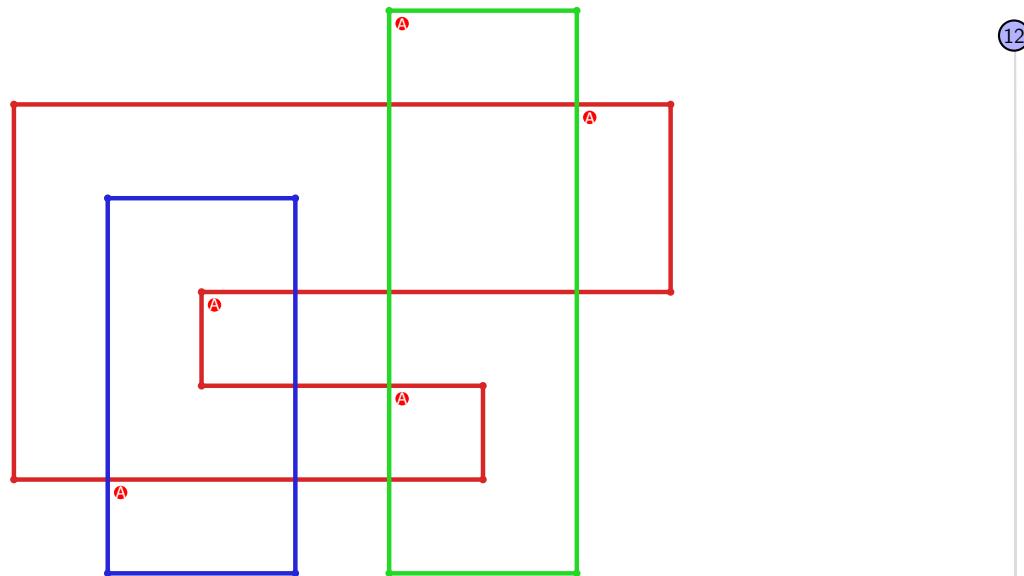


Figure 1677: SnapPy multiloop plot.

5

Figure 1678: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.542 [[5, 20, 6, 1], [19, 4, 20, 5], [6, 4, 7, 3], [1, 16, 2, 17], [11, 18, 12, 19], [7, 12, 8, 13], [15, 2, 16, 3], [17, 10, 18, 11], [8, 14, 9, 13], [9, 14, 10, 15]]

PD code drawn by `SnapPy`: [(13, 20, 14, 1), (1, 4, 2, 5), (17, 2, 18, 3), (15, 8, 16, 9), (5, 10, 6, 11), (11, 6, 12, 7), (7, 12, 8, 13), (19, 14, 20, 15), (9, 16, 10, 17), (3, 18, 4, 19)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 6], [0, 6, 6, 7], [1, 7, 7, 5], [2, 4, 8, 8], [2, 9, 3, 3], [3, 9, 4, 4], [5, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 128
 Pinning number: 5

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.91

Table 838: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

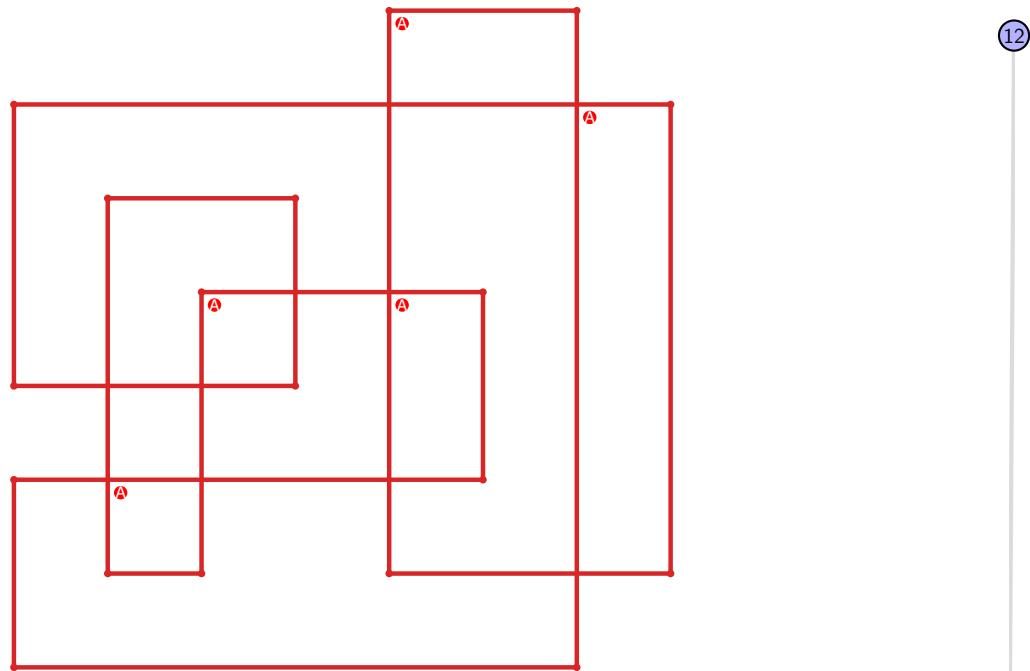


Figure 1679: `SnapPy` multiloop plot.

Figure 1680: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.543 $[[20, 9, 1, 10], [10, 3, 11, 4], [6, 19, 7, 20], [8, 17, 9, 18], [1, 14, 2, 15], [15, 2, 16, 3], [11, 5, 12, 4], [12, 5, 13, 6], [18, 7, 19, 8], [13, 16, 14, 17]]$

PD code drawn by `SnapPy`: $[(13, 20, 14, 1), (8, 1, 9, 2), (2, 9, 3, 10), (10, 3, 11, 4), (16, 5, 17, 6), (18, 7, 19, 8), (19, 12, 20, 13), (11, 14, 12, 15), (6, 15, 7, 16), (4, 17, 5, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 6, 6], [0, 7, 8, 8], [0, 8, 8, 9], [0, 9, 5, 5], [1, 4, 4, 9], [1, 7, 7, 1], [2, 6, 6, 9], [2, 3, 3, 2], [3, 7, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 839: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

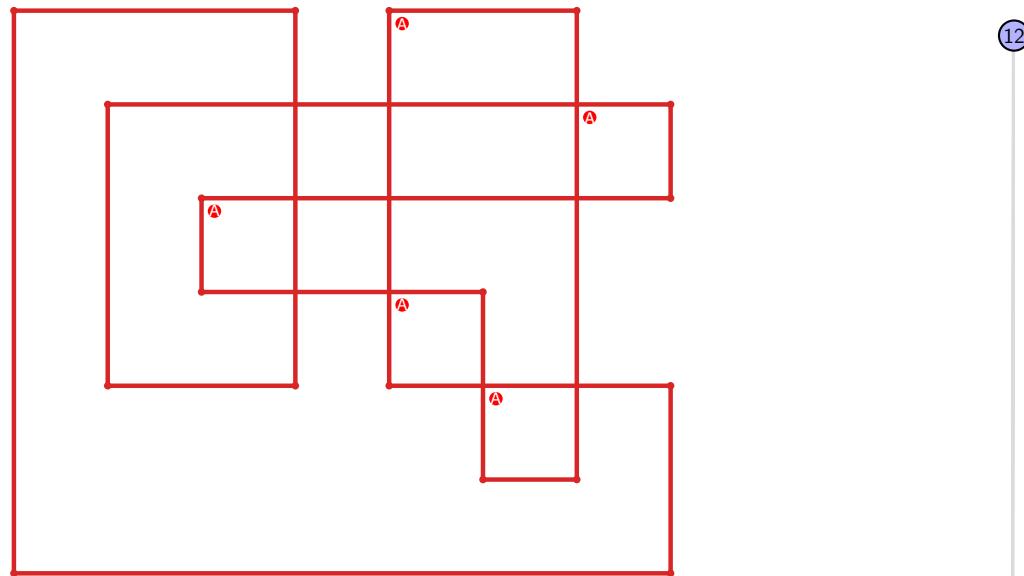


Figure 1681: `SnapPy` multiloop plot.

Figure 1682: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.544 [[15, 20, 16, 1], [3, 14, 4, 15], [19, 12, 20, 13], [16, 10, 17, 9], [1, 6, 2, 7], [7, 2, 8, 3], [13, 4, 14, 5], [11, 18, 12, 19], [10, 18, 11, 17], [5, 8, 6, 9]]

PD code drawn by `SnapPy`: [(5, 20, 6, 1), (11, 2, 12, 3), (19, 4, 20, 5), (3, 6, 4, 7), (7, 14, 8, 15), (17, 10, 18, 11), (1, 12, 2, 13), (15, 8, 16, 9), (9, 16, 10, 17), (13, 18, 14, 19)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 7, 7], [0, 8, 8, 9], [0, 9, 5, 5], [1, 4, 4, 9], [1, 9, 2, 1], [2, 8, 8, 2], [3, 7, 7, 3], [3, 6, 5, 4]]

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 840: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

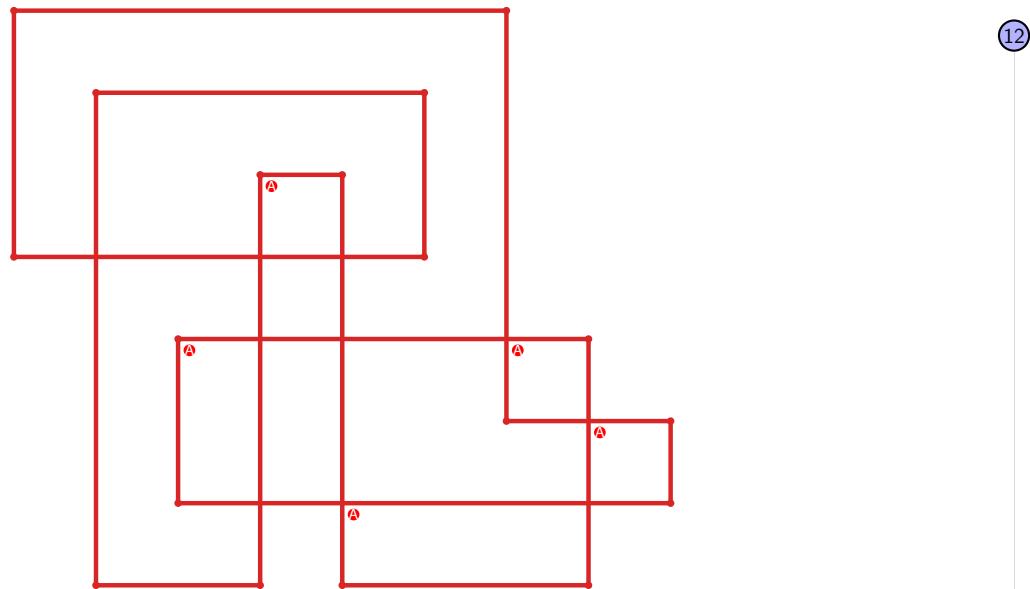


Figure 1683: `SnapPy` multiloop plot.

Figure 1684: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.545 [[13, 20, 14, 1], [3, 12, 4, 13], [19, 14, 20, 15], [1, 6, 2, 7], [7, 2, 8, 3], [11, 4, 12, 5], [15, 18, 16, 19], [5, 8, 6, 9], [17, 10, 18, 11], [16, 10, 17, 9]]

PD code drawn by `SnapPy`: [(5, 20, 6, 1), (9, 2, 10, 3), (19, 4, 20, 5), (3, 6, 4, 7), (7, 14, 8, 15), (15, 8, 16, 9), (1, 10, 2, 11), (17, 12, 18, 13), (13, 16, 14, 17), (11, 18, 12, 19)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 6, 0], [0, 7, 4, 4], [1, 3, 3, 7], [1, 7, 8, 1], [2, 8, 9, 2], [3, 9, 5, 4], [5, 9, 9, 6], [6, 8, 8, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 128

Pinning number: 5

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.91

Table 841: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

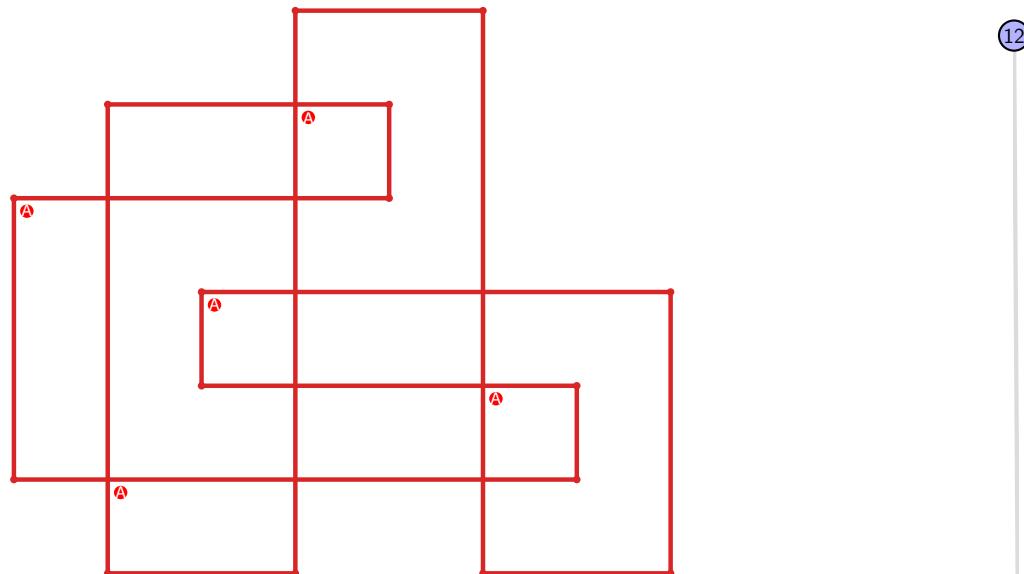


Figure 1685: `SnapPy` multiloop plot.

5

Figure 1686: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.546 [[15, 20, 16, 1], [3, 14, 4, 15], [19, 16, 20, 17], [1, 9, 2, 8], [2, 7, 3, 8], [13, 4, 14, 5], [17, 13, 18, 12], [18, 11, 19, 12], [9, 6, 10, 7], [5, 10, 6, 11]]

PD code drawn by `SnapPy`: [(11, 2, 12, 3), (7, 4, 8, 5), (20, 5, 1, 6), (6, 19, 7, 20), (3, 8, 4, 9), (16, 9, 17, 10), (10, 15, 11, 16), (1, 12, 2, 13), (17, 14, 18, 15), (13, 18, 14, 19)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 7, 0], [0, 8, 4, 4], [1, 3, 3, 8], [1, 9, 6, 1], [2, 5, 7, 7], [2, 6, 6, 9], [3, 9, 9, 4], [5, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 842: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

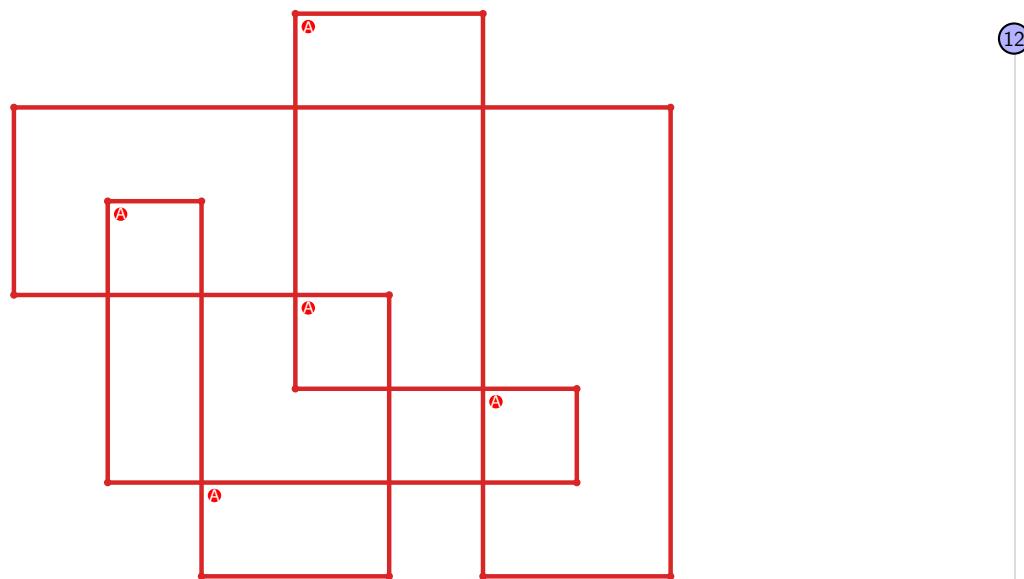


Figure 1687: `SnapPy` multiloop plot.

5

Figure 1688: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.547 `[[15, 20, 16, 1], [14, 5, 15, 6], [19, 16, 20, 17], [1, 8, 2, 9], [6, 9, 7, 10], [4, 13, 5, 14], [17, 13, 18, 12], [18, 11, 19, 12], [7, 2, 8, 3], [10, 3, 11, 4]]`

PD code drawn by `SnapPy`: `[(7, 20, 8, 1), (11, 2, 12, 3), (18, 5, 19, 6), (3, 6, 4, 7), (15, 8, 16, 9), (9, 14, 10, 15), (1, 10, 2, 11), (16, 13, 17, 14), (12, 17, 13, 18), (4, 19, 5, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 7, 0], [0, 8, 8, 4], [1, 3, 8, 9], [1, 9, 6, 1], [2, 5, 7, 7], [2, 6, 6, 9], [3, 9, 4, 3], [4, 8, 7, 5]]`

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 843: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

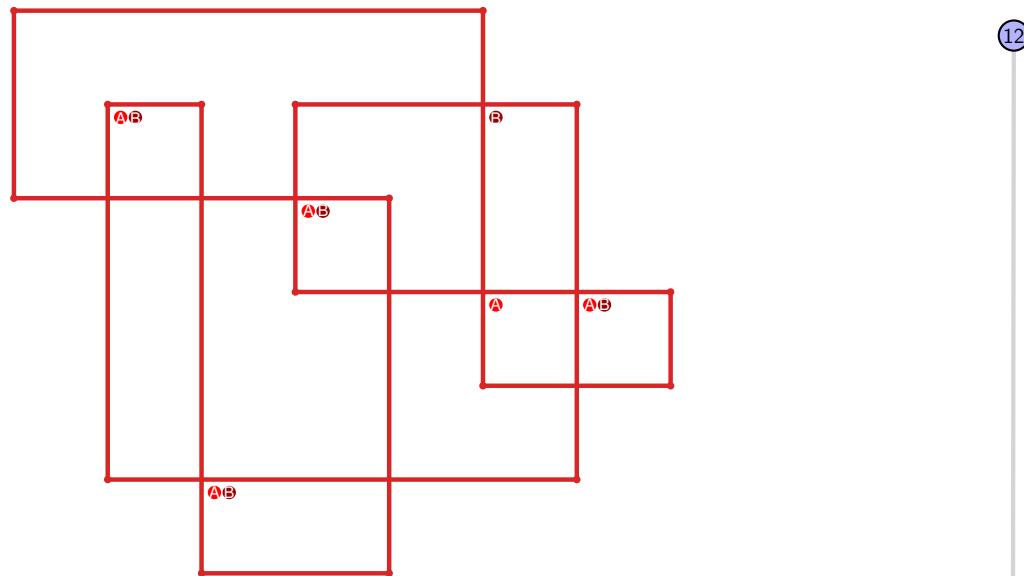


Figure 1689: `SnapPy` multiloop plot.

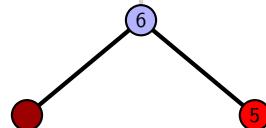


Figure 1690: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.548 [[17, 20, 18, 1], [5, 16, 6, 17], [19, 14, 20, 15], [18, 14, 19, 13], [1, 10, 2, 11], [11, 4, 12, 5], [15, 6, 16, 7], [7, 12, 8, 13], [9, 2, 10, 3], [3, 8, 4, 9]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (12, 3, 13, 4), (20, 5, 1, 6), (18, 7, 19, 8), (4, 9, 5, 10), (10, 15, 11, 16), (16, 11, 17, 12), (2, 13, 3, 14), (14, 17, 15, 18), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 8, 8, 5], [1, 4, 9, 7], [1, 7, 2, 1], [3, 6, 5, 9], [4, 9, 9, 4], [5, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 844: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

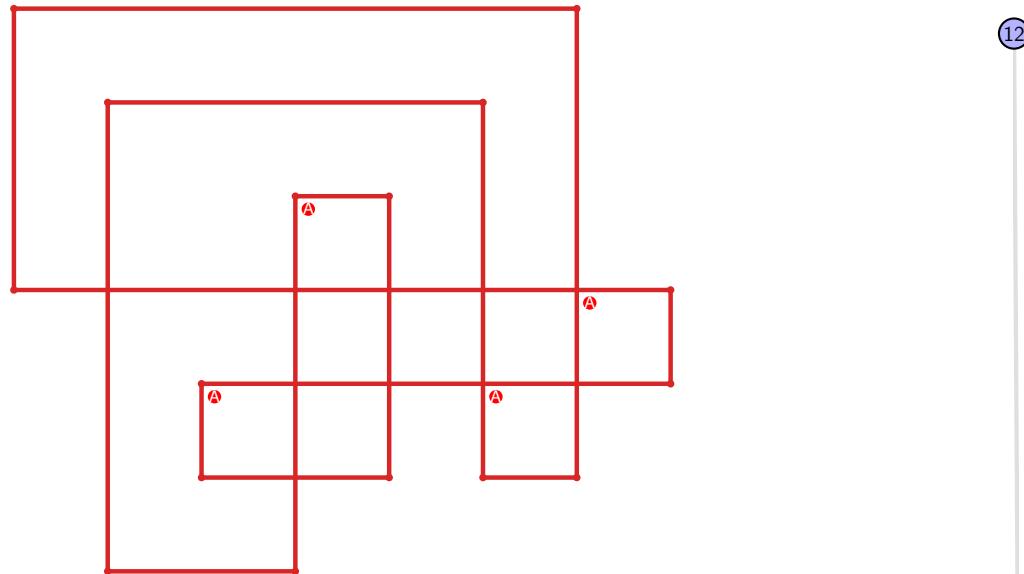


Figure 1691: SnapPy multiloop plot.

4

Figure 1692: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.549 $[[9, 12, 10, 1], [8, 20, 9, 13], [11, 6, 12, 7], [10, 6, 11, 5], [1, 15, 2, 16], [13, 3, 14, 4], [19, 7, 20, 8], [4, 18, 5, 19], [14, 17, 15, 18], [2, 17, 3, 16]]$

PD code drawn by SnapPy: $[(18, 1, 19, 2), (3, 8, 4, 9), (9, 4, 10, 5), (16, 5, 17, 6), (7, 10, 8, 11), (11, 20, 12, 13), (13, 12, 14, 1), (19, 14, 20, 15), (2, 15, 3, 16), (6, 17, 7, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 8, 9, 9], [1, 9, 8, 7], [1, 7, 2, 1], [3, 6, 5, 8], [4, 7, 5, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 845: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

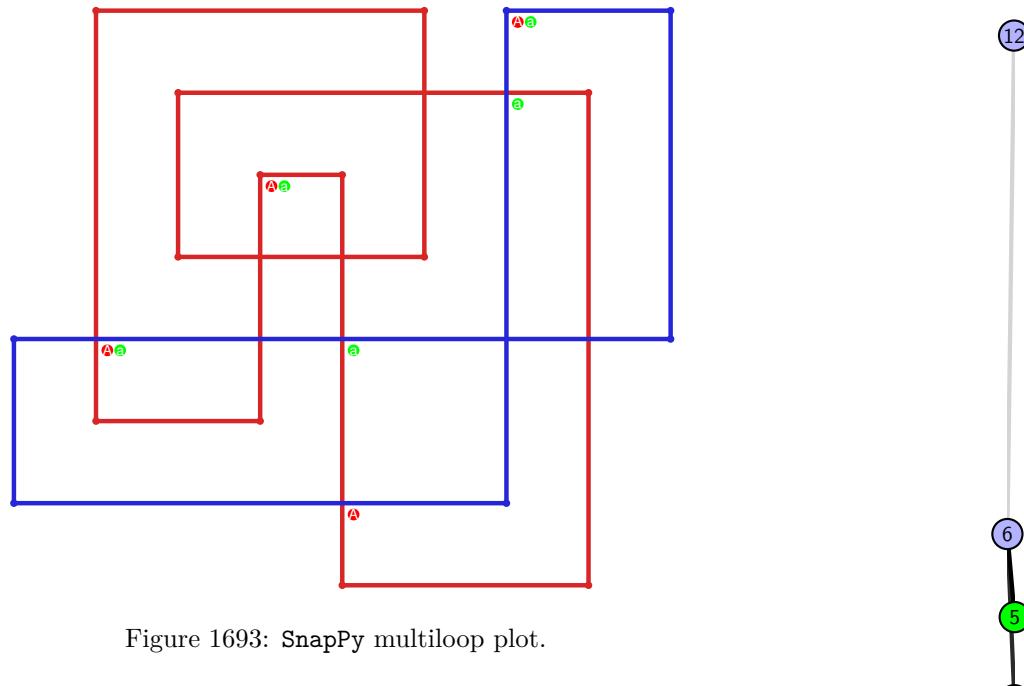


Figure 1693: SnapPy multiloop plot.

Figure 1694: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.550 `[[20, 7, 1, 8], [8, 12, 9, 11], [6, 19, 7, 20], [1, 19, 2, 18], [12, 3, 13, 4], [9, 14, 10, 15], [15, 10, 16, 11], [16, 5, 17, 6], [2, 17, 3, 18], [13, 5, 14, 4]]`

PD code drawn by `SnapPy`: `[(20, 9, 1, 10), (12, 1, 13, 2), (16, 3, 17, 4), (11, 6, 12, 7), (7, 4, 8, 5), (5, 10, 6, 11), (18, 13, 19, 14), (14, 17, 15, 18), (2, 15, 3, 16), (8, 19, 9, 20)]`

Planar representation generated by `plantri`: `[[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 3, 0], [0, 2, 8, 8], [1, 8, 9, 9], [1, 9, 6, 6], [1, 5, 5, 7], [2, 6, 9, 8], [3, 7, 4, 3], [4, 7, 5, 4]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 846: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

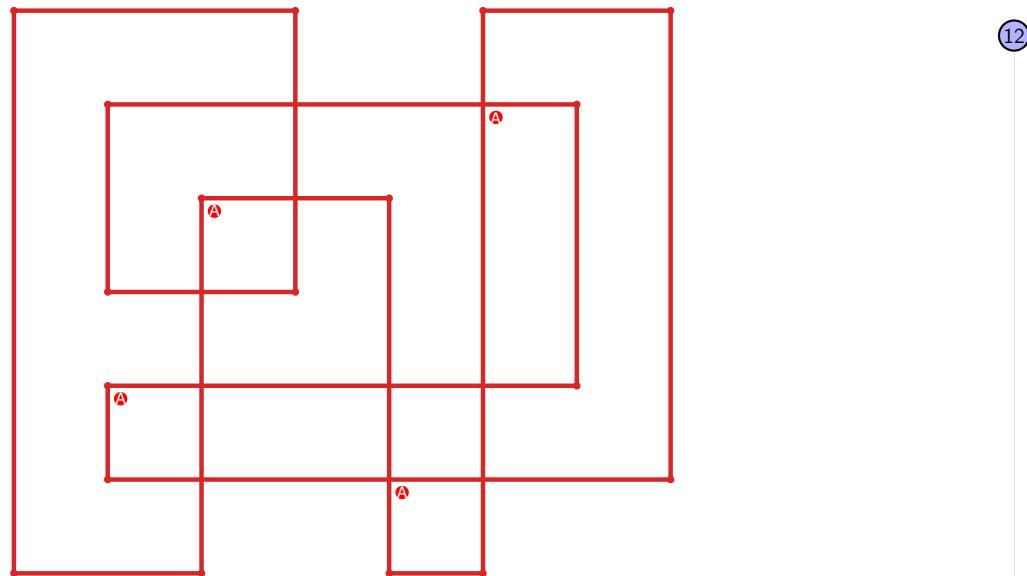


Figure 1695: `SnapPy` multiloop plot.

4

Figure 1696: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.551 $[[8, 5, 1, 6], [6, 9, 7, 20], [7, 19, 8, 20], [4, 18, 5, 19], [1, 14, 2, 13], [9, 13, 10, 12], [17, 3, 18, 4], [14, 3, 15, 2], [10, 15, 11, 16], [16, 11, 17, 12]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (5, 2, 6, 3), (7, 18, 8, 19), (16, 13, 17, 14), (17, 6, 18, 7), (14, 19, 15, 20), (1, 10, 2, 11), (4, 11, 5, 12), (12, 3, 13, 4), (20, 15, 9, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 2, 2], [0, 1, 1, 3], [0, 2, 6, 6], [0, 7, 7, 5], [1, 4, 8, 9], [3, 9, 7, 3], [4, 6, 8, 4], [5, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 847: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

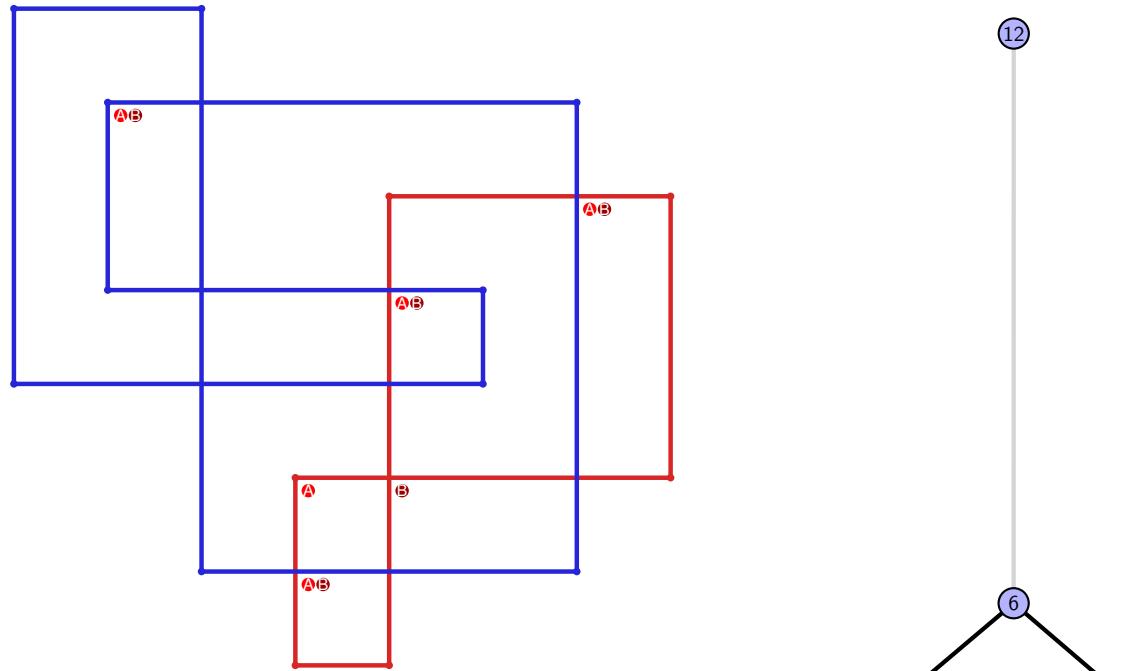


Figure 1697: SnapPy multiloop plot.

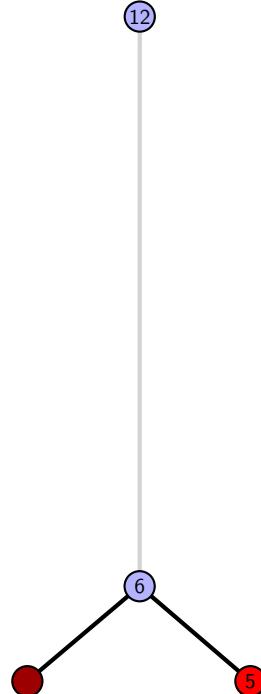


Figure 1698: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.552 [[16, 13, 1, 14], [14, 6, 15, 5], [15, 4, 16, 5], [12, 3, 13, 4], [1, 9, 2, 8], [6, 17, 7, 20], [11, 19, 12, 20], [2, 9, 3, 10], [7, 17, 8, 18], [18, 10, 19, 11]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (13, 2, 14, 3), (3, 12, 4, 13), (6, 15, 7, 16), (16, 7, 1, 8), (19, 8, 20, 9), (14, 11, 15, 12), (17, 4, 18, 5), (5, 18, 6, 19), (9, 20, 10, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 2, 2], [0, 1, 1, 3], [0, 2, 6, 7], [0, 7, 7, 8], [1, 8, 8, 6], [3, 5, 9, 9], [3, 9, 4, 4], [4, 9, 5, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 848: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

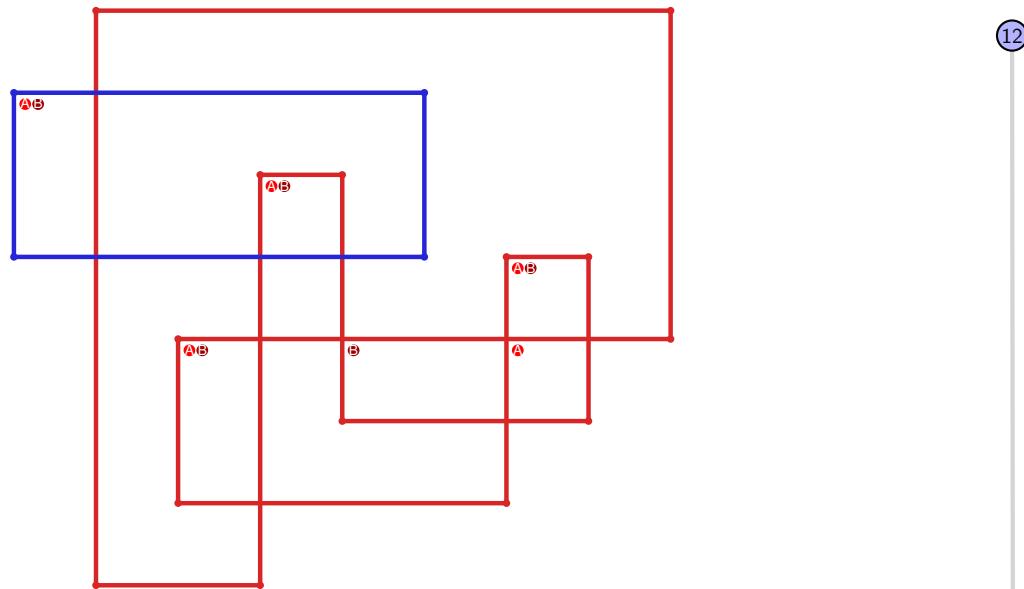


Figure 1699: SnapPy multiloop plot.

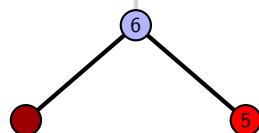


Figure 1700: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.553 [[14, 20, 1, 15], [15, 6, 16, 5], [17, 13, 18, 14], [19, 11, 20, 12], [1, 8, 2, 9], [6, 9, 7, 10], [16, 4, 17, 5], [12, 18, 13, 19], [10, 3, 11, 4], [7, 2, 8, 3]]

PD code drawn by SnapPy: [(7, 14, 8, 1), (16, 1, 17, 2), (2, 15, 3, 16), (12, 5, 13, 6), (3, 6, 4, 7), (19, 8, 20, 9), (17, 10, 18, 11), (4, 13, 5, 14), (9, 18, 10, 19), (11, 20, 12, 15)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 7, 7], [0, 7, 7, 8], [0, 9, 9, 5], [1, 4, 9, 8], [1, 8, 2, 1], [2, 3, 3, 2], [3, 6, 5, 9], [4, 8, 5, 4]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 849: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

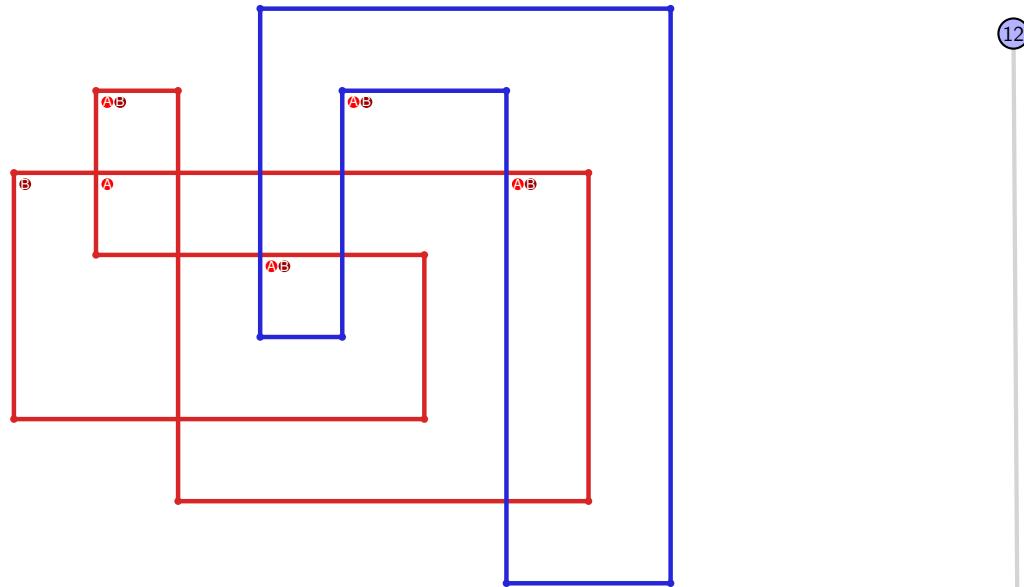


Figure 1701: SnapPy multiloop plot.

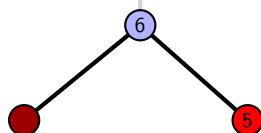


Figure 1702: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.554 [[17, 20, 18, 1], [9, 16, 10, 17], [19, 14, 20, 15], [18, 14, 19, 13], [1, 7, 2, 6], [8, 5, 9, 6], [15, 10, 16, 11], [12, 3, 13, 4], [7, 3, 8, 2], [4, 11, 5, 12]]

PD code drawn by `SnapPy`: [(9, 20, 10, 1), (5, 2, 6, 3), (3, 18, 4, 19), (12, 7, 13, 8), (1, 8, 2, 9), (10, 15, 11, 16), (16, 11, 17, 12), (6, 13, 7, 14), (14, 17, 15, 18), (19, 4, 20, 5)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 8, 8, 5], [1, 4, 8, 9], [1, 9, 2, 1], [3, 9, 9, 8], [4, 7, 5, 4], [5, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 850: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

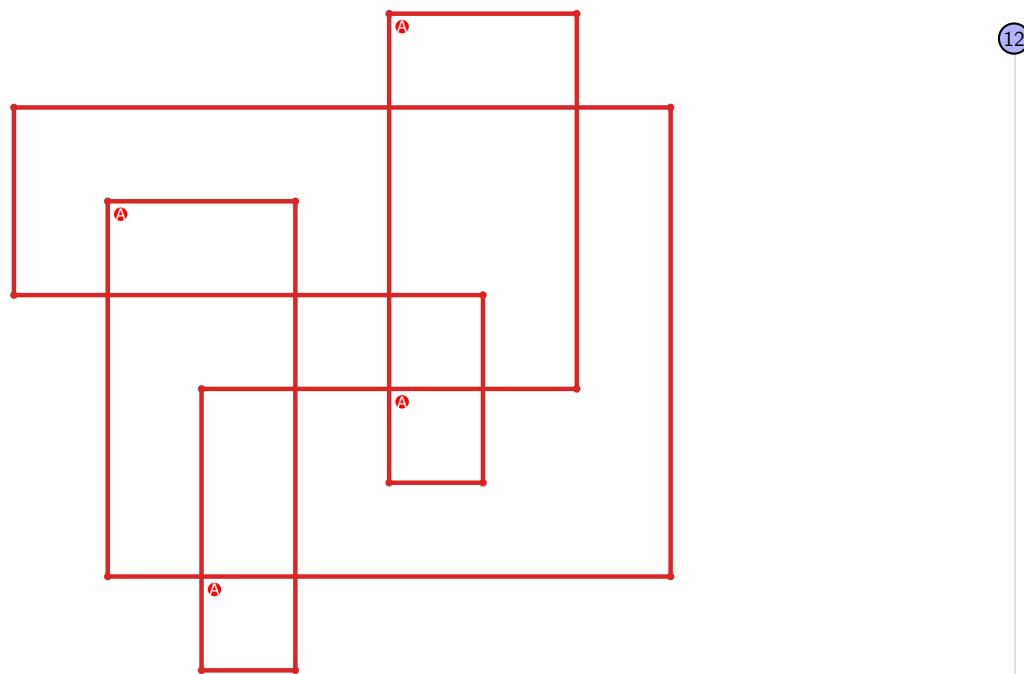


Figure 1703: `SnapPy` multiloop plot.

Figure 1704: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.555 [[10, 20, 1, 11], [11, 14, 12, 15], [19, 9, 20, 10], [1, 4, 2, 5], [5, 13, 6, 14], [12, 6, 13, 7], [15, 7, 16, 8], [8, 18, 9, 19], [3, 17, 4, 18], [2, 17, 3, 16]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (17, 4, 18, 5), (20, 5, 11, 6), (14, 7, 15, 8), (3, 18, 4, 19), (16, 19, 17, 20), (11, 10, 12, 1), (1, 12, 2, 13), (6, 13, 7, 14), (8, 15, 9, 16)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 7, 0], [0, 8, 9, 4], [1, 3, 5, 5], [1, 4, 4, 6], [1, 5, 9, 7], [2, 6, 8, 2], [3, 7, 9, 9], [3, 8, 8, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 851: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

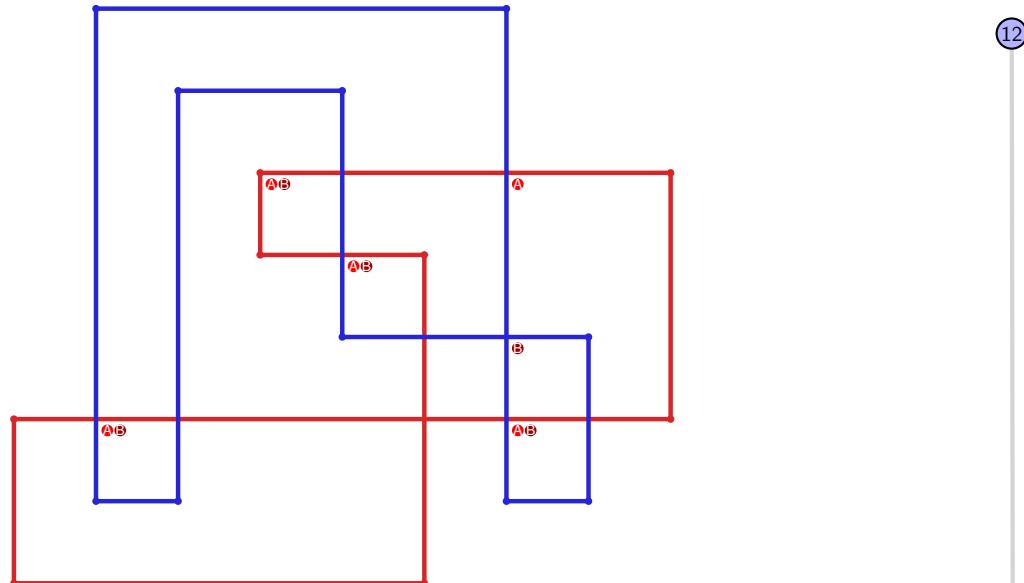


Figure 1705: SnapPy multiloop plot.

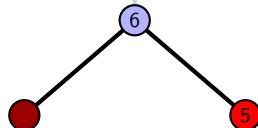


Figure 1706: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.556 $[[9, 20, 10, 1], [8, 5, 9, 6], [19, 10, 20, 11], [1, 15, 2, 14], [6, 14, 7, 13], [7, 12, 8, 13], [4, 11, 5, 12], [18, 15, 19, 16], [2, 18, 3, 17], [3, 16, 4, 17]]$

PD code drawn by `SnapPy`: $[(6, 3, 7, 4), (17, 8, 18, 9), (2, 9, 3, 10), (5, 10, 6, 11), (11, 4, 12, 5), (12, 19, 13, 20), (16, 13, 17, 14), (1, 14, 2, 15), (15, 20, 16, 1), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 7, 0], [0, 7, 8, 4], [1, 3, 5, 5], [1, 4, 4, 6], [1, 5, 9, 2], [2, 9, 8, 3], [3, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 4

Average optimal degree: 2.4

Total minimal pinning sets: 4

Average minimal degree: 2.4

Total pinning sets: 288

Average overall degree: 3.03

Pinning number: 5

Table 852: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

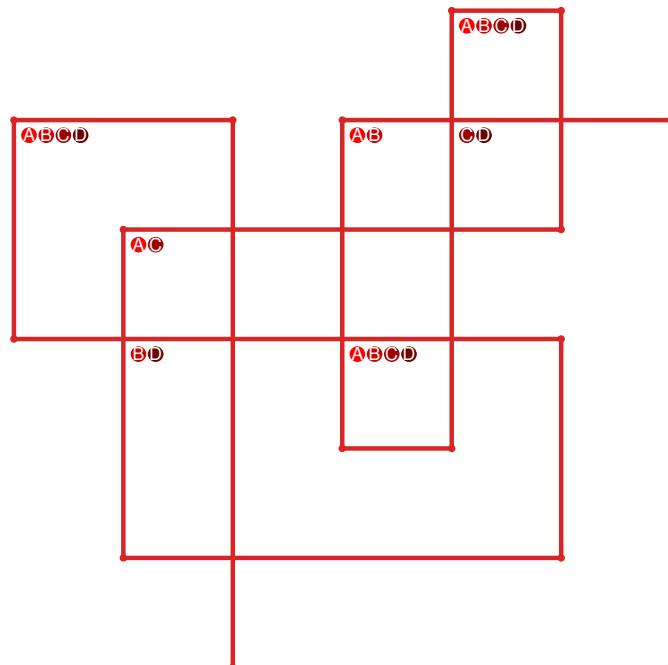


Figure 1707: `SnapPy` multiloop plot.

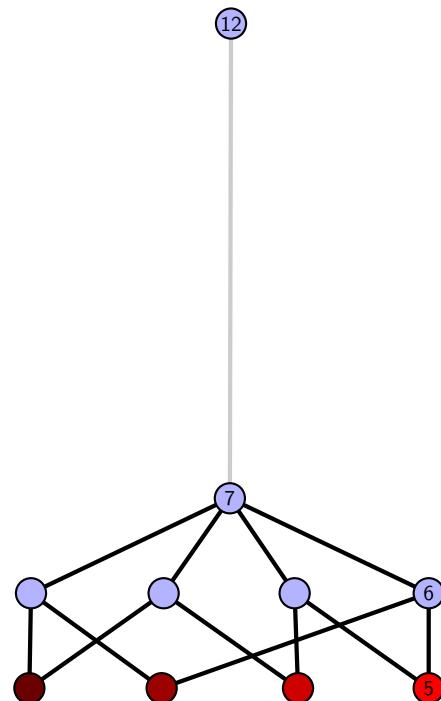


Figure 1708: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.557 `[[7, 20, 8, 1], [19, 6, 20, 7], [8, 11, 9, 12], [1, 12, 2, 13], [13, 18, 14, 19], [10, 5, 11, 6], [9, 5, 10, 4], [2, 16, 3, 15], [17, 14, 18, 15], [3, 16, 4, 17]]`

PD code drawn by `SnapPy`: `[(20, 5, 1, 6), (6, 1, 7, 2), (15, 2, 16, 3), (4, 7, 5, 8), (17, 8, 18, 9), (13, 10, 14, 11), (11, 18, 12, 19), (19, 12, 20, 13), (9, 14, 10, 15), (3, 16, 4, 17)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 3], [0, 2, 7, 4], [1, 3, 8, 8], [1, 6, 6, 2], [2, 5, 5, 9], [3, 9, 9, 8], [4, 7, 9, 4], [6, 8, 7, 7]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 853: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

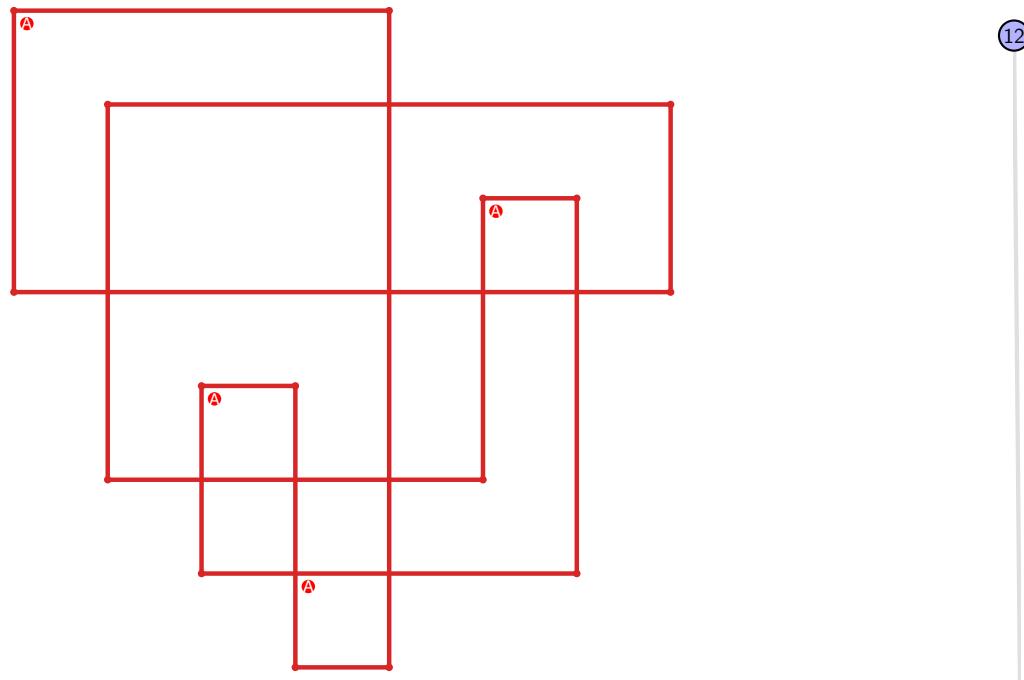


Figure 1709: `SnapPy` multiloop plot.

Figure 1710: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.558 $[[8, 20, 1, 9], [9, 7, 10, 8], [19, 16, 20, 17], [1, 16, 2, 15], [6, 10, 7, 11], [17, 6, 18, 5], [18, 4, 19, 5], [2, 13, 3, 12], [14, 11, 15, 12], [3, 13, 4, 14]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (1, 20, 2, 9), (12, 3, 13, 4), (17, 14, 18, 15), (15, 6, 16, 7), (7, 16, 8, 17), (18, 5, 19, 6), (10, 19, 11, 20), (4, 11, 5, 12), (2, 13, 3, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 8], [1, 8, 5, 1], [2, 4, 6, 6], [2, 5, 5, 9], [3, 9, 9, 8], [3, 7, 9, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 854: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

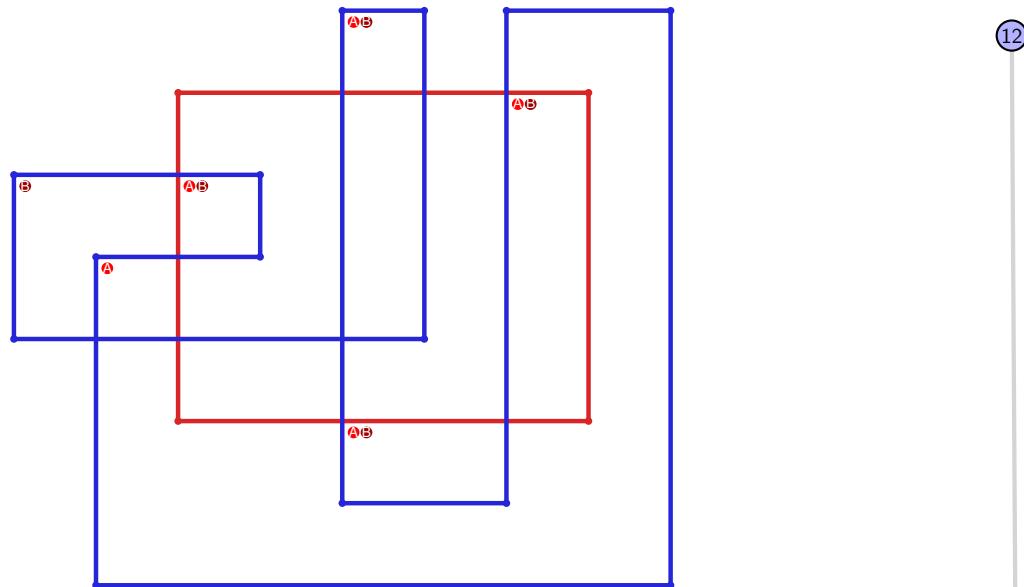


Figure 1711: SnapPy multiloop plot.

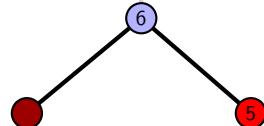


Figure 1712: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.559 $[[7, 16, 8, 1], [15, 6, 16, 7], [8, 11, 9, 12], [1, 12, 2, 13], [14, 20, 15, 17], [10, 5, 11, 6], [9, 5, 10, 4], [2, 19, 3, 18], [13, 18, 14, 17], [3, 19, 4, 20]]$

PD code drawn by SnapPy: $[(1, 6, 2, 7), (7, 2, 8, 3), (12, 3, 13, 4), (5, 8, 6, 9), (14, 9, 15, 10), (4, 13, 5, 14), (20, 15, 17, 16), (16, 17, 1, 18), (11, 18, 12, 19), (19, 10, 20, 11)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 3], [0, 2, 7, 8], [1, 8, 8, 9], [1, 6, 6, 2], [2, 5, 5, 9], [3, 9, 9, 8], [3, 7, 4, 4], [4, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 855: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

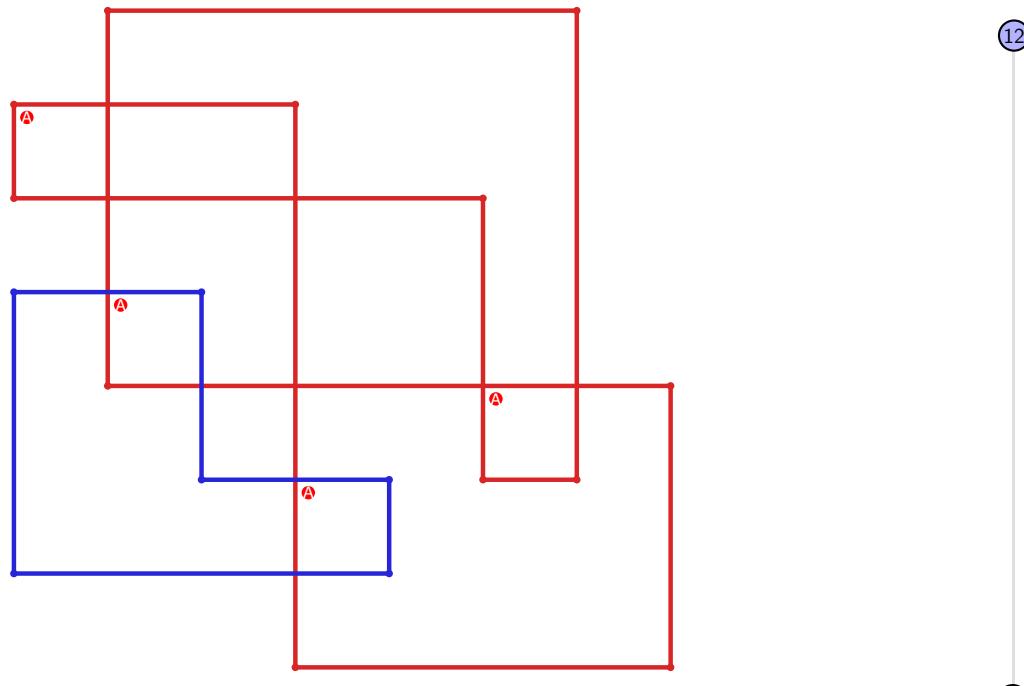


Figure 1713: SnapPy multiloop plot.

Figure 1714: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.560 `[[20, 7, 1, 8], [8, 3, 9, 4], [4, 19, 5, 20], [6, 17, 7, 18], [1, 15, 2, 14], [2, 13, 3, 14], [9, 13, 10, 12], [18, 5, 19, 6], [16, 11, 17, 12], [15, 11, 16, 10]]`

PD code drawn by `SnapPy`: `[(6, 1, 7, 2), (16, 3, 17, 4), (18, 5, 19, 6), (8, 13, 9, 14), (14, 9, 15, 10), (10, 7, 11, 8), (20, 11, 1, 12), (12, 19, 13, 20), (4, 15, 5, 16), (2, 17, 3, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 7], [0, 7, 7, 8], [0, 9, 5, 5], [1, 4, 4, 6], [1, 5, 9, 8], [2, 3, 3, 2], [3, 6, 9, 9], [4, 8, 8, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 856: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

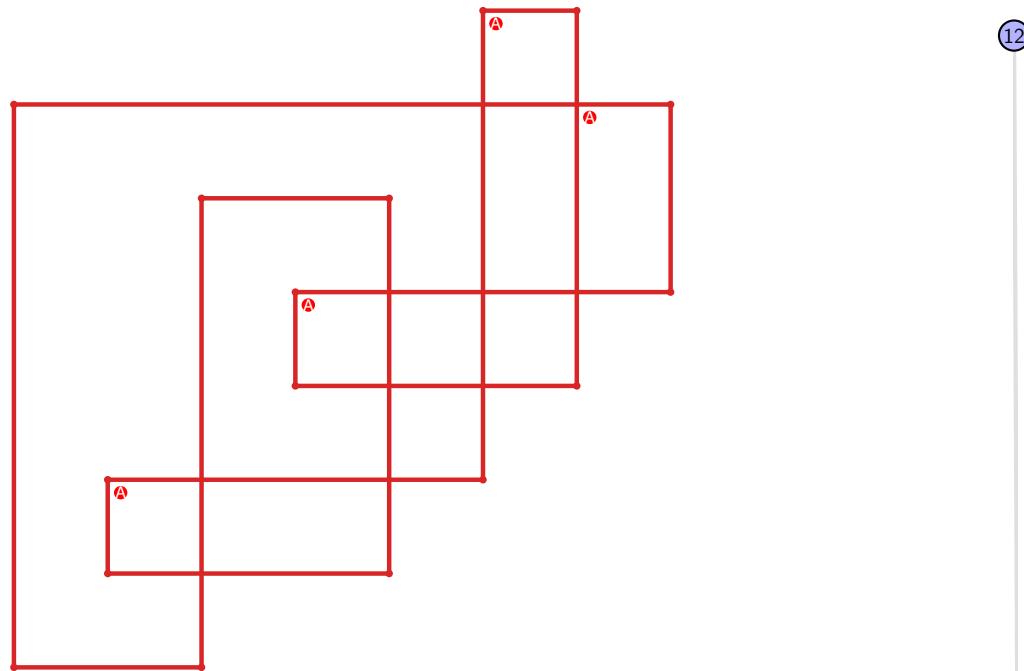


Figure 1715: `SnapPy` multiloop plot.

Figure 1716: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.561 $[[17, 20, 18, 1], [3, 16, 4, 17], [4, 19, 5, 20], [18, 5, 19, 6], [1, 11, 2, 10], [2, 9, 3, 10], [15, 8, 16, 9], [6, 13, 7, 14], [11, 14, 12, 15], [12, 7, 13, 8]]$

PD code drawn by SnapPy: $[(16, 3, 17, 4), (10, 5, 11, 6), (13, 6, 14, 7), (20, 7, 1, 8), (8, 19, 9, 20), (4, 11, 5, 12), (9, 12, 10, 13), (1, 14, 2, 15), (2, 17, 3, 18), (15, 18, 16, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 3, 3], [0, 2, 2, 7], [0, 8, 5, 5], [1, 4, 4, 6], [1, 5, 8, 9], [3, 9, 9, 8], [4, 7, 9, 6], [6, 8, 7, 7]]$

Total optimal pinning sets: 4
Total minimal pinning sets: 4
Total pinning sets: 288
Pinning number: 5

Average optimal degree: 2.4
Average minimal degree: 2.4
Average overall degree: 3.03

Table 857: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.4	2.69	2.9	3.05	3.16	3.24	3.29	3.33	

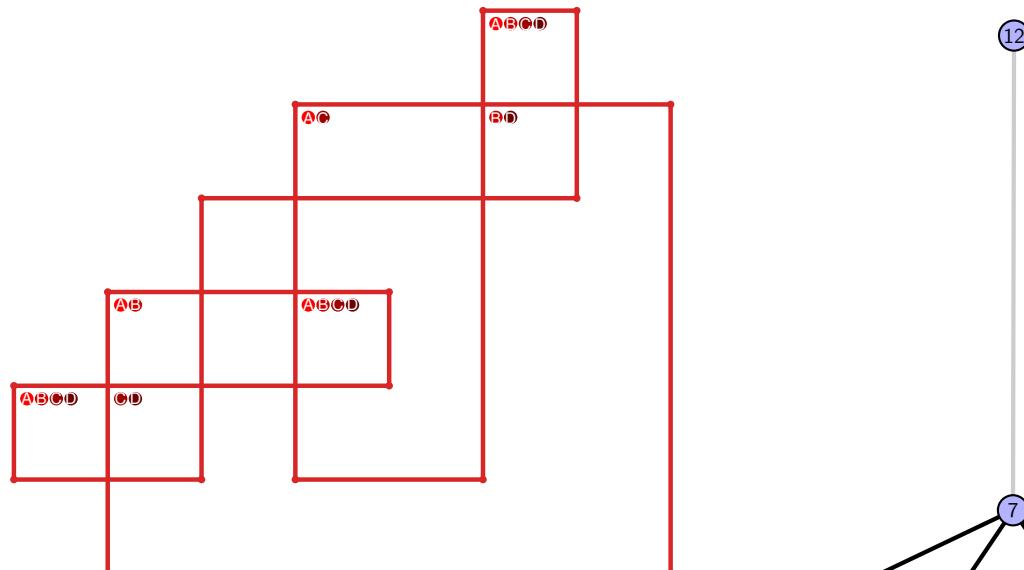


Figure 1717: SnapPy multiloop plot.

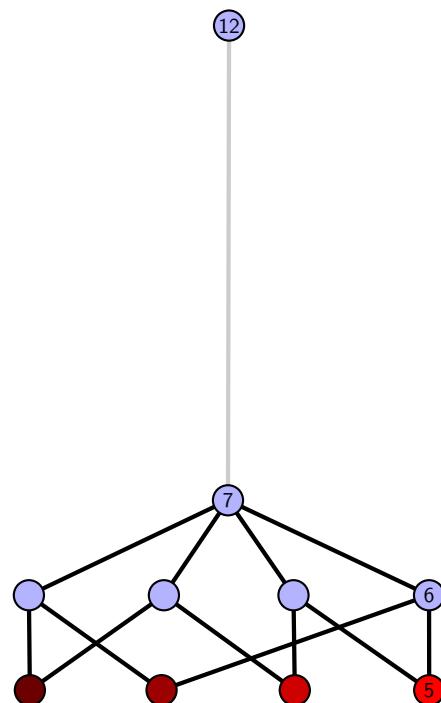


Figure 1718: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.562 $[[5, 8, 6, 1], [4, 20, 5, 9], [7, 19, 8, 20], [6, 19, 7, 18], [1, 16, 2, 15], [9, 3, 10, 4], [17, 12, 18, 13], [16, 12, 17, 11], [2, 14, 3, 15], [10, 14, 11, 13]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (2, 5, 3, 6), (11, 16, 12, 17), (17, 12, 18, 13), (13, 10, 14, 11), (7, 14, 8, 15), (15, 6, 16, 7), (18, 3, 19, 4), (4, 19, 5, 20), (1, 20, 2, 9)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 3, 3], [0, 2, 2, 6], [0, 7, 8, 8], [1, 8, 9, 1], [3, 9, 7, 7], [4, 6, 6, 9], [4, 9, 5, 4], [5, 8, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 858: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

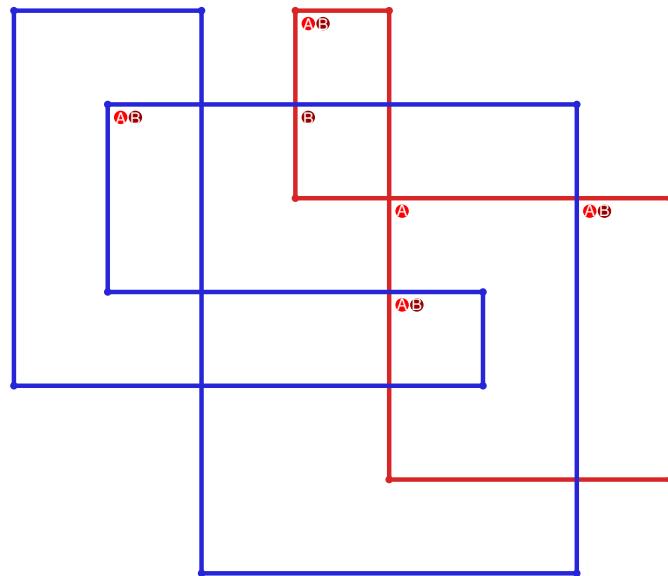


Figure 1719: SnapPy multiloop plot.

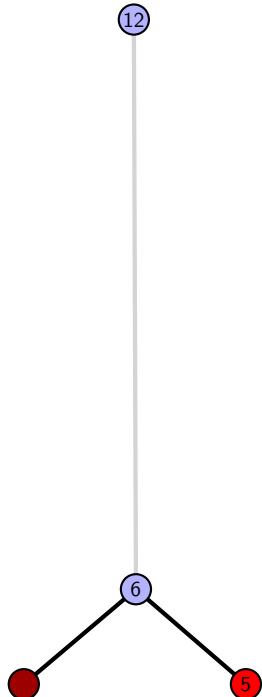


Figure 1720: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.563 $[[7, 20, 8, 1], [13, 6, 14, 7], [14, 19, 15, 20], [8, 3, 9, 4], [1, 4, 2, 5], [5, 12, 6, 13], [18, 15, 19, 16], [2, 9, 3, 10], [11, 16, 12, 17], [17, 10, 18, 11]]$

PD code drawn by SnapPy: $[(5, 20, 6, 1), (18, 1, 19, 2), (10, 3, 11, 4), (19, 6, 20, 7), (14, 7, 15, 8), (2, 9, 3, 10), (15, 12, 16, 13), (8, 13, 9, 14), (11, 16, 12, 17), (4, 17, 5, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 7, 4], [0, 3, 7, 5], [1, 4, 8, 1], [2, 8, 9, 2], [3, 9, 4, 3], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 859: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

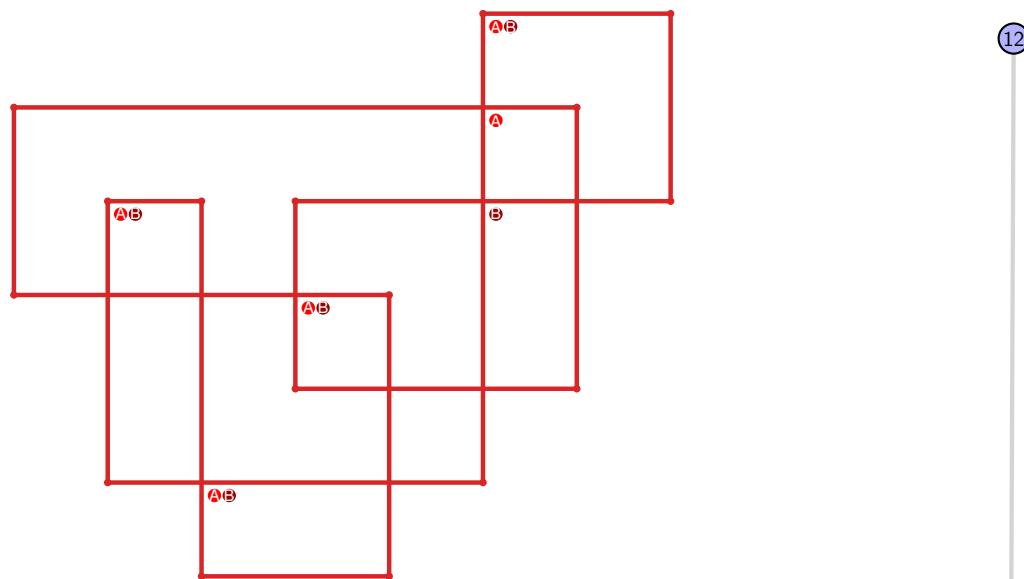


Figure 1721: SnapPy multiloop plot.

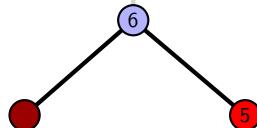


Figure 1722: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.564 [[7, 14, 8, 1], [6, 20, 7, 15], [13, 19, 14, 20], [8, 3, 9, 4], [1, 4, 2, 5], [15, 5, 16, 6], [16, 12, 17, 13], [18, 10, 19, 11], [2, 9, 3, 10], [11, 17, 12, 18]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (13, 2, 14, 3), (16, 3, 17, 4), (14, 7, 1, 8), (19, 8, 20, 9), (17, 10, 18, 11), (5, 12, 6, 13), (9, 18, 10, 19), (11, 20, 12, 15), (4, 15, 5, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 8, 8, 4], [0, 3, 8, 5], [1, 4, 6, 1], [2, 5, 9, 9], [2, 9, 9, 8], [3, 7, 4, 3], [6, 7, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 860: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

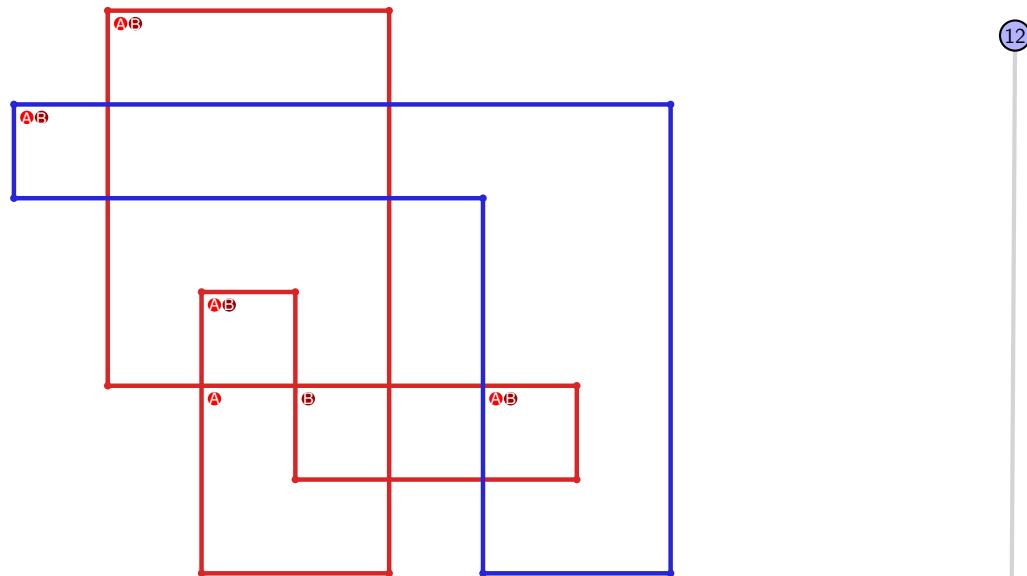


Figure 1723: SnapPy multiloop plot.

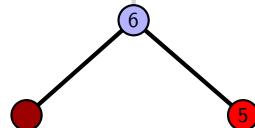


Figure 1724: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.565 `[[11, 16, 12, 1], [5, 10, 6, 11], [6, 15, 7, 16], [12, 2, 13, 1], [4, 20, 5, 17], [9, 19, 10, 20], [14, 7, 15, 8], [2, 14, 3, 13], [17, 3, 18, 4], [18, 8, 19, 9]]`

PD code drawn by `SnapPy`: `[(9, 2, 10, 3), (20, 3, 17, 4), (16, 5, 1, 6), (8, 13, 9, 14), (1, 10, 2, 11), (6, 11, 7, 12), (12, 7, 13, 8), (19, 14, 20, 15), (4, 17, 5, 18), (15, 18, 16, 19)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 6, 6], [0, 7, 7, 0], [1, 8, 8, 5], [1, 4, 9, 9], [2, 9, 7, 2], [3, 6, 8, 3], [4, 7, 9, 4], [5, 8, 6, 5]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 861: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

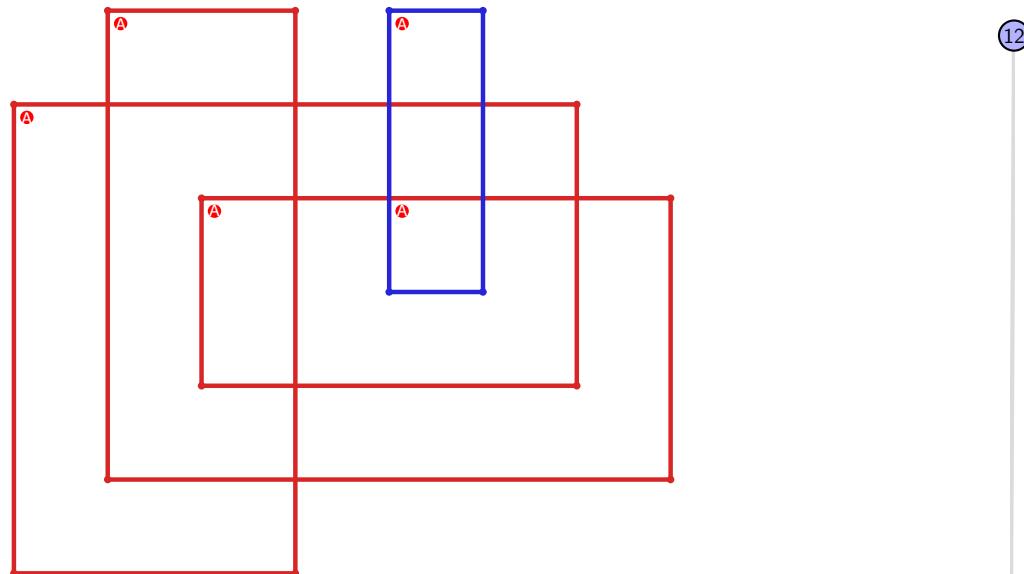


Figure 1725: `SnapPy` multiloop plot.



Figure 1726: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.566 [[6, 10, 1, 7], [7, 5, 8, 6], [9, 16, 10, 11], [1, 17, 2, 20], [4, 12, 5, 13], [8, 12, 9, 11], [15, 17, 16, 18], [2, 19, 3, 20], [13, 3, 14, 4], [18, 14, 19, 15]]

PD code drawn by `SnapPy`: [(12, 1, 13, 2), (18, 3, 19, 4), (4, 17, 5, 18), (2, 11, 3, 12), (10, 13, 7, 14), (20, 15, 17, 16), (16, 19, 11, 20), (6, 7, 1, 8), (8, 5, 9, 6), (14, 9, 15, 10)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 6, 7, 7], [1, 8, 8, 5], [1, 4, 2, 2], [2, 9, 9, 3], [3, 9, 8, 3], [4, 7, 9, 4], [6, 8, 7, 6]]

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 124
 Pinning number: 6

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.92

Table 862: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	35	35	21	7	1	119
Average degree	2.27	2.63	2.86	3.02	3.14	3.25	3.33	

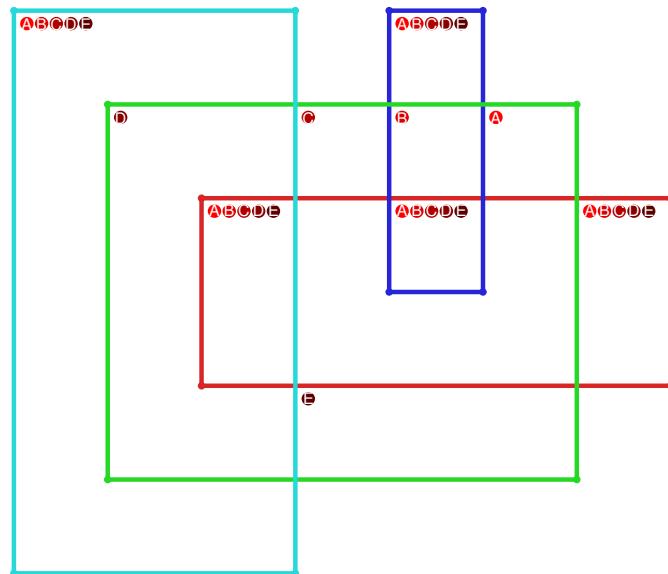


Figure 1727: `SnapPy` multiloop plot.

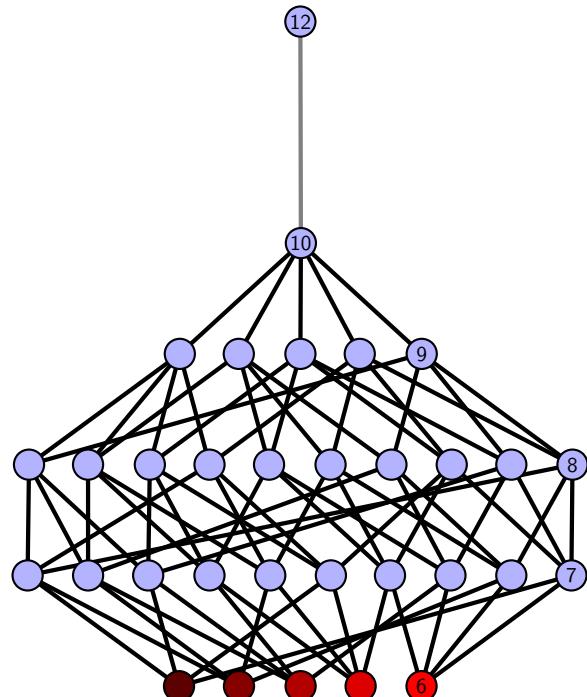


Figure 1728: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.567 `[[11, 14, 12, 1], [3, 10, 4, 11], [4, 13, 5, 14], [12, 5, 13, 6], [1, 15, 2, 20], [2, 19, 3, 20], [9, 18, 10, 19], [6, 16, 7, 15], [17, 8, 18, 9], [16, 8, 17, 7]]`

PD code drawn by `SnapPy`: `[(10, 3, 11, 4), (5, 18, 6, 19), (19, 6, 20, 7), (1, 8, 2, 9), (2, 11, 3, 12), (9, 12, 10, 13), (7, 20, 8, 15), (14, 15, 1, 16), (16, 13, 17, 14), (17, 4, 18, 5)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 3, 3], [0, 2, 2, 7], [0, 7, 5, 5], [1, 4, 4, 6], [1, 5, 8, 8], [3, 9, 9, 4], [6, 9, 9, 6], [7, 8, 8, 7]]`

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 863: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

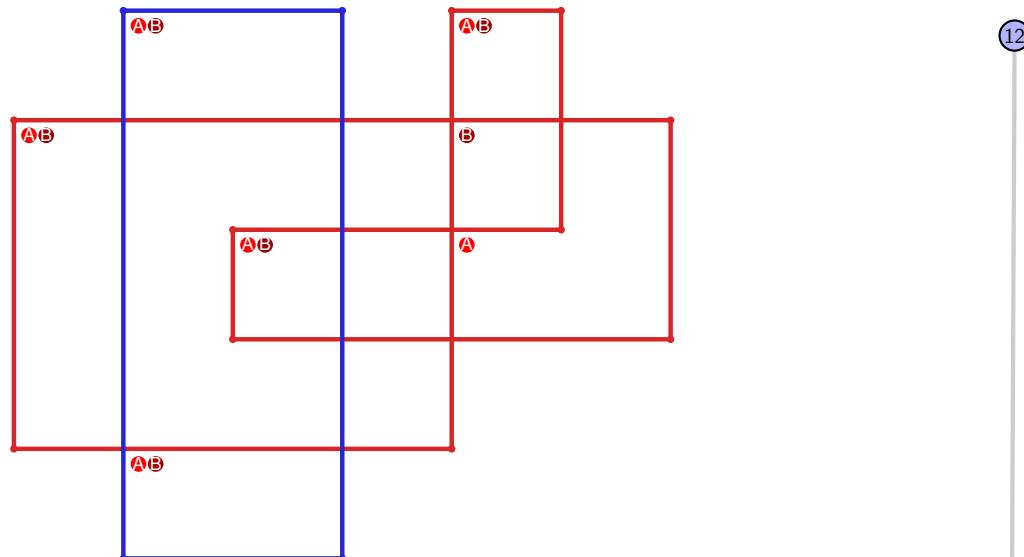


Figure 1729: `SnapPy` multiloop plot.

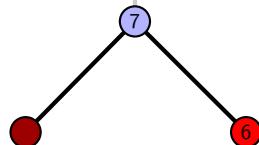


Figure 1730: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.568 [[12, 20, 1, 13], [13, 8, 14, 7], [11, 6, 12, 7], [19, 1, 20, 2], [8, 15, 9, 14], [5, 10, 6, 11], [2, 17, 3, 16], [18, 15, 19, 16], [9, 4, 10, 5], [17, 4, 18, 3]]

PD code drawn by SnapPy: [(1, 14, 2, 15), (7, 2, 8, 3), (9, 4, 10, 5), (5, 18, 6, 19), (3, 8, 4, 9), (16, 11, 17, 12), (19, 6, 20, 7), (15, 20, 16, 13), (13, 12, 14, 1), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 7, 0], [1, 7, 8, 1], [2, 8, 8, 2], [3, 9, 9, 7], [3, 6, 9, 4], [4, 9, 5, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 864: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

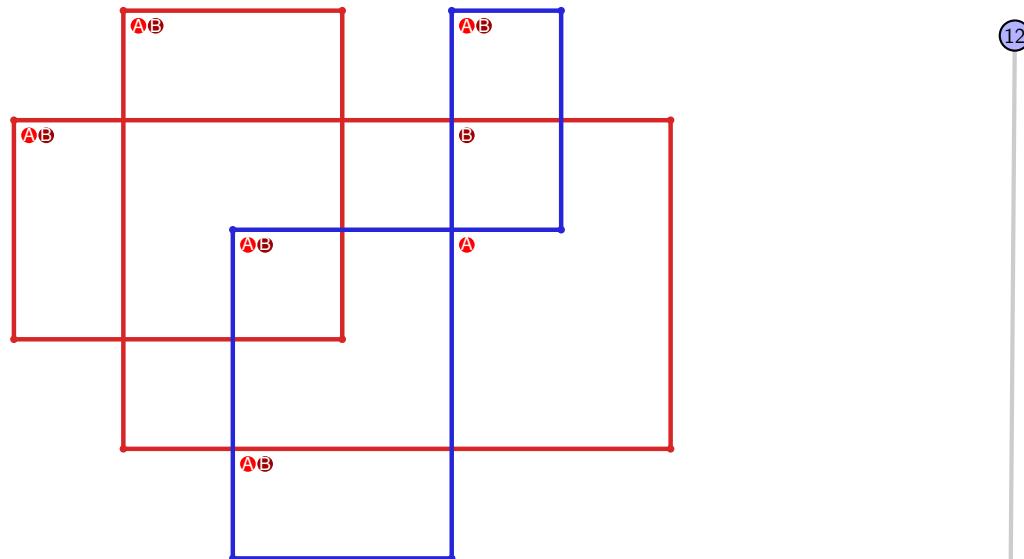


Figure 1731: SnapPy multiloop plot.

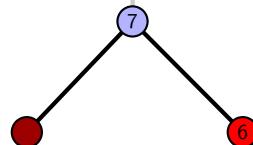


Figure 1732: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.569 $[[9, 16, 10, 1], [8, 20, 9, 17], [15, 19, 16, 20], [10, 2, 11, 1], [17, 7, 18, 8], [18, 14, 19, 15], [2, 12, 3, 11], [3, 6, 4, 7], [4, 13, 5, 14], [12, 5, 13, 6]]$

PD code drawn by `SnapPy`: $[(10, 3, 11, 4), (1, 4, 2, 5), (18, 5, 19, 6), (9, 16, 10, 1), (2, 11, 3, 12), (19, 12, 20, 13), (7, 14, 8, 15), (15, 8, 16, 9), (13, 20, 14, 17), (6, 17, 7, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 6, 0], [1, 7, 5, 1], [2, 4, 8, 2], [3, 9, 7, 3], [4, 6, 9, 8], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 4

Average minimal degree: 2.33

Total pinning sets: 92

Average overall degree: 2.92

Pinning number: 6

Table 865: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	6	24	30	20	7	1	88
Average degree	2.17	2.46	2.76	2.98	3.13	3.25	3.33	

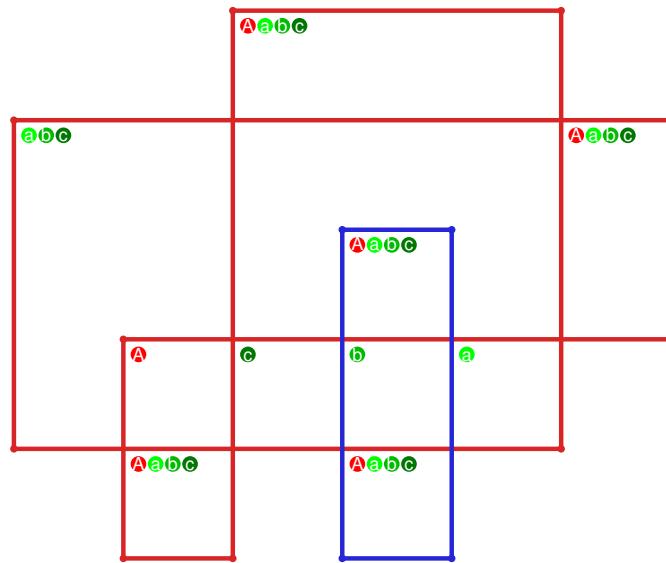


Figure 1733: `SnapPy` multiloop plot.

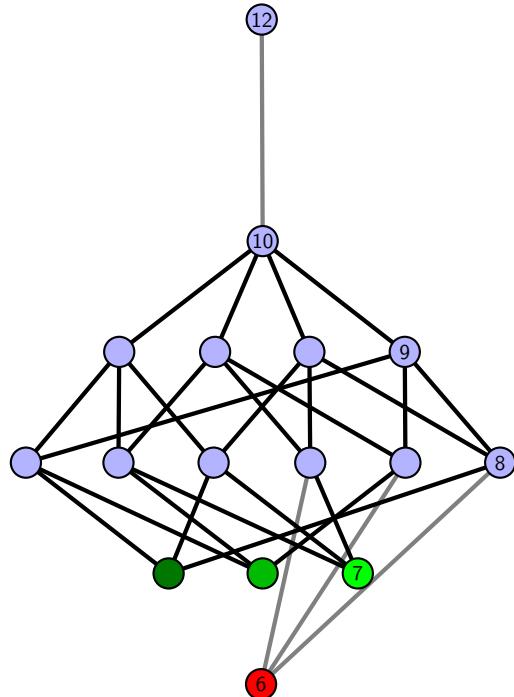


Figure 1734: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.570 [[10, 20, 1, 11], [11, 8, 12, 7], [9, 6, 10, 7], [19, 1, 20, 2], [8, 13, 9, 12], [5, 15, 6, 16], [2, 18, 3, 19], [13, 17, 14, 16], [14, 4, 15, 5], [17, 3, 18, 4]]

PD code drawn by SnapPy: [(20, 1, 11, 2), (17, 2, 18, 3), (7, 4, 8, 5), (5, 14, 6, 15), (12, 9, 13, 10), (3, 18, 4, 19), (19, 16, 20, 17), (10, 11, 1, 12), (8, 13, 9, 14), (15, 6, 16, 7)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 7, 8, 8], [3, 9, 9, 3], [4, 9, 8, 5], [5, 7, 9, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 68
 Pinning number: 7

Average optimal degree: 2.29
 Average minimal degree: 2.34
 Average overall degree: 2.92

Table 866: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	13	24	19	7	1	64
Average degree	2.29	2.62	2.91	3.12	3.25	3.33	

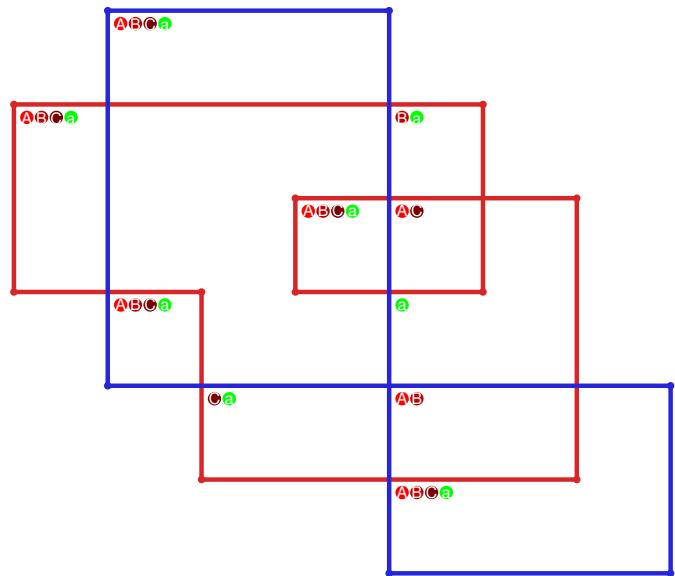


Figure 1735: SnapPy multiloop plot.

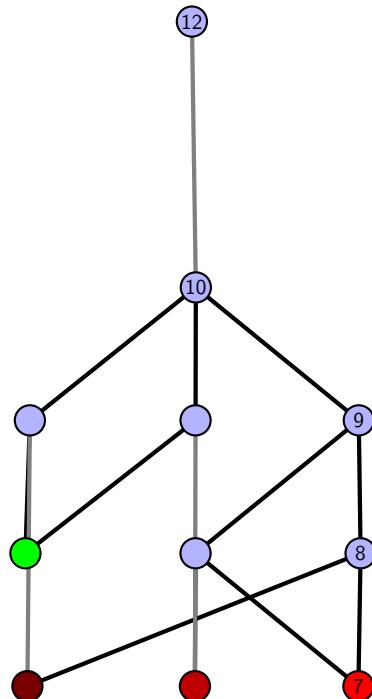


Figure 1736: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.571 [[9, 20, 10, 1], [19, 8, 20, 9], [10, 2, 11, 1], [18, 13, 19, 14], [7, 12, 8, 13], [2, 12, 3, 11], [14, 5, 15, 6], [6, 17, 7, 18], [3, 17, 4, 16], [4, 15, 5, 16]]

PD code drawn by SnapPy: [(11, 2, 12, 3), (16, 5, 17, 6), (8, 19, 9, 20), (4, 9, 5, 10), (15, 10, 16, 11), (1, 12, 2, 13), (13, 20, 14, 1), (3, 14, 4, 15), (6, 17, 7, 18), (18, 7, 19, 8)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 7, 4], [1, 3, 7, 5], [2, 4, 8, 2], [3, 9, 9, 7], [3, 6, 8, 4], [5, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 6

Table 867: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

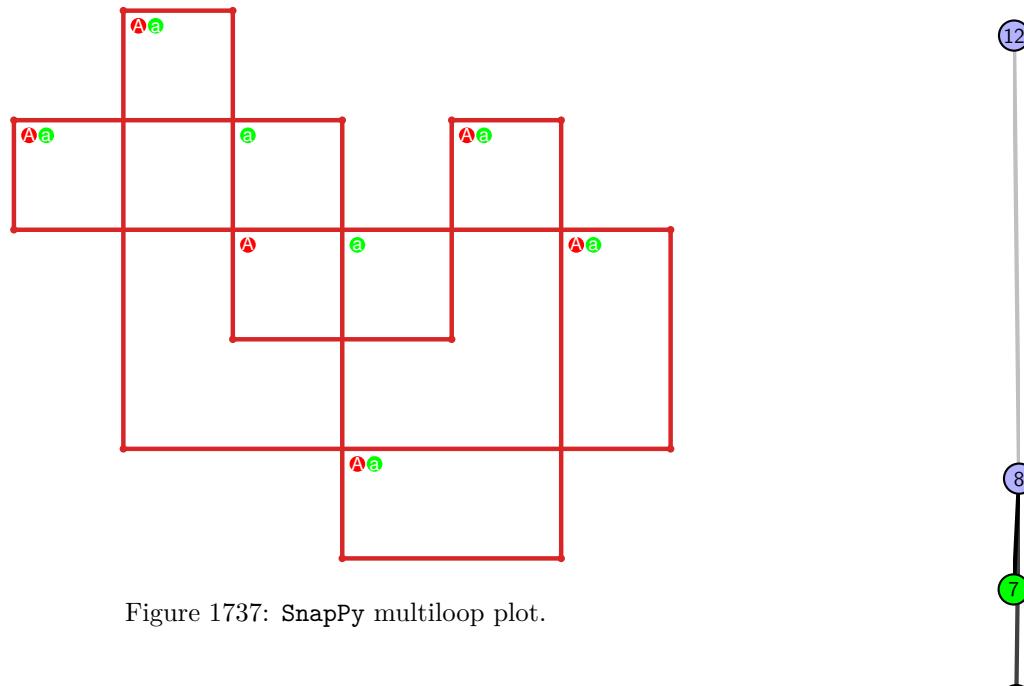


Figure 1737: SnapPy multiloop plot.

Figure 1738: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.572 `[[11, 20, 12, 1], [19, 10, 20, 11], [12, 10, 13, 9], [1, 9, 2, 8], [18, 3, 19, 4], [13, 3, 14, 2], [14, 7, 15, 8], [4, 17, 5, 18], [6, 15, 7, 16], [16, 5, 17, 6]]`

PD code drawn by `SnapPy`: `[(20, 11, 1, 12), (16, 1, 17, 2), (14, 3, 15, 4), (12, 5, 13, 6), (6, 19, 7, 20), (7, 10, 8, 11), (17, 8, 18, 9), (4, 13, 5, 14), (2, 15, 3, 16), (9, 18, 10, 19)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 5, 6], [1, 7, 7, 5], [2, 4, 6, 3], [3, 5, 8, 8], [4, 9, 9, 4], [6, 9, 9, 6], [7, 8, 8, 7]]`

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 64
 Pinning number: 7

Average optimal degree: 2.29
 Average minimal degree: 2.29
 Average overall degree: 2.92

Table 868: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	22	18	7	1	61
Average degree	2.29	2.63	2.9	3.1	3.25	3.33	

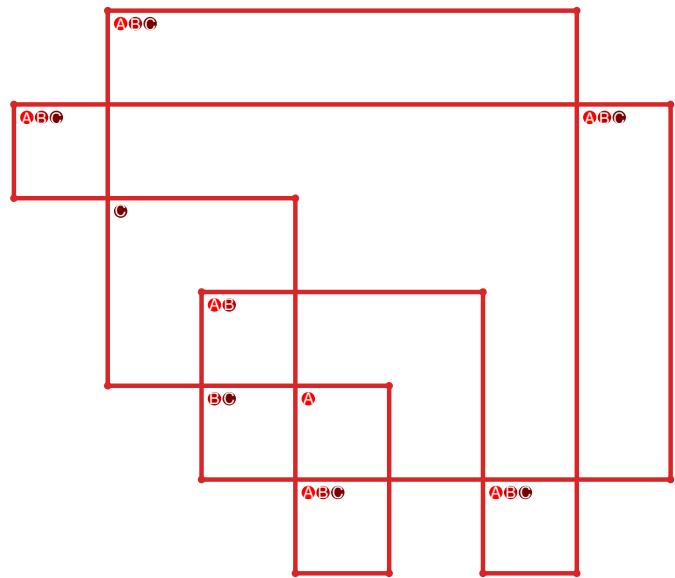


Figure 1739: `SnapPy` multiloop plot.

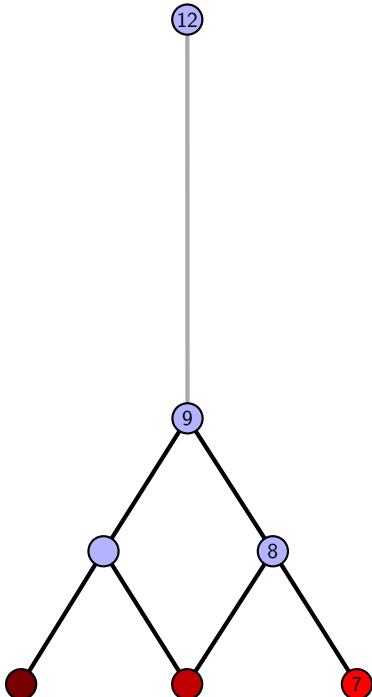


Figure 1740: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.573 $[[8, 20, 1, 9], [9, 16, 10, 17], [19, 7, 20, 8], [1, 14, 2, 13], [3, 15, 4, 16], [10, 4, 11, 5], [17, 5, 18, 6], [6, 18, 7, 19], [14, 11, 15, 12], [2, 12, 3, 13]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (11, 2, 12, 3), (13, 4, 14, 5), (20, 17, 9, 18), (7, 18, 8, 19), (19, 6, 20, 7), (8, 9, 1, 10), (15, 10, 16, 11), (3, 12, 4, 13), (5, 14, 6, 15)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 7, 0], [0, 8, 9, 9], [1, 9, 8, 5], [1, 4, 8, 6], [1, 5, 7, 7], [2, 6, 6, 2], [3, 5, 4, 9], [3, 8, 4, 3]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 104
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.4
 Average overall degree: 2.97

Table 869: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	6	26	35	24	8	1	100
Average degree	2.33	2.56	2.81	3.01	3.17	3.27	3.33	

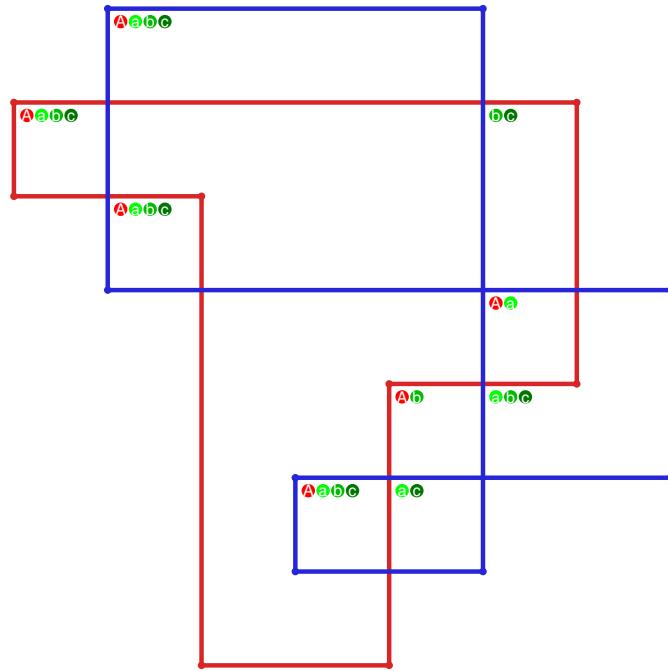


Figure 1741: SnapPy multiloop plot.

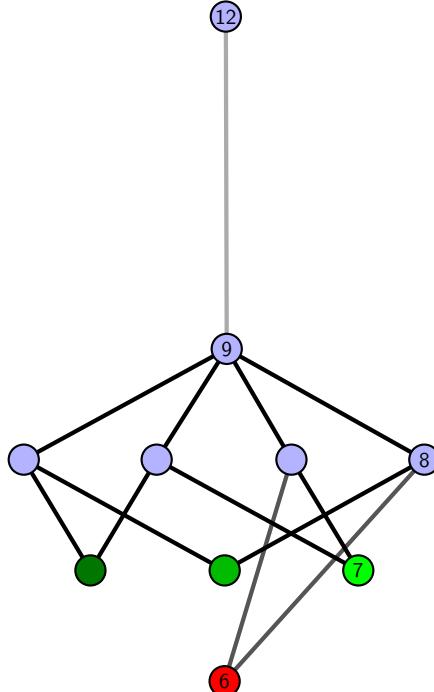


Figure 1742: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.574 $[[7, 20, 8, 1], [17, 6, 18, 7], [19, 8, 20, 9], [1, 15, 2, 14], [16, 11, 17, 12], [5, 10, 6, 11], [18, 10, 19, 9], [15, 5, 16, 4], [2, 13, 3, 14], [12, 3, 13, 4]]$

PD code drawn by SnapPy: $[(9, 20, 10, 1), (1, 12, 2, 13), (14, 3, 15, 4), (16, 5, 17, 6), (6, 15, 7, 16), (2, 7, 3, 8), (13, 8, 14, 9), (19, 10, 20, 11), (11, 18, 12, 19), (4, 17, 5, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 6, 0], [0, 7, 8, 8], [1, 9, 7, 5], [1, 4, 7, 6], [1, 5, 2, 2], [3, 5, 4, 9], [3, 9, 9, 3], [4, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 128
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 870: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	35	40	25	8	1	125
Average degree	2.33	2.64	2.87	3.04	3.18	3.27	3.33	

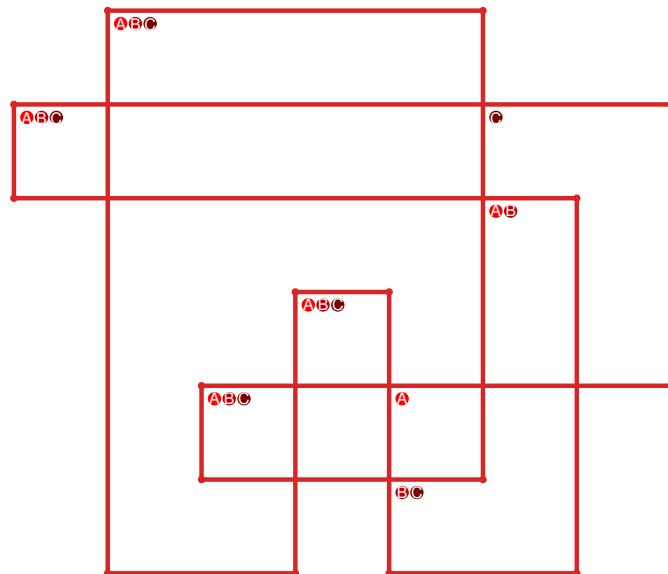


Figure 1743: SnapPy multiloop plot.

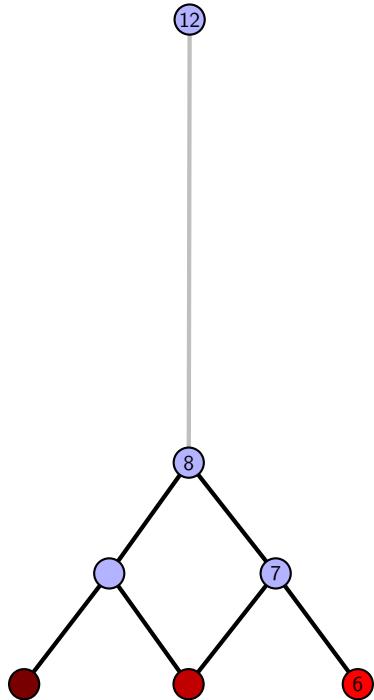


Figure 1744: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.575 $[[8, 20, 1, 9], [9, 16, 10, 17], [17, 7, 18, 8], [19, 1, 20, 2], [5, 15, 6, 16], [10, 6, 11, 7], [18, 3, 19, 2], [4, 12, 5, 13], [14, 11, 15, 12], [3, 14, 4, 13]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (11, 2, 12, 3), (13, 4, 14, 5), (5, 12, 6, 13), (7, 18, 8, 19), (19, 6, 20, 7), (8, 9, 1, 10), (15, 10, 16, 11), (3, 14, 4, 15), (20, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 0], [1, 7, 8, 5], [1, 4, 8, 2], [2, 9, 3, 3], [4, 9, 9, 8], [4, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 5
 Total pinning sets: 168
 Pinning number: 6

Average optimal degree: 2.5
 Average minimal degree: 2.51
 Average overall degree: 3.03

Table 871: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	21	48	53	31	9	1	163
Average degree	2.5	2.75	2.95	3.11	3.22	3.29	3.33	

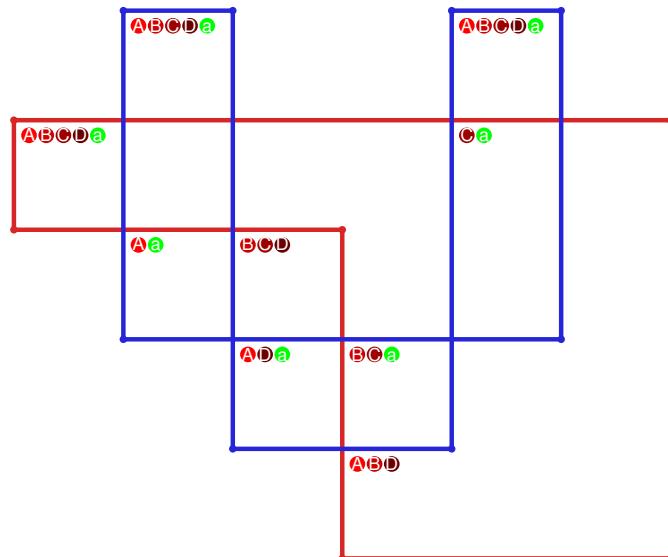


Figure 1745: SnapPy multiloop plot.

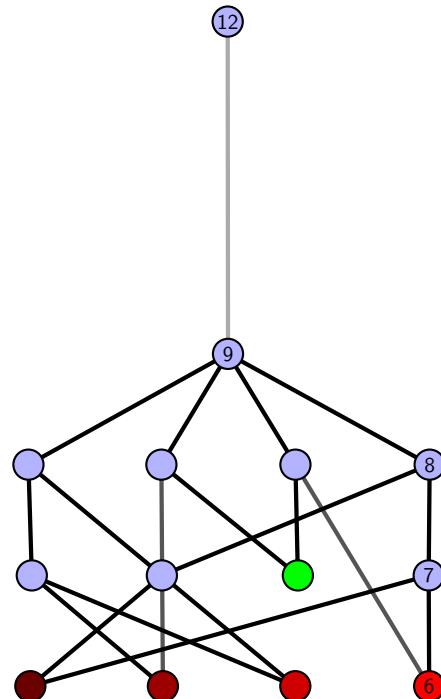


Figure 1746: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.576 $[[7, 20, 8, 1], [6, 9, 7, 10], [19, 8, 20, 9], [1, 15, 2, 14], [10, 17, 11, 18], [18, 5, 19, 6], [15, 12, 16, 13], [2, 13, 3, 14], [3, 16, 4, 17], [11, 4, 12, 5]]$

PD code drawn by SnapPy: $[(9, 2, 10, 3), (16, 3, 17, 4), (17, 6, 18, 7), (4, 7, 5, 8), (13, 10, 14, 11), (20, 11, 1, 12), (12, 19, 13, 20), (1, 14, 2, 15), (8, 15, 9, 16), (5, 18, 6, 19)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 5, 2], [0, 1, 5, 0], [0, 6, 7, 7], [1, 8, 9, 5], [1, 4, 9, 2], [3, 9, 8, 7], [3, 6, 8, 3], [4, 7, 6, 9], [4, 8, 6, 5]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 9
 Total pinning sets: 220
 Pinning number: 6

Average optimal degree: 2.67
 Average minimal degree: 2.69
 Average overall degree: 3.1

Table 872: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	4
Nonminimal pinning sets	0	26	66	70	38	10	1	211
Average degree	2.67	2.86	3.03	3.17	3.26	3.31	3.33	

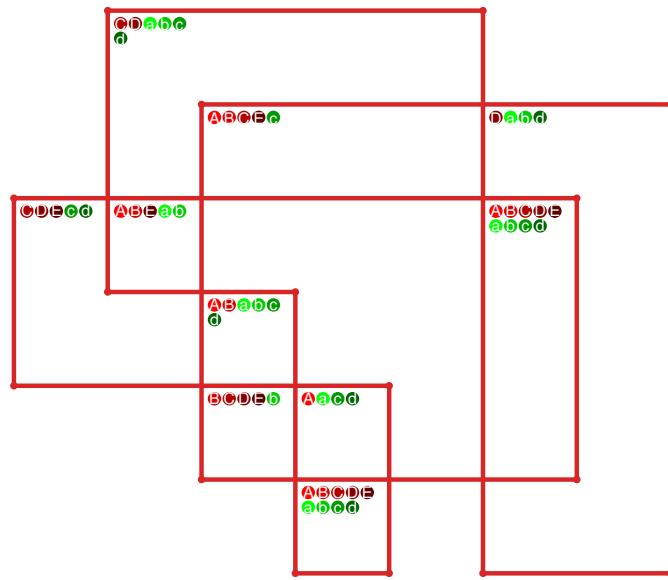


Figure 1747: SnapPy multiloop plot.

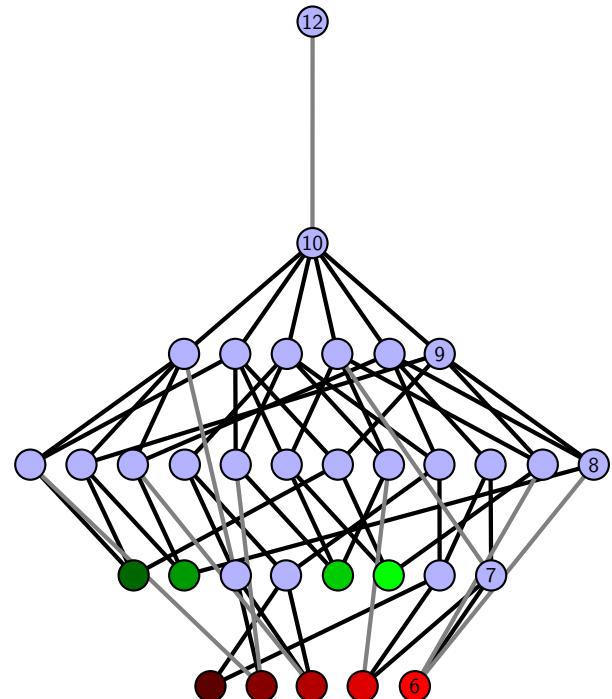


Figure 1748: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.577 $[[20, 7, 1, 8], [8, 19, 9, 20], [9, 6, 10, 7], [1, 14, 2, 15], [18, 11, 19, 12], [5, 10, 6, 11], [13, 16, 14, 17], [2, 16, 3, 15], [12, 3, 13, 4], [4, 17, 5, 18]]$

PD code drawn by `SnapPy`: $[(4, 1, 5, 2), (15, 2, 16, 3), (20, 5, 1, 6), (13, 6, 14, 7), (16, 9, 17, 10), (10, 17, 11, 18), (8, 11, 9, 12), (19, 12, 20, 13), (3, 14, 4, 15), (7, 18, 8, 19)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 7], [1, 8, 9, 5], [2, 4, 9, 2], [3, 9, 8, 7], [3, 6, 8, 3], [4, 7, 6, 9], [4, 8, 6, 5]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 7
 Total pinning sets: 188
 Pinning number: 6

Average optimal degree: 2.53
 Average minimal degree: 2.56
 Average overall degree: 3.04

Table 873: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	25	56	58	32	9	1	181
Average degree	2.53	2.78	2.98	3.12	3.22	3.29	3.33	

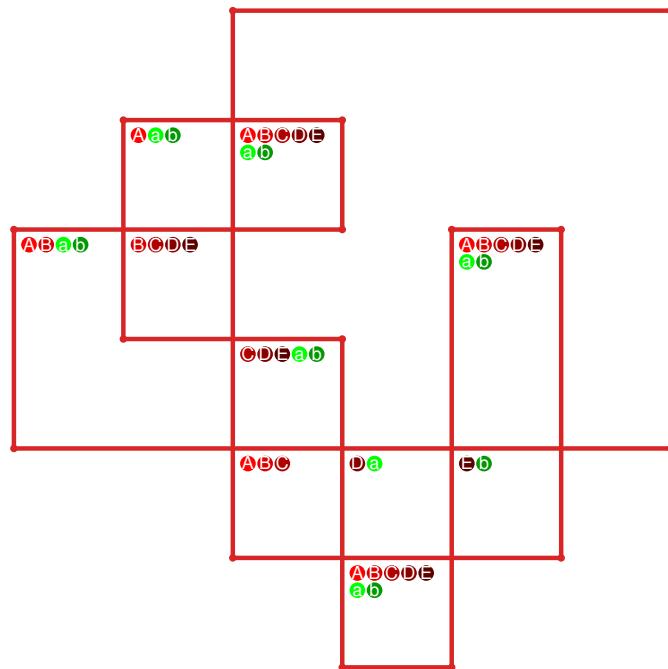


Figure 1749: `SnapPy` multiloop plot.

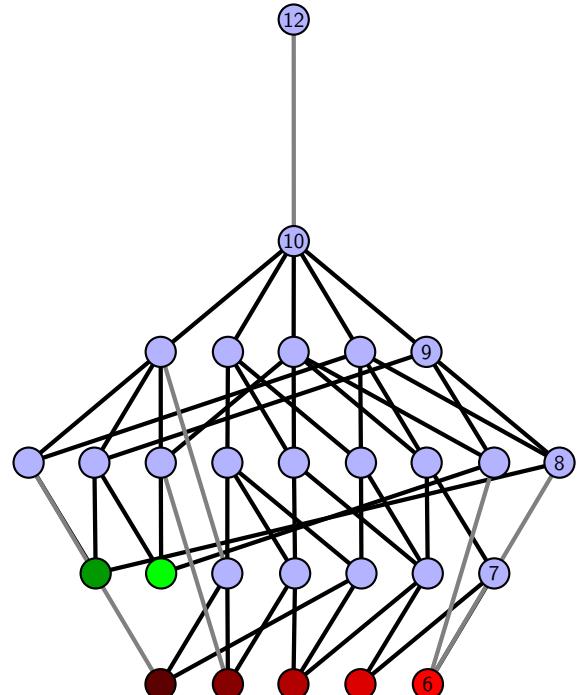


Figure 1750: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.578 [[20, 7, 1, 8], [8, 19, 9, 20], [9, 6, 10, 7], [1, 14, 2, 15], [5, 18, 6, 19], [10, 18, 11, 17], [13, 16, 14, 17], [2, 16, 3, 15], [4, 11, 5, 12], [12, 3, 13, 4]]

PD code drawn by SnapPy: [(9, 20, 10, 1), (6, 3, 7, 4), (17, 4, 18, 5), (1, 8, 2, 9), (18, 11, 19, 12), (12, 19, 13, 20), (10, 13, 11, 14), (14, 7, 15, 8), (2, 15, 3, 16), (5, 16, 6, 17)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 4, 5], [0, 6, 7, 7], [1, 8, 5, 2], [2, 4, 8, 6], [3, 5, 9, 7], [3, 6, 9, 3], [4, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 4
Total minimal pinning sets: 7

Total pinning sets: 180

Pinning number: 6

Average optimal degree: 2.5
Average minimal degree: 2.57

Average overall degree: 3.04

Table 874: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	3
Nonminimal pinning sets	0	21	53	57	32	9	1	173
Average degree	2.5	2.75	2.96	3.12	3.23	3.29	3.33	

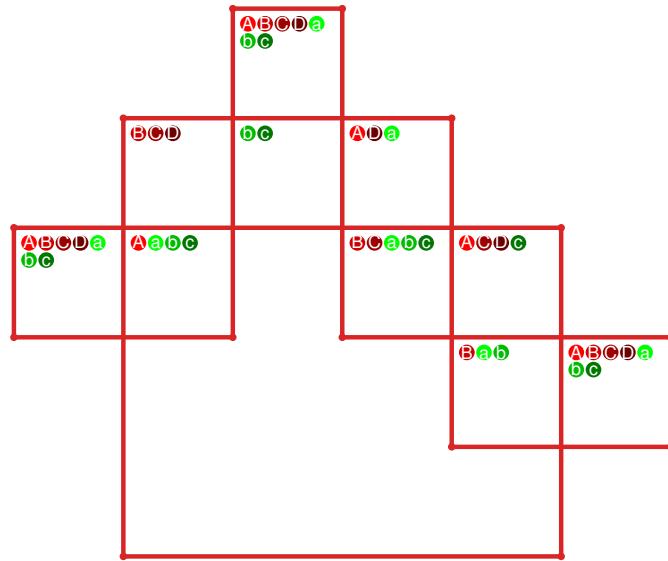


Figure 1751: SnapPy multiloop plot.

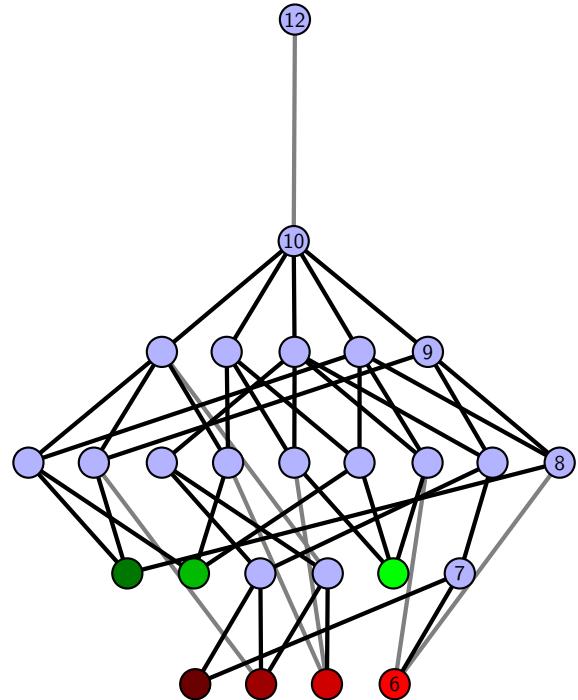


Figure 1752: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.579 $[[12, 20, 1, 13], [13, 10, 14, 9], [11, 8, 12, 9], [19, 7, 20, 8], [1, 18, 2, 17], [10, 15, 11, 14], [6, 18, 7, 19], [2, 6, 3, 5], [16, 4, 17, 5], [15, 4, 16, 3]]$

PD code drawn by SnapPy: $[(12, 13, 1, 14), (14, 1, 15, 2), (2, 11, 3, 12), (17, 4, 18, 5), (8, 5, 9, 6), (6, 19, 7, 20), (15, 10, 16, 11), (3, 16, 4, 17), (9, 18, 10, 19), (20, 7, 13, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 6, 7, 8], [1, 9, 2, 1], [3, 7, 4, 3], [4, 6, 9, 8], [4, 7, 9, 9], [5, 8, 8, 7]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 6
 Total pinning sets: 184
 Pinning number: 6

Average optimal degree: 2.53
 Average minimal degree: 2.54
 Average overall degree: 3.04

Table 875: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	25	54	57	32	9	1	178
Average degree	2.53	2.78	2.97	3.12	3.23	3.29	3.33	

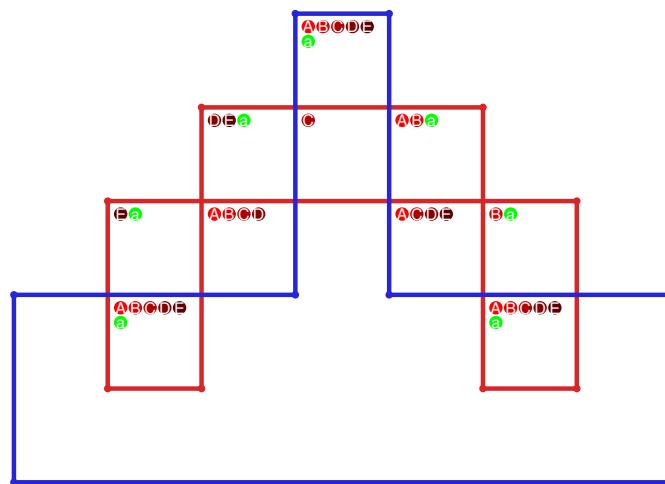


Figure 1753: SnapPy multiloop plot.

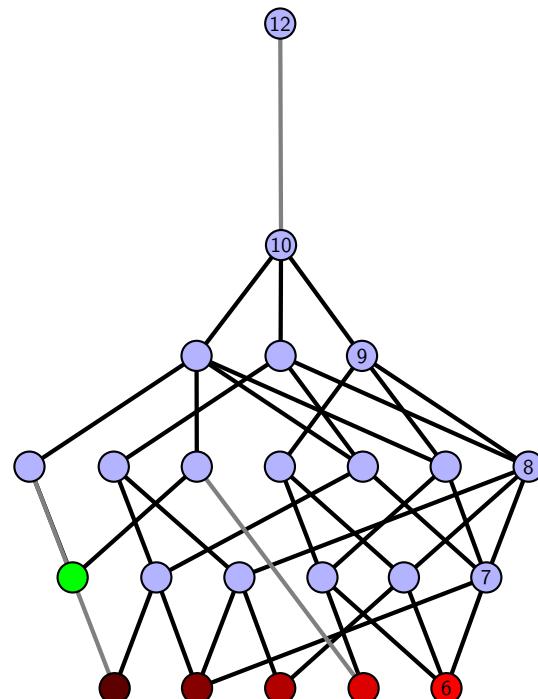


Figure 1754: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.580 $[[13, 20, 14, 1], [5, 12, 6, 13], [6, 19, 7, 20], [14, 7, 15, 8], [1, 8, 2, 9], [17, 4, 18, 5], [18, 11, 19, 12], [15, 3, 16, 2], [9, 16, 10, 17], [10, 3, 11, 4]]$

PD code drawn by SnapPy: $[(7, 20, 8, 1), (14, 1, 15, 2), (11, 4, 12, 5), (18, 5, 19, 6), (15, 8, 16, 9), (2, 9, 3, 10), (6, 13, 7, 14), (3, 16, 4, 17), (10, 17, 11, 18), (19, 12, 20, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 4], [0, 3, 7, 8], [1, 8, 9, 6], [1, 5, 9, 2], [3, 9, 8, 4], [4, 7, 9, 5], [5, 8, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 3.0

Total minimal pinning sets: 17

Average minimal degree: 3.0

Total pinning sets: 492

Average overall degree: 3.23

Pinning number: 5

Table 876: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	15	0	0	0	0	0	0	15
Nonminimal pinning sets	0	14	102	160	130	56	12	1	475
Average degree	3.0	3.05	3.15	3.23	3.29	3.32	3.33	3.33	

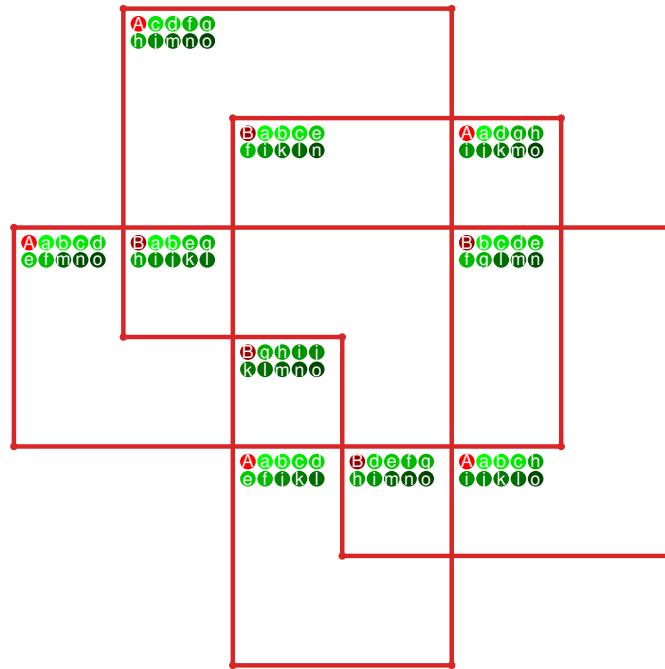


Figure 1755: SnapPy multiloop plot.

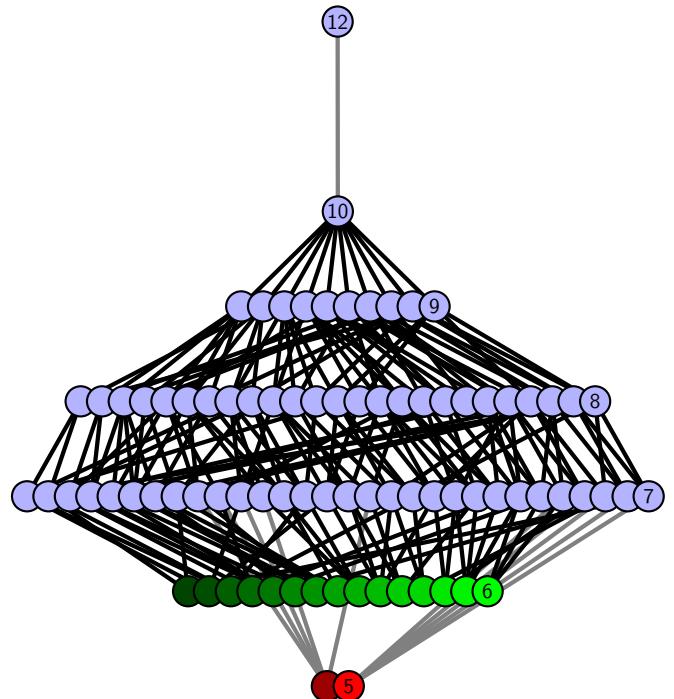


Figure 1756: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.581 $[[20, 7, 1, 8], [8, 17, 9, 18], [6, 19, 7, 20], [1, 12, 2, 13], [16, 9, 17, 10], [18, 5, 19, 6], [11, 14, 12, 15], [2, 14, 3, 13], [10, 3, 11, 4], [4, 15, 5, 16]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (16, 3, 17, 4), (18, 5, 19, 6), (14, 7, 15, 8), (19, 10, 20, 11), (11, 20, 12, 1), (9, 12, 10, 13), (2, 13, 3, 14), (6, 15, 7, 16), (4, 17, 5, 18)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 5, 0], [0, 6, 7, 7], [1, 8, 9, 1], [1, 9, 2, 2], [3, 9, 8, 7], [3, 6, 8, 3], [4, 7, 6, 9], [4, 8, 6, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 128
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 877: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	35	40	25	8	1	125
Average degree	2.33	2.64	2.87	3.04	3.18	3.27	3.33	

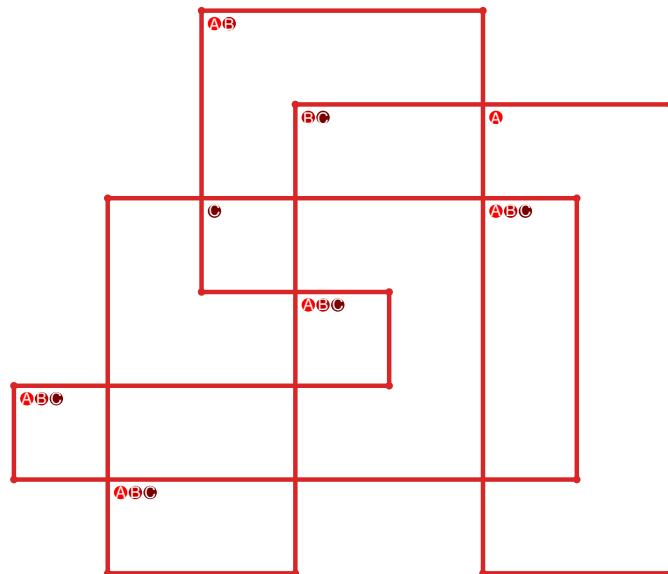


Figure 1757: SnapPy multiloop plot.

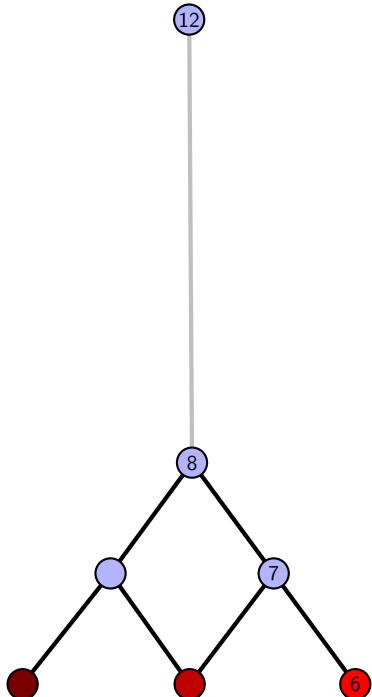


Figure 1758: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.582 $[[7, 20, 8, 1], [19, 6, 20, 7], [8, 18, 9, 17], [1, 17, 2, 16], [5, 18, 6, 19], [9, 3, 10, 2], [10, 15, 11, 16], [4, 13, 5, 14], [3, 13, 4, 12], [14, 11, 15, 12]]$

PD code drawn by SnapPy: $[(20, 7, 1, 8), (17, 4, 18, 5), (12, 9, 13, 10), (10, 1, 11, 2), (2, 11, 3, 12), (8, 13, 9, 14), (14, 19, 15, 20), (15, 6, 16, 7), (3, 16, 4, 17), (5, 18, 6, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 3], [0, 2, 5, 6], [1, 7, 2, 1], [2, 8, 6, 3], [3, 5, 9, 9], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 144
 Pinning number: 6

Average optimal degree: 2.38
 Average minimal degree: 2.38
 Average overall degree: 2.98

Table 878: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.38	2.68	2.9	3.06	3.18	3.27	3.33	

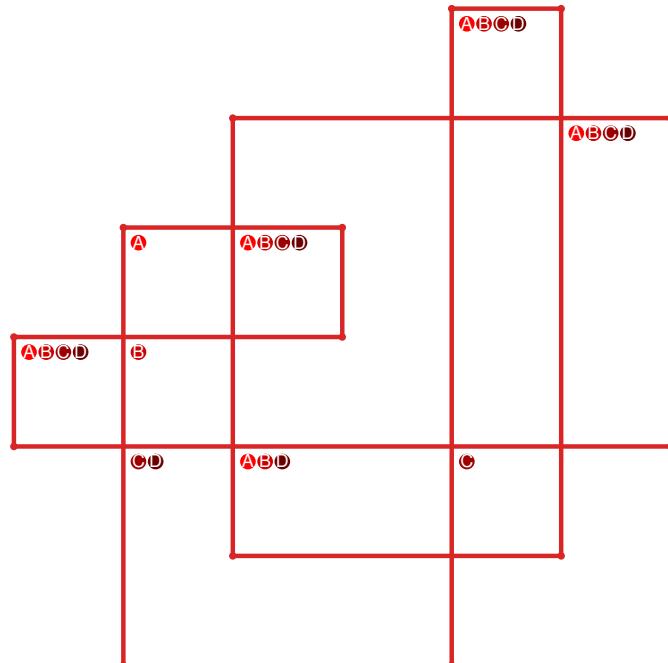


Figure 1759: SnapPy multiloop plot.

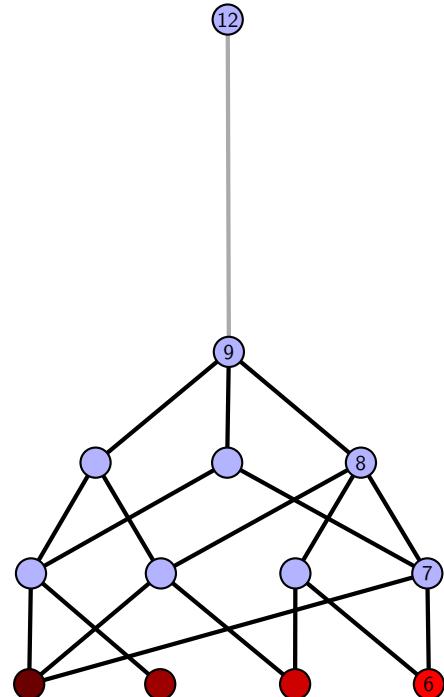


Figure 1760: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.583 $[[14, 20, 1, 15], [15, 7, 16, 8], [13, 2, 14, 3], [19, 1, 20, 2], [6, 9, 7, 10], [16, 9, 17, 8], [3, 12, 4, 13], [4, 18, 5, 19], [10, 5, 11, 6], [17, 11, 18, 12]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (15, 4, 16, 5), (5, 16, 6, 17), (3, 6, 4, 7), (17, 8, 18, 9), (14, 9, 1, 10), (19, 12, 20, 13), (10, 13, 11, 14), (11, 20, 12, 15), (1, 18, 2, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 0], [1, 8, 8, 5], [1, 4, 9, 1], [2, 9, 7, 2], [3, 6, 9, 8], [4, 7, 9, 4], [5, 8, 7, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 160
 Pinning number: 6

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 2.99

Table 879: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	47	48	27	8	1	155
Average degree	2.4	2.7	2.92	3.08	3.19	3.27	3.33	

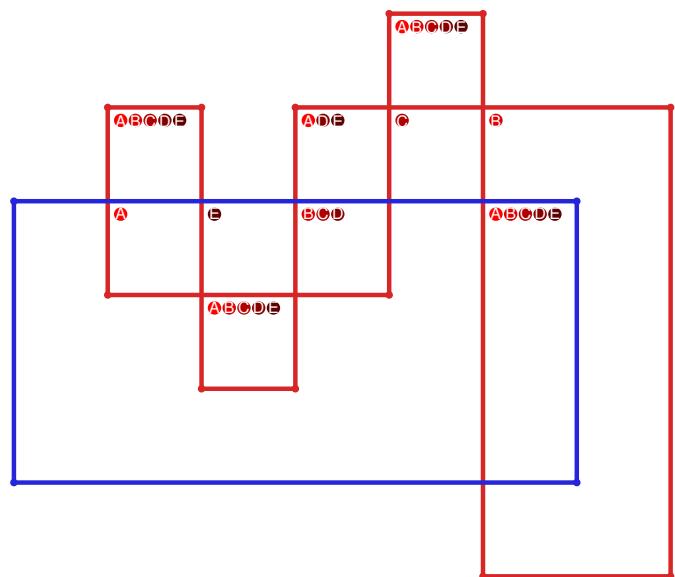


Figure 1761: SnapPy multiloop plot.

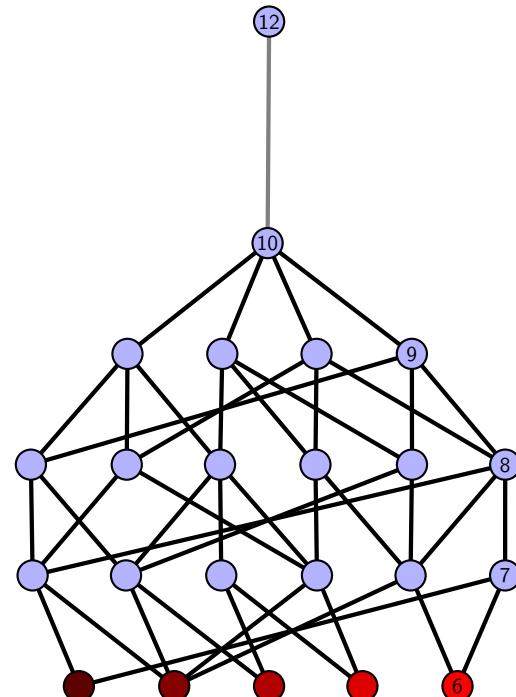


Figure 1762: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.584 [[14, 20, 1, 15], [15, 12, 16, 11], [13, 10, 14, 11], [19, 9, 20, 10], [1, 9, 2, 8], [12, 17, 13, 16], [18, 4, 19, 5], [2, 7, 3, 8], [17, 6, 18, 5], [6, 3, 7, 4]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (15, 2, 16, 3), (3, 20, 4, 15), (14, 5, 1, 6), (6, 13, 7, 14), (16, 7, 17, 8), (11, 8, 12, 9), (9, 18, 10, 19), (12, 17, 13, 18), (19, 10, 20, 11)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 4], [0, 3, 7, 7], [1, 8, 2, 1], [3, 8, 8, 9], [4, 9, 9, 4], [5, 9, 6, 6], [6, 8, 7, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 128
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 880: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	35	40	25	8	1	125
Average degree	2.33	2.64	2.87	3.04	3.18	3.27	3.33	

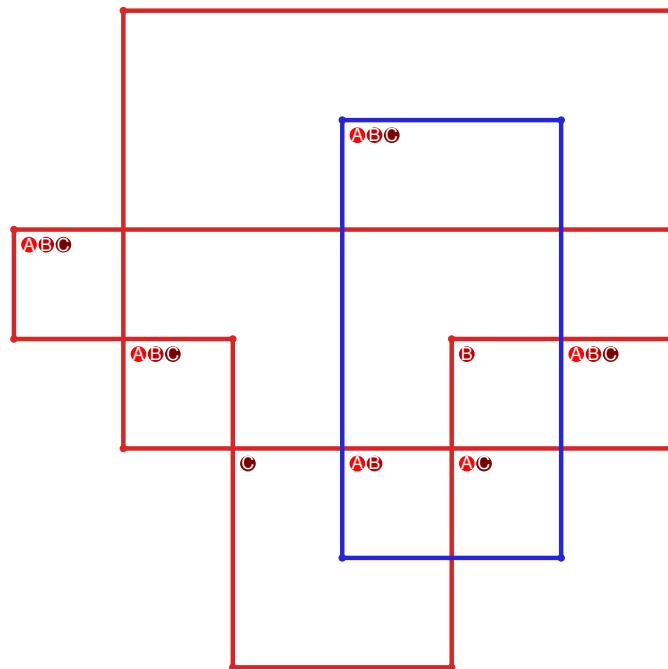


Figure 1763: SnapPy multiloop plot.

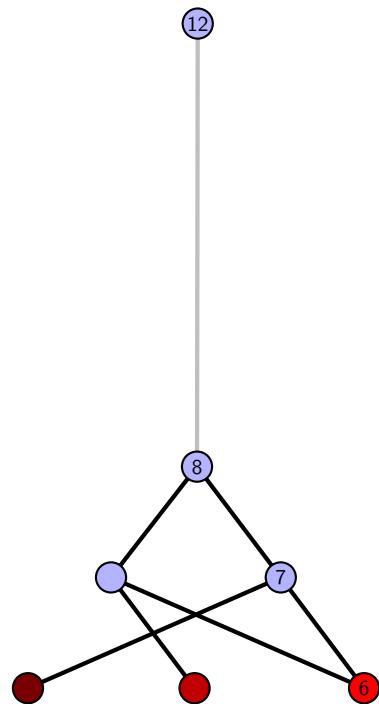


Figure 1764: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.585 $[[11, 20, 12, 1], [17, 10, 18, 11], [19, 4, 20, 5], [12, 4, 13, 3], [1, 14, 2, 15], [16, 7, 17, 8], [9, 6, 10, 7], [18, 6, 19, 5], [13, 2, 14, 3], [15, 9, 16, 8]]$

PD code drawn by SnapPy: $[(11, 20, 12, 1), (1, 10, 2, 11), (17, 2, 18, 3), (3, 16, 4, 17), (7, 4, 8, 5), (14, 5, 15, 6), (6, 13, 7, 14), (15, 8, 16, 9), (19, 12, 20, 13), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 8, 8], [0, 8, 8, 9], [1, 9, 9, 6], [1, 5, 9, 7], [1, 6, 2, 2], [3, 4, 4, 3], [4, 6, 5, 5]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 144
 Pinning number: 6

Average optimal degree: 2.38
 Average minimal degree: 2.38
 Average overall degree: 2.98

Table 881: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.38	2.68	2.9	3.06	3.18	3.27	3.33	

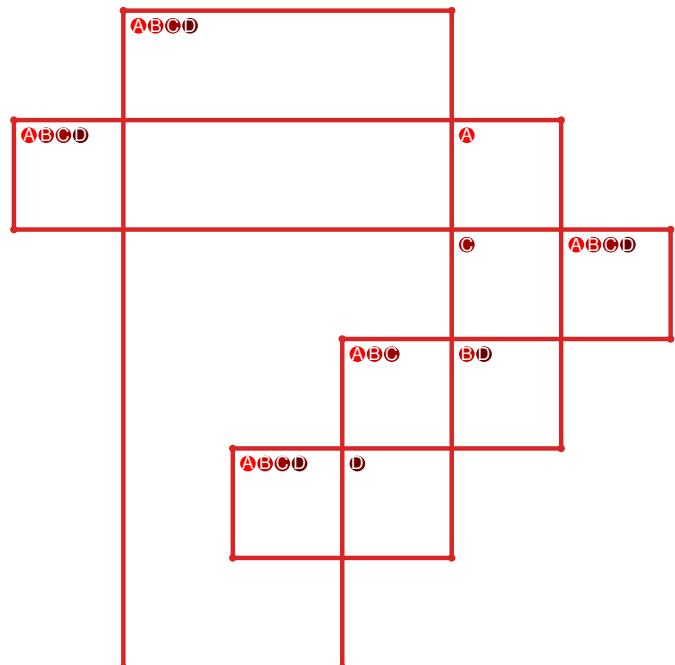


Figure 1765: SnapPy multiloop plot.

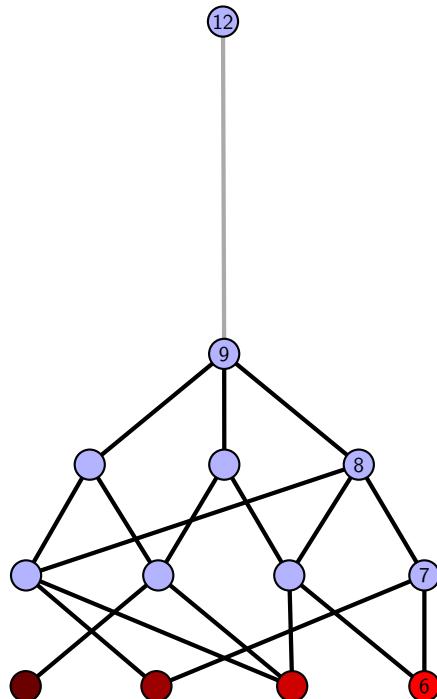


Figure 1766: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.586 $[[12, 20, 1, 13], [13, 11, 14, 12], [19, 9, 20, 10], [1, 9, 2, 8], [10, 14, 11, 15], [18, 2, 19, 3], [4, 7, 5, 8], [15, 5, 16, 6], [3, 17, 4, 18], [6, 16, 7, 17]]$

PD code drawn by SnapPy: $[(19, 2, 20, 3), (1, 4, 2, 5), (5, 10, 6, 11), (15, 6, 16, 7), (17, 8, 18, 9), (14, 11, 15, 12), (3, 20, 4, 13), (12, 13, 1, 14), (9, 16, 10, 17), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 3], [0, 2, 5, 6], [1, 7, 2, 1], [2, 8, 8, 3], [3, 8, 9, 7], [4, 6, 9, 9], [5, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 136
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.39
 Average overall degree: 2.98

Table 882: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	16	38	43	26	8	1	132
Average degree	2.33	2.64	2.88	3.05	3.18	3.27	3.33	

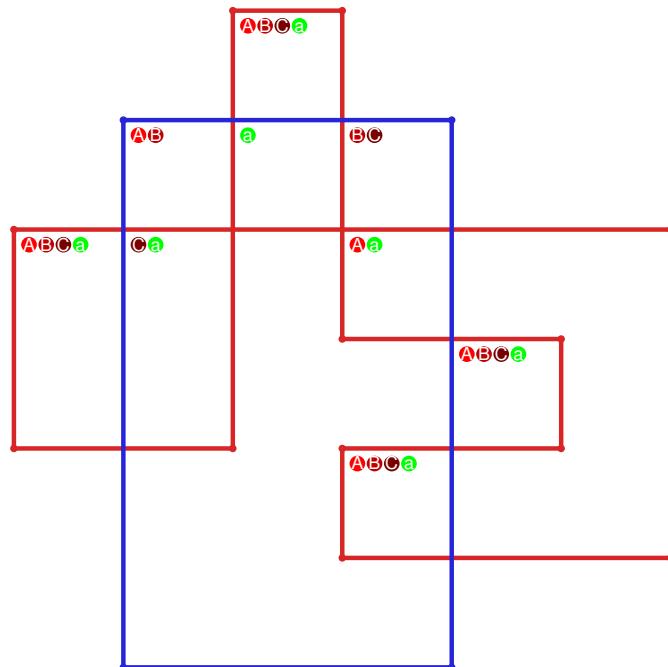


Figure 1767: SnapPy multiloop plot.

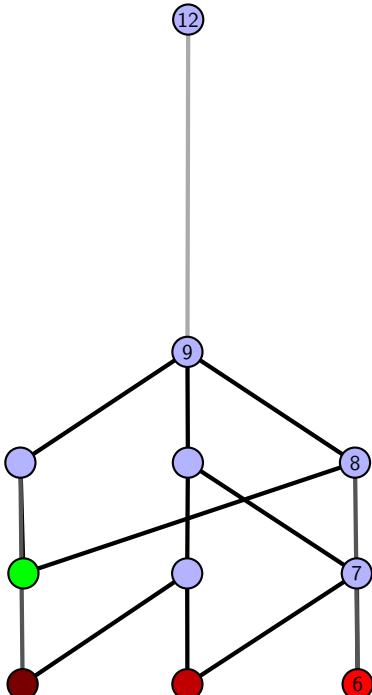


Figure 1768: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.587 [[20, 13, 1, 14], [14, 8, 15, 7], [19, 2, 20, 3], [12, 1, 13, 2], [8, 5, 9, 6], [15, 6, 16, 7], [3, 18, 4, 19], [4, 11, 5, 12], [9, 17, 10, 16], [10, 17, 11, 18]]

PD code drawn by **SnapPy**: [(5, 2, 6, 3), (12, 3, 13, 4), (4, 11, 5, 12), (1, 8, 2, 9), (17, 10, 18, 11), (13, 6, 14, 7), (7, 14, 8, 15), (20, 15, 1, 16), (9, 18, 10, 19), (16, 19, 17, 20)]

Planar representation generated by **plantri**: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 0], [1, 7, 8, 5], [1, 4, 8, 1], [2, 9, 7, 2], [3, 6, 9, 4], [4, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 4
Total minimal pinning sets: 6
Total pinning sets: 156
Pinning number: 6

Average optimal degree: 2.38
Average minimal degree: 2.46
Average overall degree: 2.99

Table 883: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	20	46	48	27	8	1	150
Average degree	2.38	2.68	2.91	3.08	3.19	3.27	3.33	

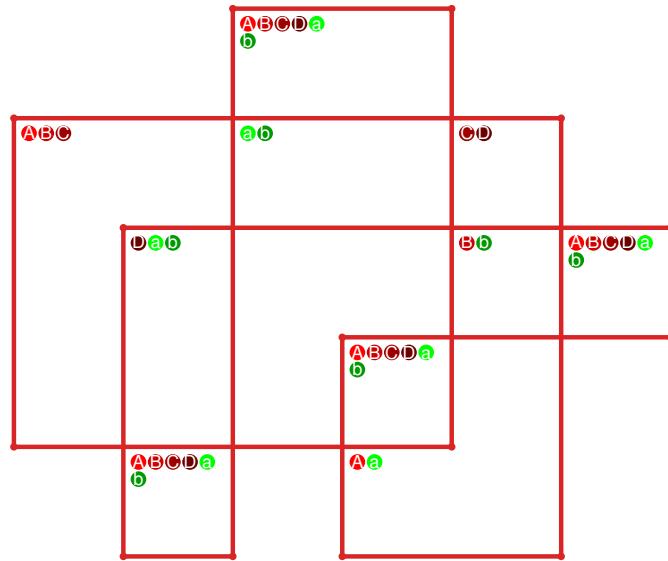


Figure 1769: SnapPy multiloop plot.

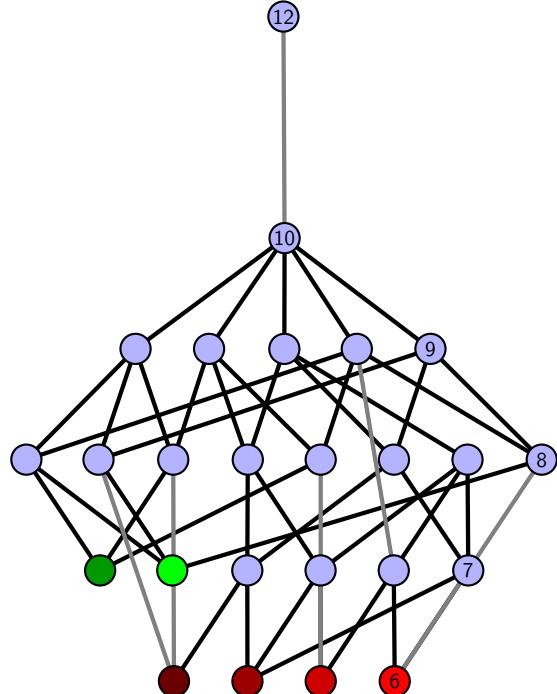


Figure 1770: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.588 $[[7, 20, 8, 1], [6, 13, 7, 14], [19, 2, 20, 3], [8, 2, 9, 1], [14, 11, 15, 12], [12, 5, 13, 6], [3, 16, 4, 17], [18, 9, 19, 10], [10, 17, 11, 18], [15, 4, 16, 5]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (9, 2, 10, 3), (15, 6, 16, 7), (11, 8, 12, 9), (3, 10, 4, 11), (20, 13, 1, 14), (7, 14, 8, 15), (4, 17, 5, 18), (18, 5, 19, 6), (16, 19, 17, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 7, 0], [1, 8, 9, 5], [1, 4, 9, 1], [2, 9, 9, 8], [2, 8, 8, 3], [4, 7, 7, 6], [4, 6, 6, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 5
 Total pinning sets: 140
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.43
 Average overall degree: 2.98

Table 884: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	16	40	44	26	8	1	135
Average degree	2.33	2.63	2.88	3.06	3.18	3.27	3.33	

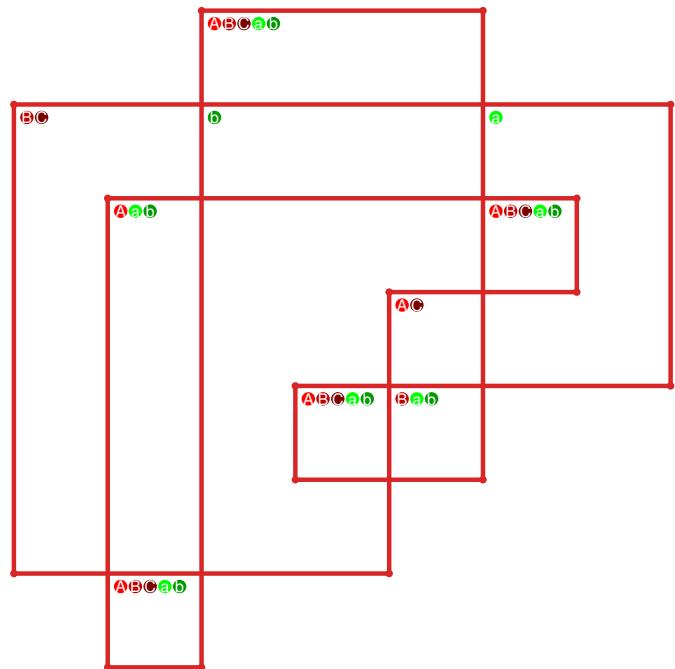


Figure 1771: SnapPy multiloop plot.

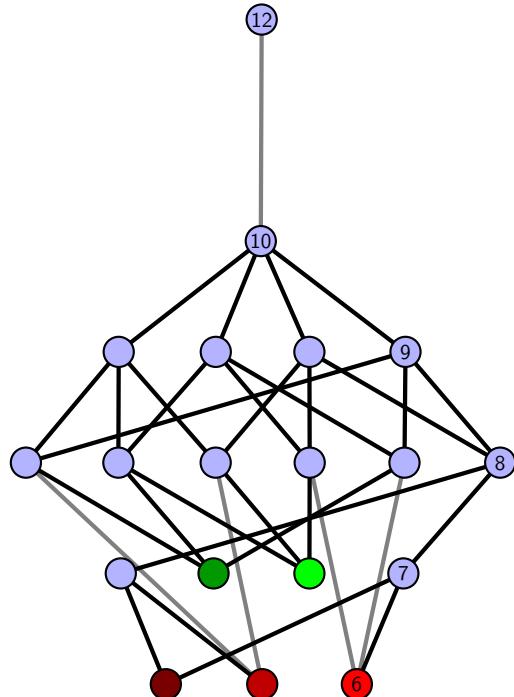


Figure 1772: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.589 $[[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [8, 15, 9, 16], [1, 7, 2, 6], [18, 12, 19, 11], [14, 7, 15, 8], [2, 5, 3, 6], [12, 3, 13, 4], [4, 13, 5, 14]]$

PD code drawn by `SnapPy`: $[(9, 20, 10, 1), (19, 2, 20, 3), (3, 18, 4, 19), (11, 4, 12, 5), (17, 6, 18, 7), (8, 15, 9, 16), (1, 10, 2, 11), (5, 12, 6, 13), (16, 13, 17, 14), (14, 7, 15, 8)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 6, 7, 7], [1, 8, 2, 1], [3, 9, 4, 3], [4, 9, 8, 4], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 152
 Pinning number: 6

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 2.98

Table 885: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	23	44	45	26	8	1	147
Average degree	2.4	2.7	2.91	3.07	3.18	3.27	3.33	

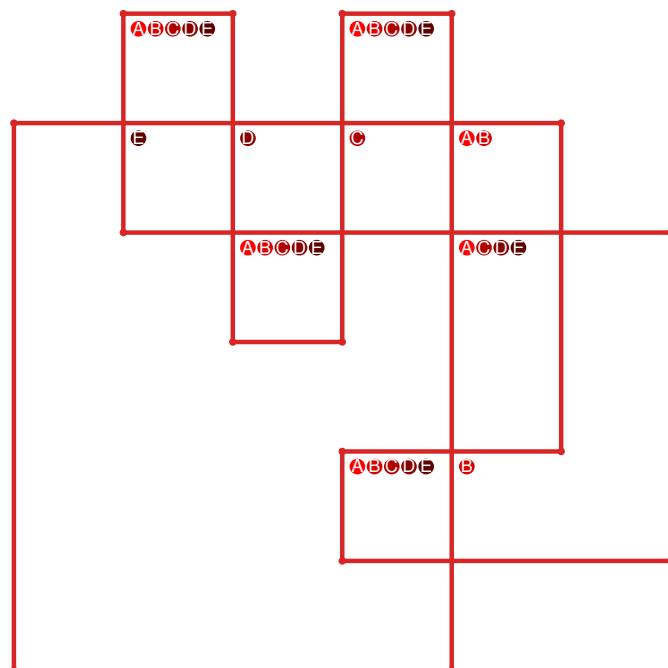


Figure 1773: `SnapPy` multiloop plot.

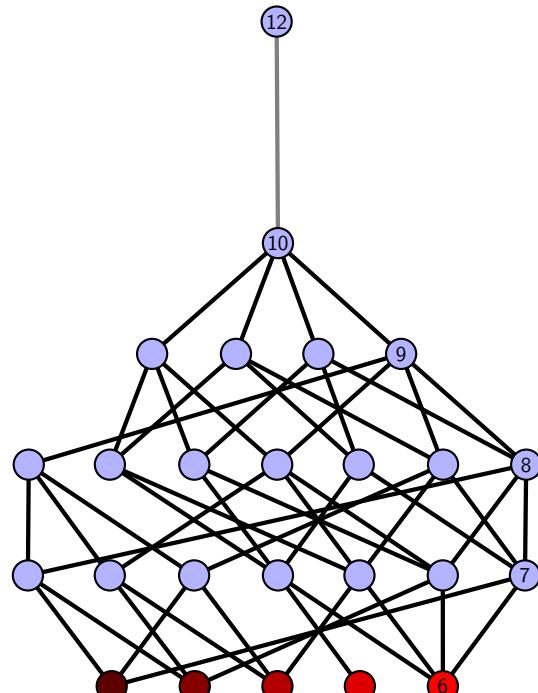


Figure 1774: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.590 $[[12, 3, 1, 4], [4, 13, 5, 20], [11, 17, 12, 18], [2, 16, 3, 17], [1, 16, 2, 15], [13, 7, 14, 8], [5, 8, 6, 9], [9, 19, 10, 20], [18, 10, 19, 11], [6, 14, 7, 15]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (18, 5, 19, 6), (3, 6, 4, 7), (15, 8, 16, 9), (20, 11, 13, 12), (12, 13, 1, 14), (9, 14, 10, 15), (7, 16, 8, 17), (17, 2, 18, 3), (4, 19, 5, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 8, 8, 3], [0, 2, 4, 4], [0, 3, 3, 9], [1, 9, 9, 6], [1, 5, 9, 7], [1, 6, 8, 8], [2, 7, 7, 2], [4, 6, 5, 5]]$

Total optimal pinning sets: 2

Average optimal degree: 2.33

Total minimal pinning sets: 4

Average minimal degree: 2.38

Total pinning sets: 120

Average overall degree: 2.97

Pinning number: 6

Table 886: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	11	32	39	25	8	1	116
Average degree	2.33	2.6	2.84	3.03	3.18	3.27	3.33	

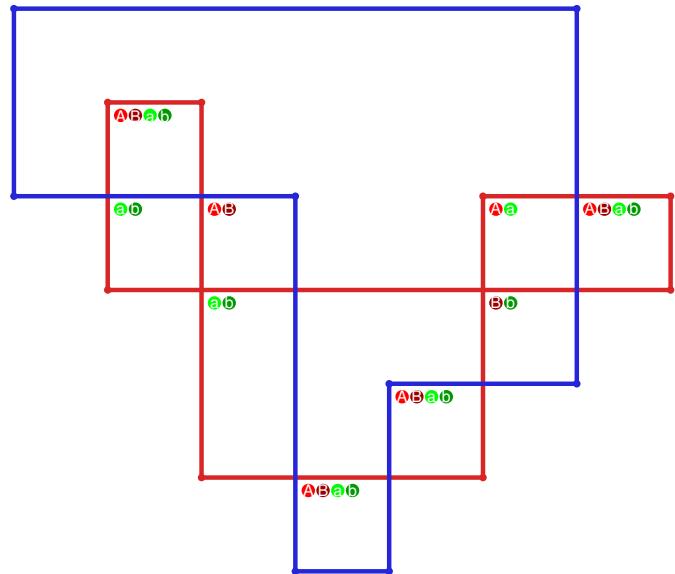


Figure 1775: SnapPy multiloop plot.

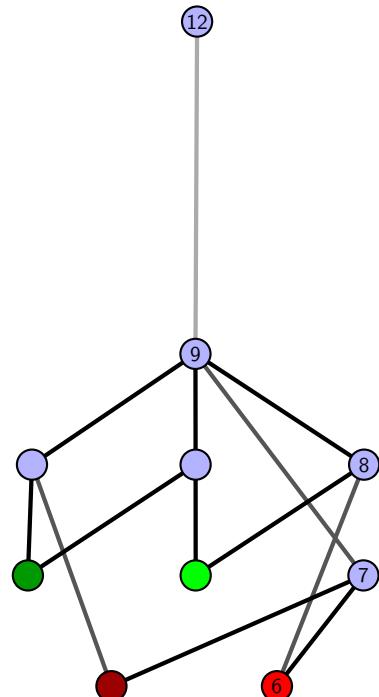


Figure 1776: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.591 [[11, 20, 12, 1], [19, 10, 20, 11], [12, 2, 13, 1], [18, 5, 19, 6], [9, 2, 10, 3], [13, 9, 14, 8], [6, 17, 7, 18], [4, 15, 5, 16], [3, 15, 4, 14], [16, 7, 17, 8]]

PD code drawn by SnapPy: [(15, 2, 16, 3), (13, 4, 14, 5), (5, 10, 6, 11), (16, 7, 17, 8), (11, 20, 12, 1), (1, 12, 2, 13), (3, 14, 4, 15), (8, 17, 9, 18), (18, 9, 19, 10), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 4, 5, 0], [1, 6, 6, 7], [1, 8, 5, 2], [2, 4, 8, 9], [3, 9, 9, 3], [3, 9, 8, 8], [4, 7, 7, 5], [5, 7, 6, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 887: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

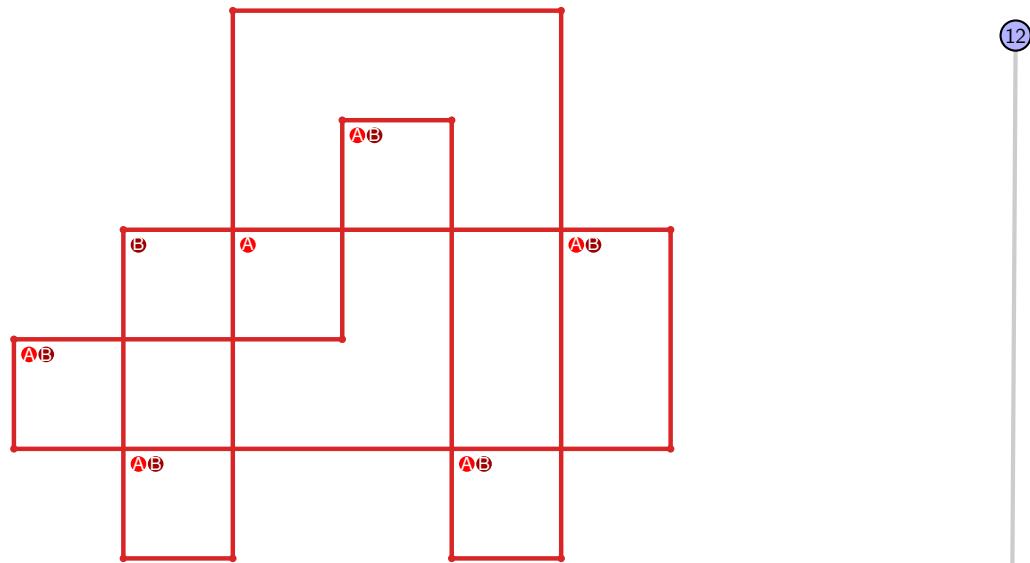


Figure 1777: SnapPy multiloop plot.

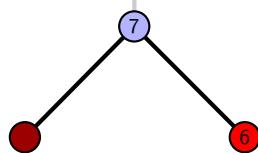


Figure 1778: Minimal join sub-semi-lattice of minimal pinning sets.

$$4.9.592 \quad [[9, 20, 10, 1], [19, 8, 20, 9], [10, 8, 11, 7], [1, 17, 2, 16], [5, 18, 6, 19], [11, 6, 12, 7], [17, 12, 18, 13], [2, 15, 3, 16], [4, 13, 5, 14], [14, 3, 15, 4]]$$

PD code drawn by SnapPy: [(11, 20, 12, 1), (8, 3, 9, 4), (4, 7, 5, 8), (16, 5, 17, 6), (14, 9, 15, 10), (1, 10, 2, 11), (19, 12, 20, 13), (13, 18, 14, 19), (2, 15, 3, 16), (6, 17, 7, 18)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 7], [1, 8, 6, 5], [2, 4, 6, 2], [3, 5, 4, 8], [3, 9, 9, 3], [4, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1
Total pinned pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 3

Average minimal degree: 2.29

Total pinning sets: 88

Average minimal degree: 2.2

Pinning number: 6

Table 888: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	6	22	29	20	7	1	85
Average degree	2.17	2.46	2.74	2.97	3.13	3.25	3.33	

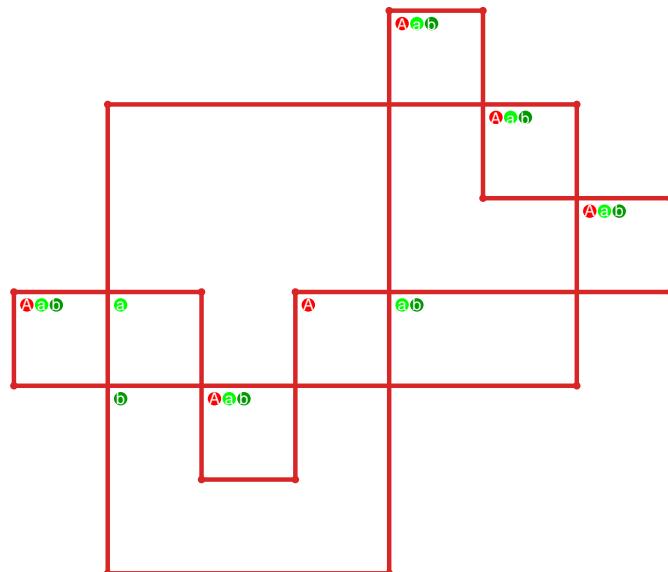


Figure 1779: SnapPy multiloop plot.

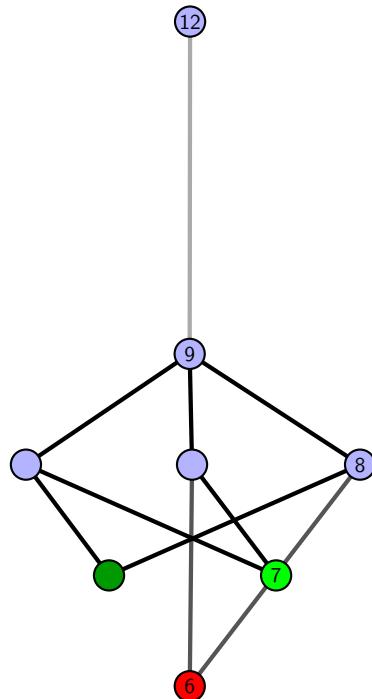


Figure 1780: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.593 [[20, 15, 1, 16], [16, 5, 17, 6], [6, 19, 7, 20], [7, 14, 8, 15], [1, 10, 2, 11], [4, 17, 5, 18], [18, 3, 19, 4], [13, 8, 14, 9], [9, 12, 10, 13], [2, 12, 3, 11]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (13, 2, 14, 3), (10, 5, 11, 6), (18, 7, 19, 8), (8, 19, 9, 20), (6, 9, 7, 10), (4, 11, 5, 12), (17, 12, 18, 13), (1, 14, 2, 15), (3, 16, 4, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 7, 7], [0, 8, 9, 9], [1, 6, 6, 1], [2, 5, 5, 9], [3, 8, 8, 3], [4, 7, 7, 9], [4, 8, 6, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 889: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

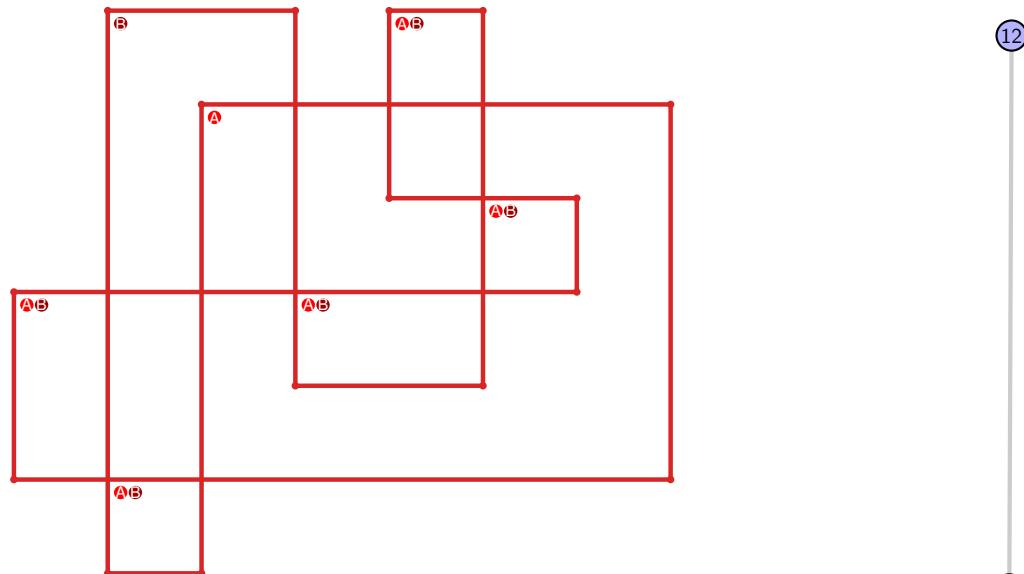


Figure 1781: SnapPy multiloop plot.

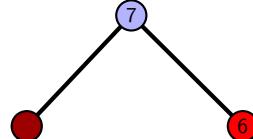


Figure 1782: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.594 $[[7, 20, 8, 1], [6, 13, 7, 14], [19, 2, 20, 3], [8, 2, 9, 1], [14, 5, 15, 6], [15, 12, 16, 13], [3, 18, 4, 19], [9, 4, 10, 5], [11, 16, 12, 17], [17, 10, 18, 11]]$

PD code drawn by SnapPy: $[(6, 1, 7, 2), (11, 2, 12, 3), (14, 7, 15, 8), (12, 9, 13, 10), (3, 10, 4, 11), (8, 13, 9, 14), (20, 15, 1, 16), (4, 17, 5, 18), (18, 5, 19, 6), (16, 19, 17, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 7, 0], [1, 7, 5, 1], [1, 4, 8, 8], [2, 9, 7, 2], [3, 6, 9, 4], [5, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 112
 Pinning number: 6

Average optimal degree: 2.22
 Average minimal degree: 2.22
 Average overall degree: 2.92

Table 890: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

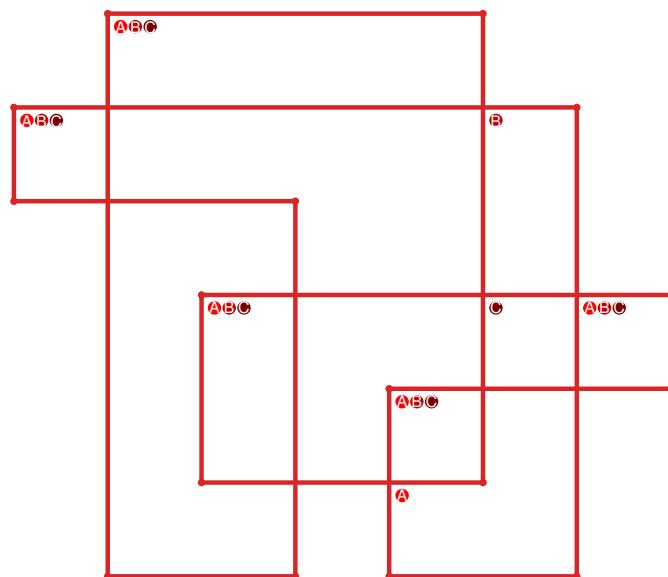


Figure 1783: SnapPy multiloop plot.

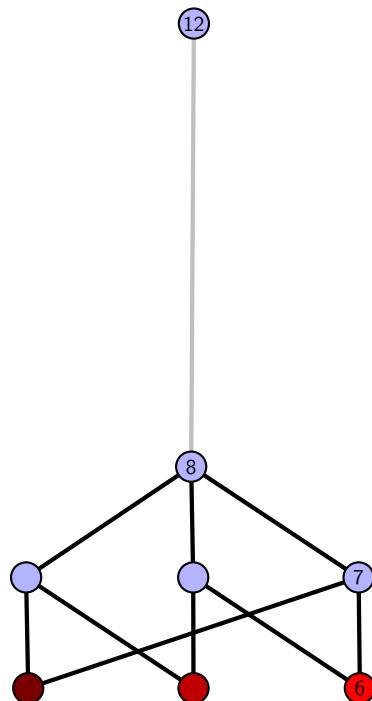


Figure 1784: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.595 $[[12, 20, 1, 13], [13, 7, 14, 8], [17, 11, 18, 12], [19, 1, 20, 2], [6, 14, 7, 15], [8, 6, 9, 5], [10, 16, 11, 17], [18, 3, 19, 2], [15, 3, 16, 4], [9, 4, 10, 5]]$

PD code drawn by SnapPy: $[(12, 13, 1, 14), (18, 1, 19, 2), (7, 2, 8, 3), (3, 6, 4, 7), (16, 5, 17, 6), (20, 9, 13, 10), (14, 11, 15, 12), (4, 17, 5, 18), (8, 19, 9, 20), (10, 15, 11, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 7, 0], [1, 8, 5, 1], [1, 4, 9, 9], [2, 9, 8, 2], [2, 8, 3, 3], [4, 7, 6, 9], [5, 8, 6, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 112
 Pinning number: 6

Average optimal degree: 2.22
 Average minimal degree: 2.22
 Average overall degree: 2.92

Table 891: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

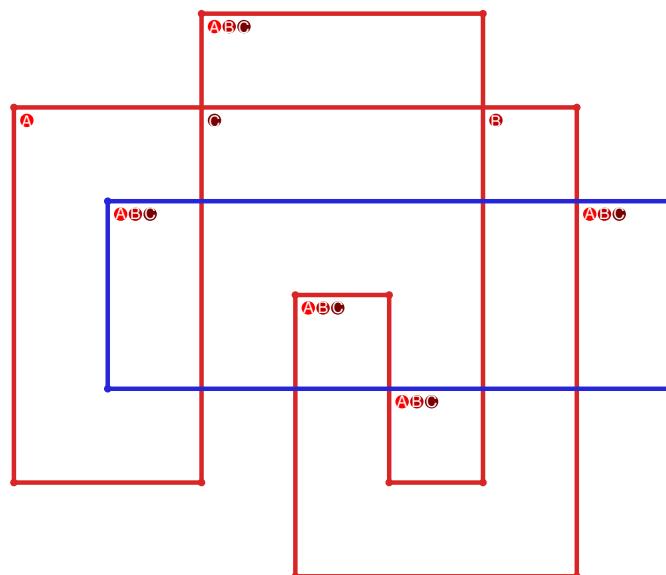


Figure 1785: SnapPy multiloop plot.

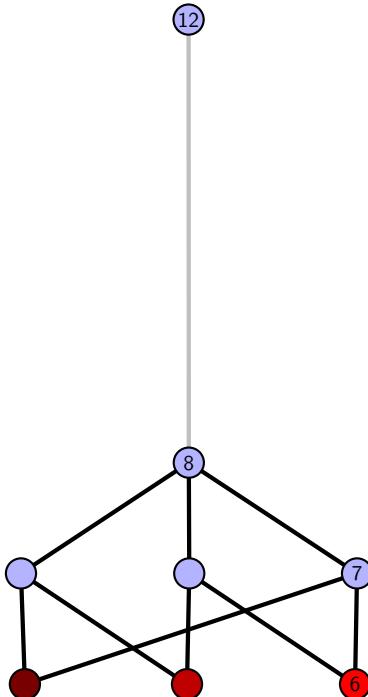


Figure 1786: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.596 `[[14, 20, 1, 15], [15, 11, 16, 12], [13, 2, 14, 3], [19, 1, 20, 2], [10, 16, 11, 17], [12, 4, 13, 3], [6, 18, 7, 19], [17, 7, 18, 8], [9, 4, 10, 5], [5, 8, 6, 9]]`

PD code drawn by `SnapPy`: `[(11, 14, 12, 1), (1, 10, 2, 11), (7, 2, 8, 3), (20, 5, 15, 6), (3, 6, 4, 7), (18, 9, 19, 10), (16, 13, 17, 14), (8, 19, 9, 20), (4, 15, 5, 16), (12, 17, 13, 18)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 5, 3], [0, 2, 6, 0], [1, 7, 8, 1], [1, 8, 2, 2], [3, 9, 7, 7], [4, 6, 6, 9], [4, 9, 9, 5], [6, 8, 8, 7]]`

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 124
 Pinning number: 6

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.92

Table 892: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	35	35	21	7	1	119
Average degree	2.27	2.63	2.86	3.02	3.14	3.25	3.33	

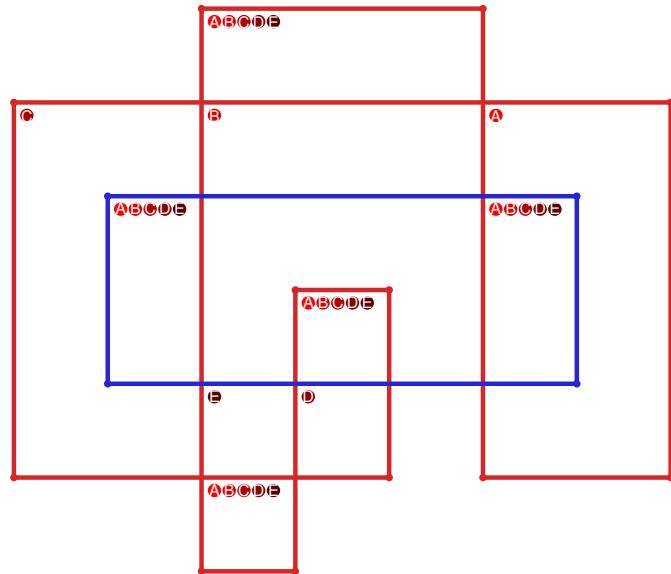


Figure 1787: `SnapPy` multiloop plot.

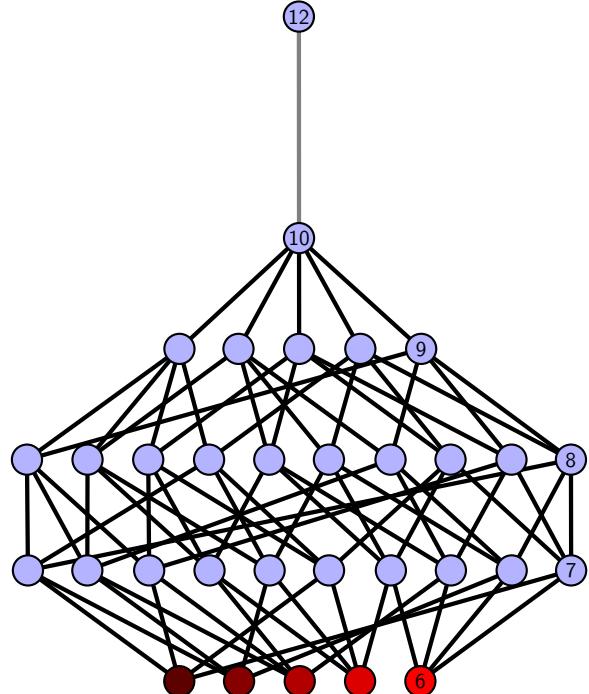


Figure 1788: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.597 [[20, 11, 1, 12], [12, 19, 13, 20], [13, 10, 14, 11], [1, 14, 2, 15], [7, 18, 8, 19], [9, 2, 10, 3], [15, 4, 16, 5], [17, 6, 18, 7], [8, 4, 9, 3], [16, 6, 17, 5]]

PD code drawn by SnapPy: [(20, 5, 1, 6), (12, 1, 13, 2), (2, 13, 3, 14), (14, 3, 15, 4), (10, 7, 11, 8), (17, 8, 18, 9), (18, 11, 19, 12), (4, 15, 5, 16), (9, 16, 10, 17), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 5, 6], [1, 7, 7, 8], [2, 8, 8, 3], [3, 8, 9, 9], [4, 9, 9, 4], [4, 6, 5, 5], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 6

Table 893: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

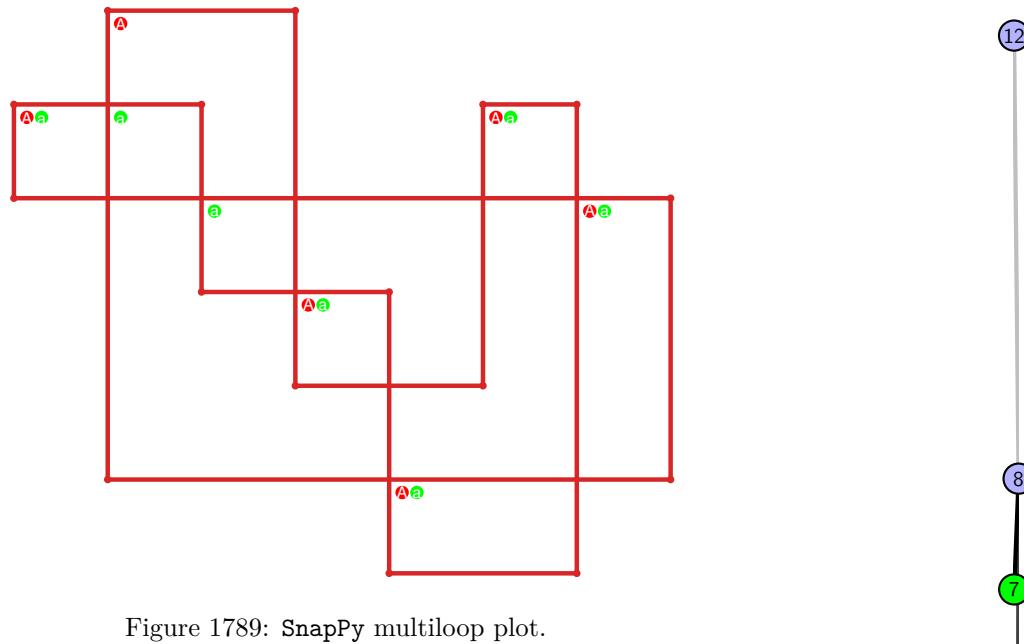


Figure 1789: SnapPy multiloop plot.

Figure 1790: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.598 [[20, 11, 1, 12], [12, 5, 13, 6], [8, 19, 9, 20], [10, 1, 11, 2], [15, 4, 16, 5], [13, 16, 14, 17], [6, 17, 7, 18], [18, 7, 19, 8], [9, 3, 10, 2], [3, 14, 4, 15]]

PD code drawn by SnapPy: [(7, 20, 8, 1), (13, 2, 14, 3), (15, 6, 16, 7), (18, 9, 19, 10), (8, 11, 9, 12), (1, 12, 2, 13), (3, 14, 4, 15), (5, 16, 6, 17), (17, 4, 18, 5), (10, 19, 11, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 7, 7, 8], [0, 8, 8, 0], [1, 9, 9, 5], [1, 4, 9, 6], [1, 5, 7, 7], [2, 6, 6, 2], [2, 9, 3, 3], [4, 8, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.23

Total pinning sets: 80

Average overall degree: 2.91

Pinning number: 6

Table 894: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

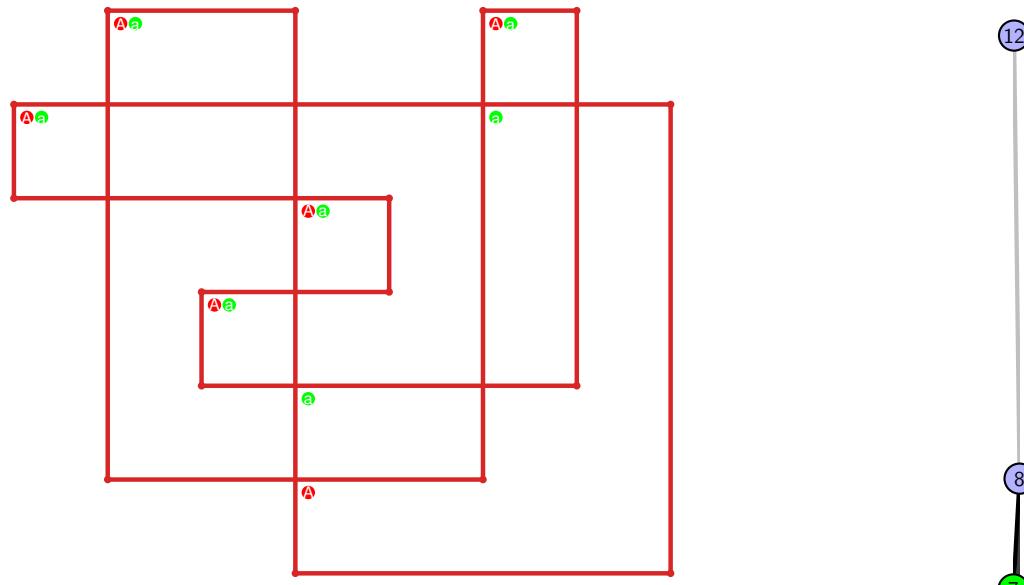


Figure 1791: SnapPy multiloop plot.

Figure 1792: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.599 $[[20, 7, 1, 8], [8, 19, 9, 20], [9, 6, 10, 7], [1, 14, 2, 15], [18, 11, 19, 12], [5, 10, 6, 11], [13, 4, 14, 5], [2, 16, 3, 15], [12, 17, 13, 18], [3, 16, 4, 17]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (6, 3, 7, 4), (17, 4, 18, 5), (2, 7, 3, 8), (15, 8, 16, 9), (18, 11, 19, 12), (12, 19, 13, 20), (20, 13, 1, 14), (9, 14, 10, 15), (5, 16, 6, 17)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 7], [1, 8, 8, 5], [2, 4, 6, 2], [3, 5, 8, 9], [3, 9, 9, 3], [4, 9, 6, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 4

Average optimal degree: 2.25

Total minimal pinning sets: 4

Average minimal degree: 2.25

Total pinning sets: 120

Average overall degree: 2.92

Pinning number: 6

Table 895: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	34	35	21	7	1	116
Average degree	2.25	2.6	2.85	3.02	3.14	3.25	3.33	

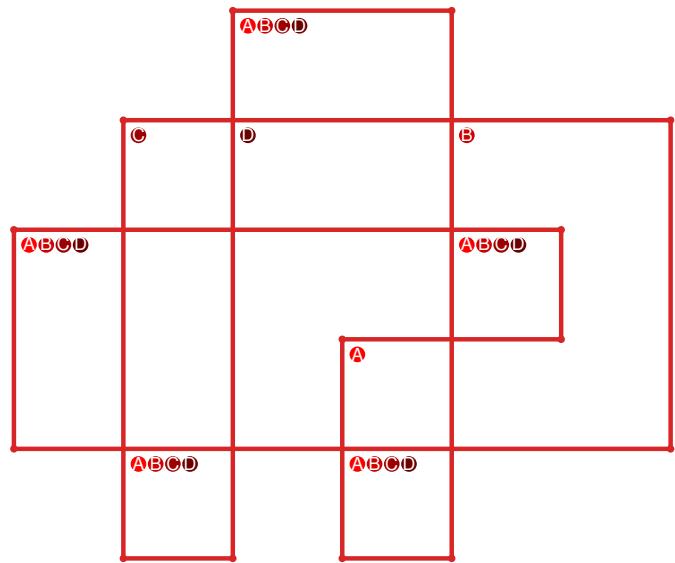


Figure 1793: SnapPy multiloop plot.

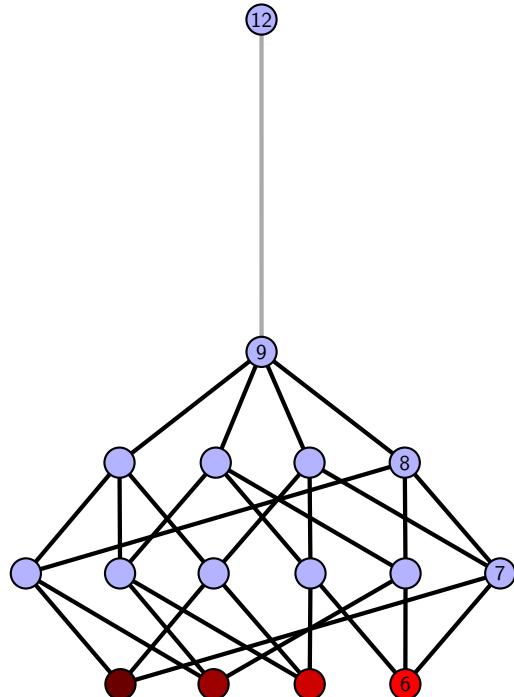


Figure 1794: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.600 [[20, 9, 1, 10], [10, 19, 11, 20], [11, 8, 12, 9], [1, 12, 2, 13], [5, 18, 6, 19], [7, 14, 8, 15], [2, 14, 3, 13], [17, 4, 18, 5], [6, 16, 7, 15], [3, 16, 4, 17]]

PD code drawn by SnapPy: [(6, 3, 7, 4), (15, 4, 16, 5), (16, 7, 17, 8), (8, 17, 9, 18), (2, 9, 3, 10), (10, 1, 11, 2), (18, 11, 19, 12), (20, 13, 1, 14), (5, 14, 6, 15), (12, 19, 13, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 6], [1, 7, 7, 8], [2, 8, 8, 6], [3, 5, 9, 3], [4, 9, 9, 4], [4, 9, 5, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 896: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

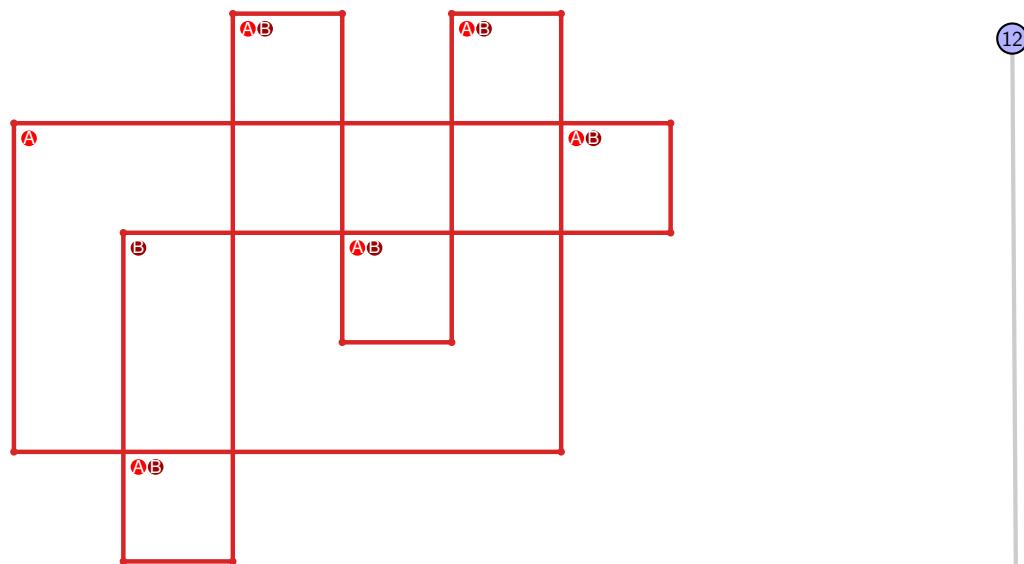


Figure 1795: SnapPy multiloop plot.

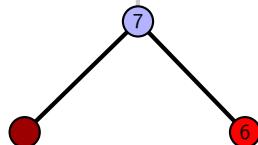


Figure 1796: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.601 [[14, 20, 1, 15], [15, 12, 16, 11], [13, 10, 14, 11], [19, 1, 20, 2], [12, 17, 13, 16], [9, 2, 10, 3], [18, 6, 19, 7], [17, 6, 18, 5], [3, 8, 4, 9], [7, 4, 8, 5]]

PD code drawn by SnapPy: [(7, 14, 8, 1), (5, 2, 6, 3), (3, 20, 4, 15), (15, 4, 16, 5), (1, 6, 2, 7), (11, 8, 12, 9), (9, 18, 10, 19), (16, 13, 17, 14), (19, 10, 20, 11), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 5, 6, 0], [1, 7, 2, 1], [2, 8, 8, 3], [3, 9, 7, 7], [4, 6, 6, 9], [5, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 96
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.91

Table 897: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

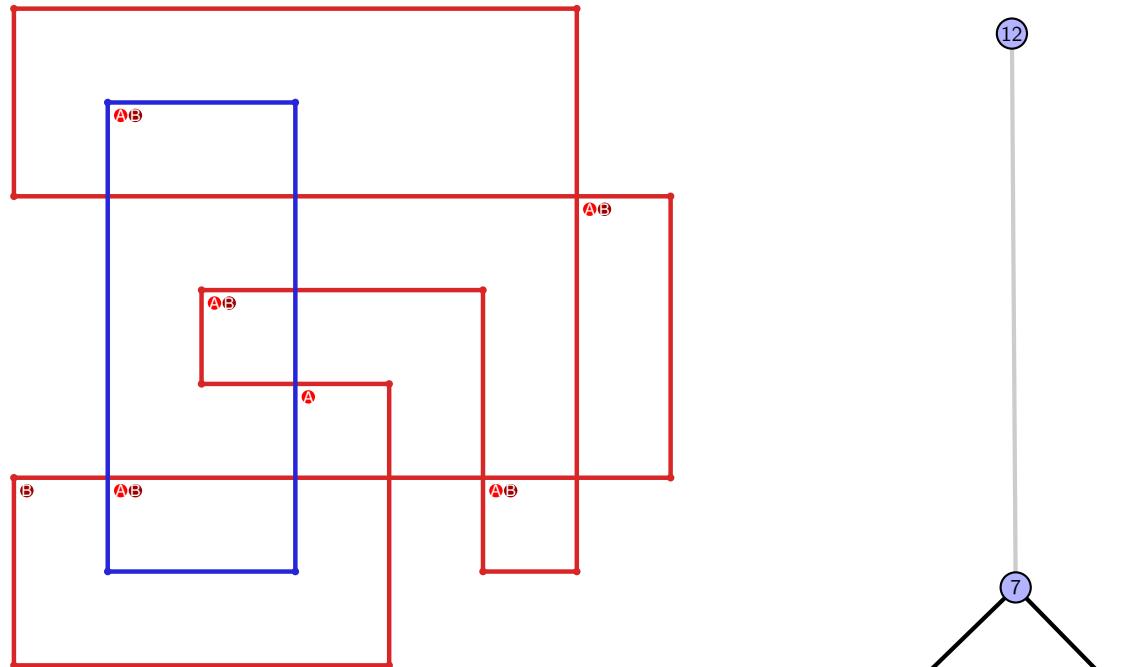


Figure 1797: SnapPy multiloop plot.

Figure 1798: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.602 [[11, 20, 12, 1], [17, 10, 18, 11], [19, 2, 20, 3], [12, 2, 13, 1], [9, 16, 10, 17], [18, 4, 19, 3], [13, 7, 14, 6], [15, 8, 16, 9], [4, 8, 5, 7], [14, 5, 15, 6]]

PD code drawn by SnapPy: [(20, 7, 1, 8), (1, 18, 2, 19), (9, 2, 10, 3), (11, 4, 12, 5), (3, 10, 4, 11), (5, 14, 6, 15), (15, 6, 16, 7), (13, 16, 14, 17), (17, 12, 18, 13), (8, 19, 9, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 5, 5, 3], [0, 2, 6, 0], [1, 7, 7, 1], [1, 8, 2, 2], [3, 8, 9, 9], [4, 9, 8, 4], [5, 7, 9, 6], [6, 8, 7, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 898: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

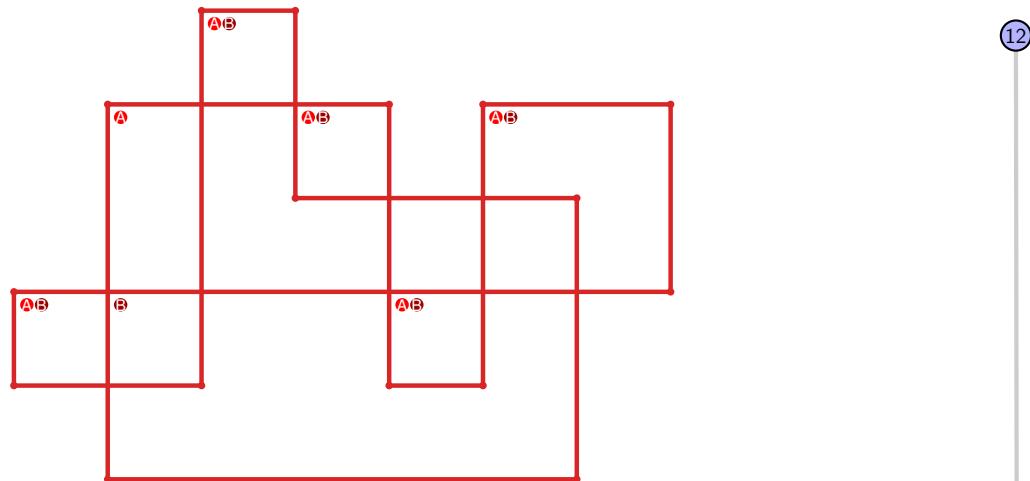


Figure 1799: SnapPy multiloop plot.

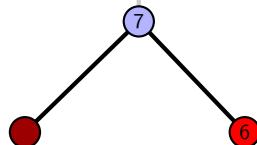


Figure 1800: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.603 [[5, 20, 6, 1], [4, 17, 5, 18], [19, 16, 20, 17], [6, 16, 7, 15], [1, 10, 2, 11], [18, 3, 19, 4], [7, 14, 8, 15], [9, 12, 10, 13], [2, 12, 3, 11], [13, 8, 14, 9]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (10, 5, 11, 6), (18, 7, 19, 8), (8, 19, 9, 20), (6, 9, 7, 10), (4, 11, 5, 12), (12, 3, 13, 4), (16, 13, 17, 14), (1, 14, 2, 15), (2, 17, 3, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 8, 8], [1, 8, 2, 1], [3, 9, 9, 3], [4, 9, 9, 8], [4, 7, 5, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 80
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.23
 Average overall degree: 2.91

Table 899: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	6	19	26	19	7	1	78
Average degree	2.17	2.47	2.73	2.94	3.12	3.25	3.33	

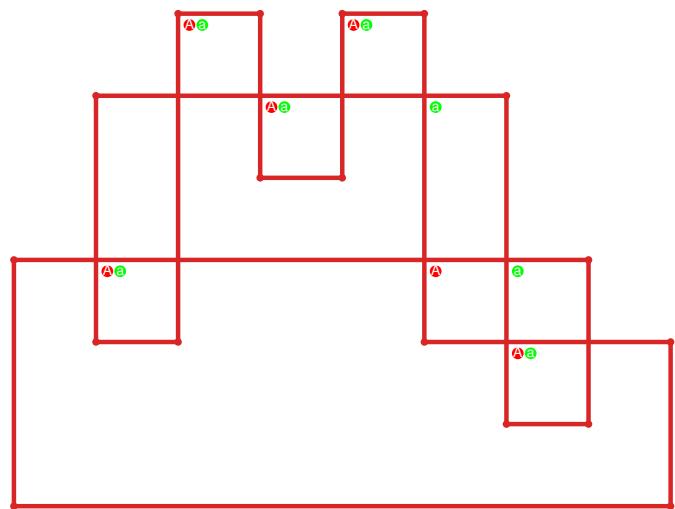


Figure 1801: SnapPy multiloop plot.



Figure 1802: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.604 [[8, 20, 1, 9], [9, 7, 10, 8], [19, 1, 20, 2], [12, 6, 13, 7], [10, 13, 11, 14], [2, 18, 3, 19], [5, 11, 6, 12], [14, 17, 15, 18], [3, 15, 4, 16], [16, 4, 17, 5]]

PD code drawn by `SnapPy`: [(10, 1, 11, 2), (18, 3, 19, 4), (15, 4, 16, 5), (13, 6, 14, 7), (2, 17, 3, 18), (16, 19, 17, 20), (8, 9, 1, 10), (20, 11, 9, 12), (7, 12, 8, 13), (5, 14, 6, 15)]

Planar representation generated by `plantri`: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 6, 4], [1, 3, 6, 7], [2, 7, 8, 2], [3, 9, 4, 3], [4, 9, 8, 5], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 68
 Pinning number: 7

Average optimal degree: 2.29
 Average minimal degree: 2.34
 Average overall degree: 2.92

Table 900: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	1
Nonminimal pinning sets	0	13	24	19	7	1	64
Average degree	2.29	2.62	2.91	3.12	3.25	3.33	

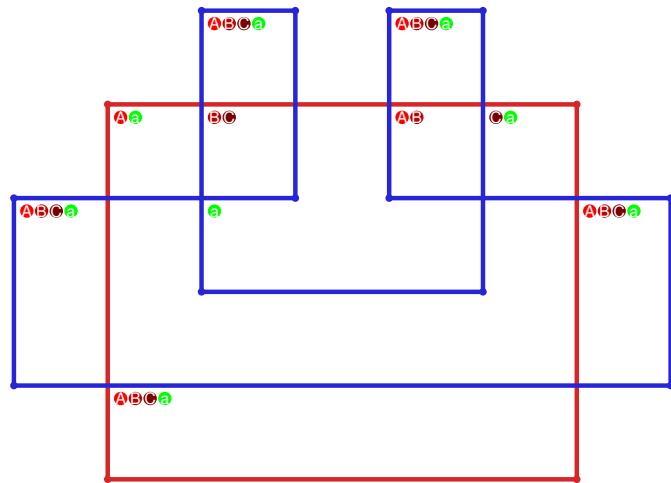


Figure 1803: `SnapPy` multiloop plot.

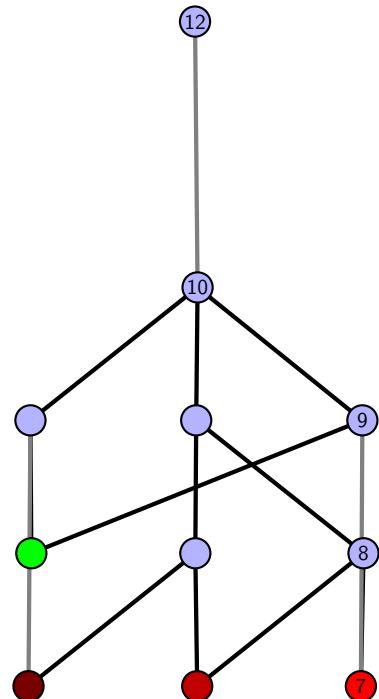


Figure 1804: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.605 $[[8, 20, 1, 9], [9, 16, 10, 17], [17, 7, 18, 8], [19, 1, 20, 2], [15, 10, 16, 11], [6, 14, 7, 15], [18, 3, 19, 2], [11, 5, 12, 6], [13, 3, 14, 4], [4, 12, 5, 13]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (15, 2, 16, 3), (17, 4, 18, 5), (5, 16, 6, 17), (11, 6, 12, 7), (7, 10, 8, 11), (1, 12, 2, 13), (19, 14, 20, 15), (3, 18, 4, 19), (13, 20, 14, 9)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 6, 6, 0], [1, 7, 5, 1], [2, 4, 7, 8], [2, 8, 3, 3], [4, 9, 9, 5], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 112
 Pinning number: 6

Average optimal degree: 2.22
 Average minimal degree: 2.22
 Average overall degree: 2.92

Table 901: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

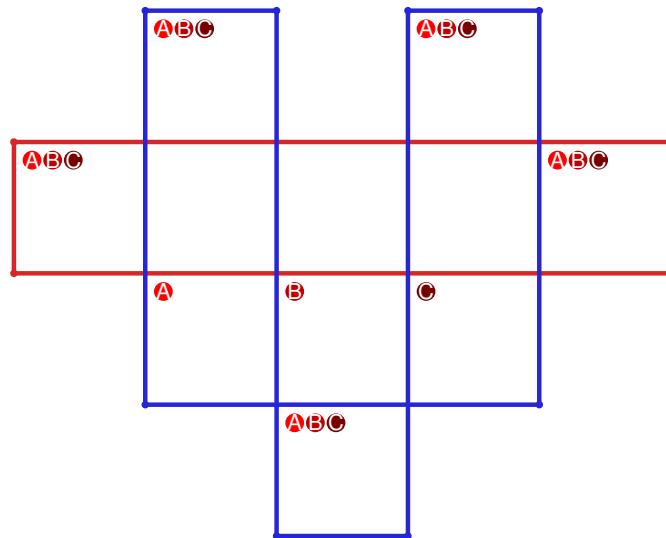


Figure 1805: SnapPy multiloop plot.

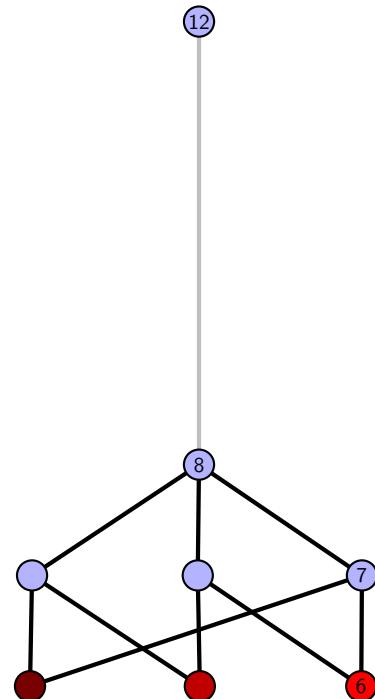


Figure 1806: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.606 $[[8, 20, 1, 9], [9, 7, 10, 8], [10, 19, 11, 20], [1, 11, 2, 12], [6, 14, 7, 15], [18, 13, 19, 14], [2, 13, 3, 12], [15, 5, 16, 6], [17, 3, 18, 4], [4, 16, 5, 17]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (15, 2, 16, 3), (11, 6, 12, 7), (4, 17, 5, 18), (18, 5, 19, 6), (12, 19, 13, 20), (1, 20, 2, 9), (7, 10, 8, 11), (16, 13, 17, 14), (3, 14, 4, 15)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 6], [1, 7, 7, 5], [2, 4, 8, 6], [3, 5, 8, 3], [4, 9, 9, 4], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 88
 Pinning number: 6

Average optimal degree: 2.17
 Average minimal degree: 2.29
 Average overall degree: 2.92

Table 902: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	2
Nonminimal pinning sets	0	6	22	29	20	7	1	85
Average degree	2.17	2.46	2.74	2.97	3.13	3.25	3.33	

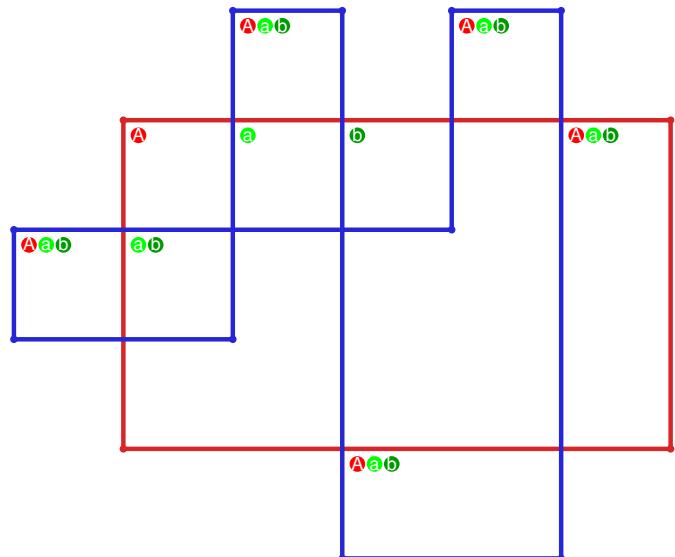


Figure 1807: SnapPy multiloop plot.

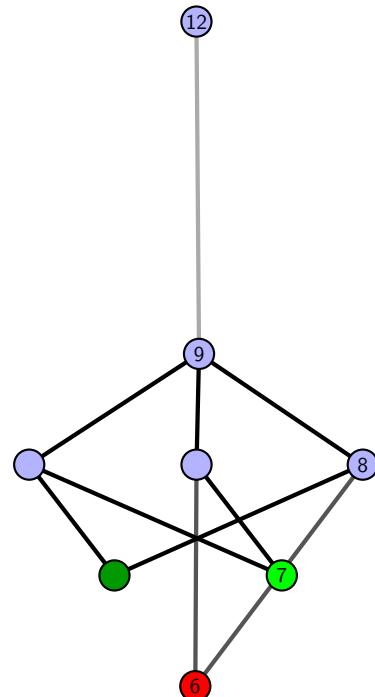


Figure 1808: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.607 $[[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [8, 1, 9, 2], [18, 12, 19, 11], [6, 15, 7, 16], [2, 7, 3, 8], [12, 5, 13, 6], [14, 3, 15, 4], [4, 13, 5, 14]]$

PD code drawn by SnapPy: $[(7, 20, 8, 1), (17, 2, 18, 3), (15, 4, 16, 5), (6, 13, 7, 14), (19, 8, 20, 9), (1, 10, 2, 11), (14, 11, 15, 12), (12, 5, 13, 6), (3, 16, 4, 17), (9, 18, 10, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 7, 8, 6], [3, 5, 8, 3], [4, 9, 9, 5], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.17

Total minimal pinning sets: 2

Average minimal degree: 2.17

Total pinning sets: 96

Average overall degree: 2.91

Pinning number: 6

Table 903: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	11	25	30	20	7	1	94
Average degree	2.17	2.52	2.78	2.98	3.13	3.25	3.33	

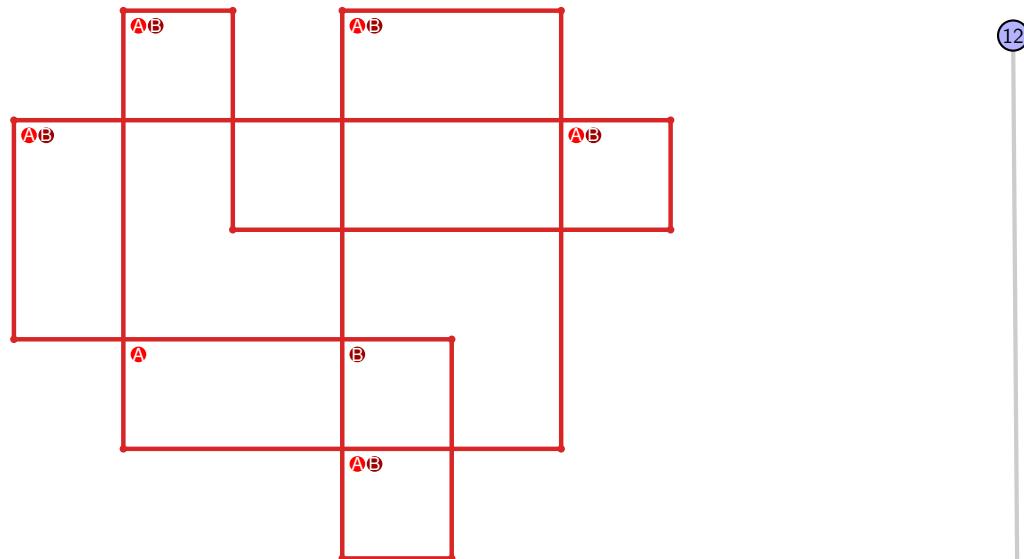


Figure 1809: SnapPy multiloop plot.

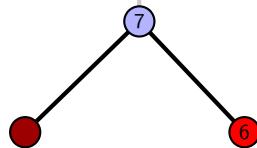


Figure 1810: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.608 [[5, 20, 6, 1], [11, 4, 12, 5], [12, 19, 13, 20], [6, 13, 7, 14], [1, 16, 2, 17], [17, 10, 18, 11], [18, 3, 19, 4], [7, 15, 8, 14], [8, 15, 9, 16], [2, 9, 3, 10]]

PD code drawn by `SnapPy`: [(15, 20, 16, 1), (8, 1, 9, 2), (19, 6, 20, 7), (14, 7, 15, 8), (3, 10, 4, 11), (11, 4, 12, 5), (5, 12, 6, 13), (18, 13, 19, 14), (9, 16, 10, 17), (2, 17, 3, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 7], [0, 8, 9, 5], [1, 4, 9, 6], [1, 5, 9, 2], [3, 8, 8, 3], [4, 7, 7, 9], [4, 8, 6, 5]]

Total optimal pinning sets: 1
Total minimal pinning sets: 7

Total pinning sets: 264

Pinning number: 5

Average optimal degree: 2.6

Average minimal degree: 2.68

Average overall degree: 3.1

Table 904: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	1	0	0	0	0	0	6
Nonminimal pinning sets	0	7	44	80	76	39	10	1	257
Average degree	2.6	2.75	2.93	3.07	3.18	3.26	3.31	3.33	

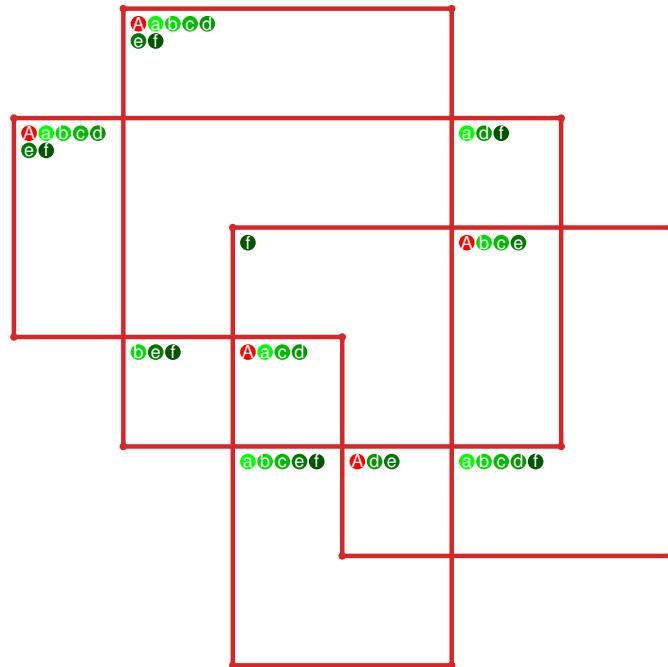


Figure 1811: `SnapPy` multiloop plot.

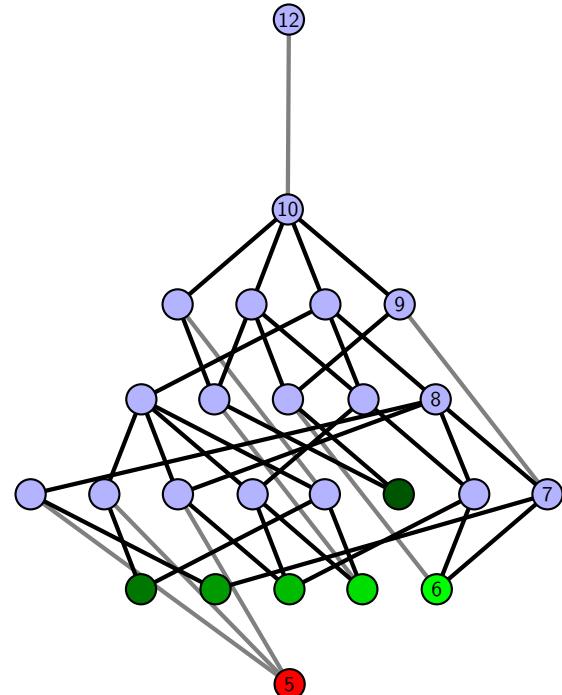


Figure 1812: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.609 $[[5, 20, 6, 1], [4, 9, 5, 10], [19, 8, 20, 9], [6, 14, 7, 13], [1, 16, 2, 17], [10, 17, 11, 18], [18, 3, 19, 4], [7, 14, 8, 15], [15, 12, 16, 13], [2, 12, 3, 11]]$

PD code drawn by SnapPy: $[(15, 20, 16, 1), (16, 5, 17, 6), (1, 6, 2, 7), (8, 19, 9, 20), (12, 9, 13, 10), (10, 3, 11, 4), (4, 11, 5, 12), (18, 13, 19, 14), (7, 14, 8, 15), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 7, 7, 8], [0, 8, 9, 5], [1, 4, 9, 6], [1, 5, 9, 2], [2, 8, 3, 3], [3, 7, 9, 4], [4, 8, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.75

Total minimal pinning sets: 12

Average minimal degree: 2.92

Total pinning sets: 612

Average overall degree: 3.19

Pinning number: 4

Table 905: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	9	2	0	0	0	0	0	0	11
Nonminimal pinning sets	0	8	73	155	179	123	50	11	1	600
Average degree	2.75	2.93	3.05	3.14	3.21	3.26	3.3	3.32	3.33	

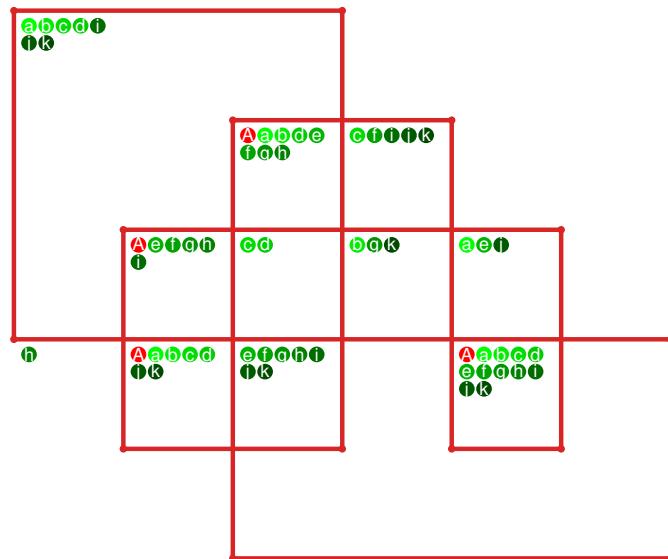


Figure 1813: SnapPy multiloop plot.

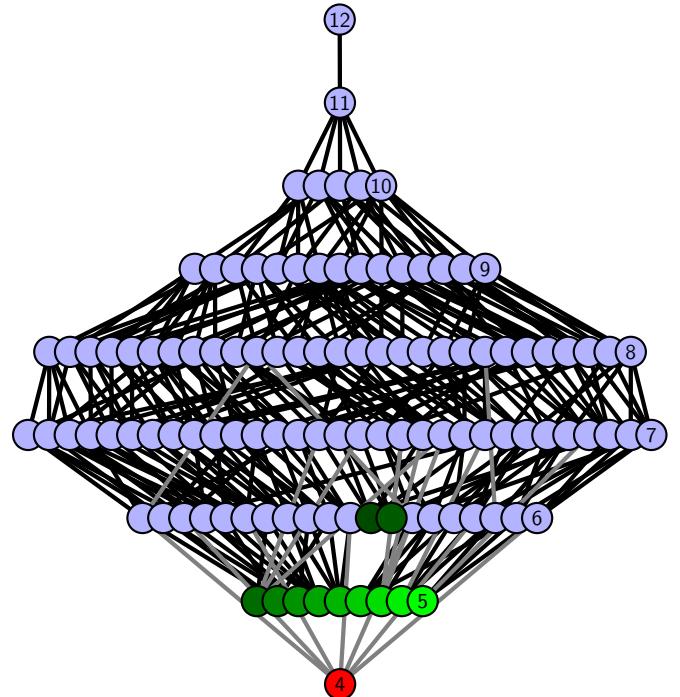


Figure 1814: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.610 $[[6, 14, 1, 7], [7, 15, 8, 20], [5, 19, 6, 20], [13, 18, 14, 19], [1, 12, 2, 11], [15, 3, 16, 4], [8, 4, 9, 5], [17, 12, 18, 13], [2, 10, 3, 11], [16, 10, 17, 9]]$

PD code drawn by SnapPy: $[(20, 1, 15, 2), (13, 2, 14, 3), (14, 15, 7, 16), (6, 7, 1, 8), (8, 5, 9, 6), (16, 9, 17, 10), (4, 11, 5, 12), (10, 17, 11, 18), (3, 18, 4, 19), (19, 12, 20, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 7], [0, 7, 8, 8], [1, 8, 9, 6], [1, 5, 9, 2], [3, 9, 4, 3], [4, 9, 5, 4], [5, 8, 7, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 9
 Total pinning sets: 324
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.73
 Average overall degree: 3.11

Table 906: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	14	66	100	84	40	10	1	315
Average degree	2.6	2.79	2.97	3.1	3.2	3.26	3.31	3.33	

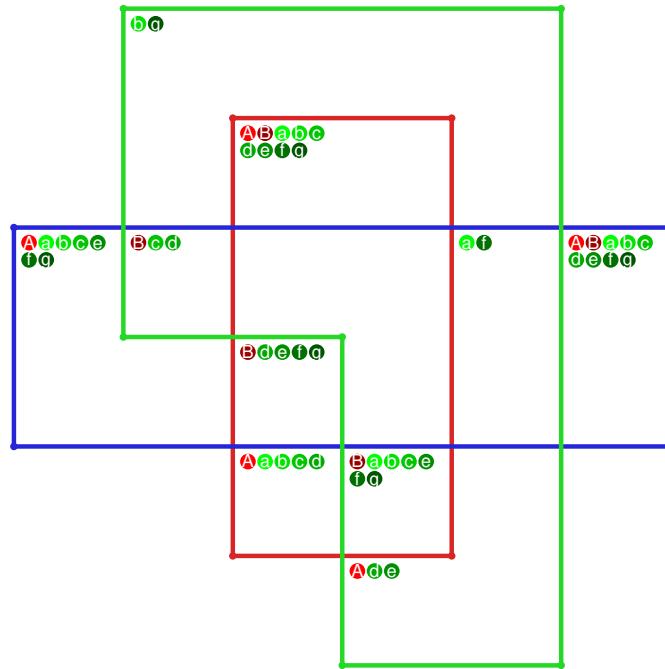


Figure 1815: SnapPy multiloop plot.

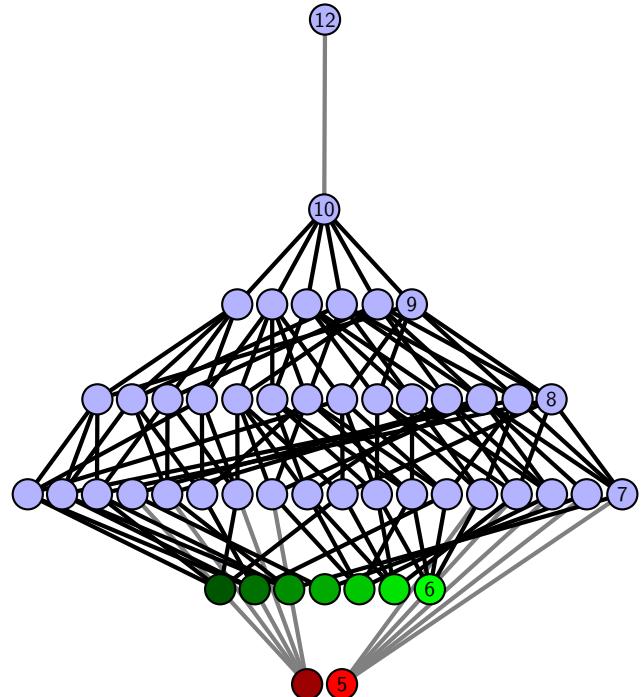


Figure 1816: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.611 [[13, 20, 14, 1], [17, 12, 18, 13], [6, 19, 7, 20], [14, 7, 15, 8], [1, 8, 2, 9], [9, 16, 10, 17], [4, 11, 5, 12], [18, 5, 19, 6], [15, 3, 16, 2], [10, 3, 11, 4]]

PD code drawn by SnapPy: [(7, 20, 8, 1), (15, 2, 16, 3), (11, 4, 12, 5), (18, 5, 19, 6), (1, 8, 2, 9), (14, 9, 15, 10), (6, 13, 7, 14), (3, 16, 4, 17), (10, 17, 11, 18), (19, 12, 20, 13)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 8, 4], [0, 3, 8, 5], [1, 4, 8, 9], [1, 9, 9, 7], [1, 6, 2, 2], [3, 9, 5, 4], [5, 8, 6, 6]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 10
 Total pinning sets: 344
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.75
 Average overall degree: 3.11

Table 907: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	8	0	0	0	0	0	0	8
Nonminimal pinning sets	0	14	71	108	89	41	10	1	334
Average degree	2.6	2.8	2.98	3.12	3.21	3.27	3.31	3.33	

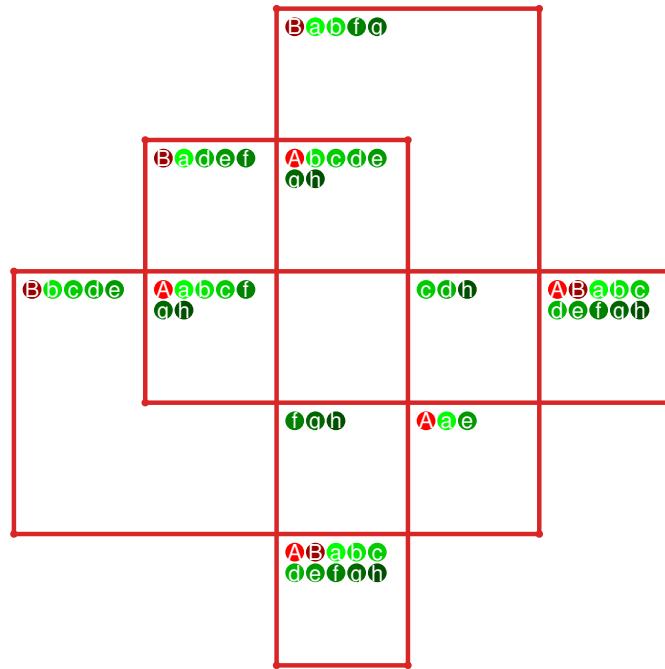


Figure 1817: SnapPy multiloop plot.

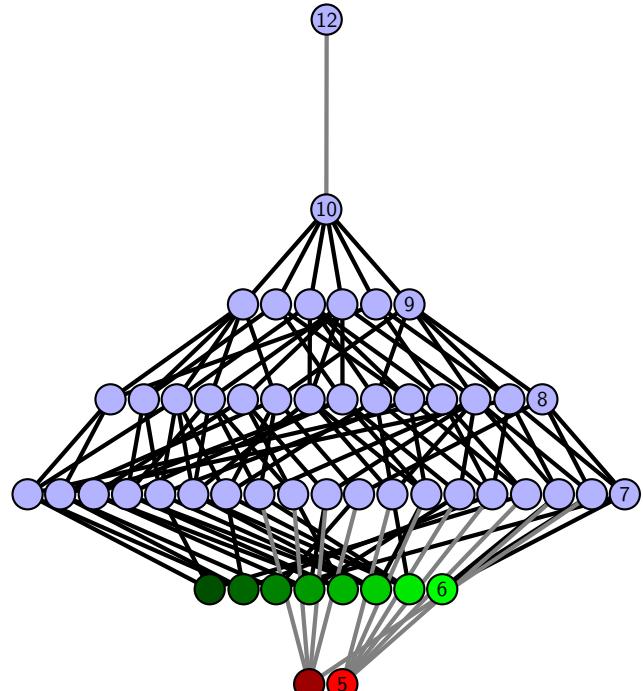


Figure 1818: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.612 [[8, 14, 1, 9], [9, 5, 10, 6], [7, 20, 8, 15], [13, 19, 14, 20], [1, 19, 2, 18], [4, 17, 5, 18], [10, 17, 11, 16], [6, 16, 7, 15], [12, 2, 13, 3], [3, 11, 4, 12]]

PD code drawn by SnapPy: [(13, 2, 14, 3), (10, 7, 11, 8), (8, 9, 1, 10), (5, 12, 6, 13), (17, 14, 18, 9), (1, 18, 2, 19), (19, 6, 20, 7), (11, 20, 12, 15), (4, 15, 5, 16), (16, 3, 17, 4)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 8, 4], [0, 3, 8, 5], [1, 4, 9, 6], [1, 5, 9, 7], [1, 6, 2, 2], [3, 9, 9, 4], [5, 8, 8, 6]]

Total optimal pinning sets: 2

Average optimal degree: 2.6

Total minimal pinning sets: 10

Average minimal degree: 2.77

Total pinning sets: 332

Average overall degree: 3.11

Pinning number: 5

Table 908: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	7	1	0	0	0	0	0	8
Nonminimal pinning sets	0	14	66	103	87	41	10	1	322
Average degree	2.6	2.81	2.99	3.11	3.2	3.27	3.31	3.33	

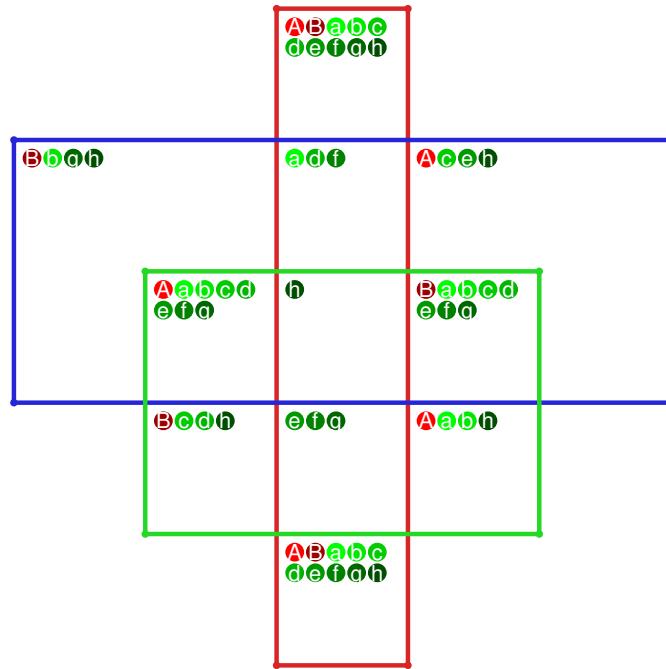


Figure 1819: SnapPy multiloop plot.

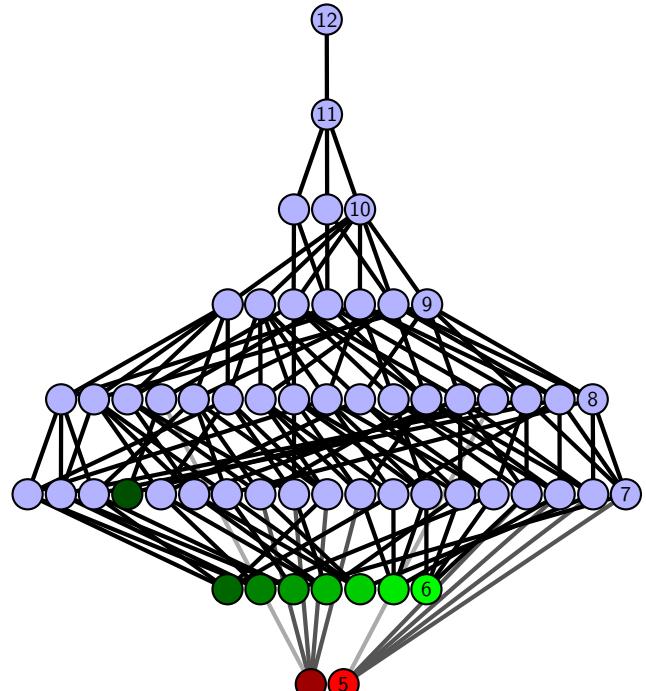


Figure 1820: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.613 [[5, 20, 6, 1], [17, 4, 18, 5], [12, 19, 13, 20], [6, 13, 7, 14], [1, 14, 2, 15], [9, 16, 10, 17], [10, 3, 11, 4], [18, 11, 19, 12], [7, 3, 8, 2], [15, 8, 16, 9]]

PD code drawn by SnapPy: [(20, 5, 1, 6), (8, 1, 9, 2), (15, 2, 16, 3), (13, 6, 14, 7), (16, 9, 17, 10), (4, 11, 5, 12), (19, 12, 20, 13), (7, 14, 8, 15), (10, 17, 11, 18), (3, 18, 4, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 8, 4], [0, 3, 8, 9], [1, 9, 9, 6], [1, 5, 8, 7], [1, 6, 2, 2], [3, 6, 9, 4], [4, 8, 5, 5]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 9
 Total pinning sets: 336
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.73
 Average overall degree: 3.11

Table 909: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	14	68	105	88	41	10	1	327
Average degree	2.6	2.79	2.97	3.11	3.2	3.27	3.31	3.33	

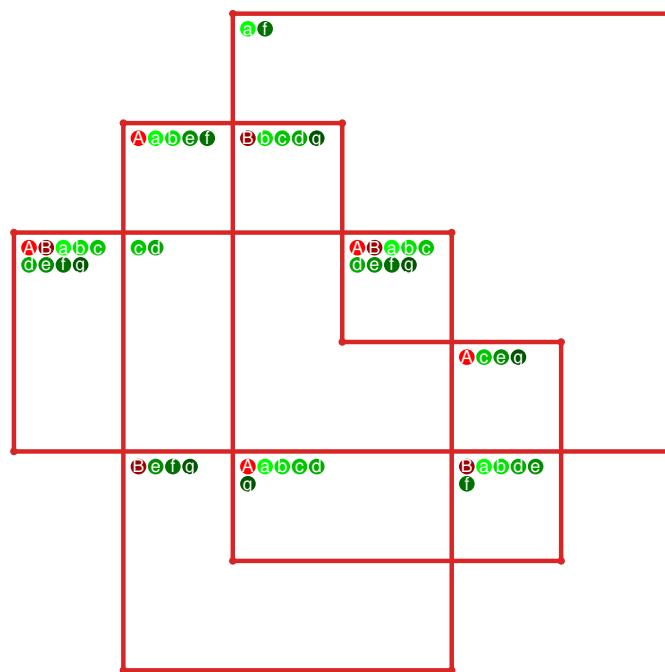


Figure 1821: SnapPy multiloop plot.

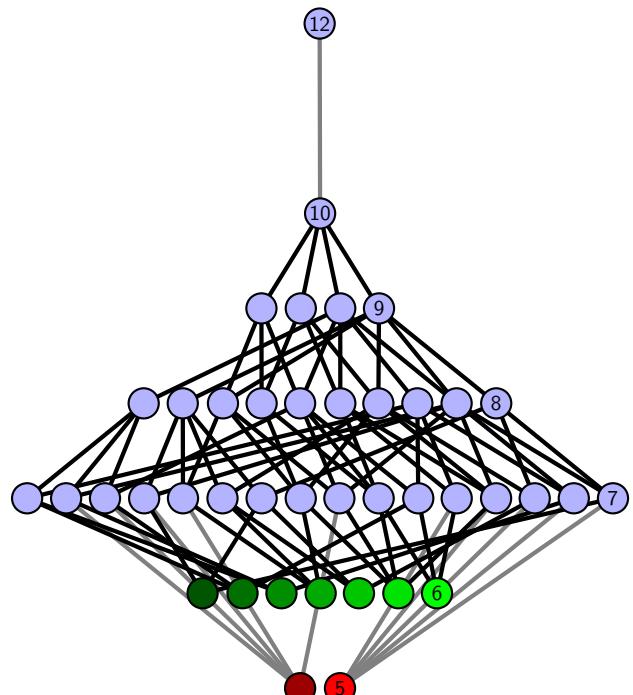


Figure 1822: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.614 [[5, 20, 6, 1], [11, 4, 12, 5], [19, 6, 20, 7], [1, 14, 2, 15], [15, 10, 16, 11], [16, 3, 17, 4], [12, 17, 13, 18], [7, 18, 8, 19], [8, 13, 9, 14], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(13, 20, 14, 1), (16, 3, 17, 4), (9, 4, 10, 5), (2, 7, 3, 8), (15, 8, 16, 9), (6, 11, 7, 12), (1, 12, 2, 13), (19, 14, 20, 15), (10, 17, 11, 18), (5, 18, 6, 19)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 6], [0, 7, 7, 0], [0, 8, 9, 4], [1, 3, 9, 5], [1, 4, 9, 6], [1, 5, 8, 7], [2, 6, 8, 2], [3, 7, 6, 9], [3, 8, 5, 4]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 6
 Total pinning sets: 360
 Pinning number: 5

Average optimal degree: 2.65
 Average minimal degree: 2.66
 Average overall degree: 3.11

Table 910: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	26	77	110	89	41	10	1	354
Average degree	2.65	2.85	3.0	3.12	3.21	3.27	3.31	3.33	

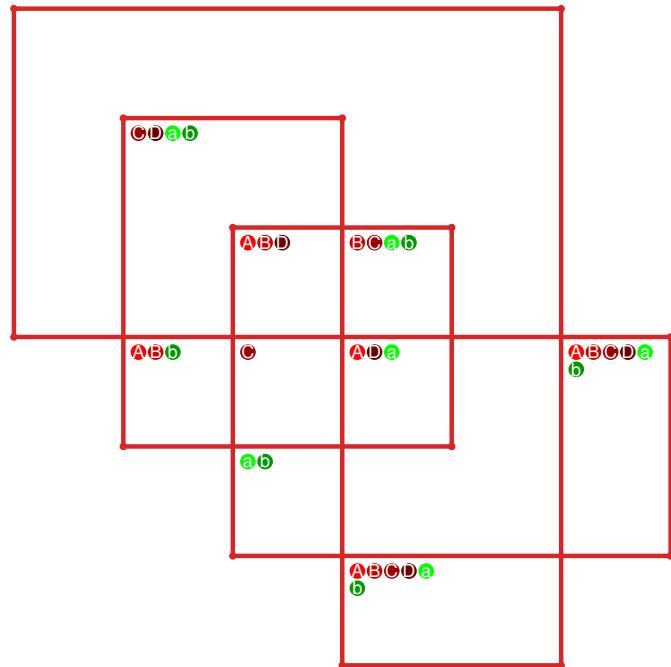


Figure 1823: SnapPy multiloop plot.

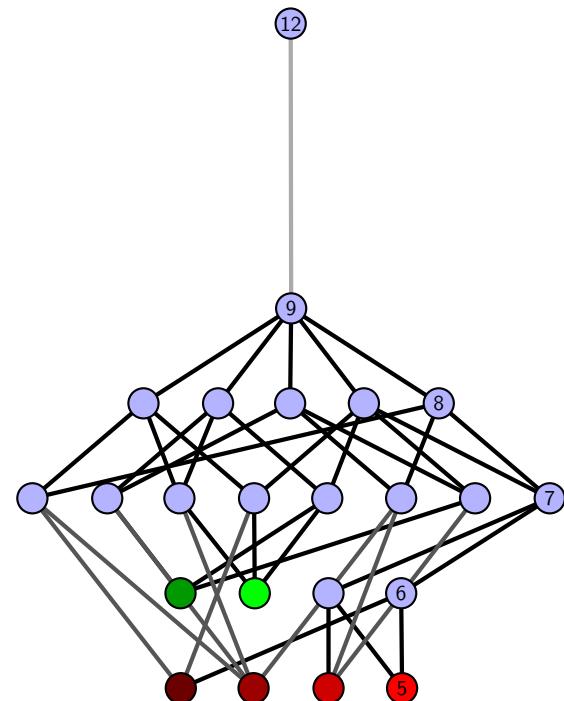


Figure 1824: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.615 [[14, 20, 1, 15], [15, 10, 16, 9], [13, 2, 14, 3], [19, 1, 20, 2], [10, 6, 11, 5], [16, 5, 17, 4], [8, 3, 9, 4], [12, 7, 13, 8], [18, 6, 19, 7], [11, 18, 12, 17]]

PD code drawn by SnapPy: [(15, 14, 16, 1), (6, 1, 7, 2), (3, 18, 4, 19), (16, 9, 17, 10), (7, 10, 8, 11), (2, 11, 3, 12), (12, 19, 13, 20), (13, 4, 14, 5), (8, 17, 9, 18), (20, 5, 15, 6)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 8, 0], [1, 8, 9, 5], [1, 4, 9, 6], [1, 5, 7, 2], [2, 6, 9, 8], [3, 7, 9, 4], [4, 8, 7, 5]]

Total optimal pinning sets: 7
 Total minimal pinning sets: 19
 Total pinning sets: 574
 Pinning number: 5

Average optimal degree: 2.94
 Average minimal degree: 2.97
 Average overall degree: 3.2

Table 911: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	7	0	0	0	0	0	0	0	7
Minimal (suboptimal) pinning sets	0	12	0	0	0	0	0	0	12
Nonminimal pinning sets	0	41	141	182	128	51	11	1	555
Average degree	2.94	3.05	3.15	3.22	3.27	3.3	3.32	3.33	

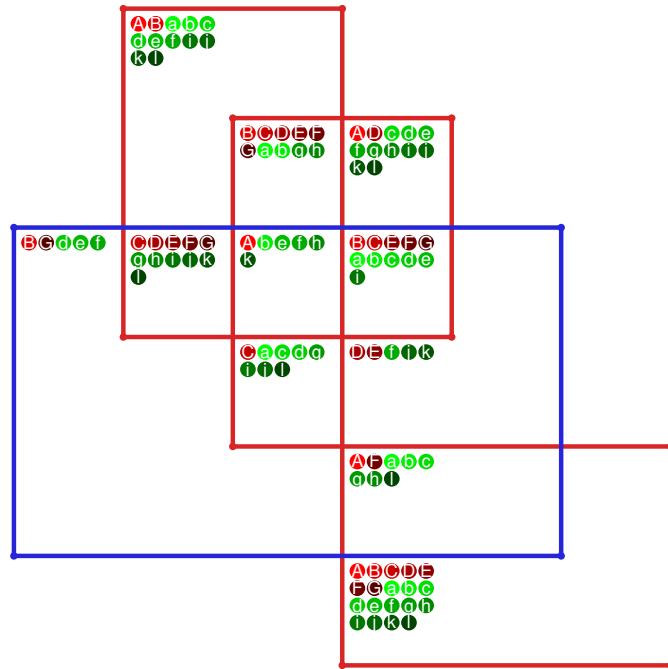


Figure 1825: SnapPy multiloop plot.

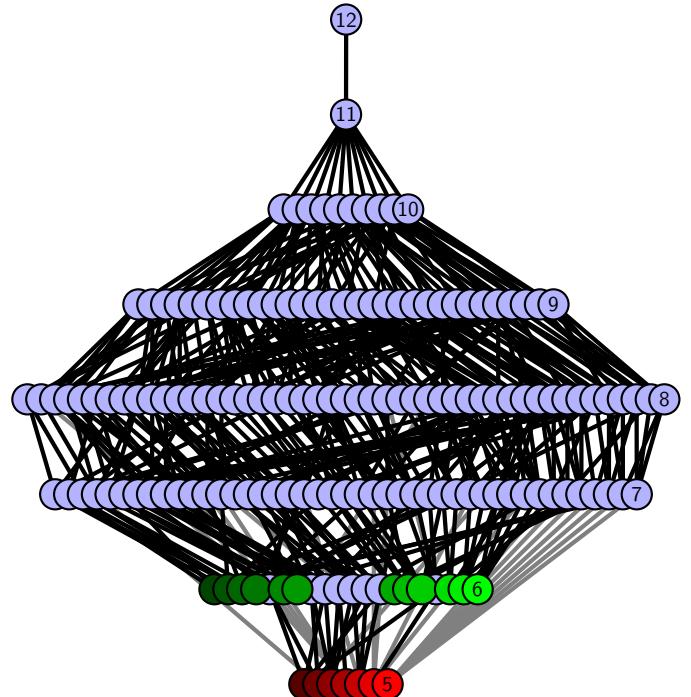


Figure 1826: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.616 [[20, 13, 1, 14], [14, 5, 15, 6], [12, 19, 13, 20], [1, 8, 2, 9], [4, 15, 5, 16], [6, 11, 7, 12], [7, 18, 8, 19], [2, 18, 3, 17], [9, 17, 10, 16], [10, 3, 11, 4]]

PD code drawn by SnapPy: [(9, 20, 10, 1), (16, 3, 17, 4), (1, 6, 2, 7), (15, 8, 16, 9), (19, 10, 20, 11), (11, 4, 12, 5), (12, 17, 13, 18), (2, 13, 3, 14), (7, 14, 8, 15), (5, 18, 6, 19)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 6, 7, 8], [1, 8, 9, 1], [1, 9, 6, 2], [2, 5, 7, 3], [3, 6, 9, 8], [3, 7, 9, 4], [4, 8, 7, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 6

Average minimal degree: 2.68

Total pinning sets: 464

Average overall degree: 3.11

Pinning number: 4

Table 912: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	0	5
Nonminimal pinning sets	0	8	54	112	134	97	42	10	1	458
Average degree	2.5	2.74	2.92	3.05	3.15	3.22	3.27	3.31	3.33	

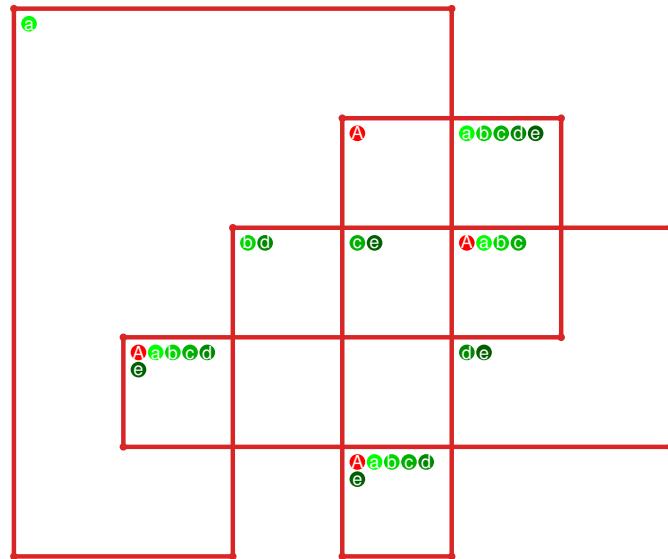


Figure 1827: SnapPy multiloop plot.

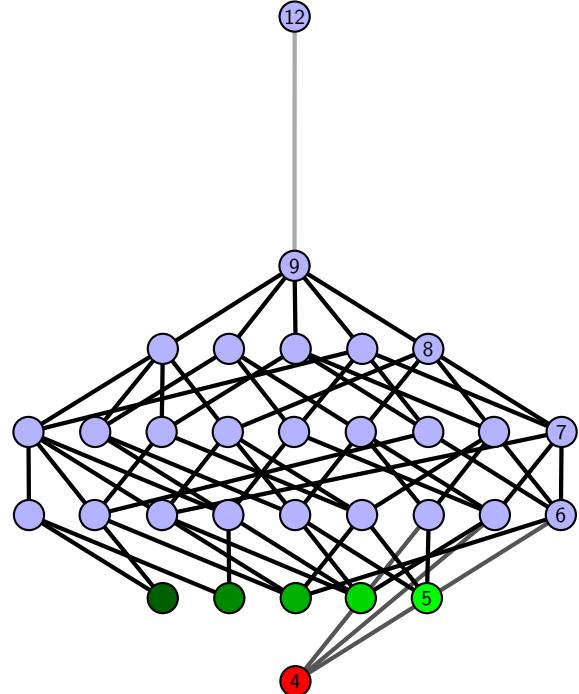


Figure 1828: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.617 [[20, 11, 1, 12], [12, 7, 13, 8], [8, 19, 9, 20], [10, 3, 11, 4], [1, 16, 2, 17], [17, 6, 18, 7], [13, 18, 14, 19], [9, 5, 10, 4], [15, 2, 16, 3], [5, 14, 6, 15]]

PD code drawn by `SnapPy`: [(13, 20, 14, 1), (8, 1, 9, 2), (2, 7, 3, 8), (15, 4, 16, 5), (10, 5, 11, 6), (18, 9, 19, 10), (3, 12, 4, 13), (19, 14, 20, 15), (11, 16, 12, 17), (6, 17, 7, 18)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 7, 7, 8], [0, 8, 8, 5], [1, 4, 9, 6], [1, 5, 9, 2], [2, 9, 3, 3], [3, 9, 4, 4], [5, 8, 7, 6]]

Total optimal pinning sets: 3
Total minimal pinning sets: 3
Total pinning sets: 512
Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.5
Average overall degree: 3.11

Table 913: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	70	126	140	98	42	10	1	509
Average degree	2.5	2.76	2.94	3.06	3.15	3.22	3.27	3.31	3.33	

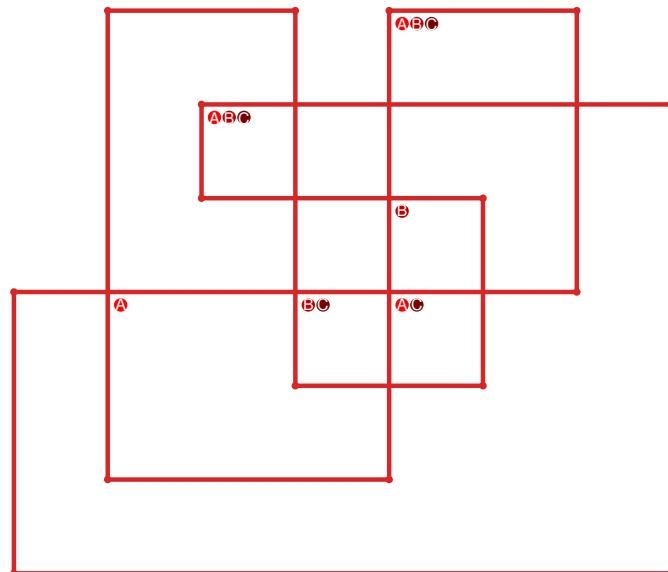


Figure 1829: `SnapPy` multiloop plot.

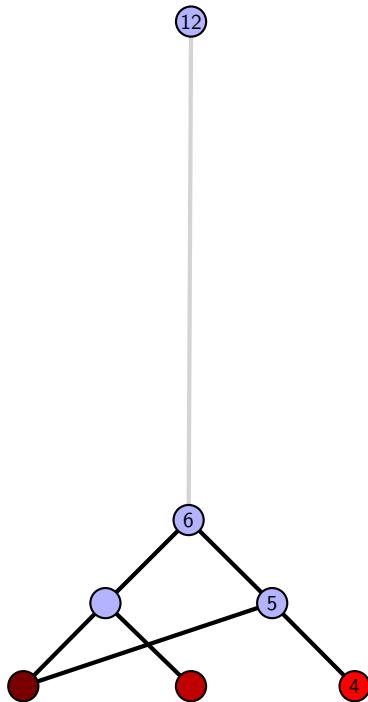


Figure 1830: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.618 $[[8, 20, 1, 9], [9, 17, 10, 16], [7, 15, 8, 16], [19, 14, 20, 15], [1, 4, 2, 5], [17, 5, 18, 6], [10, 6, 11, 7], [11, 18, 12, 19], [3, 13, 4, 14], [2, 13, 3, 12]]$

PD code drawn by SnapPy: $[(7, 2, 8, 3), (14, 3, 15, 4), (19, 4, 20, 5), (9, 8, 10, 1), (1, 10, 2, 11), (16, 11, 17, 12), (5, 12, 6, 13), (13, 18, 14, 19), (20, 15, 9, 16), (6, 17, 7, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 8], [0, 8, 9, 5], [1, 4, 7, 6], [1, 5, 7, 2], [3, 6, 5, 9], [3, 9, 9, 4], [4, 8, 8, 7]]$

Total optimal pinning sets: 16
 Total minimal pinning sets: 17
 Total pinning sets: 644
 Pinning number: 5

Average optimal degree: 2.91
 Average minimal degree: 2.94
 Average overall degree: 3.19

Table 914: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	16	0	0	0	0	0	0	0	16
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	78	166	191	129	51	11	1	627
Average degree	2.91	3.05	3.15	3.22	3.27	3.3	3.32	3.33	

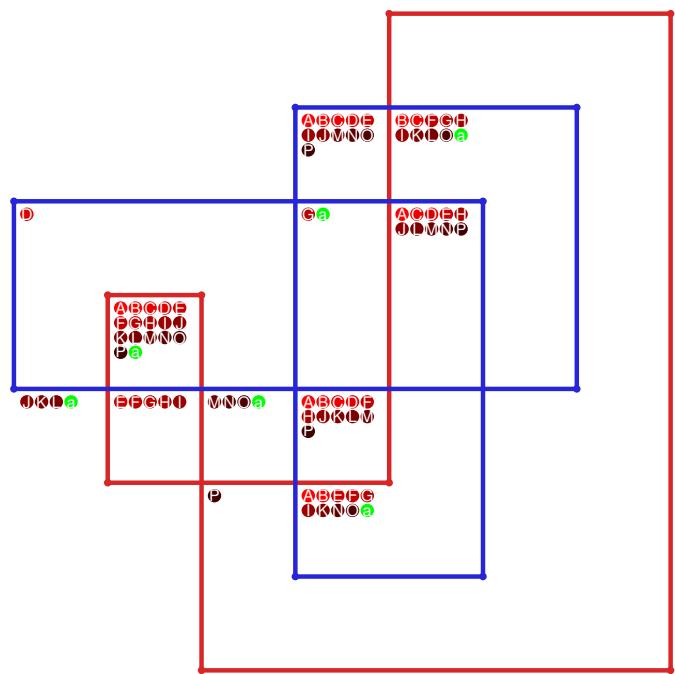


Figure 1831: SnapPy multiloop plot.

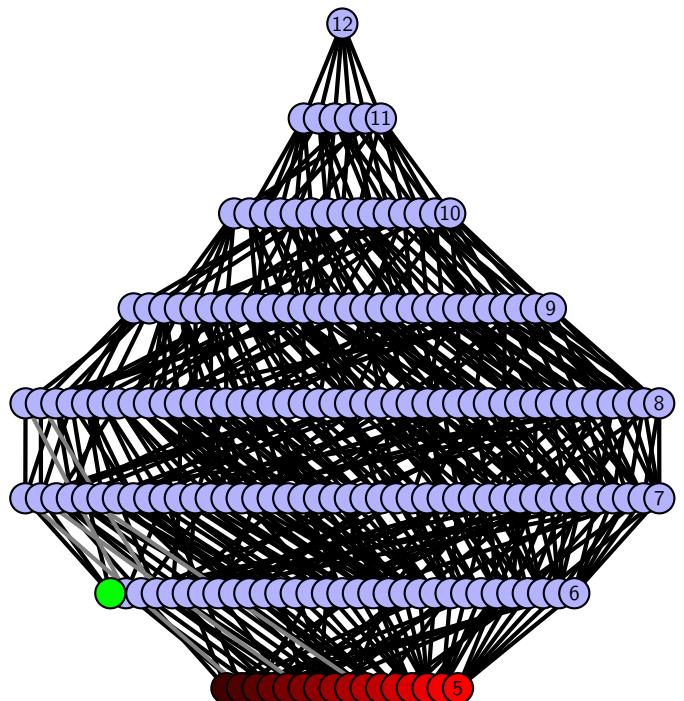


Figure 1832: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.619 [[10, 20, 1, 11], [11, 6, 12, 5], [9, 4, 10, 5], [19, 3, 20, 4], [1, 15, 2, 16], [6, 16, 7, 17], [12, 8, 13, 9], [13, 18, 14, 19], [14, 2, 15, 3], [7, 18, 8, 17]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (16, 1, 17, 2), (7, 2, 8, 3), (3, 18, 4, 19), (19, 6, 20, 7), (9, 12, 10, 13), (4, 13, 5, 14), (14, 5, 15, 6), (20, 15, 11, 16), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 8], [0, 8, 8, 5], [1, 4, 9, 9], [1, 9, 7, 2], [3, 6, 9, 8], [3, 7, 4, 4], [5, 7, 6, 5]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 5
 Total pinning sets: 512
 Pinning number: 4

Average optimal degree: 2.62
 Average minimal degree: 2.7
 Average overall degree: 3.13

Table 915: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	1	2	0	0	0	0	0	0	3
Nonminimal pinning sets	0	16	61	126	147	103	43	10	1	507
Average degree	2.62	2.82	2.96	3.07	3.16	3.23	3.27	3.31	3.33	

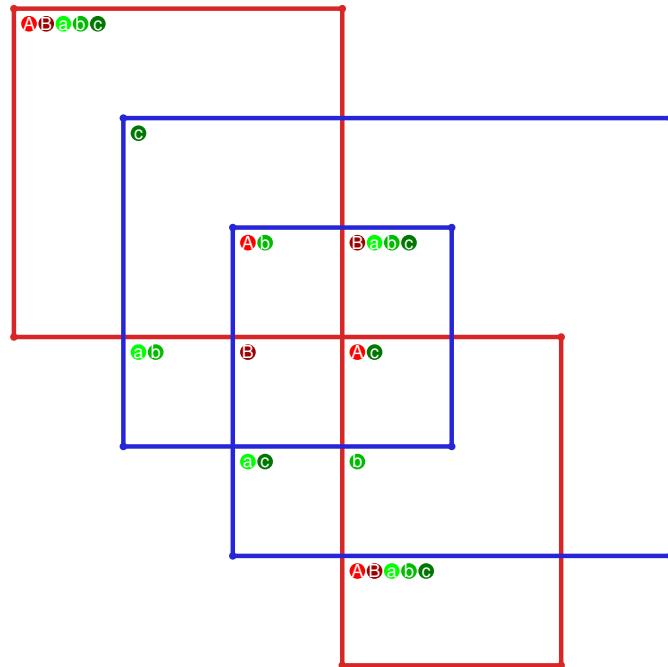


Figure 1833: SnapPy multiloop plot.

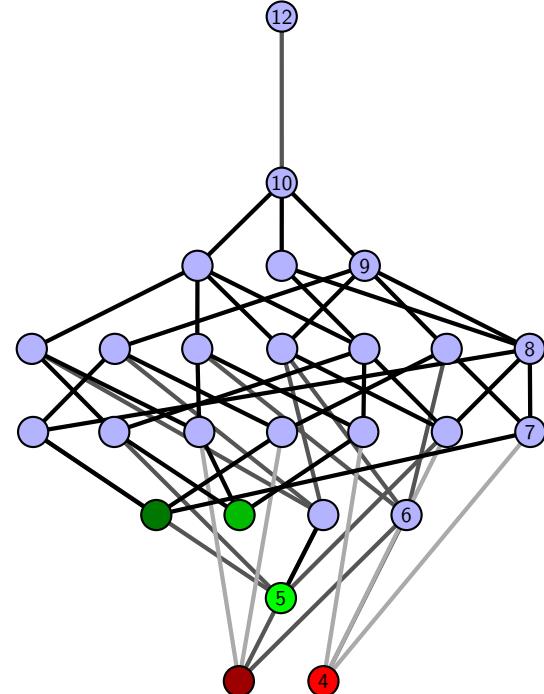


Figure 1834: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.620 $[[7, 20, 8, 1], [11, 6, 12, 7], [19, 4, 20, 5], [8, 4, 9, 3], [1, 16, 2, 17], [17, 10, 18, 11], [5, 12, 6, 13], [13, 18, 14, 19], [9, 14, 10, 15], [15, 2, 16, 3]]$

PD code drawn by SnapPy: $[(20, 5, 1, 6), (16, 1, 17, 2), (8, 3, 9, 4), (14, 7, 15, 8), (2, 9, 3, 10), (6, 11, 7, 12), (18, 13, 19, 14), (10, 15, 11, 16), (4, 17, 5, 18), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 7, 3], [0, 2, 8, 9], [0, 9, 9, 5], [1, 4, 8, 7], [1, 7, 2, 1], [2, 6, 5, 8], [3, 7, 5, 9], [3, 8, 4, 4]]$

Total optimal pinning sets: 3

Average optimal degree: 2.83

Total minimal pinning sets: 15

Average minimal degree: 2.86

Total pinning sets: 708

Average overall degree: 3.15

Pinning number: 4

Table 916: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	12	0	0	0	0	0	0	0	12
Nonminimal pinning sets	0	21	113	193	192	118	45	10	1	693
Average degree	2.83	2.95	3.04	3.13	3.19	3.24	3.28	3.31	3.33	

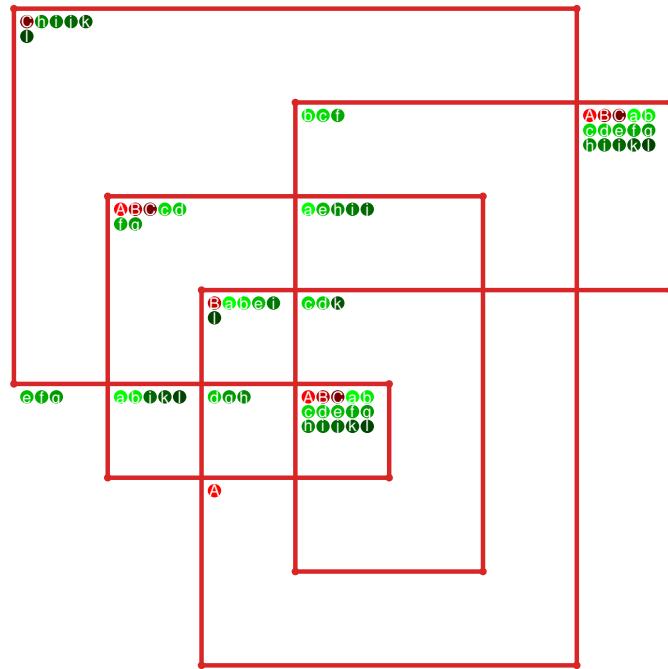


Figure 1835: SnapPy multiloop plot.

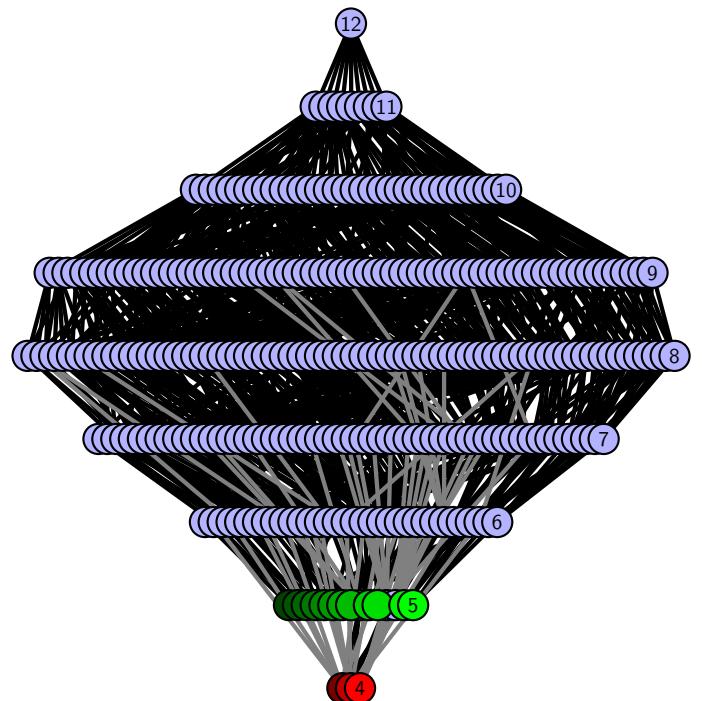


Figure 1836: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.621 [[13, 20, 14, 1], [17, 12, 18, 13], [19, 4, 20, 5], [14, 4, 15, 3], [1, 9, 2, 8], [16, 7, 17, 8], [11, 6, 12, 7], [18, 6, 19, 5], [15, 11, 16, 10], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(1, 12, 2, 13), (17, 2, 18, 3), (3, 16, 4, 17), (9, 4, 10, 5), (14, 5, 15, 6), (6, 19, 7, 20), (20, 7, 1, 8), (8, 13, 9, 14), (15, 10, 16, 11), (11, 18, 12, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 8, 9], [0, 9, 9, 5], [1, 4, 8, 6], [1, 5, 8, 7], [1, 6, 2, 2], [3, 6, 5, 9], [3, 8, 4, 4]]

Total optimal pinning sets: 2

Average optimal degree: 2.5

Total minimal pinning sets: 8

Average minimal degree: 2.78

Total pinning sets: 552

Average overall degree: 3.12

Pinning number: 4

Table 917: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	0	6
Nonminimal pinning sets	0	15	76	141	154	104	43	10	1	544
Average degree	2.5	2.79	2.96	3.08	3.16	3.23	3.27	3.31	3.33	

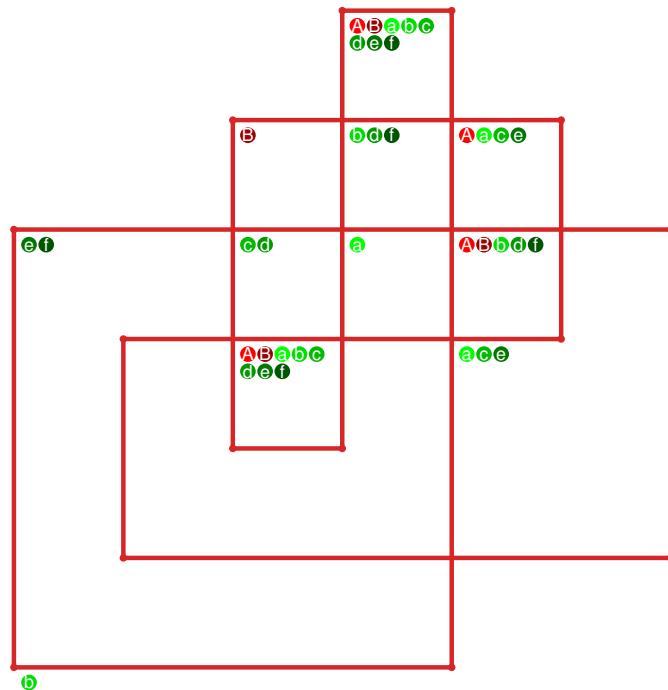


Figure 1837: SnapPy multiloop plot.

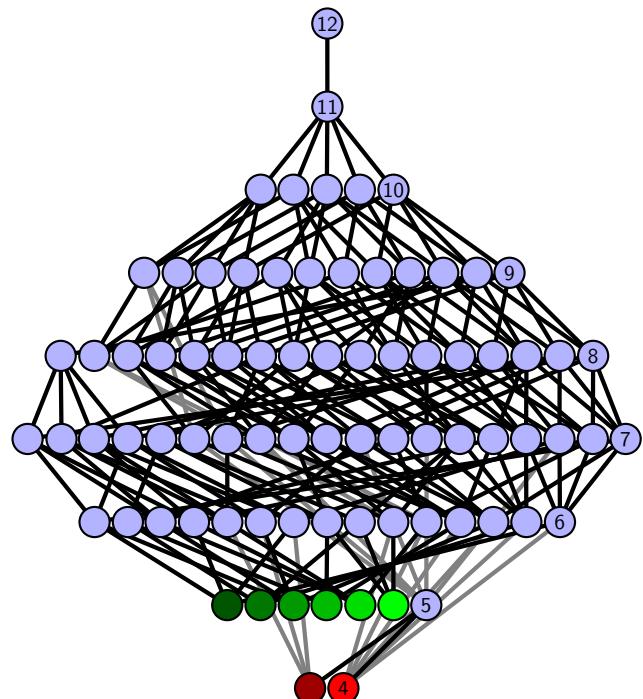


Figure 1838: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.622 [[14, 5, 1, 6], [6, 15, 7, 20], [13, 19, 14, 20], [4, 18, 5, 19], [1, 10, 2, 11], [15, 11, 16, 12], [7, 12, 8, 13], [17, 3, 18, 4], [9, 2, 10, 3], [16, 9, 17, 8]]

PD code drawn by SnapPy: [(7, 14, 8, 1), (20, 1, 15, 2), (12, 3, 13, 4), (6, 19, 7, 20), (13, 8, 14, 9), (18, 9, 19, 10), (5, 10, 6, 11), (2, 15, 3, 16), (11, 16, 12, 17), (17, 4, 18, 5)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 7], [0, 8, 8, 5], [1, 4, 9, 6], [1, 5, 9, 2], [3, 9, 8, 3], [4, 7, 9, 4], [5, 8, 7, 6]]

Total optimal pinning sets: 6
 Total minimal pinning sets: 12
 Total pinning sets: 396
 Pinning number: 5

Average optimal degree: 2.7
 Average minimal degree: 2.74
 Average overall degree: 3.11

Table 918: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	6	0	0	0	0	0	0	6
Nonminimal pinning sets	0	31	91	119	91	41	10	1	384
Average degree	2.7	2.87	3.02	3.13	3.21	3.27	3.31	3.33	

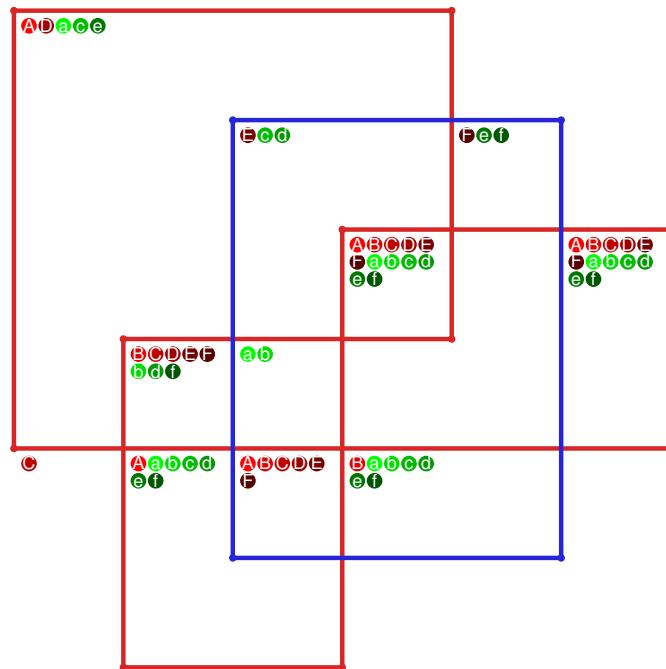


Figure 1839: SnapPy multiloop plot.

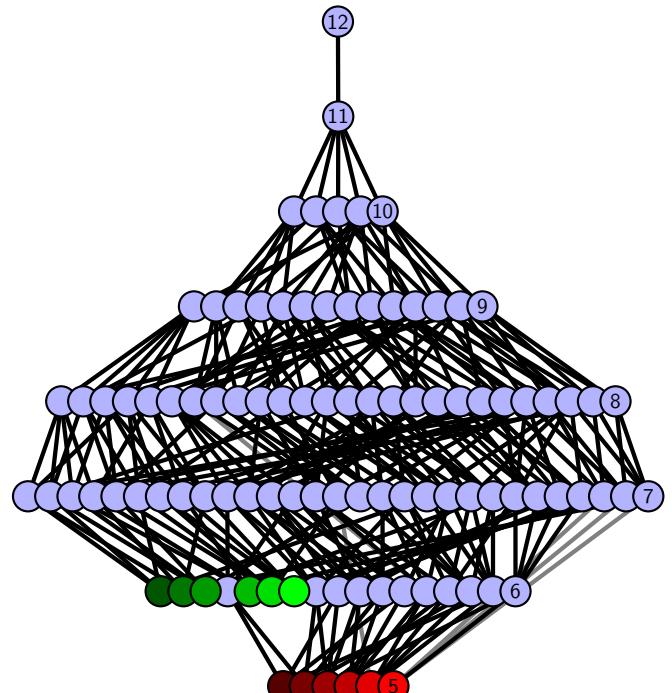


Figure 1840: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.623 [[14, 9, 1, 10], [10, 6, 11, 5], [13, 4, 14, 5], [8, 3, 9, 4], [1, 15, 2, 20], [6, 20, 7, 19], [11, 19, 12, 18], [12, 17, 13, 18], [7, 16, 8, 17], [2, 15, 3, 16]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (11, 2, 12, 3), (3, 8, 4, 9), (12, 7, 13, 8), (5, 16, 6, 17), (10, 17, 11, 18), (18, 9, 19, 10), (19, 4, 20, 5), (20, 13, 15, 14), (14, 15, 1, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 3], [0, 2, 8, 9], [0, 9, 9, 5], [1, 4, 8, 6], [1, 5, 7, 7], [2, 6, 6, 8], [3, 7, 5, 9], [3, 8, 4, 4]]

Total optimal pinning sets: 16
 Total minimal pinning sets: 18
 Total pinning sets: 603
 Pinning number: 5

Average optimal degree: 2.8
 Average minimal degree: 2.84
 Average overall degree: 3.14

Table 919: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	16	0	0	0	0	0	0	0	16
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	78	164	176	112	44	10	1	585
Average degree	2.8	2.98	3.1	3.18	3.24	3.28	3.31	3.33	

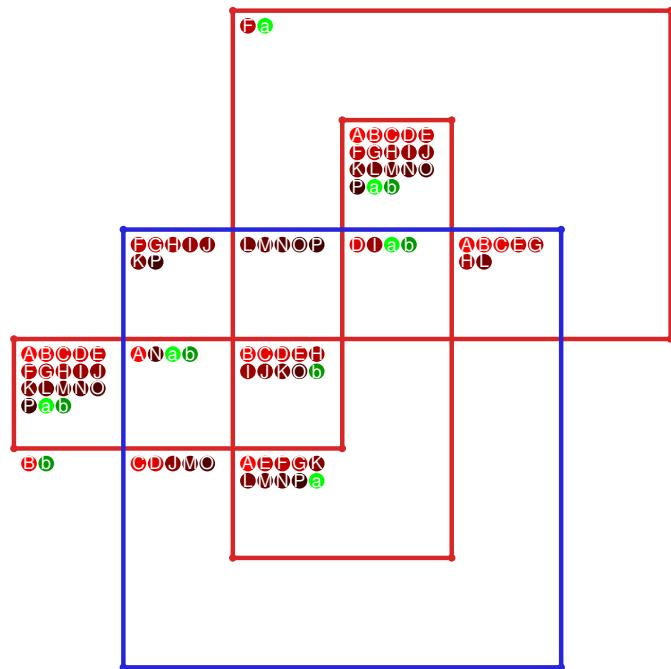


Figure 1841: SnapPy multiloop plot.

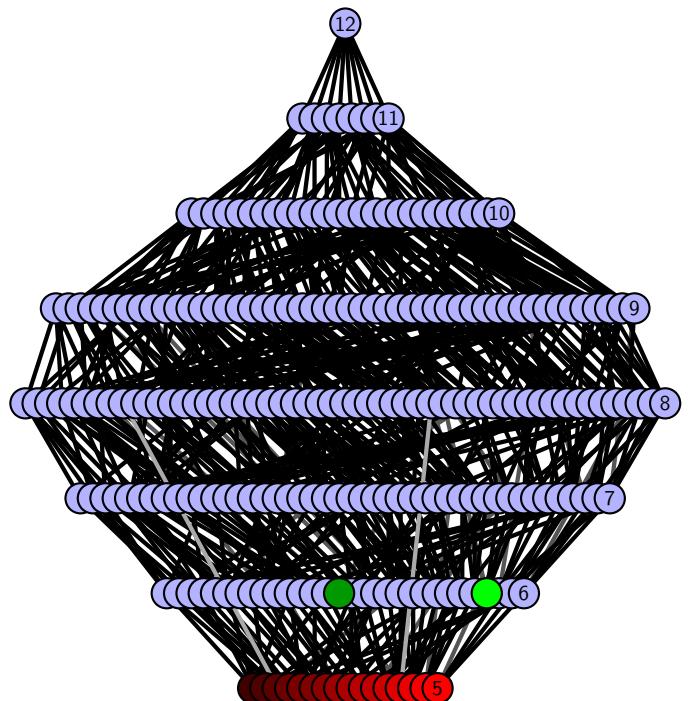


Figure 1842: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.624 [[14, 20, 1, 15], [15, 6, 16, 5], [13, 4, 14, 5], [19, 3, 20, 4], [1, 10, 2, 11], [6, 17, 7, 16], [7, 12, 8, 13], [8, 18, 9, 19], [9, 2, 10, 3], [11, 18, 12, 17]]

PD code drawn by SnapPy: [(7, 14, 8, 1), (18, 1, 19, 2), (11, 2, 12, 3), (3, 20, 4, 15), (13, 8, 14, 9), (5, 10, 6, 11), (16, 9, 17, 10), (6, 17, 7, 18), (12, 19, 13, 20), (15, 4, 16, 5)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 7, 8], [0, 8, 8, 9], [1, 9, 6, 1], [2, 5, 9, 7], [3, 6, 9, 8], [3, 7, 4, 4], [4, 7, 6, 5]]

Total optimal pinning sets: 10
 Total minimal pinning sets: 10
 Total pinning sets: 480
 Pinning number: 5

Average optimal degree: 2.72
 Average minimal degree: 2.72
 Average overall degree: 3.12

Table 920: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	10	0	0	0	0	0	0	0	10
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	53	118	143	102	43	10	1	470
Average degree	2.72	2.92	3.06	3.15	3.22	3.27	3.31	3.33	

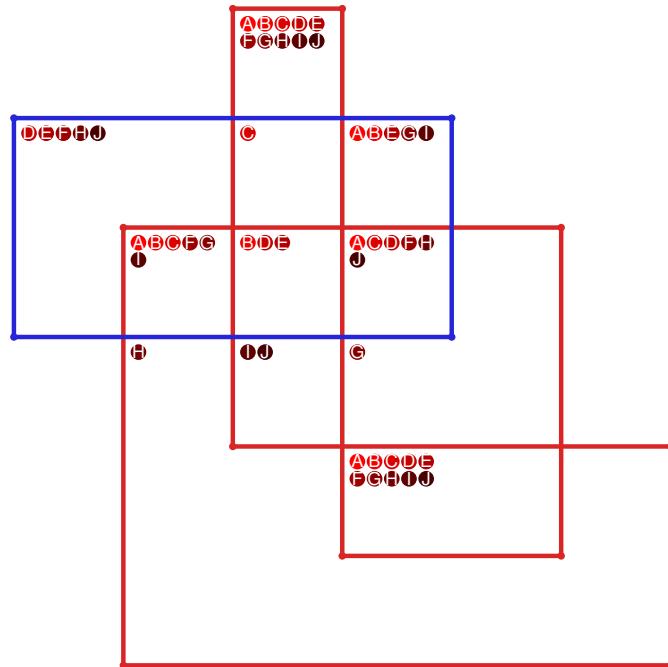


Figure 1843: SnapPy multiloop plot.

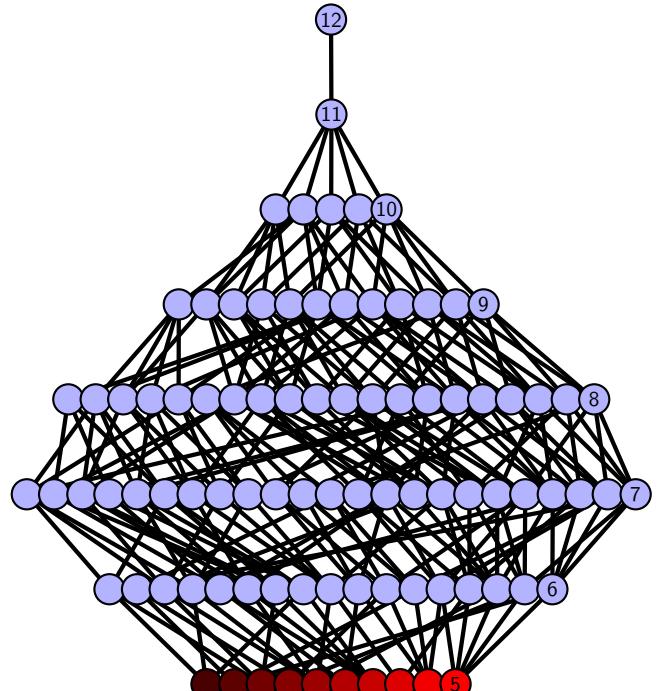


Figure 1844: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.625 $[[9, 20, 10, 1], [19, 8, 20, 9], [10, 2, 11, 1], [7, 18, 8, 19], [2, 16, 3, 15], [11, 15, 12, 14], [6, 13, 7, 14], [17, 4, 18, 5], [16, 4, 17, 3], [12, 5, 13, 6]]$

PD code drawn by SnapPy: $[(1, 14, 2, 15), (15, 2, 16, 3), (10, 3, 11, 4), (17, 6, 18, 7), (4, 11, 5, 12), (12, 9, 13, 10), (13, 20, 14, 1), (5, 16, 6, 17), (7, 18, 8, 19), (19, 8, 20, 9)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 6, 7, 1], [2, 8, 8, 5], [2, 4, 9, 6], [3, 5, 9, 9], [3, 9, 8, 8], [4, 7, 7, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 921: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

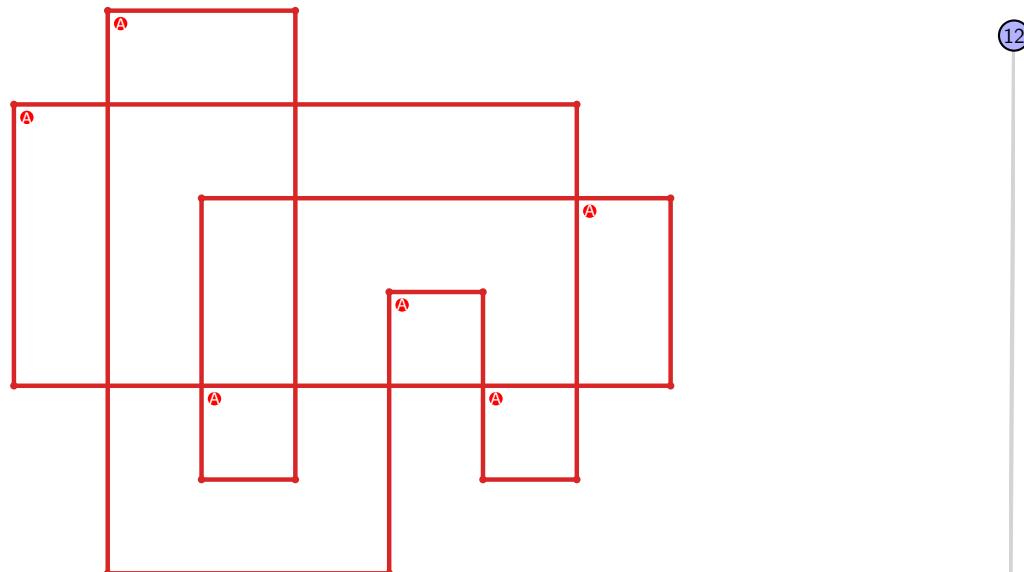


Figure 1845: SnapPy multiloop plot.



Figure 1846: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.626 $[[9, 20, 10, 1], [8, 13, 9, 14], [19, 6, 20, 7], [10, 2, 11, 1], [14, 11, 15, 12], [12, 7, 13, 8], [5, 18, 6, 19], [2, 16, 3, 15], [17, 4, 18, 5], [16, 4, 17, 3]]$

PD code drawn by SnapPy: $[(20, 13, 1, 14), (14, 1, 15, 2), (16, 3, 17, 4), (9, 4, 10, 5), (11, 8, 12, 9), (5, 10, 6, 11), (12, 19, 13, 20), (2, 15, 3, 16), (6, 17, 7, 18), (18, 7, 19, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 5, 6, 6], [0, 7, 4, 0], [1, 3, 7, 5], [1, 4, 2, 1], [2, 8, 8, 2], [3, 9, 9, 4], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 922: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

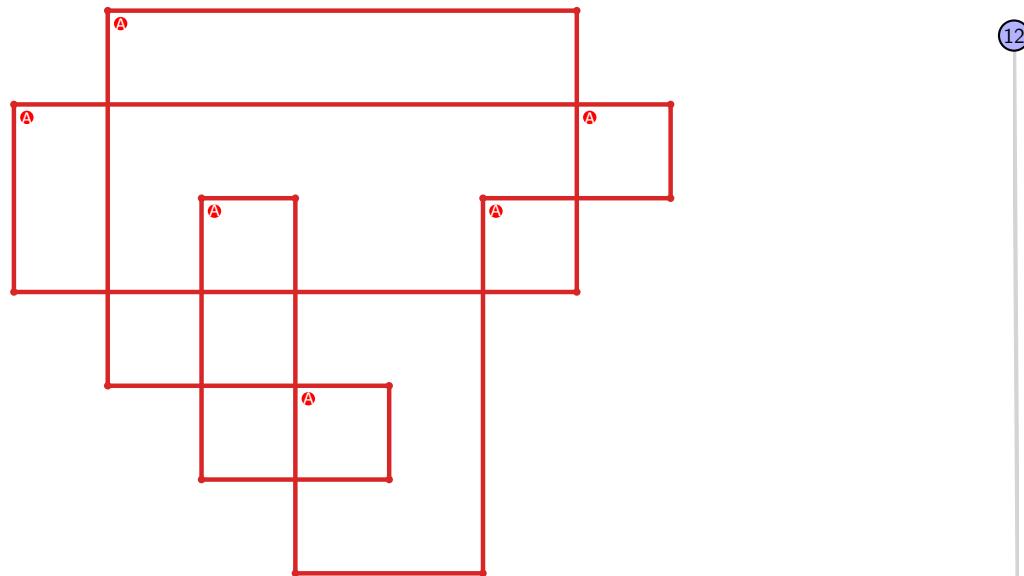


Figure 1847: SnapPy multiloop plot.



Figure 1848: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.627 $[[8, 14, 1, 9], [9, 15, 10, 20], [7, 19, 8, 20], [13, 3, 14, 4], [1, 12, 2, 11], [15, 11, 16, 10], [16, 6, 17, 7], [18, 4, 19, 5], [2, 12, 3, 13], [5, 17, 6, 18]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (15, 2, 16, 3), (19, 4, 20, 5), (13, 18, 14, 19), (14, 7, 9, 8), (8, 9, 1, 10), (6, 11, 7, 12), (3, 20, 4, 15), (5, 16, 6, 17), (17, 12, 18, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 8, 8], [0, 8, 8, 5], [1, 4, 6, 1], [2, 5, 9, 9], [2, 9, 9, 3], [3, 4, 4, 3], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 923: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

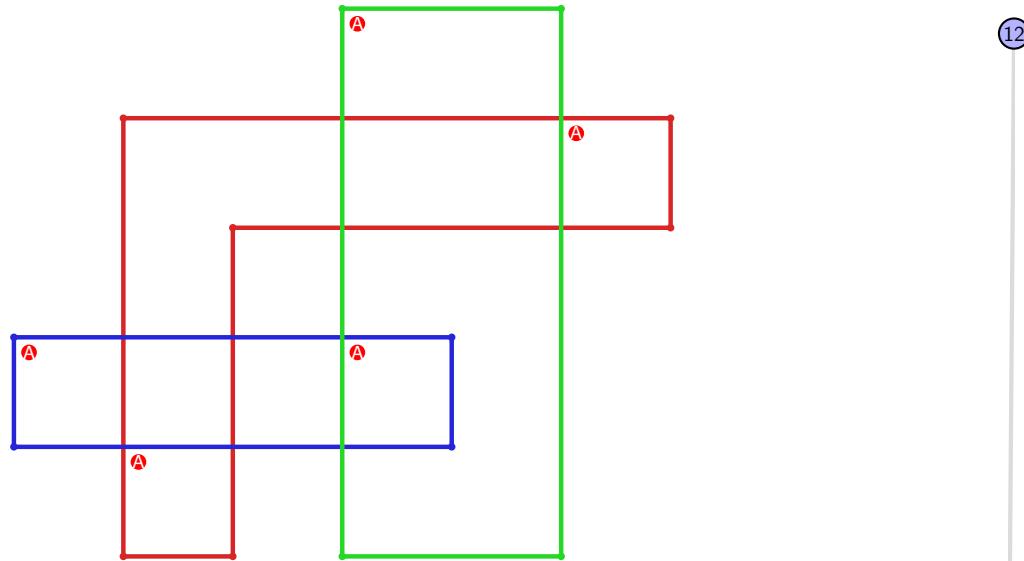


Figure 1849: SnapPy multiloop plot.



Figure 1850: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.628 [[20, 5, 1, 6], [6, 15, 7, 16], [16, 19, 17, 20], [4, 11, 5, 12], [1, 9, 2, 8], [14, 7, 15, 8], [18, 13, 19, 14], [17, 13, 18, 12], [10, 3, 11, 4], [9, 3, 10, 2]]

PD code drawn by SnapPy: [(20, 7, 1, 8), (8, 1, 9, 2), (18, 3, 19, 4), (12, 5, 13, 6), (6, 19, 7, 20), (2, 9, 3, 10), (10, 15, 11, 16), (16, 11, 17, 12), (4, 13, 5, 14), (14, 17, 15, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 8, 8], [0, 9, 9, 5], [1, 4, 6, 1], [2, 5, 7, 7], [2, 6, 6, 3], [3, 9, 9, 3], [4, 8, 8, 4]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 120
 Pinning number: 6

Average optimal degree: 2.25
 Average minimal degree: 2.25
 Average overall degree: 2.92

Table 924: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	34	35	21	7	1	116
Average degree	2.25	2.6	2.85	3.02	3.14	3.25	3.33	

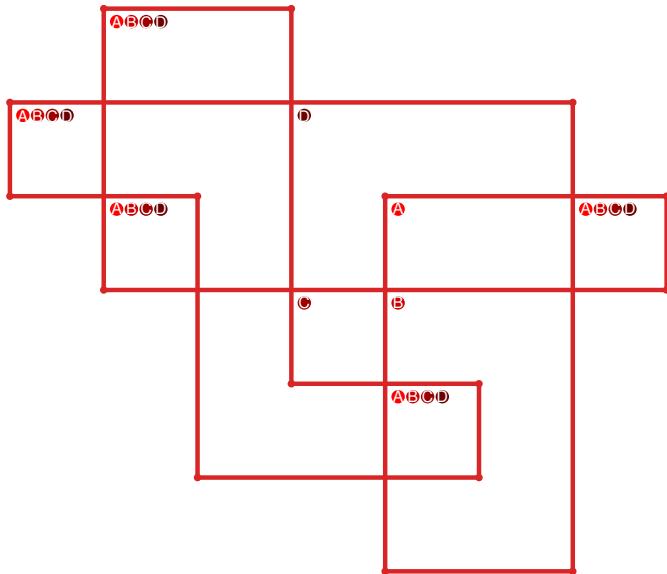


Figure 1851: SnapPy multiloop plot.

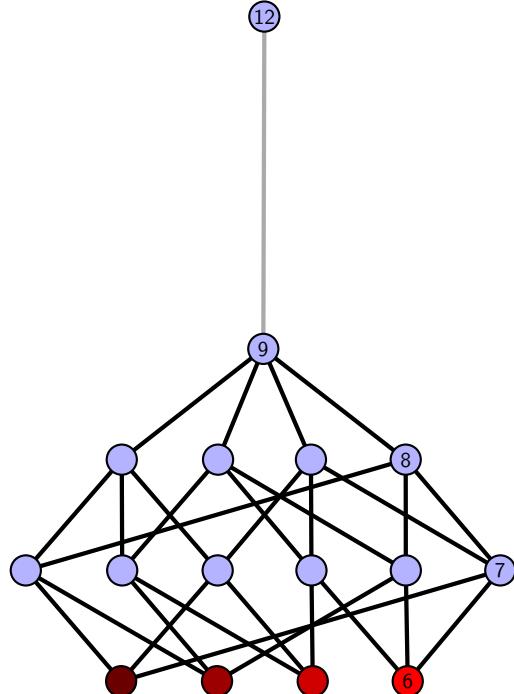


Figure 1852: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.629 [[20, 11, 1, 12], [12, 19, 13, 20], [10, 1, 11, 2], [18, 13, 19, 14], [2, 5, 3, 6], [6, 9, 7, 10], [14, 7, 15, 8], [4, 17, 5, 18], [3, 17, 4, 16], [8, 15, 9, 16]]

PD code drawn by SnapPy: [(20, 3, 1, 4), (12, 5, 13, 6), (4, 7, 5, 8), (18, 9, 19, 10), (16, 11, 17, 12), (6, 13, 7, 14), (14, 1, 15, 2), (2, 15, 3, 16), (10, 17, 11, 18), (8, 19, 9, 20)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 6, 7, 1], [2, 7, 8, 5], [2, 4, 9, 6], [3, 5, 9, 9], [3, 8, 8, 4], [4, 7, 7, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 3

Average optimal degree: 2.22

Total minimal pinning sets: 3

Average minimal degree: 2.22

Total pinning sets: 112

Average overall degree: 2.92

Pinning number: 6

Table 925: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	31	34	21	7	1	109
Average degree	2.22	2.57	2.82	3.01	3.14	3.25	3.33	

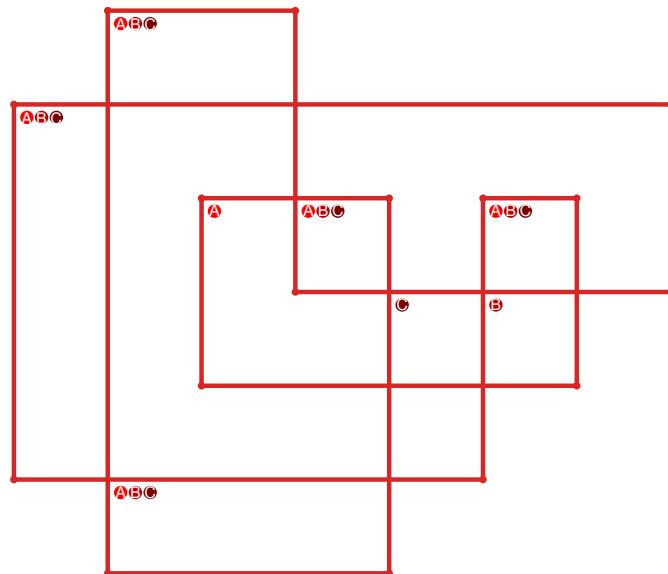


Figure 1853: SnapPy multiloop plot.

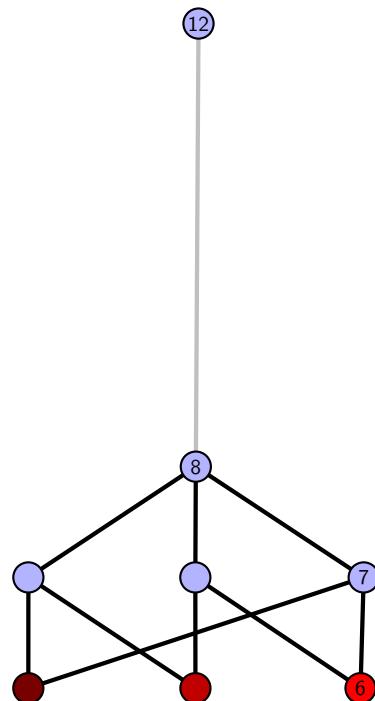


Figure 1854: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.630 [[14, 20, 1, 15], [15, 6, 16, 5], [19, 13, 20, 14], [1, 13, 2, 12], [6, 3, 7, 4], [16, 4, 17, 5], [18, 8, 19, 9], [2, 11, 3, 12], [7, 11, 8, 10], [17, 10, 18, 9]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (15, 2, 16, 3), (3, 20, 4, 15), (17, 6, 18, 7), (7, 16, 8, 17), (8, 5, 9, 6), (14, 9, 1, 10), (10, 13, 11, 14), (18, 11, 19, 12), (12, 19, 13, 20)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 5], [0, 6, 3, 0], [0, 2, 7, 7], [1, 7, 8, 5], [1, 4, 9, 1], [2, 9, 9, 8], [3, 8, 4, 3], [4, 7, 6, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 8

Average minimal degree: 2.42

Total pinning sets: 216

Average overall degree: 2.99

Pinning number: 5

Table 926: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	7	44	65	55	28	8	1	208
Average degree	2.4	2.55	2.81	2.98	3.11	3.2	3.27	3.33	

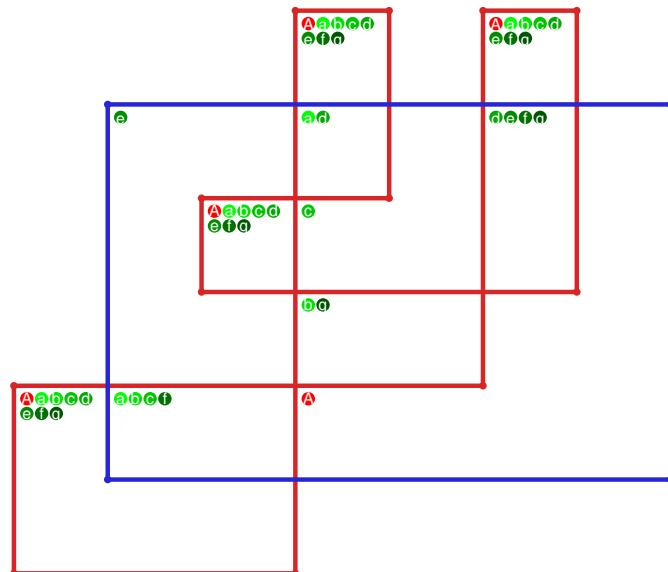


Figure 1855: SnapPy multiloop plot.

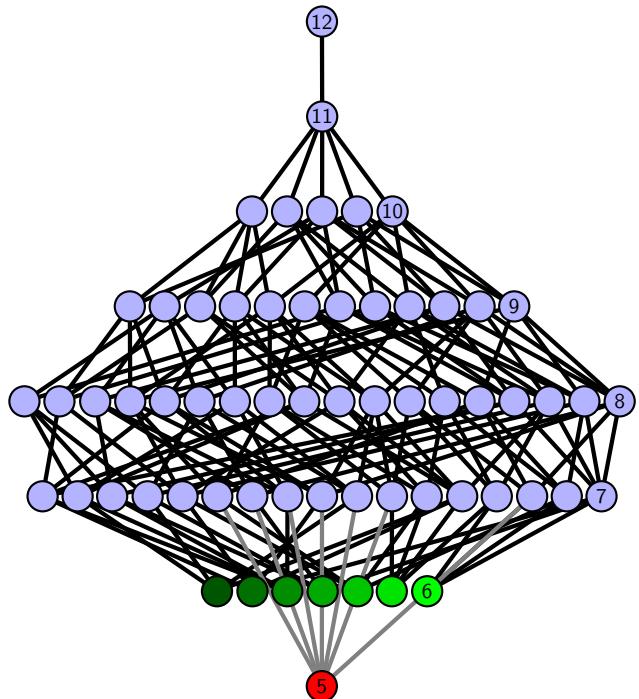


Figure 1856: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.631 [[13, 20, 14, 1], [12, 5, 13, 6], [19, 8, 20, 9], [14, 2, 15, 1], [6, 3, 7, 4], [4, 11, 5, 12], [9, 18, 10, 19], [7, 16, 8, 17], [2, 16, 3, 15], [17, 10, 18, 11]]

PD code drawn by SnapPy: [(4, 1, 5, 2), (10, 3, 11, 4), (17, 6, 18, 7), (15, 8, 16, 9), (2, 9, 3, 10), (13, 20, 14, 1), (5, 14, 6, 15), (7, 16, 8, 17), (11, 18, 12, 19), (19, 12, 20, 13)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 7], [0, 8, 8, 0], [1, 8, 7, 5], [1, 4, 9, 1], [2, 9, 9, 2], [2, 9, 4, 8], [3, 7, 4, 3], [5, 7, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 927: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

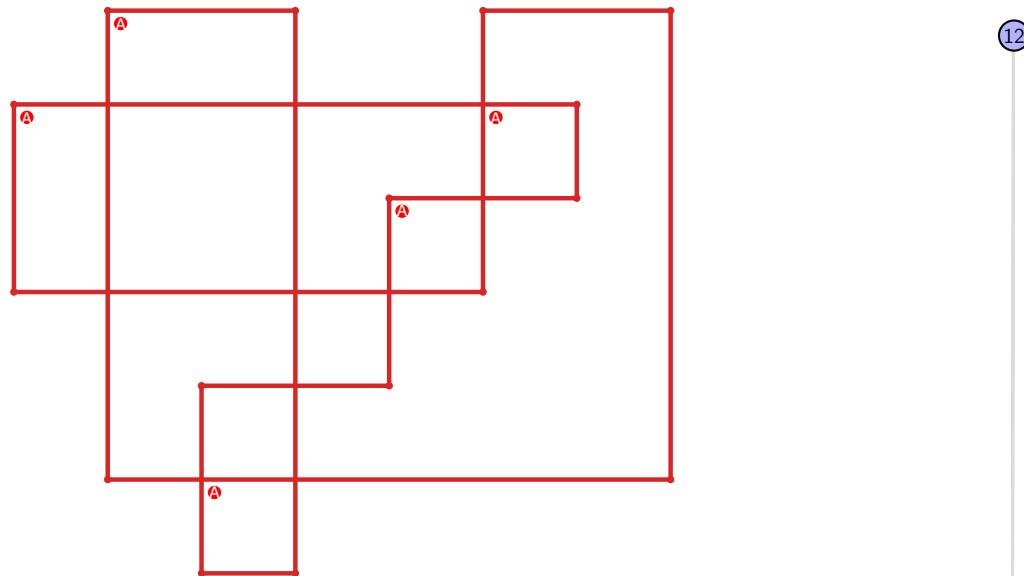


Figure 1857: SnapPy multiloop plot.



Figure 1858: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.632 [[20, 15, 1, 16], [16, 5, 17, 6], [19, 10, 20, 11], [14, 1, 15, 2], [4, 7, 5, 8], [17, 7, 18, 6], [11, 18, 12, 19], [12, 9, 13, 10], [2, 13, 3, 14], [8, 3, 9, 4]]

PD code drawn by SnapPy: [(5, 20, 6, 1), (13, 2, 14, 3), (3, 14, 4, 15), (1, 4, 2, 5), (9, 6, 10, 7), (16, 7, 17, 8), (19, 10, 20, 11), (17, 12, 18, 13), (8, 15, 9, 16), (11, 18, 12, 19)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 7], [0, 8, 8, 0], [1, 9, 9, 5], [1, 4, 6, 1], [2, 5, 7, 2], [2, 6, 9, 8], [3, 7, 9, 3], [4, 8, 7, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 928: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

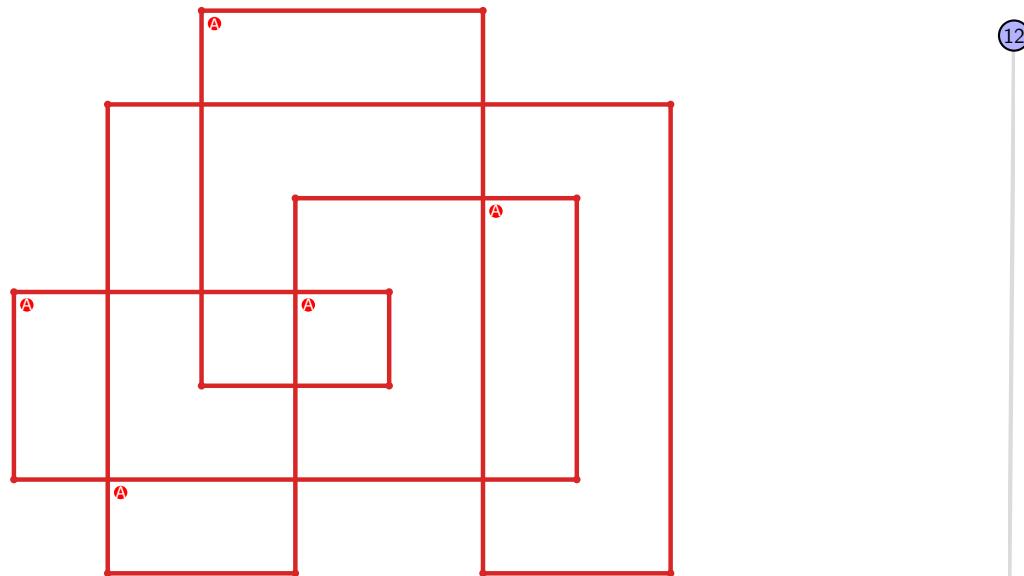


Figure 1859: SnapPy multiloop plot.

5

Figure 1860: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.633 [[20, 13, 1, 14], [14, 19, 15, 20], [12, 9, 13, 10], [1, 9, 2, 8], [18, 5, 19, 6], [15, 11, 16, 10], [16, 11, 17, 12], [2, 7, 3, 8], [6, 3, 7, 4], [4, 17, 5, 18]]

PD code drawn by `SnapPy`: [(4, 1, 5, 2), (16, 3, 17, 4), (20, 5, 1, 6), (6, 19, 7, 20), (10, 7, 11, 8), (8, 13, 9, 14), (14, 9, 15, 10), (18, 11, 19, 12), (2, 15, 3, 16), (12, 17, 13, 18)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 3], [0, 2, 7, 7], [1, 8, 9, 9], [1, 6, 6, 2], [2, 5, 5, 9], [3, 8, 8, 3], [4, 7, 7, 9], [4, 8, 6, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 929: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

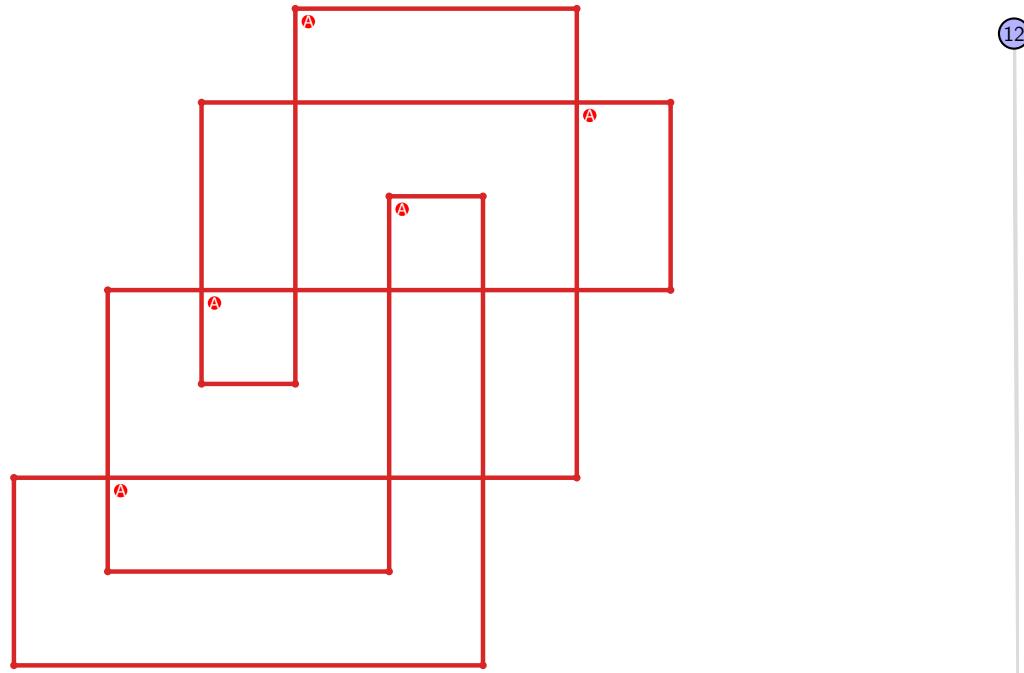


Figure 1861: `SnapPy` multiloop plot.

Figure 1862: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.634 [[20, 5, 1, 6], [6, 13, 7, 14], [14, 19, 15, 20], [4, 1, 5, 2], [12, 7, 13, 8], [18, 15, 19, 16], [2, 10, 3, 9], [3, 8, 4, 9], [11, 16, 12, 17], [17, 10, 18, 11]]

PD code drawn by SnapPy: [(18, 3, 19, 4), (10, 5, 11, 6), (1, 6, 2, 7), (7, 20, 8, 1), (15, 8, 16, 9), (4, 11, 5, 12), (16, 13, 17, 14), (9, 14, 10, 15), (12, 17, 13, 18), (2, 19, 3, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 7, 0], [1, 7, 8, 1], [2, 8, 9, 2], [3, 9, 7, 7], [3, 6, 6, 4], [4, 9, 9, 5], [5, 8, 8, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 930: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

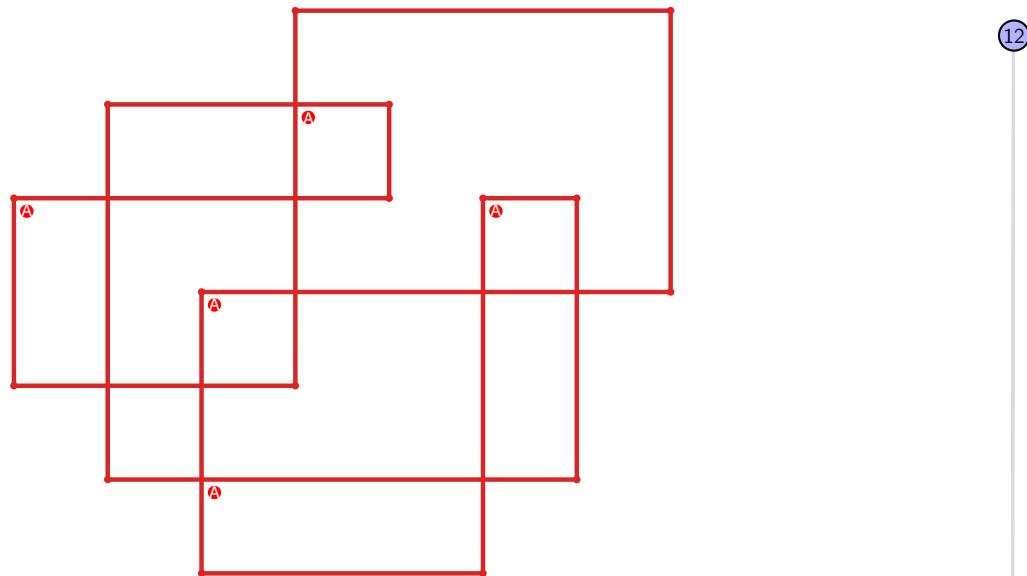


Figure 1863: SnapPy multiloop plot.



Figure 1864: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.635 $[[14, 5, 1, 6], [6, 15, 7, 20], [13, 19, 14, 20], [4, 1, 5, 2], [15, 8, 16, 7], [16, 12, 17, 13], [18, 10, 19, 11], [2, 10, 3, 9], [3, 8, 4, 9], [11, 17, 12, 18]]$

PD code drawn by `SnapPy`: $[(11, 2, 12, 3), (4, 15, 5, 16), (14, 5, 1, 6), (6, 13, 7, 14), (18, 7, 19, 8), (16, 9, 17, 10), (1, 12, 2, 13), (8, 17, 9, 18), (10, 19, 11, 20), (20, 3, 15, 4)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 7, 8, 0], [1, 8, 5, 1], [2, 4, 9, 9], [2, 9, 9, 7], [3, 6, 8, 8], [3, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 931: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

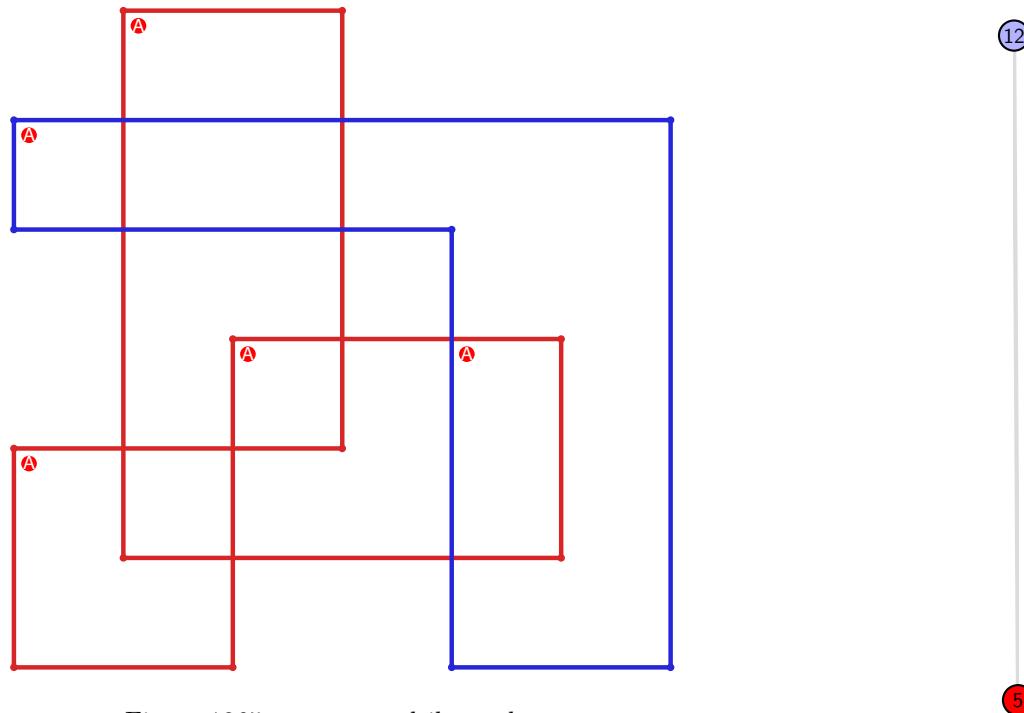


Figure 1865: `SnapPy` multiloop plot.

Figure 1866: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.636 $[[7, 20, 8, 1], [15, 6, 16, 7], [16, 19, 17, 20], [8, 2, 9, 1], [5, 14, 6, 15], [18, 13, 19, 14], [17, 13, 18, 12], [2, 12, 3, 11], [9, 4, 10, 5], [3, 10, 4, 11]]$

PD code drawn by `SnapPy`: $[(6, 1, 7, 2), (12, 3, 13, 4), (20, 7, 1, 8), (8, 19, 9, 20), (9, 14, 10, 15), (15, 10, 16, 11), (2, 11, 3, 12), (13, 16, 14, 17), (4, 17, 5, 18), (18, 5, 19, 6)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 7, 8, 0], [1, 8, 5, 1], [2, 4, 6, 6], [2, 5, 5, 7], [3, 6, 9, 9], [3, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 128

Average overall degree: 2.91

Pinning number: 5

Table 932: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	7	21	35	35	21	7	1	127
Average degree	2.0	2.38	2.65	2.86	3.02	3.14	3.25	3.33	

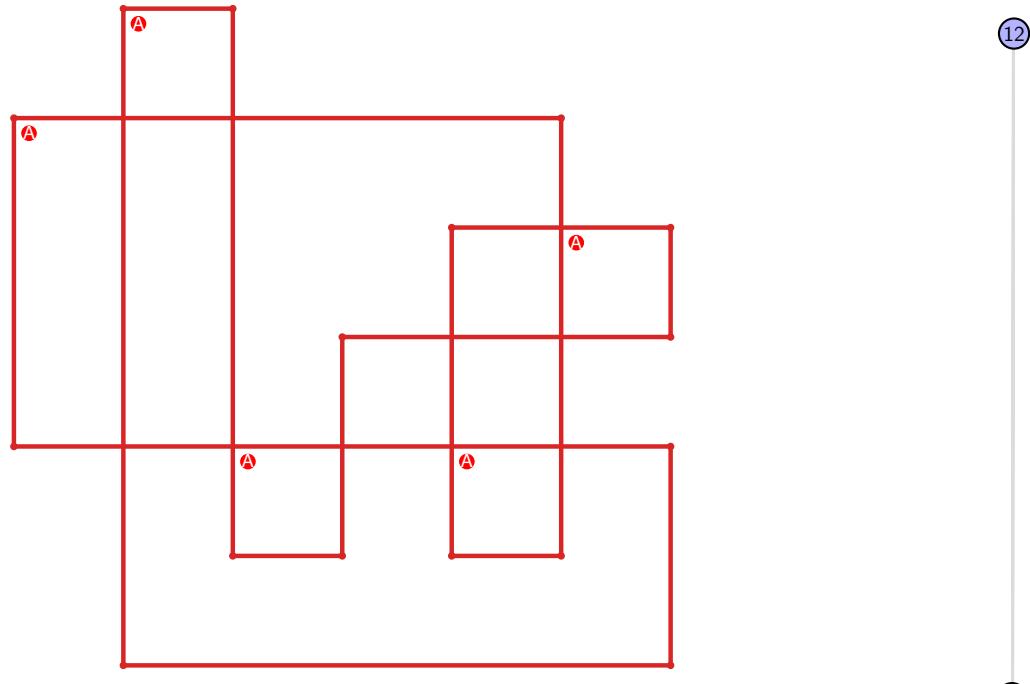


Figure 1867: `SnapPy` multiloop plot.

Figure 1868: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.637 [[20, 3, 1, 4], [4, 15, 5, 16], [16, 19, 17, 20], [2, 9, 3, 10], [1, 9, 2, 8], [14, 7, 15, 8], [5, 13, 6, 12], [18, 11, 19, 12], [17, 11, 18, 10], [6, 13, 7, 14]]

PD code drawn by SnapPy: [(18, 1, 19, 2), (12, 5, 13, 6), (6, 19, 7, 20), (20, 7, 1, 8), (8, 15, 9, 16), (16, 9, 17, 10), (10, 3, 11, 4), (4, 11, 5, 12), (2, 13, 3, 14), (14, 17, 15, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 8], [0, 8, 4, 4], [0, 3, 3, 5], [1, 4, 9, 9], [1, 9, 9, 7], [2, 6, 8, 8], [2, 7, 7, 3], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 6

Average minimal degree: 2.4

Total pinning sets: 208

Average overall degree: 2.99

Pinning number: 5

Table 933: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	5
Nonminimal pinning sets	0	7	40	63	55	28	8	1	202
Average degree	2.4	2.56	2.79	2.98	3.11	3.2	3.27	3.33	

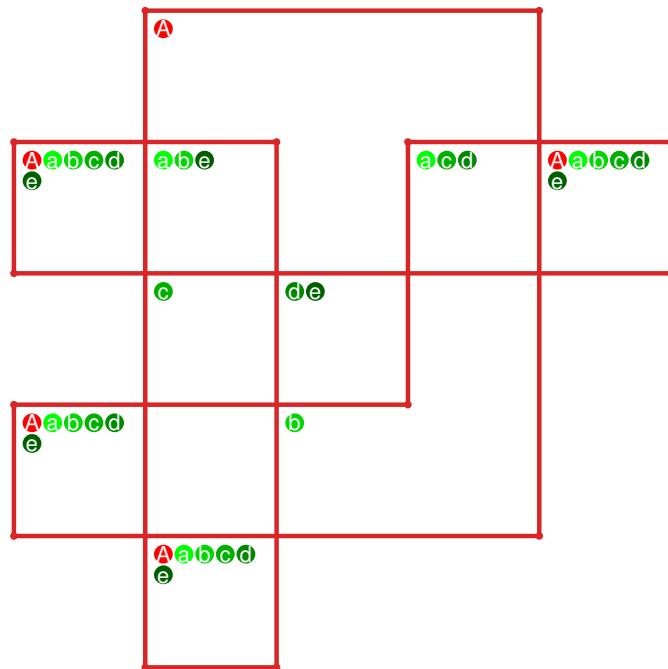


Figure 1869: SnapPy multiloop plot.

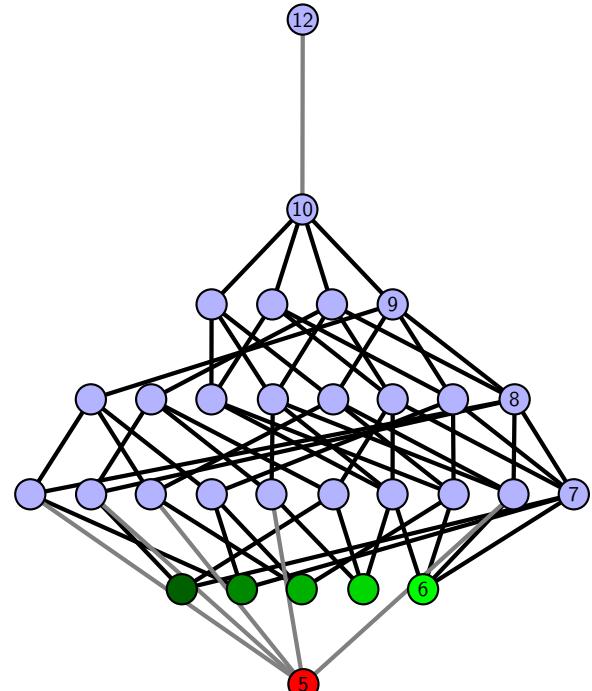


Figure 1870: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.638 [[8, 12, 1, 9], [9, 7, 10, 8], [11, 20, 12, 13], [1, 20, 2, 19], [6, 18, 7, 19], [10, 14, 11, 13], [2, 14, 3, 15], [17, 5, 18, 6], [3, 16, 4, 15], [4, 16, 5, 17]]

PD code drawn by SnapPy: [(12, 3, 13, 4), (18, 5, 19, 6), (6, 17, 7, 18), (2, 11, 3, 12), (4, 13, 5, 14), (14, 7, 15, 8), (20, 15, 17, 16), (16, 19, 9, 20), (8, 9, 1, 10), (10, 1, 11, 2)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 3], [0, 2, 6, 4], [1, 3, 7, 7], [1, 6, 2, 2], [3, 5, 8, 8], [4, 9, 9, 4], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 64
 Pinning number: 6

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.85

Table 934: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

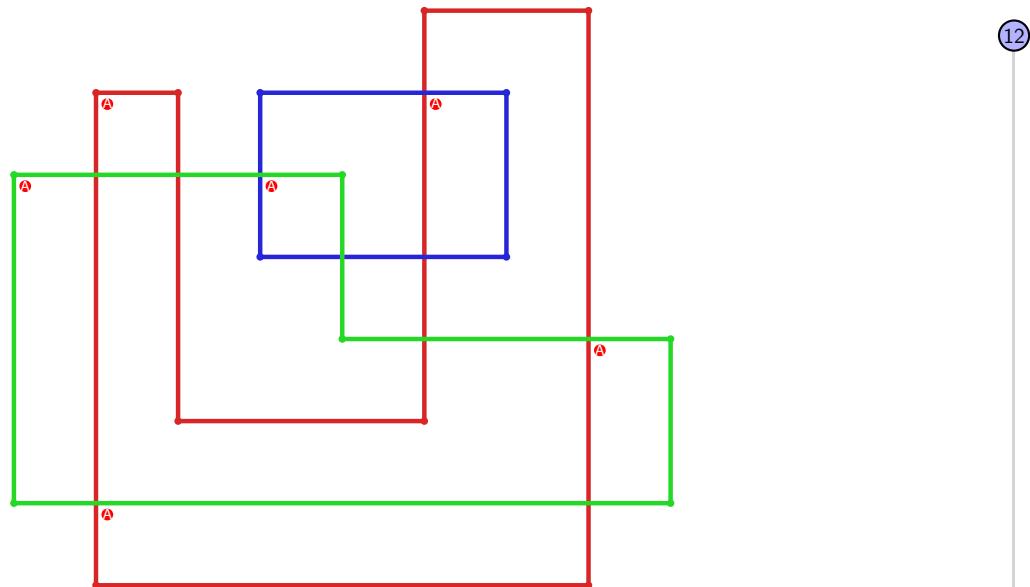


Figure 1871: SnapPy multiloop plot.



Figure 1872: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.639 `[[7, 20, 8, 1], [19, 6, 20, 7], [8, 16, 9, 15], [1, 15, 2, 14], [5, 18, 6, 19], [16, 10, 17, 9], [2, 11, 3, 12], [4, 13, 5, 14], [17, 10, 18, 11], [3, 13, 4, 12]]`

PD code drawn by `SnapPy`: `[(17, 4, 18, 5), (7, 14, 8, 15), (15, 8, 16, 9), (20, 9, 1, 10), (10, 1, 11, 2), (2, 11, 3, 12), (12, 19, 13, 20), (13, 6, 14, 7), (3, 16, 4, 17), (5, 18, 6, 19)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 3], [0, 2, 6, 7], [1, 7, 8, 1], [2, 8, 8, 2], [3, 8, 9, 9], [3, 9, 9, 4], [4, 6, 5, 5], [6, 7, 7, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 935: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

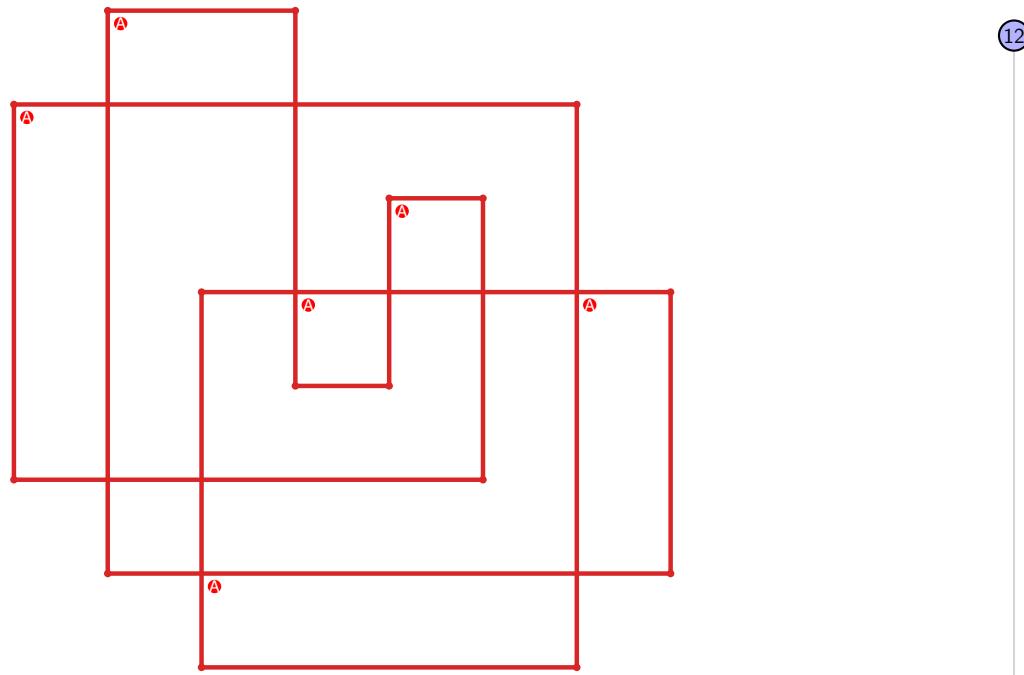


Figure 1873: `SnapPy` multiloop plot.

Figure 1874: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.640 $[[6, 12, 1, 7], [7, 5, 8, 6], [11, 20, 12, 13], [1, 20, 2, 19], [4, 18, 5, 19], [8, 16, 9, 15], [13, 10, 14, 11], [2, 16, 3, 17], [17, 3, 18, 4], [9, 14, 10, 15]]$

PD code drawn by `SnapPy`: $[(8, 1, 9, 2), (16, 3, 17, 4), (12, 19, 13, 20), (4, 15, 5, 16), (14, 17, 7, 18), (6, 7, 1, 8), (2, 9, 3, 10), (10, 5, 11, 6), (20, 11, 15, 12), (18, 13, 19, 14)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 3], [0, 2, 7, 4], [1, 3, 8, 8], [1, 7, 9, 9], [2, 9, 9, 2], [3, 5, 8, 8], [4, 7, 7, 4], [5, 6, 6, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 936: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

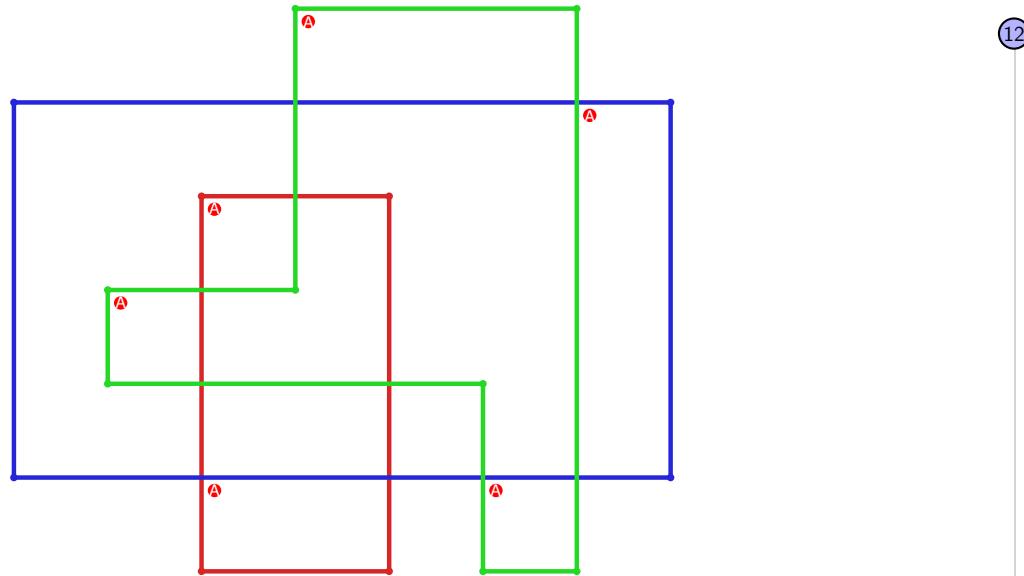


Figure 1875: `SnapPy` multiloop plot.

6

Figure 1876: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.641 $[[20, 5, 1, 6], [6, 16, 7, 15], [19, 14, 20, 15], [4, 11, 5, 12], [1, 9, 2, 8], [16, 8, 17, 7], [13, 18, 14, 19], [12, 18, 13, 17], [10, 3, 11, 4], [9, 3, 10, 2]]$

PD code drawn by SnapPy: $[(20, 7, 1, 8), (8, 1, 9, 2), (18, 3, 19, 4), (5, 14, 6, 15), (6, 19, 7, 20), (2, 9, 3, 10), (17, 12, 18, 13), (13, 4, 14, 5), (15, 10, 16, 11), (11, 16, 12, 17)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 6], [0, 7, 8, 8], [0, 9, 9, 5], [1, 4, 7, 1], [2, 7, 7, 2], [3, 6, 6, 5], [3, 9, 9, 3], [4, 8, 8, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 937: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

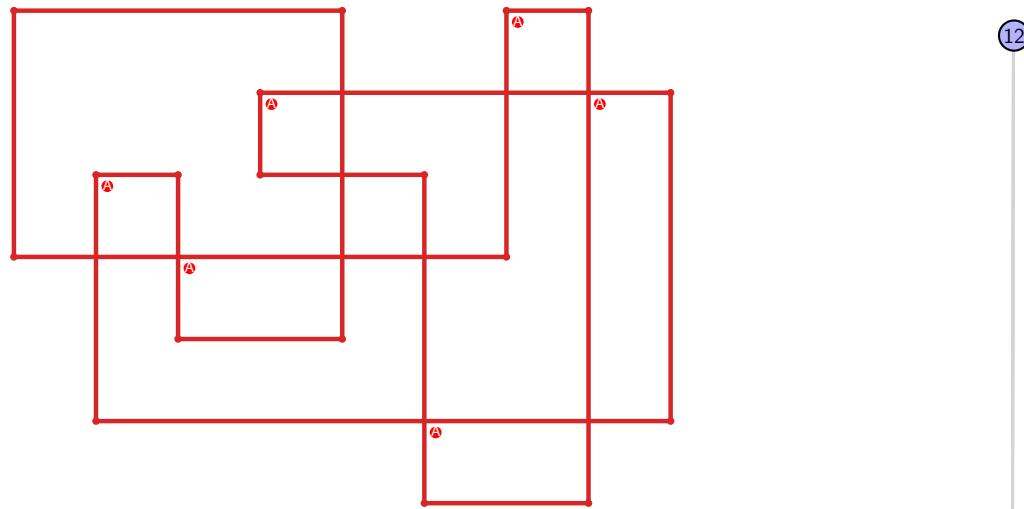


Figure 1877: SnapPy multiloop plot.

6

12

Figure 1878: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.642 [[8, 16, 1, 9], [9, 17, 10, 20], [7, 19, 8, 20], [15, 1, 16, 2], [17, 11, 18, 10], [18, 6, 19, 7], [2, 14, 3, 15], [11, 3, 12, 4], [13, 5, 14, 6], [12, 5, 13, 4]]

PD code drawn by `SnapPy`: [(14, 1, 15, 2), (2, 15, 3, 16), (16, 3, 9, 4), (17, 4, 18, 5), (10, 7, 11, 8), (8, 9, 1, 10), (6, 11, 7, 12), (13, 20, 14, 17), (5, 18, 6, 19), (19, 12, 20, 13)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 6, 0], [1, 7, 5, 1], [2, 4, 8, 2], [3, 8, 7, 3], [4, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 938: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

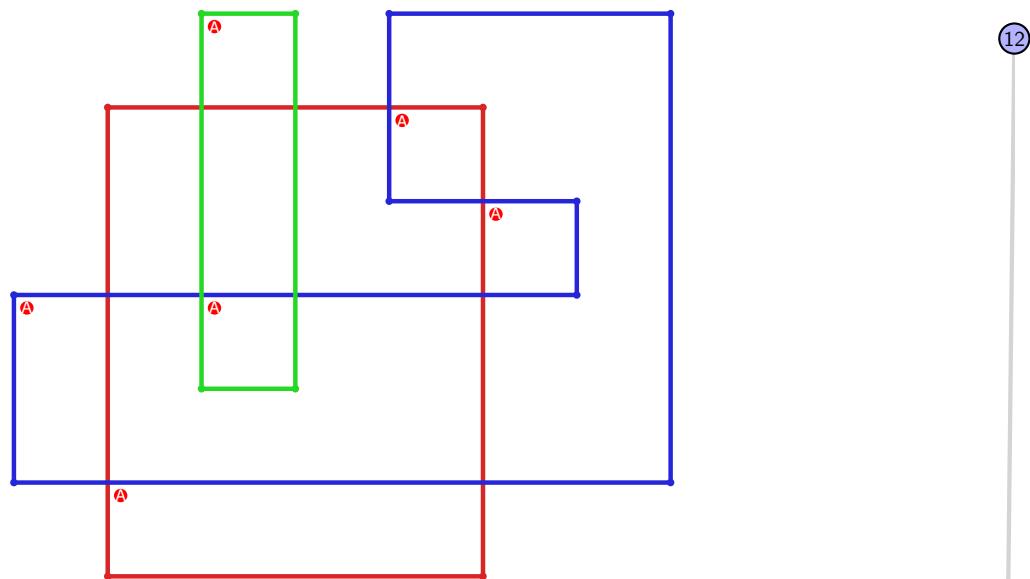


Figure 1879: `SnapPy` multiloop plot.

12

6

Figure 1880: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.643 [[16, 5, 1, 6], [6, 15, 7, 16], [9, 4, 10, 5], [1, 12, 2, 13], [14, 20, 15, 17], [7, 20, 8, 19], [8, 18, 9, 19], [3, 10, 4, 11], [11, 2, 12, 3], [13, 18, 14, 17]]

PD code drawn by `SnapPy`: [(9, 16, 10, 1), (7, 2, 8, 3), (14, 3, 15, 4), (1, 8, 2, 9), (15, 10, 16, 11), (4, 13, 5, 14), (6, 17, 7, 18), (18, 5, 19, 6), (12, 19, 13, 20), (20, 11, 17, 12)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 7, 7], [0, 8, 8, 9], [1, 9, 9, 5], [1, 4, 6, 6], [2, 5, 5, 9], [2, 8, 8, 2], [3, 7, 7, 3], [3, 6, 4, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 939: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

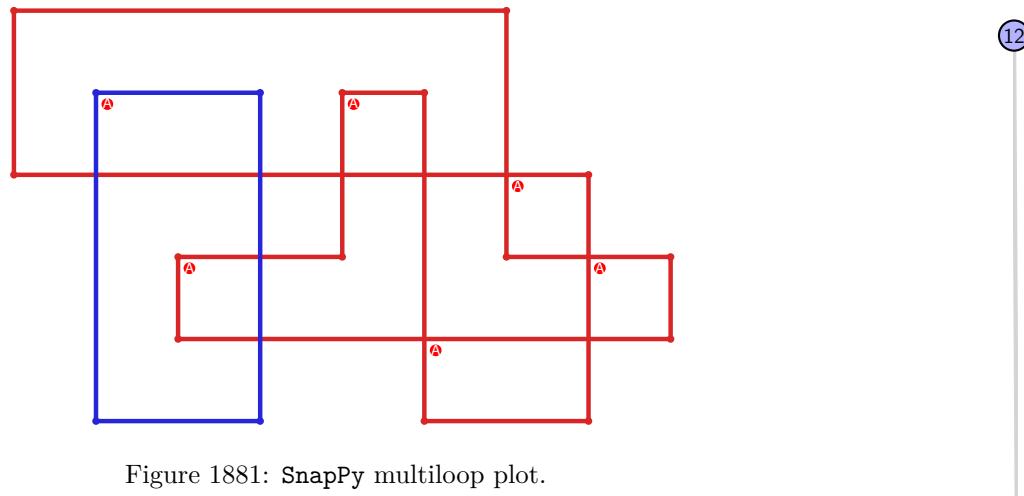


Figure 1881: `SnapPy` multiloop plot.

(6)

Figure 1882: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.644 [[13, 20, 14, 1], [19, 12, 20, 13], [14, 4, 15, 3], [1, 16, 2, 17], [18, 7, 19, 8], [11, 6, 12, 7], [4, 10, 5, 9], [15, 2, 16, 3], [17, 9, 18, 8], [5, 10, 6, 11]]

PD code drawn by SnapPy: [(13, 20, 14, 1), (1, 12, 2, 13), (9, 4, 10, 5), (16, 5, 17, 6), (6, 15, 7, 16), (7, 2, 8, 3), (3, 8, 4, 9), (17, 10, 18, 11), (19, 14, 20, 15), (11, 18, 12, 19)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 7, 7], [0, 7, 7, 8], [1, 8, 8, 5], [1, 4, 9, 9], [2, 9, 9, 8], [2, 3, 3, 2], [3, 6, 4, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 940: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

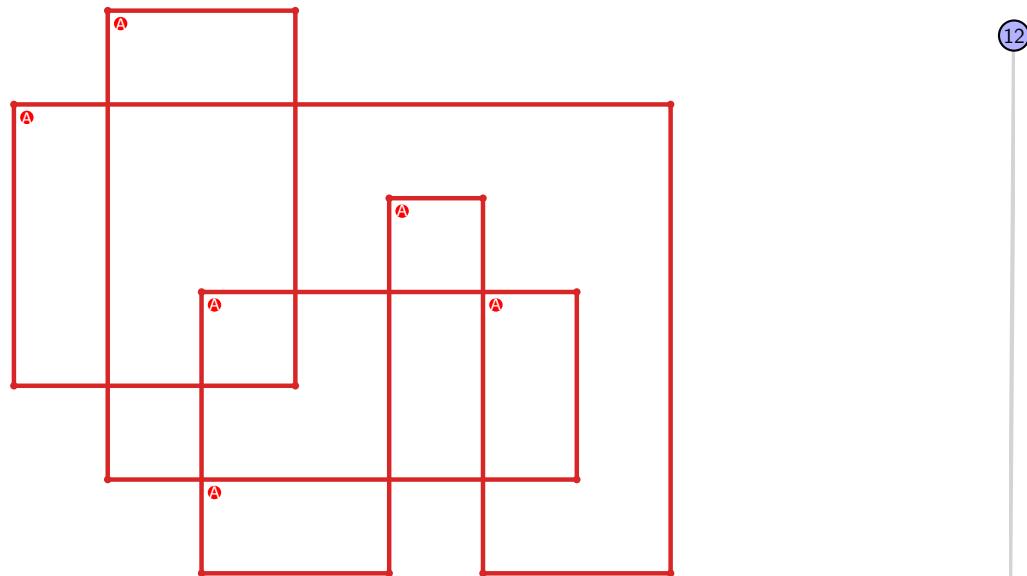


Figure 1883: SnapPy multiloop plot.



Figure 1884: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.645 [[10, 14, 1, 11], [11, 9, 12, 10], [13, 5, 14, 6], [1, 15, 2, 20], [8, 19, 9, 20], [12, 7, 13, 6], [4, 17, 5, 18], [15, 3, 16, 2], [18, 7, 19, 8], [16, 3, 17, 4]]

PD code drawn by `SnapPy`: [(10, 11, 1, 12), (12, 1, 13, 2), (18, 3, 19, 4), (4, 17, 5, 18), (14, 5, 15, 6), (20, 7, 17, 8), (8, 19, 9, 20), (2, 13, 3, 14), (6, 15, 7, 16), (16, 9, 11, 10)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 7, 7, 4], [1, 3, 8, 8], [1, 8, 2, 2], [2, 8, 9, 9], [3, 9, 9, 3], [4, 6, 5, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 941: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

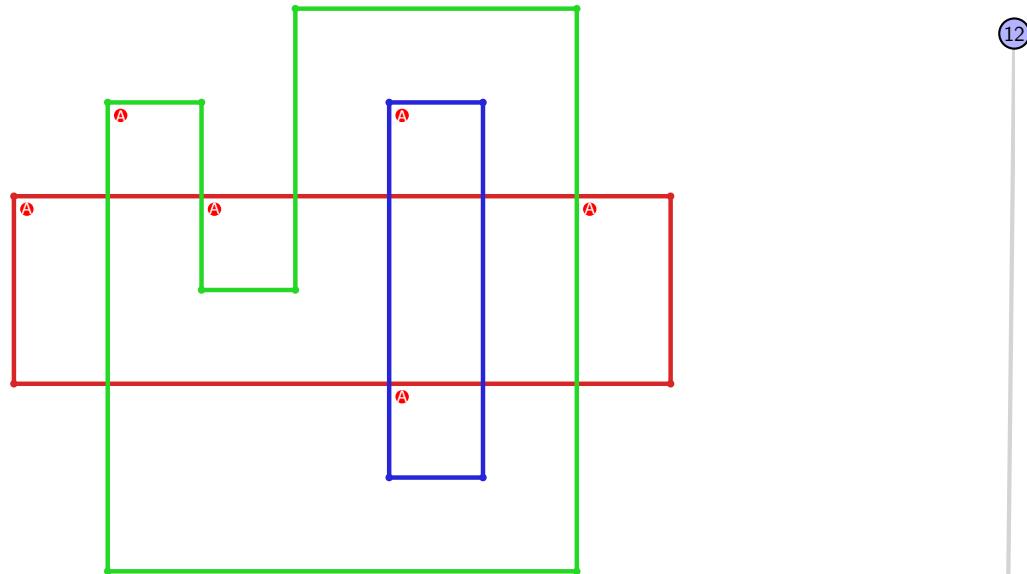


Figure 1885: `SnapPy` multiloop plot.



Figure 1886: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.646 $[[5, 20, 6, 1], [19, 4, 20, 5], [6, 2, 7, 1], [18, 11, 19, 12], [3, 16, 4, 17], [2, 16, 3, 15], [7, 13, 8, 12], [10, 17, 11, 18], [14, 9, 15, 10], [13, 9, 14, 8]]$

PD code drawn by `SnapPy`: $[(16, 1, 17, 2), (5, 10, 6, 11), (11, 6, 12, 7), (15, 8, 16, 9), (9, 4, 10, 5), (12, 19, 13, 20), (20, 13, 1, 14), (7, 14, 8, 15), (2, 17, 3, 18), (18, 3, 19, 4)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 6, 0], [1, 6, 7, 7], [1, 7, 5, 5], [2, 4, 4, 8], [2, 9, 9, 3], [3, 8, 4, 3], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 942: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

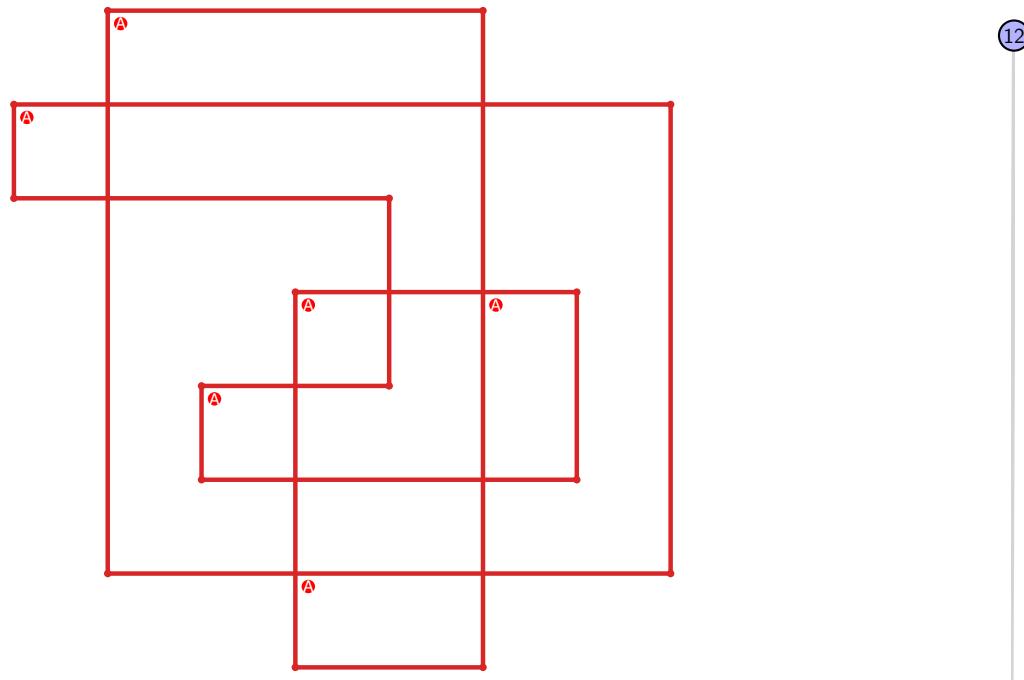


Figure 1887: `SnapPy` multiloop plot.

Figure 1888: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.647 `[[8, 12, 1, 9], [9, 7, 10, 8], [11, 20, 12, 13], [1, 18, 2, 17], [6, 16, 7, 17], [10, 14, 11, 13], [19, 3, 20, 4], [18, 3, 19, 2], [15, 5, 16, 6], [14, 5, 15, 4]]`

PD code drawn by `SnapPy`: `[(8, 9, 1, 10), (10, 1, 11, 2), (2, 13, 3, 14), (14, 3, 15, 4), (18, 5, 19, 6), (6, 17, 7, 18), (4, 15, 5, 16), (16, 7, 9, 8), (20, 11, 17, 12), (12, 19, 13, 20)]`

Planar representation generated by `plantri`: `[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 5, 6], [0, 7, 7, 4], [1, 3, 8, 8], [1, 9, 2, 2], [2, 9, 7, 7], [3, 6, 6, 3], [4, 9, 9, 4], [5, 8, 8, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 943: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

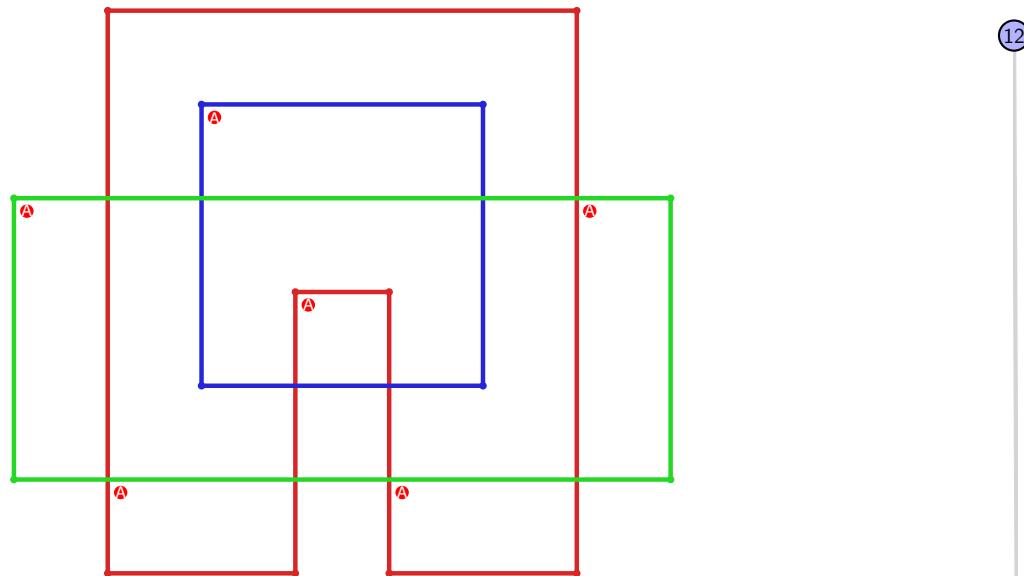


Figure 1889: `SnapPy` multiloop plot.



Figure 1890: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.648 [[16, 5, 1, 6], [6, 15, 7, 16], [4, 1, 5, 2], [14, 7, 15, 8], [2, 12, 3, 11], [3, 10, 4, 11], [8, 17, 9, 20], [13, 19, 14, 20], [12, 19, 13, 18], [9, 17, 10, 18]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (10, 3, 11, 4), (15, 6, 16, 7), (7, 14, 8, 15), (2, 11, 3, 12), (16, 13, 1, 14), (9, 20, 10, 17), (17, 4, 18, 5), (5, 18, 6, 19), (19, 8, 20, 9)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 6, 7, 1], [2, 8, 5, 5], [2, 4, 4, 9], [3, 9, 9, 7], [3, 6, 8, 8], [4, 7, 7, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 944: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

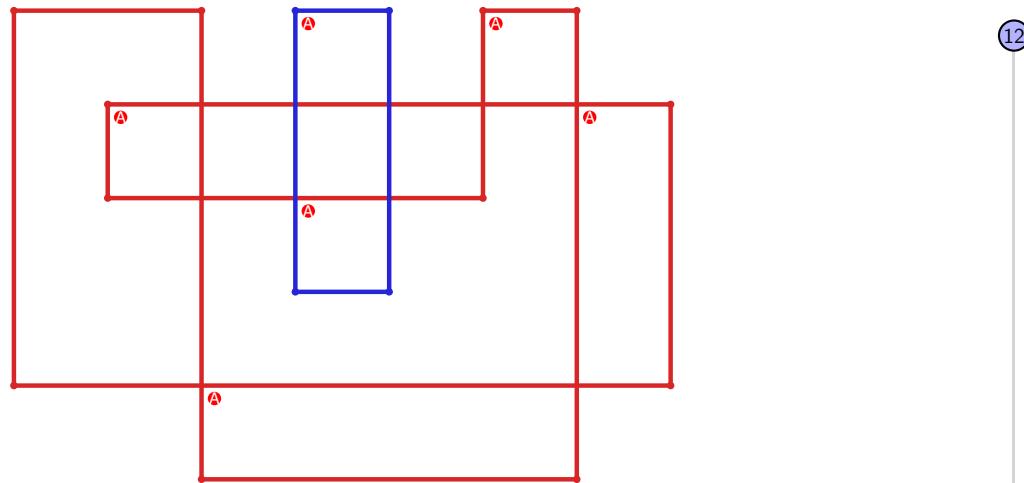


Figure 1891: SnapPy multiloop plot.



Figure 1892: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.649 [[12, 20, 1, 13], [13, 11, 14, 12], [19, 7, 20, 8], [1, 7, 2, 6], [10, 14, 11, 15], [8, 18, 9, 19], [2, 5, 3, 6], [15, 3, 16, 4], [17, 9, 18, 10], [4, 16, 5, 17]]

PD code drawn by SnapPy: [(20, 1, 13, 2), (12, 3, 1, 4), (4, 11, 5, 12), (16, 5, 17, 6), (14, 7, 15, 8), (18, 9, 19, 10), (2, 13, 3, 14), (6, 15, 7, 16), (10, 17, 11, 18), (8, 19, 9, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 5, 3], [0, 2, 6, 6], [1, 7, 8, 1], [2, 8, 8, 2], [3, 9, 7, 3], [4, 6, 9, 9], [4, 9, 5, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 945: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

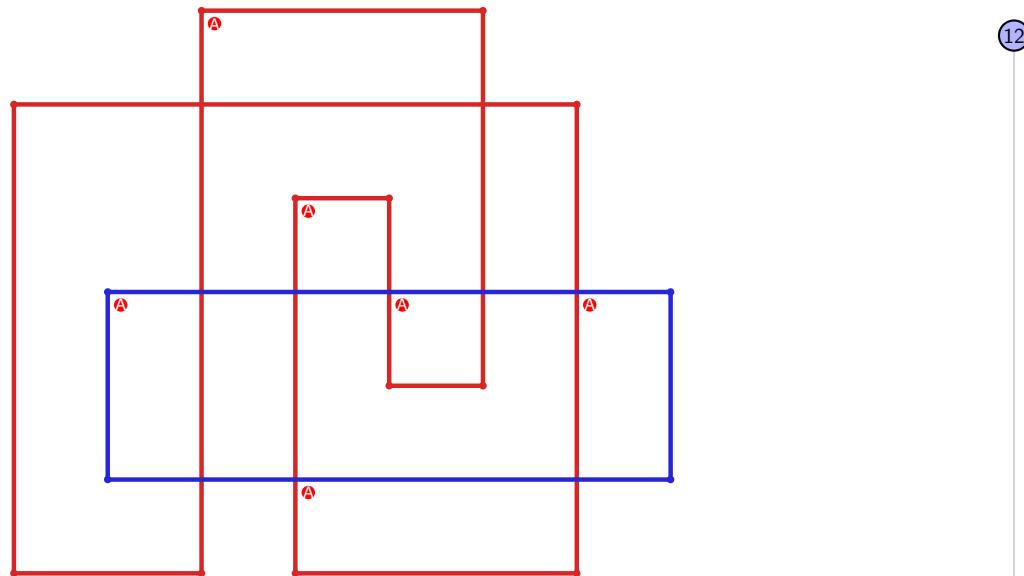


Figure 1893: SnapPy multiloop plot.



Figure 1894: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.650 [[14, 20, 1, 15], [15, 13, 16, 14], [19, 7, 20, 8], [1, 7, 2, 6], [3, 12, 4, 13], [16, 11, 17, 10], [8, 18, 9, 19], [2, 5, 3, 6], [11, 4, 12, 5], [17, 9, 18, 10]]

PD code drawn by SnapPy: [(9, 2, 10, 3), (14, 3, 1, 4), (4, 13, 5, 14), (16, 5, 17, 6), (20, 7, 15, 8), (8, 19, 9, 20), (1, 10, 2, 11), (18, 11, 19, 12), (6, 15, 7, 16), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 3], [0, 2, 7, 7], [1, 7, 8, 8], [1, 8, 9, 9], [2, 9, 9, 2], [3, 8, 4, 3], [4, 7, 5, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 64
 Pinning number: 6

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.85

Table 946: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

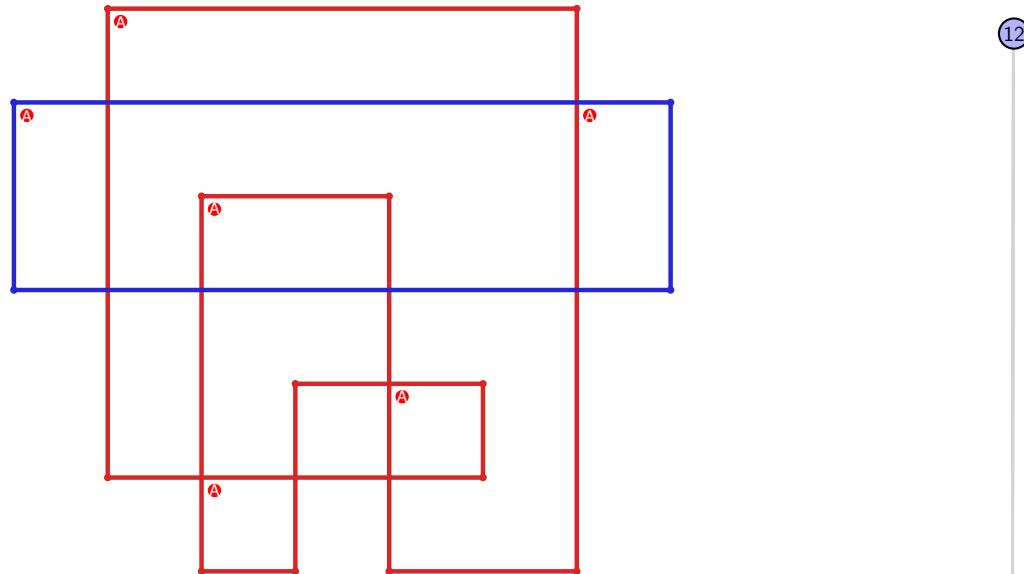


Figure 1895: SnapPy multiloop plot.



Figure 1896: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.651 $[[13, 20, 14, 1], [19, 12, 20, 13], [14, 10, 15, 9], [1, 9, 2, 8], [18, 5, 19, 6], [11, 16, 12, 17], [10, 16, 11, 15], [2, 7, 3, 8], [6, 3, 7, 4], [4, 17, 5, 18]]$

PD code drawn by SnapPy: $[(4, 1, 5, 2), (16, 3, 17, 4), (20, 5, 1, 6), (6, 19, 7, 20), (7, 12, 8, 13), (17, 10, 18, 11), (13, 8, 14, 9), (9, 14, 10, 15), (2, 15, 3, 16), (11, 18, 12, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 3], [0, 2, 7, 7], [1, 8, 9, 9], [1, 9, 6, 6], [2, 5, 5, 2], [3, 8, 8, 3], [4, 7, 7, 9], [4, 8, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 947: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

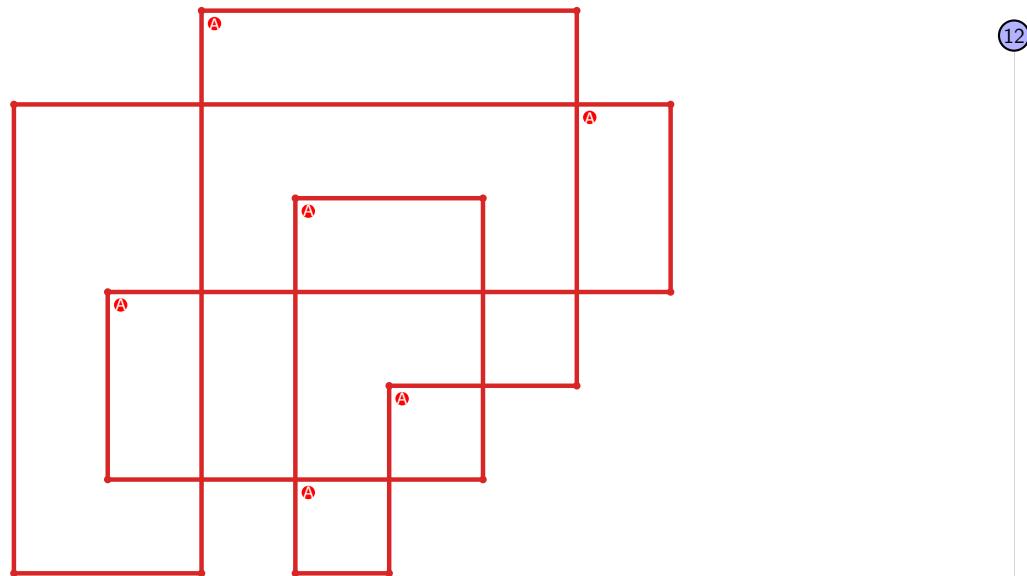


Figure 1897: SnapPy multiloop plot.



Figure 1898: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.652 $[[9, 20, 10, 1], [8, 17, 9, 18], [19, 16, 20, 17], [10, 2, 11, 1], [18, 7, 19, 8], [15, 2, 16, 3], [11, 6, 12, 7], [3, 14, 4, 15], [5, 12, 6, 13], [13, 4, 14, 5]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (8, 3, 9, 4), (15, 4, 16, 5), (2, 9, 3, 10), (20, 11, 1, 12), (16, 13, 17, 14), (5, 14, 6, 15), (6, 17, 7, 18), (18, 7, 19, 8), (12, 19, 13, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 5, 6, 0], [1, 6, 2, 1], [2, 7, 7, 3], [3, 8, 8, 4], [5, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 48
 Pinning number: 7

Average optimal degree: 2.14
 Average minimal degree: 2.14
 Average overall degree: 2.86

Table 948: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.14	2.53	2.82	3.04	3.21	3.33	

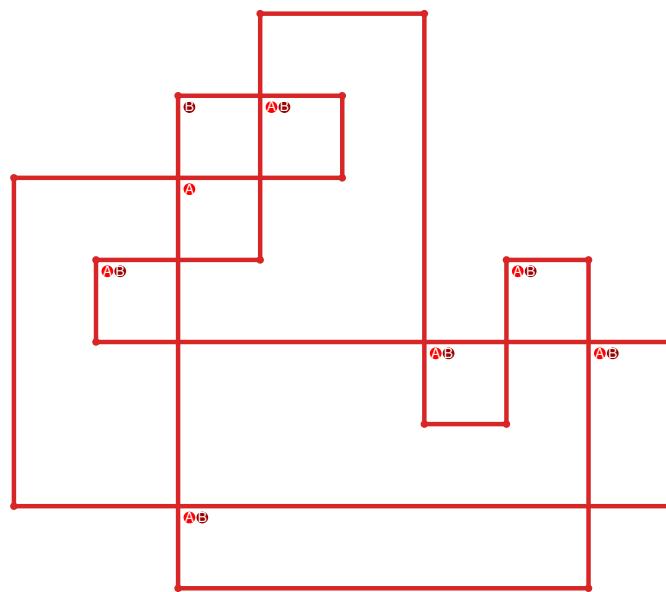


Figure 1899: SnapPy multiloop plot.

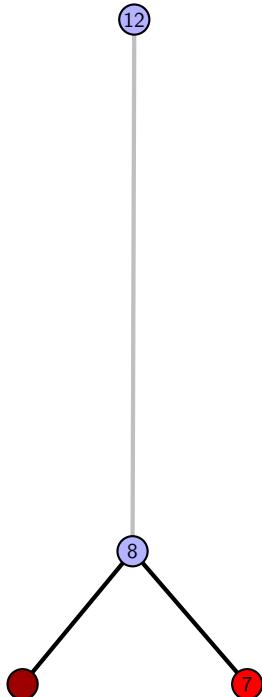


Figure 1900: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.653 [[12, 5, 1, 6], [6, 11, 7, 12], [4, 20, 5, 13], [1, 18, 2, 17], [10, 14, 11, 15], [7, 14, 8, 13], [19, 3, 20, 4], [18, 3, 19, 2], [8, 16, 9, 17], [15, 9, 16, 10]]

PD code drawn by SnapPy: [(12, 13, 1, 14), (14, 1, 15, 2), (10, 3, 11, 4), (18, 7, 19, 8), (4, 9, 5, 10), (6, 19, 7, 20), (20, 11, 13, 12), (2, 15, 3, 16), (16, 5, 17, 6), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 6], [0, 7, 7, 8], [1, 9, 9, 5], [1, 4, 8, 2], [2, 7, 7, 2], [3, 6, 6, 3], [3, 5, 9, 9], [4, 8, 8, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 949: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

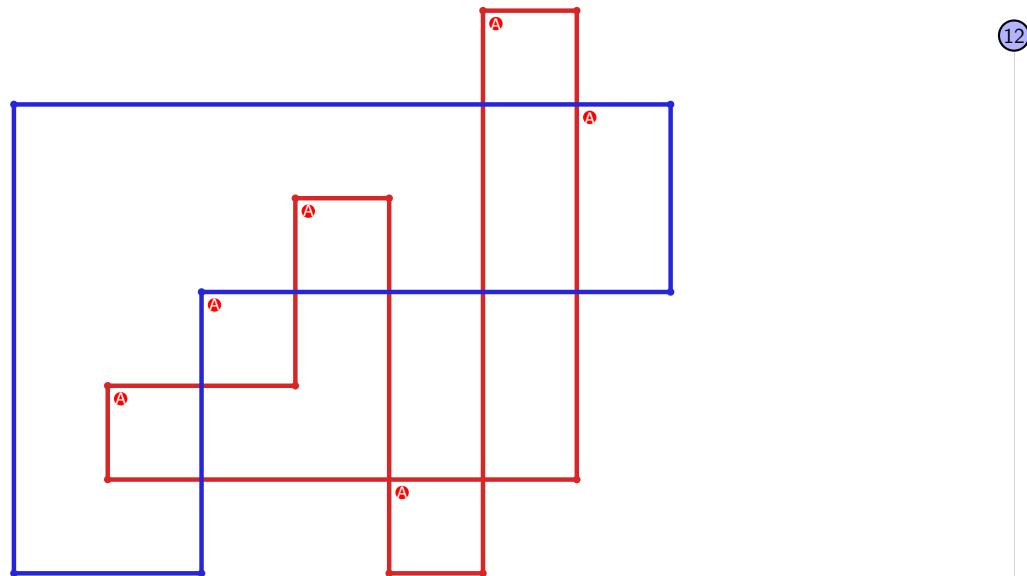


Figure 1901: SnapPy multiloop plot.



Figure 1902: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.654 [[20, 7, 1, 8], [8, 19, 9, 20], [11, 6, 12, 7], [1, 12, 2, 13], [18, 9, 19, 10], [10, 17, 11, 18], [5, 14, 6, 15], [2, 14, 3, 13], [3, 16, 4, 17], [15, 4, 16, 5]]

PD code drawn by SnapPy: [(11, 20, 12, 1), (7, 2, 8, 3), (16, 3, 17, 4), (14, 5, 15, 6), (17, 8, 18, 9), (9, 18, 10, 19), (1, 10, 2, 11), (19, 12, 20, 13), (6, 13, 7, 14), (4, 15, 5, 16)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 7], [1, 5, 5, 1], [2, 4, 4, 8], [2, 9, 9, 7], [3, 6, 8, 3], [5, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 64
 Pinning number: 6

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.85

Table 950: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

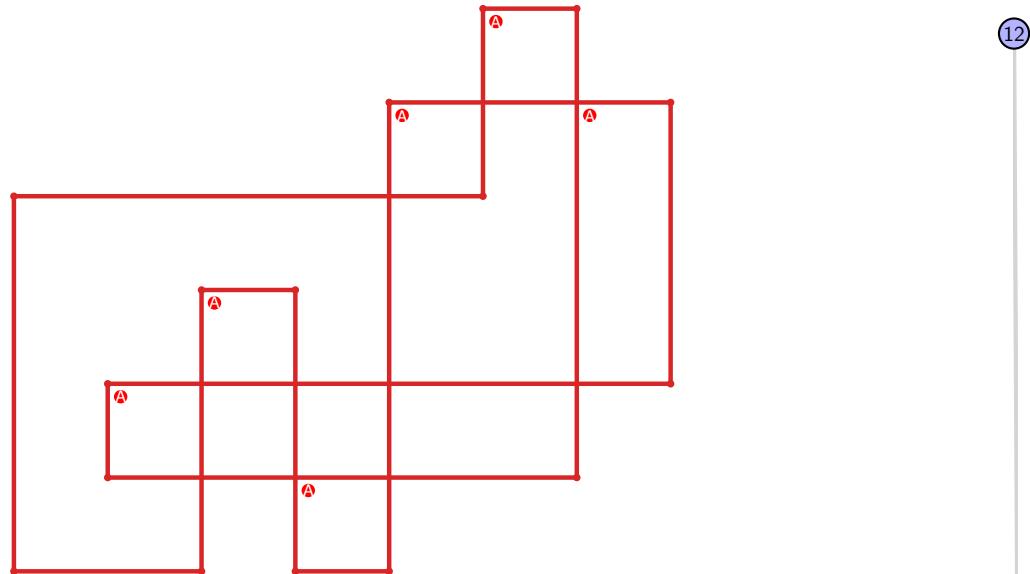


Figure 1903: SnapPy multiloop plot.

(6)

Figure 1904: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.655 [[20, 15, 1, 16], [16, 8, 17, 7], [19, 6, 20, 7], [14, 1, 15, 2], [8, 18, 9, 17], [9, 18, 10, 19], [12, 5, 13, 6], [2, 13, 3, 14], [10, 3, 11, 4], [4, 11, 5, 12]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (15, 2, 16, 3), (3, 12, 4, 13), (20, 7, 1, 8), (18, 9, 19, 10), (16, 11, 17, 12), (13, 4, 14, 5), (5, 14, 6, 15), (10, 17, 11, 18), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 7, 7, 0], [1, 5, 5, 1], [2, 4, 4, 8], [2, 9, 9, 7], [3, 6, 8, 3], [5, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 951: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

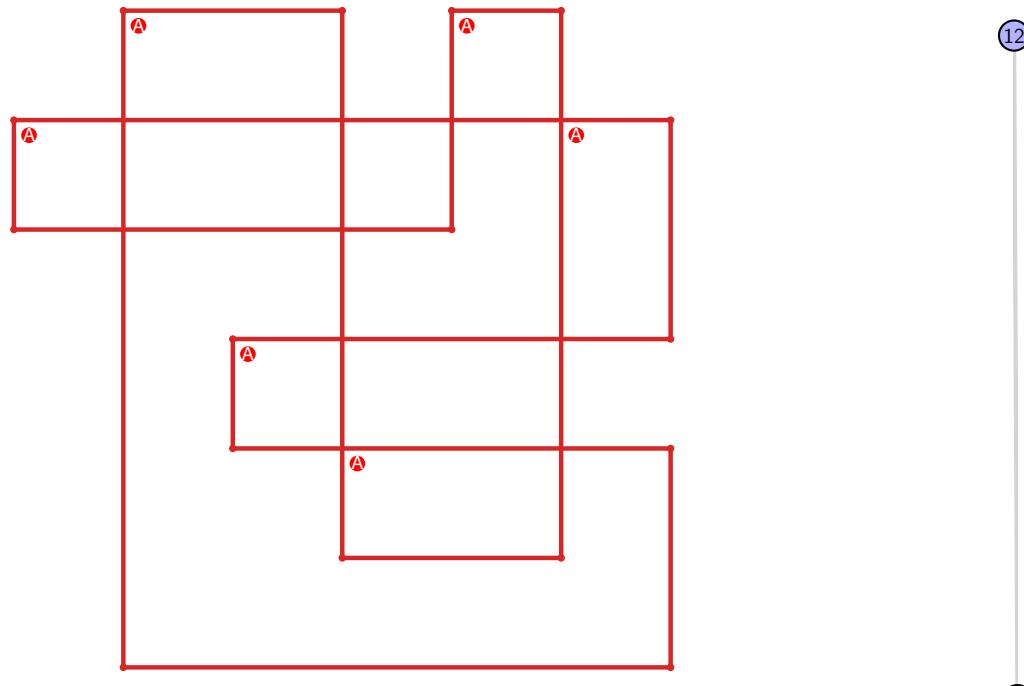


Figure 1905: SnapPy multiloop plot.

12

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Figure 1906: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.656 [[20, 9, 1, 10], [10, 18, 11, 17], [19, 16, 20, 17], [8, 1, 9, 2], [18, 12, 19, 11], [6, 15, 7, 16], [2, 7, 3, 8], [12, 3, 13, 4], [14, 5, 15, 6], [13, 5, 14, 4]]

PD code drawn by SnapPy: [(9, 20, 10, 1), (1, 10, 2, 11), (11, 2, 12, 3), (19, 4, 20, 5), (17, 6, 18, 7), (8, 15, 9, 16), (3, 12, 4, 13), (16, 13, 17, 14), (14, 7, 15, 8), (5, 18, 6, 19)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 8, 8, 6], [3, 5, 7, 3], [4, 6, 9, 9], [5, 9, 9, 5], [7, 8, 8, 7]]

Total optimal pinning sets: 2
Total minimal pinning sets: 2
Total pinning sets: 48
Pinning number: 7

Average optimal degree: 2.14
Average minimal degree: 2.14
Average overall degree: 2.86

Table 952: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.14	2.53	2.82	3.04	3.21	3.33	

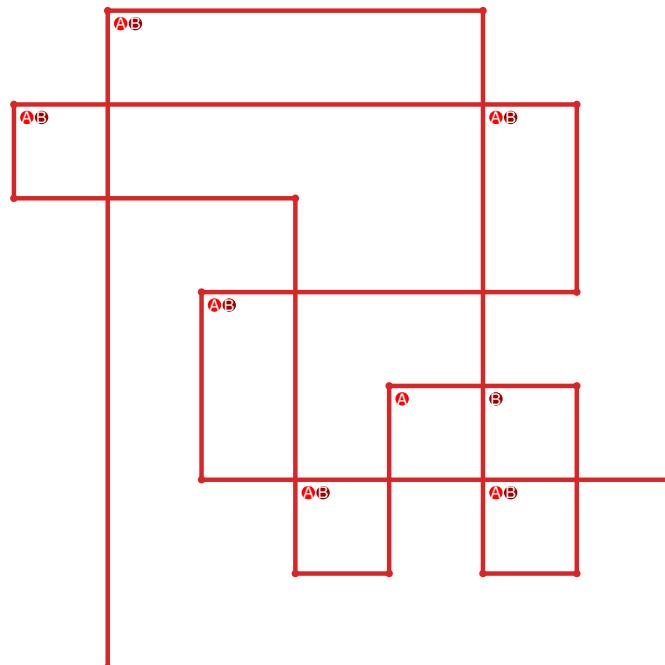


Figure 1907: SnapPy multiloop plot.

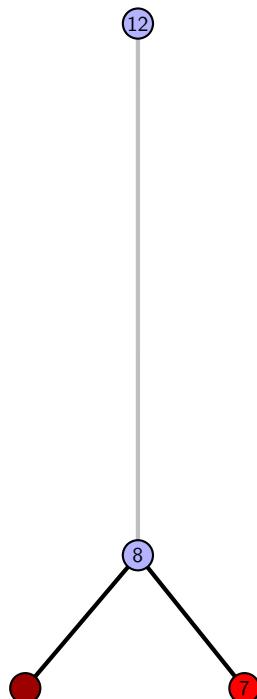


Figure 1908: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.657 $[[9, 20, 10, 1], [8, 17, 9, 18], [19, 16, 20, 17], [10, 2, 11, 1], [18, 7, 19, 8], [15, 4, 16, 5], [2, 12, 3, 11], [13, 6, 14, 7], [5, 14, 6, 15], [3, 12, 4, 13]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (10, 3, 11, 4), (15, 4, 16, 5), (8, 19, 9, 20), (20, 9, 1, 10), (2, 11, 3, 12), (16, 13, 17, 14), (5, 14, 6, 15), (6, 17, 7, 18), (18, 7, 19, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 4, 5], [0, 6, 6, 0], [1, 7, 2, 1], [2, 8, 8, 9], [3, 9, 9, 3], [4, 9, 8, 8], [5, 7, 7, 5], [5, 7, 6, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 48
 Pinning number: 7

Average optimal degree: 2.14
 Average minimal degree: 2.14
 Average overall degree: 2.86

Table 953: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.14	2.53	2.82	3.04	3.21	3.33	

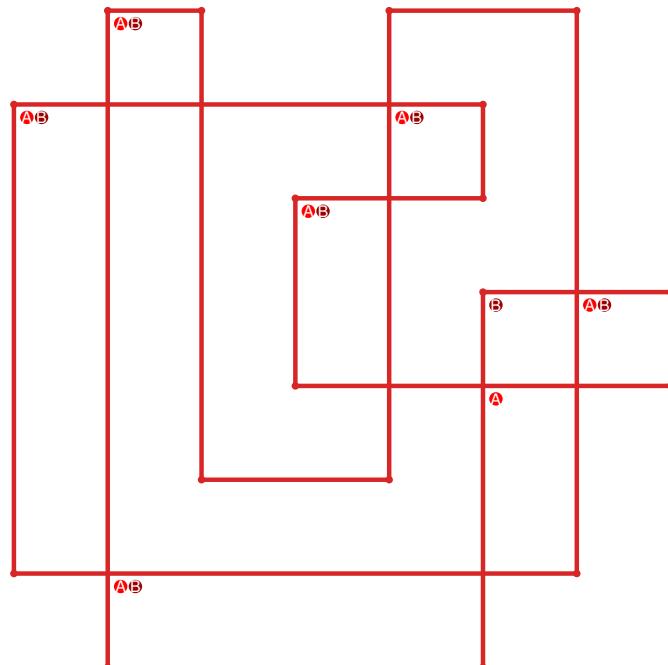


Figure 1909: SnapPy multiloop plot.

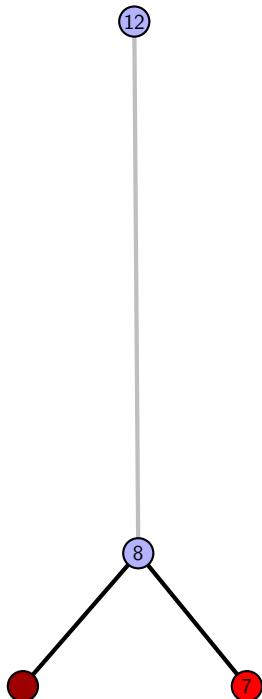


Figure 1910: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.658 [[12, 20, 1, 13], [13, 11, 14, 12], [19, 7, 20, 8], [1, 7, 2, 6], [10, 14, 11, 15], [8, 16, 9, 17], [4, 18, 5, 19], [2, 5, 3, 6], [15, 9, 16, 10], [17, 3, 18, 4]]

PD code drawn by SnapPy: [(13, 12, 14, 1), (11, 2, 12, 3), (3, 10, 4, 11), (15, 4, 16, 5), (19, 6, 20, 7), (17, 8, 18, 9), (7, 18, 8, 19), (5, 20, 6, 13), (1, 14, 2, 15), (9, 16, 10, 17)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 7], [1, 8, 8, 1], [2, 8, 8, 9], [2, 9, 9, 7], [3, 6, 9, 3], [4, 5, 5, 4], [5, 7, 6, 6]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 56
 Pinning number: 7

Average optimal degree: 2.19
 Average minimal degree: 2.19
 Average overall degree: 2.87

Table 954: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	12	19	15	6	1	53
Average degree	2.19	2.58	2.87	3.07	3.21	3.33	

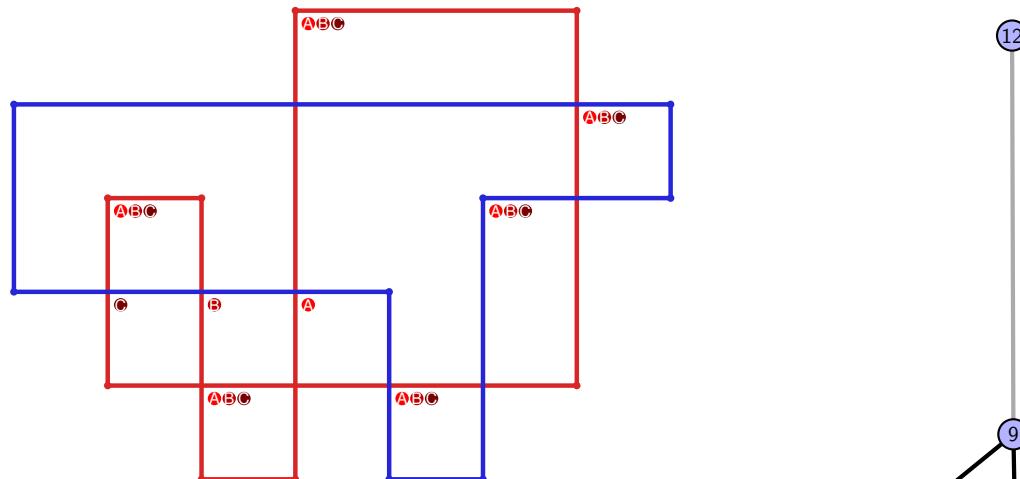


Figure 1911: SnapPy multiloop plot.

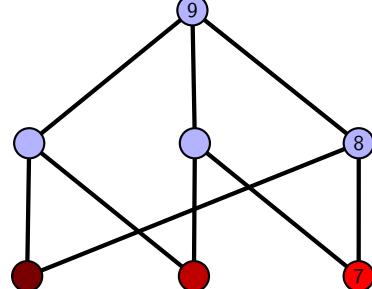


Figure 1912: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.659 [[13, 20, 14, 1], [19, 12, 20, 13], [14, 10, 15, 9], [1, 9, 2, 8], [11, 18, 12, 19], [10, 18, 11, 17], [15, 5, 16, 4], [2, 7, 3, 8], [16, 5, 17, 6], [6, 3, 7, 4]]

PD code drawn by SnapPy: [(3, 20, 4, 1), (1, 12, 2, 13), (13, 2, 14, 3), (19, 4, 20, 5), (5, 18, 6, 19), (6, 11, 7, 12), (16, 9, 17, 10), (14, 7, 15, 8), (8, 15, 9, 16), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 7], [1, 5, 5, 1], [2, 4, 4, 8], [2, 8, 8, 9], [3, 9, 9, 3], [5, 9, 6, 6], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 955: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

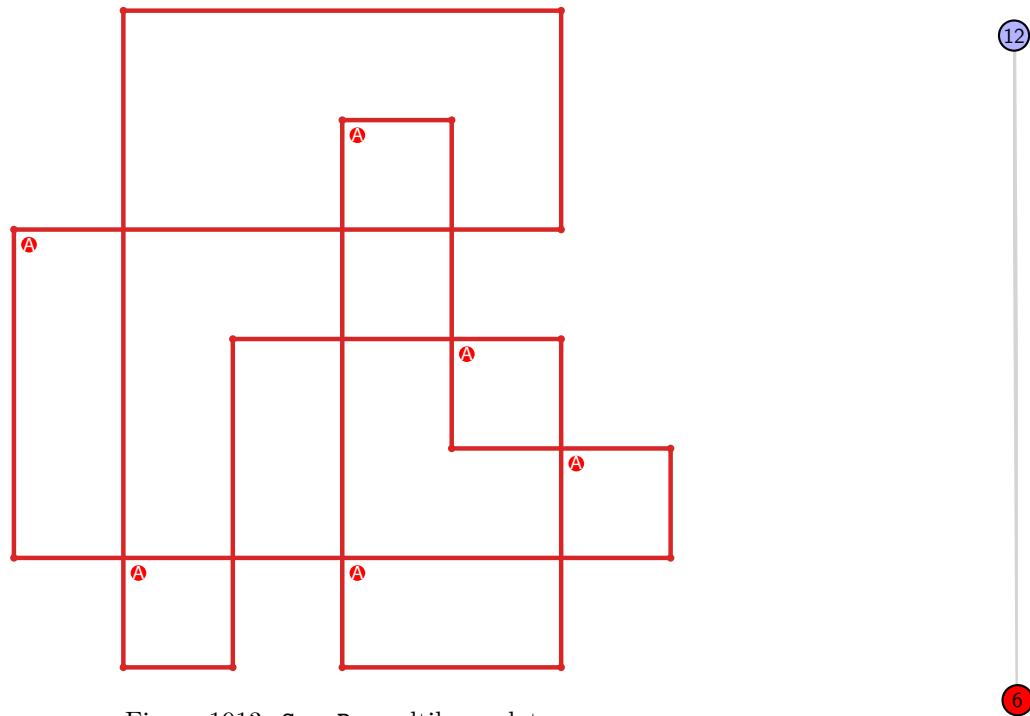


Figure 1913: SnapPy multiloop plot.

Figure 1914: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.660 `[[14, 20, 1, 15], [15, 7, 16, 8], [17, 13, 18, 14], [19, 1, 20, 2], [6, 9, 7, 10], [16, 9, 17, 8], [12, 3, 13, 4], [18, 3, 19, 2], [10, 5, 11, 6], [4, 11, 5, 12]]`

PD code drawn by `SnapPy`: `[(9, 14, 10, 1), (7, 2, 8, 3), (15, 4, 16, 5), (5, 16, 6, 17), (3, 6, 4, 7), (1, 8, 2, 9), (17, 10, 18, 11), (19, 12, 20, 13), (13, 18, 14, 19), (11, 20, 12, 15)]`

Planar representation generated by `plantri`: `[[1, 2, 3, 3], [0, 4, 5, 5], [0, 5, 6, 7], [0, 7, 7, 0], [1, 8, 8, 5], [1, 4, 2, 1], [2, 9, 9, 7], [2, 6, 3, 3], [4, 9, 9, 4], [6, 8, 8, 6]]`

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 956: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

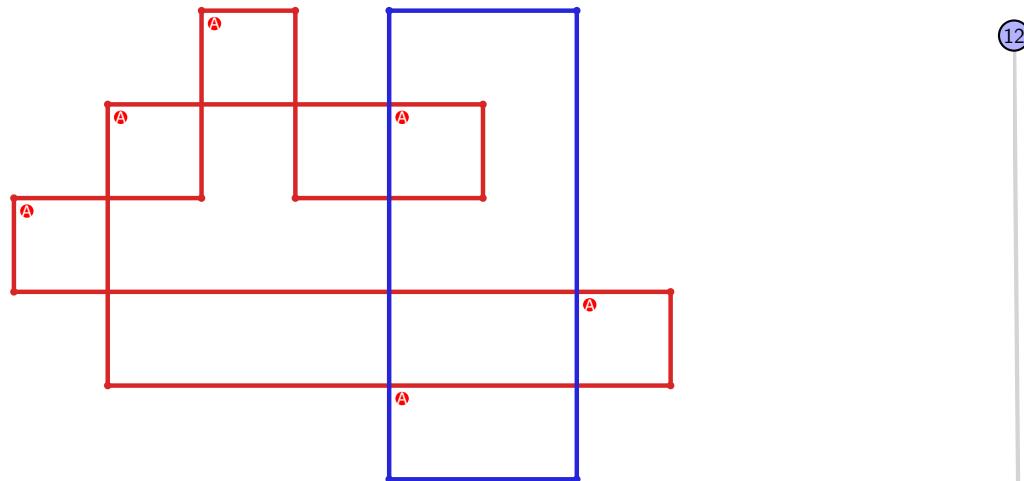


Figure 1915: `SnapPy` multiloop plot.

(12)

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Figure 1916: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.661 [[13, 20, 14, 1], [19, 12, 20, 13], [14, 12, 15, 11], [1, 9, 2, 8], [18, 5, 19, 6], [15, 10, 16, 11], [9, 16, 10, 17], [2, 7, 3, 8], [6, 3, 7, 4], [4, 17, 5, 18]]

PD code drawn by SnapPy: [(13, 20, 14, 1), (17, 2, 18, 3), (3, 16, 4, 17), (10, 5, 11, 6), (6, 9, 7, 10), (14, 7, 15, 8), (4, 11, 5, 12), (19, 12, 20, 13), (8, 15, 9, 16), (1, 18, 2, 19)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 5], [0, 6, 7, 7], [1, 8, 9, 9], [2, 6, 6, 2], [3, 5, 5, 9], [3, 8, 8, 3], [4, 7, 7, 9], [4, 8, 6, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 957: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

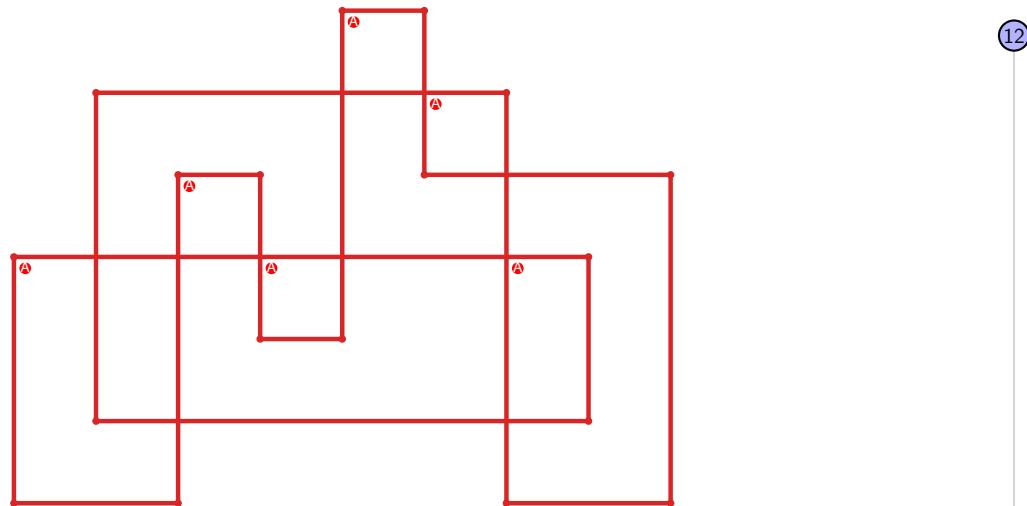


Figure 1917: SnapPy multiloop plot.

6

Figure 1918: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.662 [[20, 5, 1, 6], [6, 15, 7, 16], [19, 10, 20, 11], [4, 1, 5, 2], [14, 7, 15, 8], [16, 14, 17, 13], [11, 18, 12, 19], [9, 2, 10, 3], [3, 8, 4, 9], [17, 12, 18, 13]]

PD code drawn by SnapPy: [(17, 2, 18, 3), (11, 4, 12, 5), (20, 5, 1, 6), (16, 7, 17, 8), (14, 9, 15, 10), (10, 13, 11, 14), (3, 12, 4, 13), (8, 15, 9, 16), (1, 18, 2, 19), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 0], [1, 8, 5, 1], [1, 4, 9, 9], [2, 9, 9, 2], [2, 8, 8, 3], [3, 7, 7, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 64
 Pinning number: 6

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.85

Table 958: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

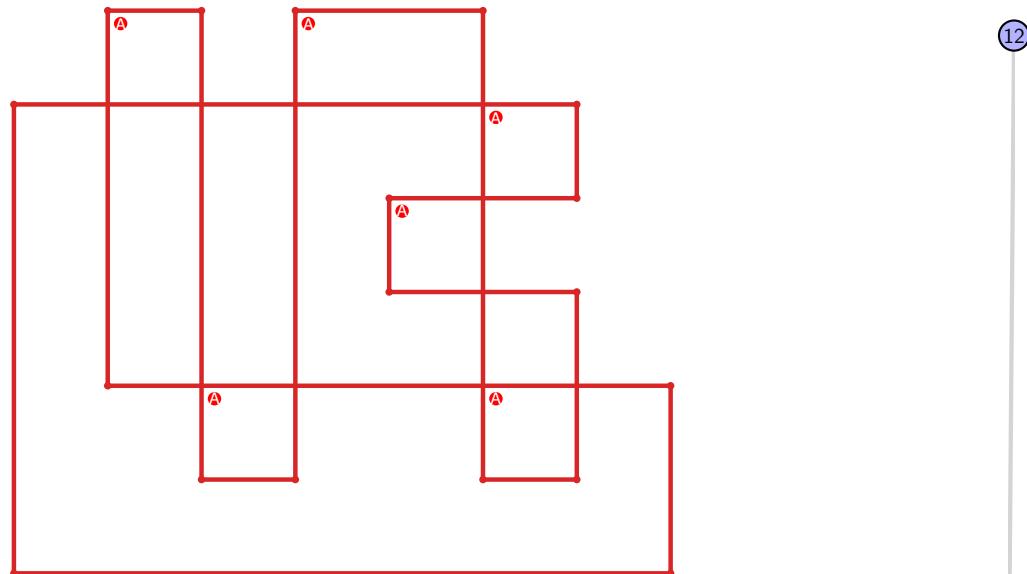


Figure 1919: SnapPy multiloop plot.

12
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Figure 1920: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.663 [[10, 20, 1, 11], [11, 7, 12, 8], [19, 9, 20, 10], [1, 16, 2, 15], [6, 12, 7, 13], [8, 18, 9, 19], [16, 5, 17, 4], [2, 14, 3, 15], [13, 3, 14, 4], [17, 5, 18, 6]]

PD code drawn by SnapPy: [(20, 1, 11, 2), (2, 13, 3, 14), (14, 3, 15, 4), (18, 5, 19, 6), (16, 7, 17, 8), (6, 15, 7, 16), (8, 17, 9, 18), (4, 19, 5, 20), (10, 11, 1, 12), (12, 9, 13, 10)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 5, 0], [0, 6, 7, 7], [1, 8, 9, 1], [1, 9, 2, 2], [3, 9, 9, 8], [3, 8, 8, 3], [4, 7, 7, 6], [4, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 959: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

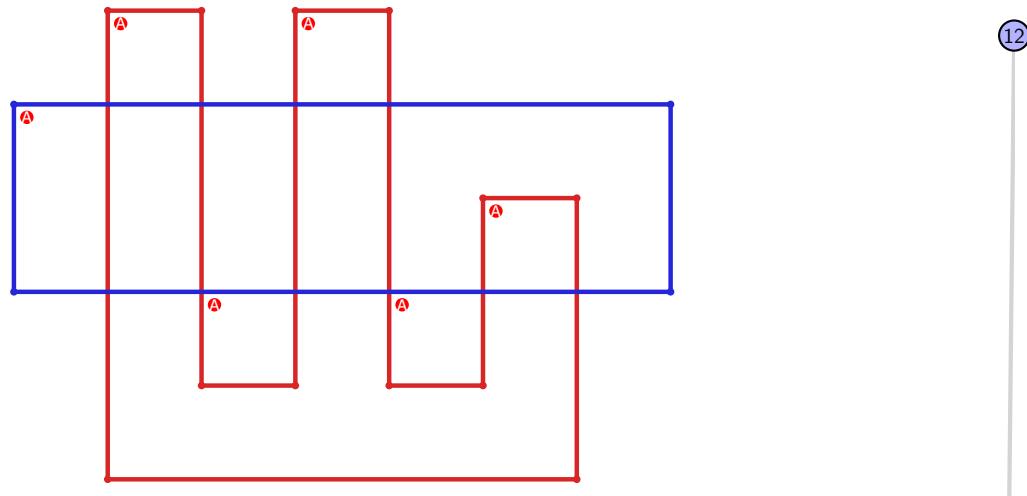


Figure 1921: SnapPy multiloop plot.

6

Figure 1922: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.664 [[20, 9, 1, 10], [10, 19, 11, 20], [13, 8, 14, 9], [1, 7, 2, 6], [18, 11, 19, 12], [12, 17, 13, 18], [7, 14, 8, 15], [2, 5, 3, 6], [3, 16, 4, 17], [15, 4, 16, 5]]

PD code drawn by `SnapPy`: [(12, 1, 13, 2), (19, 2, 20, 3), (3, 18, 4, 19), (10, 5, 11, 6), (17, 6, 18, 7), (15, 8, 16, 9), (4, 11, 5, 12), (20, 13, 1, 14), (9, 14, 10, 15), (7, 16, 8, 17)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 6], [0, 6, 7, 7], [1, 5, 5, 1], [2, 4, 4, 8], [2, 9, 3, 2], [3, 9, 8, 3], [5, 7, 9, 9], [6, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 960: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

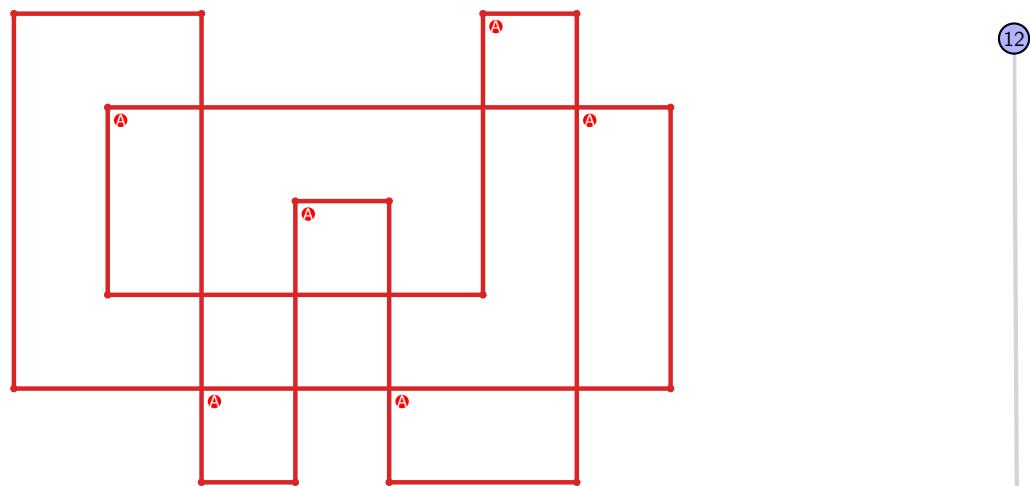


Figure 1923: `SnapPy` multiloop plot.

6

Figure 1924: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.665 [[20, 15, 1, 16], [16, 8, 17, 7], [12, 19, 13, 20], [14, 1, 15, 2], [8, 5, 9, 6], [17, 6, 18, 7], [18, 11, 19, 12], [13, 3, 14, 2], [4, 9, 5, 10], [10, 3, 11, 4]]

PD code drawn by SnapPy: [(3, 20, 4, 1), (12, 1, 13, 2), (2, 11, 3, 12), (19, 4, 20, 5), (13, 6, 14, 7), (15, 10, 16, 11), (7, 14, 8, 15), (9, 16, 10, 17), (17, 8, 18, 9), (5, 18, 6, 19)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 5], [0, 6, 6, 7], [0, 7, 7, 0], [1, 8, 8, 5], [1, 4, 6, 1], [2, 5, 9, 2], [2, 9, 3, 3], [4, 9, 9, 4], [6, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 961: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

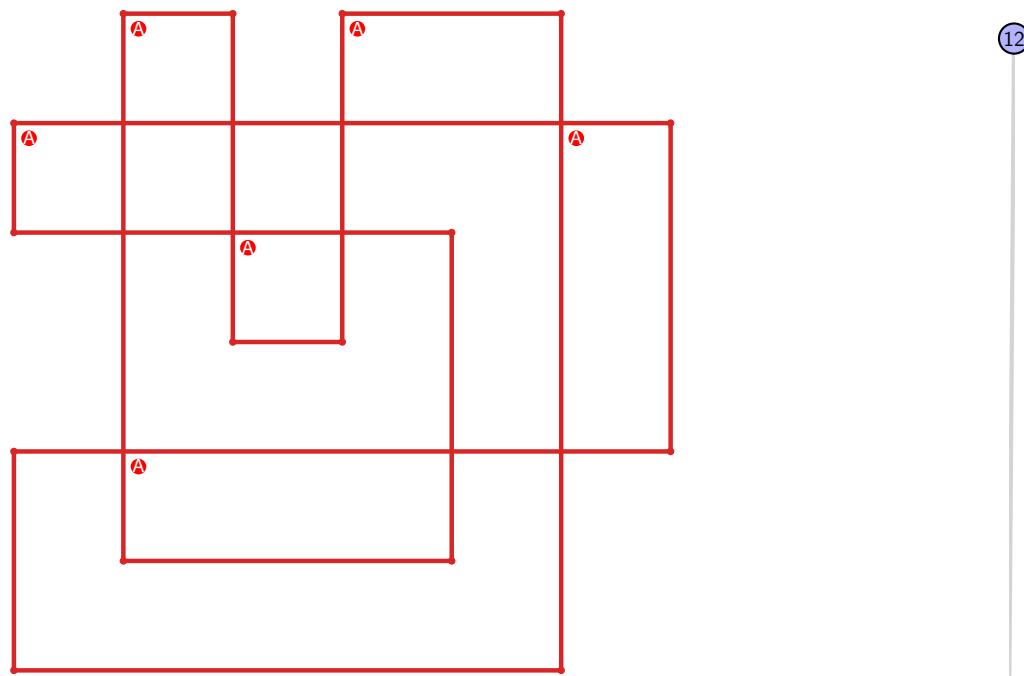


Figure 1925: SnapPy multiloop plot.

12

6

Figure 1926: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.666 [[12, 5, 1, 6], [6, 13, 7, 20], [11, 17, 12, 18], [4, 1, 5, 2], [13, 8, 14, 7], [9, 19, 10, 20], [18, 10, 19, 11], [16, 2, 17, 3], [3, 15, 4, 16], [8, 15, 9, 14]]

PD code drawn by `SnapPy`: [(9, 2, 10, 3), (4, 19, 5, 20), (16, 7, 17, 8), (1, 10, 2, 11), (14, 11, 15, 12), (12, 13, 1, 14), (8, 15, 9, 16), (6, 17, 7, 18), (18, 3, 19, 4), (20, 5, 13, 6)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 7], [0, 7, 8, 0], [1, 9, 9, 1], [1, 9, 6, 6], [2, 5, 5, 2], [2, 8, 8, 3], [3, 7, 7, 9], [4, 8, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 64

Average overall degree: 2.85

Pinning number: 6

Table 962: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	6	15	20	15	6	1	63
Average degree	2.0	2.38	2.67	2.89	3.07	3.21	3.33	

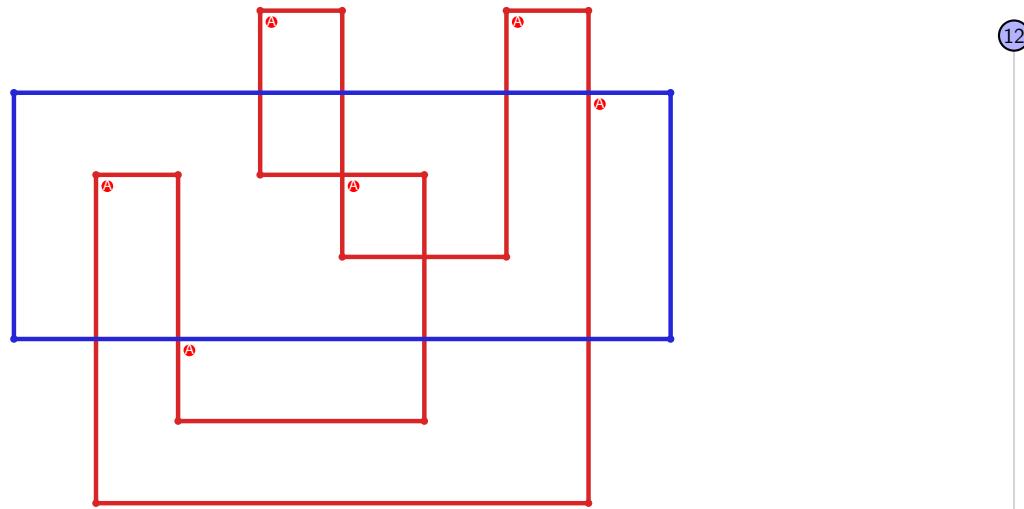


Figure 1927: `SnapPy` multiloop plot.

6

Figure 1928: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.667 [[15, 20, 16, 1], [19, 14, 20, 15], [16, 14, 17, 13], [1, 13, 2, 12], [18, 7, 19, 8], [17, 7, 18, 6], [2, 11, 3, 12], [8, 5, 9, 6], [10, 3, 11, 4], [4, 9, 5, 10]]

PD code drawn by SnapPy: [(7, 20, 8, 1), (5, 2, 6, 3), (3, 14, 4, 15), (15, 4, 16, 5), (1, 6, 2, 7), (19, 8, 20, 9), (9, 18, 10, 19), (10, 13, 11, 14), (16, 11, 17, 12), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 2, 0], [0, 1, 5, 3], [0, 2, 6, 6], [1, 7, 5, 5], [2, 4, 4, 7], [3, 8, 8, 3], [4, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 48
 Pinning number: 7

Average optimal degree: 2.14
 Average minimal degree: 2.14
 Average overall degree: 2.86

Table 963: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	9	16	14	6	1	46
Average degree	2.14	2.53	2.82	3.04	3.21	3.33	

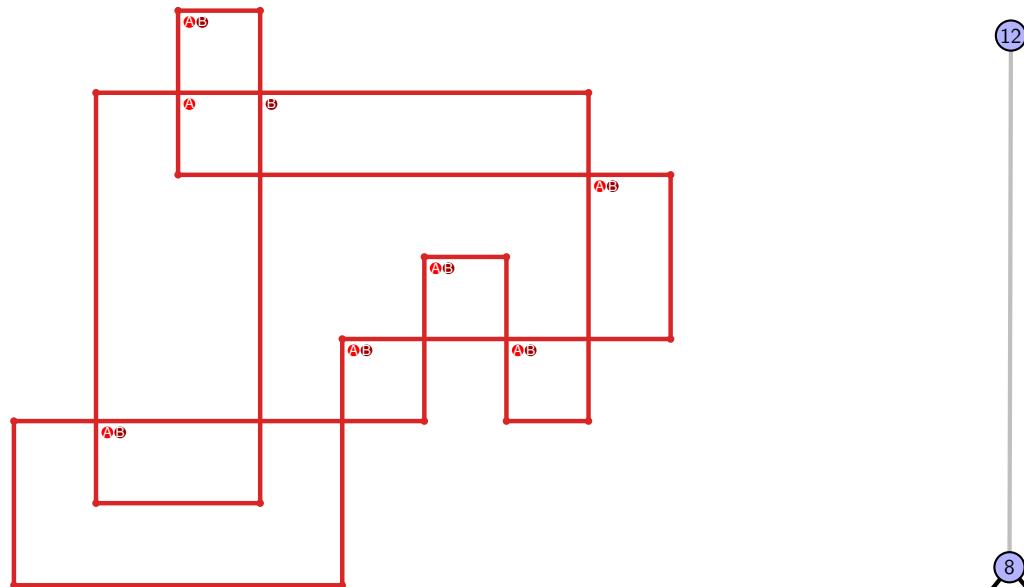


Figure 1929: SnapPy multiloop plot.

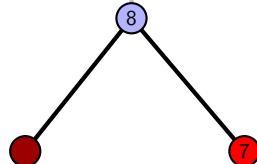


Figure 1930: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.668 [[16, 20, 1, 17], [17, 9, 18, 10], [15, 2, 16, 3], [19, 1, 20, 2], [8, 18, 9, 19], [10, 8, 11, 7], [3, 14, 4, 15], [11, 6, 12, 7], [13, 4, 14, 5], [5, 12, 6, 13]]

PD code drawn by SnapPy: [(13, 16, 14, 1), (11, 2, 12, 3), (9, 4, 10, 5), (5, 8, 6, 9), (20, 7, 17, 8), (3, 10, 4, 11), (1, 12, 2, 13), (18, 15, 19, 16), (14, 19, 15, 20), (6, 17, 7, 18)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 5], [0, 6, 6, 3], [0, 2, 4, 0], [1, 3, 5, 1], [1, 4, 7, 7], [2, 8, 8, 2], [5, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 964: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

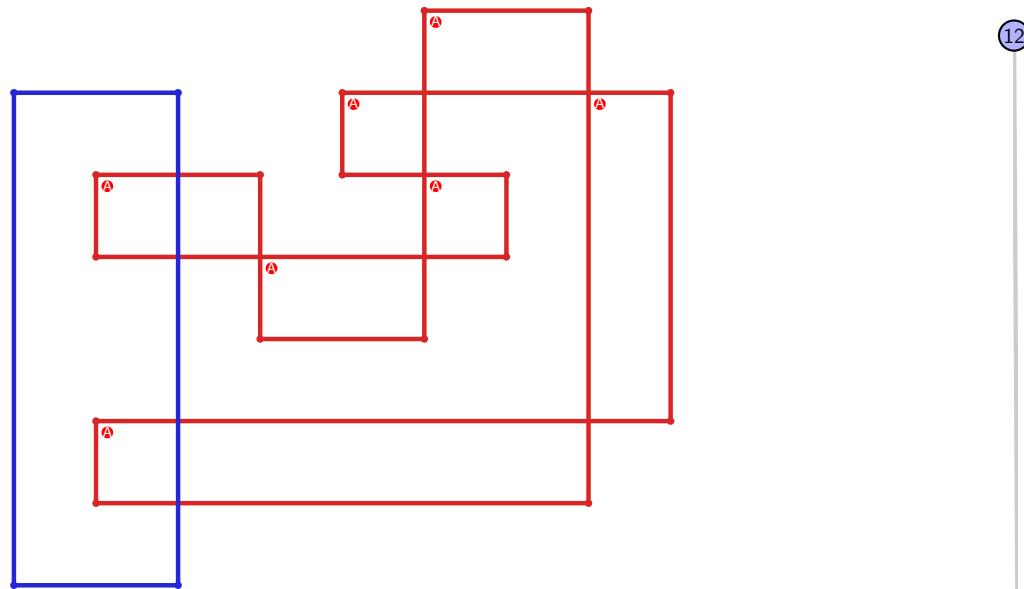


Figure 1931: SnapPy multiloop plot.

7

Figure 1932: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.669 $[[8, 20, 1, 9], [9, 7, 10, 8], [19, 1, 20, 2], [6, 10, 7, 11], [2, 18, 3, 19], [11, 5, 12, 6], [12, 17, 13, 18], [3, 16, 4, 15], [4, 14, 5, 15], [16, 13, 17, 14]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (19, 2, 20, 3), (17, 4, 18, 5), (1, 20, 2, 9), (14, 11, 15, 12), (7, 12, 8, 13), (13, 6, 14, 7), (10, 15, 11, 16), (5, 16, 6, 17), (3, 18, 4, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 5, 1], [2, 6, 7, 2], [3, 8, 6, 3], [4, 5, 9, 9], [4, 9, 8, 8], [5, 7, 7, 9], [6, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 965: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

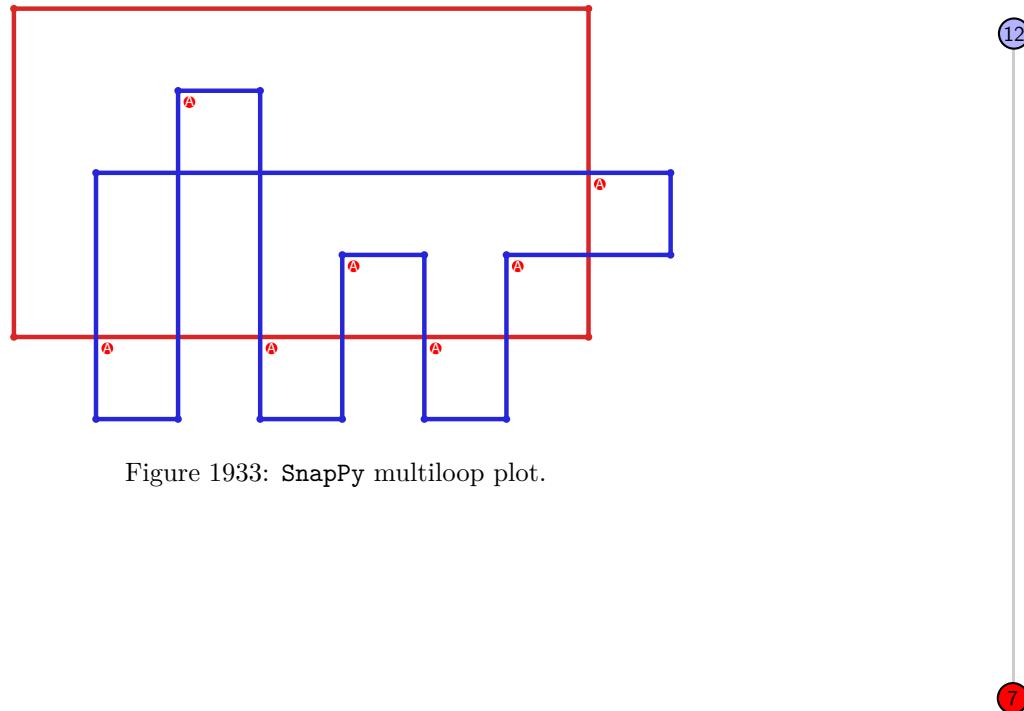


Figure 1933: SnapPy multiloop plot.

Figure 1934: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.670 $[[5, 20, 6, 1], [19, 4, 20, 5], [6, 18, 7, 17], [1, 13, 2, 12], [3, 18, 4, 19], [7, 16, 8, 17], [13, 10, 14, 11], [2, 11, 3, 12], [15, 8, 16, 9], [9, 14, 10, 15]]$

PD code drawn by `SnapPy`: $[(17, 2, 18, 3), (13, 6, 14, 7), (11, 8, 12, 9), (20, 9, 1, 10), (10, 19, 11, 20), (7, 12, 8, 13), (5, 14, 6, 15), (15, 4, 16, 5), (1, 16, 2, 17), (3, 18, 4, 19)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 6, 7, 7], [1, 7, 2, 1], [2, 8, 8, 2], [3, 9, 9, 7], [3, 6, 4, 3], [5, 9, 9, 5], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 966: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

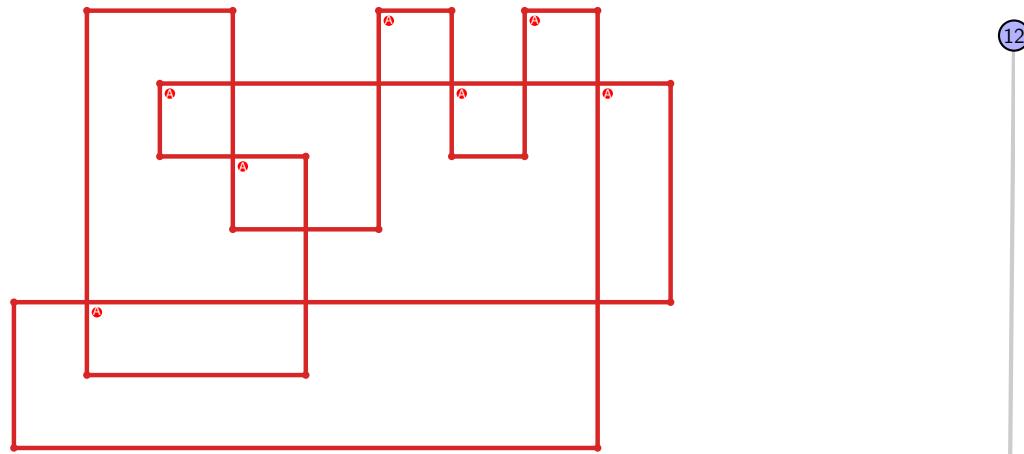


Figure 1935: `SnapPy` multiloop plot.



Figure 1936: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.671 $[[7, 20, 8, 1], [19, 6, 20, 7], [8, 2, 9, 1], [5, 18, 6, 19], [2, 10, 3, 9], [4, 13, 5, 14], [17, 10, 18, 11], [3, 15, 4, 14], [15, 12, 16, 13], [11, 16, 12, 17]]$

PD code drawn by SnapPy: $[(16, 3, 17, 4), (6, 19, 7, 20), (14, 7, 15, 8), (12, 9, 13, 10), (1, 10, 2, 11), (11, 20, 12, 1), (8, 13, 9, 14), (2, 15, 3, 16), (4, 17, 5, 18), (18, 5, 19, 6)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 7, 2], [3, 7, 7, 8], [3, 9, 9, 4], [4, 8, 5, 5], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 967: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

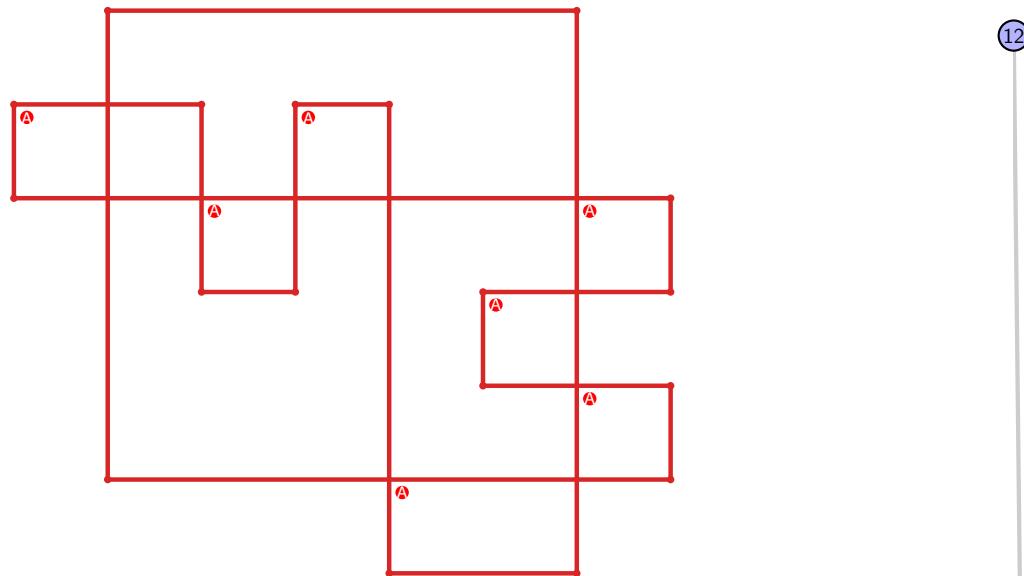


Figure 1937: SnapPy multiloop plot.



Figure 1938: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.672 $[[6, 20, 1, 7], [7, 5, 8, 6], [10, 19, 11, 20], [1, 16, 2, 15], [4, 8, 5, 9], [9, 3, 10, 4], [18, 11, 19, 12], [16, 13, 17, 14], [2, 14, 3, 15], [12, 17, 13, 18]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (14, 3, 15, 4), (2, 15, 3, 16), (11, 18, 12, 19), (9, 20, 10, 7), (6, 7, 1, 8), (8, 5, 9, 6), (19, 10, 20, 11), (17, 12, 18, 13), (4, 13, 5, 14)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 6], [0, 7, 8, 8], [1, 5, 5, 1], [2, 4, 4, 8], [2, 9, 9, 2], [3, 9, 9, 8], [3, 7, 5, 3], [6, 7, 7, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 32
 Pinning number: 7

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.81

Table 968: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

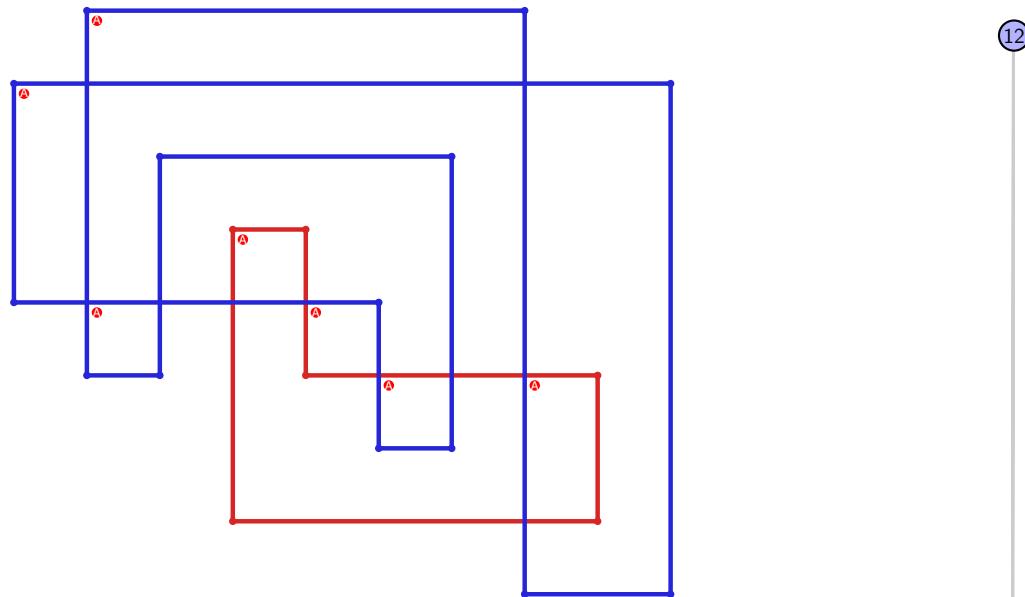


Figure 1939: SnapPy multiloop plot.



Figure 1940: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.673 [[20, 11, 1, 12], [12, 19, 13, 20], [10, 1, 11, 2], [5, 18, 6, 19], [13, 8, 14, 9], [2, 9, 3, 10], [17, 4, 18, 5], [6, 16, 7, 15], [7, 14, 8, 15], [3, 16, 4, 17]]

PD code drawn by SnapPy: [(14, 1, 15, 2), (10, 5, 11, 6), (19, 6, 20, 7), (17, 8, 18, 9), (4, 11, 5, 12), (12, 3, 13, 4), (20, 13, 1, 14), (2, 15, 3, 16), (9, 16, 10, 17), (7, 18, 8, 19)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 6, 7], [1, 8, 8, 5], [2, 4, 9, 2], [3, 9, 9, 3], [3, 9, 8, 8], [4, 7, 7, 4], [5, 7, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 969: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

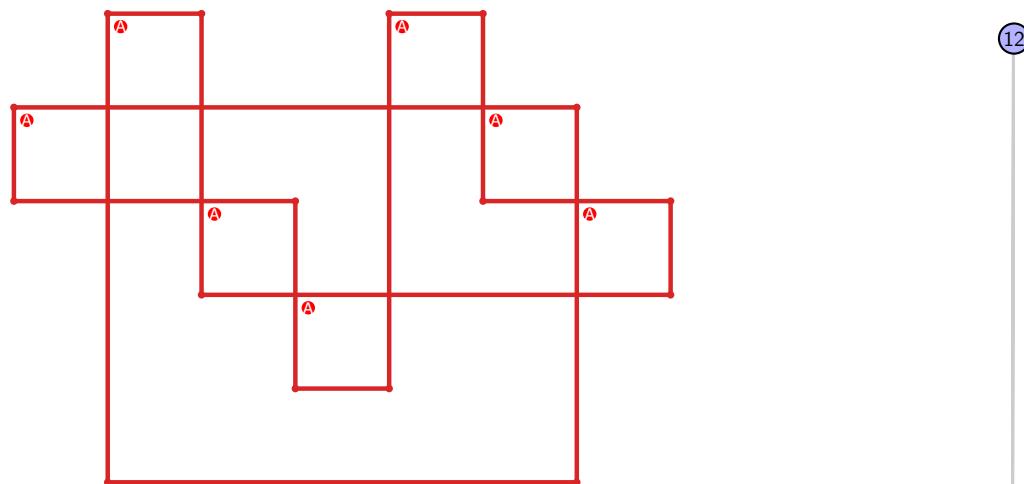


Figure 1941: SnapPy multiloop plot.

12
7

Figure 1942: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.674 [[10, 20, 1, 11], [11, 9, 12, 10], [19, 7, 20, 8], [1, 16, 2, 15], [8, 12, 9, 13], [6, 18, 7, 19], [16, 5, 17, 4], [2, 14, 3, 15], [13, 3, 14, 4], [17, 5, 18, 6]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (1, 14, 2, 15), (15, 2, 16, 3), (17, 4, 18, 5), (19, 6, 20, 7), (5, 20, 6, 11), (9, 12, 10, 13), (13, 8, 14, 9), (3, 16, 4, 17), (7, 18, 8, 19)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 4, 5, 5], [0, 6, 7, 7], [1, 8, 2, 1], [2, 9, 9, 2], [3, 9, 9, 8], [3, 8, 8, 3], [4, 7, 7, 6], [5, 6, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 970: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

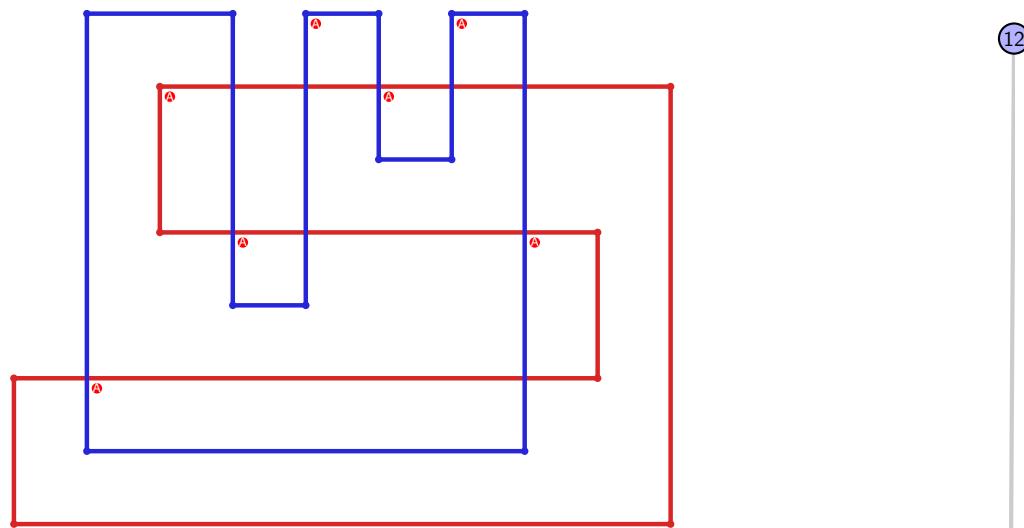


Figure 1943: SnapPy multiloop plot.

7

Figure 1944: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.675 [[10, 20, 1, 11], [11, 9, 12, 10], [19, 1, 20, 2], [8, 12, 9, 13], [2, 18, 3, 19], [13, 5, 14, 6], [17, 7, 18, 8], [3, 16, 4, 15], [4, 14, 5, 15], [6, 16, 7, 17]]

PD code drawn by SnapPy: [(16, 3, 17, 4), (20, 5, 11, 6), (14, 7, 15, 8), (12, 9, 13, 10), (2, 17, 3, 18), (18, 1, 19, 2), (4, 19, 5, 20), (10, 11, 1, 12), (8, 13, 9, 14), (6, 15, 7, 16)]

Planar representation generated by plantri: [[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 6, 7, 2], [3, 8, 8, 9], [3, 9, 9, 4], [4, 9, 8, 8], [5, 7, 7, 5], [5, 7, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 971: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

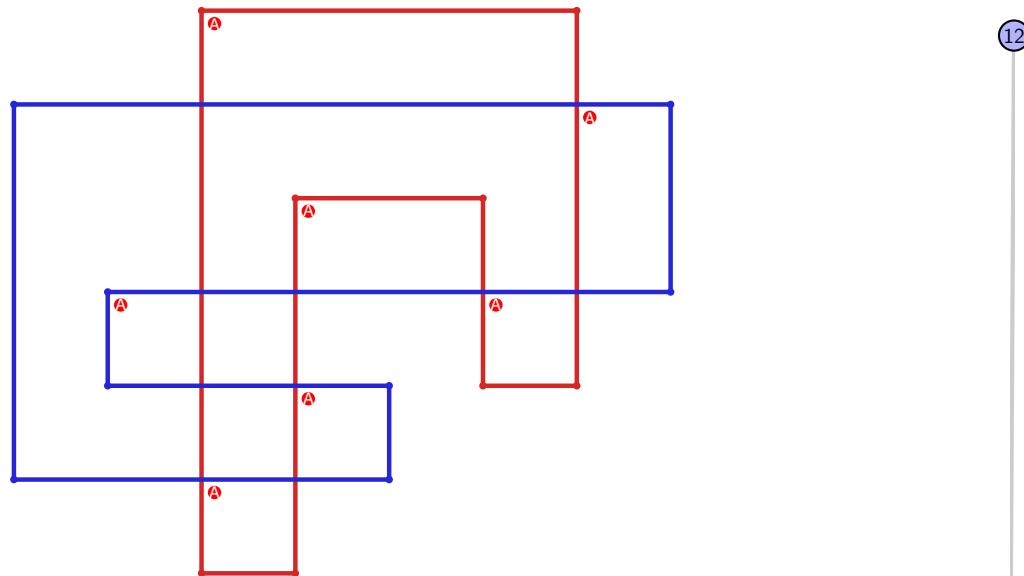


Figure 1945: SnapPy multiloop plot.



Figure 1946: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.676 $[[8, 20, 1, 9], [9, 7, 10, 8], [12, 19, 13, 20], [1, 18, 2, 17], [6, 10, 7, 11], [11, 5, 12, 6], [18, 13, 19, 14], [2, 16, 3, 17], [4, 14, 5, 15], [15, 3, 16, 4]]$

PD code drawn by `SnapPy`: $[(9, 8, 10, 1), (17, 2, 18, 3), (15, 4, 16, 5), (12, 19, 13, 20), (1, 20, 2, 9), (7, 10, 8, 11), (11, 6, 12, 7), (18, 13, 19, 14), (5, 14, 6, 15), (3, 16, 4, 17)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 6], [0, 6, 7, 7], [1, 5, 5, 1], [2, 4, 4, 8], [2, 8, 3, 2], [3, 9, 9, 3], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 972: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

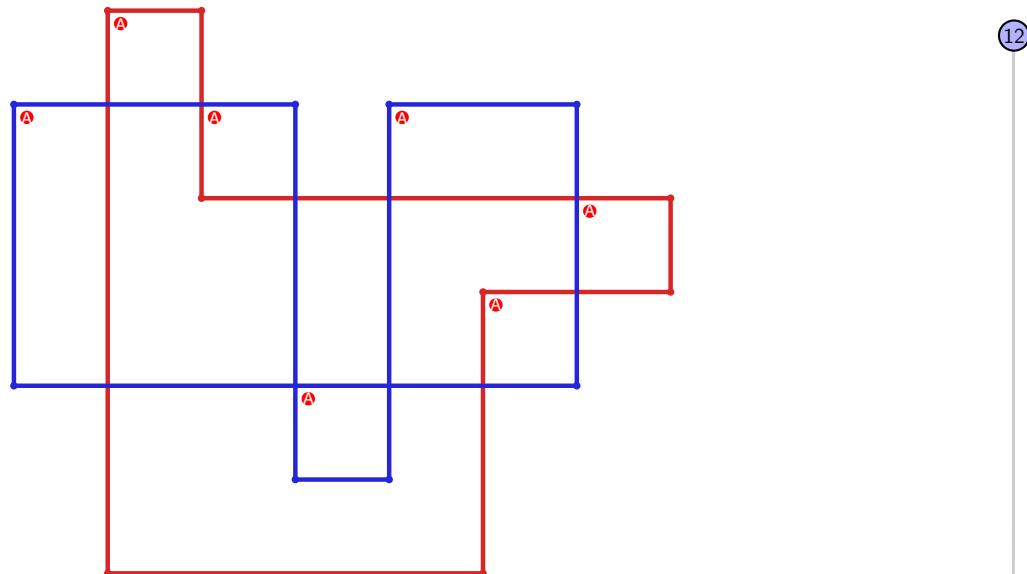


Figure 1947: `SnapPy` multiloop plot.



Figure 1948: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.677 $[[8, 12, 1, 9], [9, 13, 10, 20], [7, 19, 8, 20], [11, 1, 12, 2], [13, 11, 14, 10], [18, 6, 19, 7], [2, 15, 3, 14], [5, 17, 6, 18], [15, 4, 16, 3], [16, 4, 17, 5]]$

PD code drawn by `SnapPy`: $[(8, 9, 1, 10), (10, 1, 11, 2), (12, 3, 13, 4), (17, 6, 18, 7), (20, 15, 17, 16), (5, 18, 6, 19), (16, 7, 9, 8), (2, 11, 3, 12), (4, 13, 5, 14), (14, 19, 15, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 4, 0], [1, 3, 6, 1], [2, 7, 7, 2], [3, 8, 8, 4], [5, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 28
 Pinning number: 8

Average optimal degree: 2.17
 Average minimal degree: 2.17
 Average overall degree: 2.82

Table 973: Pinning sets/average degree by cardinal

Cardinal	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0
Nonminimal pinning sets	0	9	10	5	1	25
Average degree	2.17	2.64	2.96	3.16	3.33	

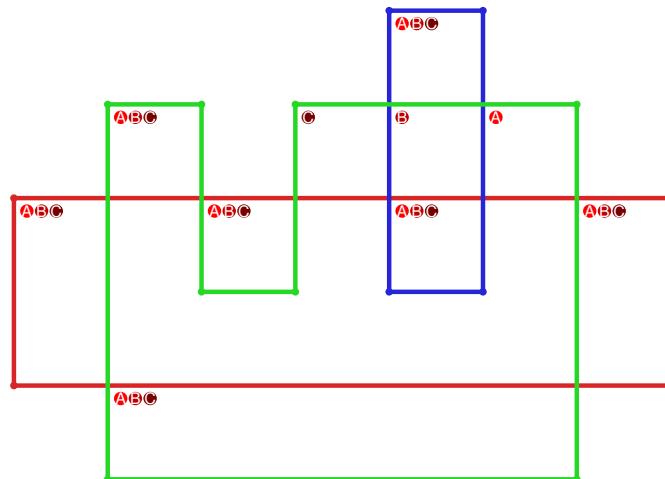


Figure 1949: `SnapPy` multiloop plot.

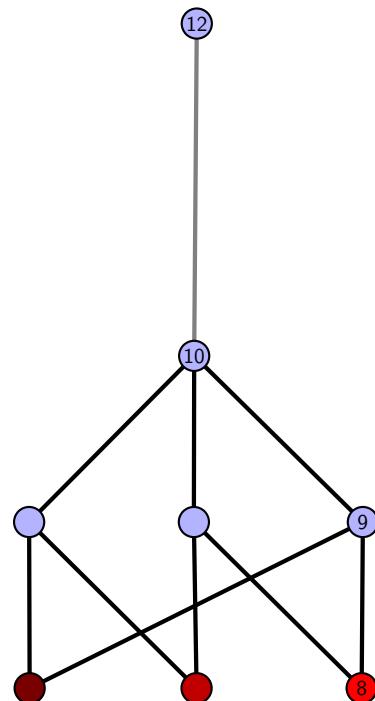


Figure 1950: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.678 $[[7, 20, 8, 1], [19, 6, 20, 7], [8, 2, 9, 1], [5, 18, 6, 19], [2, 10, 3, 9], [4, 13, 5, 14], [17, 12, 18, 13], [10, 16, 11, 15], [3, 15, 4, 14], [11, 16, 12, 17]]$

PD code drawn by SnapPy: $[(17, 4, 18, 5), (7, 20, 8, 1), (15, 10, 16, 11), (2, 11, 3, 12), (12, 1, 13, 2), (13, 8, 14, 9), (9, 14, 10, 15), (3, 16, 4, 17), (5, 18, 6, 19), (19, 6, 20, 7)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 4, 0], [1, 5, 6, 1], [2, 7, 8, 2], [3, 8, 8, 6], [3, 5, 9, 9], [4, 9, 9, 8], [4, 7, 5, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 1

Total pinning sets: 32
Pinning number: 7

Average optimal degree: 2.0

Average minimal degree: 2.0

Average overall degree: 2.81

Table 974: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

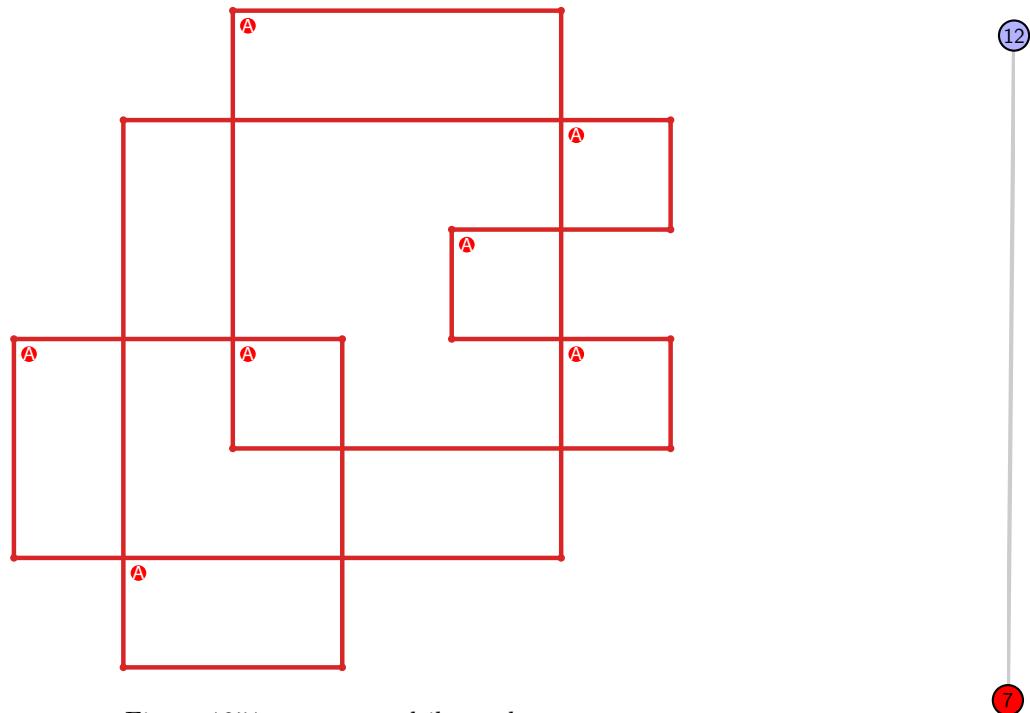


Figure 1951: SnapPy multiloop plot.

Figure 1952: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.679 $[[8, 14, 1, 9], [9, 15, 10, 20], [7, 19, 8, 20], [13, 1, 14, 2], [15, 11, 16, 10], [18, 6, 19, 7], [2, 12, 3, 13], [11, 3, 12, 4], [16, 4, 17, 5], [5, 17, 6, 18]]$

PD code drawn by SnapPy: $[(14, 1, 9, 2), (15, 2, 16, 3), (17, 4, 18, 5), (10, 7, 11, 8), (13, 20, 14, 15), (8, 9, 1, 10), (6, 11, 7, 12), (3, 16, 4, 17), (5, 18, 6, 19), (19, 12, 20, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 5], [0, 6, 6, 0], [1, 7, 8, 1], [2, 9, 9, 2], [3, 7, 7, 3], [4, 6, 6, 8], [4, 7, 9, 9], [5, 8, 8, 5]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 975: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

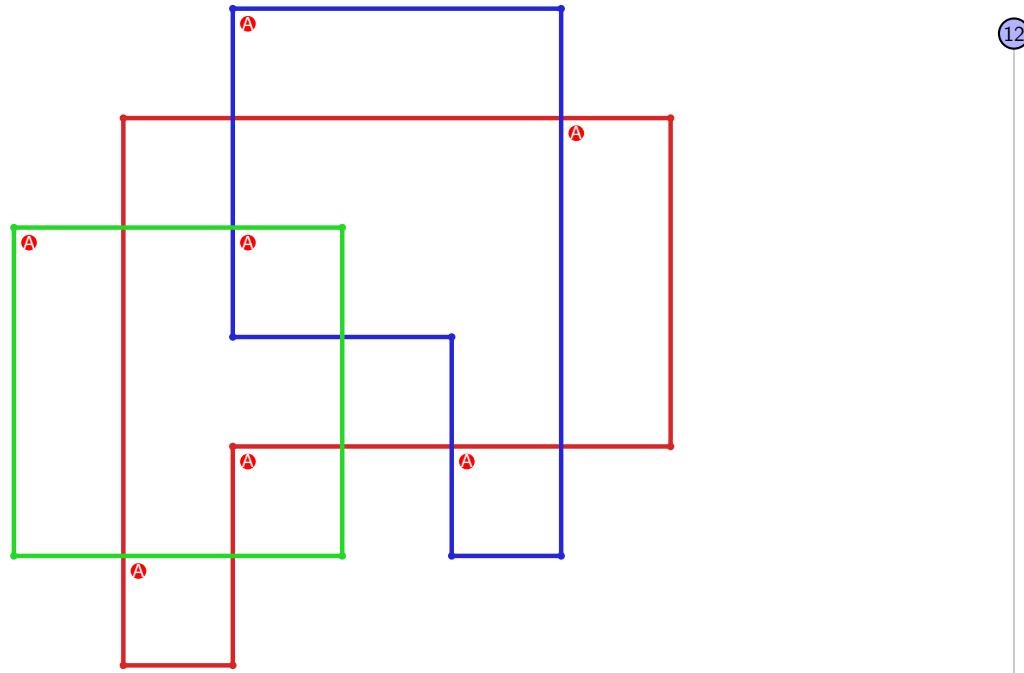


Figure 1953: SnapPy multiloop plot.

Figure 1954: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.680 [[20, 11, 1, 12], [12, 19, 13, 20], [10, 1, 11, 2], [5, 18, 6, 19], [13, 6, 14, 7], [2, 9, 3, 10], [17, 4, 18, 5], [14, 8, 15, 7], [15, 8, 16, 9], [3, 16, 4, 17]]

PD code drawn by `SnapPy`: [(14, 1, 15, 2), (10, 3, 11, 4), (4, 11, 5, 12), (12, 5, 13, 6), (19, 6, 20, 7), (17, 8, 18, 9), (20, 13, 1, 14), (2, 15, 3, 16), (9, 16, 10, 17), (7, 18, 8, 19)]

Planar representation generated by `plantri`: [[1, 1, 2, 2], [0, 3, 4, 0], [0, 5, 5, 0], [1, 6, 6, 4], [1, 3, 7, 7], [2, 8, 9, 2], [3, 9, 9, 3], [4, 8, 8, 4], [5, 7, 7, 9], [5, 8, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 32

Average overall degree: 2.81

Pinning number: 7

Table 976: Pinning sets/average degree by cardinal

Cardinal	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0
Nonminimal pinning sets	0	5	10	10	5	1	31
Average degree	2.0	2.4	2.71	2.96	3.16	3.33	

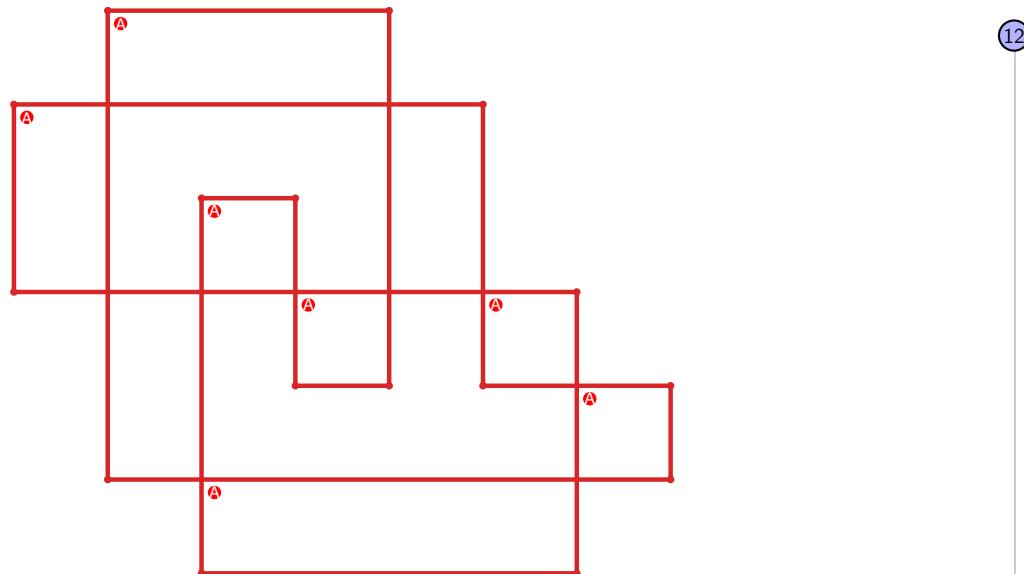


Figure 1955: `SnapPy` multiloop plot.



Figure 1956: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.681 $[[4, 12, 1, 5], [5, 13, 6, 20], [3, 19, 4, 20], [11, 18, 12, 19], [1, 14, 2, 13], [6, 2, 7, 3], [17, 10, 18, 11], [14, 8, 15, 7], [9, 16, 10, 17], [8, 16, 9, 15]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (6, 15, 7, 16), (18, 9, 19, 10), (2, 11, 3, 12), (16, 7, 17, 8), (8, 17, 9, 18), (10, 19, 11, 20), (1, 20, 2, 13), (13, 12, 14, 5), (14, 3, 15, 4)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 5, 1], [1, 4, 7, 2], [3, 8, 8, 3], [4, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 84
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.46
 Average overall degree: 2.97

Table 977: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	3	0	0	0	0	3
Nonminimal pinning sets	0	6	15	28	22	8	1	80
Average degree	2.33	2.62	2.78	2.97	3.15	3.27	3.33	

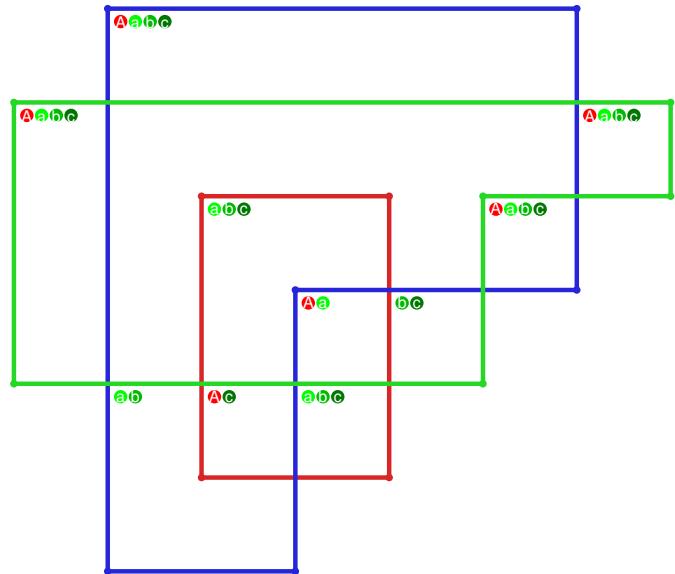


Figure 1957: SnapPy multiloop plot.

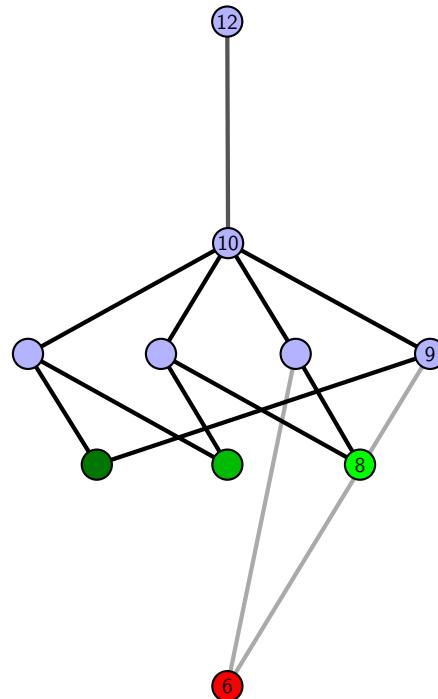


Figure 1958: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.682 $[[4, 12, 1, 5], [5, 13, 6, 20], [3, 19, 4, 20], [11, 18, 12, 19], [1, 14, 2, 13], [6, 2, 7, 3], [15, 10, 16, 11], [17, 8, 18, 9], [14, 8, 15, 7], [9, 16, 10, 17]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (6, 15, 7, 16), (18, 7, 19, 8), (16, 9, 17, 10), (2, 11, 3, 12), (8, 17, 9, 18), (10, 19, 11, 20), (1, 20, 2, 13), (13, 12, 14, 5), (14, 3, 15, 4)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 8, 5, 1], [1, 4, 8, 2], [3, 8, 9, 9], [3, 9, 9, 8], [4, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1
Total minimal pinning sets: 4
Total pinning sets: 336
Pinning number: 4

Average optimal degree: 2.5
Average minimal degree: 2.62
Average overall degree: 3.1

Table 978: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	28	70	96	80	39	10	1	332
Average degree	2.5	2.75	2.89	3.01	3.11	3.19	3.26	3.31	3.33	

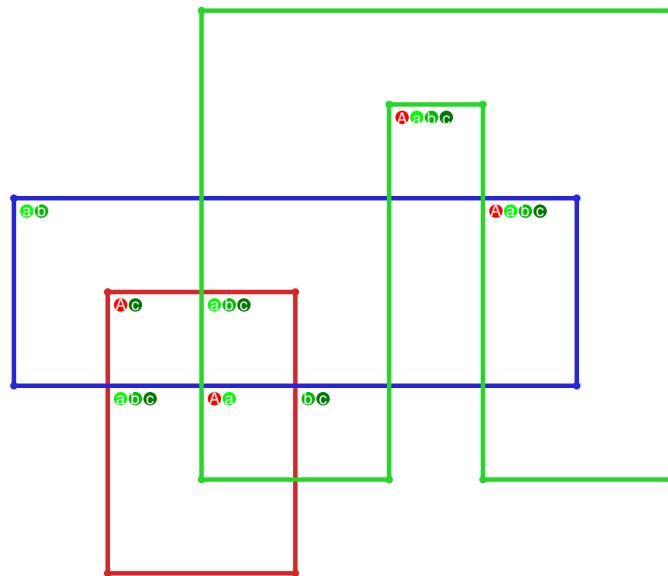


Figure 1959: SnapPy multiloop plot.

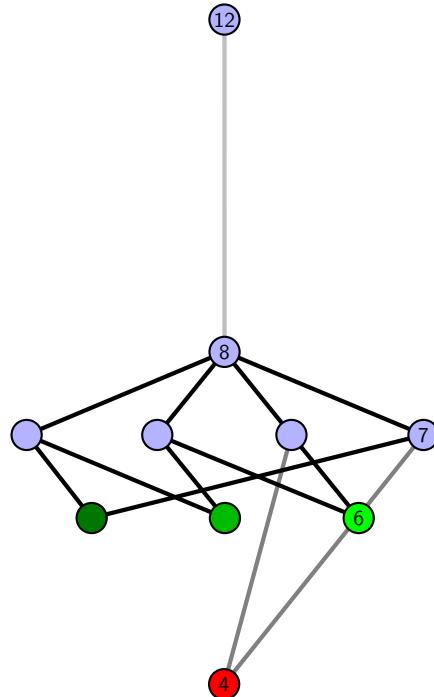


Figure 1960: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.683 $[[4, 20, 1, 5], [5, 13, 6, 12], [3, 11, 4, 12], [19, 10, 20, 11], [1, 14, 2, 13], [6, 2, 7, 3], [15, 18, 16, 19], [16, 9, 17, 10], [14, 8, 15, 7], [8, 17, 9, 18]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (15, 8, 16, 9), (18, 9, 19, 10), (1, 10, 2, 11), (11, 20, 12, 5), (12, 3, 13, 4), (7, 16, 8, 17), (14, 17, 15, 18), (2, 19, 3, 20), (6, 13, 7, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 8, 5, 1], [1, 4, 8, 2], [3, 8, 9, 7], [3, 6, 9, 9], [4, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 7
 Total minimal pinning sets: 13
 Total pinning sets: 416
 Pinning number: 5

Average optimal degree: 2.94
 Average minimal degree: 2.9
 Average overall degree: 3.17

Table 979: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	7	0	0	0	0	0	0	0	7
Minimal (suboptimal) pinning sets	0	3	3	0	0	0	0	0	6
Nonminimal pinning sets	0	33	85	124	102	47	11	1	403
Average degree	2.94	3.02	3.09	3.17	3.24	3.29	3.32	3.33	

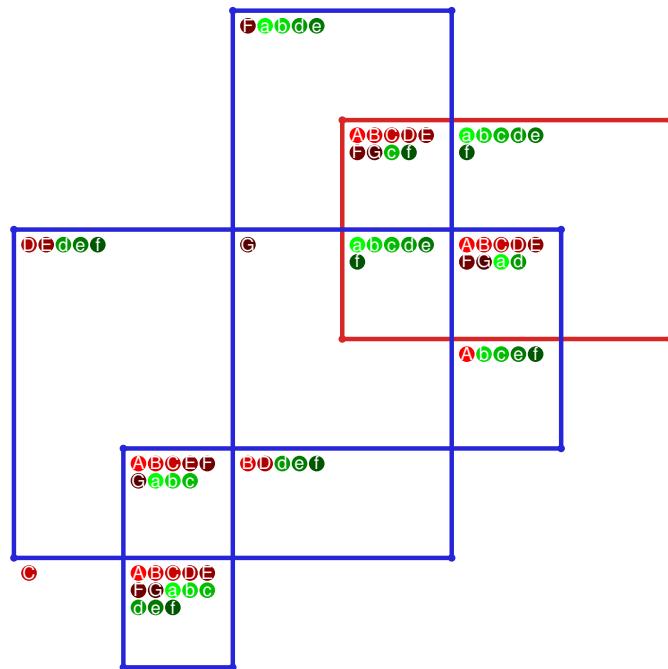


Figure 1961: SnapPy multiloop plot.

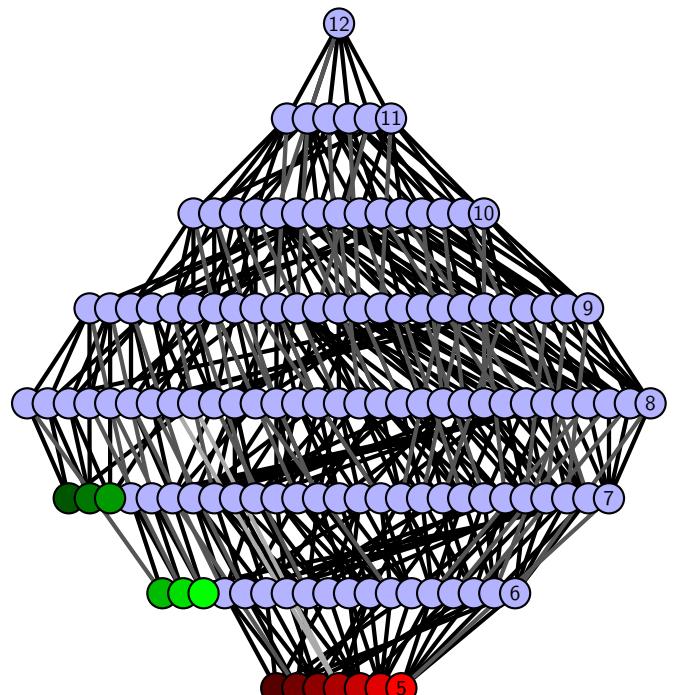


Figure 1962: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.684 $[[4, 20, 1, 5], [5, 12, 6, 13], [13, 3, 14, 4], [14, 19, 15, 20], [1, 11, 2, 12], [6, 2, 7, 3], [18, 15, 19, 16], [10, 7, 11, 8], [16, 10, 17, 9], [17, 8, 18, 9]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (14, 3, 15, 4), (9, 16, 10, 17), (17, 8, 18, 9), (2, 19, 3, 20), (13, 20, 14, 5), (10, 7, 11, 8), (6, 11, 7, 12), (1, 12, 2, 13), (18, 15, 19, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 5, 1], [1, 4, 7, 2], [3, 8, 9, 3], [4, 9, 8, 5], [6, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 336
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.62
 Average overall degree: 3.1

Table 980: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	28	70	96	80	39	10	1	332
Average degree	2.5	2.75	2.89	3.01	3.11	3.19	3.26	3.31	3.33	

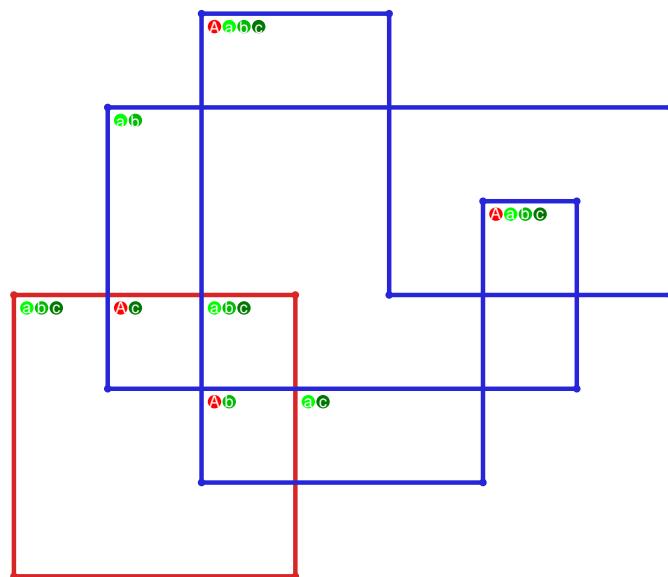


Figure 1963: SnapPy multiloop plot.

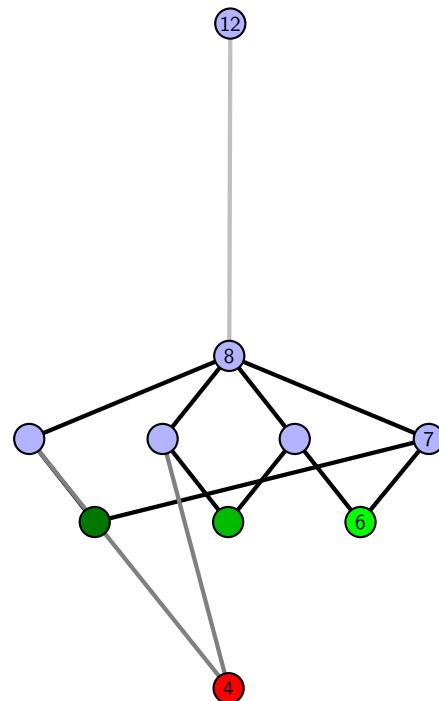


Figure 1964: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.685 $[[4, 16, 1, 5], [5, 10, 6, 11], [11, 3, 12, 4], [12, 15, 13, 16], [1, 9, 2, 10], [6, 2, 7, 3], [14, 20, 15, 17], [13, 20, 14, 19], [8, 18, 9, 19], [7, 18, 8, 17]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (12, 3, 13, 4), (2, 15, 3, 16), (11, 16, 12, 5), (6, 9, 7, 10), (1, 10, 2, 11), (18, 13, 19, 14), (14, 19, 15, 20), (20, 7, 17, 8), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 8, 5, 1], [1, 4, 9, 2], [3, 9, 7, 7], [3, 6, 6, 8], [4, 7, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 384
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.57
 Average overall degree: 3.1

Table 981: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	40	86	110	86	40	10	1	381
Average degree	2.5	2.72	2.89	3.02	3.12	3.2	3.26	3.31	3.33	

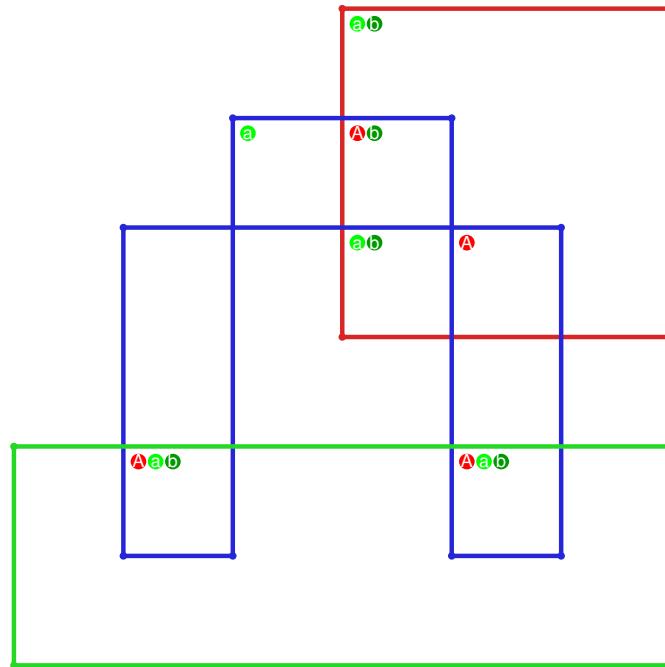


Figure 1965: SnapPy multiloop plot.

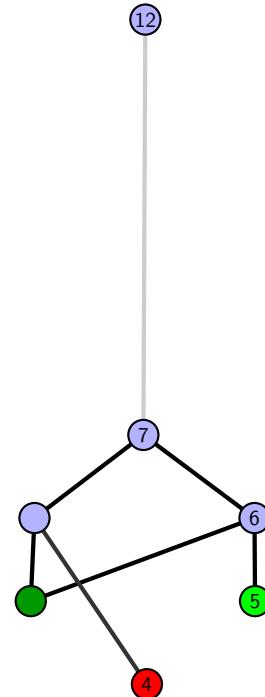


Figure 1966: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.686 [[20, 9, 1, 10], [10, 3, 11, 4], [4, 19, 5, 20], [5, 8, 6, 9], [1, 16, 2, 17], [17, 2, 18, 3], [11, 18, 12, 19], [7, 14, 8, 15], [6, 14, 7, 13], [15, 12, 16, 13]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (8, 1, 9, 2), (3, 6, 4, 7), (18, 7, 19, 8), (13, 10, 14, 11), (11, 4, 12, 5), (5, 12, 6, 13), (19, 14, 20, 15), (9, 16, 10, 17), (2, 17, 3, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 8], [0, 9, 5, 5], [1, 4, 4, 6], [1, 5, 9, 2], [3, 9, 8, 8], [3, 7, 7, 9], [4, 8, 7, 6]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 512
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.11

Table 982: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	70	126	140	98	42	10	1	509
Average degree	2.5	2.76	2.94	3.06	3.15	3.22	3.27	3.31	3.33	

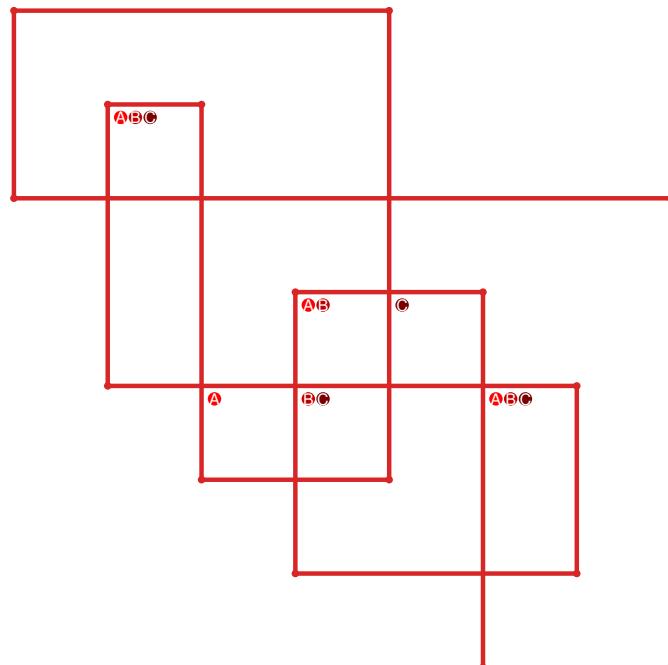


Figure 1967: SnapPy multiloop plot.

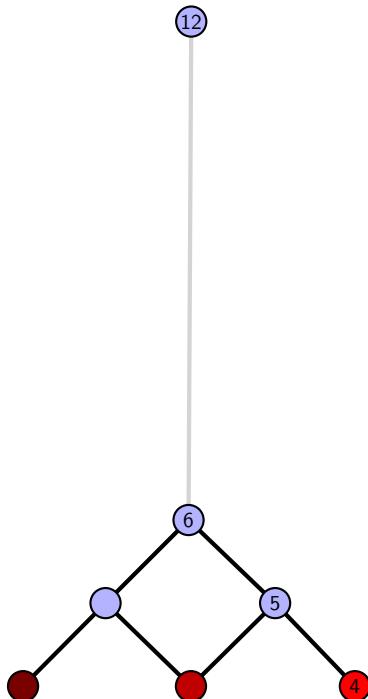


Figure 1968: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.687 [[20, 11, 1, 12], [12, 8, 13, 7], [19, 16, 20, 17], [10, 15, 11, 16], [1, 9, 2, 8], [13, 2, 14, 3], [3, 6, 4, 7], [17, 4, 18, 5], [5, 18, 6, 19], [14, 9, 15, 10]]

PD code drawn by `SnapPy`: [(11, 20, 12, 1), (15, 2, 16, 3), (1, 4, 2, 5), (5, 10, 6, 11), (6, 19, 7, 20), (12, 7, 13, 8), (18, 9, 19, 10), (8, 13, 9, 14), (17, 14, 18, 15), (3, 16, 4, 17)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 8, 3], [0, 2, 9, 9], [0, 9, 5, 1], [1, 4, 9, 6], [1, 5, 8, 7], [2, 6, 8, 8], [2, 7, 7, 6], [3, 5, 4, 3]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 6
 Total pinning sets: 504
 Pinning number: 4

Average optimal degree: 2.62
 Average minimal degree: 2.68
 Average overall degree: 3.12

Table 983: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	15	67	125	140	98	42	10	1	498
Average degree	2.62	2.81	2.96	3.07	3.16	3.22	3.27	3.31	3.33	

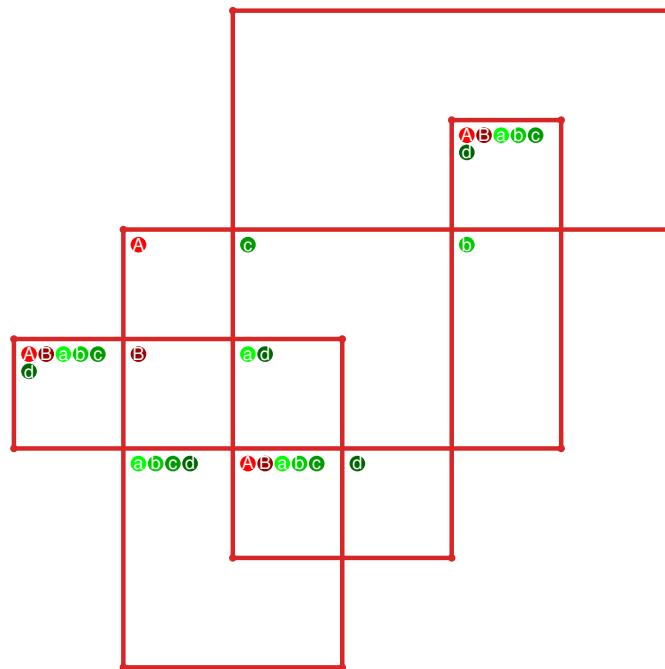


Figure 1969: `SnapPy` multiloop plot.

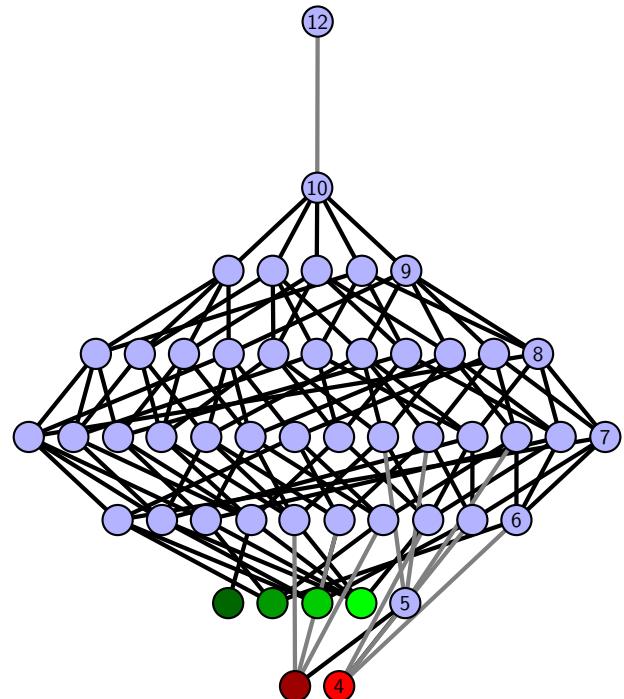


Figure 1970: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.688 [[8, 12, 1, 9], [9, 13, 10, 20], [7, 4, 8, 5], [11, 3, 12, 4], [1, 14, 2, 13], [10, 15, 11, 16], [16, 19, 17, 20], [5, 17, 6, 18], [18, 6, 19, 7], [2, 14, 3, 15]]

PD code drawn by SnapPy: [(20, 1, 17, 2), (5, 2, 6, 3), (13, 4, 14, 5), (6, 17, 7, 18), (19, 10, 20, 11), (3, 12, 4, 13), (11, 14, 12, 15), (15, 18, 16, 19), (16, 7, 9, 8), (8, 9, 1, 10)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 8, 3], [0, 2, 5, 9], [0, 9, 9, 1], [1, 9, 3, 6], [1, 5, 8, 7], [2, 6, 8, 8], [2, 7, 7, 6], [3, 5, 4, 4]]

Total optimal pinning sets: 2

Average optimal degree: 3.0

Total minimal pinning sets: 25

Average minimal degree: 2.87

Total pinning sets: 747

Average overall degree: 3.15

Pinning number: 4

Table 984: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	18	5	0	0	0	0	0	0	23
Nonminimal pinning sets	0	16	125	210	197	118	45	10	1	722
Average degree	3.0	2.93	3.04	3.13	3.19	3.24	3.28	3.31	3.33	

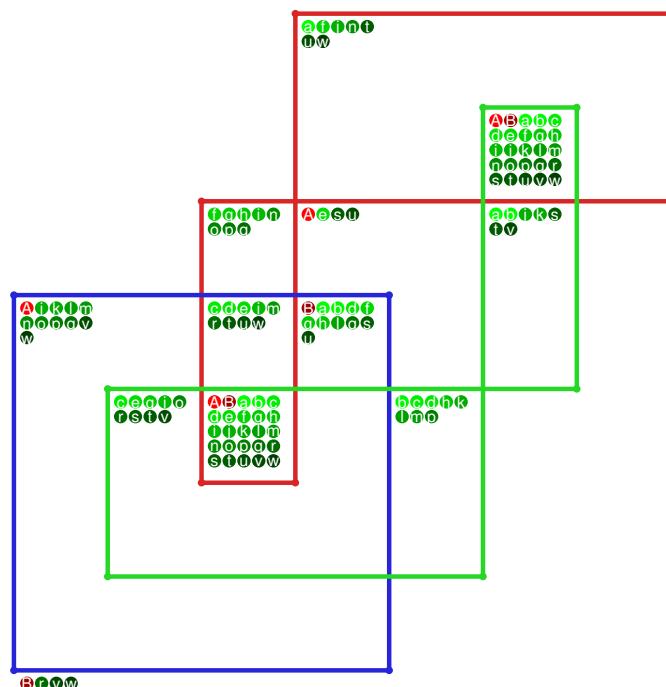


Figure 1971: SnapPy multiloop plot.

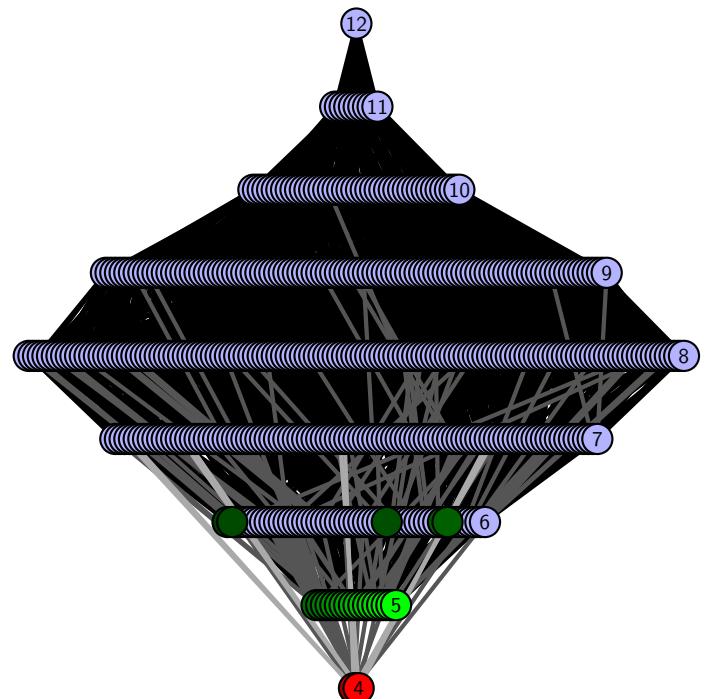


Figure 1972: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.689 $[[16, 20, 1, 17], [17, 3, 18, 4], [15, 12, 16, 13], [19, 11, 20, 12], [1, 11, 2, 10], [2, 9, 3, 10], [18, 9, 19, 8], [4, 8, 5, 7], [13, 7, 14, 6], [14, 5, 15, 6]]$

PD code drawn by SnapPy: $[(20, 1, 17, 2), (12, 3, 13, 4), (4, 11, 5, 12), (5, 2, 6, 3), (6, 17, 7, 18), (16, 7, 1, 8), (8, 15, 9, 16), (18, 9, 19, 10), (13, 10, 14, 11), (14, 19, 15, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 8, 9, 3], [0, 2, 6, 4], [0, 3, 5, 5], [1, 4, 4, 6], [1, 5, 3, 7], [1, 6, 9, 8], [2, 7, 9, 9], [2, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 6
 Total pinning sets: 516
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.78
 Average overall degree: 3.12

Table 985: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	2	0	0	0	0	0	0	4
Nonminimal pinning sets	0	16	64	128	146	102	43	10	1	510
Average degree	2.5	2.78	2.94	3.06	3.16	3.22	3.27	3.31	3.33	

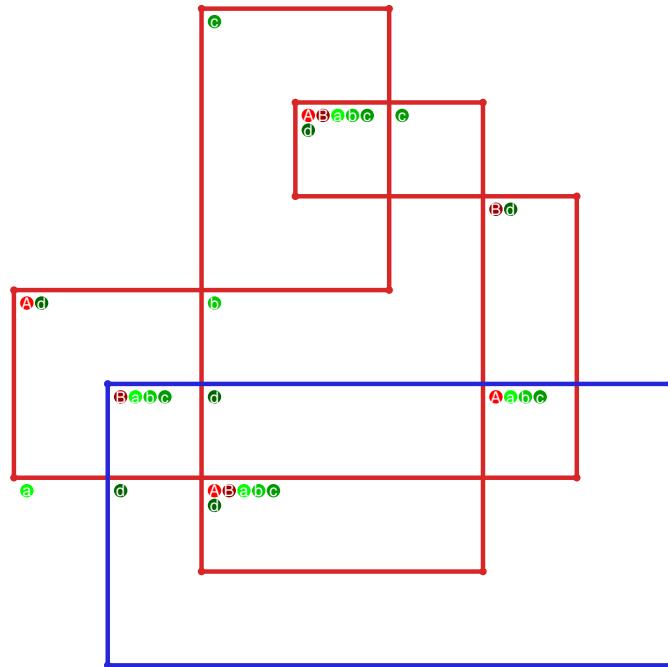


Figure 1973: SnapPy multiloop plot.

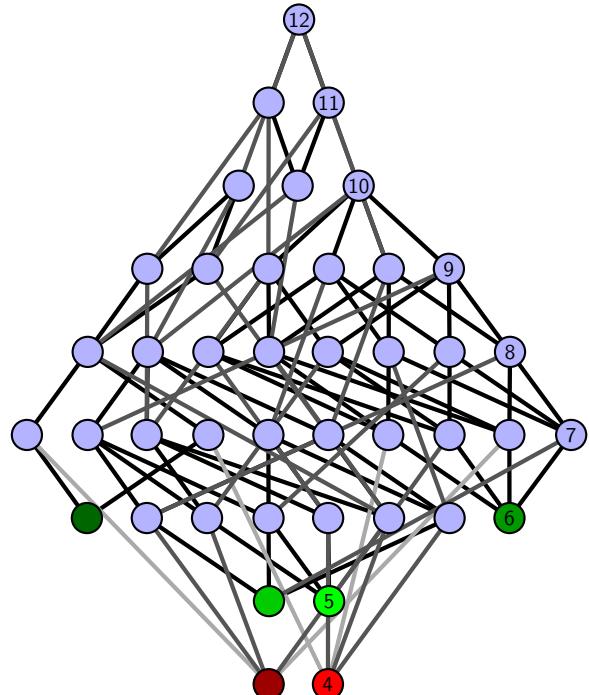


Figure 1974: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.690 [[16, 7, 1, 8], [8, 17, 9, 20], [15, 19, 16, 20], [6, 18, 7, 19], [1, 18, 2, 17], [9, 14, 10, 15], [10, 5, 11, 6], [2, 13, 3, 14], [4, 11, 5, 12], [12, 3, 13, 4]]

PD code drawn by SnapPy: [(10, 1, 11, 2), (8, 3, 9, 4), (14, 5, 15, 6), (2, 9, 3, 10), (16, 11, 1, 12), (7, 12, 8, 13), (4, 17, 5, 18), (13, 18, 14, 19), (19, 6, 20, 7), (20, 15, 17, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 4], [0, 3, 7, 1], [1, 7, 6, 2], [3, 5, 8, 8], [4, 9, 9, 5], [6, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 3

Average minimal degree: 2.47

Total pinning sets: 192

Average overall degree: 3.03

Pinning number: 5

Table 986: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	31	55	55	31	9	1	189
Average degree	2.4	2.63	2.83	2.99	3.12	3.22	3.29	3.33	

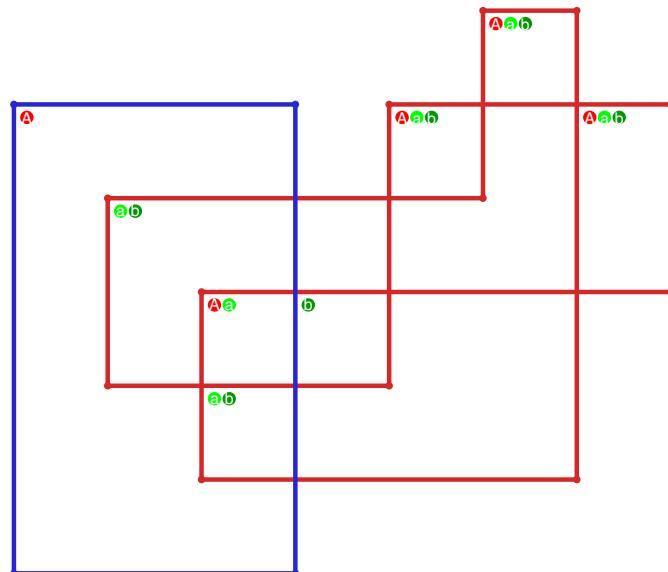


Figure 1975: SnapPy multiloop plot.

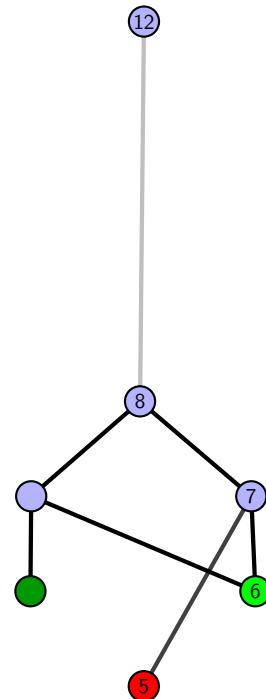


Figure 1976: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.691 [[13, 20, 14, 1], [12, 5, 13, 6], [19, 4, 20, 5], [14, 4, 15, 3], [1, 7, 2, 6], [18, 11, 19, 12], [15, 11, 16, 10], [2, 7, 3, 8], [8, 17, 9, 18], [16, 9, 17, 10]]

PD code drawn by SnapPy: [(20, 11, 1, 12), (16, 1, 17, 2), (9, 2, 10, 3), (3, 18, 4, 19), (19, 4, 20, 5), (13, 6, 14, 7), (7, 12, 8, 13), (15, 8, 16, 9), (5, 14, 6, 15), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 7, 7, 1], [1, 8, 6, 2], [3, 5, 9, 9], [3, 8, 4, 4], [5, 7, 9, 9], [6, 8, 8, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.38

Total pinning sets: 288

Average overall degree: 3.03

Pinning number: 4

Table 987: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	28	61	80	66	33	9	1	286
Average degree	2.25	2.58	2.78	2.93	3.05	3.15	3.23	3.29	3.33	

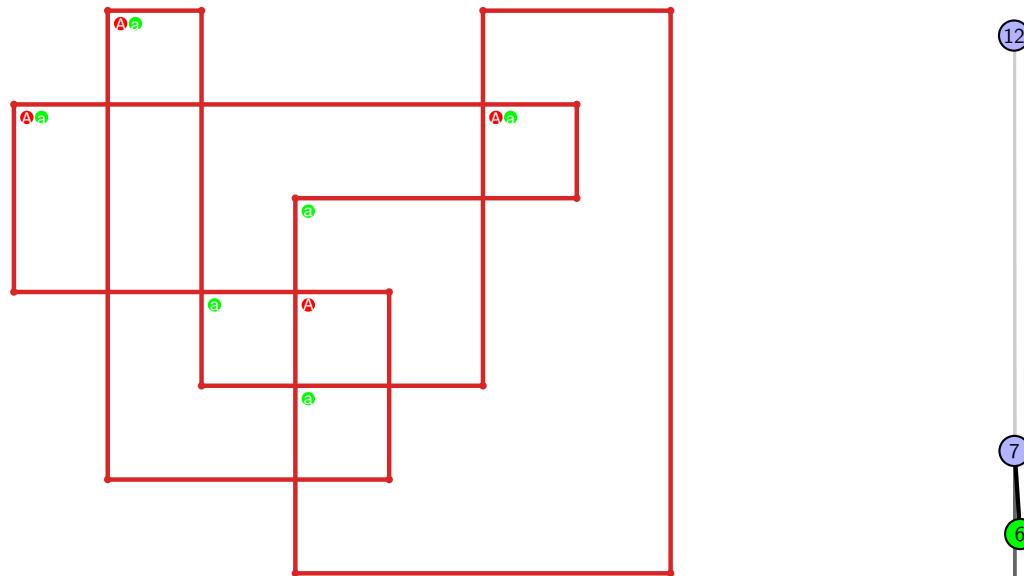


Figure 1977: SnapPy multiloop plot.

Figure 1978: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.692 $[[8, 16, 1, 9], [9, 17, 10, 20], [7, 19, 8, 20], [15, 18, 16, 19], [1, 18, 2, 17], [10, 6, 11, 7], [11, 14, 12, 15], [2, 5, 3, 6], [3, 13, 4, 14], [12, 4, 13, 5]]$

PD code drawn by SnapPy: $[(9, 2, 10, 3), (8, 3, 1, 4), (15, 4, 16, 5), (1, 10, 2, 11), (16, 11, 9, 12), (6, 13, 7, 14), (12, 17, 13, 18), (5, 18, 6, 19), (19, 14, 20, 15), (20, 7, 17, 8)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 4], [0, 3, 7, 1], [1, 7, 6, 2], [3, 5, 8, 9], [4, 9, 8, 5], [6, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.88

Total minimal pinning sets: 17

Average minimal degree: 2.99

Total pinning sets: 700

Average overall degree: 3.2

Pinning number: 4

Table 988: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	10	5	0	0	0	0	0	0	15
Nonminimal pinning sets	0	16	99	186	194	126	50	11	1	683
Average degree	2.88	3.02	3.1	3.17	3.23	3.27	3.3	3.32	3.33	

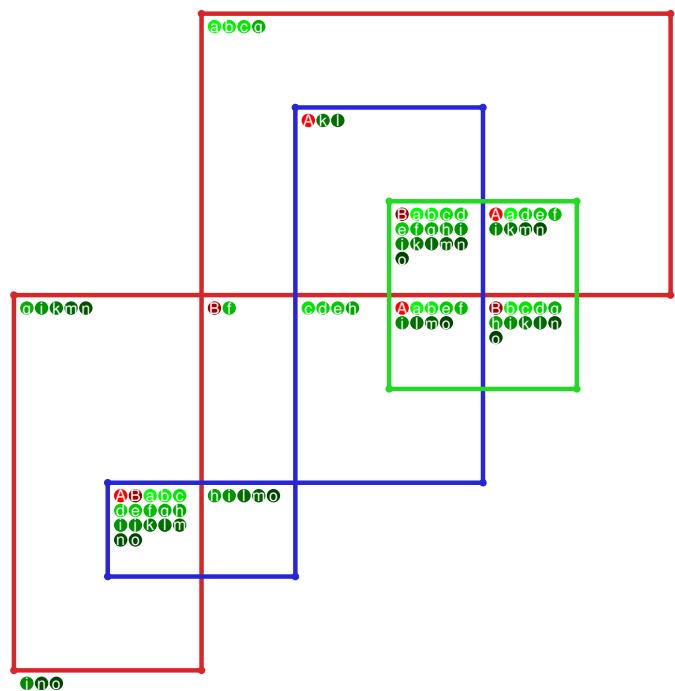


Figure 1979: SnapPy multiloop plot.

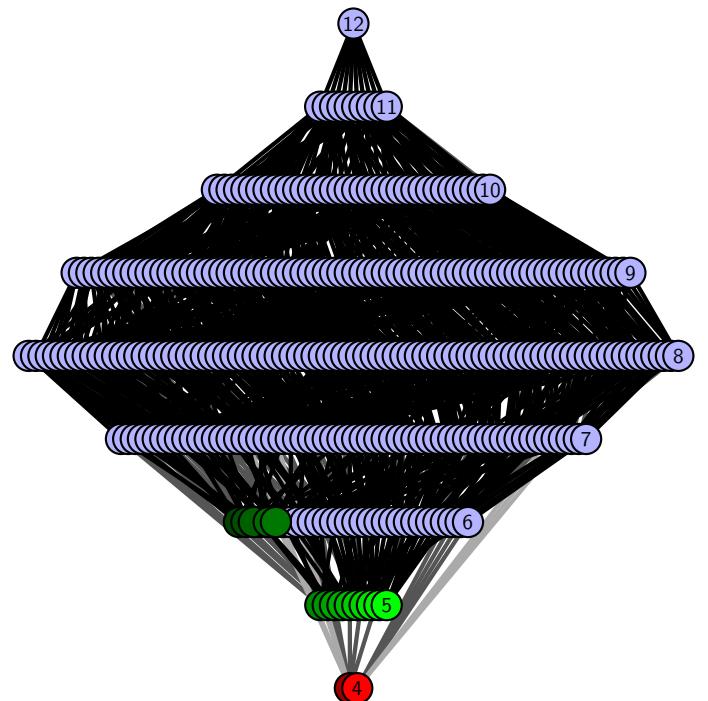


Figure 1980: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.693 $[[8, 16, 1, 9], [9, 17, 10, 20], [7, 19, 8, 20], [15, 18, 16, 19], [1, 18, 2, 17], [10, 6, 11, 7], [14, 4, 15, 5], [2, 13, 3, 12], [5, 11, 6, 12], [3, 13, 4, 14]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (13, 2, 14, 3), (1, 14, 2, 15), (15, 6, 16, 7), (7, 16, 8, 9), (4, 11, 5, 12), (10, 17, 11, 18), (3, 18, 4, 19), (19, 12, 20, 13), (20, 5, 17, 6)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 4], [0, 3, 7, 1], [1, 8, 8, 2], [3, 8, 9, 9], [4, 9, 9, 8], [5, 7, 6, 5], [6, 7, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.4

Total minimal pinning sets: 3

Average minimal degree: 2.47

Total pinning sets: 192

Average overall degree: 3.03

Pinning number: 5

Table 989: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	31	55	55	31	9	1	189
Average degree	2.4	2.63	2.83	2.99	3.12	3.22	3.29	3.33	

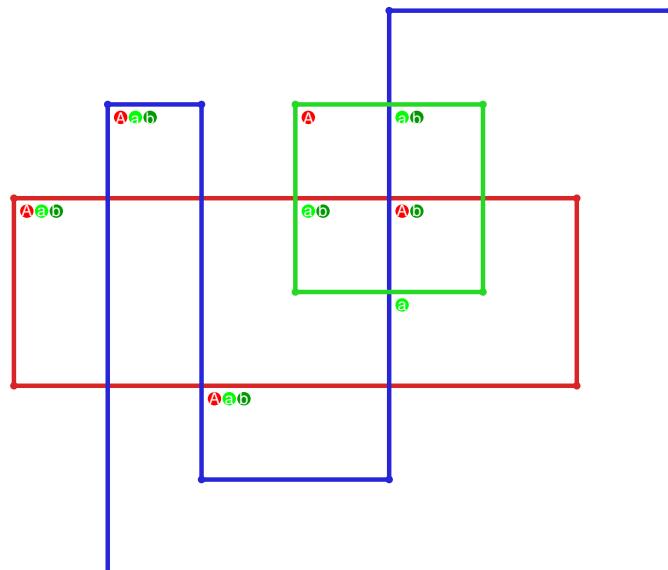


Figure 1981: SnapPy multiloop plot.

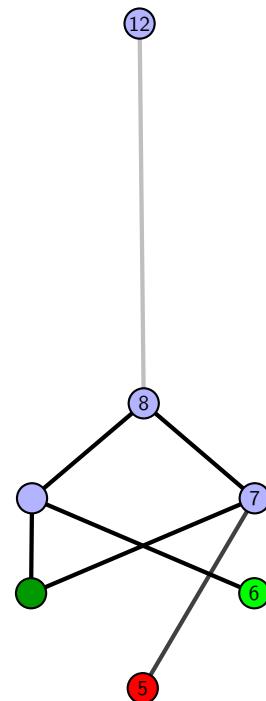


Figure 1982: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.694 [[13, 20, 14, 1], [3, 12, 4, 13], [4, 19, 5, 20], [14, 5, 15, 6], [1, 6, 2, 7], [7, 2, 8, 3], [18, 11, 19, 12], [15, 11, 16, 10], [8, 17, 9, 18], [16, 9, 17, 10]]

PD code drawn by SnapPy: [(5, 20, 6, 1), (12, 3, 13, 4), (19, 4, 20, 5), (14, 7, 15, 8), (8, 13, 9, 14), (16, 9, 17, 10), (1, 10, 2, 11), (6, 15, 7, 16), (2, 17, 3, 18), (11, 18, 12, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 3], [0, 2, 7, 4], [0, 3, 5, 5], [1, 4, 4, 8], [1, 8, 7, 2], [3, 6, 9, 9], [5, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 256
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 3.03

Table 990: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

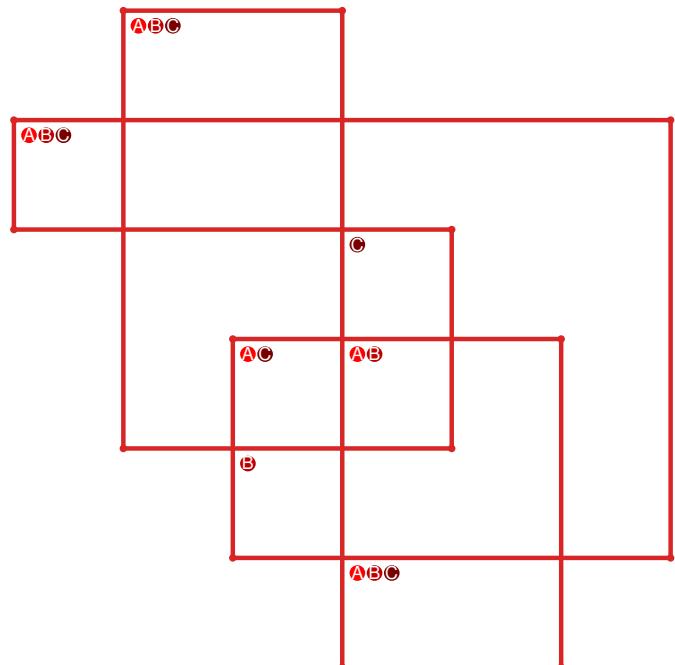


Figure 1983: SnapPy multiloop plot.

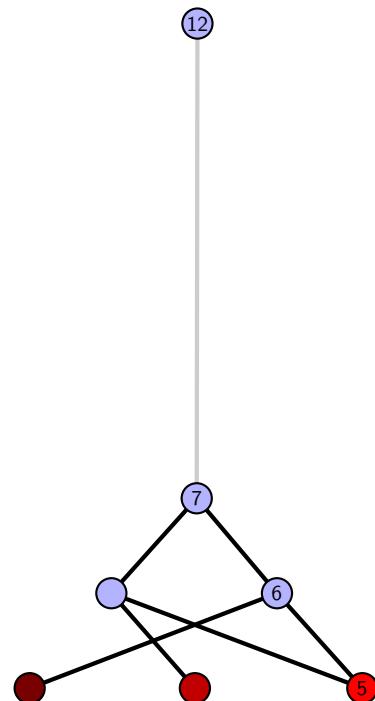


Figure 1984: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.695 [[12, 5, 1, 6], [6, 13, 7, 20], [4, 11, 5, 12], [1, 14, 2, 13], [7, 2, 8, 3], [3, 19, 4, 20], [16, 10, 17, 11], [14, 9, 15, 8], [15, 18, 16, 19], [9, 17, 10, 18]]

PD code drawn by SnapPy: [(5, 12, 6, 1), (10, 3, 11, 4), (6, 15, 7, 16), (17, 8, 18, 9), (2, 9, 3, 10), (7, 18, 8, 19), (16, 19, 17, 20), (1, 20, 2, 13), (13, 4, 14, 5), (14, 11, 15, 12)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 7, 4, 1], [1, 3, 7, 5], [1, 4, 8, 2], [2, 8, 9, 9], [3, 9, 8, 4], [5, 7, 9, 6], [6, 8, 7, 6]]

Total optimal pinning sets: 6
 Total minimal pinning sets: 8
 Total pinning sets: 384
 Pinning number: 5

Average optimal degree: 2.7
 Average minimal degree: 2.69
 Average overall degree: 3.11

Table 991: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	33	86	115	90	41	10	1	376
Average degree	2.7	2.89	3.02	3.13	3.21	3.27	3.31	3.33	

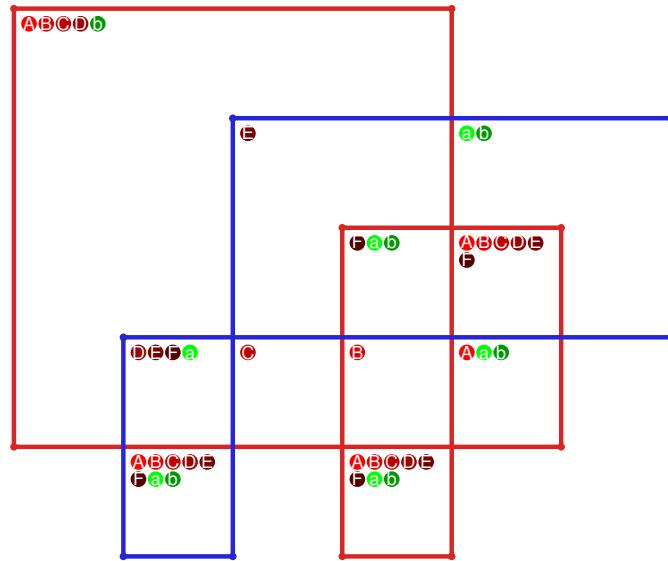


Figure 1985: SnapPy multiloop plot.

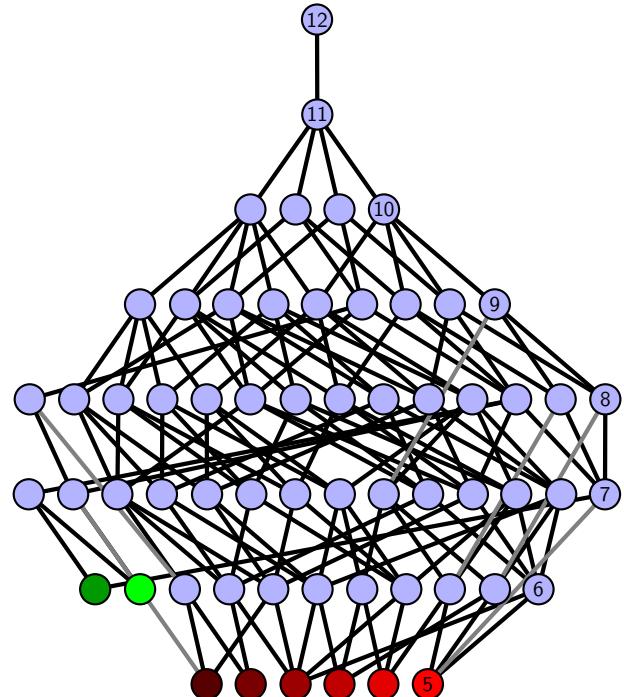


Figure 1986: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.696 [[14, 20, 1, 15], [15, 10, 16, 9], [13, 8, 14, 9], [5, 19, 6, 20], [1, 11, 2, 10], [16, 12, 17, 13], [4, 7, 5, 8], [18, 6, 19, 7], [11, 3, 12, 2], [17, 3, 18, 4]]

PD code drawn by SnapPy: [(15, 14, 16, 1), (16, 3, 17, 4), (1, 4, 2, 5), (10, 5, 11, 6), (6, 19, 7, 20), (7, 12, 8, 13), (20, 9, 15, 10), (13, 8, 14, 9), (2, 17, 3, 18), (11, 18, 12, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 8, 1], [1, 8, 9, 2], [2, 9, 7, 3], [3, 6, 9, 3], [4, 9, 5, 4], [5, 8, 7, 6]]

Total optimal pinning sets: 3

Average optimal degree: 2.67

Total minimal pinning sets: 11

Average minimal degree: 2.77

Total pinning sets: 380

Average overall degree: 3.12

Pinning number: 5

Table 992: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	8	0	0	0	0	0	0	8
Nonminimal pinning sets	0	20	83	119	94	42	10	1	369
Average degree	2.67	2.85	3.01	3.13	3.21	3.27	3.31	3.33	

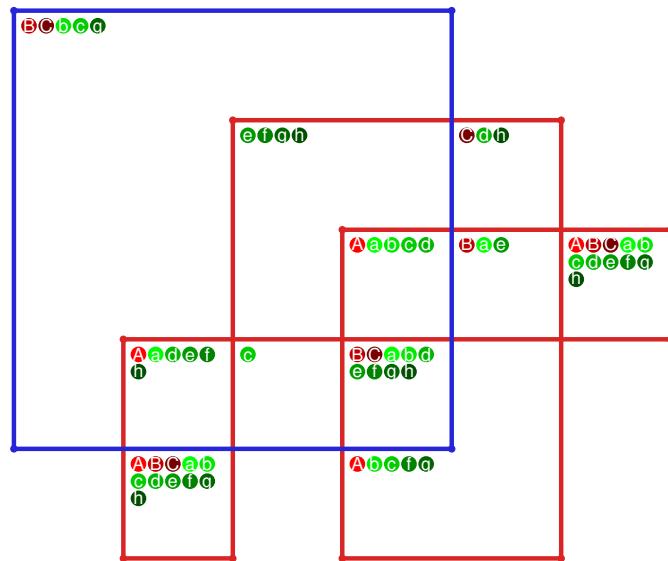


Figure 1987: SnapPy multiloop plot.

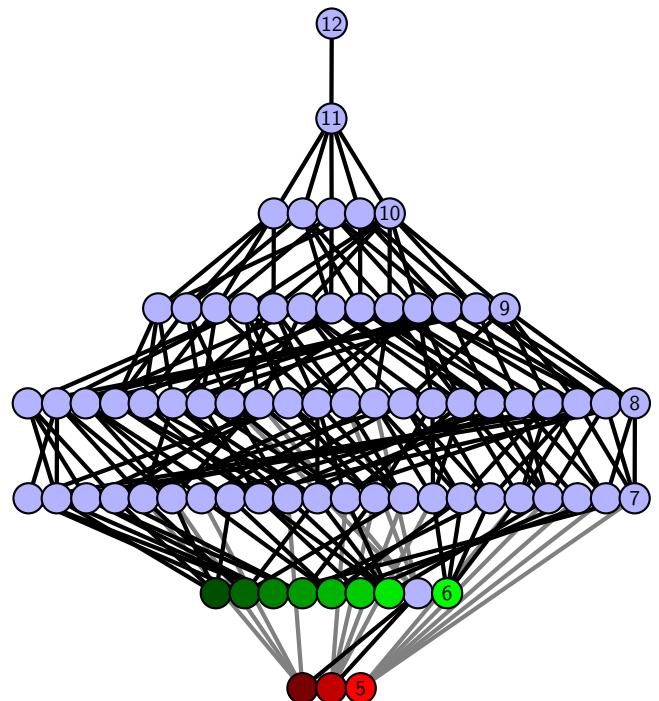


Figure 1988: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.697 $[[7, 12, 8, 1], [6, 20, 7, 13], [11, 19, 12, 20], [8, 2, 9, 1], [13, 9, 14, 10], [10, 5, 11, 6], [15, 18, 16, 19], [2, 16, 3, 17], [14, 4, 15, 5], [17, 3, 18, 4]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (19, 2, 20, 3), (8, 3, 9, 4), (18, 7, 19, 8), (5, 10, 6, 11), (11, 6, 12, 7), (12, 13, 1, 14), (20, 15, 13, 16), (9, 16, 10, 17), (4, 17, 5, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 4, 0], [1, 3, 8, 5], [1, 4, 8, 2], [2, 8, 9, 7], [3, 6, 9, 9], [4, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 6
 Total pinning sets: 368
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.64
 Average overall degree: 3.1

Table 993: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	30	80	111	89	41	10	1	362
Average degree	2.6	2.83	3.0	3.12	3.21	3.27	3.31	3.33	

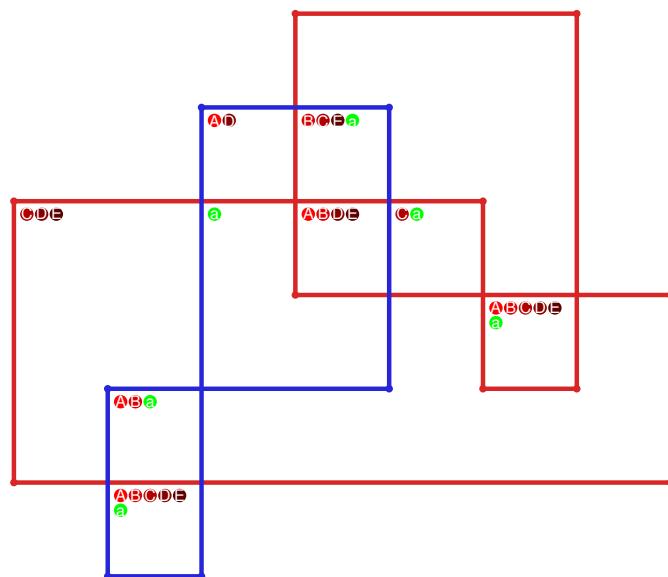


Figure 1989: SnapPy multiloop plot.

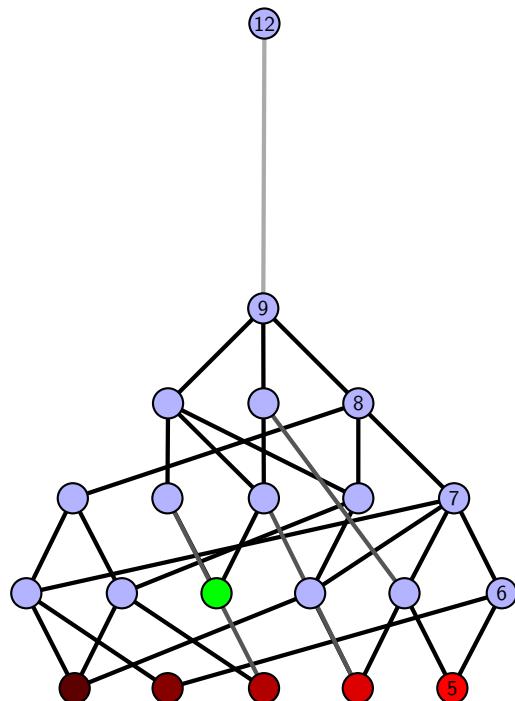


Figure 1990: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.698 [[14, 20, 1, 15], [15, 6, 16, 5], [13, 4, 14, 5], [9, 19, 10, 20], [1, 7, 2, 6], [16, 2, 17, 3], [3, 12, 4, 13], [8, 11, 9, 12], [18, 10, 19, 11], [7, 18, 8, 17]]

PD code drawn by SnapPy: [(15, 14, 16, 1), (11, 2, 12, 3), (3, 20, 4, 15), (4, 13, 5, 14), (17, 8, 18, 9), (6, 9, 7, 10), (1, 10, 2, 11), (7, 18, 8, 19), (12, 19, 13, 20), (16, 5, 17, 6)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 6, 6], [0, 7, 8, 8], [0, 9, 5, 1], [1, 4, 9, 6], [2, 5, 7, 2], [3, 6, 9, 8], [3, 7, 9, 3], [4, 8, 7, 5]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 9
 Total pinning sets: 372
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.71
 Average overall degree: 3.11

Table 994: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	5
Nonminimal pinning sets	0	25	82	114	90	41	10	1	363
Average degree	2.6	2.82	3.0	3.12	3.21	3.27	3.31	3.33	

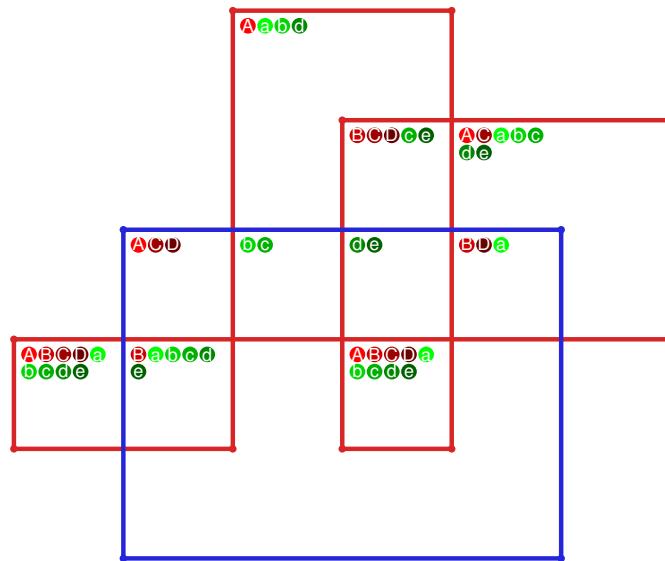


Figure 1991: SnapPy multiloop plot.

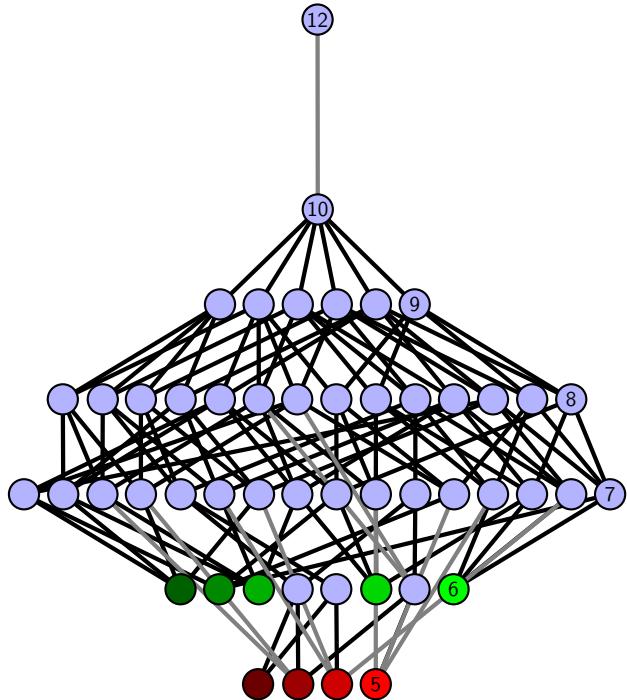


Figure 1992: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.699 $[[5, 12, 6, 1], [4, 20, 5, 13], [11, 19, 12, 20], [6, 16, 7, 17], [1, 14, 2, 13], [10, 3, 11, 4], [15, 18, 16, 19], [7, 18, 8, 17], [14, 8, 15, 9], [2, 9, 3, 10]]$

PD code drawn by SnapPy: $[(7, 12, 8, 1), (18, 5, 19, 6), (11, 6, 12, 7), (2, 9, 3, 10), (3, 20, 4, 13), (13, 4, 14, 5), (19, 14, 20, 15), (8, 15, 9, 16), (1, 16, 2, 17), (17, 10, 18, 11)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 9, 1], [1, 9, 9, 2], [2, 8, 7, 3], [3, 6, 8, 3], [4, 7, 6, 9], [4, 8, 5, 5]]$

Total optimal pinning sets: 7
 Total minimal pinning sets: 8
 Total pinning sets: 416
 Pinning number: 5

Average optimal degree: 2.66
 Average minimal degree: 2.68
 Average overall degree: 3.11

Table 995: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	7	0	0	0	0	0	0	0	7
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	39	96	125	95	42	10	1	408
Average degree	2.66	2.87	3.03	3.14	3.22	3.27	3.31	3.33	

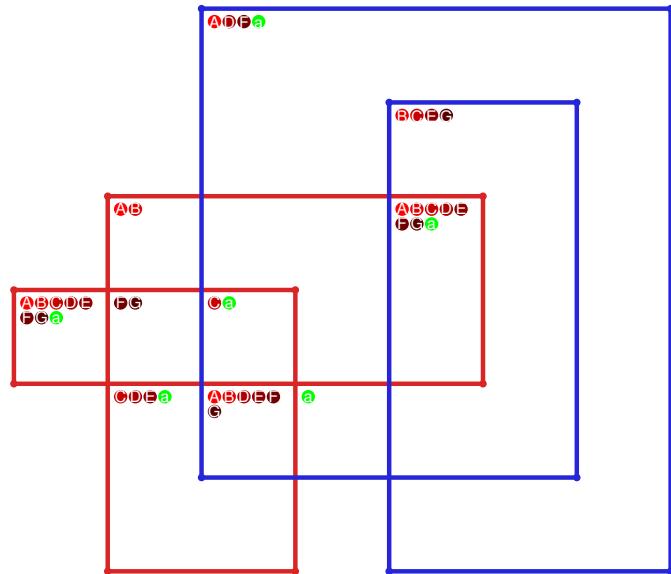


Figure 1993: SnapPy multiloop plot.

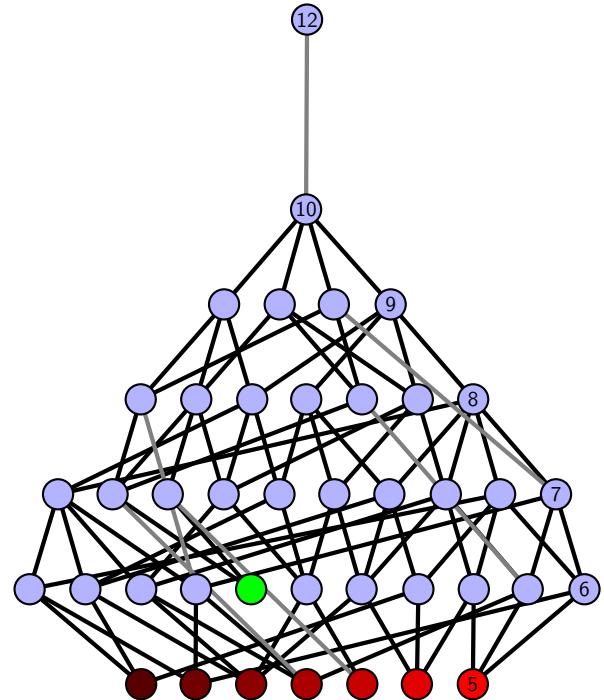


Figure 1994: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.700 [[14, 20, 1, 15], [15, 11, 16, 12], [4, 13, 5, 14], [19, 7, 20, 8], [1, 10, 2, 11], [16, 2, 17, 3], [12, 3, 13, 4], [5, 9, 6, 8], [6, 18, 7, 19], [9, 17, 10, 18]]

PD code drawn by SnapPy: [(9, 14, 10, 1), (15, 4, 16, 5), (5, 2, 6, 3), (12, 7, 13, 8), (17, 8, 18, 9), (1, 10, 2, 11), (18, 13, 19, 14), (3, 20, 4, 15), (11, 16, 12, 17), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 7], [0, 7, 8, 8], [0, 9, 5, 1], [1, 4, 9, 6], [1, 5, 2, 2], [2, 9, 8, 3], [3, 7, 9, 3], [4, 8, 7, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 6

Average minimal degree: 2.67

Total pinning sets: 416

Average overall degree: 3.11

Pinning number: 4

Table 996: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	2	0	0	0	0	0	0	5
Nonminimal pinning sets	0	8	43	96	120	91	41	10	1	410
Average degree	2.5	2.75	2.91	3.04	3.13	3.21	3.27	3.31	3.33	

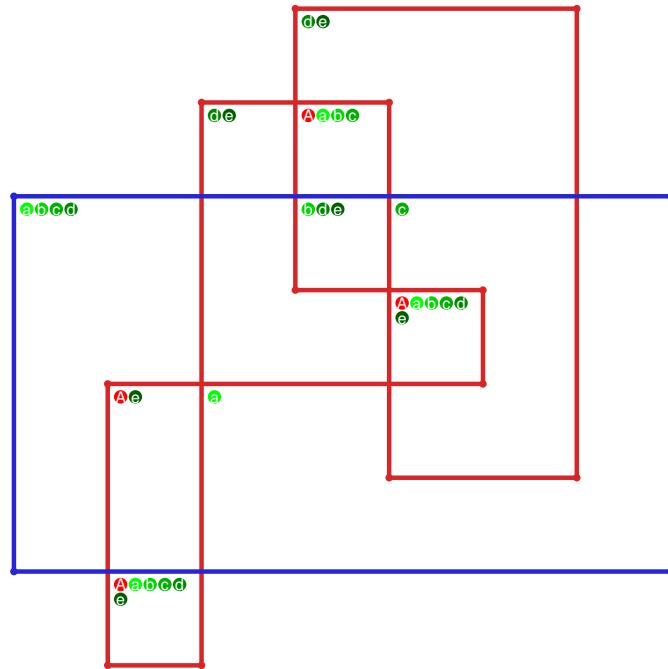


Figure 1995: SnapPy multiloop plot.

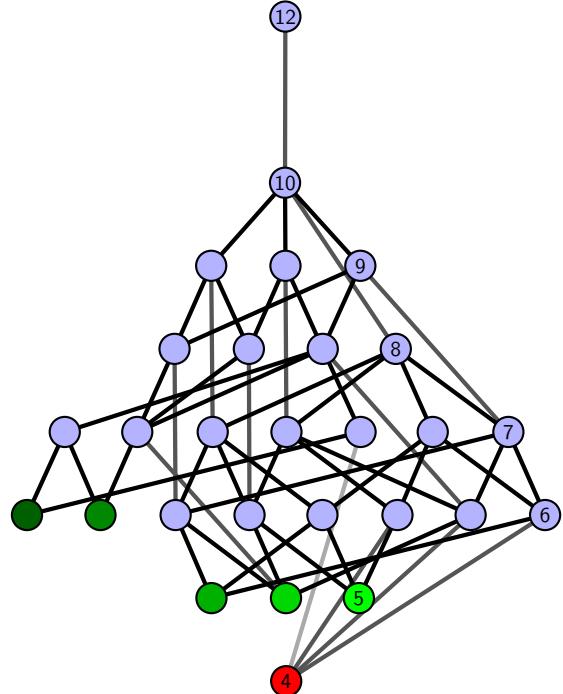


Figure 1996: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.701 [[4, 10, 1, 5], [5, 11, 6, 20], [3, 19, 4, 20], [9, 16, 10, 17], [1, 12, 2, 11], [6, 2, 7, 3], [13, 18, 14, 19], [17, 14, 18, 15], [15, 8, 16, 9], [12, 8, 13, 7]]

PD code drawn by SnapPy: [(5, 4, 6, 1), (6, 13, 7, 14), (16, 7, 17, 8), (2, 9, 3, 10), (18, 15, 19, 16), (8, 17, 9, 18), (14, 19, 15, 20), (1, 20, 2, 11), (11, 10, 12, 5), (12, 3, 13, 4)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 8, 8], [0, 9, 5, 1], [1, 4, 9, 2], [2, 9, 7, 7], [3, 6, 6, 8], [3, 7, 9, 3], [4, 8, 6, 5]]

Total optimal pinning sets: 6
Total minimal pinning sets: 6
Total pinning sets: 366
Pinning number: 5

Average optimal degree: 2.67
Average minimal degree: 2.67
Average overall degree: 3.11

Table 997: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	34	82	109	86	40	10	1	362
Average degree	2.67	2.87	3.02	3.12	3.2	3.27	3.31	3.33	

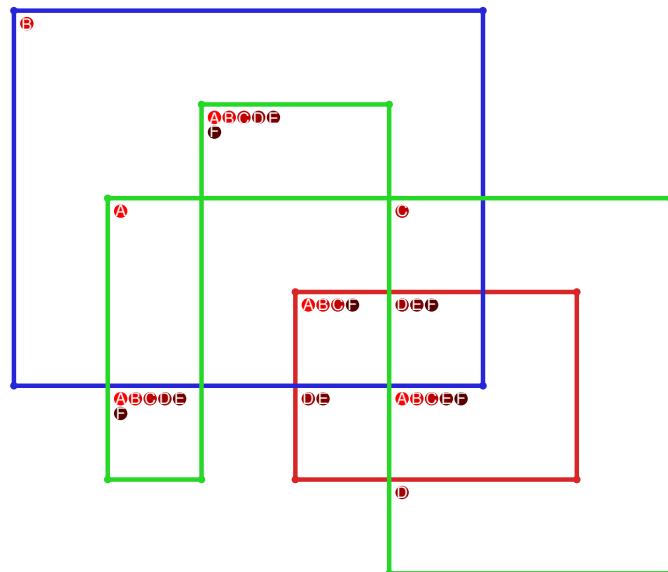


Figure 1997: SnapPy multiloop plot.

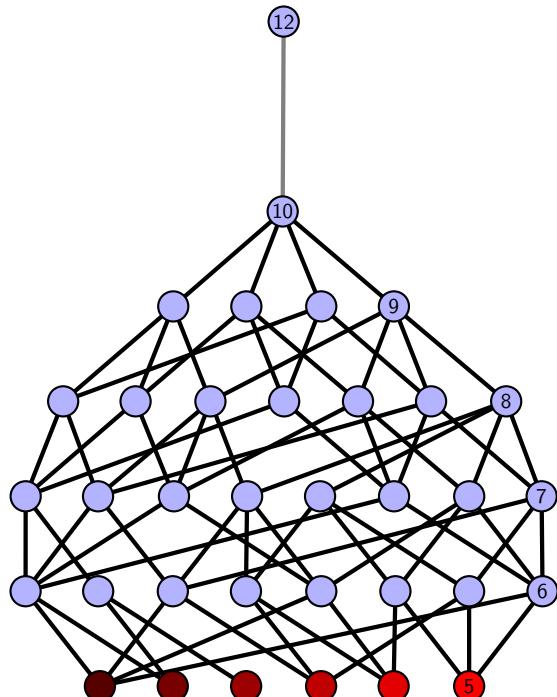


Figure 1998: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.702 $[[4, 20, 1, 5], [5, 15, 6, 14], [3, 13, 4, 14], [10, 19, 11, 20], [1, 16, 2, 15], [6, 2, 7, 3], [9, 12, 10, 13], [18, 11, 19, 12], [16, 8, 17, 7], [17, 8, 18, 9]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (16, 7, 17, 8), (17, 10, 18, 11), (8, 11, 9, 12), (1, 12, 2, 13), (13, 20, 14, 5), (14, 3, 15, 4), (9, 18, 10, 19), (2, 19, 3, 20), (6, 15, 7, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 5, 1], [1, 4, 8, 2], [2, 9, 7, 3], [3, 6, 9, 3], [4, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 7
 Total pinning sets: 276
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.71
 Average overall degree: 3.1

Table 998: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	3	0	0	0	0	0	5
Nonminimal pinning sets	0	13	46	83	77	39	10	1	269
Average degree	2.6	2.8	2.95	3.08	3.19	3.26	3.31	3.33	

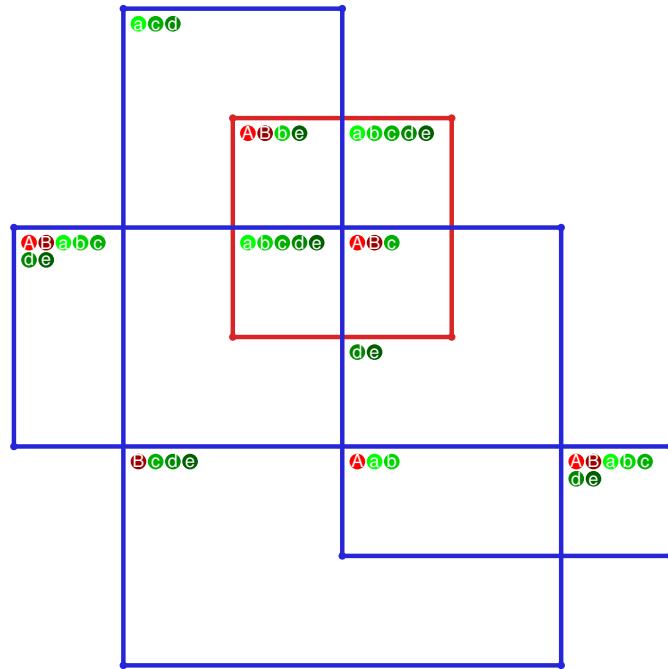


Figure 1999: SnapPy multiloop plot.

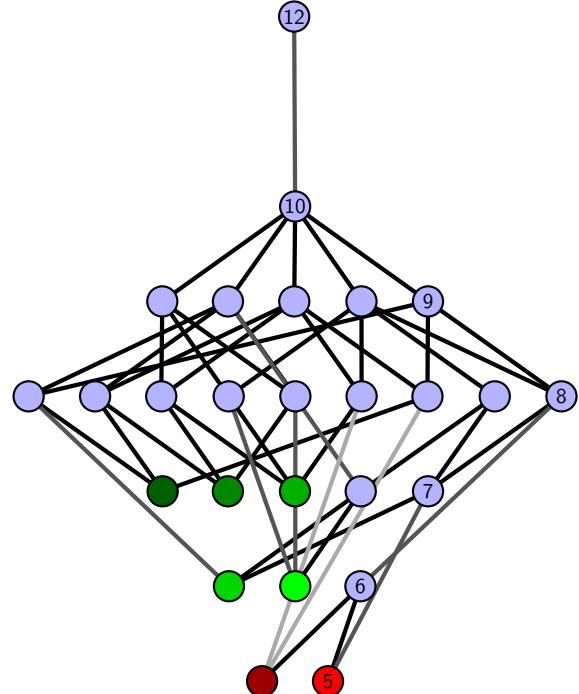


Figure 2000: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.703 $[[4, 20, 1, 5], [5, 15, 6, 14], [3, 13, 4, 14], [10, 19, 11, 20], [1, 16, 2, 15], [6, 2, 7, 3], [17, 12, 18, 13], [18, 9, 19, 10], [11, 9, 12, 8], [16, 8, 17, 7]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (7, 10, 8, 11), (17, 8, 18, 9), (16, 11, 17, 12), (1, 12, 2, 13), (13, 20, 14, 5), (14, 3, 15, 4), (9, 18, 10, 19), (2, 19, 3, 20), (6, 15, 7, 16)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 9, 5, 1], [1, 4, 9, 2], [2, 9, 8, 7], [3, 6, 8, 3], [3, 7, 6, 9], [4, 8, 6, 5]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 8
 Total pinning sets: 448
 Pinning number: 5

Average optimal degree: 2.83
 Average minimal degree: 2.83
 Average overall degree: 3.17

Table 999: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	36	99	137	108	48	11	1	440
Average degree	2.83	2.98	3.1	3.18	3.25	3.3	3.32	3.33	

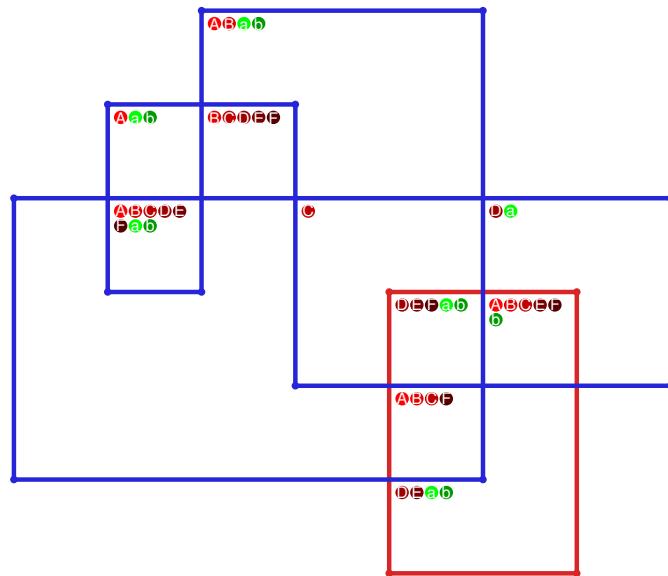


Figure 2001: SnapPy multiloop plot.

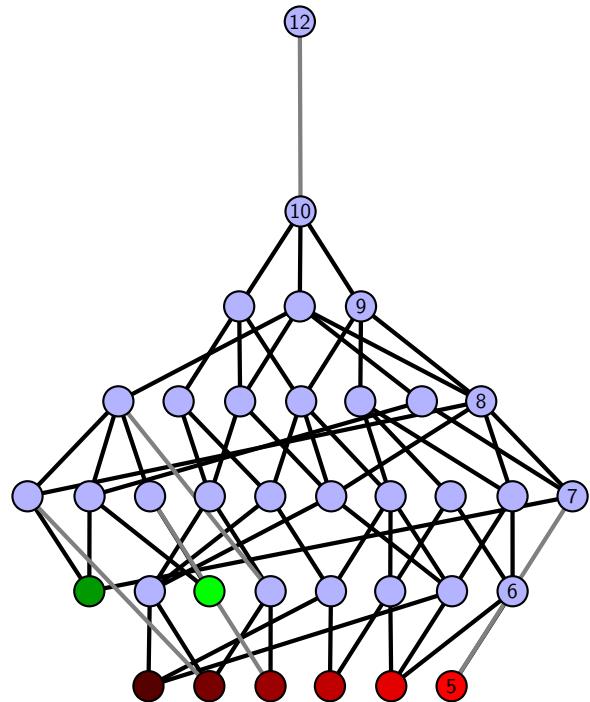


Figure 2002: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.704 [[4, 20, 1, 5], [5, 13, 6, 12], [3, 11, 4, 12], [16, 19, 17, 20], [1, 14, 2, 13], [6, 2, 7, 3], [15, 10, 16, 11], [18, 9, 19, 10], [17, 9, 18, 8], [14, 8, 15, 7]]

PD code drawn by SnapPy: [(5, 4, 6, 1), (6, 13, 7, 14), (7, 16, 8, 17), (17, 8, 18, 9), (14, 9, 15, 10), (1, 10, 2, 11), (11, 20, 12, 5), (12, 3, 13, 4), (15, 18, 16, 19), (2, 19, 3, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 7, 8], [0, 9, 5, 1], [1, 4, 9, 2], [2, 9, 7, 3], [3, 6, 8, 8], [3, 7, 7, 9], [4, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.75

Total minimal pinning sets: 11

Average minimal degree: 2.93

Total pinning sets: 548

Average overall degree: 3.18

Pinning number: 4

Table 1000: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	3	0	0	0	0	0	0	10
Nonminimal pinning sets	0	8	60	132	160	116	49	11	1	537
Average degree	2.75	2.93	3.04	3.13	3.2	3.26	3.3	3.32	3.33	

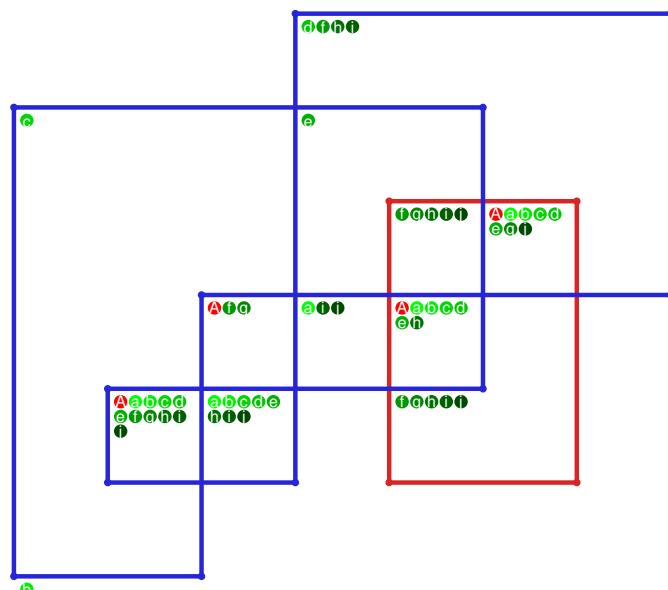


Figure 2003: SnapPy multiloop plot.

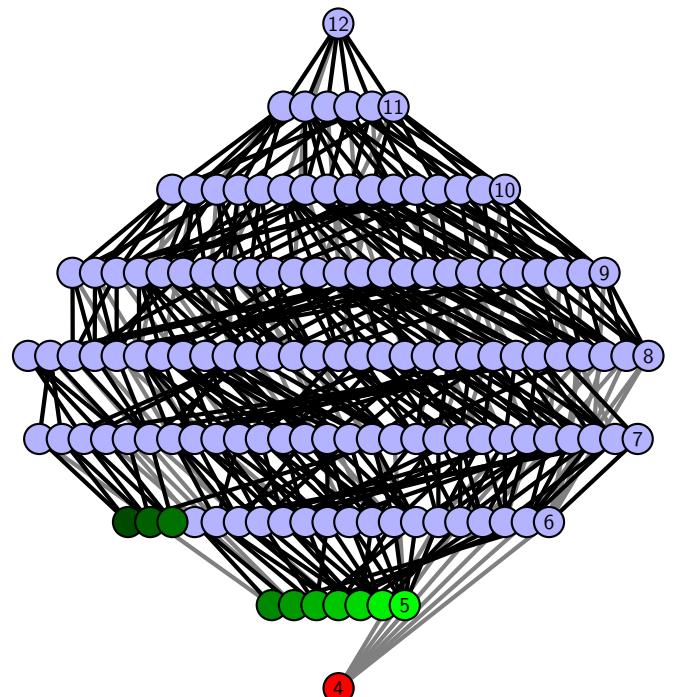


Figure 2004: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.705 $[[4, 10, 1, 5], [5, 11, 6, 16], [3, 15, 4, 16], [9, 20, 10, 17], [1, 12, 2, 11], [6, 2, 7, 3], [14, 17, 15, 18], [19, 8, 20, 9], [12, 8, 13, 7], [18, 13, 19, 14]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (6, 13, 7, 14), (20, 7, 17, 8), (2, 9, 3, 10), (19, 14, 20, 15), (1, 16, 2, 11), (11, 10, 12, 5), (12, 3, 13, 4), (8, 17, 9, 18), (15, 18, 16, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 5, 1], [1, 4, 8, 2], [2, 9, 9, 3], [3, 9, 8, 3], [4, 7, 9, 5], [6, 8, 7, 6]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 372
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.73
 Average overall degree: 3.11

Table 1001: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	8	28	82	109	86	40	10	1	364
Average degree	2.5	2.75	2.89	3.02	3.12	3.2	3.27	3.31	3.33	

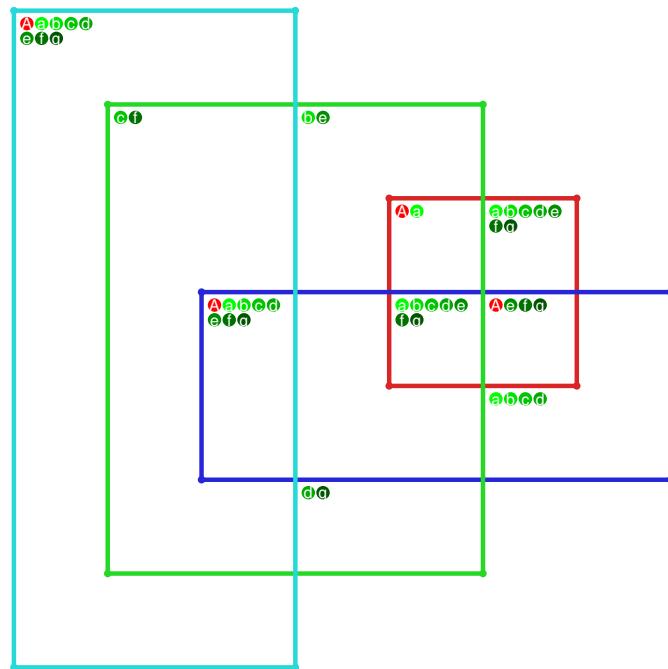


Figure 2005: SnapPy multiloop plot.

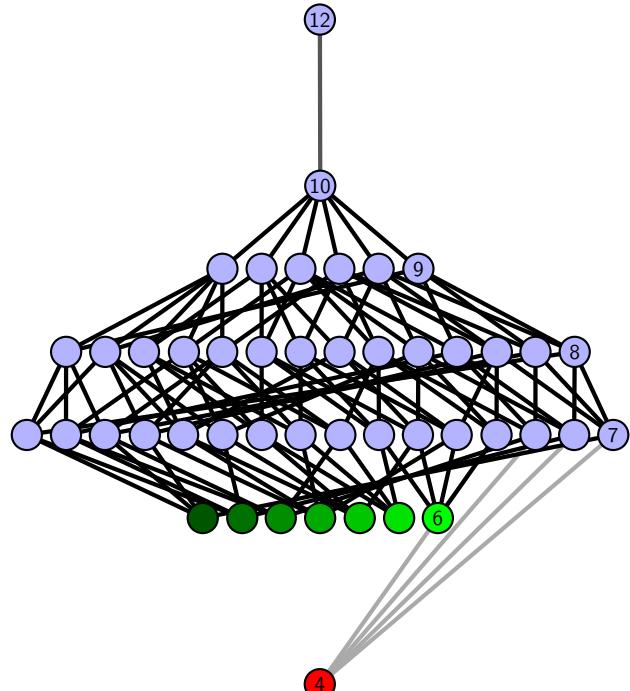


Figure 2006: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.706 $[[4, 20, 1, 5], [5, 14, 6, 15], [15, 3, 16, 4], [19, 10, 20, 11], [1, 13, 2, 14], [6, 2, 7, 3], [16, 12, 17, 11], [9, 18, 10, 19], [12, 7, 13, 8], [17, 8, 18, 9]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (12, 3, 13, 4), (7, 14, 8, 15), (9, 16, 10, 17), (17, 6, 18, 7), (2, 19, 3, 20), (11, 20, 12, 5), (15, 8, 16, 9), (1, 10, 2, 11), (18, 13, 19, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 7, 7], [0, 8, 5, 1], [1, 4, 8, 2], [2, 8, 9, 3], [3, 9, 9, 3], [4, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 5
 Total pinning sets: 352
 Pinning number: 5

Average optimal degree: 2.64
 Average minimal degree: 2.64
 Average overall degree: 3.11

Table 1002: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	30	76	105	85	40	10	1	347
Average degree	2.64	2.86	3.01	3.12	3.2	3.26	3.31	3.33	

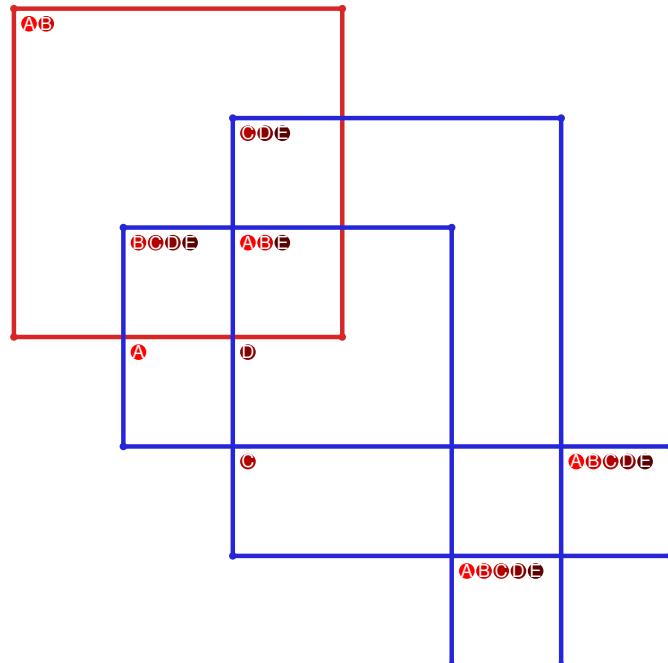


Figure 2007: SnapPy multiloop plot.

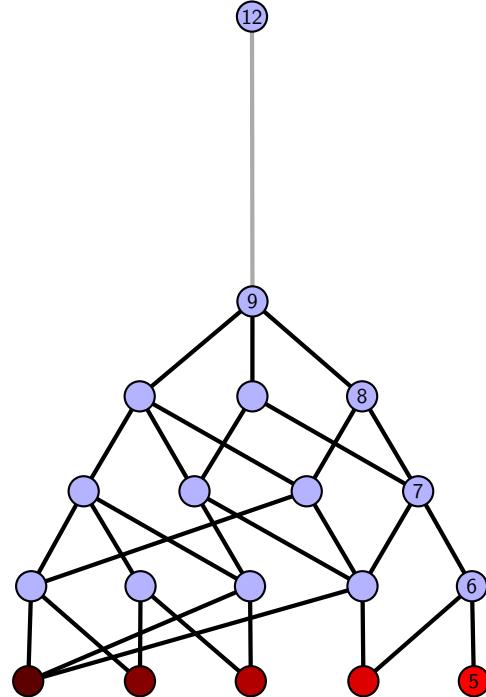


Figure 2008: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.707 [[14, 20, 1, 15], [15, 6, 16, 5], [13, 4, 14, 5], [9, 19, 10, 20], [1, 10, 2, 11], [6, 11, 7, 12], [16, 12, 17, 13], [8, 3, 9, 4], [18, 2, 19, 3], [7, 18, 8, 17]]

PD code drawn by SnapPy: [(15, 14, 16, 1), (6, 1, 7, 2), (11, 2, 12, 3), (3, 18, 4, 19), (13, 8, 14, 9), (4, 9, 5, 10), (19, 10, 20, 11), (20, 5, 15, 6), (7, 16, 8, 17), (12, 17, 13, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 7, 8, 4], [0, 3, 8, 5], [1, 4, 9, 6], [1, 5, 9, 2], [2, 9, 8, 3], [3, 7, 9, 4], [5, 8, 7, 6]]

Total optimal pinning sets: 12
 Total minimal pinning sets: 24
 Total pinning sets: 767
 Pinning number: 5

Average optimal degree: 3.13
 Average minimal degree: 3.15
 Average overall degree: 3.27

Table 1003: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	12	0	0	0	0	0	0	0	12
Minimal (suboptimal) pinning sets	0	12	0	0	0	0	0	0	12
Nonminimal pinning sets	0	68	200	242	160	60	12	1	743
Average degree	3.13	3.19	3.25	3.29	3.31	3.33	3.33	3.33	

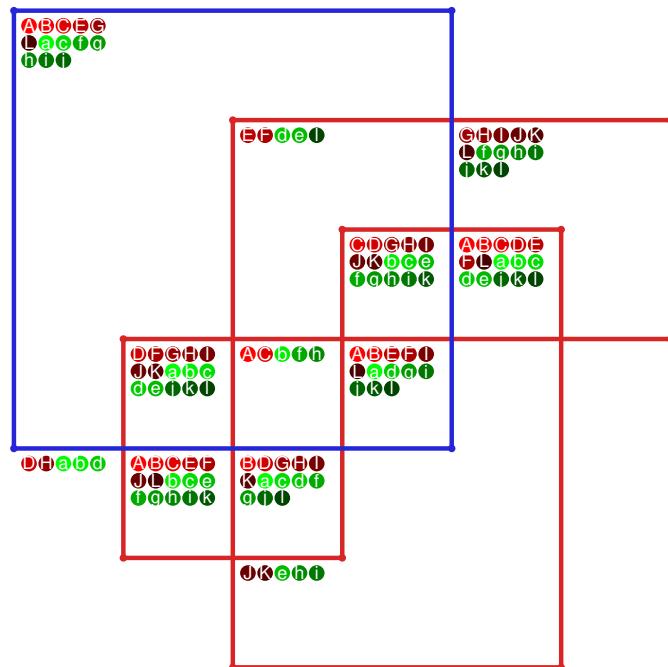


Figure 2009: SnapPy multiloop plot.

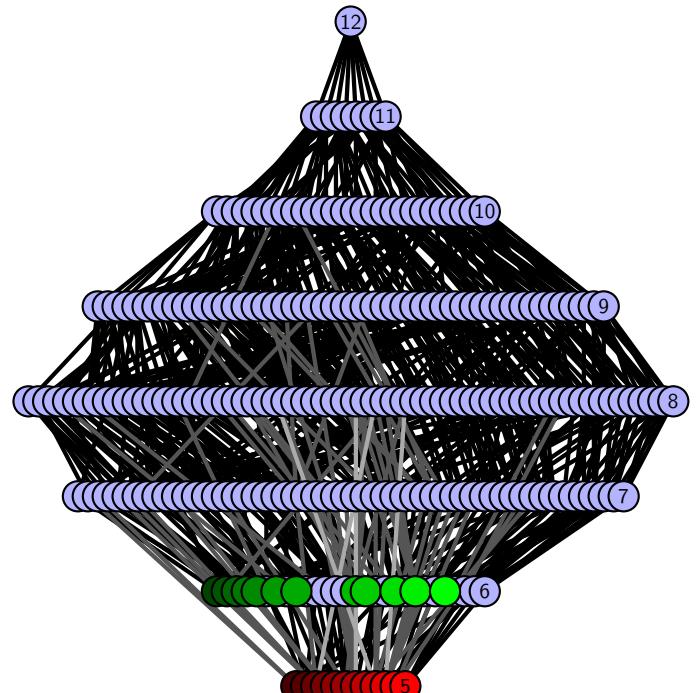


Figure 2010: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.708 [[17, 20, 18, 1], [16, 9, 17, 10], [4, 19, 5, 20], [18, 5, 19, 6], [1, 11, 2, 10], [2, 15, 3, 16], [3, 8, 4, 9], [6, 13, 7, 14], [11, 14, 12, 15], [12, 7, 13, 8]]

PD code drawn by SnapPy: [(16, 3, 17, 4), (10, 5, 11, 6), (1, 6, 2, 7), (14, 7, 15, 8), (8, 19, 9, 20), (4, 11, 5, 12), (9, 12, 10, 13), (20, 13, 1, 14), (2, 17, 3, 18), (15, 18, 16, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 3, 3], [0, 2, 2, 7], [0, 8, 5, 1], [1, 4, 8, 6], [1, 5, 9, 2], [3, 9, 9, 8], [4, 7, 9, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 8

Average optimal degree: 2.75

Total minimal pinning sets: 10

Average minimal degree: 2.77

Total pinning sets: 450

Average overall degree: 3.13

Pinning number: 5

Table 1004: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	46	110	134	97	42	10	1	440
Average degree	2.75	2.92	3.06	3.15	3.22	3.27	3.31	3.33	

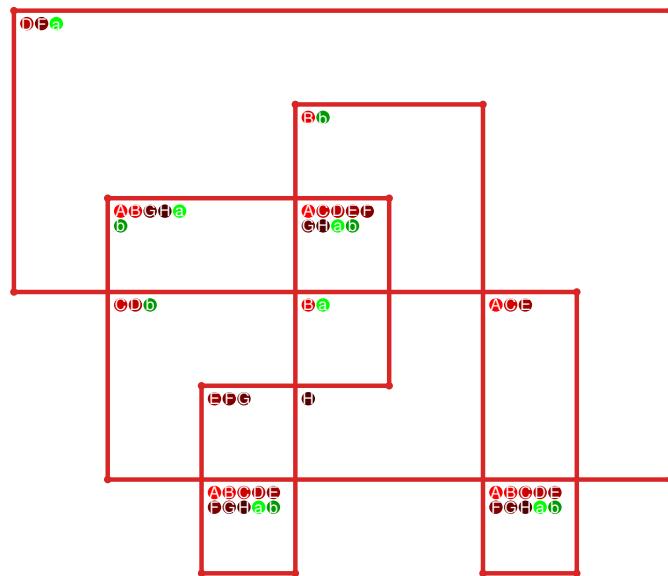


Figure 2011: SnapPy multiloop plot.

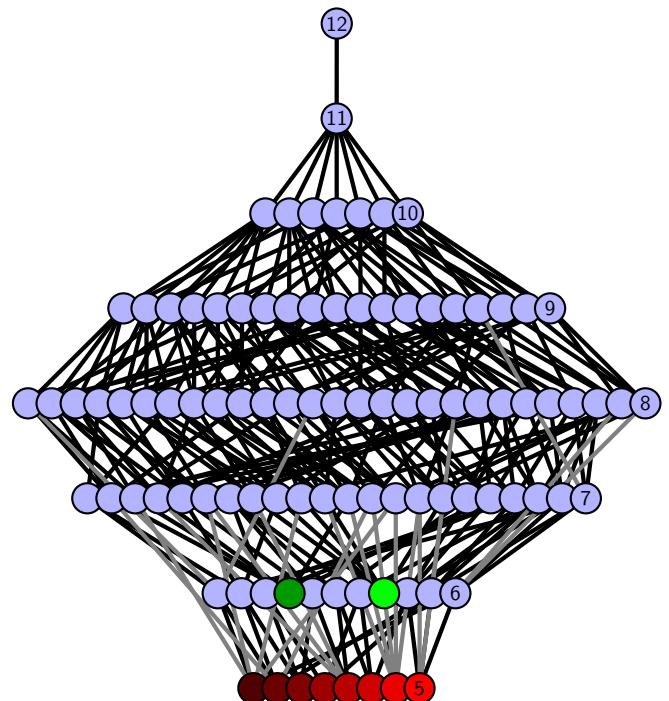


Figure 2012: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.709 $[[8, 20, 1, 9], [9, 16, 10, 17], [19, 7, 20, 8], [1, 15, 2, 16], [10, 2, 11, 3], [17, 3, 18, 4], [4, 18, 5, 19], [6, 12, 7, 13], [14, 11, 15, 12], [5, 14, 6, 13]]$

PD code drawn by SnapPy: $[(9, 8, 10, 1), (16, 1, 17, 2), (18, 5, 19, 6), (13, 10, 14, 11), (4, 11, 5, 12), (12, 3, 13, 4), (7, 14, 8, 15), (20, 15, 9, 16), (2, 17, 3, 18), (6, 19, 7, 20)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 8, 4, 1], [1, 3, 8, 5], [1, 4, 6, 6], [2, 5, 5, 9], [2, 9, 9, 8], [3, 7, 9, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.38

Total pinning sets: 288

Average overall degree: 3.03

Pinning number: 4

Table 1005: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	28	61	80	66	33	9	1	286
Average degree	2.25	2.57	2.78	2.93	3.05	3.15	3.23	3.29	3.33	

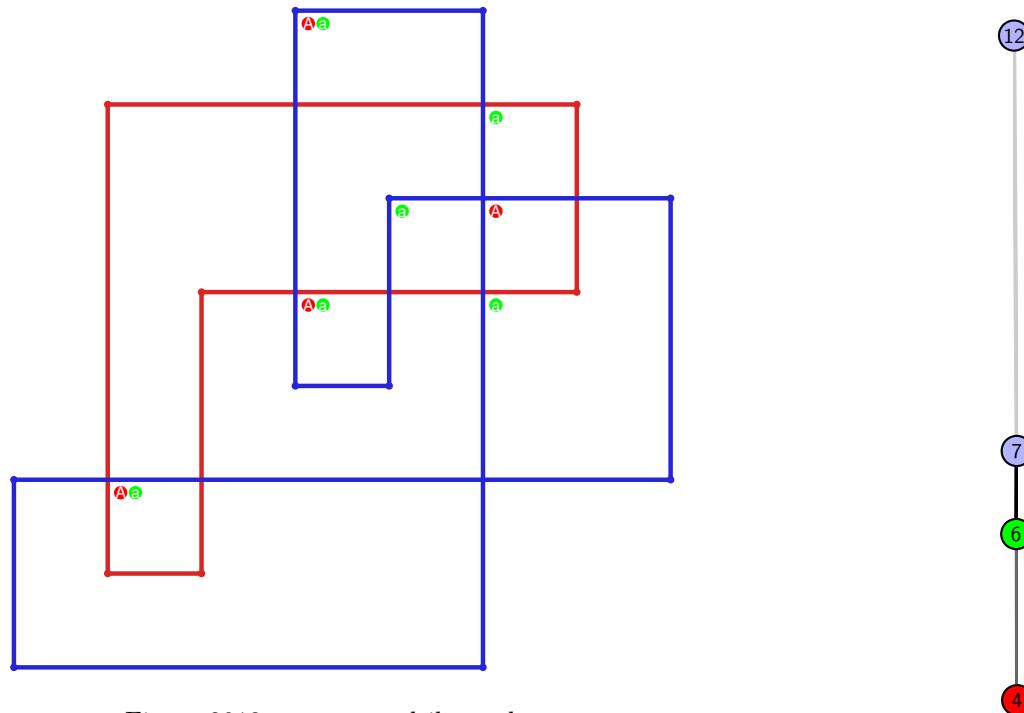


Figure 2013: SnapPy multiloop plot.

Figure 2014: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.710 [[20, 5, 1, 6], [6, 15, 7, 16], [4, 19, 5, 20], [1, 14, 2, 15], [7, 2, 8, 3], [16, 3, 17, 4], [11, 18, 12, 19], [13, 8, 14, 9], [17, 10, 18, 11], [12, 10, 13, 9]]

PD code drawn by SnapPy: [(5, 20, 6, 1), (14, 1, 15, 2), (18, 3, 19, 4), (11, 6, 12, 7), (7, 10, 8, 11), (15, 8, 16, 9), (19, 12, 20, 13), (4, 13, 5, 14), (9, 16, 10, 17), (2, 17, 3, 18)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 7, 4, 1], [1, 3, 7, 5], [1, 4, 8, 2], [2, 8, 8, 9], [3, 9, 9, 4], [5, 9, 6, 6], [6, 8, 7, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 2
Total pinning sets: 288
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.38
Average overall degree: 3.03

Table 1006: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	28	61	80	66	33	9	1	286
Average degree	2.25	2.57	2.78	2.93	3.05	3.15	3.23	3.29	3.33	

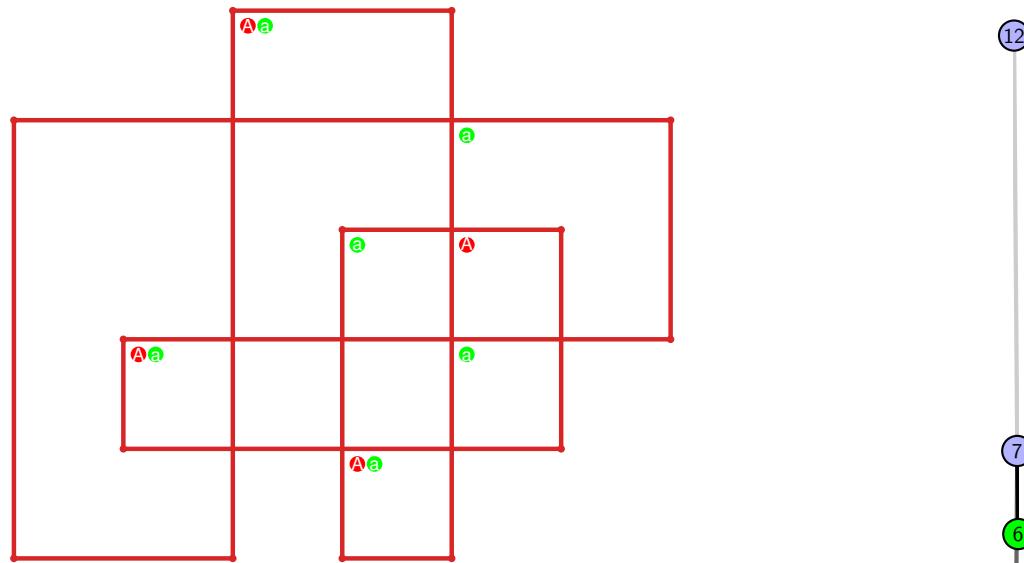


Figure 2015: SnapPy multiloop plot.

Figure 2016: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.711 $[[6, 20, 1, 7], [7, 14, 8, 15], [19, 5, 20, 6], [1, 13, 2, 14], [8, 2, 9, 3], [15, 3, 16, 4], [4, 18, 5, 19], [12, 9, 13, 10], [16, 12, 17, 11], [17, 10, 18, 11]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (14, 1, 15, 2), (18, 3, 19, 4), (16, 9, 17, 10), (10, 15, 11, 16), (5, 12, 6, 13), (20, 13, 7, 14), (2, 17, 3, 18), (4, 19, 5, 20), (11, 8, 12, 9)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 7, 4, 1], [1, 3, 7, 5], [1, 4, 8, 6], [2, 5, 9, 2], [3, 9, 8, 4], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 256
 Pinning number: 5

Average optimal degree: 2.47
 Average minimal degree: 2.48
 Average overall degree: 3.04

Table 1007: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	18	51	75	65	33	9	1	252
Average degree	2.47	2.72	2.9	3.04	3.15	3.23	3.29	3.33	

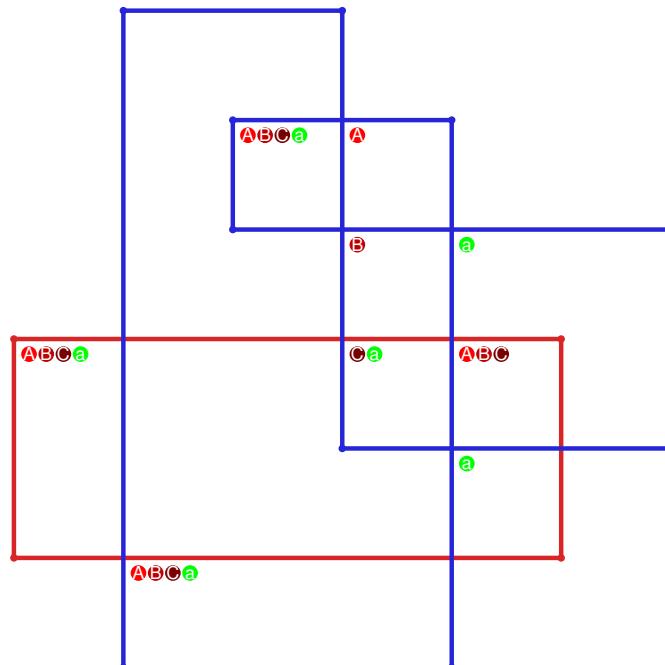


Figure 2017: SnapPy multiloop plot.

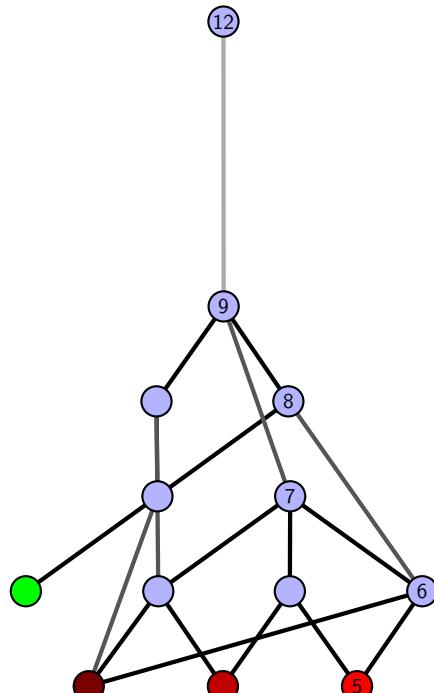


Figure 2018: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.712 $[[4, 20, 1, 5], [5, 16, 6, 17], [17, 3, 18, 4], [19, 10, 20, 11], [1, 15, 2, 16], [6, 2, 7, 3], [18, 12, 19, 11], [12, 9, 13, 10], [14, 7, 15, 8], [8, 13, 9, 14]]$

PD code drawn by `SnapPy`: $[(5, 4, 6, 1), (16, 1, 17, 2), (13, 6, 14, 7), (11, 8, 12, 9), (18, 9, 19, 10), (10, 17, 11, 18), (7, 12, 8, 13), (3, 14, 4, 15), (20, 15, 5, 16), (2, 19, 3, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 8, 5, 1], [1, 4, 8, 2], [2, 7, 3, 3], [3, 6, 9, 9], [4, 9, 9, 5], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.47
 Average overall degree: 3.03

Table 1008: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	31	55	55	31	9	1	189
Average degree	2.4	2.63	2.83	2.99	3.12	3.22	3.29	3.33	

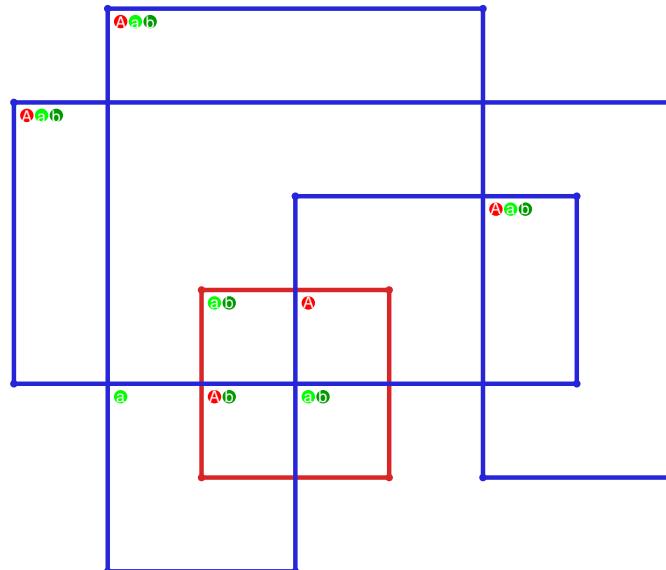


Figure 2019: `SnapPy` multiloop plot.

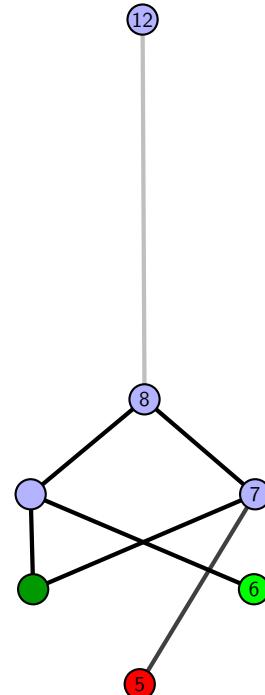


Figure 2020: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.713 $[[4, 14, 1, 5], [5, 10, 6, 11], [11, 3, 12, 4], [13, 20, 14, 15], [1, 9, 2, 10], [6, 2, 7, 3], [12, 16, 13, 15], [16, 19, 17, 20], [17, 8, 18, 9], [7, 18, 8, 19]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (10, 1, 11, 2), (20, 7, 15, 8), (3, 8, 4, 9), (14, 9, 5, 10), (2, 13, 3, 14), (6, 15, 7, 16), (19, 16, 20, 17), (12, 17, 13, 18), (18, 11, 19, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 8, 5, 1], [1, 4, 9, 2], [2, 7, 3, 3], [3, 6, 9, 8], [4, 7, 9, 9], [5, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 448
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.1

Table 1009: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	55	106	125	92	41	10	1	446
Average degree	2.5	2.75	2.92	3.05	3.14	3.21	3.27	3.31	3.33	

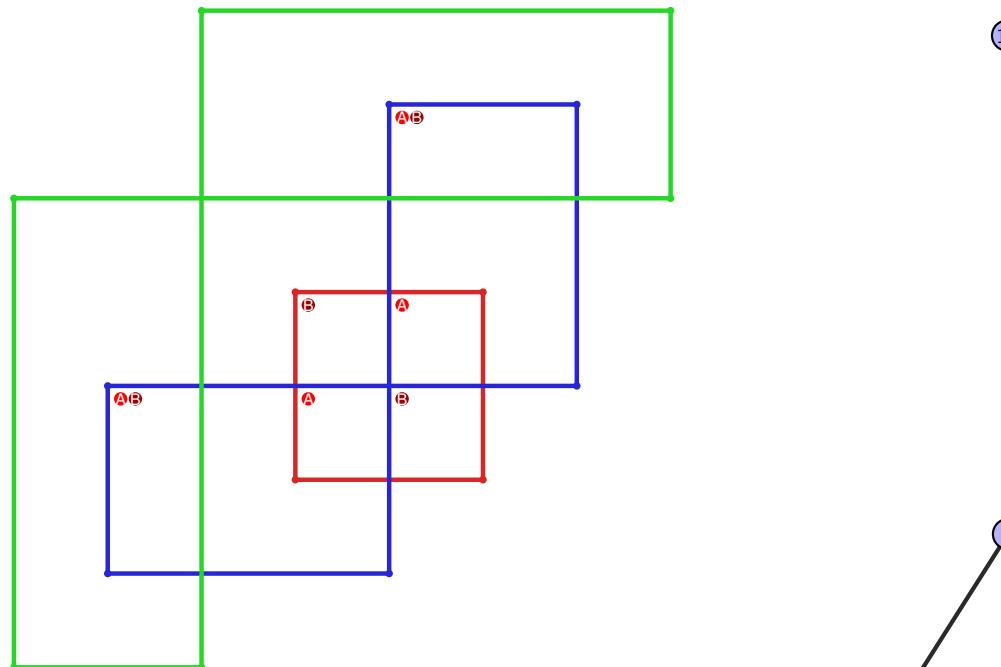


Figure 2021: SnapPy multiloop plot.

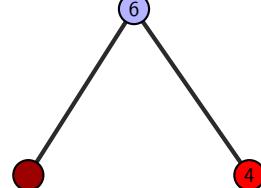


Figure 2022: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.714 $[[4, 20, 1, 5], [5, 16, 6, 17], [17, 3, 18, 4], [19, 10, 20, 11], [1, 15, 2, 16], [6, 2, 7, 3], [18, 12, 19, 11], [14, 9, 15, 10], [7, 13, 8, 12], [8, 13, 9, 14]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (16, 1, 17, 2), (13, 8, 14, 9), (18, 9, 19, 10), (10, 17, 11, 18), (11, 6, 12, 7), (7, 12, 8, 13), (3, 14, 4, 15), (20, 15, 5, 16), (2, 19, 3, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 5, 1], [1, 4, 8, 2], [2, 8, 3, 3], [3, 9, 9, 4], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.4
 Average overall degree: 3.03

Table 1010: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	14	41	65	60	32	9	1	222
Average degree	2.4	2.67	2.86	3.02	3.13	3.22	3.29	3.33	

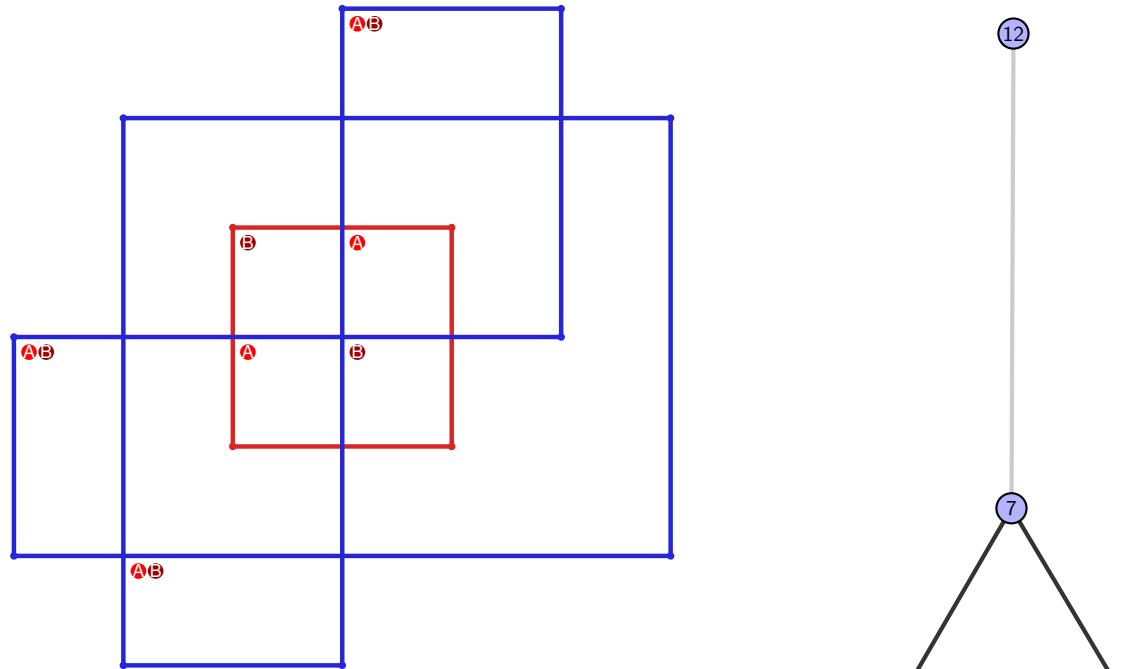


Figure 2023: SnapPy multiloop plot.

Figure 2024: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.715 $[[4, 20, 1, 5], [5, 16, 6, 17], [17, 3, 18, 4], [10, 19, 11, 20], [1, 15, 2, 16], [6, 2, 7, 3], [18, 9, 19, 10], [11, 14, 12, 15], [7, 12, 8, 13], [13, 8, 14, 9]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (16, 1, 17, 2), (12, 7, 13, 8), (17, 8, 18, 9), (6, 11, 7, 12), (10, 13, 11, 14), (3, 14, 4, 15), (20, 15, 5, 16), (9, 18, 10, 19), (2, 19, 3, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 5, 1], [1, 4, 8, 2], [2, 9, 3, 3], [3, 9, 8, 4], [5, 7, 9, 9], [6, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 416
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.62
 Average overall degree: 3.11

Table 1011: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	45	96	120	91	41	10	1	412
Average degree	2.5	2.73	2.9	3.04	3.14	3.21	3.27	3.31	3.33	

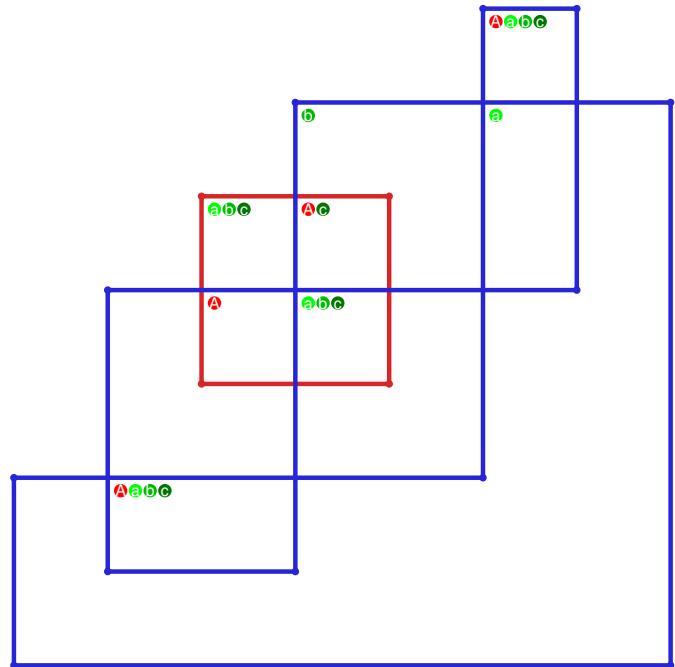


Figure 2025: SnapPy multiloop plot.

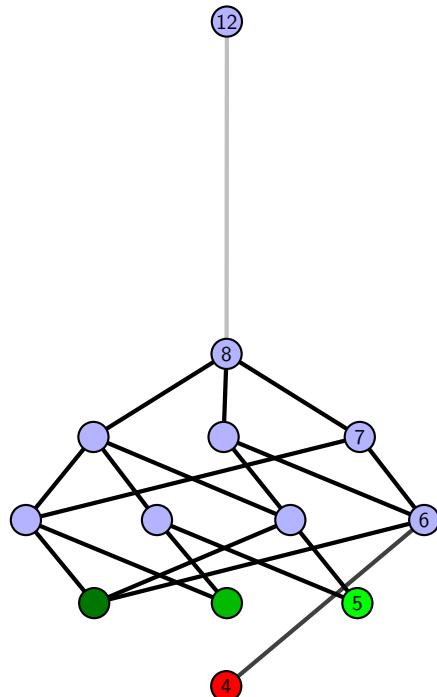


Figure 2026: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.716 [[5, 16, 6, 1], [4, 9, 5, 10], [15, 8, 16, 9], [6, 17, 7, 20], [1, 11, 2, 10], [14, 3, 15, 4], [7, 17, 8, 18], [19, 11, 20, 12], [2, 13, 3, 14], [18, 13, 19, 12]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (13, 6, 14, 7), (2, 7, 3, 8), (8, 15, 9, 16), (20, 9, 17, 10), (10, 19, 11, 20), (16, 11, 1, 12), (3, 14, 4, 15), (17, 4, 18, 5), (5, 18, 6, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 8, 1], [1, 8, 8, 2], [2, 9, 3, 3], [3, 9, 9, 4], [4, 9, 5, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 1012: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

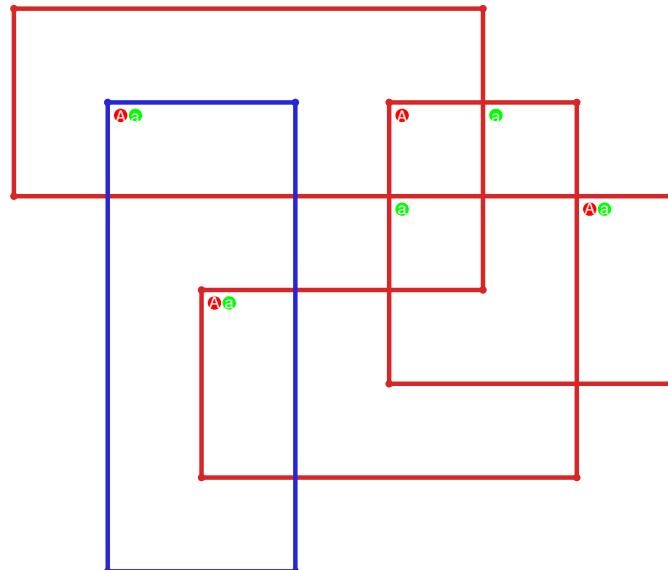


Figure 2027: SnapPy multiloop plot.



Figure 2028: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.717 $[[6, 12, 1, 7], [7, 13, 8, 16], [5, 15, 6, 16], [11, 14, 12, 15], [1, 14, 2, 13], [8, 17, 9, 20], [4, 19, 5, 20], [10, 18, 11, 19], [2, 18, 3, 17], [9, 3, 10, 4]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (4, 11, 5, 12), (16, 17, 11, 18), (3, 18, 4, 19), (19, 12, 20, 13), (20, 5, 17, 6), (10, 13, 7, 14), (7, 6, 8, 1), (15, 8, 16, 9), (2, 9, 3, 10)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 6, 3], [0, 2, 7, 4], [0, 3, 8, 1], [1, 8, 9, 6], [2, 5, 9, 7], [3, 6, 9, 8], [4, 7, 9, 5], [5, 8, 7, 6]]$

Total optimal pinning sets: 2

Average optimal degree: 3.0

Total minimal pinning sets: 16

Average minimal degree: 3.12

Total pinning sets: 664

Average overall degree: 3.25

Pinning number: 4

Table 1013: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	14	0	0	0	0	0	0	14
Nonminimal pinning sets	0	16	56	160	201	144	58	12	1	648
Average degree	3.0	3.1	3.16	3.22	3.27	3.3	3.32	3.33	3.33	

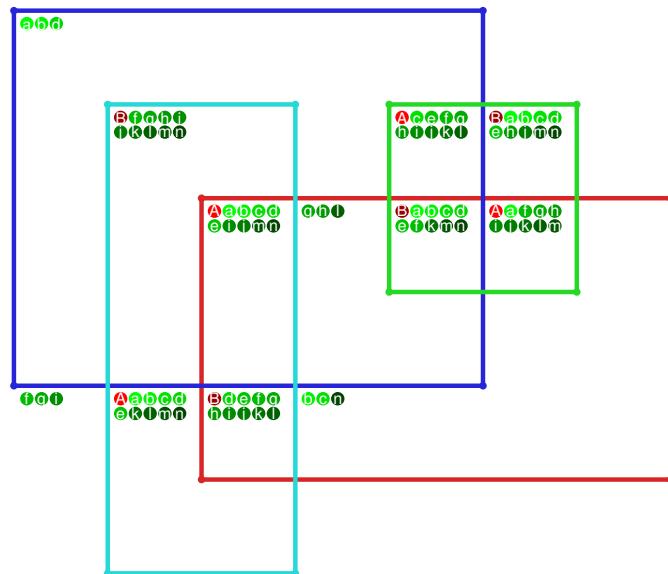


Figure 2029: SnapPy multiloop plot.

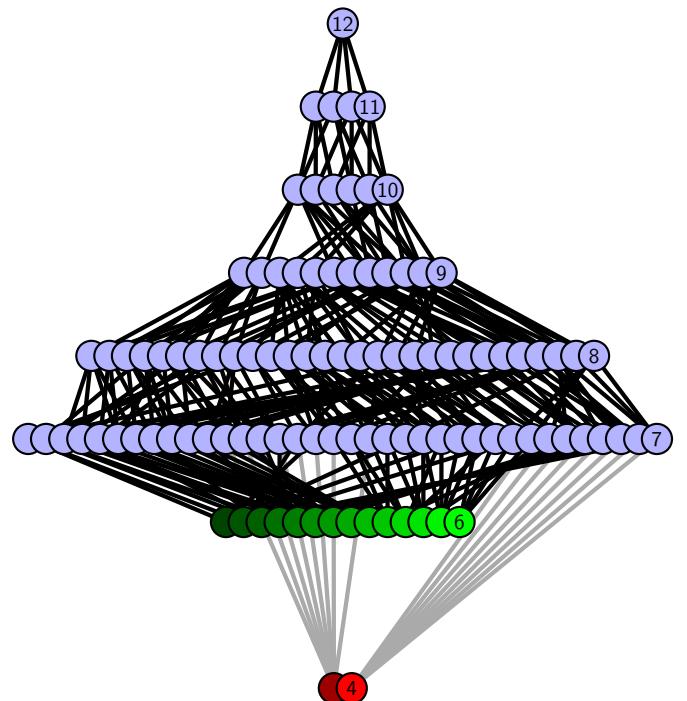


Figure 2030: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.718 [[12, 20, 1, 13], [13, 6, 14, 5], [11, 4, 12, 5], [19, 3, 20, 4], [1, 16, 2, 15], [6, 15, 7, 14], [7, 10, 8, 11], [8, 18, 9, 19], [2, 16, 3, 17], [17, 9, 18, 10]]

PD code drawn by SnapPy: [(16, 1, 17, 2), (9, 2, 10, 3), (3, 18, 4, 19), (14, 7, 15, 8), (5, 8, 6, 9), (19, 4, 20, 5), (20, 11, 13, 12), (12, 13, 1, 14), (6, 15, 7, 16), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 7, 8], [0, 8, 8, 5], [1, 4, 6, 1], [2, 5, 9, 7], [3, 6, 9, 9], [3, 9, 4, 4], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.42

Total pinning sets: 352

Average overall degree: 3.04

Pinning number: 4

Table 1014: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	39	81	100	76	35	9	1	349
Average degree	2.25	2.56	2.79	2.95	3.08	3.17	3.24	3.29	3.33	

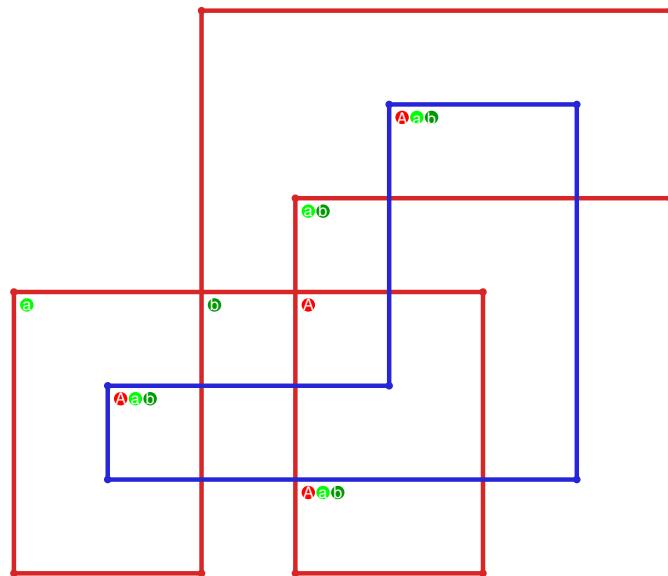


Figure 2031: SnapPy multiloop plot.

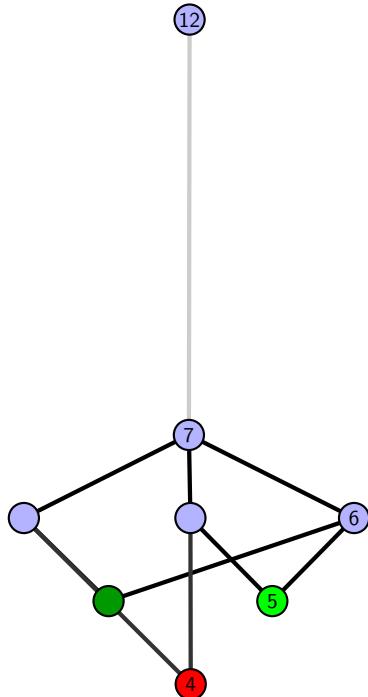


Figure 2032: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.719 [[20, 5, 1, 6], [6, 9, 7, 10], [10, 19, 11, 20], [11, 4, 12, 5], [1, 12, 2, 13], [13, 8, 14, 9], [7, 14, 8, 15], [15, 18, 16, 19], [16, 3, 17, 4], [2, 17, 3, 18]]

PD code drawn by SnapPy: [(14, 1, 15, 2), (9, 2, 10, 3), (18, 3, 19, 4), (11, 6, 12, 7), (4, 7, 5, 8), (19, 10, 20, 11), (5, 12, 6, 13), (20, 15, 1, 16), (13, 16, 14, 17), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 7, 3], [0, 2, 8, 4], [0, 3, 9, 5], [1, 4, 6, 6], [1, 5, 5, 7], [2, 6, 9, 8], [3, 7, 9, 9], [4, 8, 8, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 6
 Total pinning sets: 528
 Pinning number: 4

Average optimal degree: 2.62
 Average minimal degree: 2.67
 Average overall degree: 3.12

Table 1015: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	15	69	132	149	103	43	10	1	522
Average degree	2.62	2.81	2.96	3.08	3.16	3.23	3.27	3.31	3.33	

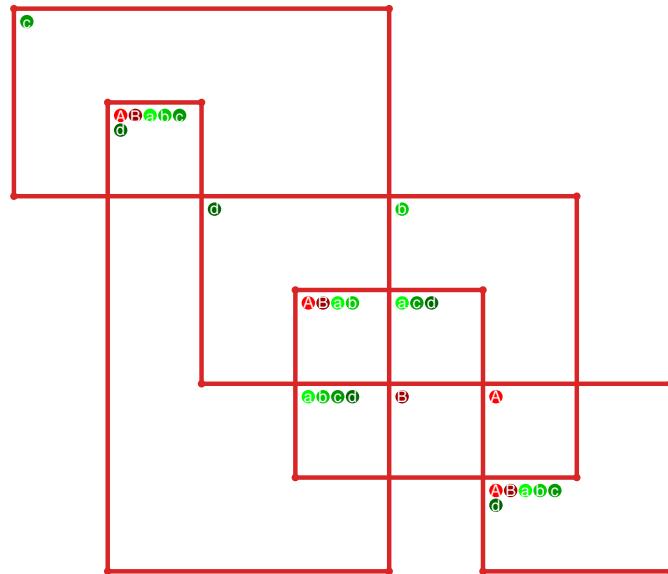


Figure 2033: SnapPy multiloop plot.

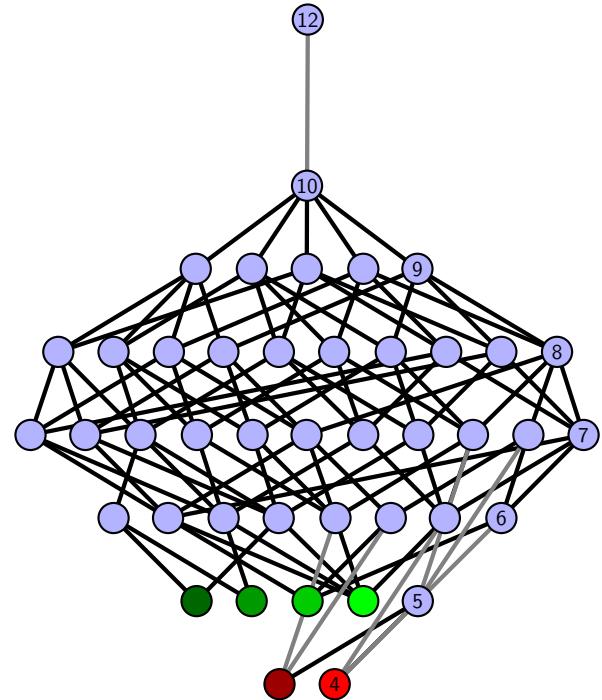


Figure 2034: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.720 [[20, 5, 1, 6], [6, 14, 7, 13], [8, 19, 9, 20], [9, 4, 10, 5], [1, 10, 2, 11], [14, 11, 15, 12], [7, 12, 8, 13], [15, 18, 16, 19], [16, 3, 17, 4], [2, 17, 3, 18]]

PD code drawn by `SnapPy`: [(13, 20, 14, 1), (6, 1, 7, 2), (17, 2, 18, 3), (18, 7, 19, 8), (11, 8, 12, 9), (4, 9, 5, 10), (10, 3, 11, 4), (19, 14, 20, 15), (12, 15, 13, 16), (5, 16, 6, 17)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 6, 7, 3], [0, 2, 8, 4], [0, 3, 9, 5], [1, 4, 7, 6], [1, 5, 2, 1], [2, 5, 9, 8], [3, 7, 9, 9], [4, 8, 8, 7]]

Total optimal pinning sets: 4
 Total minimal pinning sets: 6
 Total pinning sets: 636
 Pinning number: 4

Average optimal degree: 2.62
 Average minimal degree: 2.68
 Average overall degree: 3.13

Table 1016: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	0	2
Nonminimal pinning sets	0	30	99	166	170	110	44	10	1	630
Average degree	2.62	2.84	2.99	3.1	3.18	3.23	3.28	3.31	3.33	

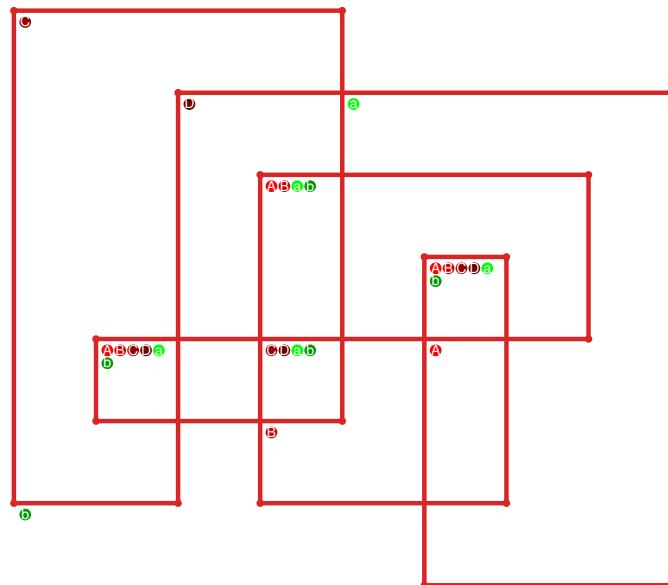


Figure 2035: `SnapPy` multiloop plot.

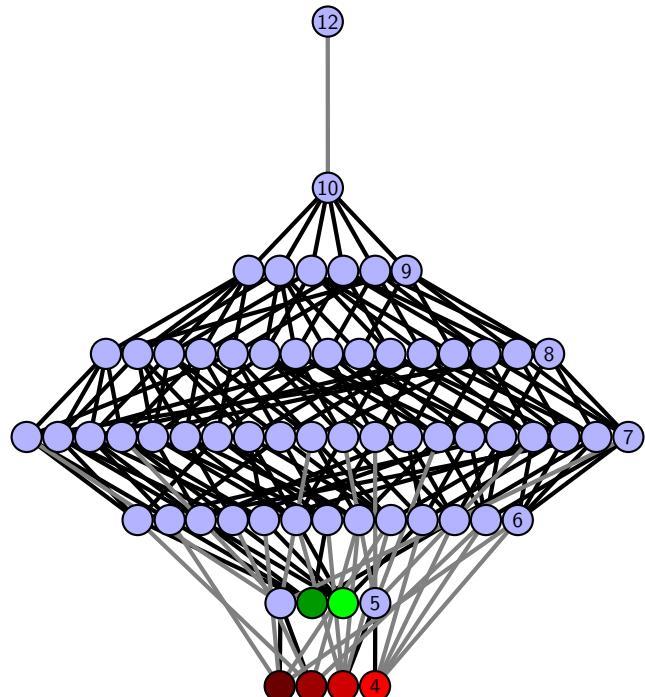


Figure 2036: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.721 $[[9, 20, 10, 1], [8, 13, 9, 14], [19, 12, 20, 13], [10, 5, 11, 6], [1, 6, 2, 7], [14, 7, 15, 8], [15, 18, 16, 19], [4, 11, 5, 12], [2, 17, 3, 18], [16, 3, 17, 4]]$

PD code drawn by SnapPy: $[(14, 1, 15, 2), (8, 3, 9, 4), (19, 4, 20, 5), (12, 5, 13, 6), (2, 9, 3, 10), (17, 10, 18, 11), (6, 11, 7, 12), (20, 15, 1, 16), (13, 16, 14, 17), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 7], [0, 7, 7, 4], [0, 3, 8, 5], [1, 4, 6, 1], [2, 5, 8, 9], [2, 9, 3, 3], [4, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 11
 Total minimal pinning sets: 12
 Total pinning sets: 430
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.62
 Average overall degree: 3.06

Table 1017: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	11	0	0	0	0	0	0	0	11
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	54	111	123	84	36	9	1	418
Average degree	2.6	2.84	3.0	3.11	3.19	3.24	3.29	3.33	

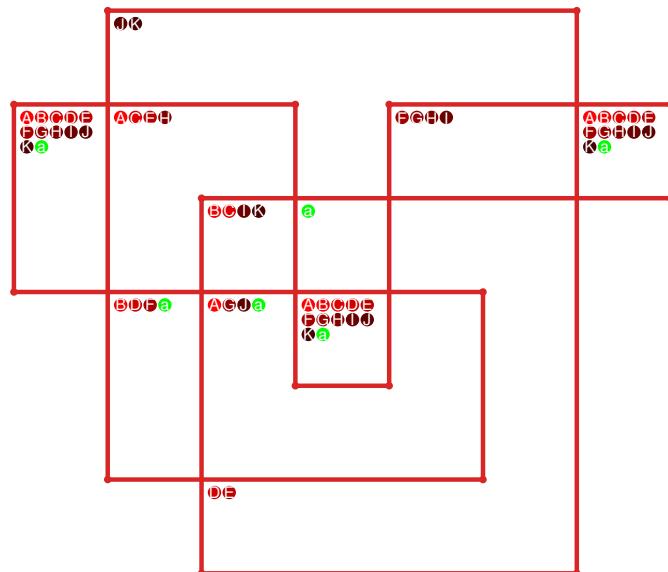


Figure 2037: SnapPy multiloop plot.

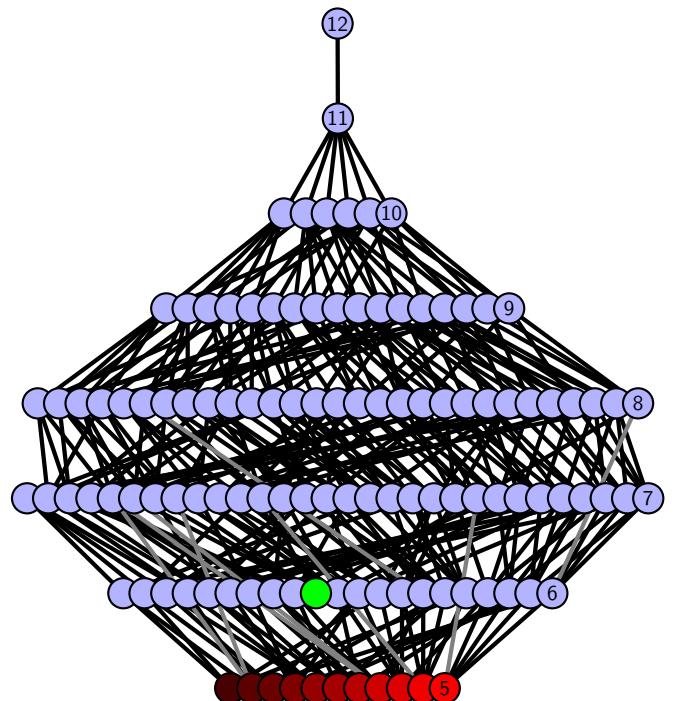


Figure 2038: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.722 [[5, 20, 6, 1], [4, 13, 5, 14], [19, 12, 20, 13], [6, 12, 7, 11], [1, 11, 2, 10], [14, 3, 15, 4], [15, 18, 16, 19], [7, 16, 8, 17], [2, 9, 3, 10], [17, 8, 18, 9]]

PD code drawn by SnapPy: [(12, 1, 13, 2), (15, 6, 16, 7), (20, 7, 1, 8), (8, 19, 9, 20), (9, 4, 10, 5), (17, 10, 18, 11), (2, 11, 3, 12), (5, 14, 6, 15), (13, 16, 14, 17), (3, 18, 4, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 2], [0, 1, 6, 3], [0, 2, 7, 4], [0, 3, 8, 8], [1, 8, 6, 1], [2, 5, 9, 7], [3, 6, 9, 9], [4, 9, 5, 4], [6, 8, 7, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 304
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.47
 Average overall degree: 3.04

Table 1018: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	28	65	86	70	34	9	1	301
Average degree	2.25	2.58	2.78	2.93	3.06	3.16	3.24	3.29	3.33	

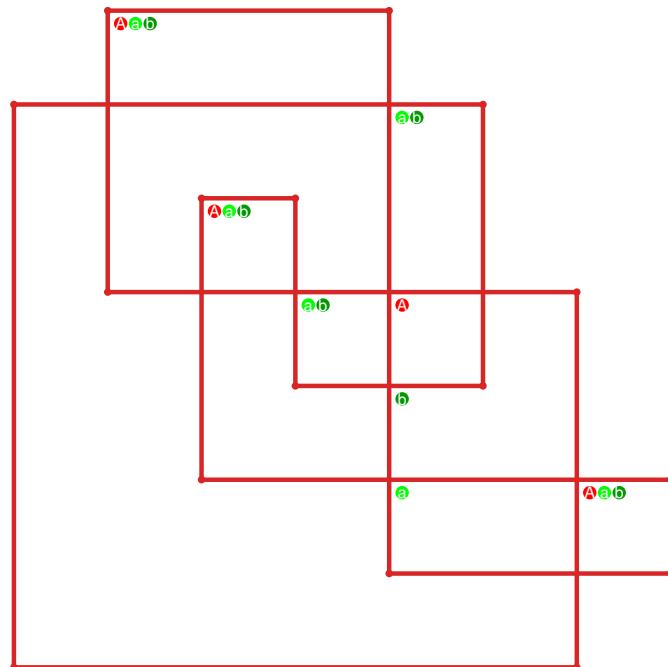


Figure 2039: SnapPy multiloop plot.

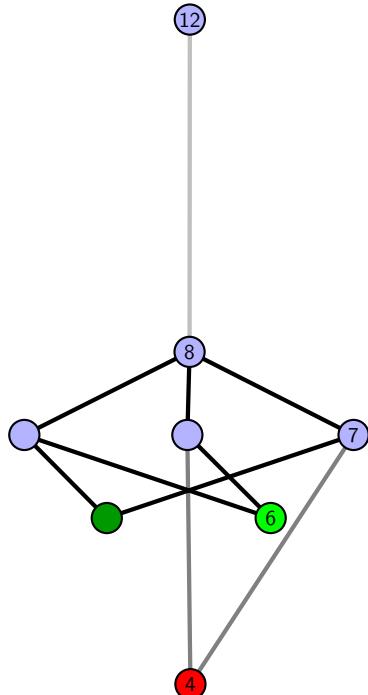


Figure 2040: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.723 [[20, 7, 1, 8], [8, 3, 9, 4], [4, 19, 5, 20], [15, 6, 16, 7], [1, 13, 2, 12], [2, 11, 3, 12], [9, 18, 10, 19], [5, 14, 6, 15], [16, 14, 17, 13], [17, 10, 18, 11]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (13, 4, 14, 5), (18, 5, 19, 6), (15, 8, 16, 9), (20, 9, 1, 10), (10, 19, 11, 20), (11, 14, 12, 15), (3, 12, 4, 13), (7, 16, 8, 17), (2, 17, 3, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 7, 7, 8], [0, 8, 5, 5], [1, 4, 4, 9], [1, 9, 9, 2], [2, 8, 3, 3], [3, 7, 9, 4], [5, 8, 6, 6]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 384
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.25
 Average overall degree: 3.03

Table 1019: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

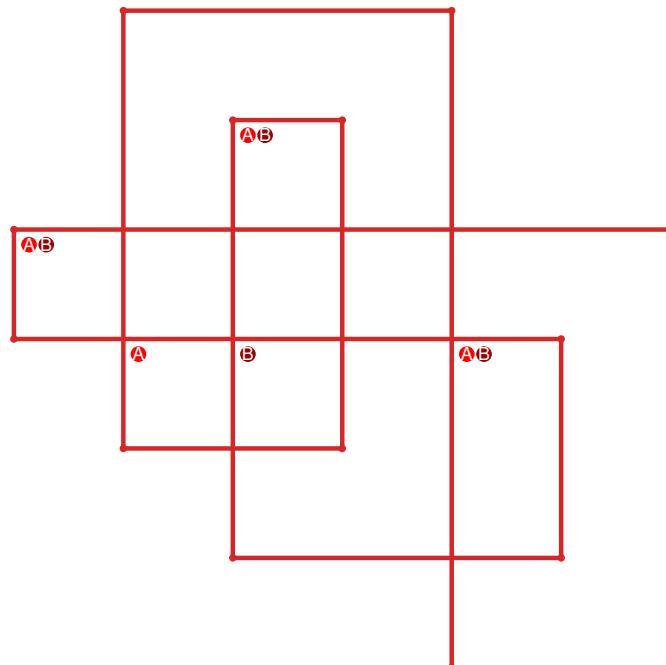


Figure 2041: SnapPy multiloop plot.

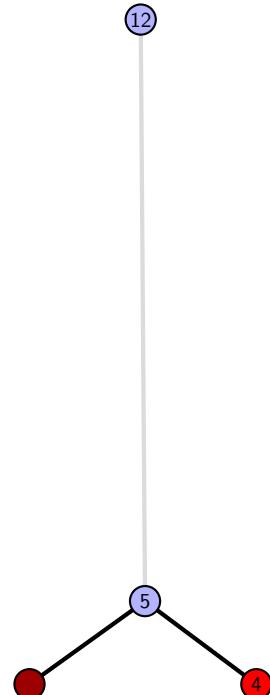


Figure 2042: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.724 $[[6, 20, 1, 7], [7, 3, 8, 4], [17, 5, 18, 6], [19, 10, 20, 11], [1, 13, 2, 14], [14, 2, 15, 3], [8, 15, 9, 16], [4, 16, 5, 17], [18, 12, 19, 11], [12, 9, 13, 10]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (14, 1, 15, 2), (10, 3, 11, 4), (19, 16, 20, 17), (12, 17, 13, 18), (18, 11, 19, 12), (5, 20, 6, 7), (15, 8, 16, 9), (2, 9, 3, 10), (4, 13, 5, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 8], [0, 8, 8, 9], [0, 9, 5, 5], [1, 4, 4, 6], [1, 5, 9, 7], [1, 6, 2, 2], [2, 9, 3, 3], [3, 8, 6, 4]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 368
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.46
 Average overall degree: 3.04

Table 1020: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	43	87	104	77	35	9	1	364
Average degree	2.25	2.56	2.79	2.96	3.08	3.17	3.24	3.29	3.33	

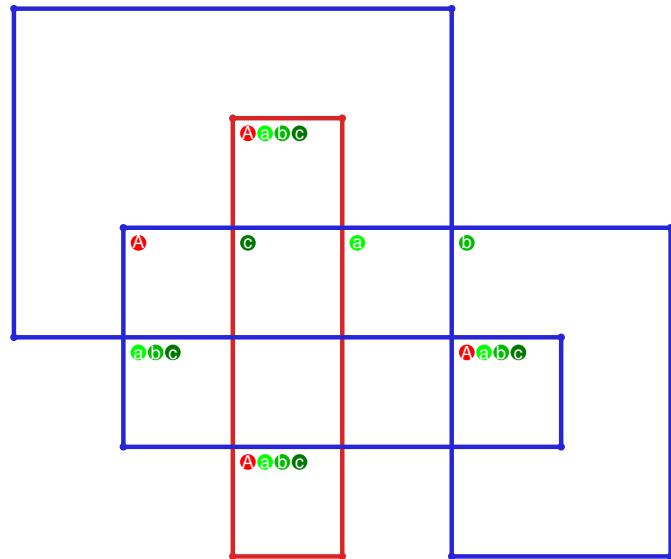


Figure 2043: SnapPy multiloop plot.

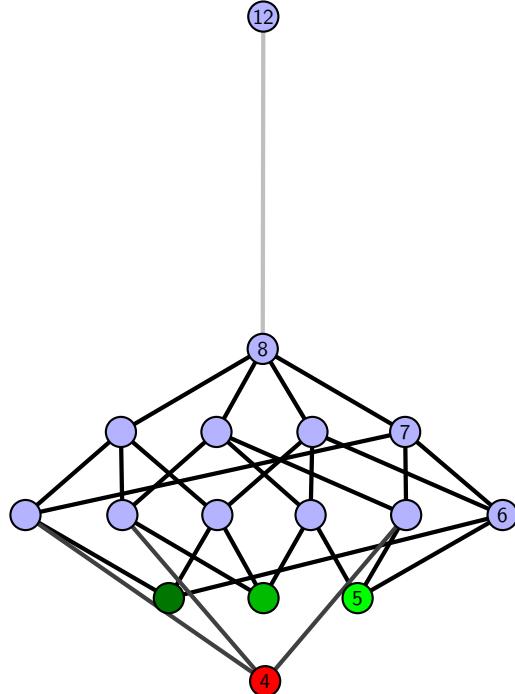


Figure 2044: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.725 [[12, 20, 1, 13], [13, 11, 14, 12], [19, 7, 20, 8], [1, 7, 2, 6], [10, 5, 11, 6], [14, 17, 15, 18], [8, 18, 9, 19], [2, 9, 3, 10], [16, 4, 17, 5], [15, 4, 16, 3]]

PD code drawn by SnapPy: [(12, 13, 1, 14), (14, 1, 15, 2), (7, 2, 8, 3), (3, 10, 4, 11), (17, 4, 18, 5), (11, 6, 12, 7), (19, 8, 20, 9), (20, 15, 13, 16), (5, 16, 6, 17), (9, 18, 10, 19)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 3], [0, 2, 7, 4], [1, 3, 7, 8], [1, 8, 9, 6], [2, 5, 7, 2], [3, 6, 9, 4], [4, 9, 9, 5], [5, 8, 8, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 8

Total pinning sets: 436
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.64
Average overall degree: 3.06

Table 1021: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	1	0	0	0	0	0	0	7
Nonminimal pinning sets	0	8	56	111	123	84	36	9	1	428
Average degree	2.25	2.61	2.84	3.0	3.11	3.19	3.24	3.29	3.33	

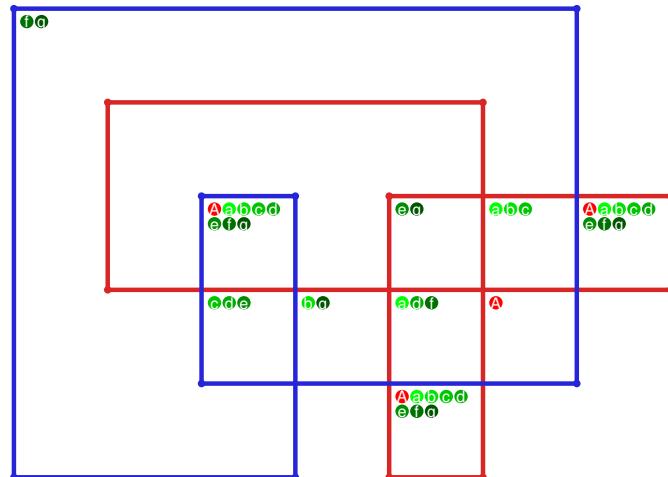


Figure 2045: SnapPy multiloop plot.

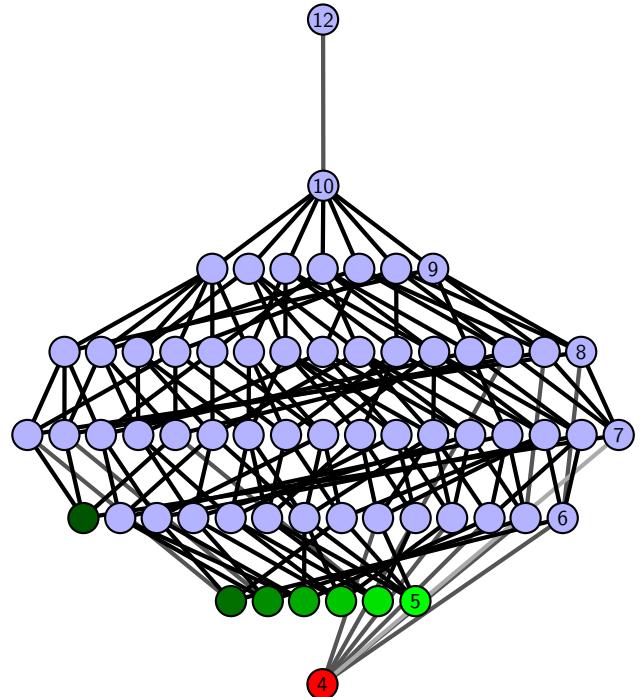


Figure 2046: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.726 [[11, 16, 12, 1], [15, 10, 16, 11], [12, 8, 13, 7], [1, 7, 2, 6], [14, 5, 15, 6], [9, 20, 10, 17], [8, 20, 9, 19], [13, 3, 14, 2], [4, 17, 5, 18], [18, 3, 19, 4]]

PD code drawn by SnapPy: [(17, 16, 18, 1), (11, 2, 12, 3), (3, 14, 4, 15), (4, 9, 5, 10), (12, 7, 13, 8), (8, 13, 9, 14), (15, 10, 16, 11), (18, 5, 19, 6), (6, 19, 7, 20), (1, 20, 2, 17)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 7, 3], [0, 2, 7, 4], [1, 3, 7, 8], [1, 8, 6, 6], [2, 5, 5, 9], [2, 9, 4, 3], [4, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 1022: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

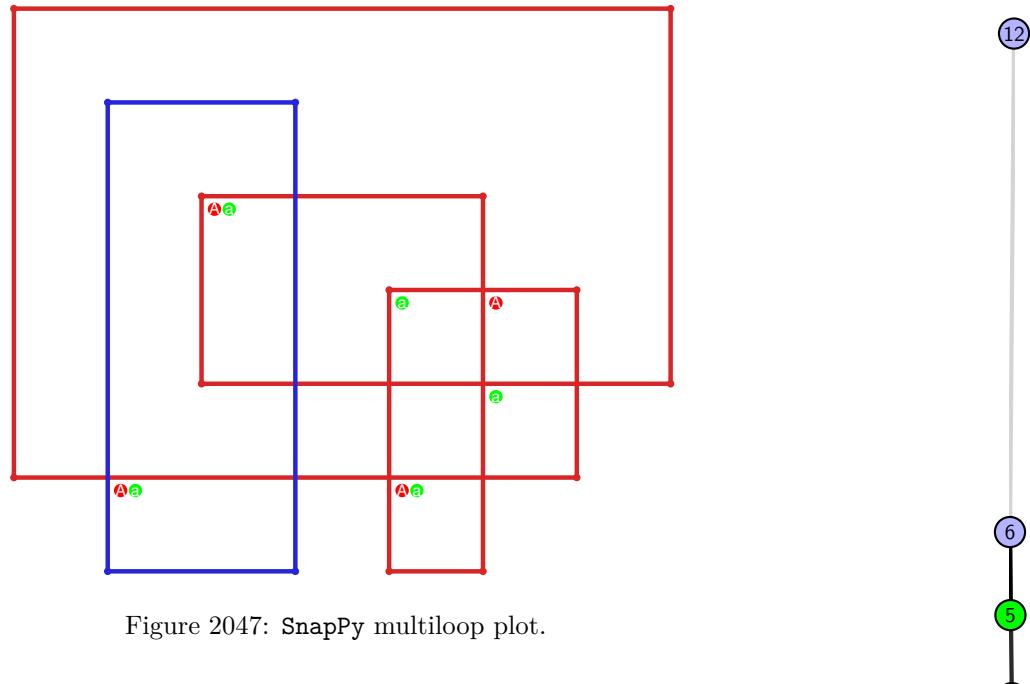


Figure 2047: SnapPy multiloop plot.

Figure 2048: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.727 $[[15, 20, 16, 1], [19, 14, 20, 15], [16, 7, 17, 8], [1, 8, 2, 9], [9, 18, 10, 19], [6, 13, 7, 14], [17, 3, 18, 2], [10, 5, 11, 6], [12, 3, 13, 4], [4, 11, 5, 12]]$

PD code drawn by SnapPy: $[(20, 15, 1, 16), (10, 1, 11, 2), (8, 3, 9, 4), (14, 5, 15, 6), (19, 6, 20, 7), (2, 9, 3, 10), (4, 11, 5, 12), (17, 12, 18, 13), (7, 16, 8, 17), (13, 18, 14, 19)]$

Planar representation generated by plantri: $[[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 3], [0, 2, 6, 4], [1, 3, 6, 7], [1, 7, 8, 2], [2, 8, 4, 3], [4, 9, 9, 5], [5, 9, 9, 6], [7, 8, 8, 7]]$

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 320
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.33
 Average overall degree: 3.03

Table 1023: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

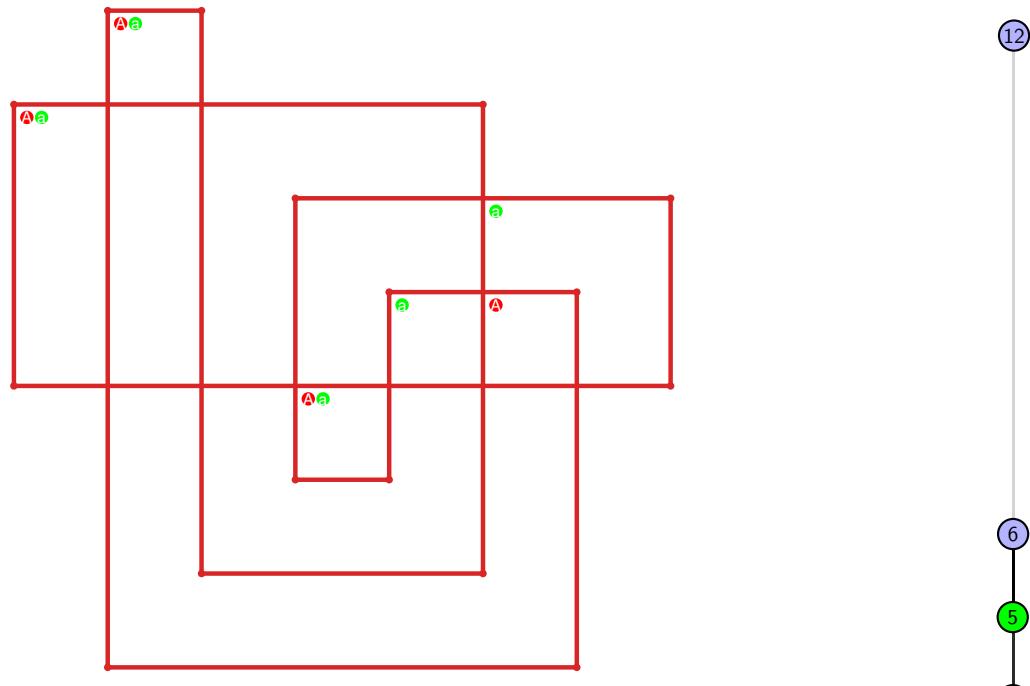


Figure 2049: SnapPy multiloop plot.

Figure 2050: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.728 [[15, 20, 16, 1], [19, 14, 20, 15], [16, 8, 17, 7], [1, 7, 2, 6], [18, 5, 19, 6], [13, 8, 14, 9], [17, 3, 18, 2], [11, 4, 12, 5], [9, 12, 10, 13], [3, 10, 4, 11]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (15, 2, 16, 3), (3, 18, 4, 19), (4, 13, 5, 14), (10, 5, 11, 6), (20, 7, 1, 8), (6, 9, 7, 10), (16, 11, 17, 12), (12, 17, 13, 18), (19, 14, 20, 15)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 5, 6, 3], [0, 2, 6, 4], [1, 3, 6, 7], [1, 8, 8, 2], [2, 9, 4, 3], [4, 9, 9, 8], [5, 7, 9, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 1024: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

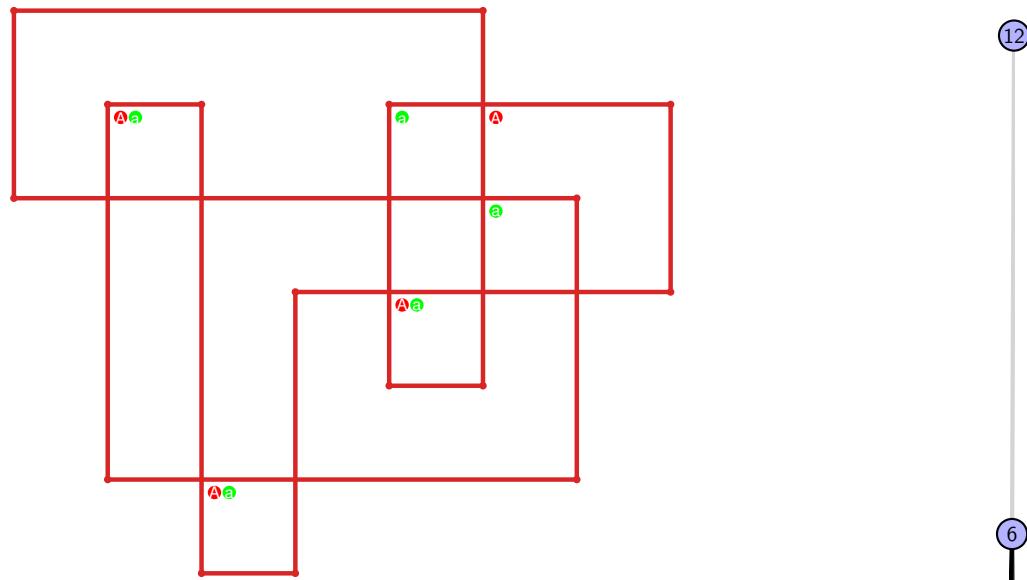


Figure 2051: `SnapPy` multiloop plot.

Figure 2052: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.729 [[14, 20, 1, 15], [15, 13, 16, 14], [19, 7, 20, 8], [1, 7, 2, 6], [12, 16, 13, 17], [8, 12, 9, 11], [18, 2, 19, 3], [5, 17, 6, 18], [9, 5, 10, 4], [10, 3, 11, 4]]

PD code drawn by SnapPy: [(15, 14, 16, 1), (8, 1, 9, 2), (2, 7, 3, 8), (4, 13, 5, 14), (16, 5, 17, 6), (9, 6, 10, 7), (18, 11, 19, 12), (3, 20, 4, 15), (12, 17, 13, 18), (10, 19, 11, 20)]

Planar representation generated by plantri: [[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 6, 7], [1, 7, 5, 1], [2, 4, 8, 9], [2, 9, 7, 3], [3, 6, 8, 4], [5, 7, 9, 9], [5, 8, 8, 6]]

Total optimal pinning sets: 1
Total minimal pinning sets: 3
Total pinning sets: 304
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.47
Average overall degree: 3.04

Table 1025: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	28	65	86	70	34	9	1	301
Average degree	2.25	2.58	2.78	2.93	3.06	3.16	3.24	3.29	3.33	

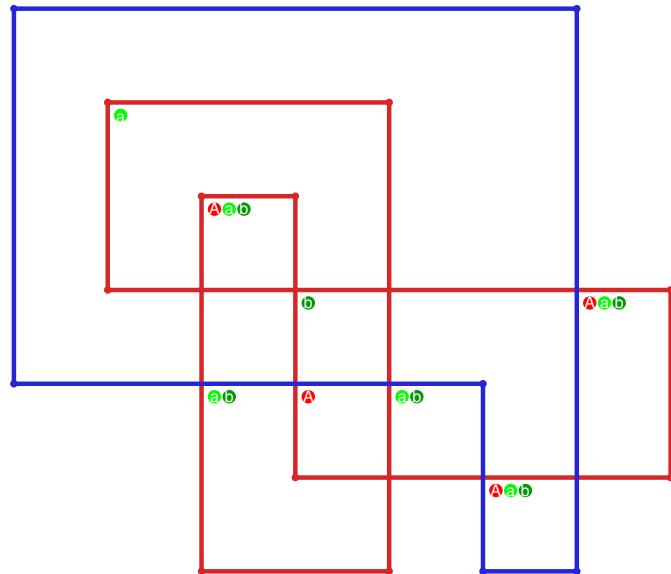


Figure 2053: SnapPy multiloop plot.

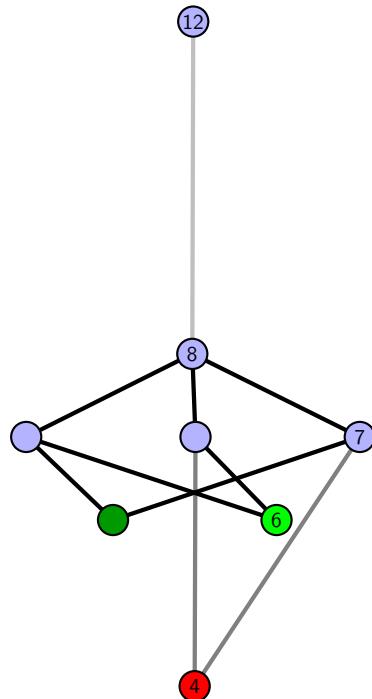


Figure 2054: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.730 [[5, 12, 6, 1], [4, 20, 5, 13], [11, 15, 12, 16], [6, 2, 7, 1], [13, 7, 14, 8], [8, 3, 9, 4], [19, 16, 20, 17], [10, 18, 11, 19], [14, 2, 15, 3], [9, 18, 10, 17]]

PD code drawn by SnapPy: [(13, 12, 14, 1), (6, 1, 7, 2), (20, 5, 13, 6), (3, 10, 4, 11), (11, 4, 12, 5), (9, 14, 10, 15), (18, 15, 19, 16), (16, 7, 17, 8), (8, 17, 9, 18), (2, 19, 3, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 6, 7, 8], [0, 8, 4, 0], [1, 3, 8, 5], [1, 4, 8, 9], [1, 9, 7, 2], [2, 6, 9, 9], [2, 5, 4, 3], [5, 7, 7, 6]]

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 432
 Pinning number: 5

Average optimal degree: 2.68
 Average minimal degree: 2.68
 Average overall degree: 3.11

Table 1026: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	44	102	129	96	42	10	1	424
Average degree	2.68	2.89	3.03	3.14	3.22	3.27	3.31	3.33	

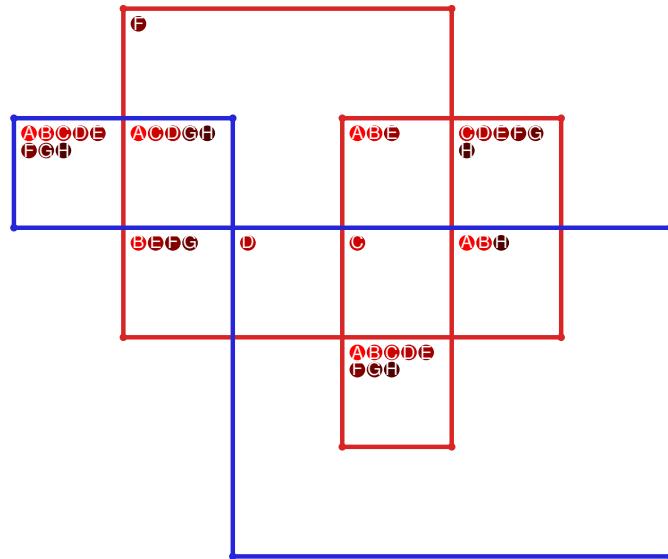


Figure 2055: SnapPy multiloop plot.

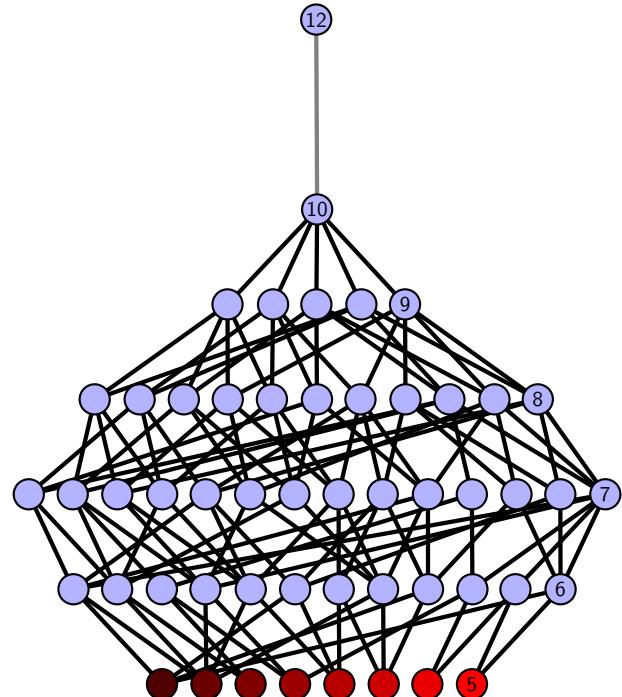


Figure 2056: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.731 [[5, 14, 6, 1], [4, 20, 5, 15], [13, 17, 14, 18], [6, 2, 7, 1], [15, 7, 16, 8], [8, 3, 9, 4], [19, 11, 20, 12], [18, 11, 19, 10], [12, 9, 13, 10], [16, 2, 17, 3]]

PD code drawn by SnapPy: [(15, 14, 16, 1), (6, 1, 7, 2), (20, 5, 15, 6), (10, 7, 11, 8), (8, 17, 9, 18), (18, 9, 19, 10), (3, 12, 4, 13), (13, 4, 14, 5), (11, 16, 12, 17), (2, 19, 3, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 7, 8, 9], [0, 9, 4, 0], [1, 3, 9, 5], [1, 4, 9, 8], [1, 8, 7, 7], [2, 6, 6, 8], [2, 7, 6, 5], [2, 5, 4, 3]]

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 5

Average minimal degree: 2.67

Total pinning sets: 432

Average overall degree: 3.11

Pinning number: 4

Table 1027: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	1	0	0	0	0	0	0	4
Nonminimal pinning sets	0	8	45	100	126	95	42	10	1	427
Average degree	2.5	2.73	2.9	3.04	3.14	3.22	3.27	3.31	3.33	

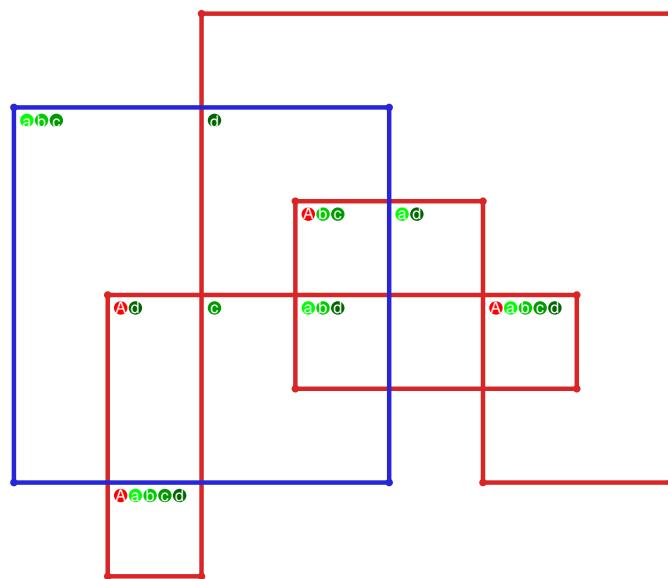


Figure 2057: SnapPy multiloop plot.

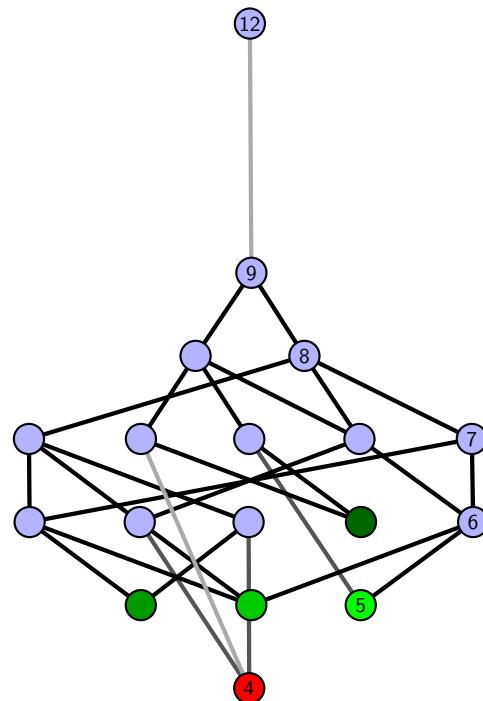


Figure 2058: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.732 [[7, 20, 8, 1], [11, 6, 12, 7], [19, 16, 20, 17], [8, 16, 9, 15], [1, 15, 2, 14], [10, 13, 11, 14], [5, 12, 6, 13], [17, 5, 18, 4], [18, 3, 19, 4], [9, 3, 10, 2]]

PD code drawn by SnapPy: [(20, 7, 1, 8), (16, 1, 17, 2), (2, 15, 3, 16), (9, 4, 10, 5), (3, 10, 4, 11), (8, 11, 9, 12), (12, 19, 13, 20), (13, 6, 14, 7), (17, 14, 18, 15), (5, 18, 6, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 7, 8, 3], [0, 2, 9, 4], [0, 3, 9, 5], [1, 4, 9, 6], [1, 5, 7, 1], [2, 6, 8, 8], [2, 7, 7, 9], [3, 8, 5, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 5

Average minimal degree: 2.66

Total pinning sets: 448

Average overall degree: 3.11

Pinning number: 4

Table 1028: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	8	50	106	130	96	42	10	1	443
Average degree	2.5	2.73	2.91	3.05	3.14	3.22	3.27	3.31	3.33	

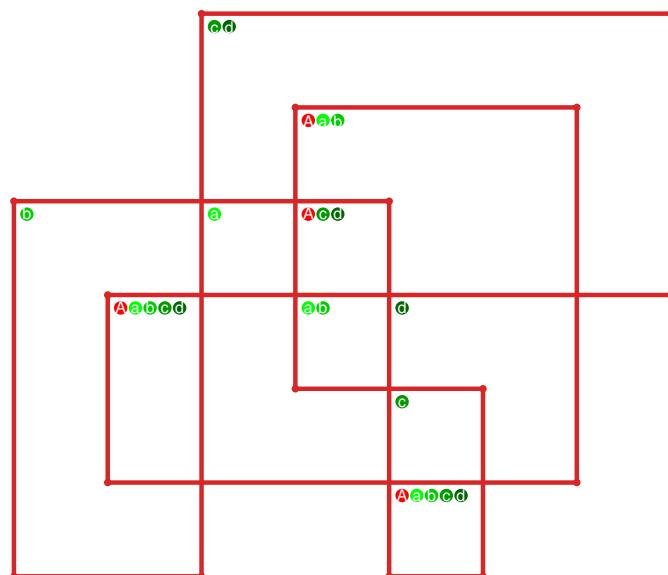


Figure 2059: SnapPy multiloop plot.

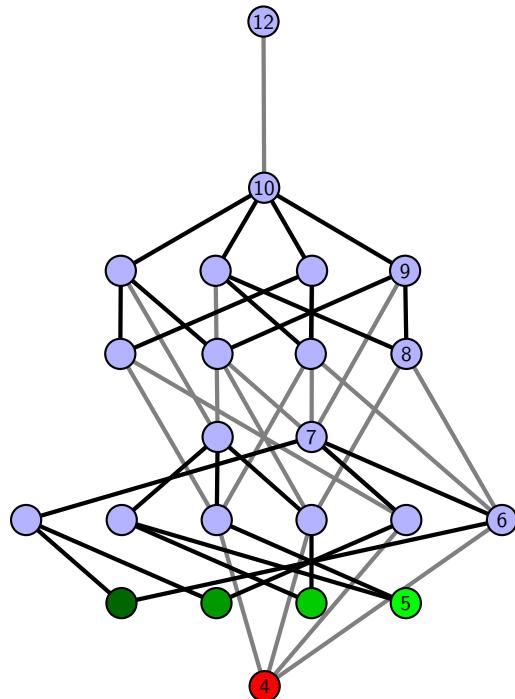


Figure 2060: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.733 [[14, 5, 1, 6], [6, 15, 7, 20], [13, 10, 14, 11], [4, 9, 5, 10], [1, 9, 2, 8], [15, 8, 16, 7], [19, 11, 20, 12], [12, 18, 13, 19], [3, 17, 4, 18], [2, 17, 3, 16]]

PD code drawn by SnapPy: [(12, 3, 13, 4), (5, 20, 6, 15), (6, 13, 7, 14), (2, 7, 3, 8), (11, 8, 12, 9), (18, 9, 19, 10), (15, 14, 16, 1), (1, 16, 2, 17), (10, 17, 11, 18), (19, 4, 20, 5)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 3], [0, 2, 8, 4], [0, 3, 9, 5], [1, 4, 9, 1], [1, 7, 7, 2], [2, 6, 6, 8], [3, 7, 9, 9], [4, 8, 8, 5]]

Total optimal pinning sets: 2

Average optimal degree: 2.4

Total minimal pinning sets: 12

Average minimal degree: 2.71

Total pinning sets: 322

Average overall degree: 3.06

Pinning number: 5

Table 1029: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	10	0	0	0	0	0	0	10
Nonminimal pinning sets	0	14	73	101	77	35	9	1	310
Average degree	2.4	2.71	2.93	3.08	3.17	3.24	3.29	3.33	

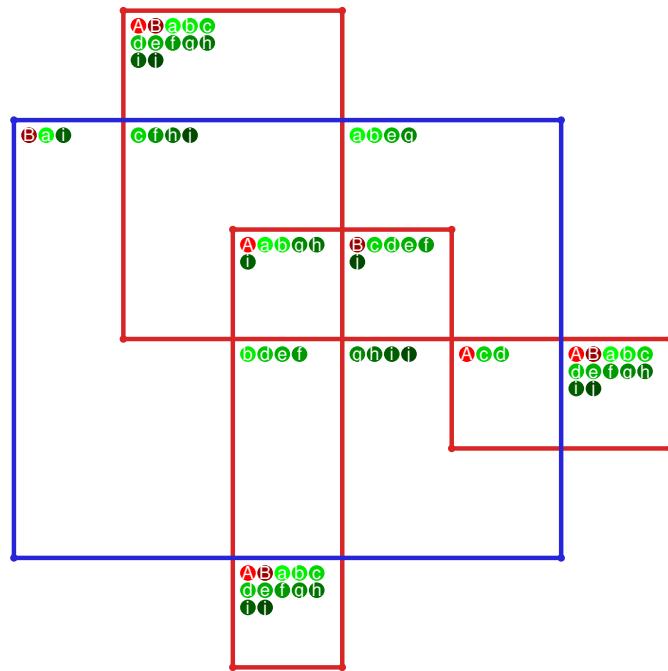


Figure 2061: SnapPy multiloop plot.

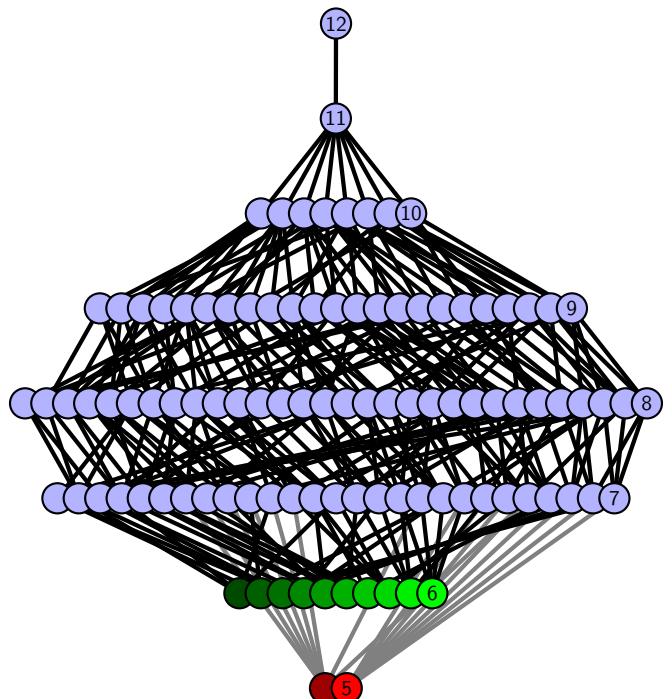


Figure 2062: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.734 [[20, 9, 1, 10], [10, 17, 11, 18], [19, 4, 20, 5], [8, 1, 9, 2], [16, 7, 17, 8], [11, 7, 12, 6], [18, 6, 19, 5], [3, 14, 4, 15], [2, 14, 3, 13], [15, 12, 16, 13]]

PD code drawn by SnapPy: [(16, 1, 17, 2), (2, 15, 3, 16), (3, 8, 4, 9), (13, 4, 14, 5), (17, 6, 18, 7), (12, 9, 13, 10), (10, 19, 11, 20), (20, 11, 1, 12), (7, 14, 8, 15), (5, 18, 6, 19)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 6, 6, 7], [0, 8, 4, 0], [1, 3, 9, 5], [1, 4, 9, 6], [1, 5, 2, 2], [2, 9, 8, 8], [3, 7, 7, 9], [4, 8, 7, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 1030: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

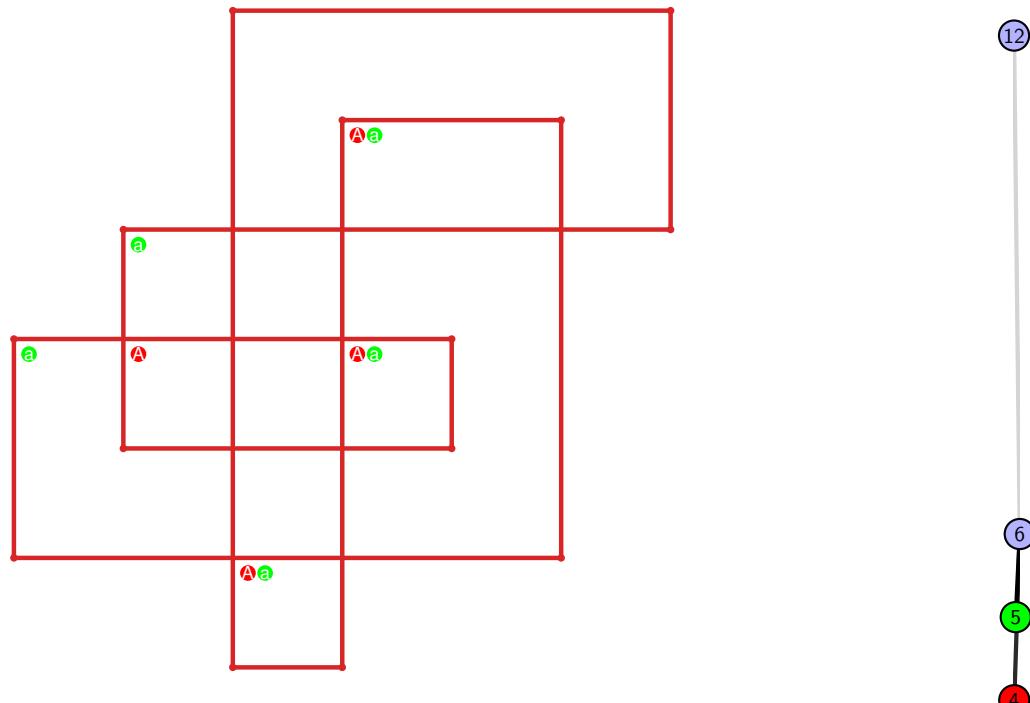


Figure 2063: SnapPy multiloop plot.

Figure 2064: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.735 [[15, 20, 16, 1], [14, 5, 15, 6], [19, 4, 20, 5], [16, 2, 17, 1], [6, 17, 7, 18], [18, 13, 19, 14], [3, 10, 4, 11], [2, 10, 3, 9], [7, 12, 8, 13], [11, 8, 12, 9]]

PD code drawn by SnapPy: [(16, 1, 17, 2), (11, 2, 12, 3), (8, 5, 9, 6), (6, 19, 7, 20), (20, 7, 1, 8), (4, 9, 5, 10), (15, 10, 16, 11), (3, 14, 4, 15), (12, 17, 13, 18), (18, 13, 19, 14)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 4, 0], [1, 3, 8, 5], [1, 4, 8, 2], [2, 9, 7, 7], [3, 6, 6, 9], [4, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 3

Average optimal degree: 2.4

Total minimal pinning sets: 3

Average minimal degree: 2.4

Total pinning sets: 256

Average overall degree: 3.03

Pinning number: 5

Table 1031: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	19	51	75	65	33	9	1	253
Average degree	2.4	2.68	2.89	3.03	3.15	3.23	3.29	3.33	

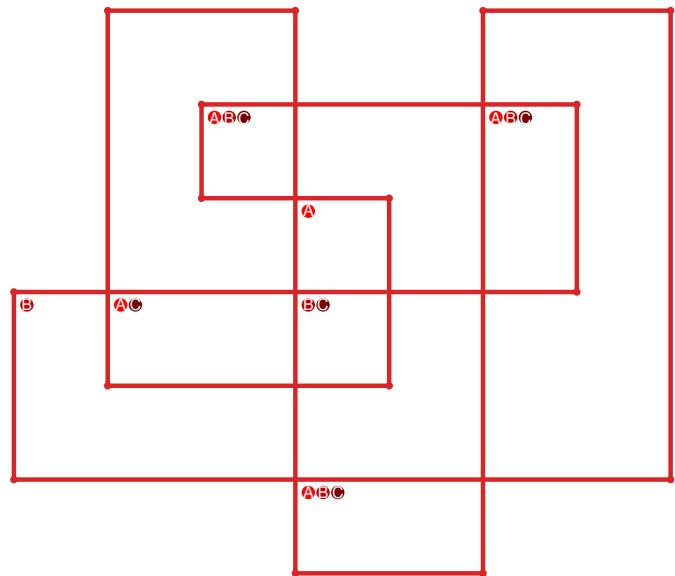


Figure 2065: SnapPy multiloop plot.

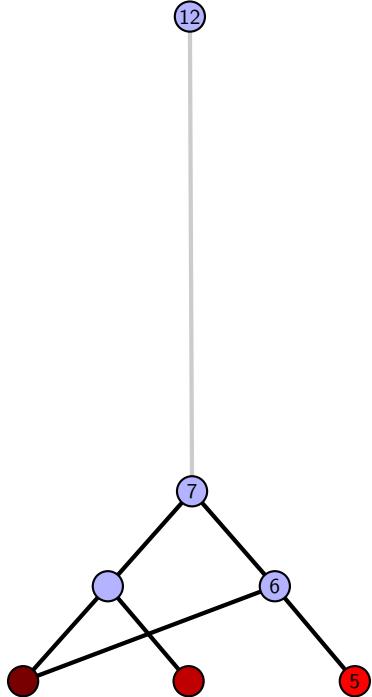


Figure 2066: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.736 [[6, 20, 1, 7], [7, 14, 8, 15], [15, 5, 16, 6], [19, 1, 20, 2], [3, 13, 4, 14], [8, 4, 9, 5], [16, 12, 17, 11], [2, 18, 3, 19], [12, 9, 13, 10], [17, 10, 18, 11]]

PD code drawn by SnapPy: [(11, 2, 12, 3), (18, 3, 19, 4), (8, 5, 9, 6), (14, 19, 15, 20), (1, 16, 2, 17), (10, 17, 11, 18), (6, 7, 1, 8), (4, 9, 5, 10), (15, 12, 16, 13), (20, 13, 7, 14)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 0], [1, 7, 8, 5], [1, 4, 8, 2], [2, 8, 9, 9], [3, 9, 4, 3], [4, 9, 6, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 6
 Total pinning sets: 232
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.57
 Average overall degree: 3.04

Table 1032: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	5	0	0	0	0	0	0	5
Nonminimal pinning sets	0	7	42	70	64	33	9	1	226
Average degree	2.4	2.64	2.86	3.02	3.14	3.23	3.29	3.33	

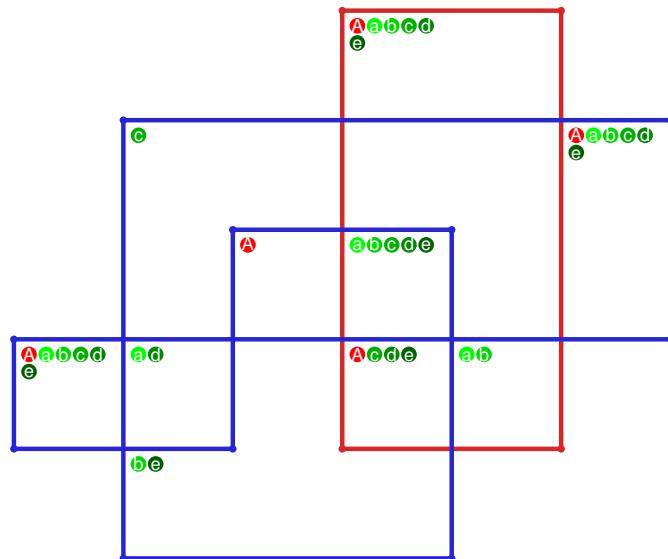


Figure 2067: SnapPy multiloop plot.

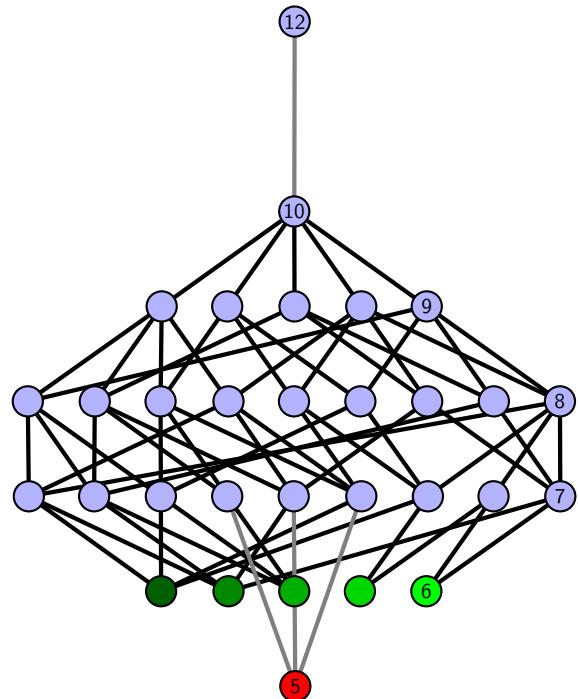


Figure 2068: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.737 $[[16, 5, 1, 6], [6, 15, 7, 16], [4, 20, 5, 17], [1, 20, 2, 19], [14, 7, 15, 8], [17, 14, 18, 13], [10, 3, 11, 4], [2, 11, 3, 12], [18, 8, 19, 9], [9, 12, 10, 13]]$

PD code drawn by `SnapPy`: $[(7, 16, 8, 1), (13, 2, 14, 3), (11, 4, 12, 5), (18, 5, 19, 6), (15, 8, 16, 9), (6, 9, 7, 10), (10, 17, 11, 18), (3, 12, 4, 13), (19, 14, 20, 15), (1, 20, 2, 17)]$

Planar representation generated by `plantri`: $[[1, 1, 2, 3], [0, 4, 4, 0], [0, 5, 6, 3], [0, 2, 7, 8], [1, 8, 5, 1], [2, 4, 8, 9], [2, 9, 7, 7], [3, 6, 6, 9], [3, 9, 5, 4], [5, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 4

Average minimal degree: 2.53

Total pinning sets: 360

Average overall degree: 3.05

Pinning number: 4

Table 1033: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	1	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	39	84	103	77	35	9	1	356
Average degree	2.25	2.58	2.8	2.96	3.08	3.17	3.24	3.29	3.33	

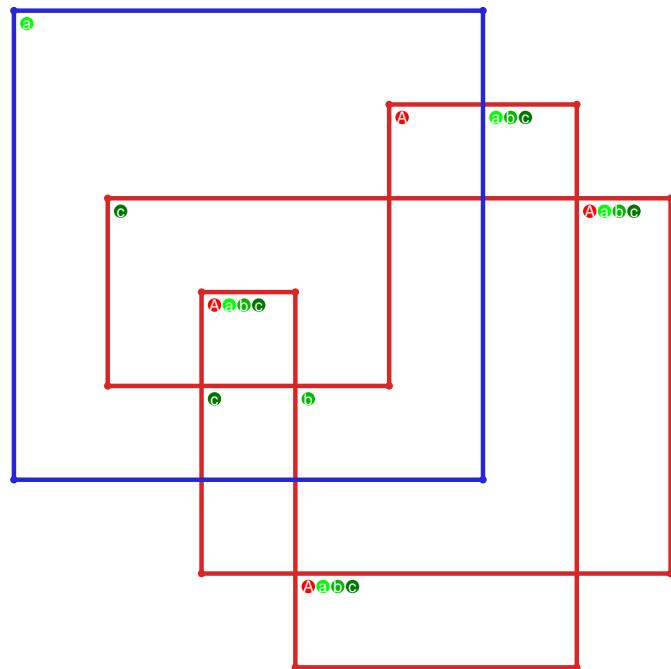


Figure 2069: `SnapPy` multiloop plot.

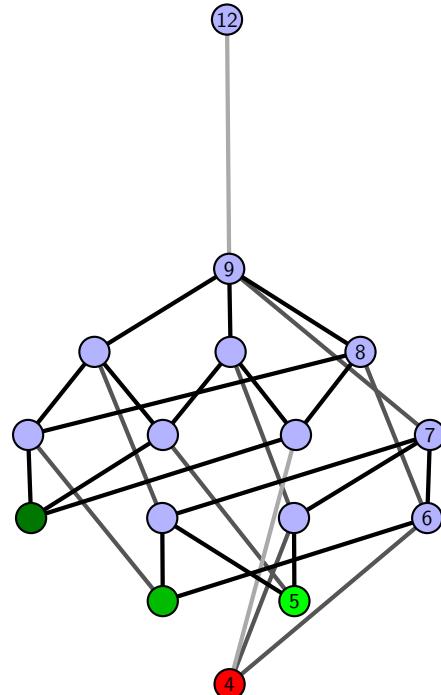


Figure 2070: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.738 [[8, 16, 1, 9], [9, 17, 10, 20], [15, 7, 16, 8], [1, 7, 2, 6], [17, 6, 18, 5], [10, 13, 11, 14], [14, 19, 15, 20], [2, 19, 3, 18], [12, 4, 13, 5], [11, 4, 12, 3]]

PD code drawn by SnapPy: [(8, 9, 1, 10), (10, 1, 11, 2), (2, 17, 3, 18), (3, 6, 4, 7), (13, 4, 14, 5), (16, 11, 9, 12), (5, 14, 6, 15), (18, 7, 19, 8), (12, 19, 13, 20), (20, 15, 17, 16)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 5, 6], [0, 6, 3, 0], [0, 2, 7, 4], [1, 3, 7, 8], [1, 8, 9, 6], [1, 5, 7, 2], [3, 6, 9, 4], [4, 9, 9, 5], [5, 8, 8, 7]]

Total optimal pinning sets: 2

Average optimal degree: 3.0

Total minimal pinning sets: 25

Average minimal degree: 2.91

Total pinning sets: 767

Average overall degree: 3.16

Pinning number: 4

Table 1034: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	18	5	0	0	0	0	0	0	23
Nonminimal pinning sets	0	16	128	218	204	120	45	10	1	742
Average degree	3.0	2.96	3.07	3.14	3.2	3.24	3.28	3.31	3.33	

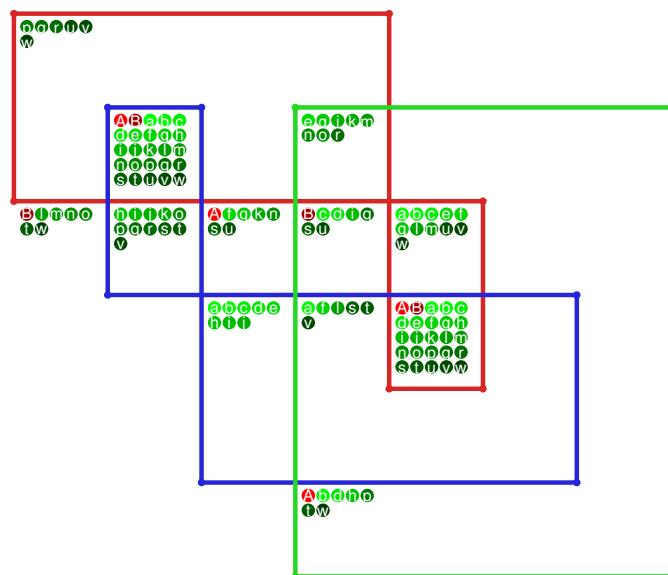


Figure 2071: SnapPy multiloop plot.

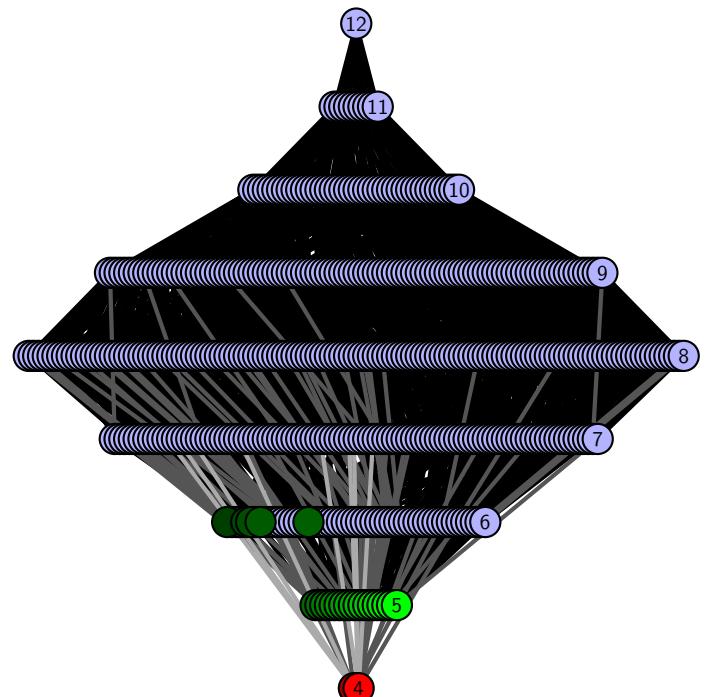


Figure 2072: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.739 [[20, 7, 1, 8], [8, 17, 9, 18], [14, 19, 15, 20], [6, 1, 7, 2], [16, 5, 17, 6], [9, 12, 10, 13], [18, 13, 19, 14], [15, 3, 16, 2], [11, 4, 12, 5], [10, 4, 11, 3]]

PD code drawn by SnapPy: [(20, 7, 1, 8), (8, 1, 9, 2), (13, 2, 14, 3), (17, 4, 18, 5), (6, 9, 7, 10), (15, 10, 16, 11), (5, 14, 6, 15), (11, 16, 12, 17), (3, 18, 4, 19), (19, 12, 20, 13)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 6], [0, 6, 6, 7], [0, 7, 4, 0], [1, 3, 7, 8], [1, 8, 9, 6], [1, 5, 2, 2], [2, 9, 4, 3], [4, 9, 9, 5], [5, 8, 8, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 6
 Total pinning sets: 476
 Pinning number: 4

Average optimal degree: 2.33
 Average minimal degree: 2.57
 Average overall degree: 3.05

Table 1035: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	0	3
Nonminimal pinning sets	0	21	73	121	125	84	36	9	1	470
Average degree	2.33	2.67	2.87	3.01	3.11	3.19	3.24	3.29	3.33	

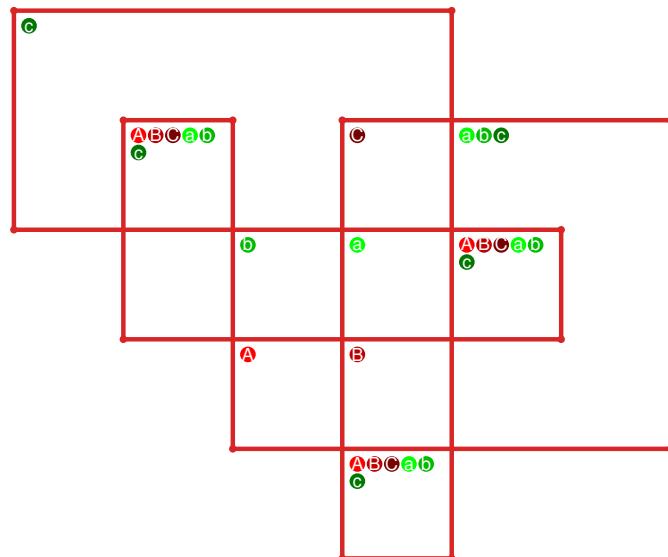


Figure 2073: SnapPy multiloop plot.

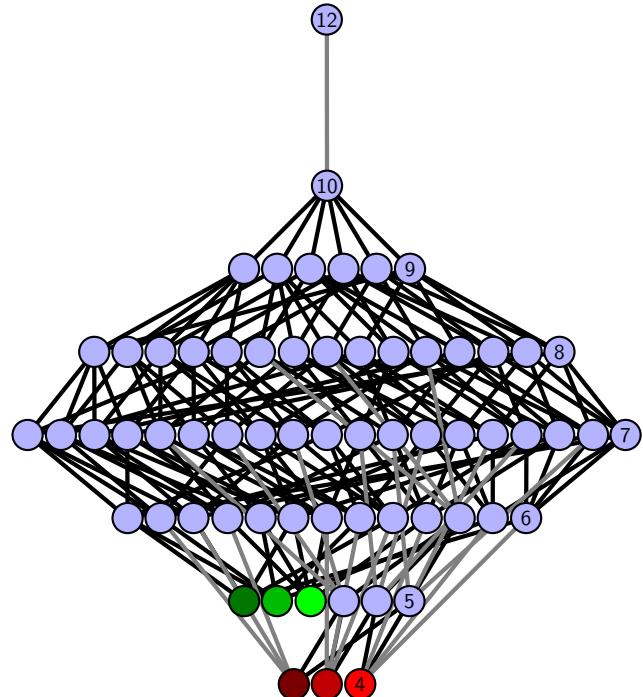


Figure 2074: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.740 [[20, 13, 1, 14], [14, 5, 15, 6], [6, 19, 7, 20], [12, 1, 13, 2], [4, 11, 5, 12], [15, 18, 16, 19], [7, 3, 8, 2], [8, 3, 9, 4], [17, 10, 18, 11], [16, 10, 17, 9]]

PD code drawn by `SnapPy`: [(5, 20, 6, 1), (11, 2, 12, 3), (6, 13, 7, 14), (14, 7, 15, 8), (1, 8, 2, 9), (17, 10, 18, 11), (12, 15, 13, 16), (3, 16, 4, 17), (9, 18, 10, 19), (19, 4, 20, 5)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 4, 0], [1, 3, 7, 8], [1, 8, 9, 2], [2, 7, 7, 3], [4, 6, 6, 9], [4, 9, 9, 5], [5, 8, 8, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 384
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.25
 Average overall degree: 3.03

Table 1036: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	15	49	91	105	77	35	9	1	382
Average degree	2.25	2.59	2.81	2.97	3.08	3.17	3.24	3.29	3.33	

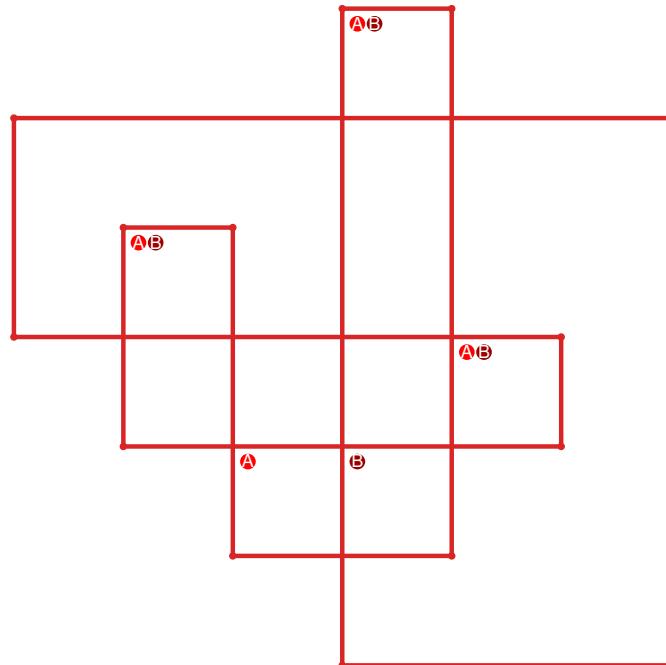


Figure 2075: `SnapPy` multiloop plot.

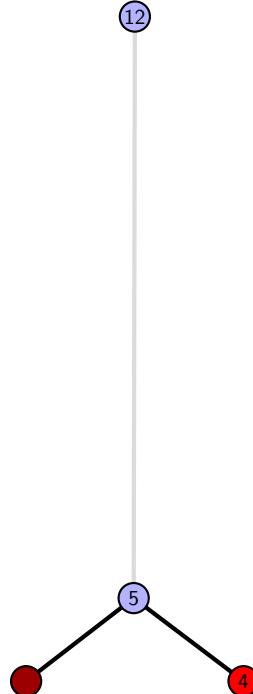


Figure 2076: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.741 $[[10, 3, 1, 4], [4, 11, 5, 14], [9, 13, 10, 14], [2, 20, 3, 15], [1, 20, 2, 19], [11, 19, 12, 18], [5, 8, 6, 9], [12, 15, 13, 16], [7, 17, 8, 18], [6, 17, 7, 16]]$

PD code drawn by SnapPy: $[(8, 1, 9, 2), (3, 6, 4, 7), (7, 20, 8, 17), (17, 2, 18, 3), (13, 4, 14, 5), (5, 14, 6, 15), (15, 18, 16, 19), (16, 9, 11, 10), (10, 11, 1, 12), (19, 12, 20, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 2], [0, 1, 6, 7], [0, 7, 4, 4], [0, 3, 3, 5], [1, 4, 7, 8], [1, 8, 9, 2], [2, 9, 5, 3], [5, 9, 9, 6], [6, 8, 8, 7]]$

Total optimal pinning sets: 18
 Total minimal pinning sets: 18
 Total pinning sets: 612
 Pinning number: 5

Average optimal degree: 2.84
 Average minimal degree: 2.84
 Average overall degree: 3.15

Table 1037: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	18	0	0	0	0	0	0	0	18
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	85	166	176	112	44	10	1	594
Average degree	2.84	3.0	3.11	3.18	3.24	3.28	3.31	3.33	

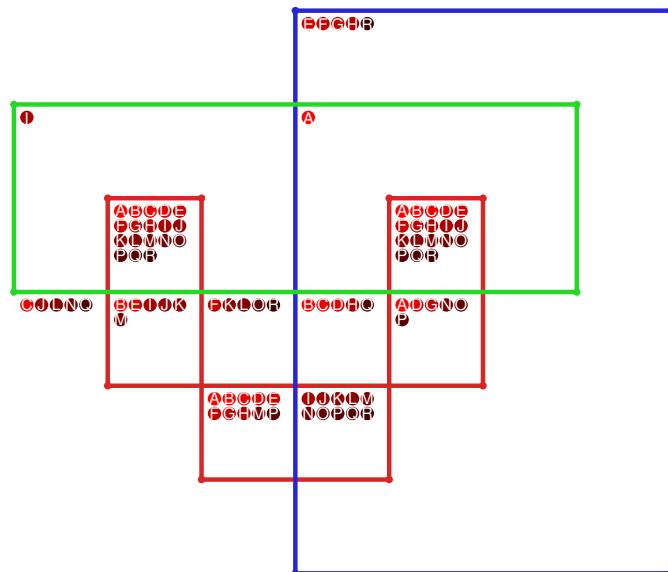


Figure 2077: SnapPy multiloop plot.

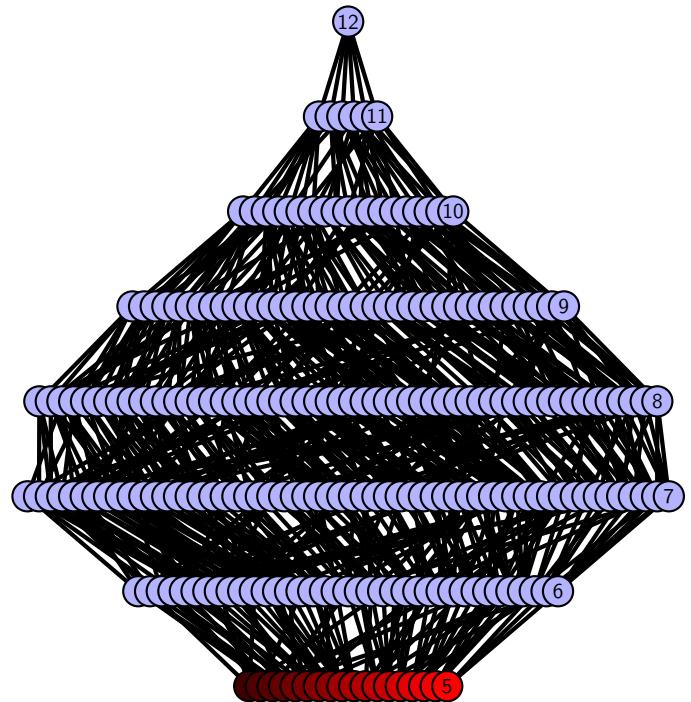


Figure 2078: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.742 [[20, 7, 1, 8], [8, 14, 9, 13], [19, 12, 20, 13], [6, 1, 7, 2], [14, 10, 15, 9], [15, 18, 16, 19], [11, 2, 12, 3], [5, 10, 6, 11], [17, 4, 18, 5], [16, 4, 17, 3]]

PD code drawn by SnapPy: [(15, 2, 16, 3), (4, 9, 5, 10), (20, 5, 1, 6), (14, 7, 15, 8), (8, 3, 9, 4), (10, 13, 11, 14), (1, 16, 2, 17), (6, 17, 7, 18), (18, 11, 19, 12), (12, 19, 13, 20)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 6, 7, 0], [1, 7, 5, 1], [2, 4, 8, 9], [2, 9, 7, 3], [3, 6, 8, 4], [5, 7, 9, 9], [5, 8, 8, 6]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 6
 Total pinning sets: 444
 Pinning number: 4

Average optimal degree: 2.38
 Average minimal degree: 2.49
 Average overall degree: 3.05

Table 1038: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	0	4
Nonminimal pinning sets	0	15	63	111	120	83	36	9	1	438
Average degree	2.38	2.64	2.85	3.0	3.1	3.18	3.24	3.29	3.33	

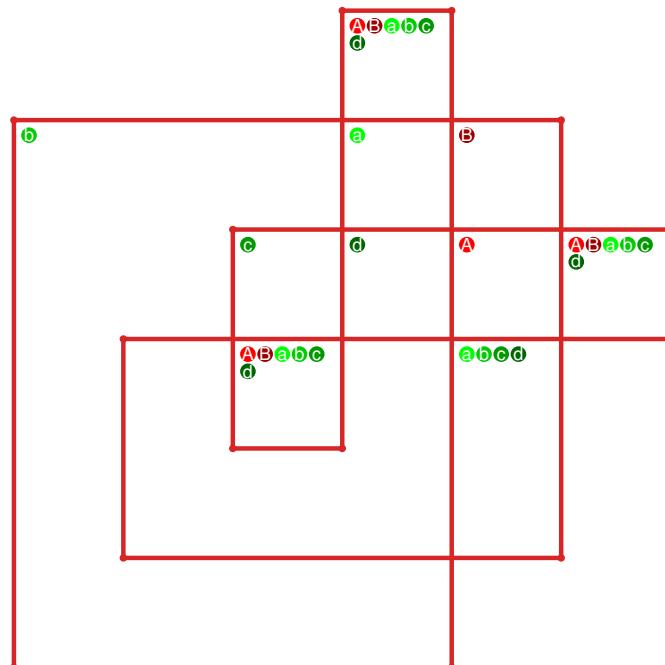


Figure 2079: SnapPy multiloop plot.

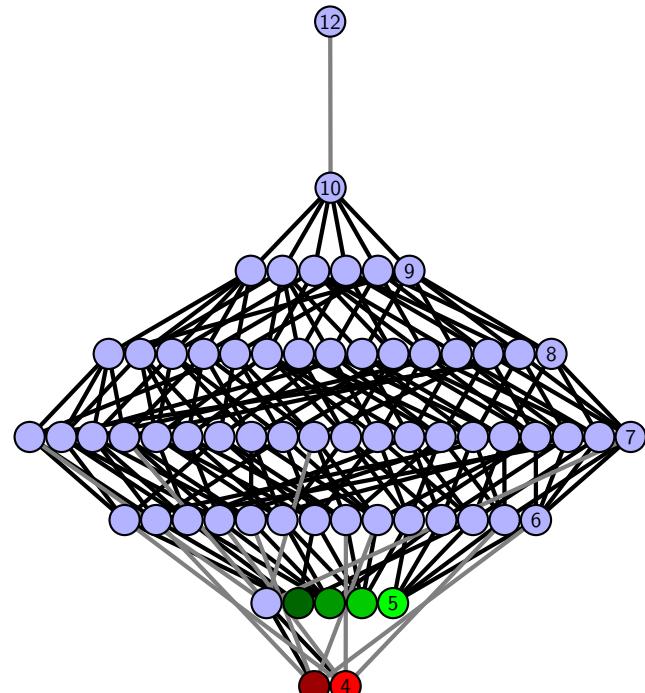


Figure 2080: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.743 [[12, 16, 1, 13], [13, 3, 14, 4], [11, 20, 12, 17], [15, 9, 16, 10], [1, 9, 2, 8], [2, 7, 3, 8], [14, 7, 15, 6], [4, 18, 5, 17], [19, 10, 20, 11], [5, 18, 6, 19]]

PD code drawn by SnapPy: [(1, 20, 2, 17), (9, 2, 10, 3), (3, 8, 4, 9), (17, 4, 18, 5), (14, 5, 15, 6), (19, 10, 20, 11), (7, 18, 8, 19), (6, 15, 7, 16), (16, 11, 13, 12), (12, 13, 1, 14)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 8, 8], [0, 8, 6, 4], [0, 3, 5, 5], [1, 4, 4, 6], [1, 5, 3, 9], [1, 9, 9, 2], [2, 9, 3, 2], [6, 8, 7, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 3
 Total pinning sets: 416
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.43
 Average overall degree: 3.05

Table 1039: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	15	54	101	115	82	36	9	1	413
Average degree	2.25	2.6	2.83	2.98	3.1	3.18	3.24	3.29	3.33	

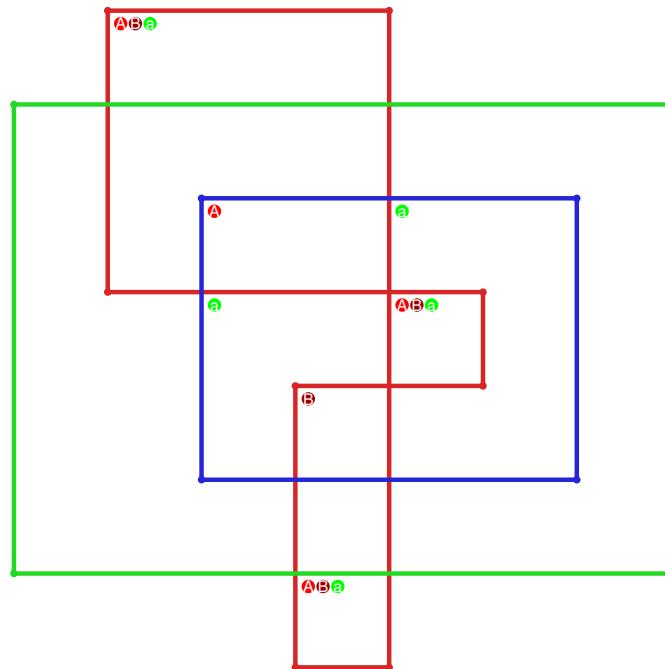


Figure 2081: SnapPy multiloop plot.

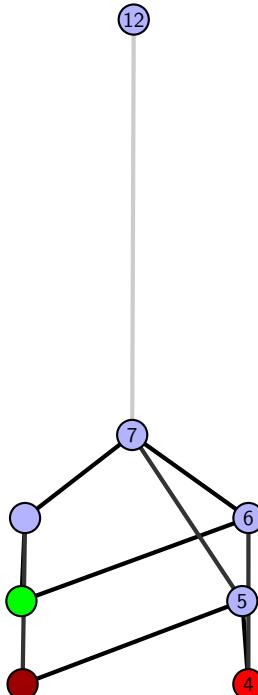


Figure 2082: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.744 [[8, 12, 1, 9], [9, 3, 10, 4], [7, 20, 8, 13], [11, 19, 12, 20], [1, 19, 2, 18], [2, 17, 3, 18], [10, 17, 11, 16], [4, 14, 5, 13], [15, 6, 16, 7], [14, 6, 15, 5]]

PD code drawn by SnapPy: [(18, 1, 19, 2), (3, 14, 4, 15), (15, 4, 16, 5), (6, 17, 7, 18), (16, 19, 9, 20), (8, 9, 1, 10), (10, 7, 11, 8), (20, 11, 17, 12), (5, 12, 6, 13), (13, 2, 14, 3)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 8, 3], [0, 2, 6, 4], [0, 3, 5, 5], [1, 4, 4, 6], [1, 5, 3, 8], [1, 9, 9, 2], [2, 9, 9, 6], [7, 8, 8, 7]]

Total optimal pinning sets: 1
Total minimal pinning sets: 3
Total pinning sets: 336
Pinning number: 4

Average optimal degree: 2.25
Average minimal degree: 2.49
Average overall degree: 3.04

Table 1040: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	1	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	34	75	96	75	35	9	1	333
Average degree	2.25	2.56	2.78	2.94	3.07	3.17	3.24	3.29	3.33	

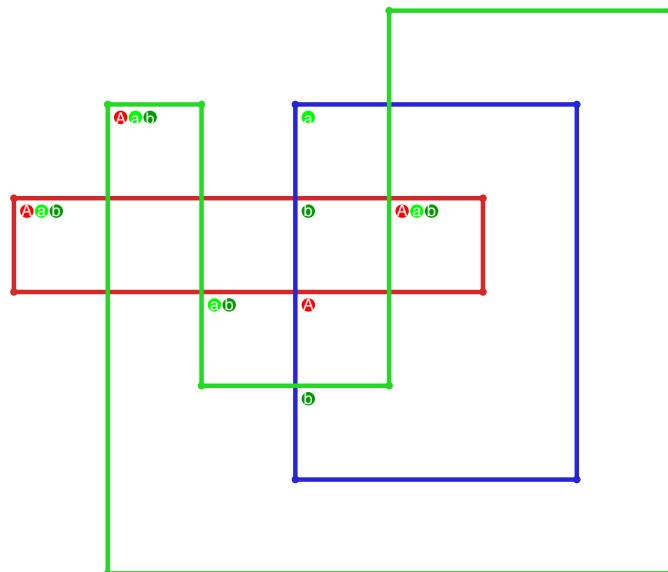


Figure 2083: SnapPy multiloop plot.

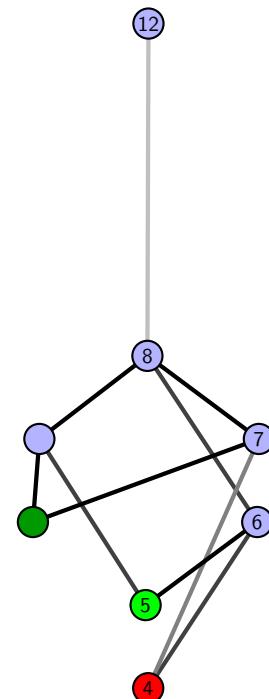


Figure 2084: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.745 $[[9, 20, 10, 1], [3, 8, 4, 9], [19, 16, 20, 17], [10, 16, 11, 15], [1, 15, 2, 14], [2, 13, 3, 14], [7, 12, 8, 13], [4, 18, 5, 17], [5, 18, 6, 19], [11, 6, 12, 7]]$

PD code drawn by SnapPy: $[(9, 4, 10, 5), (1, 6, 2, 7), (5, 10, 6, 11), (20, 11, 1, 12), (12, 19, 13, 20), (13, 8, 14, 9), (17, 14, 18, 15), (15, 2, 16, 3), (3, 16, 4, 17), (7, 18, 8, 19)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 8, 3], [0, 2, 9, 4], [0, 3, 5, 5], [1, 4, 4, 6], [1, 5, 9, 9], [1, 8, 8, 2], [2, 7, 7, 9], [3, 8, 6, 6]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 336
 Pinning number: 5

Average optimal degree: 2.5
 Average minimal degree: 2.5
 Average overall degree: 3.05

Table 1041: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	33	77	99	76	35	9	1	330
Average degree	2.5	2.76	2.94	3.07	3.17	3.24	3.29	3.33	

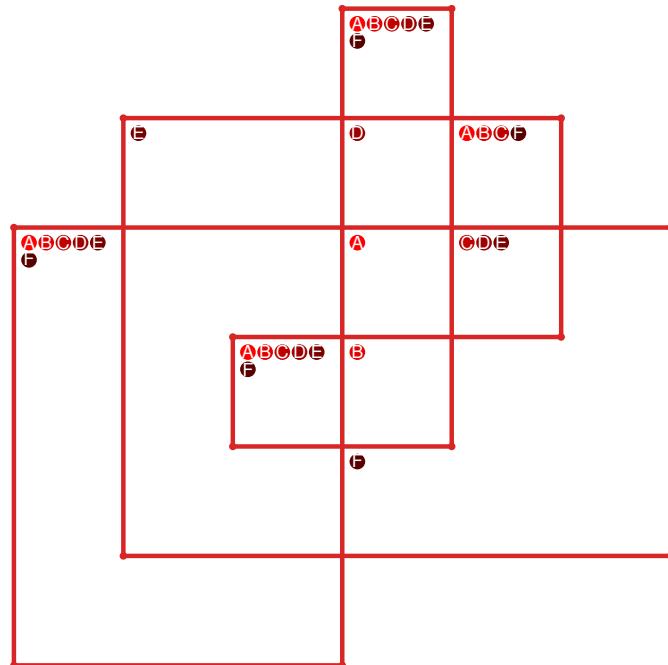


Figure 2085: SnapPy multiloop plot.

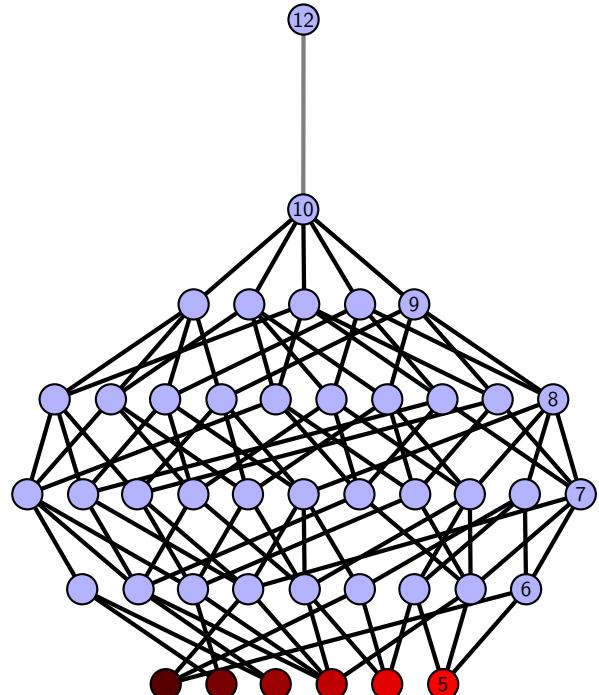


Figure 2086: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.746 [[16, 20, 1, 17], [17, 3, 18, 4], [15, 10, 16, 11], [19, 9, 20, 10], [1, 9, 2, 8], [2, 7, 3, 8], [18, 7, 19, 6], [4, 13, 5, 14], [11, 14, 12, 15], [12, 5, 13, 6]]

PD code drawn by SnapPy: [(20, 1, 17, 2), (10, 3, 11, 4), (4, 17, 5, 18), (16, 5, 1, 6), (6, 15, 7, 16), (18, 7, 19, 8), (13, 8, 14, 9), (2, 11, 3, 12), (9, 12, 10, 13), (14, 19, 15, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 8, 8, 3], [0, 2, 6, 4], [0, 3, 5, 5], [1, 4, 4, 6], [1, 5, 3, 9], [1, 9, 9, 8], [2, 7, 9, 2], [6, 8, 7, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 3

Average minimal degree: 2.49

Total pinning sets: 336

Average overall degree: 3.04

Pinning number: 4

Table 1042: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	1	0	0	0	0	0	0	2
Nonminimal pinning sets	0	8	34	75	96	75	35	9	1	333
Average degree	2.25	2.56	2.78	2.94	3.07	3.17	3.24	3.29	3.33	

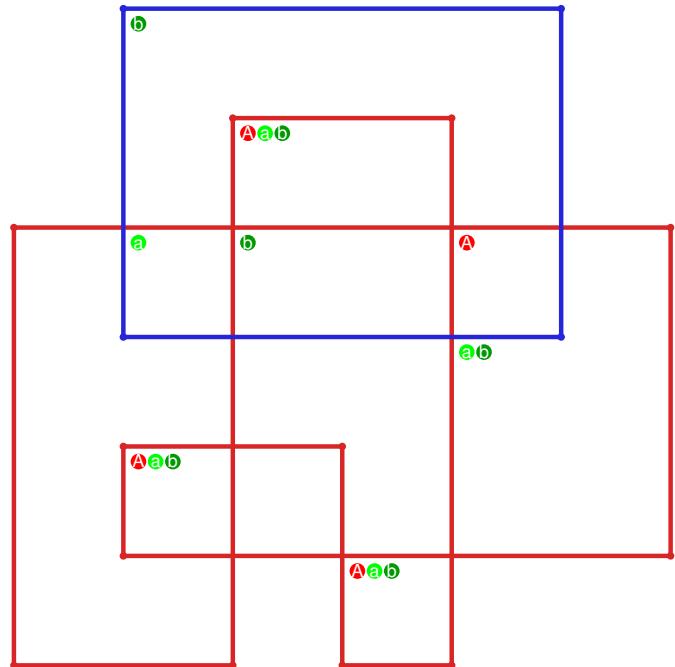


Figure 2087: SnapPy multiloop plot.

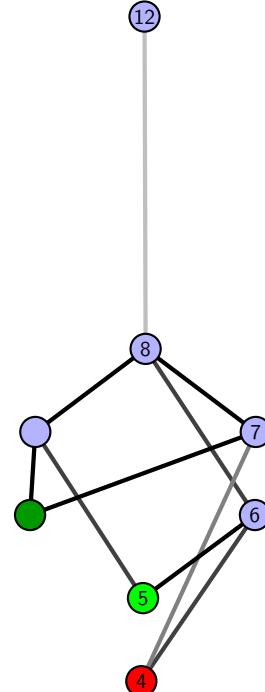


Figure 2088: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.747 [[16, 20, 1, 17], [17, 3, 18, 4], [6, 15, 7, 16], [7, 19, 8, 20], [1, 8, 2, 9], [9, 2, 10, 3], [18, 10, 19, 11], [4, 14, 5, 13], [5, 12, 6, 13], [14, 11, 15, 12]]

PD code drawn by SnapPy: [(13, 4, 14, 5), (17, 6, 18, 7), (10, 7, 11, 8), (1, 8, 2, 9), (9, 16, 10, 1), (2, 11, 3, 12), (5, 14, 6, 15), (20, 15, 17, 16), (3, 18, 4, 19), (12, 19, 13, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 7], [0, 8, 9, 3], [0, 2, 6, 4], [0, 3, 5, 5], [1, 4, 4, 6], [1, 5, 3, 9], [1, 9, 8, 8], [2, 7, 7, 9], [2, 8, 7, 6]]

Total optimal pinning sets: 9

Average optimal degree: 2.71

Total minimal pinning sets: 11

Average minimal degree: 2.78

Total pinning sets: 460

Average overall degree: 3.12

Pinning number: 5

Table 1043: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	9	0	0	0	0	0	0	0	9
Minimal (suboptimal) pinning sets	0	1	1	0	0	0	0	0	2
Nonminimal pinning sets	0	47	109	138	101	43	10	1	449
Average degree	2.71	2.9	3.04	3.15	3.22	3.27	3.31	3.33	

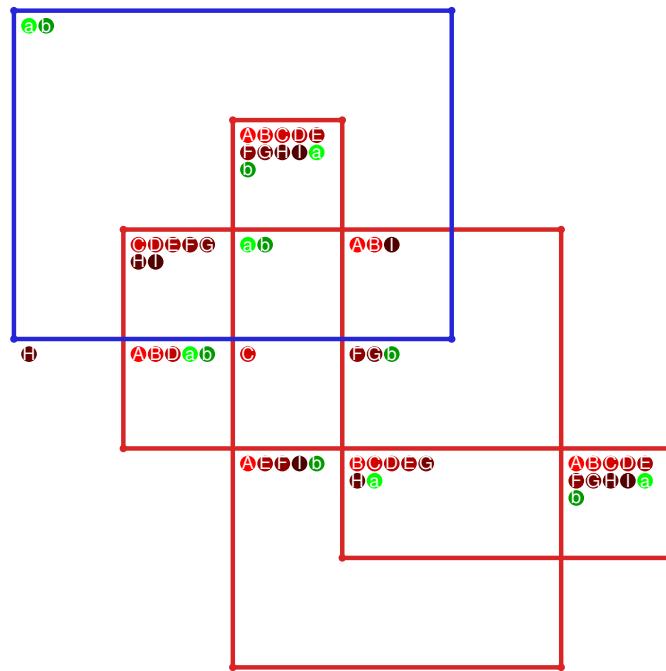


Figure 2089: SnapPy multiloop plot.

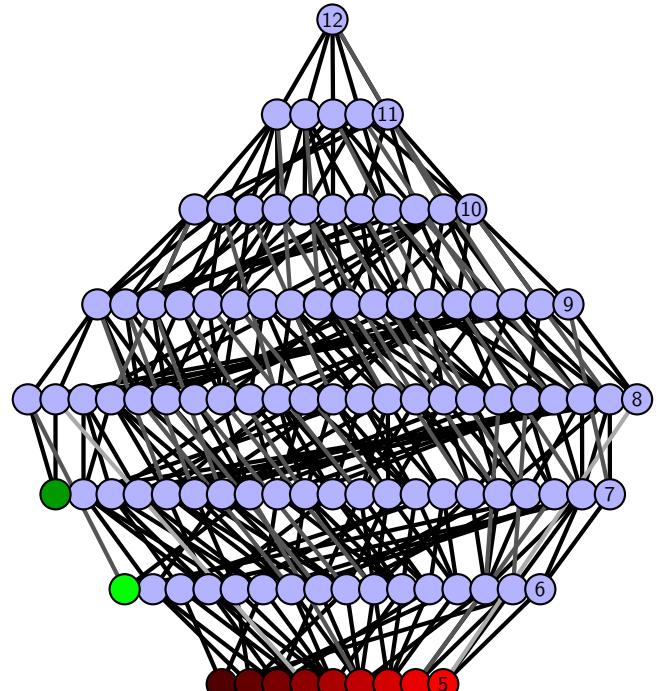


Figure 2090: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.748 [[11, 20, 12, 1], [17, 10, 18, 11], [19, 4, 20, 5], [12, 4, 13, 3], [1, 16, 2, 17], [9, 6, 10, 7], [18, 6, 19, 5], [13, 9, 14, 8], [15, 2, 16, 3], [7, 15, 8, 14]]

PD code drawn by SnapPy: [(13, 20, 14, 1), (1, 10, 2, 11), (17, 2, 18, 3), (3, 16, 4, 17), (7, 4, 8, 5), (6, 11, 7, 12), (15, 8, 16, 9), (12, 5, 13, 6), (19, 14, 20, 15), (9, 18, 10, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 3], [0, 2, 7, 8], [0, 8, 8, 1], [1, 9, 7, 6], [1, 5, 2, 2], [3, 5, 9, 9], [3, 9, 4, 4], [5, 8, 7, 7]]

Total optimal pinning sets: 2

Average optimal degree: 2.38

Total minimal pinning sets: 4

Average minimal degree: 2.44

Total pinning sets: 432

Average overall degree: 3.05

Pinning number: 4

Table 1044: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	0	2
Nonminimal pinning sets	0	15	58	107	119	83	36	9	1	428
Average degree	2.38	2.65	2.85	2.99	3.1	3.18	3.24	3.29	3.33	

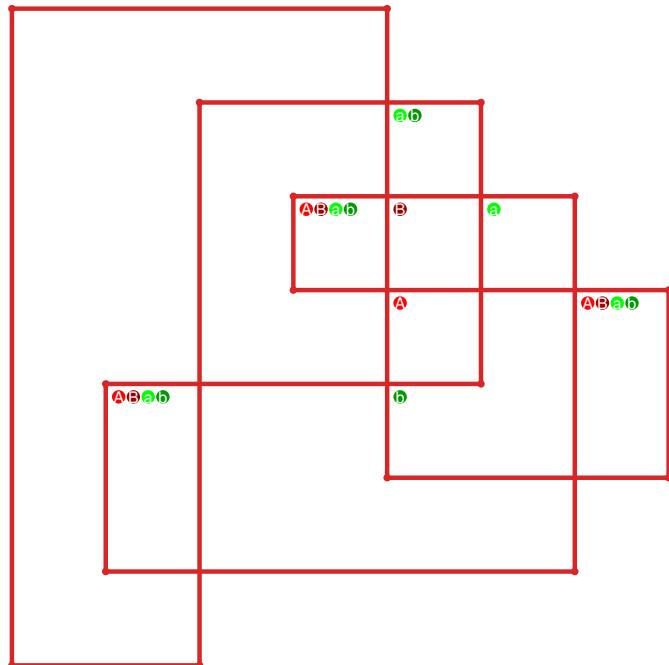


Figure 2091: SnapPy multiloop plot.

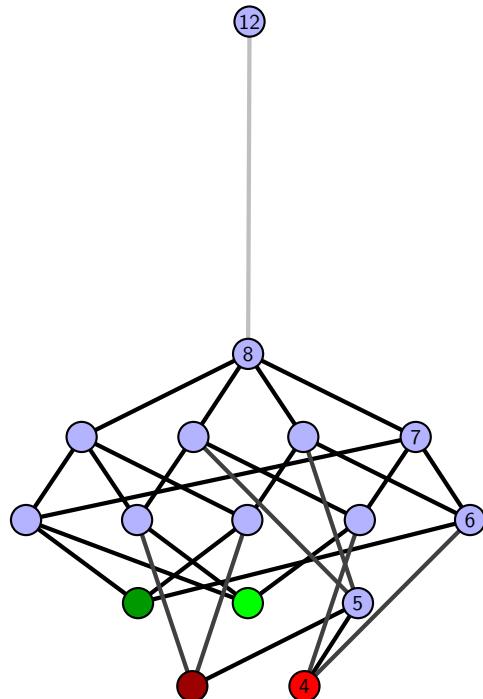


Figure 2092: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.749 $[[10, 5, 1, 6], [6, 11, 7, 20], [9, 13, 10, 14], [4, 12, 5, 13], [1, 12, 2, 11], [7, 19, 8, 20], [14, 8, 15, 9], [3, 17, 4, 18], [2, 17, 3, 16], [18, 15, 19, 16]]$

PD code drawn by SnapPy: $[(8, 3, 9, 4), (19, 6, 20, 7), (2, 17, 3, 18), (7, 18, 8, 19), (13, 20, 14, 11), (11, 10, 12, 1), (1, 12, 2, 13), (5, 14, 6, 15), (15, 4, 16, 5), (16, 9, 17, 10)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 4], [0, 3, 8, 1], [1, 9, 6, 1], [2, 5, 9, 2], [3, 9, 8, 8], [4, 7, 7, 9], [5, 8, 7, 6]]$

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 2

Average minimal degree: 2.33

Total pinning sets: 320

Average overall degree: 3.03

Pinning number: 4

Table 1045: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	0	1
Nonminimal pinning sets	0	8	34	71	90	71	34	9	1	318
Average degree	2.25	2.56	2.77	2.94	3.06	3.16	3.24	3.29	3.33	

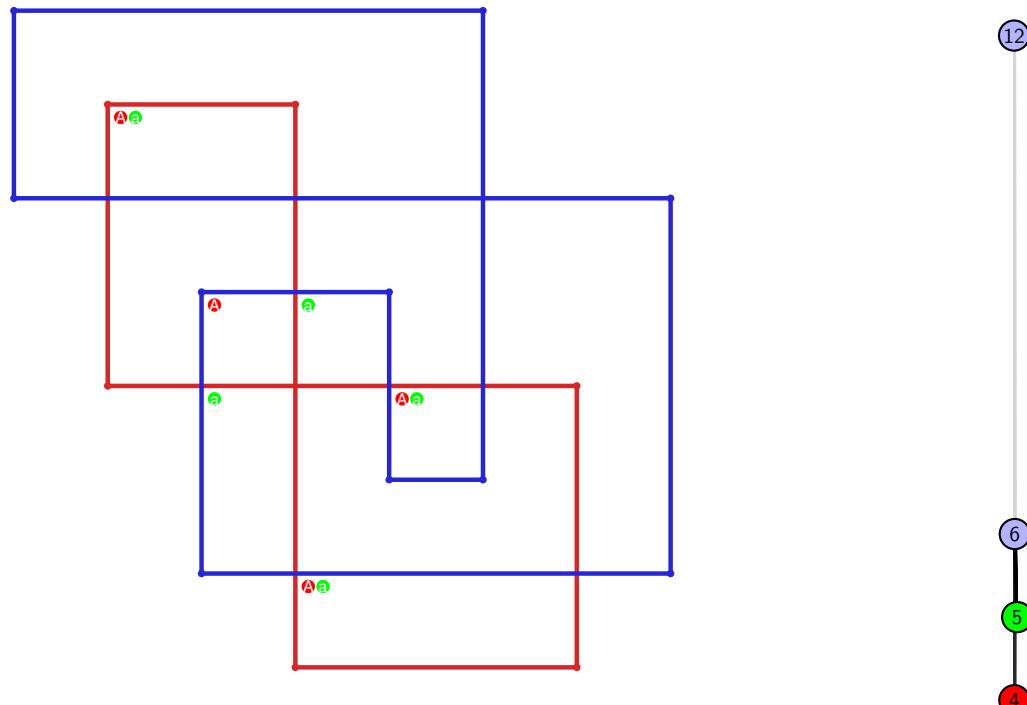


Figure 2093: SnapPy multiloop plot.

Figure 2094: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.750 [[10, 20, 1, 11], [11, 7, 12, 8], [17, 9, 18, 10], [5, 19, 6, 20], [1, 6, 2, 7], [12, 15, 13, 16], [8, 16, 9, 17], [18, 4, 19, 5], [2, 14, 3, 15], [13, 3, 14, 4]]

PD code drawn by SnapPy: [(20, 1, 11, 2), (15, 2, 16, 3), (9, 4, 10, 5), (18, 5, 19, 6), (14, 7, 15, 8), (10, 11, 1, 12), (19, 12, 20, 13), (6, 13, 7, 14), (3, 16, 4, 17), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 7], [0, 7, 7, 4], [0, 3, 8, 1], [1, 8, 9, 6], [1, 5, 2, 2], [2, 9, 3, 3], [4, 9, 9, 5], [5, 8, 8, 7]]

Total optimal pinning sets: 1

Average optimal degree: 2.25

Total minimal pinning sets: 4

Average minimal degree: 2.5

Total pinning sets: 344

Average overall degree: 3.04

Pinning number: 4

Table 1046: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	2	0	0	0	0	0	0	3
Nonminimal pinning sets	0	8	34	78	99	76	35	9	1	340
Average degree	2.25	2.58	2.79	2.95	3.07	3.17	3.24	3.29	3.33	

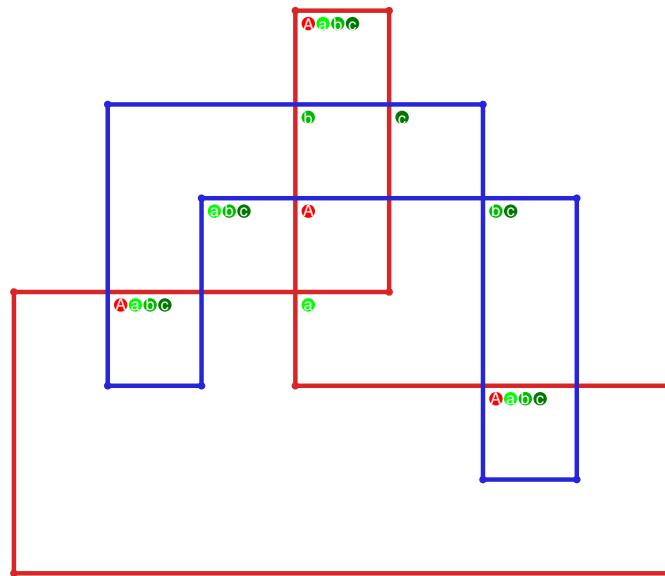


Figure 2095: SnapPy multiloop plot.

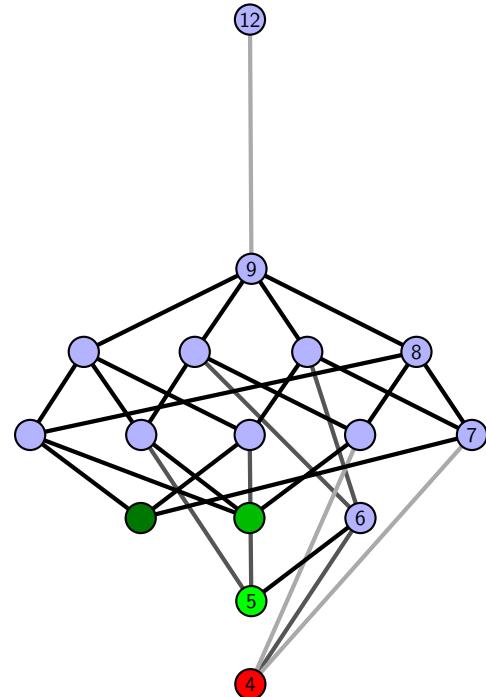


Figure 2096: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.751 $[[6, 20, 1, 7], [7, 3, 8, 4], [13, 5, 14, 6], [14, 19, 15, 20], [1, 15, 2, 16], [16, 2, 17, 3], [8, 11, 9, 12], [4, 12, 5, 13], [9, 18, 10, 19], [17, 10, 18, 11]]$

PD code drawn by SnapPy: $[(7, 6, 8, 1), (12, 1, 13, 2), (18, 3, 19, 4), (8, 15, 9, 16), (13, 16, 14, 17), (2, 17, 3, 18), (5, 20, 6, 7), (14, 9, 15, 10), (19, 10, 20, 11), (4, 11, 5, 12)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 6, 7], [0, 7, 7, 3], [0, 2, 8, 4], [0, 3, 5, 5], [1, 4, 4, 9], [1, 9, 8, 7], [1, 6, 2, 2], [3, 6, 9, 9], [5, 8, 8, 6]]$

Total optimal pinning sets: 5
 Total minimal pinning sets: 8
 Total pinning sets: 332
 Pinning number: 5

Average optimal degree: 2.48
 Average minimal degree: 2.61
 Average overall degree: 3.05

Table 1047: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	5	0	0	0	0	0	0	0	5
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	28	76	99	76	35	9	1	324
Average degree	2.48	2.75	2.94	3.07	3.17	3.24	3.29	3.33	

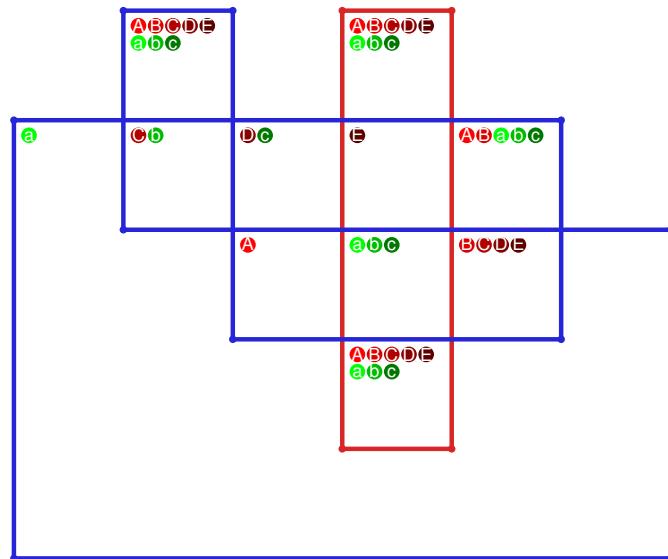


Figure 2097: SnapPy multiloop plot.

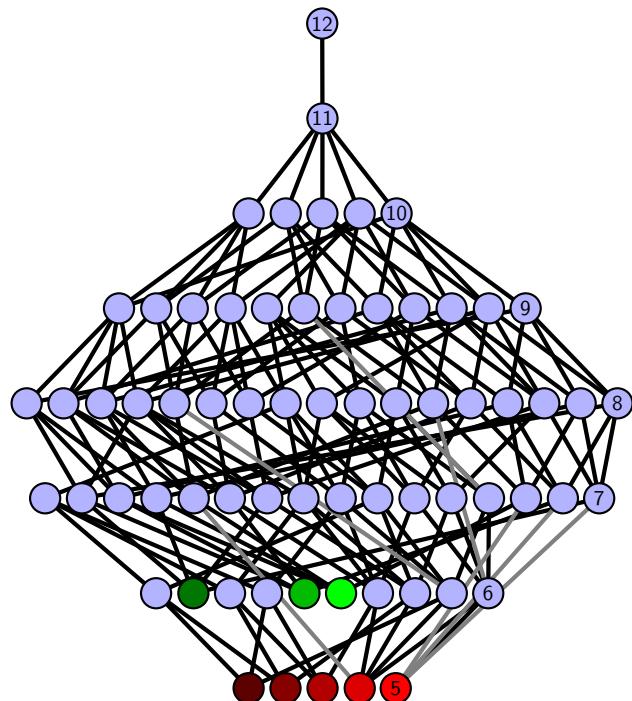


Figure 2098: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.752 [[5, 20, 6, 1], [17, 4, 18, 5], [19, 8, 20, 9], [6, 14, 7, 13], [1, 16, 2, 17], [3, 10, 4, 11], [18, 10, 19, 9], [7, 14, 8, 15], [15, 12, 16, 13], [2, 12, 3, 11]]

PD code drawn by SnapPy: [(14, 1, 15, 2), (16, 5, 17, 6), (6, 15, 7, 16), (20, 7, 1, 8), (8, 19, 9, 20), (12, 9, 13, 10), (10, 3, 11, 4), (4, 11, 5, 12), (18, 13, 19, 14), (2, 17, 3, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 7], [0, 7, 7, 8], [0, 8, 9, 1], [1, 9, 9, 6], [1, 5, 2, 2], [2, 8, 3, 3], [3, 7, 9, 4], [4, 8, 5, 5]]

Total optimal pinning sets: 6
 Total minimal pinning sets: 9
 Total pinning sets: 372
 Pinning number: 5

Average optimal degree: 2.57
 Average minimal degree: 2.6
 Average overall degree: 3.06

Table 1048: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	34	89	112	82	36	9	1	363
Average degree	2.57	2.79	2.97	3.09	3.18	3.24	3.29	3.33	

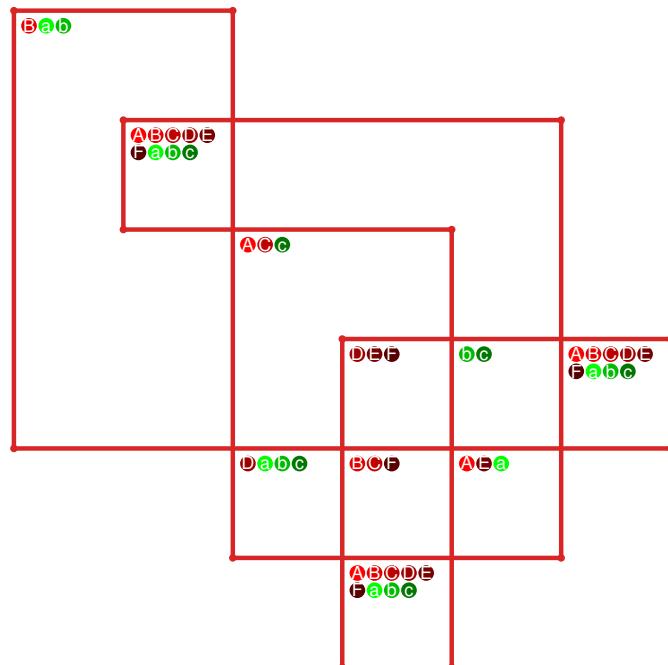


Figure 2099: SnapPy multiloop plot.

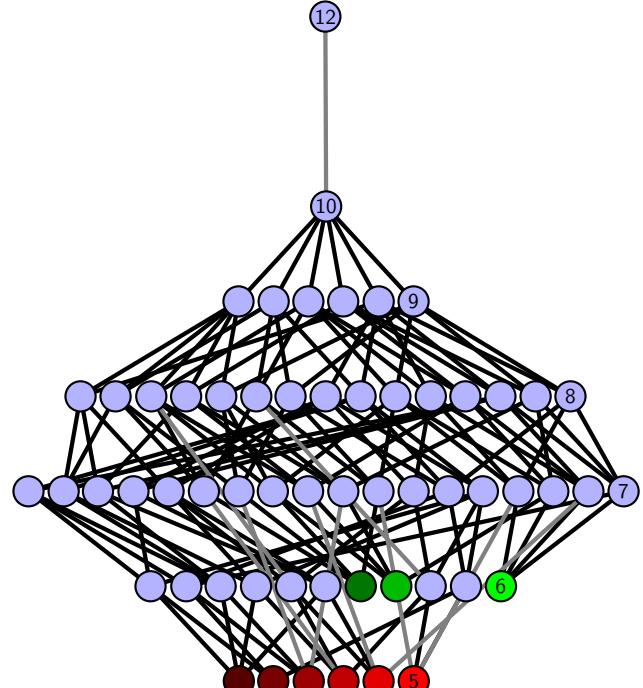


Figure 2100: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.753 [[20, 13, 1, 14], [14, 9, 15, 10], [10, 19, 11, 20], [12, 5, 13, 6], [1, 8, 2, 9], [15, 18, 16, 19], [11, 7, 12, 6], [7, 4, 8, 5], [2, 17, 3, 18], [16, 3, 17, 4]]

PD code drawn by SnapPy: [(14, 1, 15, 2), (5, 2, 6, 3), (10, 3, 11, 4), (4, 9, 5, 10), (19, 6, 20, 7), (12, 7, 13, 8), (18, 11, 19, 12), (20, 15, 1, 16), (13, 16, 14, 17), (8, 17, 9, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 8, 1], [1, 8, 9, 2], [2, 7, 3, 3], [3, 6, 9, 4], [4, 9, 9, 5], [5, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 9
 Total pinning sets: 520
 Pinning number: 4

Average optimal degree: 2.5
 Average minimal degree: 2.74
 Average overall degree: 3.12

Table 1049: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	8	0	0	0	0	0	0	0	8
Nonminimal pinning sets	0	8	66	131	149	103	43	10	1	511
Average degree	2.5	2.76	2.94	3.07	3.16	3.23	3.27	3.31	3.33	

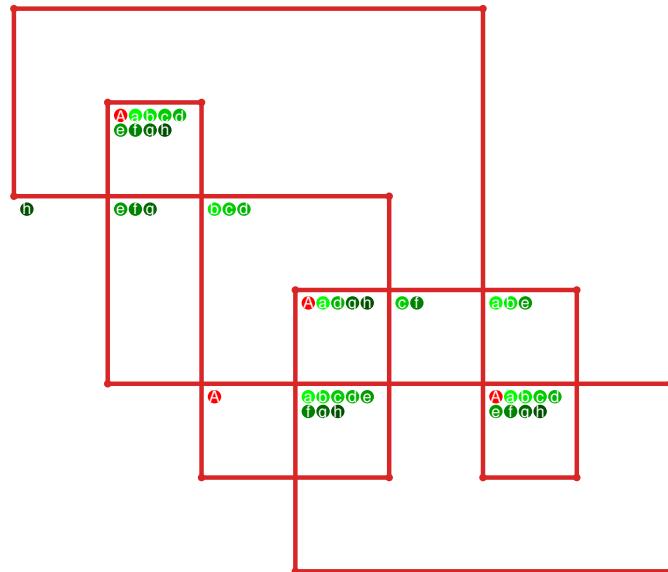


Figure 2101: SnapPy multiloop plot.

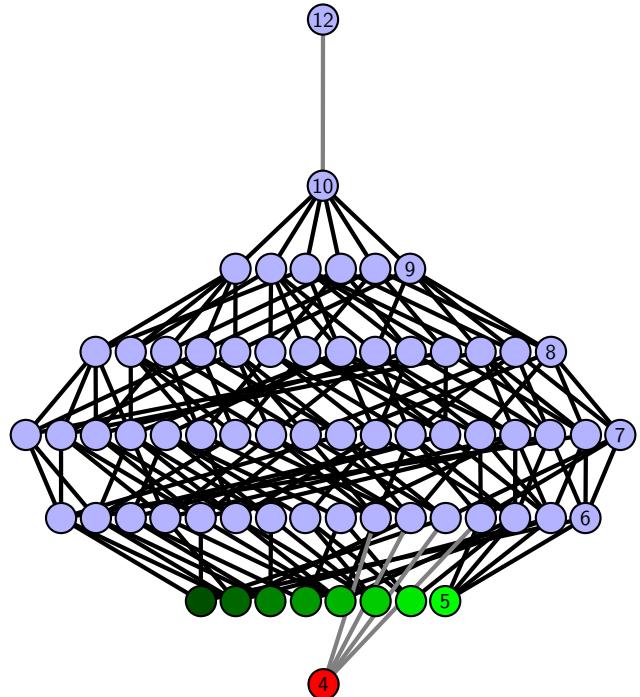


Figure 2102: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.754 [[20, 15, 1, 16], [16, 11, 17, 12], [12, 19, 13, 20], [14, 7, 15, 8], [1, 10, 2, 11], [17, 5, 18, 4], [18, 3, 19, 4], [13, 9, 14, 8], [9, 6, 10, 7], [2, 6, 3, 5]]

PD code drawn by SnapPy: [(15, 20, 16, 1), (1, 14, 2, 15), (2, 19, 3, 20), (6, 3, 7, 4), (11, 4, 12, 5), (5, 10, 6, 11), (18, 7, 19, 8), (13, 8, 14, 9), (17, 12, 18, 13), (9, 16, 10, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 6, 7], [0, 7, 7, 8], [0, 8, 9, 1], [1, 9, 6, 6], [2, 5, 5, 9], [2, 8, 3, 3], [3, 7, 9, 4], [4, 8, 6, 5]]

Total optimal pinning sets: 4

Average optimal degree: 2.75

Total minimal pinning sets: 12

Average minimal degree: 2.79

Total pinning sets: 634

Average overall degree: 3.13

Pinning number: 4

Table 1050: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	7	1	0	0	0	0	0	0	8
Nonminimal pinning sets	0	26	98	164	169	110	44	10	1	622
Average degree	2.75	2.89	3.0	3.1	3.18	3.23	3.28	3.31	3.33	

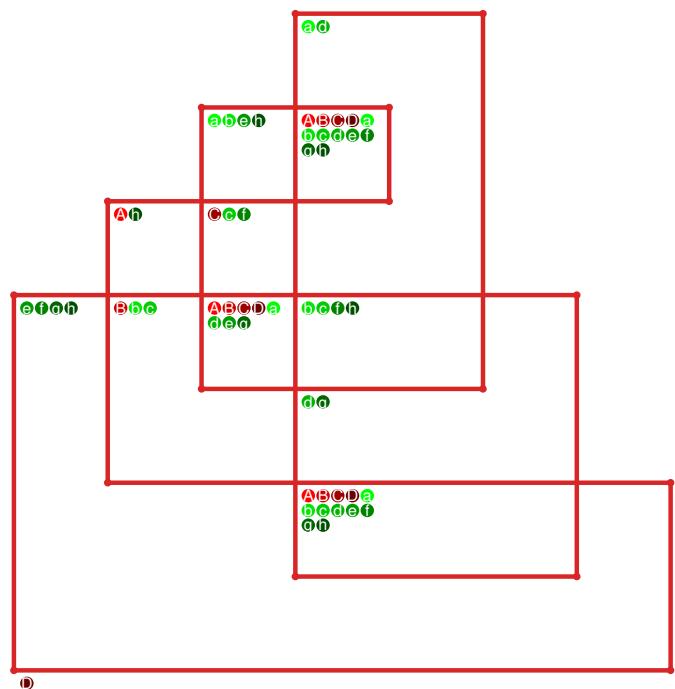


Figure 2103: SnapPy multiloop plot.

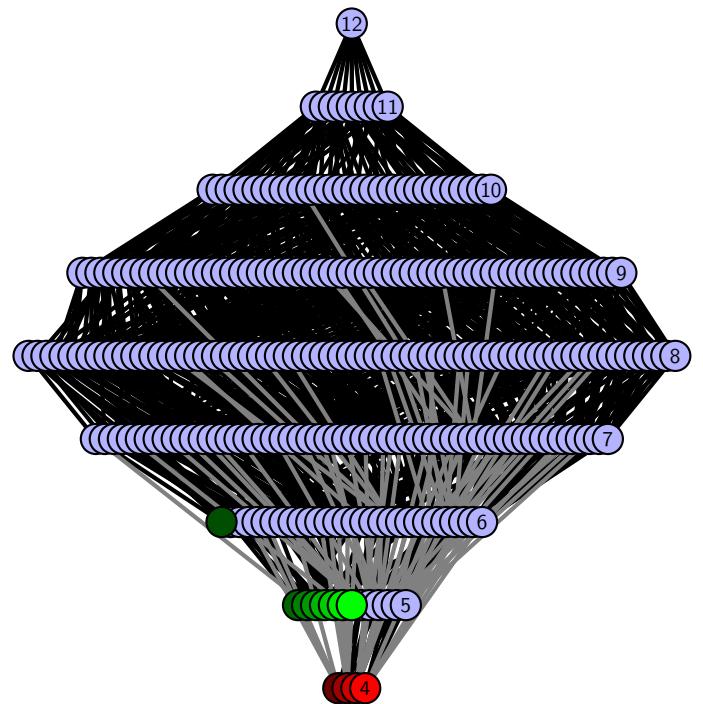


Figure 2104: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.755 $[[5, 20, 6, 1], [11, 4, 12, 5], [12, 19, 13, 20], [6, 15, 7, 16], [1, 10, 2, 11], [18, 3, 19, 4], [13, 9, 14, 8], [14, 7, 15, 8], [16, 9, 17, 10], [2, 17, 3, 18]]$

PD code drawn by SnapPy: $[(15, 20, 16, 1), (8, 1, 9, 2), (11, 4, 12, 5), (5, 10, 6, 11), (13, 6, 14, 7), (18, 7, 19, 8), (3, 12, 4, 13), (19, 14, 20, 15), (9, 16, 10, 17), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 8, 9, 1], [1, 9, 9, 2], [2, 8, 7, 7], [3, 6, 6, 3], [3, 6, 9, 4], [4, 8, 5, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 280
 Pinning number: 5

Average optimal degree: 2.47
 Average minimal degree: 2.52
 Average overall degree: 3.05

Table 1051: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	20	58	84	70	34	9	1	276
Average degree	2.47	2.71	2.91	3.05	3.16	3.24	3.29	3.33	

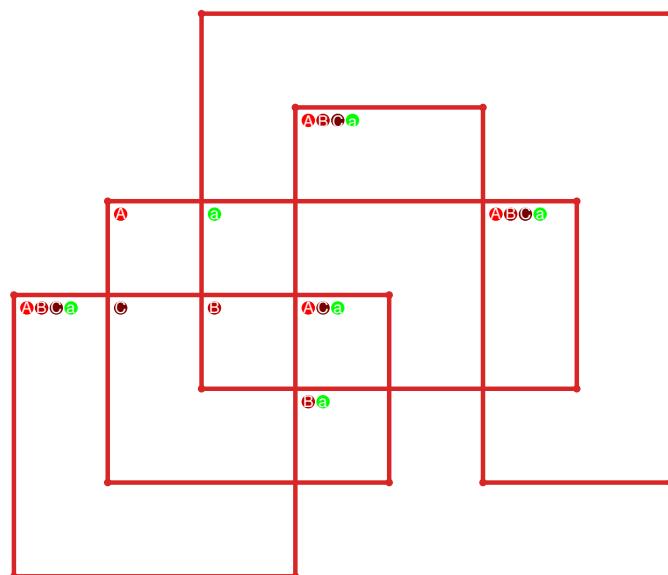


Figure 2105: SnapPy multiloop plot.

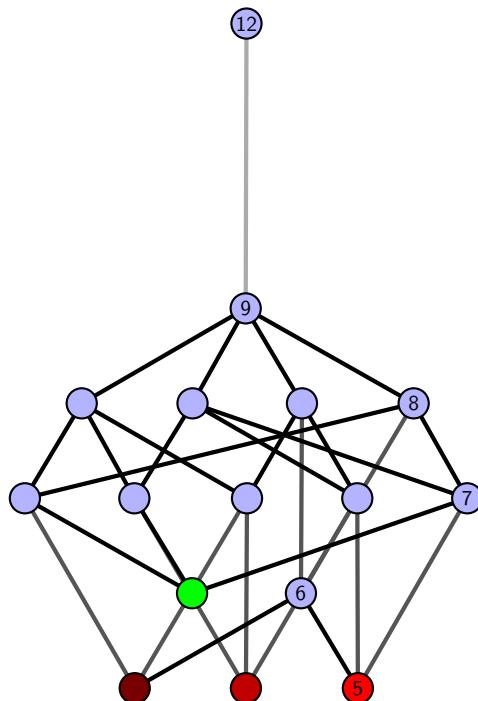


Figure 2106: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.756 $[[5, 20, 6, 1], [4, 9, 5, 10], [19, 8, 20, 9], [6, 14, 7, 13], [1, 11, 2, 10], [18, 3, 19, 4], [7, 14, 8, 15], [15, 12, 16, 13], [11, 16, 12, 17], [2, 17, 3, 18]]$

PD code drawn by SnapPy: $[(15, 20, 16, 1), (16, 5, 17, 6), (1, 6, 2, 7), (7, 18, 8, 19), (12, 9, 13, 10), (10, 3, 11, 4), (4, 11, 5, 12), (8, 13, 9, 14), (19, 14, 20, 15), (2, 17, 3, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 8, 9, 1], [1, 9, 9, 2], [2, 7, 3, 3], [3, 6, 8, 8], [4, 7, 7, 9], [4, 8, 5, 5]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 5
 Total pinning sets: 284
 Pinning number: 5

Average optimal degree: 2.47
 Average minimal degree: 2.55
 Average overall degree: 3.05

Table 1052: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	20	60	85	70	34	9	1	279
Average degree	2.47	2.71	2.91	3.05	3.16	3.24	3.29	3.33	

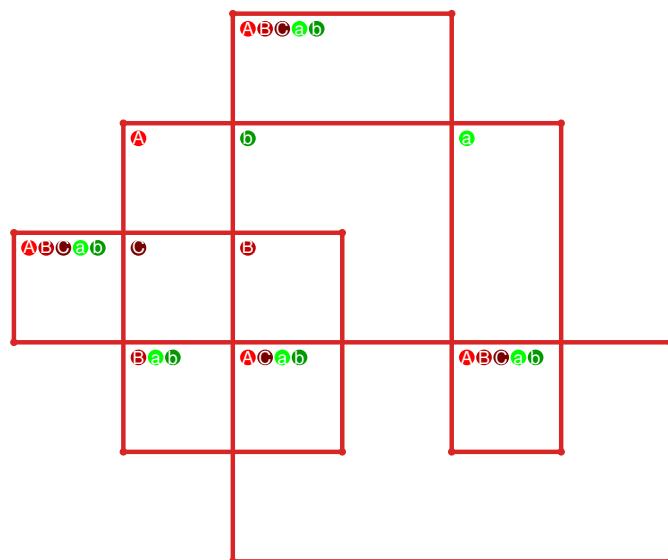


Figure 2107: SnapPy multiloop plot.

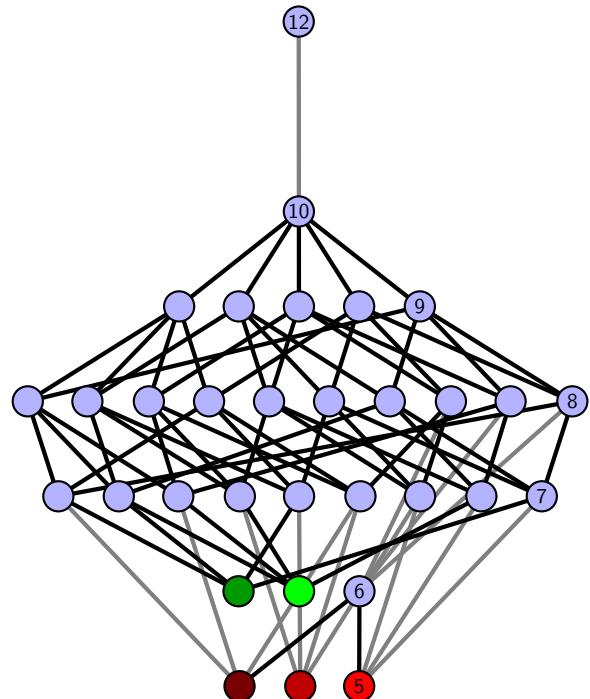


Figure 2108: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.757 $[[6, 20, 1, 7], [7, 16, 8, 17], [17, 5, 18, 6], [19, 12, 20, 13], [1, 15, 2, 16], [8, 4, 9, 5], [18, 14, 19, 13], [14, 11, 15, 12], [2, 11, 3, 10], [3, 9, 4, 10]]$

PD code drawn by `SnapPy`: $[(20, 1, 7, 2), (15, 2, 16, 3), (6, 7, 1, 8), (8, 5, 9, 6), (12, 9, 13, 10), (17, 10, 18, 11), (11, 16, 12, 17), (4, 13, 5, 14), (19, 14, 20, 15), (3, 18, 4, 19)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 6, 7], [0, 7, 8, 1], [1, 9, 9, 2], [2, 7, 3, 3], [3, 6, 8, 4], [4, 7, 9, 9], [5, 8, 8, 5]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 288
 Pinning number: 5

Average optimal degree: 2.45
 Average minimal degree: 2.45
 Average overall degree: 3.04

Table 1053: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	24	61	85	70	34	9	1	284
Average degree	2.45	2.72	2.91	3.05	3.16	3.24	3.29	3.33	

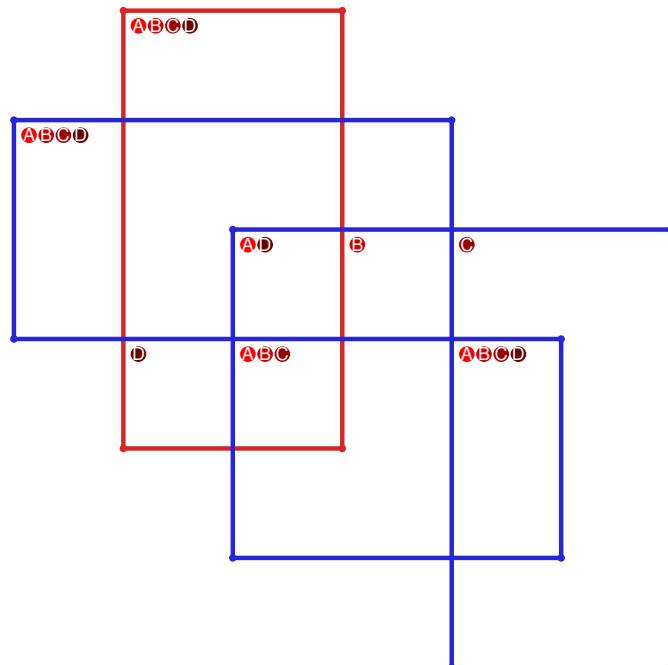


Figure 2109: `SnapPy` multiloop plot.

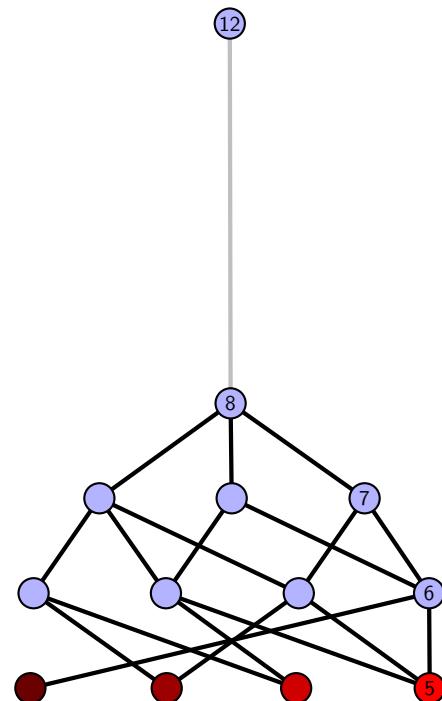


Figure 2110: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.758 [[4, 20, 1, 5], [5, 14, 6, 15], [17, 3, 18, 4], [19, 10, 20, 11], [1, 13, 2, 14], [6, 16, 7, 15], [7, 16, 8, 17], [8, 2, 9, 3], [18, 12, 19, 11], [12, 9, 13, 10]]

PD code drawn by SnapPy: [(5, 4, 6, 1), (14, 1, 15, 2), (9, 6, 10, 7), (16, 7, 17, 8), (8, 15, 9, 16), (3, 10, 4, 11), (18, 11, 19, 12), (12, 19, 13, 20), (20, 13, 5, 14), (2, 17, 3, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 8], [0, 8, 8, 9], [0, 9, 7, 1], [1, 6, 6, 1], [2, 5, 5, 7], [2, 6, 4, 9], [2, 9, 3, 3], [3, 8, 7, 4]]

Total optimal pinning sets: 7
 Total minimal pinning sets: 8
 Total pinning sets: 376
 Pinning number: 5

Average optimal degree: 2.6
 Average minimal degree: 2.59
 Average overall degree: 3.07

Table 1054: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	7	0	0	0	0	0	0	0	7
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	38	90	112	82	36	9	1	368
Average degree	2.6	2.82	2.98	3.09	3.18	3.24	3.29	3.33	

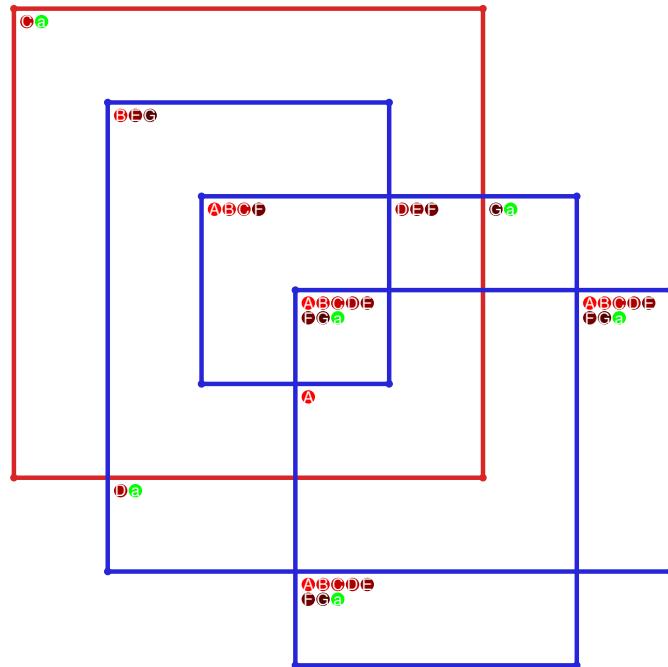


Figure 2111: SnapPy multiloop plot.

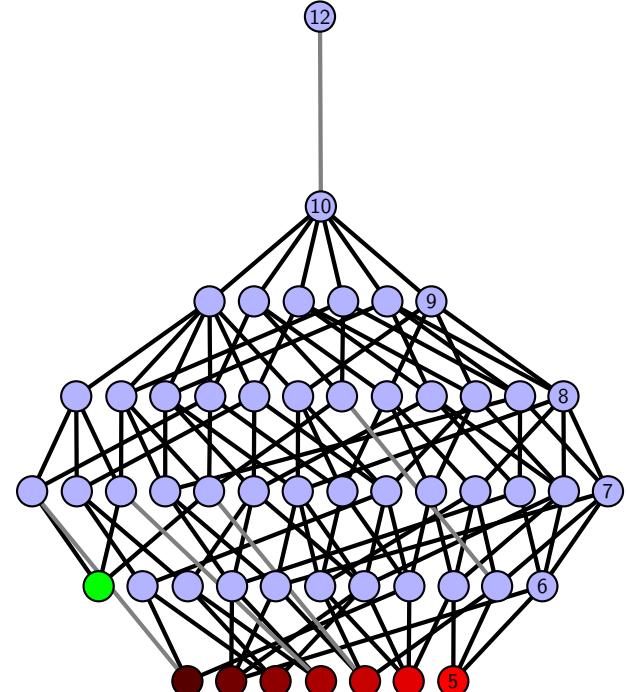


Figure 2112: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.759 $[[4, 20, 1, 5], [5, 15, 6, 14], [17, 3, 18, 4], [10, 19, 11, 20], [1, 8, 2, 7], [15, 7, 16, 6], [16, 13, 17, 14], [2, 12, 3, 13], [18, 9, 19, 10], [11, 9, 12, 8]]$

PD code drawn by SnapPy: $[(5, 4, 6, 1), (12, 15, 13, 16), (6, 13, 7, 14), (3, 16, 4, 17), (20, 17, 5, 18), (18, 9, 19, 10), (14, 7, 15, 8), (1, 8, 2, 9), (10, 19, 11, 20), (11, 2, 12, 3)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 5, 5, 6], [0, 6, 7, 8], [0, 8, 8, 9], [0, 9, 7, 5], [1, 4, 6, 1], [1, 5, 7, 2], [2, 6, 4, 9], [2, 9, 3, 3], [3, 8, 7, 4]]$

Total optimal pinning sets: 2

Average optimal degree: 2.75

Total minimal pinning sets: 14

Average minimal degree: 2.88

Total pinning sets: 680

Average overall degree: 3.16

Pinning number: 4

Table 1055: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	10	2	0	0	0	0	0	0	12
Nonminimal pinning sets	0	16	99	186	191	118	45	10	1	666
Average degree	2.75	2.92	3.04	3.13	3.19	3.24	3.28	3.31	3.33	

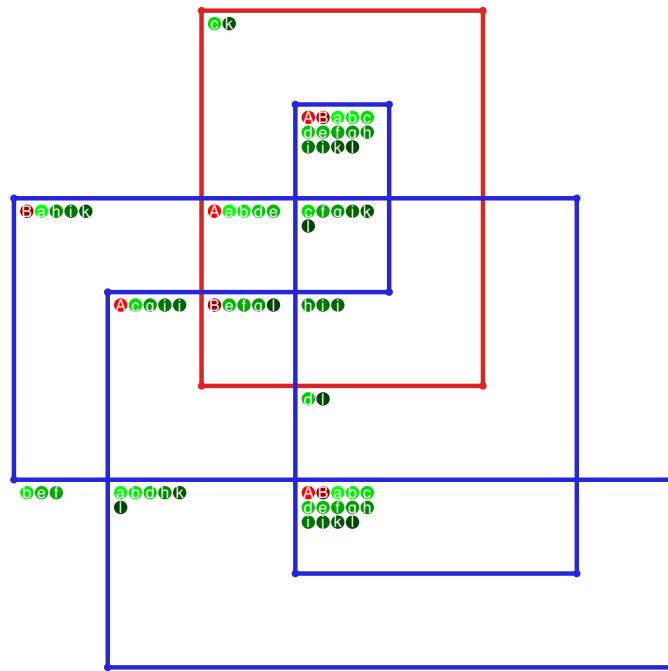


Figure 2113: SnapPy multiloop plot.

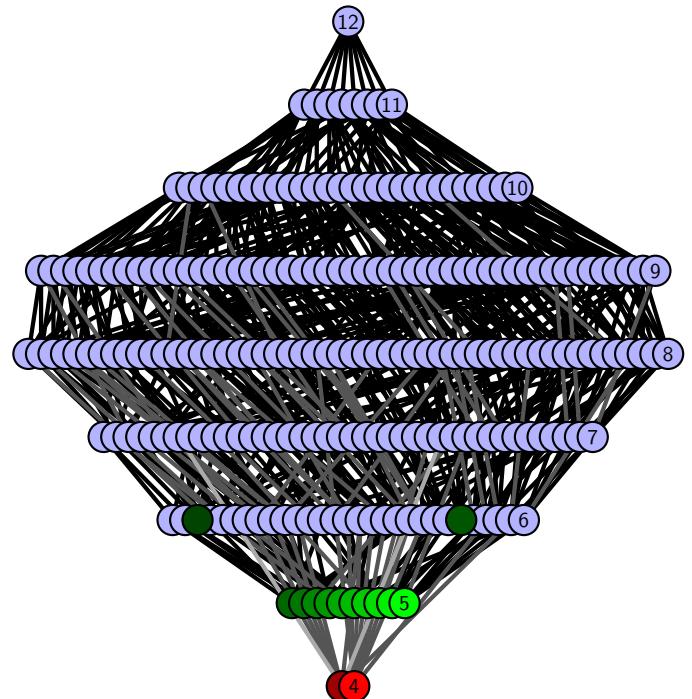


Figure 2114: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.760 $[[6, 20, 1, 7], [7, 13, 8, 12], [19, 5, 20, 6], [1, 10, 2, 9], [13, 9, 14, 8], [18, 11, 19, 12], [4, 10, 5, 11], [2, 16, 3, 17], [14, 17, 15, 18], [15, 3, 16, 4]]$

PD code drawn by `SnapPy`: $[(7, 6, 8, 1), (11, 2, 12, 3), (14, 19, 15, 20), (15, 4, 16, 5), (1, 16, 2, 17), (10, 17, 11, 18), (18, 13, 19, 14), (5, 8, 6, 9), (20, 9, 7, 10), (3, 12, 4, 13)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 6, 7, 4], [1, 3, 8, 1], [1, 8, 6, 2], [2, 5, 9, 3], [3, 9, 9, 8], [4, 7, 9, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 5
 Total pinning sets: 440
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.58
 Average overall degree: 3.05

Table 1056: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	0	3
Nonminimal pinning sets	0	15	61	110	120	83	36	9	1	435
Average degree	2.25	2.62	2.85	3.0	3.1	3.18	3.24	3.29	3.33	

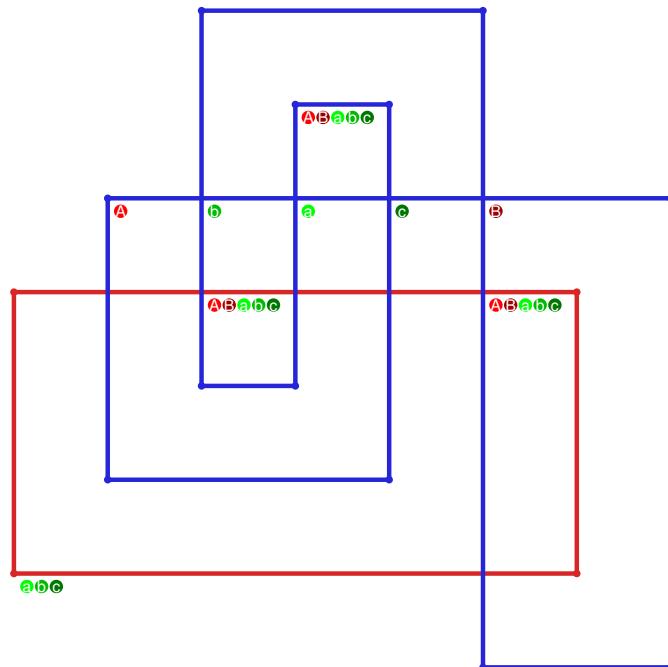


Figure 2115: `SnapPy` multiloop plot.

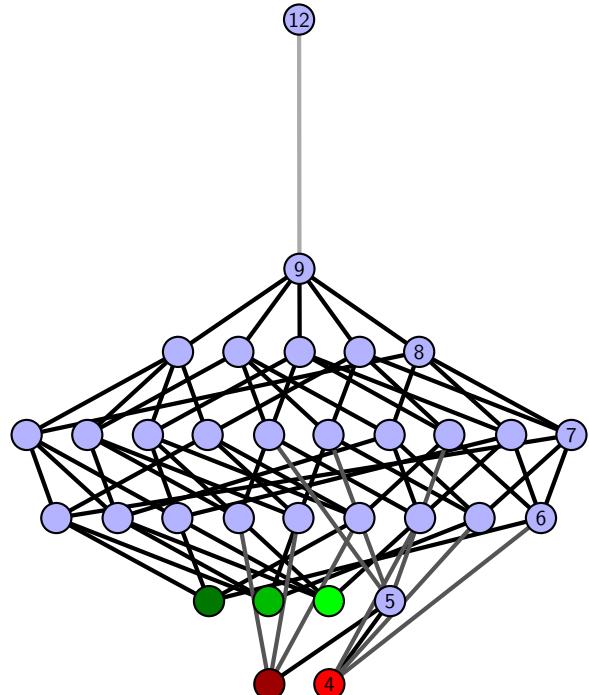


Figure 2116: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.761 $[[8, 20, 1, 9], [9, 15, 10, 14], [7, 4, 8, 5], [19, 3, 20, 4], [1, 16, 2, 15], [10, 17, 11, 18], [13, 5, 14, 6], [6, 12, 7, 13], [18, 11, 19, 12], [2, 16, 3, 17]]$

PD code drawn by SnapPy: $[(12, 1, 13, 2), (5, 2, 6, 3), (18, 3, 19, 4), (11, 16, 12, 17), (4, 17, 5, 18), (19, 14, 20, 15), (20, 7, 9, 8), (8, 9, 1, 10), (15, 10, 16, 11), (6, 13, 7, 14)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 8, 9], [0, 9, 9, 1], [1, 9, 8, 8], [1, 7, 7, 2], [2, 6, 6, 8], [3, 7, 5, 5], [3, 5, 4, 4]]$

Total optimal pinning sets: 10
Total minimal pinning sets: 10

Total pinning sets: 408

Pinning number: 5

Average optimal degree: 2.6

Average minimal degree: 2.6

Average overall degree: 3.06

Table 1057: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	10	0	0	0	0	0	0	0	10
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	49	102	118	83	36	9	1	398
Average degree	2.6	2.83	2.99	3.1	3.18	3.24	3.29	3.33	

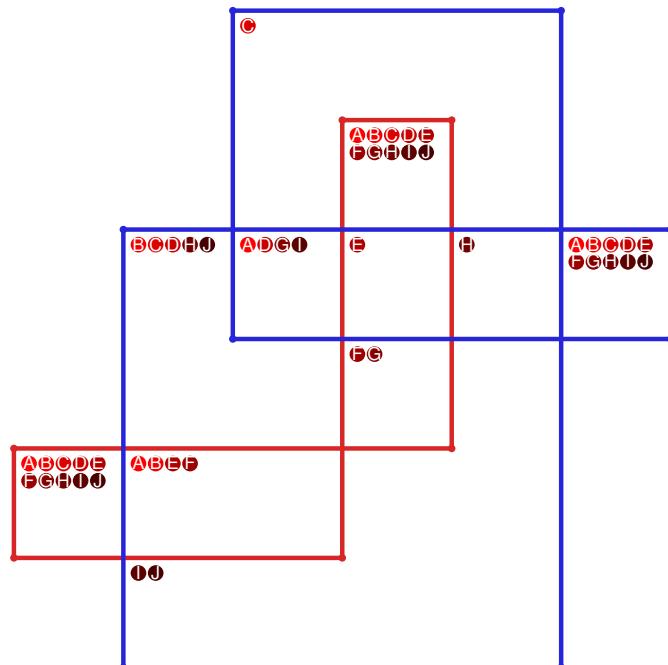


Figure 2117: SnapPy multiloop plot.

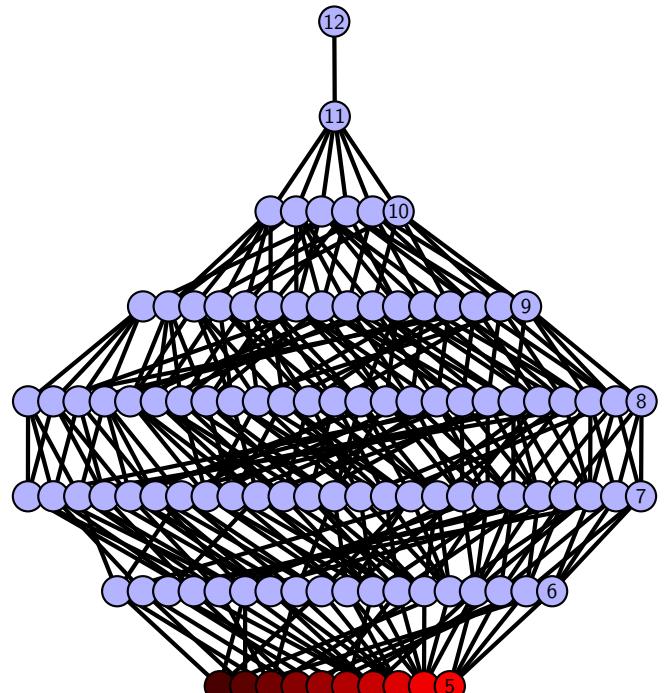


Figure 2118: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.762 [[8, 20, 1, 9], [9, 16, 10, 17], [7, 4, 8, 5], [19, 3, 20, 4], [1, 15, 2, 16], [10, 18, 11, 17], [5, 11, 6, 12], [12, 6, 13, 7], [13, 18, 14, 19], [14, 2, 15, 3]]

PD code drawn by SnapPy: [(9, 8, 10, 1), (14, 1, 15, 2), (5, 2, 6, 3), (19, 4, 20, 5), (3, 18, 4, 19), (7, 10, 8, 11), (16, 11, 17, 12), (12, 17, 13, 18), (20, 13, 9, 14), (6, 15, 7, 16)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 8, 9], [0, 9, 9, 1], [1, 8, 6, 1], [2, 5, 7, 7], [2, 6, 6, 8], [3, 7, 5, 9], [3, 8, 4, 4]]

Total optimal pinning sets: 9

Average optimal degree: 2.6

Total minimal pinning sets: 10

Average minimal degree: 2.59

Total pinning sets: 388

Average overall degree: 3.06

Pinning number: 5

Table 1058: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	9	0	0	0	0	0	0	0	9
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	43	94	113	82	36	9	1	378
Average degree	2.6	2.82	2.98	3.1	3.18	3.24	3.29	3.33	

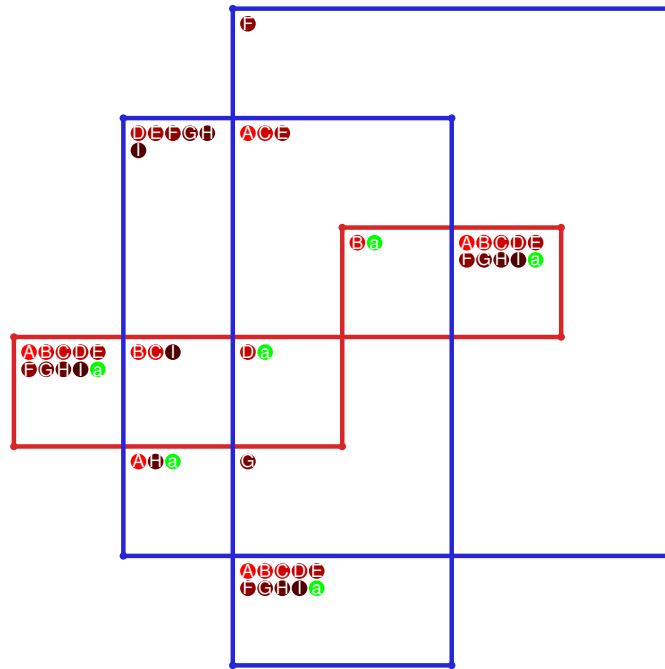


Figure 2119: SnapPy multiloop plot.

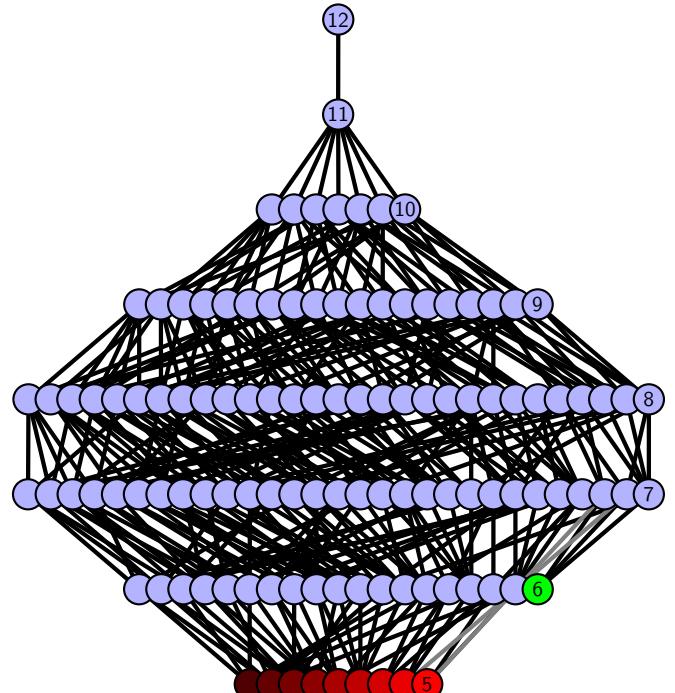


Figure 2120: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.763 [[14, 9, 1, 10], [10, 15, 11, 20], [8, 13, 9, 14], [1, 16, 2, 15], [11, 17, 12, 18], [19, 5, 20, 6], [7, 4, 8, 5], [12, 3, 13, 4], [16, 3, 17, 2], [18, 7, 19, 6]]

PD code drawn by SnapPy: [(9, 14, 10, 1), (4, 1, 5, 2), (15, 2, 16, 3), (3, 20, 4, 15), (11, 6, 12, 7), (5, 10, 6, 11), (13, 18, 14, 19), (8, 19, 9, 20), (16, 7, 17, 8), (17, 12, 18, 13)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 8, 8, 1], [1, 8, 7, 9], [1, 9, 9, 6], [2, 5, 9, 7], [2, 6, 4, 8], [3, 7, 4, 3], [4, 6, 5, 5]]

Total optimal pinning sets: 8

Average optimal degree: 2.55

Total minimal pinning sets: 10

Average minimal degree: 2.61

Total pinning sets: 388

Average overall degree: 3.06

Pinning number: 5

Table 1059: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	41	95	114	82	36	9	1	378
Average degree	2.55	2.8	2.98	3.1	3.18	3.24	3.29	3.33	

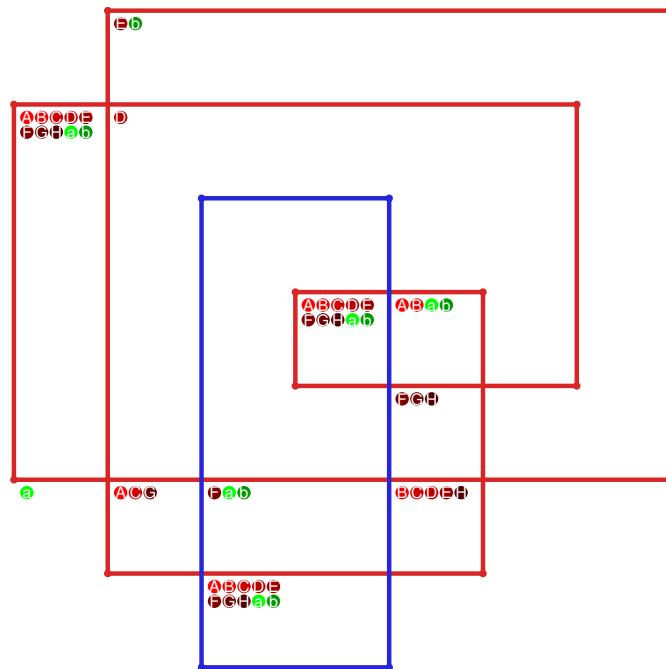


Figure 2121: SnapPy multiloop plot.

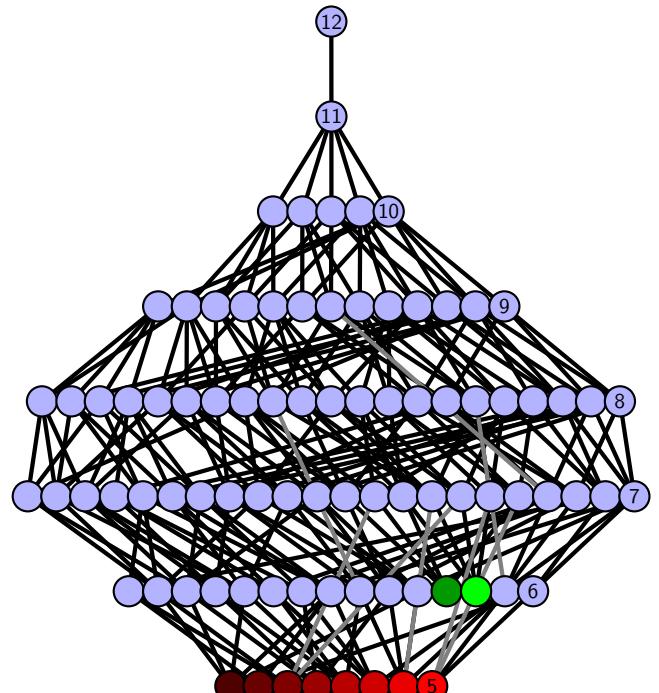


Figure 2122: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.764 [[10, 14, 1, 11], [11, 15, 12, 20], [9, 4, 10, 5], [13, 3, 14, 4], [1, 16, 2, 15], [12, 17, 13, 18], [7, 19, 8, 20], [5, 8, 6, 9], [2, 16, 3, 17], [18, 6, 19, 7]]

PD code drawn by SnapPy: [(20, 1, 17, 2), (7, 2, 8, 3), (13, 4, 14, 5), (3, 6, 4, 7), (8, 17, 9, 18), (5, 14, 6, 15), (15, 18, 16, 19), (16, 9, 11, 10), (10, 11, 1, 12), (19, 12, 20, 13)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 3], [0, 2, 5, 8], [0, 8, 8, 1], [1, 8, 3, 9], [1, 9, 9, 7], [2, 6, 9, 2], [3, 5, 4, 4], [5, 7, 6, 6]]

Total optimal pinning sets: 10
 Total minimal pinning sets: 10
 Total pinning sets: 400
 Pinning number: 5

Average optimal degree: 2.56
 Average minimal degree: 2.56
 Average overall degree: 3.06

Table 1060: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	10	0	0	0	0	0	0	0	10
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	48	99	115	82	36	9	1	390
Average degree	2.56	2.81	2.98	3.1	3.18	3.24	3.29	3.33	

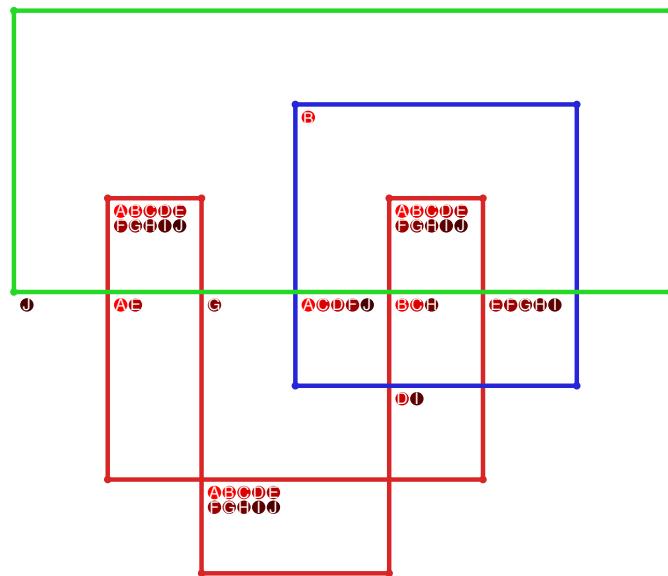


Figure 2123: SnapPy multiloop plot.

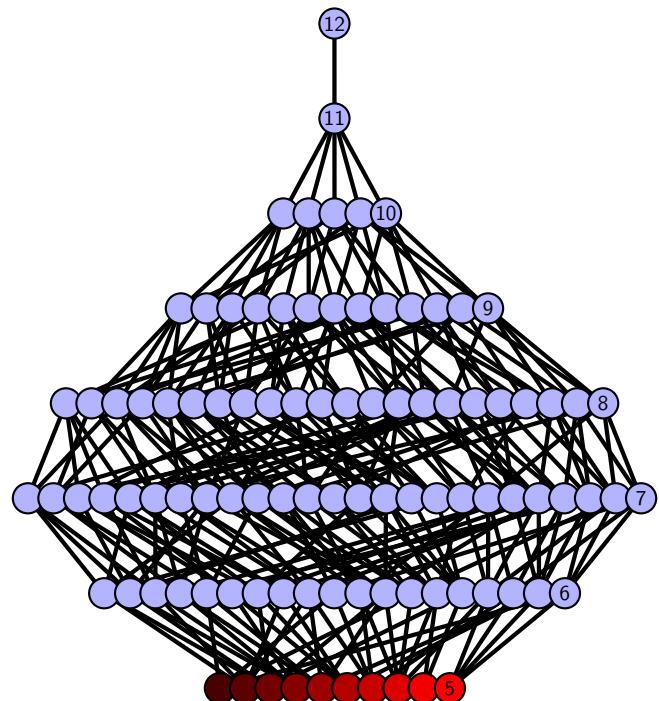


Figure 2124: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.765 [[16, 20, 1, 17], [17, 10, 18, 9], [15, 4, 16, 5], [19, 3, 20, 4], [1, 11, 2, 10], [18, 12, 19, 13], [8, 5, 9, 6], [14, 7, 15, 8], [2, 11, 3, 12], [13, 7, 14, 6]]

PD code drawn by SnapPy: [(18, 1, 19, 2), (13, 2, 14, 3), (6, 3, 7, 4), (4, 11, 5, 12), (12, 5, 13, 6), (7, 20, 8, 17), (8, 15, 9, 16), (16, 9, 1, 10), (17, 10, 18, 11), (14, 19, 15, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 5, 8], [0, 8, 8, 1], [1, 8, 3, 9], [1, 9, 7, 2], [2, 6, 9, 9], [3, 5, 4, 4], [5, 7, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.5

Total minimal pinning sets: 11

Average minimal degree: 2.81

Total pinning sets: 560

Average overall degree: 3.13

Pinning number: 4

Table 1061: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	9	1	0	0	0	0	0	0	10
Nonminimal pinning sets	0	8	71	144	162	109	44	10	1	549
Average degree	2.5	2.78	2.96	3.08	3.17	3.23	3.28	3.31	3.33	

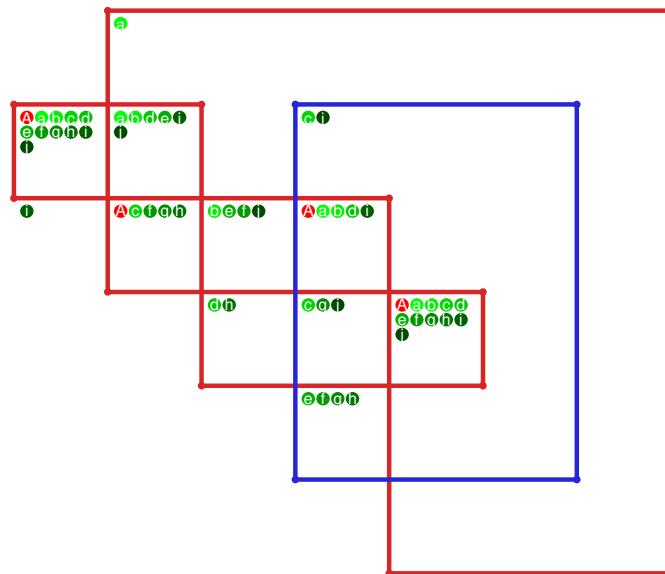


Figure 2125: SnapPy multiloop plot.

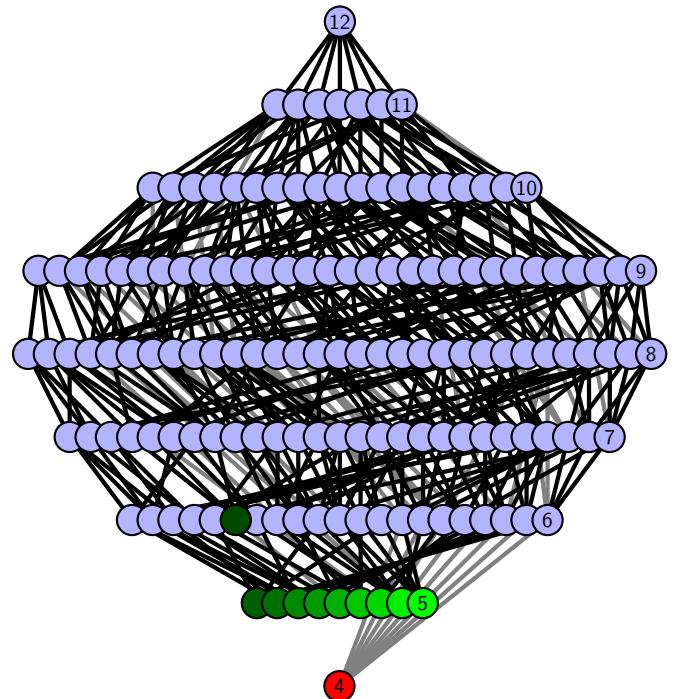


Figure 2126: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.766 [[16, 20, 1, 17], [17, 11, 18, 12], [15, 4, 16, 5], [19, 3, 20, 4], [1, 10, 2, 11], [18, 9, 19, 8], [12, 6, 13, 5], [7, 14, 8, 15], [9, 2, 10, 3], [6, 14, 7, 13]]

PD code drawn by SnapPy: [(7, 16, 8, 1), (18, 1, 19, 2), (13, 2, 14, 3), (3, 10, 4, 11), (6, 17, 7, 18), (15, 8, 16, 9), (20, 9, 17, 10), (11, 4, 12, 5), (5, 12, 6, 13), (14, 19, 15, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 5, 8], [0, 8, 8, 1], [1, 8, 3, 7], [1, 9, 9, 2], [2, 9, 9, 5], [3, 5, 4, 4], [6, 7, 7, 6]]

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 384
 Pinning number: 5

Average optimal degree: 2.55
 Average minimal degree: 2.55
 Average overall degree: 3.06

Table 1062: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	42	93	113	82	36	9	1	376
Average degree	2.55	2.8	2.97	3.1	3.18	3.24	3.29	3.33	

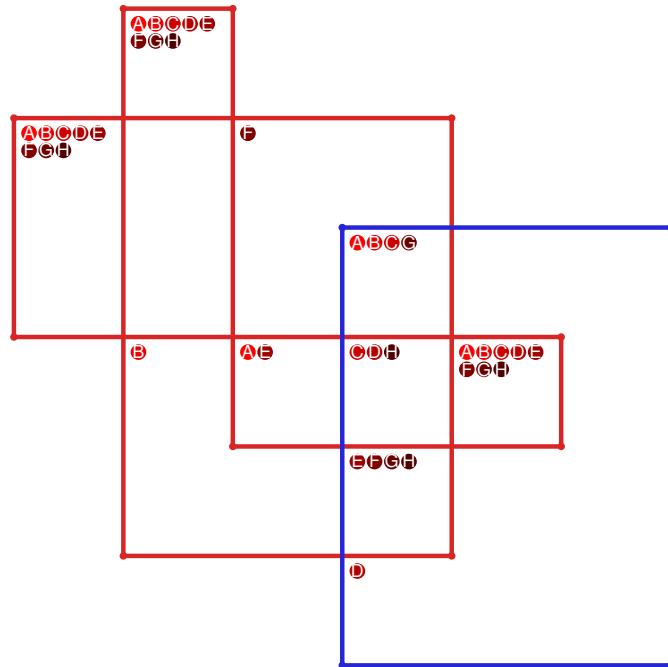


Figure 2127: SnapPy multiloop plot.

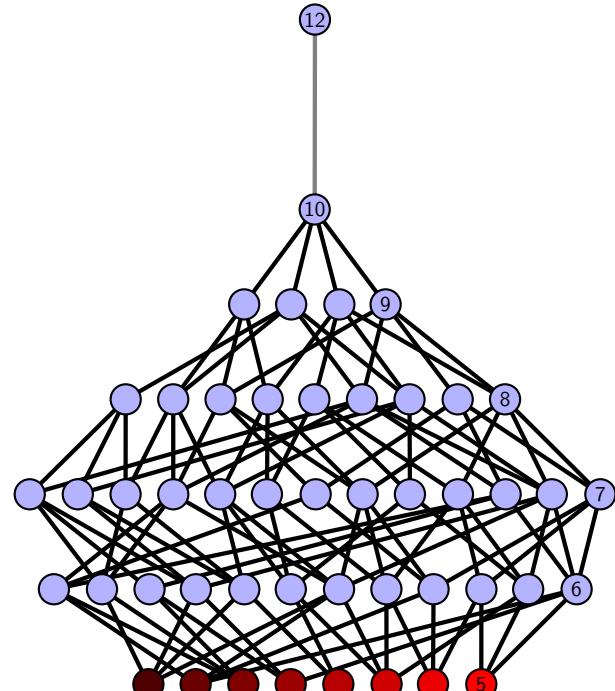


Figure 2128: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.767 $[[6, 10, 1, 7], [7, 11, 8, 16], [5, 20, 6, 17], [9, 3, 10, 4], [1, 12, 2, 11], [8, 13, 9, 14], [15, 17, 16, 18], [19, 4, 20, 5], [2, 12, 3, 13], [14, 19, 15, 18]]$

PD code drawn by SnapPy: $[(16, 1, 13, 2), (17, 2, 18, 3), (4, 13, 5, 14), (11, 14, 12, 15), (12, 5, 7, 6), (6, 7, 1, 8), (15, 8, 16, 9), (20, 9, 17, 10), (3, 18, 4, 19), (10, 19, 11, 20)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 7], [0, 7, 5, 8], [0, 8, 8, 1], [1, 8, 3, 9], [1, 9, 9, 2], [2, 9, 3, 2], [3, 5, 4, 4], [5, 7, 6, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 5
 Total pinning sets: 412
 Pinning number: 4

Average optimal degree: 2.25
 Average minimal degree: 2.7
 Average overall degree: 3.05

Table 1063: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	15	49	100	115	82	36	9	1	407
Average degree	2.25	2.59	2.82	2.98	3.1	3.18	3.24	3.29	3.33	

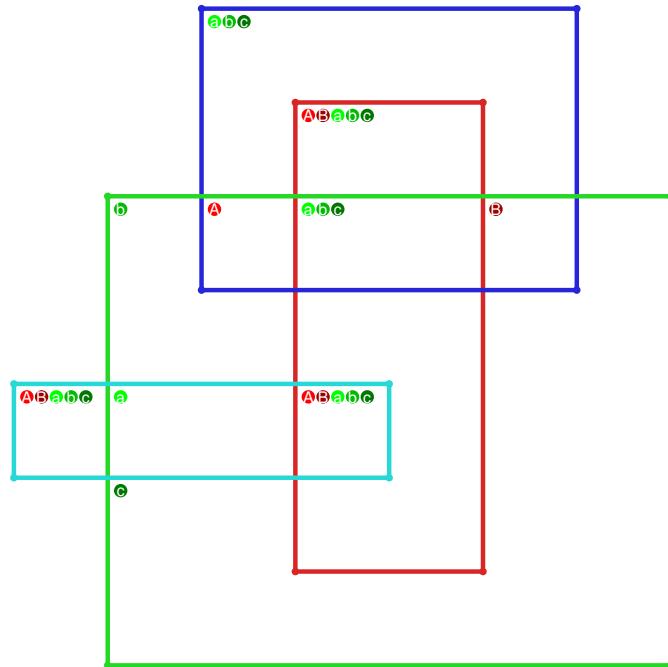


Figure 2129: SnapPy multiloop plot.

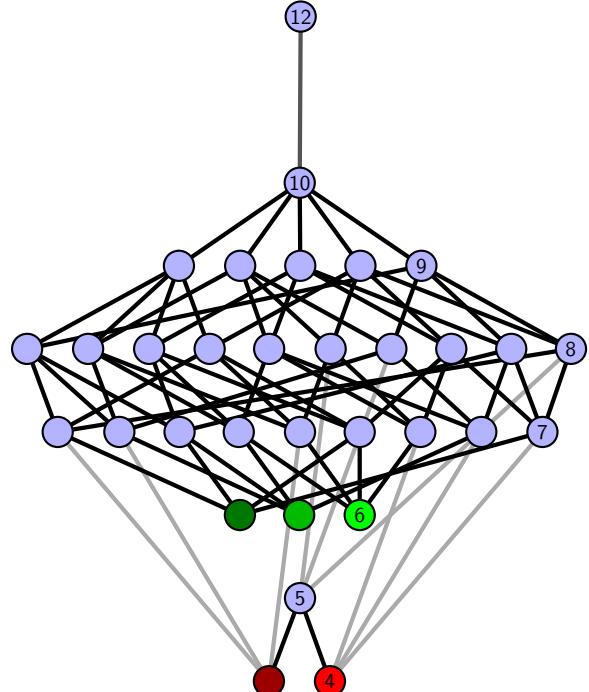


Figure 2130: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.768 [[6, 20, 1, 7], [7, 13, 8, 12], [5, 15, 6, 16], [19, 14, 20, 15], [1, 14, 2, 13], [8, 18, 9, 17], [11, 16, 12, 17], [4, 10, 5, 11], [18, 2, 19, 3], [9, 3, 10, 4]]

PD code drawn by SnapPy: [(7, 6, 8, 1), (16, 5, 17, 6), (1, 8, 2, 9), (10, 19, 11, 20), (11, 4, 12, 5), (17, 12, 18, 13), (2, 13, 3, 14), (9, 14, 10, 15), (15, 20, 16, 7), (3, 18, 4, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 8, 4], [0, 3, 8, 1], [1, 8, 9, 6], [1, 5, 7, 2], [2, 6, 9, 9], [3, 9, 5, 4], [5, 8, 7, 7]]

Total optimal pinning sets: 11
 Total minimal pinning sets: 19
 Total pinning sets: 659
 Pinning number: 5

Average optimal degree: 3.02
 Average minimal degree: 3.02
 Average overall degree: 3.22

Table 1064: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	11	0	0	0	0	0	0	0	11
Minimal (suboptimal) pinning sets	0	8	0	0	0	0	0	0	8
Nonminimal pinning sets	0	62	172	206	136	52	11	1	640
Average degree	3.02	3.1	3.18	3.24	3.28	3.3	3.32	3.33	

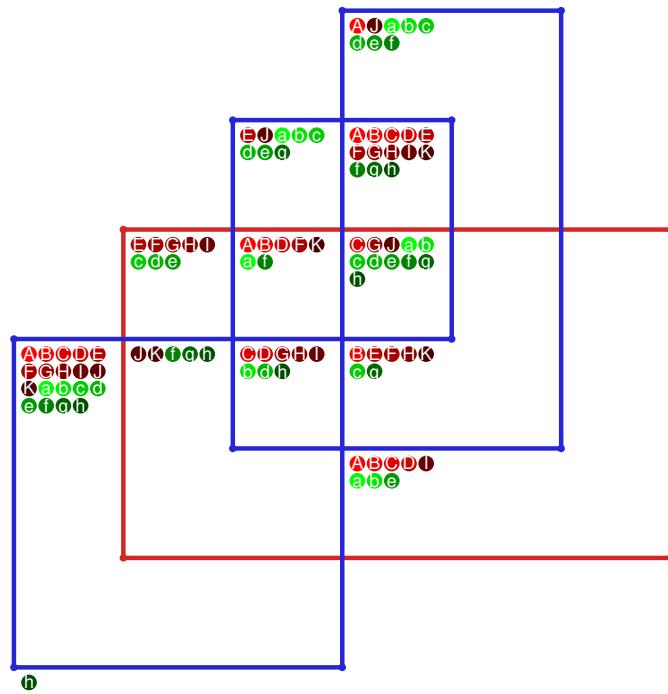


Figure 2131: SnapPy multiloop plot.

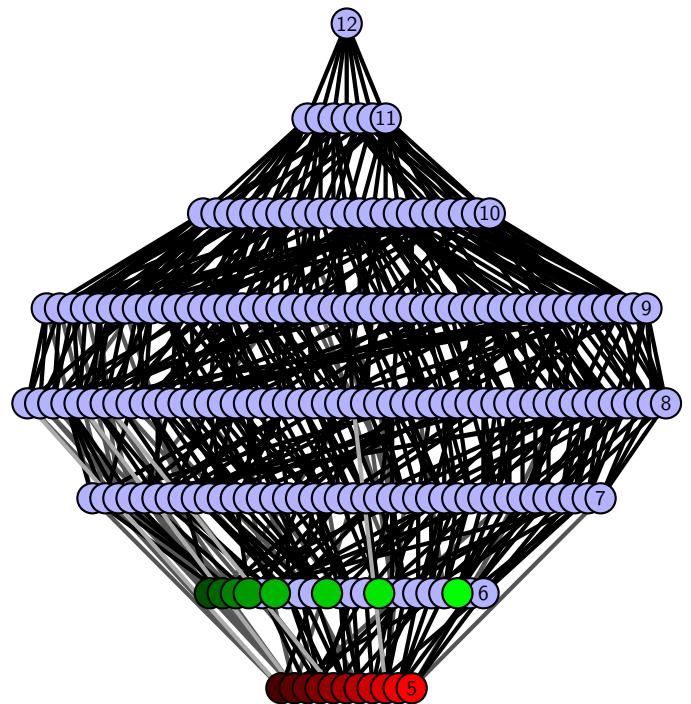


Figure 2132: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.769 [[20, 15, 1, 16], [16, 9, 17, 10], [6, 19, 7, 20], [7, 14, 8, 15], [1, 8, 2, 9], [17, 4, 18, 5], [10, 5, 11, 6], [11, 18, 12, 19], [13, 2, 14, 3], [3, 12, 4, 13]]

PD code drawn by SnapPy: [(11, 20, 12, 1), (15, 2, 16, 3), (8, 3, 9, 4), (19, 6, 20, 7), (14, 7, 15, 8), (1, 10, 2, 11), (5, 12, 6, 13), (18, 13, 19, 14), (9, 16, 10, 17), (4, 17, 5, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 8, 4], [0, 3, 8, 1], [1, 9, 7, 6], [1, 5, 7, 2], [2, 6, 5, 9], [3, 9, 9, 4], [5, 8, 8, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 536
 Pinning number: 4

Average optimal degree: 3.0
 Average minimal degree: 2.83
 Average overall degree: 3.19

Table 1065: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	6	0	1	0	0	0	0	0	7
Nonminimal pinning sets	0	8	60	127	157	115	49	11	1	528
Average degree	3.0	2.97	3.06	3.14	3.21	3.26	3.3	3.32	3.33	

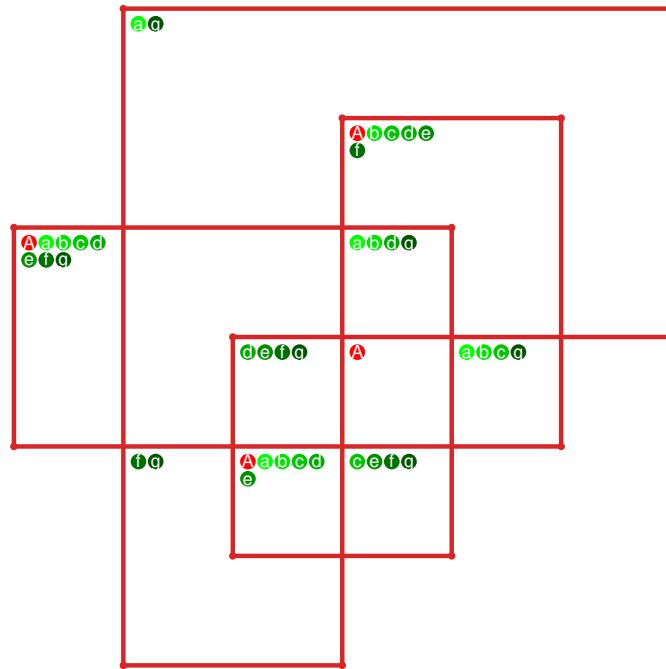


Figure 2133: SnapPy multiloop plot.

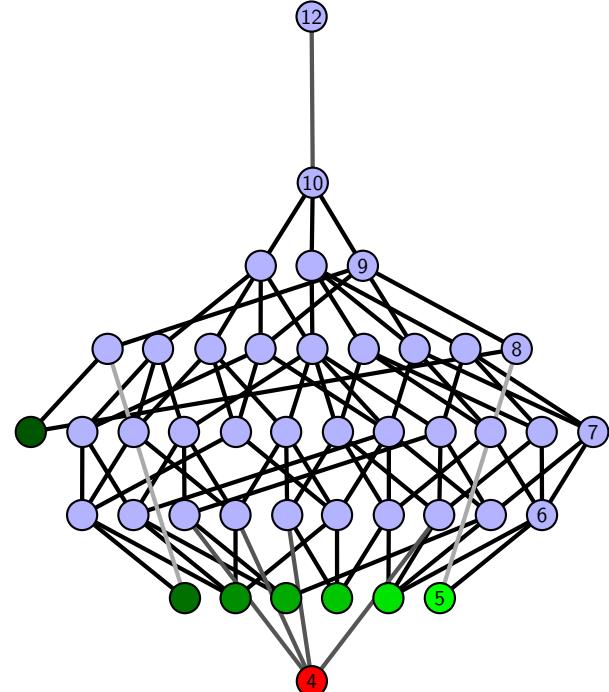


Figure 2134: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.770 [[10, 5, 1, 6], [6, 11, 7, 20], [9, 13, 10, 14], [4, 12, 5, 13], [1, 12, 2, 11], [7, 16, 8, 15], [19, 14, 20, 15], [8, 18, 9, 19], [3, 17, 4, 18], [2, 17, 3, 16]]

PD code drawn by SnapPy: [(8, 3, 9, 4), (2, 17, 3, 18), (7, 18, 8, 19), (14, 19, 15, 20), (20, 5, 11, 6), (11, 10, 12, 1), (1, 12, 2, 13), (6, 13, 7, 14), (15, 4, 16, 5), (16, 9, 17, 10)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 3], [0, 2, 8, 4], [0, 3, 9, 1], [1, 9, 7, 6], [1, 5, 7, 2], [2, 6, 5, 8], [3, 7, 9, 9], [4, 8, 8, 5]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 6
 Total pinning sets: 672
 Pinning number: 4

Average optimal degree: 2.83
 Average minimal degree: 2.88
 Average overall degree: 3.19

Table 1066: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	2	0	0	0	0	0	0	3
Nonminimal pinning sets	0	24	87	171	192	129	51	11	1	666
Average degree	2.83	2.98	3.08	3.16	3.22	3.27	3.3	3.32	3.33	

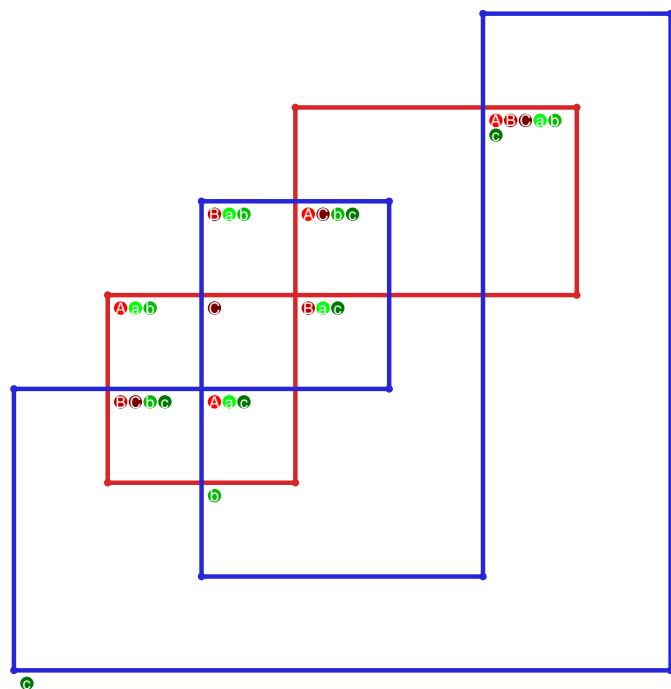


Figure 2135: SnapPy multiloop plot.

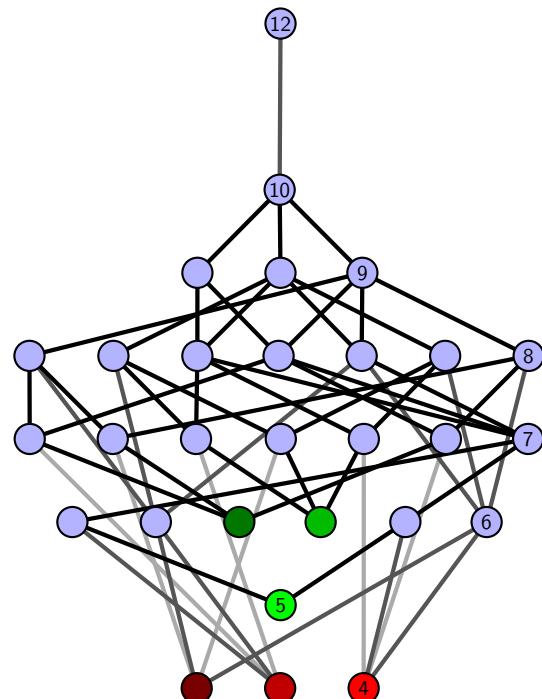


Figure 2136: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.771 [[20, 15, 1, 16], [16, 6, 17, 5], [12, 19, 13, 20], [14, 7, 15, 8], [1, 7, 2, 6], [17, 10, 18, 11], [11, 4, 12, 5], [18, 3, 19, 4], [13, 9, 14, 8], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(16, 1, 17, 2), (9, 2, 10, 3), (3, 14, 4, 15), (4, 19, 5, 20), (12, 5, 13, 6), (6, 11, 7, 12), (20, 7, 1, 8), (15, 8, 16, 9), (18, 13, 19, 14), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 7, 8], [0, 8, 8, 4], [0, 3, 9, 1], [1, 9, 7, 6], [1, 5, 7, 2], [2, 6, 5, 9], [2, 9, 3, 3], [4, 8, 7, 5]]

Total optimal pinning sets: 2

Average optimal degree: 2.88

Total minimal pinning sets: 11

Average minimal degree: 2.96

Total pinning sets: 688

Average overall degree: 3.2

Pinning number: 4

Table 1067: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	9	0	0	0	0	0	0	0	9
Nonminimal pinning sets	0	15	93	179	197	130	51	11	1	677
Average degree	2.88	3.0	3.1	3.17	3.23	3.27	3.3	3.32	3.33	

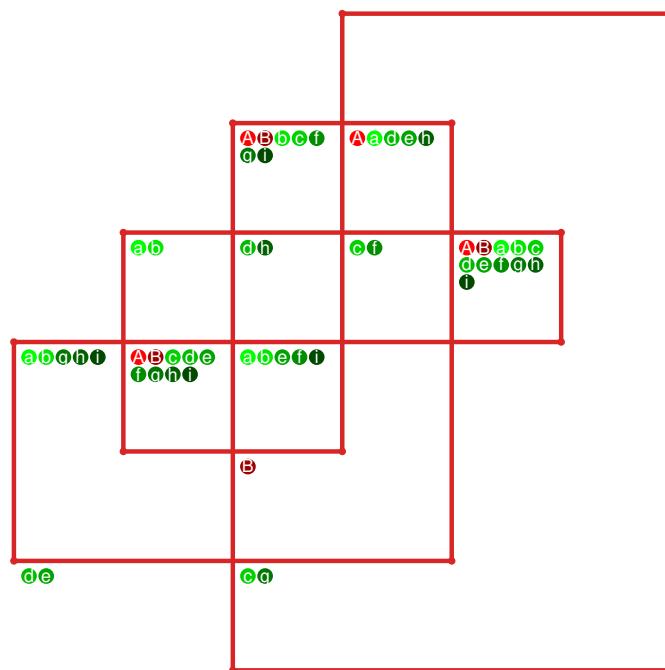


Figure 2137: SnapPy multiloop plot.

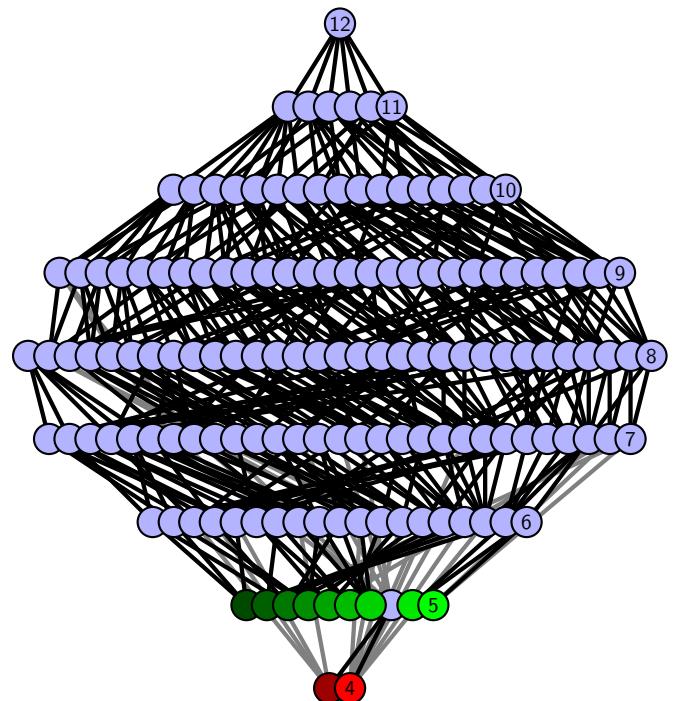


Figure 2138: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.772 [[20, 7, 1, 8], [8, 17, 9, 18], [14, 19, 15, 20], [15, 6, 16, 7], [1, 16, 2, 17], [9, 2, 10, 3], [18, 13, 19, 14], [5, 12, 6, 13], [10, 4, 11, 3], [11, 4, 12, 5]]

PD code drawn by SnapPy: [(20, 7, 1, 8), (8, 1, 9, 2), (12, 3, 13, 4), (17, 4, 18, 5), (2, 9, 3, 10), (15, 10, 16, 11), (18, 13, 19, 14), (5, 14, 6, 15), (11, 16, 12, 17), (6, 19, 7, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 3], [0, 2, 7, 4], [0, 3, 5, 1], [1, 4, 8, 8], [1, 7, 2, 2], [3, 6, 9, 9], [5, 9, 9, 5], [7, 8, 8, 7]]

Total optimal pinning sets: 3
Total minimal pinning sets: 3
Total pinning sets: 128
Pinning number: 6

Average optimal degree: 2.33
Average minimal degree: 2.33
Average overall degree: 2.97

Table 1068: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	35	40	25	8	1	125
Average degree	2.33	2.64	2.87	3.04	3.18	3.27	3.33	

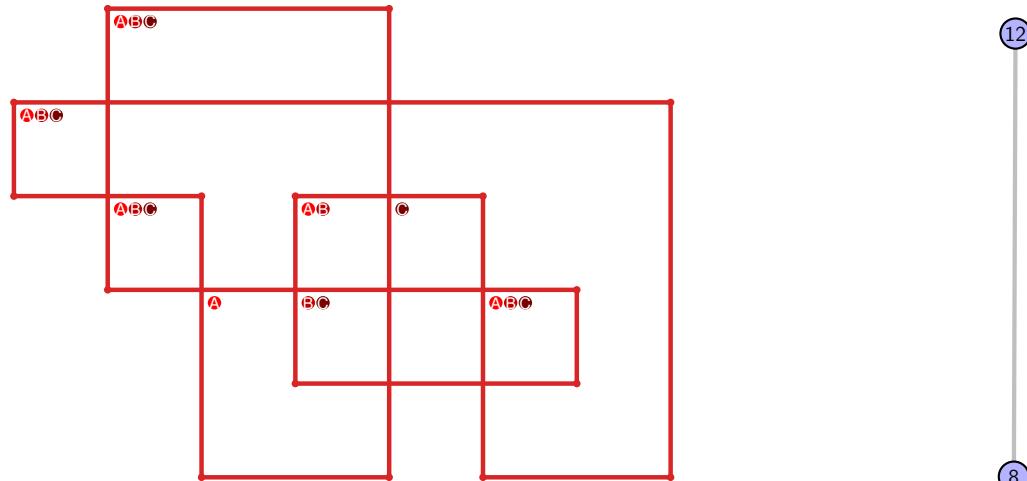


Figure 2139: SnapPy multiloop plot.

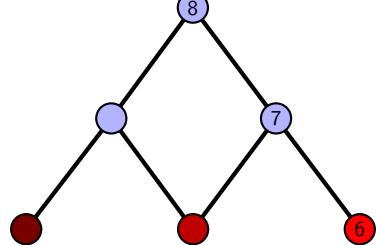


Figure 2140: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.773 [[8, 14, 1, 9], [9, 15, 10, 20], [7, 17, 8, 18], [13, 16, 14, 17], [1, 16, 2, 15], [10, 2, 11, 3], [5, 19, 6, 20], [18, 6, 19, 7], [12, 4, 13, 5], [11, 4, 12, 3]]

PD code drawn by SnapPy: [(8, 9, 1, 10), (10, 1, 11, 2), (20, 3, 15, 4), (14, 7, 9, 8), (5, 12, 6, 13), (11, 18, 12, 19), (4, 19, 5, 20), (2, 15, 3, 16), (16, 13, 17, 14), (17, 6, 18, 7)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 7, 7, 3], [0, 2, 8, 4], [0, 3, 5, 1], [1, 4, 9, 9], [1, 8, 7, 7], [2, 6, 6, 2], [3, 6, 9, 9], [5, 8, 8, 5]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 128
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 1069: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	16	35	40	25	8	1	125
Average degree	2.33	2.64	2.87	3.04	3.18	3.27	3.33	

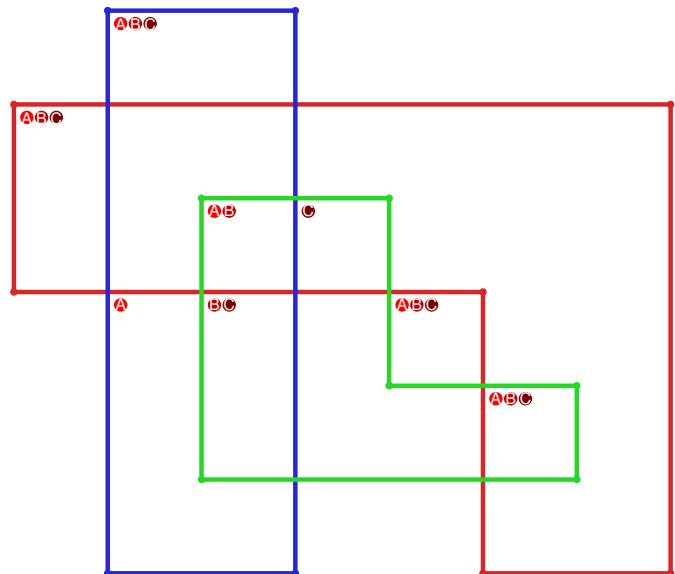


Figure 2141: SnapPy multiloop plot.

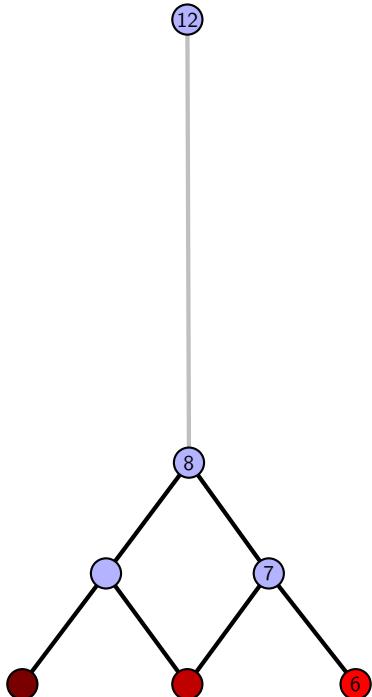


Figure 2142: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.774 [[20, 5, 1, 6], [6, 15, 7, 16], [12, 19, 13, 20], [13, 4, 14, 5], [1, 14, 2, 15], [7, 17, 8, 16], [18, 11, 19, 12], [3, 10, 4, 11], [2, 10, 3, 9], [17, 9, 18, 8]]

PD code drawn by SnapPy: [(11, 2, 12, 3), (18, 3, 19, 4), (6, 15, 7, 16), (7, 20, 8, 1), (1, 8, 2, 9), (16, 9, 17, 10), (19, 12, 20, 13), (4, 13, 5, 14), (14, 5, 15, 6), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 4], [0, 3, 8, 1], [1, 9, 9, 1], [2, 9, 7, 2], [3, 6, 8, 8], [4, 7, 7, 9], [5, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 1070: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

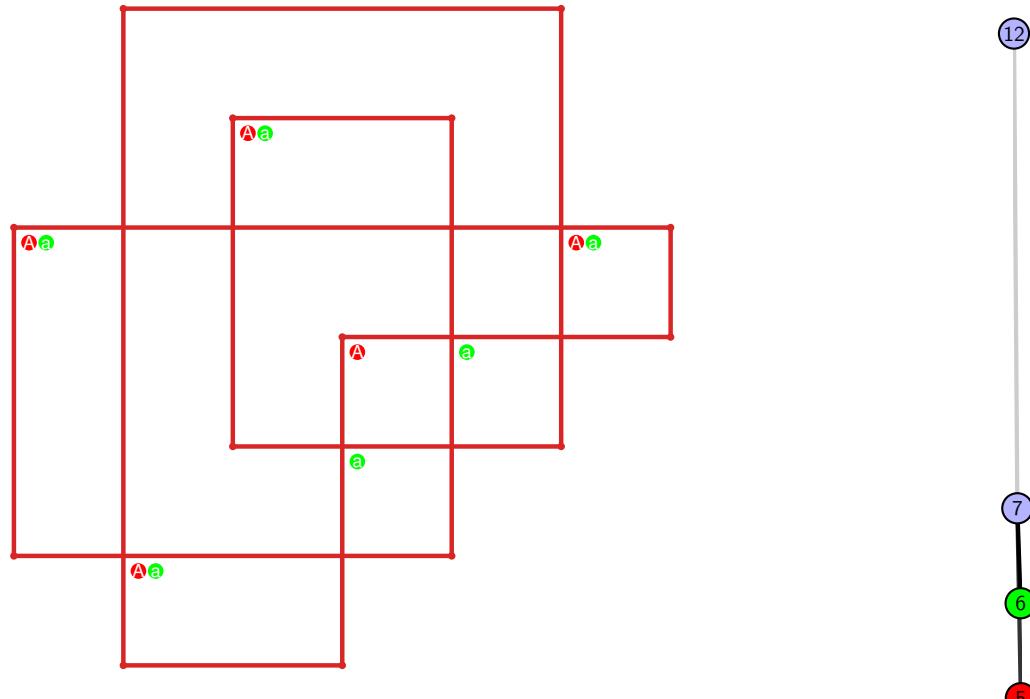


Figure 2143: SnapPy multiloop plot.

Figure 2144: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.775 [[13, 20, 14, 1], [12, 7, 13, 8], [19, 6, 20, 7], [14, 4, 15, 3], [1, 9, 2, 8], [18, 11, 19, 12], [5, 16, 6, 17], [4, 16, 5, 15], [2, 9, 3, 10], [10, 17, 11, 18]]

PD code drawn by SnapPy: [(1, 12, 2, 13), (17, 4, 18, 5), (10, 5, 11, 6), (6, 19, 7, 20), (20, 7, 1, 8), (16, 9, 17, 10), (13, 2, 14, 3), (3, 14, 4, 15), (8, 15, 9, 16), (11, 18, 12, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 8], [0, 8, 8, 1], [1, 9, 9, 2], [2, 9, 7, 7], [3, 6, 6, 3], [3, 9, 4, 4], [5, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.27

Total pinning sets: 160

Average overall degree: 2.97

Pinning number: 5

Table 1071: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	7	26	45	45	26	8	1	158
Average degree	2.2	2.5	2.74	2.92	3.07	3.18	3.27	3.33	

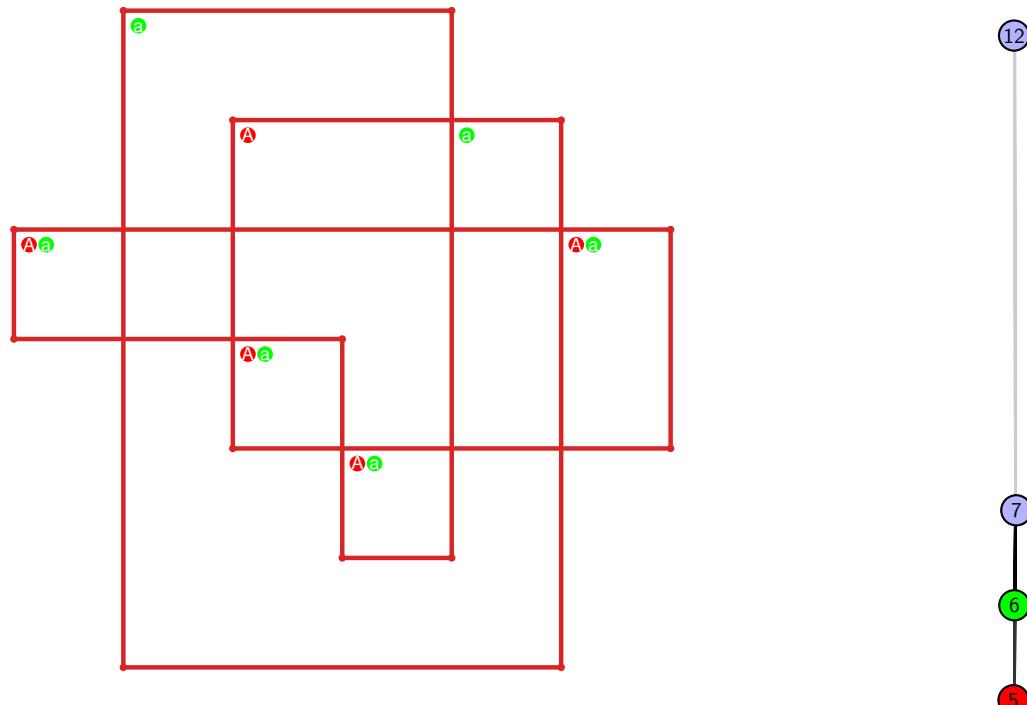


Figure 2145: SnapPy multiloop plot.

Figure 2146: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.776 [[20, 9, 1, 10], [10, 17, 11, 18], [6, 19, 7, 20], [15, 8, 16, 9], [1, 16, 2, 17], [11, 4, 12, 5], [18, 5, 19, 6], [7, 14, 8, 15], [2, 14, 3, 13], [3, 12, 4, 13]]

PD code drawn by SnapPy: [(8, 1, 9, 2), (15, 2, 16, 3), (12, 5, 13, 6), (17, 6, 18, 7), (20, 9, 1, 10), (10, 19, 11, 20), (4, 11, 5, 12), (18, 13, 19, 14), (7, 14, 8, 15), (3, 16, 4, 17)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 7], [0, 7, 7, 4], [0, 3, 8, 1], [1, 9, 9, 6], [1, 5, 2, 2], [2, 8, 3, 3], [4, 7, 9, 9], [5, 8, 8, 5]]

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 2

Average minimal degree: 2.2

Total pinning sets: 192

Average overall degree: 2.97

Pinning number: 5

Table 1072: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

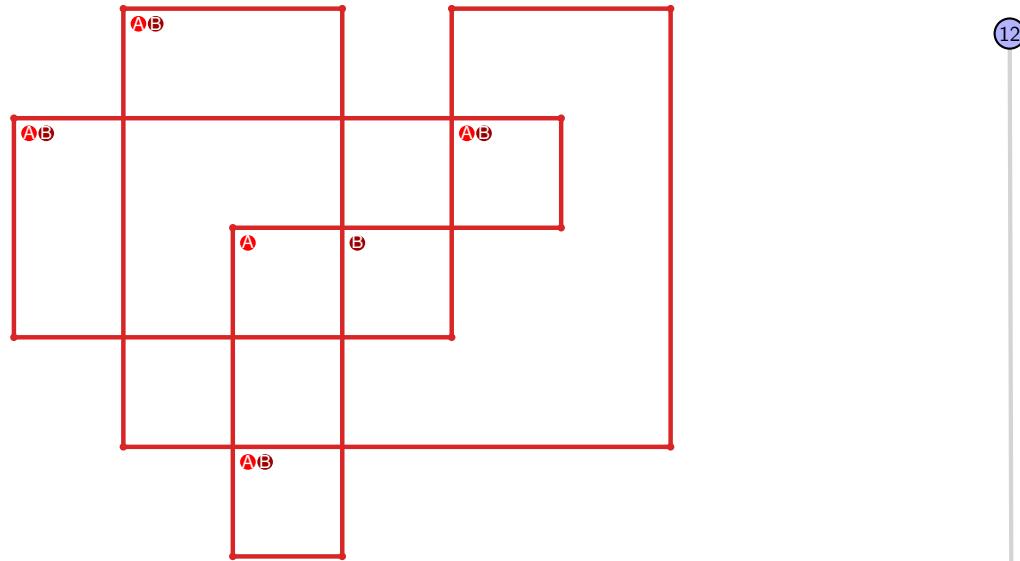


Figure 2147: SnapPy multiloop plot.

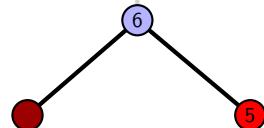


Figure 2148: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.777 [[5, 20, 6, 1], [17, 4, 18, 5], [12, 19, 13, 20], [6, 15, 7, 16], [1, 16, 2, 17], [10, 3, 11, 4], [18, 11, 19, 12], [13, 9, 14, 8], [14, 7, 15, 8], [2, 9, 3, 10]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (15, 2, 16, 3), (12, 5, 13, 6), (6, 11, 7, 12), (20, 7, 1, 8), (16, 9, 17, 10), (4, 13, 5, 14), (19, 14, 20, 15), (10, 17, 11, 18), (3, 18, 4, 19)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 7], [0, 8, 8, 4], [0, 3, 9, 1], [1, 9, 9, 6], [1, 5, 2, 2], [2, 9, 8, 8], [3, 7, 7, 3], [4, 7, 5, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 184
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.38
 Average overall degree: 2.98

Table 1073: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.2	2.5	2.76	2.95	3.09	3.19	3.27	3.33	

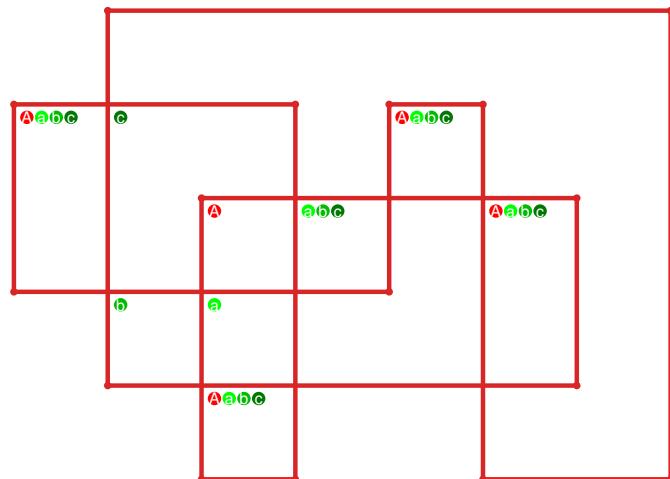


Figure 2149: `SnapPy` multiloop plot.

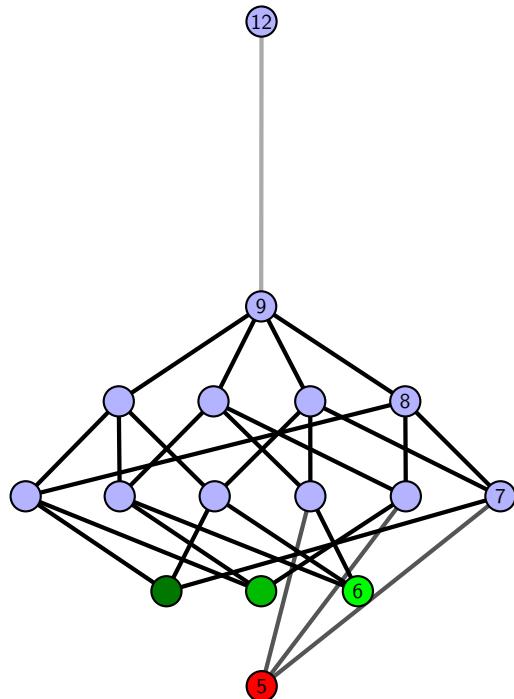


Figure 2150: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.778 [[8, 14, 1, 9], [9, 15, 10, 20], [7, 19, 8, 20], [13, 18, 14, 19], [1, 16, 2, 15], [10, 6, 11, 7], [12, 4, 13, 5], [17, 3, 18, 4], [16, 3, 17, 2], [5, 11, 6, 12]]

PD code drawn by SnapPy: [(8, 9, 1, 10), (10, 1, 11, 2), (15, 2, 16, 3), (19, 4, 20, 5), (3, 20, 4, 15), (6, 17, 7, 18), (16, 11, 17, 12), (5, 12, 6, 13), (13, 18, 14, 19), (14, 7, 9, 8)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 8, 8, 1], [1, 9, 9, 2], [3, 9, 9, 7], [3, 6, 8, 8], [4, 7, 7, 4], [5, 6, 6, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 144
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.31
 Average overall degree: 2.97

Table 1074: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	7	21	39	41	25	8	1	142
Average degree	2.2	2.52	2.74	2.91	3.05	3.18	3.27	3.33	

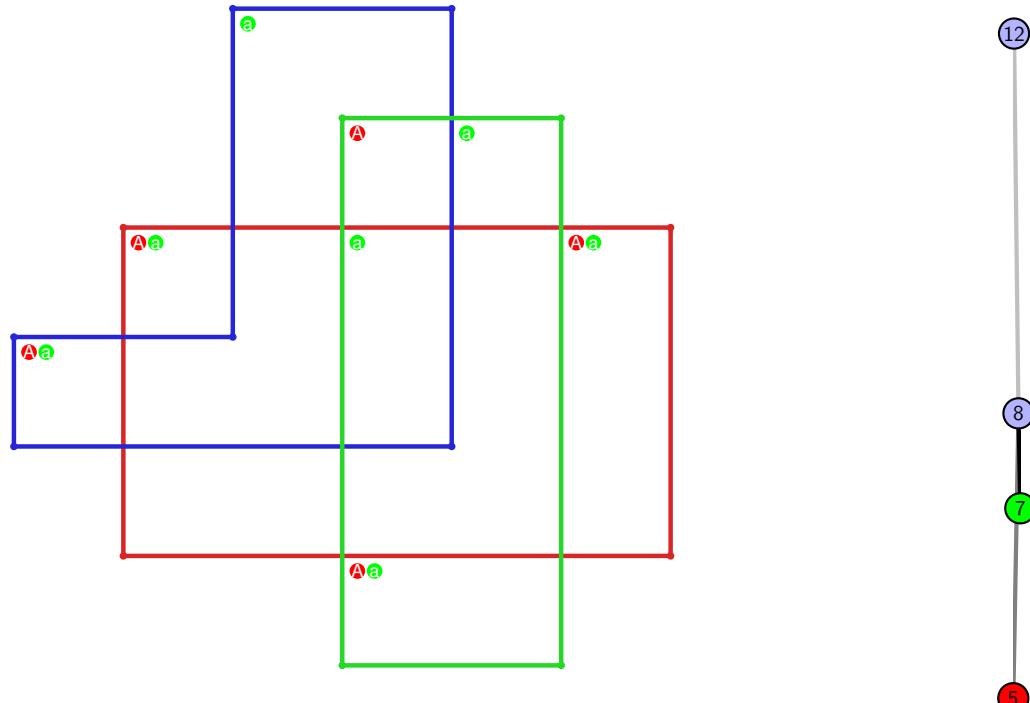


Figure 2151: SnapPy multiloop plot.

Figure 2152: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.779 [[15, 20, 16, 1], [14, 7, 15, 8], [19, 6, 20, 7], [16, 6, 17, 5], [1, 9, 2, 8], [18, 13, 19, 14], [17, 13, 18, 12], [4, 11, 5, 12], [9, 3, 10, 2], [10, 3, 11, 4]]

PD code drawn by `SnapPy`: [(20, 7, 1, 8), (8, 1, 9, 2), (3, 14, 4, 15), (17, 4, 18, 5), (12, 5, 13, 6), (6, 19, 7, 20), (2, 9, 3, 10), (10, 15, 11, 16), (16, 11, 17, 12), (13, 18, 14, 19)]

Planar representation generated by `plantri`: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 7], [0, 8, 8, 1], [1, 6, 6, 2], [3, 5, 5, 7], [3, 6, 9, 9], [4, 9, 9, 4], [7, 8, 8, 7]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 128
 Pinning number: 6

Average optimal degree: 2.39
 Average minimal degree: 2.4
 Average overall degree: 2.98

Table 1075: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	15	35	40	25	8	1	124
Average degree	2.39	2.67	2.88	3.05	3.18	3.27	3.33	

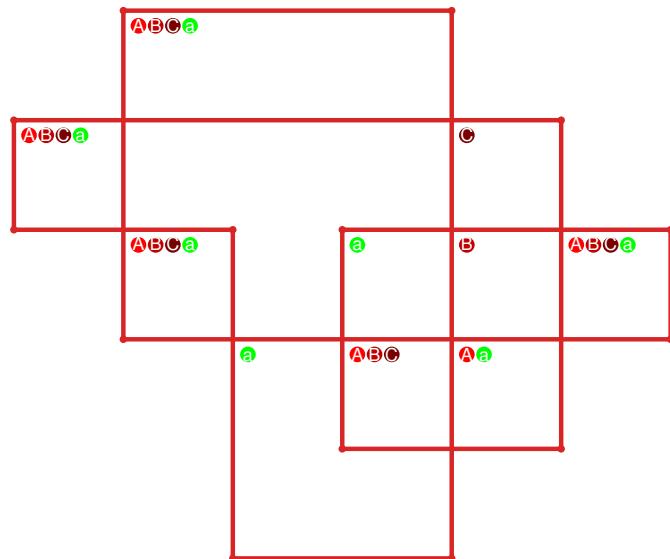


Figure 2153: `SnapPy` multiloop plot.

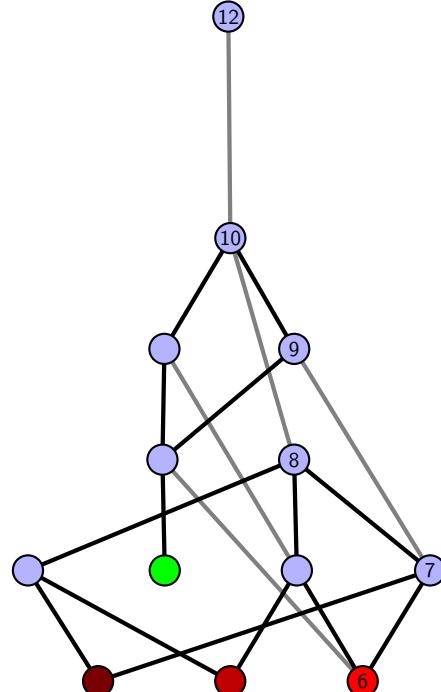


Figure 2154: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.780 [[13, 20, 14, 1], [12, 7, 13, 8], [19, 6, 20, 7], [14, 6, 15, 5], [1, 9, 2, 8], [18, 11, 19, 12], [15, 4, 16, 5], [9, 3, 10, 2], [10, 17, 11, 18], [3, 16, 4, 17]]

PD code drawn by SnapPy: [(11, 20, 12, 1), (1, 10, 2, 11), (15, 2, 16, 3), (8, 3, 9, 4), (4, 17, 5, 18), (14, 7, 15, 8), (19, 12, 20, 13), (6, 13, 7, 14), (9, 16, 10, 17), (18, 5, 19, 6)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 2], [0, 1, 5, 3], [0, 2, 6, 6], [0, 7, 7, 1], [1, 8, 8, 2], [3, 9, 9, 3], [4, 9, 8, 4], [5, 7, 9, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 2
 Total pinning sets: 144
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.31
 Average overall degree: 2.97

Table 1076: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	0	1
Nonminimal pinning sets	0	7	21	39	41	25	8	1	142
Average degree	2.2	2.52	2.74	2.91	3.05	3.18	3.27	3.33	

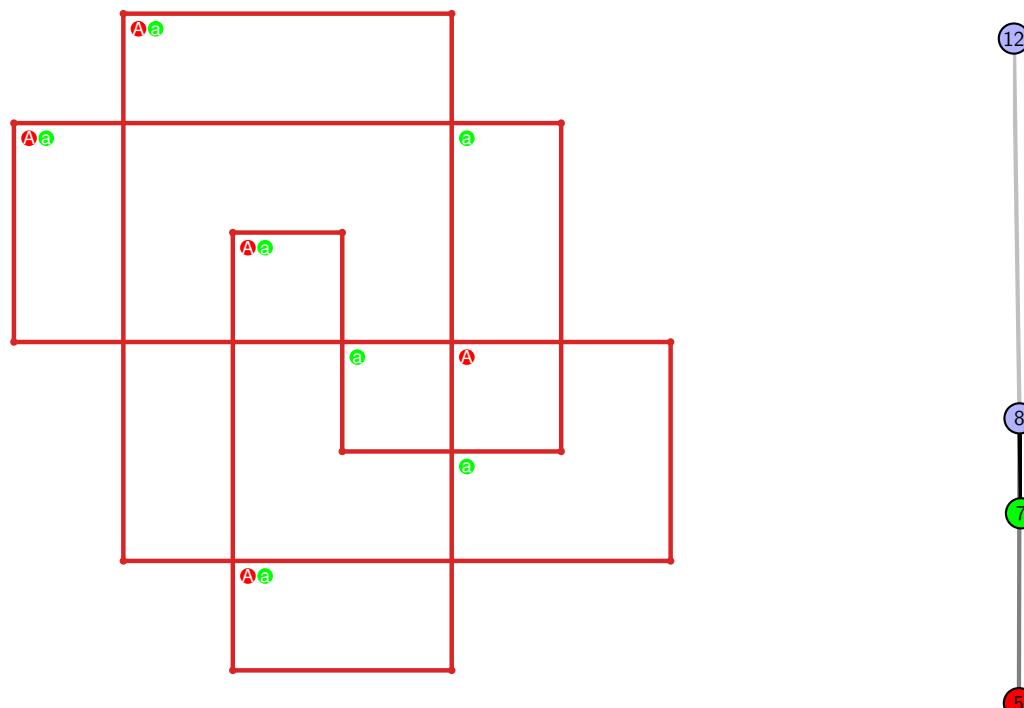


Figure 2155: SnapPy multiloop plot.

Figure 2156: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.781 [[15, 20, 16, 1], [14, 7, 15, 8], [19, 4, 20, 5], [16, 4, 17, 3], [1, 9, 2, 8], [6, 13, 7, 14], [5, 13, 6, 12], [18, 11, 19, 12], [17, 11, 18, 10], [2, 9, 3, 10]]

PD code drawn by SnapPy: [(1, 14, 2, 15), (17, 2, 18, 3), (12, 5, 13, 6), (6, 19, 7, 20), (20, 7, 1, 8), (8, 15, 9, 16), (16, 9, 17, 10), (10, 3, 11, 4), (4, 11, 5, 12), (13, 18, 14, 19)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 7, 3], [0, 2, 8, 9], [0, 9, 9, 1], [1, 6, 6, 1], [2, 5, 5, 7], [2, 6, 8, 8], [3, 7, 7, 9], [3, 8, 4, 4]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 5
 Total pinning sets: 196
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.46
 Average overall degree: 2.99

Table 1077: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	1	0	0	0	0	0	4
Nonminimal pinning sets	0	7	34	59	54	28	8	1	191
Average degree	2.2	2.53	2.77	2.96	3.1	3.2	3.27	3.33	

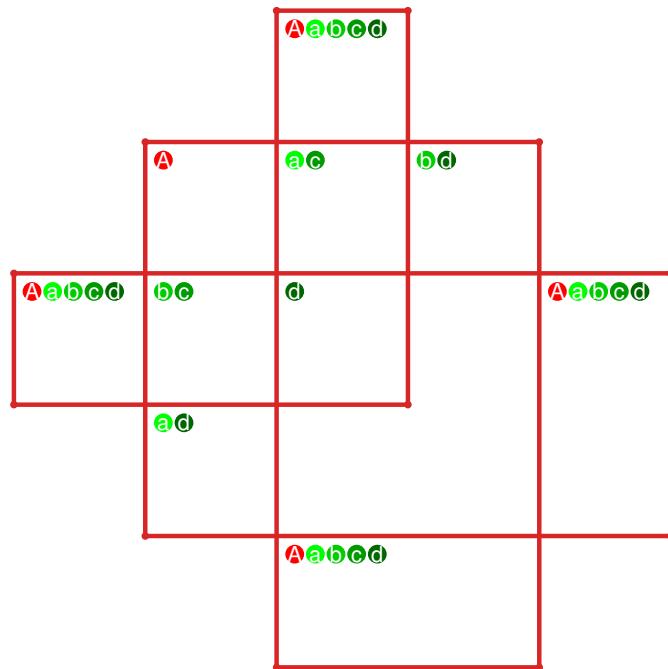


Figure 2157: SnapPy multiloop plot.

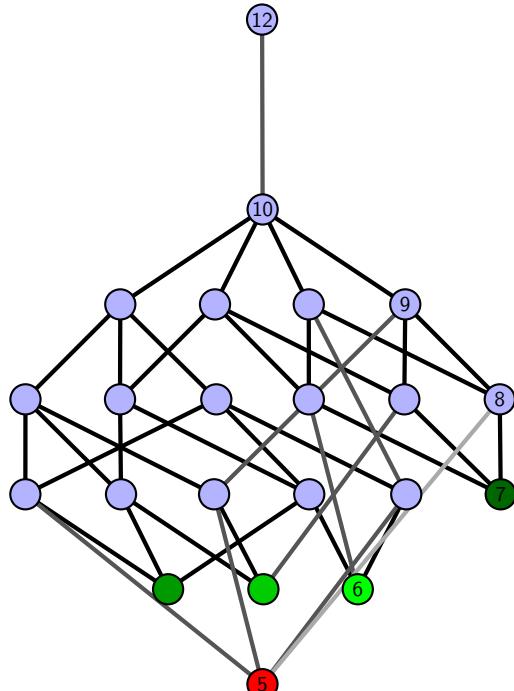


Figure 2158: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.782 $[[16, 20, 1, 17], [17, 13, 18, 14], [15, 6, 16, 7], [19, 5, 20, 6], [1, 12, 2, 13], [18, 9, 19, 8], [14, 8, 15, 7], [9, 4, 10, 5], [11, 2, 12, 3], [3, 10, 4, 11]]$

PD code drawn by `SnapPy`: $[(9, 16, 10, 1), (7, 2, 8, 3), (18, 3, 19, 4), (13, 4, 14, 5), (5, 12, 6, 13), (6, 17, 7, 18), (1, 8, 2, 9), (15, 10, 16, 11), (20, 11, 17, 12), (14, 19, 15, 20)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 3], [0, 2, 5, 7], [0, 8, 8, 1], [1, 7, 3, 6], [1, 5, 2, 2], [3, 5, 9, 9], [4, 9, 9, 4], [7, 8, 8, 7]]$

Total optimal pinning sets: 2

Average optimal degree: 2.2

Total minimal pinning sets: 3

Average minimal degree: 2.36

Total pinning sets: 208

Average overall degree: 2.98

Pinning number: 5

Table 1078: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	1	0	0	0	0	0	0	1
Nonminimal pinning sets	0	13	40	61	54	28	8	1	205
Average degree	2.2	2.55	2.79	2.97	3.1	3.2	3.27	3.33	

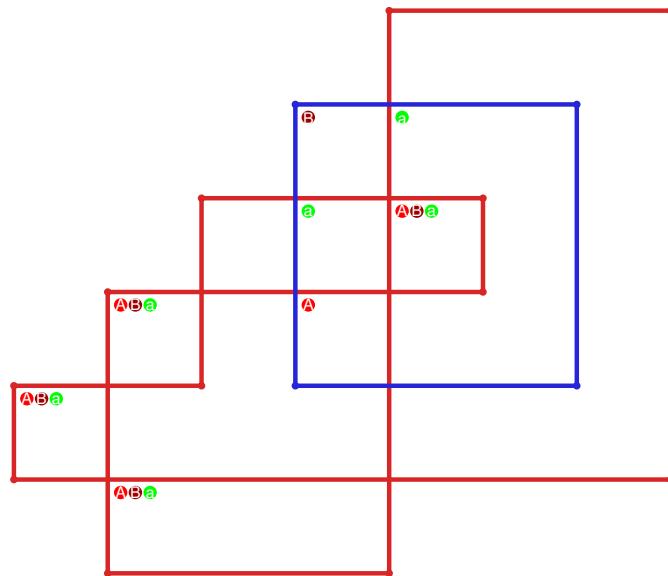


Figure 2159: `SnapPy` multiloop plot.

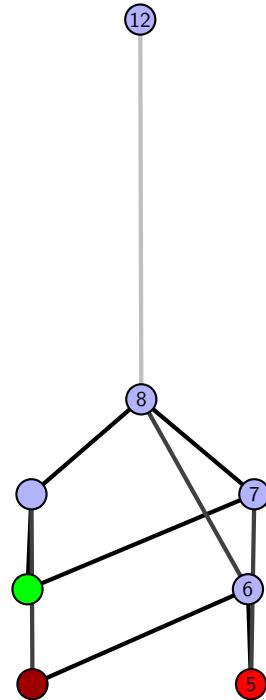


Figure 2160: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.783 [[11, 20, 12, 1], [10, 5, 11, 6], [19, 12, 20, 13], [1, 7, 2, 6], [16, 9, 17, 10], [17, 4, 18, 5], [13, 18, 14, 19], [7, 3, 8, 2], [8, 15, 9, 16], [3, 14, 4, 15]]

PD code drawn by `SnapPy`: [(14, 1, 15, 2), (7, 2, 8, 3), (3, 18, 4, 19), (13, 6, 14, 7), (16, 9, 17, 10), (20, 11, 1, 12), (5, 12, 6, 13), (10, 15, 11, 16), (8, 17, 9, 18), (19, 4, 20, 5)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 7, 7, 1], [1, 8, 8, 5], [1, 4, 9, 6], [2, 5, 9, 2], [3, 9, 8, 3], [4, 7, 9, 4], [5, 8, 7, 6]]

Total optimal pinning sets: 3
 Total minimal pinning sets: 3
 Total pinning sets: 224
 Pinning number: 5

Average optimal degree: 2.27
 Average minimal degree: 2.27
 Average overall degree: 2.98

Table 1079: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	18	46	65	55	28	8	1	221
Average degree	2.27	2.59	2.82	2.98	3.11	3.2	3.27	3.33	

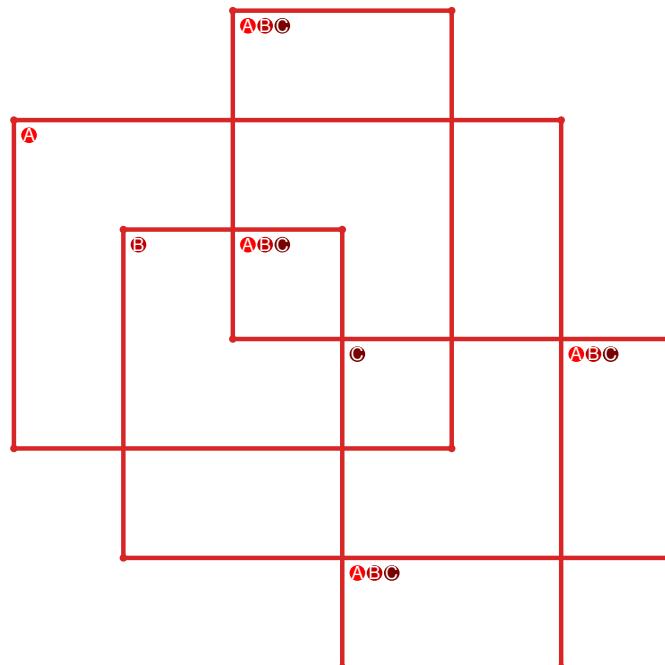


Figure 2161: `SnapPy` multiloop plot.

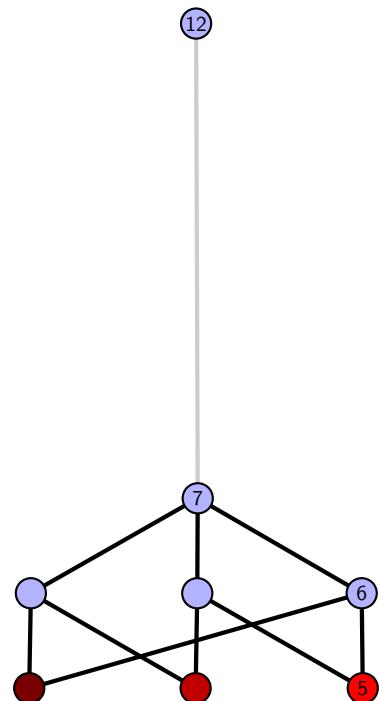


Figure 2162: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.784 [[8, 16, 1, 9], [9, 17, 10, 20], [15, 7, 16, 8], [1, 18, 2, 17], [10, 4, 11, 5], [5, 19, 6, 20], [6, 14, 7, 15], [18, 14, 19, 13], [2, 13, 3, 12], [3, 11, 4, 12]]

PD code drawn by SnapPy: [(15, 2, 16, 3), (12, 5, 13, 6), (1, 16, 2, 9), (9, 8, 10, 1), (10, 17, 11, 18), (4, 11, 5, 12), (6, 13, 7, 14), (3, 18, 4, 19), (19, 14, 20, 15), (20, 7, 17, 8)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 7, 8, 1], [1, 9, 9, 5], [1, 4, 7, 6], [2, 5, 7, 2], [3, 6, 5, 8], [3, 7, 9, 9], [4, 8, 8, 4]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 1080: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

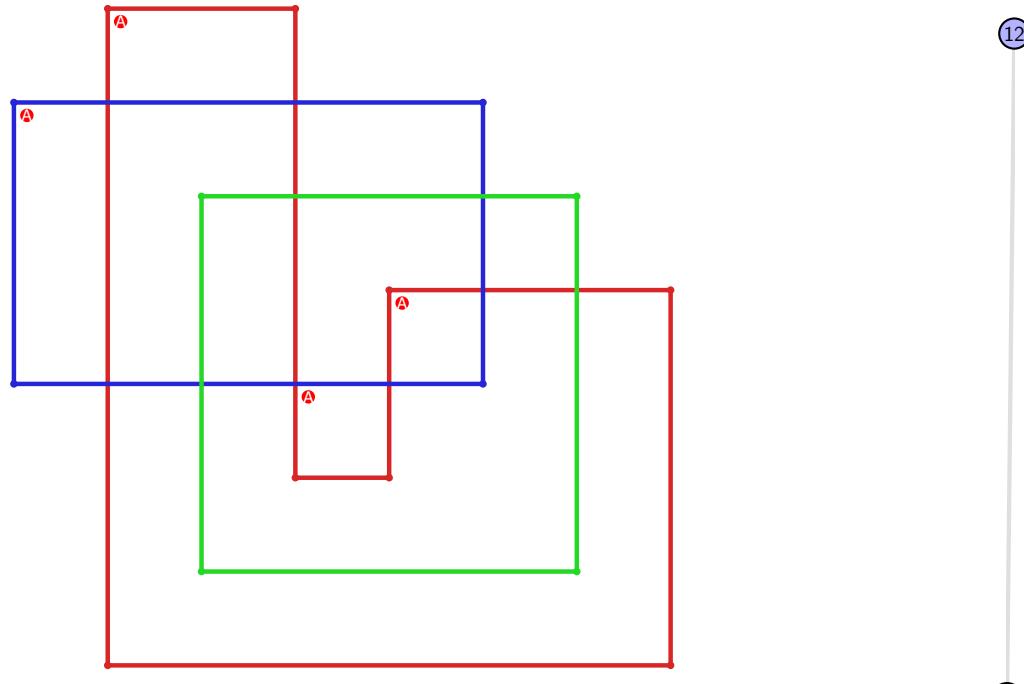


Figure 2163: SnapPy multiloop plot.

Figure 2164: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.785 $[[5, 14, 6, 1], [4, 20, 5, 15], [13, 6, 14, 7], [1, 16, 2, 15], [3, 8, 4, 9], [19, 7, 20, 8], [12, 16, 13, 17], [2, 10, 3, 9], [10, 18, 11, 19], [17, 11, 18, 12]]$

PD code drawn by SnapPy: $[(11, 4, 12, 5), (20, 5, 15, 6), (1, 6, 2, 7), (7, 14, 8, 1), (18, 9, 19, 10), (3, 12, 4, 13), (10, 17, 11, 18), (8, 19, 9, 20), (2, 15, 3, 16), (16, 13, 17, 14)]$

Planar representation generated by plantri: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 6, 7, 1], [1, 7, 7, 5], [1, 4, 8, 2], [2, 9, 9, 3], [3, 8, 4, 4], [5, 7, 9, 9], [6, 8, 8, 6]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 240
 Pinning number: 5

Average optimal degree: 2.3
 Average minimal degree: 2.3
 Average overall degree: 2.98

Table 1081: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	22	52	69	56	28	8	1	236
Average degree	2.3	2.62	2.84	3.0	3.11	3.2	3.27	3.33	

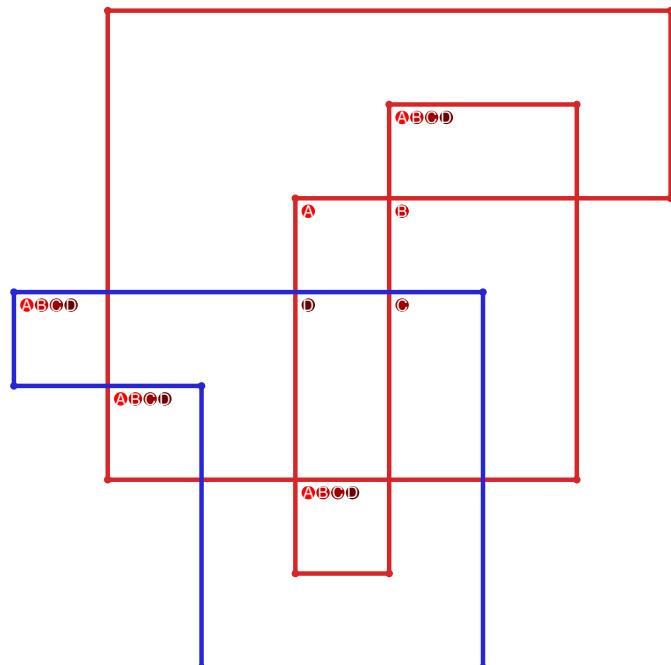


Figure 2165: SnapPy multiloop plot.

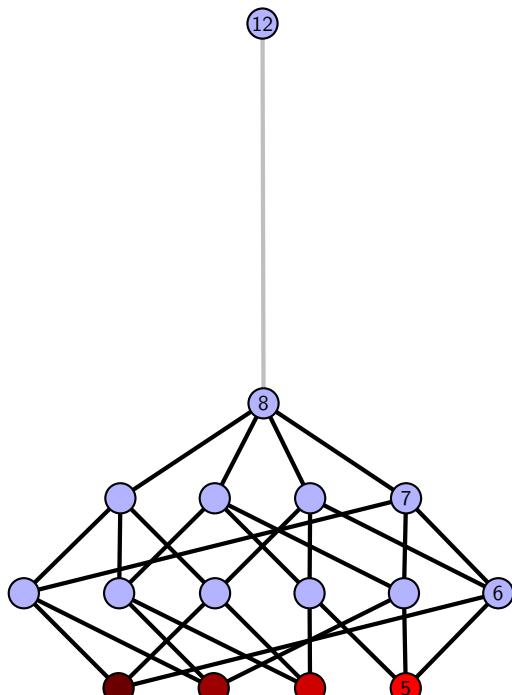


Figure 2166: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.786 $[[5, 20, 6, 1], [4, 9, 5, 10], [19, 6, 20, 7], [1, 11, 2, 10], [14, 3, 15, 4], [15, 8, 16, 9], [7, 16, 8, 17], [18, 11, 19, 12], [2, 13, 3, 14], [17, 13, 18, 12]]$

PD code drawn by `SnapPy`: $[(11, 20, 12, 1), (16, 3, 17, 4), (12, 5, 13, 6), (1, 6, 2, 7), (7, 18, 8, 19), (15, 8, 16, 9), (9, 14, 10, 15), (19, 10, 20, 11), (4, 13, 5, 14), (2, 17, 3, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 7, 8, 1], [1, 8, 8, 5], [1, 4, 6, 6], [2, 5, 5, 9], [2, 9, 9, 3], [3, 9, 4, 4], [6, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 1082: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

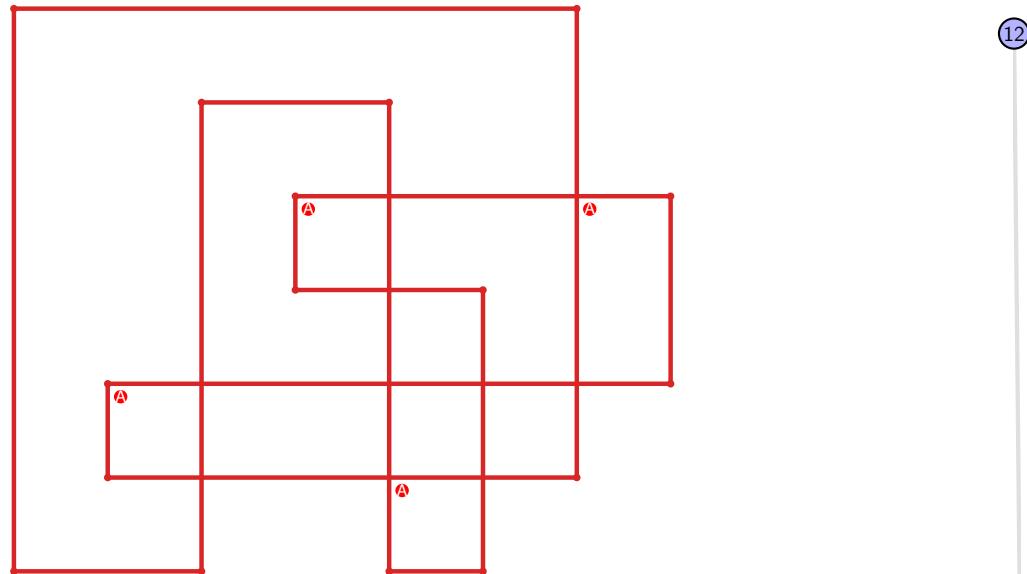


Figure 2167: `SnapPy` multiloop plot.



Figure 2168: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.787 $[[5, 20, 6, 1], [4, 11, 5, 12], [19, 6, 20, 7], [1, 13, 2, 12], [16, 3, 17, 4], [17, 10, 18, 11], [7, 18, 8, 19], [13, 8, 14, 9], [2, 15, 3, 16], [9, 14, 10, 15]]$

PD code drawn by `SnapPy`: $[(13, 20, 14, 1), (16, 3, 17, 4), (10, 5, 11, 6), (14, 7, 15, 8), (1, 8, 2, 9), (9, 18, 10, 19), (6, 11, 7, 12), (19, 12, 20, 13), (4, 15, 5, 16), (2, 17, 3, 18)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 6, 0], [0, 7, 8, 1], [1, 8, 8, 5], [1, 4, 9, 6], [2, 5, 7, 2], [3, 6, 9, 9], [3, 9, 4, 4], [5, 8, 7, 7]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 1083: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

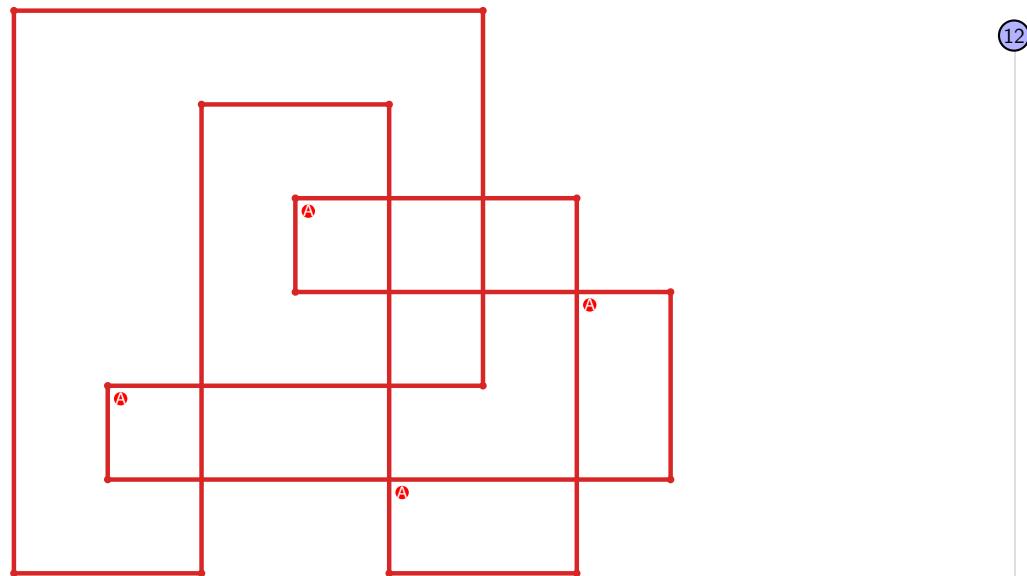


Figure 2169: `SnapPy` multiloop plot.



Figure 2170: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.788 [[5, 12, 6, 1], [4, 20, 5, 13], [11, 6, 12, 7], [1, 14, 2, 13], [17, 3, 18, 4], [19, 7, 20, 8], [10, 14, 11, 15], [2, 16, 3, 17], [18, 9, 19, 8], [15, 9, 16, 10]]

PD code drawn by SnapPy: [(13, 12, 14, 1), (8, 3, 9, 4), (15, 4, 16, 5), (5, 14, 6, 15), (19, 6, 20, 7), (2, 9, 3, 10), (11, 20, 12, 13), (1, 16, 2, 17), (17, 10, 18, 11), (7, 18, 8, 19)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 3, 4, 5], [0, 5, 6, 0], [0, 6, 7, 1], [1, 7, 7, 8], [1, 8, 8, 2], [2, 9, 9, 3], [3, 9, 4, 4], [4, 9, 5, 5], [6, 8, 7, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 1084: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

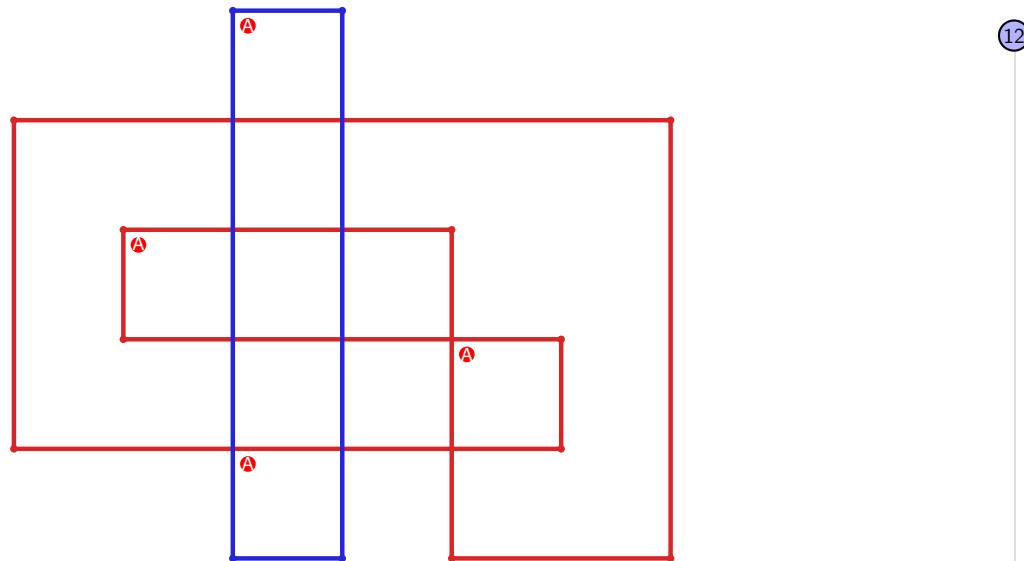


Figure 2171: SnapPy multiloop plot.

4

Figure 2172: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.789 [[10, 20, 1, 11], [11, 5, 12, 6], [19, 9, 20, 10], [1, 14, 2, 13], [4, 12, 5, 13], [6, 18, 7, 19], [8, 14, 9, 15], [2, 16, 3, 17], [17, 3, 18, 4], [7, 16, 8, 15]]

PD code drawn by SnapPy: [(11, 10, 12, 1), (15, 2, 16, 3), (13, 6, 14, 7), (1, 16, 2, 17), (17, 8, 18, 9), (5, 18, 6, 19), (19, 4, 20, 5), (9, 20, 10, 11), (3, 12, 4, 13), (7, 14, 8, 15)]

Planar representation generated by plantri: [[1, 2, 2, 3], [0, 4, 4, 5], [0, 5, 6, 0], [0, 6, 7, 4], [1, 3, 8, 1], [1, 8, 9, 2], [2, 9, 9, 3], [3, 9, 8, 8], [4, 7, 7, 5], [5, 7, 6, 6]]

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 1085: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

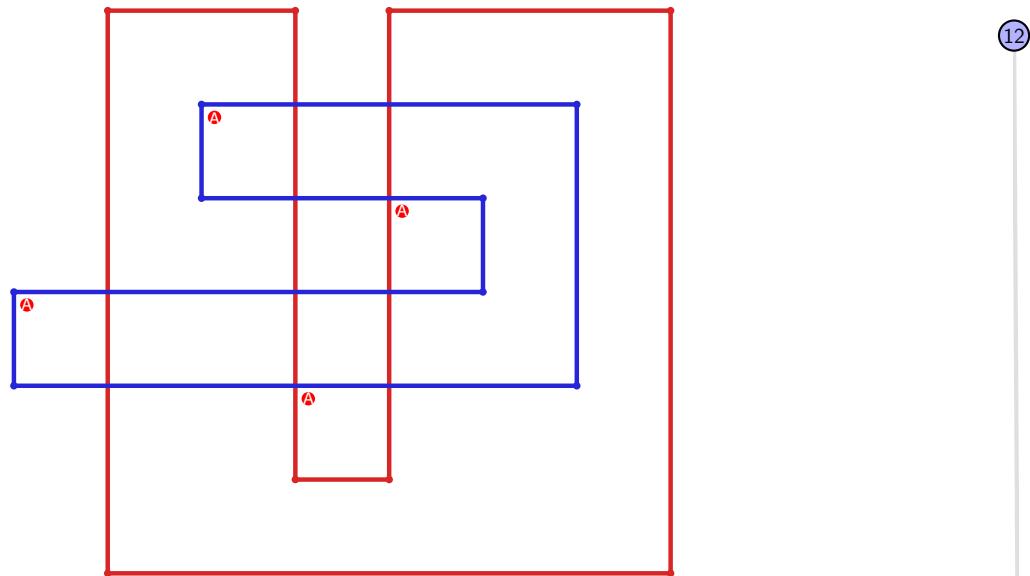


Figure 2173: SnapPy multiloop plot.



Figure 2174: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.790 $[[9, 20, 10, 1], [8, 13, 9, 14], [19, 10, 20, 11], [1, 15, 2, 14], [16, 7, 17, 8], [12, 5, 13, 6], [11, 5, 12, 4], [18, 3, 19, 4], [15, 3, 16, 2], [6, 17, 7, 18]]$

PD code drawn by `SnapPy`: $[(15, 20, 16, 1), (1, 8, 2, 9), (9, 2, 10, 3), (13, 4, 14, 5), (16, 7, 17, 8), (5, 10, 6, 11), (11, 18, 12, 19), (3, 14, 4, 15), (6, 17, 7, 18), (19, 12, 20, 13)]$

Planar representation generated by `plantri`: $[[1, 2, 2, 3], [0, 3, 4, 5], [0, 6, 7, 0], [0, 8, 8, 1], [1, 8, 9, 9], [1, 9, 6, 6], [2, 5, 5, 7], [2, 6, 9, 8], [3, 7, 4, 3], [4, 7, 5, 4]]$

Total optimal pinning sets: 1

Average optimal degree: 2.0

Total minimal pinning sets: 1

Average minimal degree: 2.0

Total pinning sets: 256

Average overall degree: 2.97

Pinning number: 4

Table 1086: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

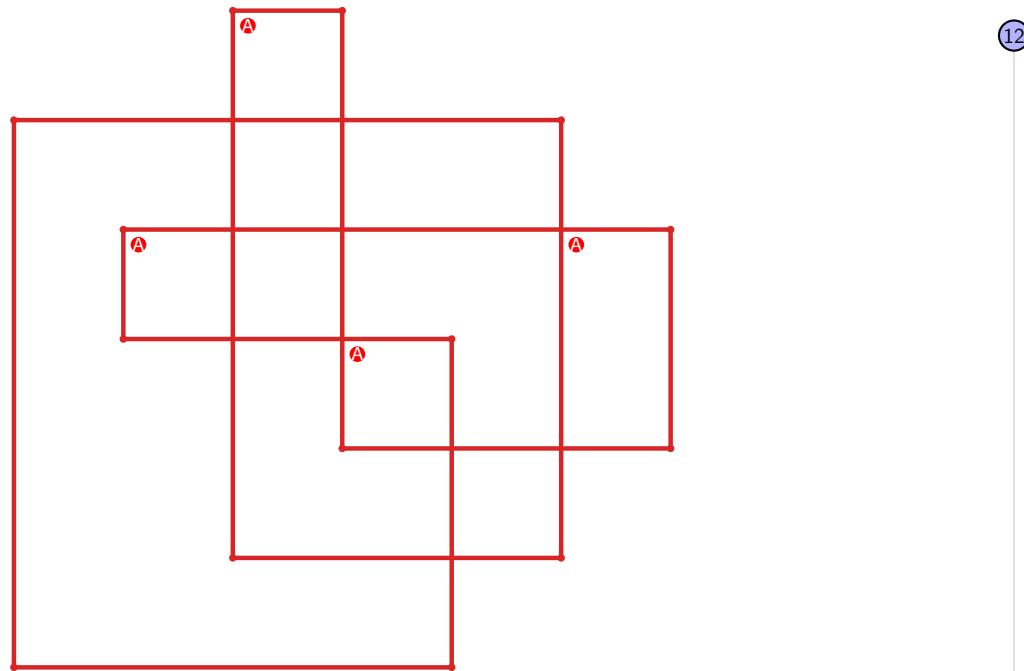


Figure 2175: `SnapPy` multiloop plot.

Figure 2176: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.791 $[[14, 20, 1, 15], [15, 11, 16, 12], [13, 6, 14, 7], [19, 5, 20, 6], [1, 10, 2, 11], [16, 9, 17, 8], [12, 8, 13, 7], [4, 18, 5, 19], [9, 2, 10, 3], [17, 3, 18, 4]]$

PD code drawn by SnapPy: $[(16, 1, 17, 2), (9, 2, 10, 3), (3, 8, 4, 9), (4, 19, 5, 20), (11, 6, 12, 7), (18, 7, 19, 8), (5, 12, 6, 13), (20, 13, 15, 14), (14, 15, 1, 16), (10, 17, 11, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 3], [0, 2, 7, 7], [0, 8, 8, 1], [1, 8, 9, 6], [1, 5, 2, 2], [3, 9, 9, 3], [4, 9, 5, 4], [5, 8, 7, 7]]$

Total optimal pinning sets: 8
 Total minimal pinning sets: 8
 Total pinning sets: 192
 Pinning number: 6

Average optimal degree: 2.46
 Average minimal degree: 2.46
 Average overall degree: 2.99

Table 1087: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	8	0	0	0	0	0	0	8
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	34	59	54	28	8	1	184
Average degree	2.46	2.76	2.96	3.1	3.2	3.27	3.33	

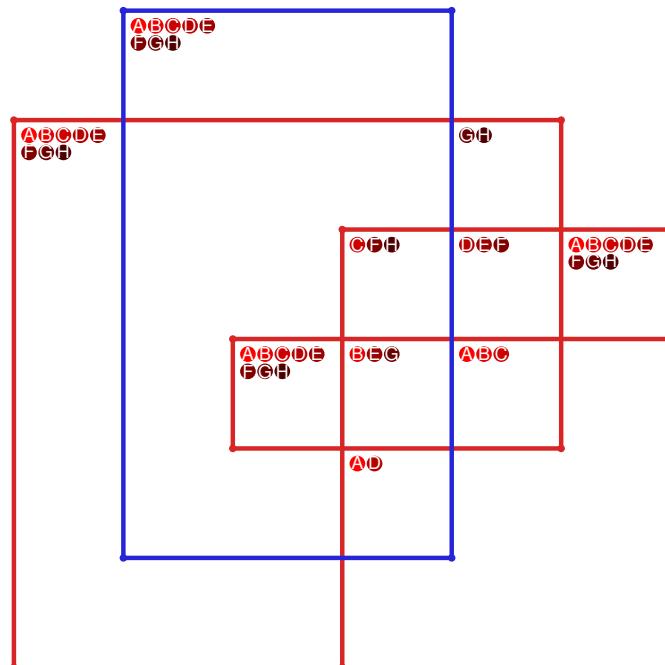


Figure 2177: SnapPy multiloop plot.

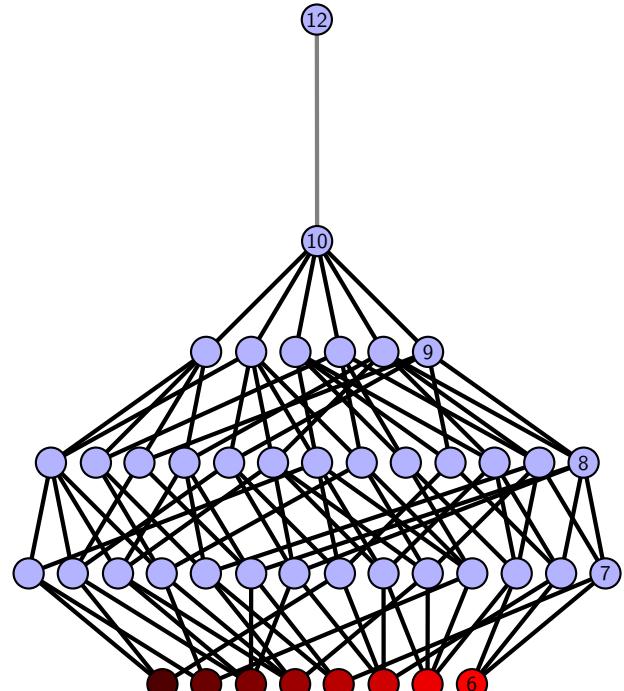


Figure 2178: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.792 [[14, 5, 1, 6], [6, 11, 7, 12], [13, 20, 14, 15], [4, 19, 5, 20], [1, 10, 2, 11], [7, 17, 8, 16], [12, 16, 13, 15], [18, 3, 19, 4], [9, 2, 10, 3], [17, 9, 18, 8]]

PD code drawn by SnapPy: [(7, 14, 8, 1), (20, 1, 15, 2), (12, 3, 13, 4), (6, 19, 7, 20), (13, 8, 14, 9), (4, 9, 5, 10), (18, 5, 19, 6), (2, 15, 3, 16), (11, 16, 12, 17), (17, 10, 18, 11)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 6], [0, 6, 6, 3], [0, 2, 7, 7], [0, 8, 8, 1], [1, 9, 9, 6], [1, 5, 2, 2], [3, 9, 8, 3], [4, 7, 9, 4], [5, 8, 7, 5]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 8
 Total pinning sets: 216
 Pinning number: 5

Average optimal degree: 2.4
 Average minimal degree: 2.42
 Average overall degree: 2.99

Table 1088: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	7	0	0	0	0	0	0	7
Nonminimal pinning sets	0	7	44	65	55	28	8	1	208
Average degree	2.4	2.55	2.81	2.98	3.11	3.2	3.27	3.33	

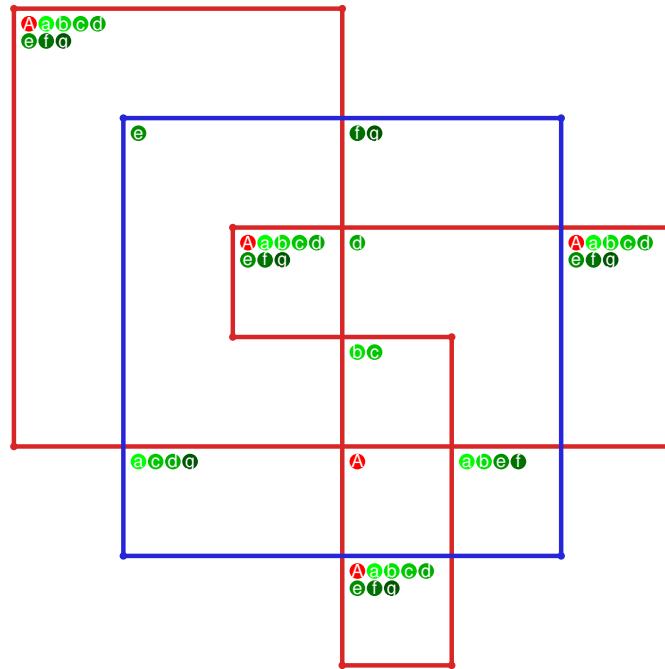


Figure 2179: SnapPy multiloop plot.

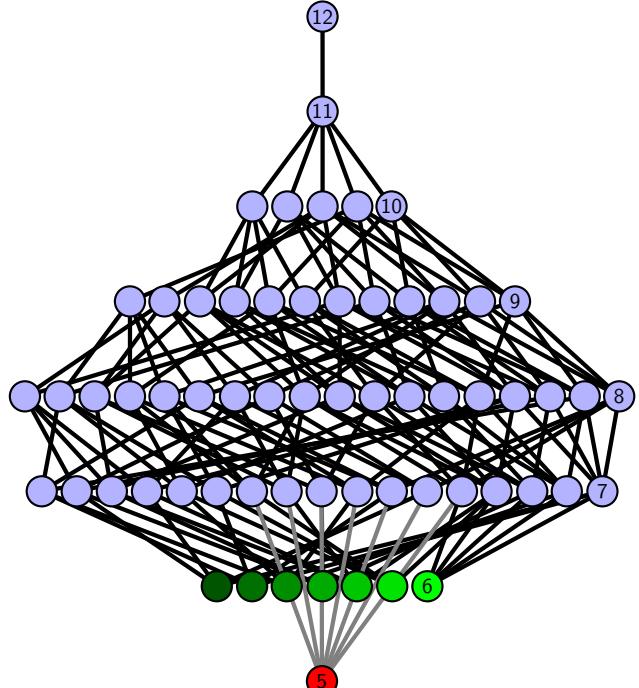


Figure 2180: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.793 [[10, 5, 1, 6], [6, 11, 7, 20], [15, 9, 16, 10], [16, 4, 17, 5], [1, 12, 2, 11], [7, 19, 8, 20], [8, 14, 9, 15], [3, 17, 4, 18], [12, 3, 13, 2], [13, 18, 14, 19]]

PD code drawn by SnapPy: [(10, 11, 1, 12), (15, 2, 16, 3), (8, 3, 9, 4), (14, 7, 15, 8), (6, 13, 7, 14), (1, 16, 2, 17), (12, 17, 13, 18), (5, 18, 6, 19), (19, 4, 20, 5), (20, 9, 11, 10)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 4, 5, 5], [0, 6, 6, 3], [0, 2, 7, 7], [0, 8, 8, 1], [1, 9, 6, 1], [2, 5, 9, 2], [3, 9, 8, 3], [4, 7, 9, 4], [5, 8, 7, 6]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 1
 Total pinning sets: 256
 Pinning number: 4

Average optimal degree: 2.0
 Average minimal degree: 2.0
 Average overall degree: 2.97

Table 1089: Pinning sets/average degree by cardinal

Cardinal	4	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	8	28	56	70	56	28	8	1	255
Average degree	2.0	2.4	2.67	2.86	3.0	3.11	3.2	3.27	3.33	

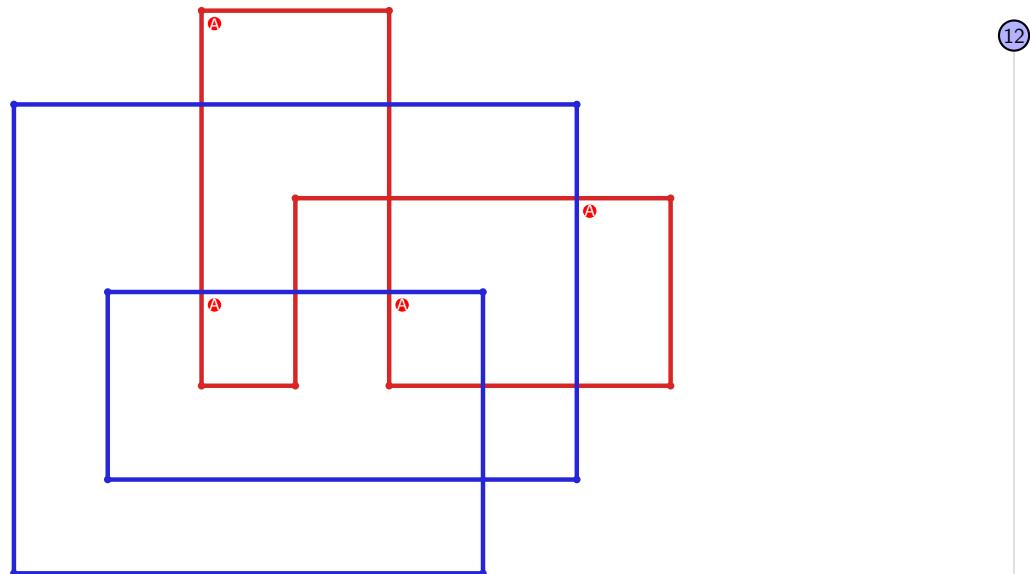


Figure 2181: SnapPy multiloop plot.



Figure 2182: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.794 $[[8, 16, 1, 9], [9, 7, 10, 8], [15, 1, 16, 2], [6, 10, 7, 11], [2, 17, 3, 20], [14, 19, 15, 20], [11, 19, 12, 18], [5, 17, 6, 18], [3, 13, 4, 14], [12, 4, 13, 5]]$

PD code drawn by SnapPy: $[(13, 2, 14, 3), (18, 5, 19, 6), (16, 7, 17, 8), (4, 19, 5, 20), (1, 14, 2, 15), (6, 17, 7, 18), (15, 12, 16, 9), (9, 8, 10, 1), (3, 10, 4, 11), (11, 20, 12, 13)]$

Planar representation generated by plantri: $[[1, 1, 2, 2], [0, 3, 3, 0], [0, 4, 5, 0], [1, 6, 7, 1], [2, 7, 8, 5], [2, 4, 8, 6], [3, 5, 9, 7], [3, 6, 9, 4], [4, 9, 9, 5], [6, 8, 8, 7]]$

Total optimal pinning sets: 3
 Total minimal pinning sets: 4
 Total pinning sets: 132
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.44
 Average overall degree: 2.98

Table 1090: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	3	0	0	0	0	0	0	3
Minimal (suboptimal) pinning sets	0	0	1	0	0	0	0	1
Nonminimal pinning sets	0	16	35	42	26	8	1	128
Average degree	2.33	2.64	2.87	3.05	3.18	3.27	3.33	

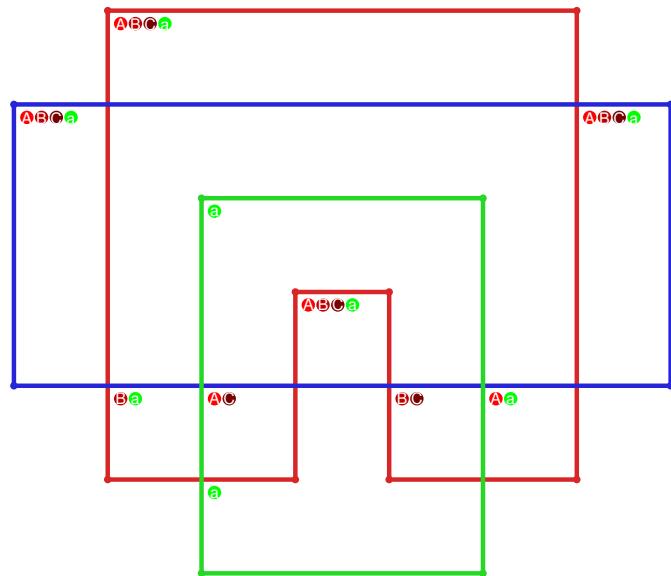


Figure 2183: SnapPy multiloop plot.

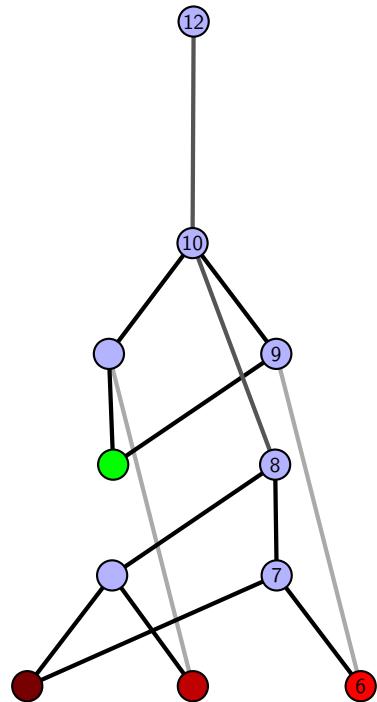


Figure 2184: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.795 $[[8, 16, 1, 9], [9, 17, 10, 20], [7, 19, 8, 20], [15, 1, 16, 2], [17, 3, 18, 4], [10, 6, 11, 7], [13, 18, 14, 19], [2, 14, 3, 15], [4, 13, 5, 12], [5, 11, 6, 12]]$

PD code drawn by SnapPy: $[(20, 1, 17, 2), (13, 4, 14, 5), (10, 7, 11, 8), (3, 14, 4, 15), (15, 2, 16, 3), (8, 9, 1, 10), (6, 11, 7, 12), (16, 17, 9, 18), (5, 18, 6, 19), (19, 12, 20, 13)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 0], [1, 7, 6, 8], [1, 9, 9, 2], [2, 8, 4, 7], [3, 6, 4, 3], [4, 6, 9, 9], [5, 8, 8, 5]]$

Total optimal pinning sets: 4
 Total minimal pinning sets: 4
 Total pinning sets: 144
 Pinning number: 6

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 1091: Pinning sets/average degree by cardinal

Cardinal	6	7	8	9	10	11	12	Total
Optimal pinning sets	4	0	0	0	0	0	0	4
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	20	41	44	26	8	1	140
Average degree	2.33	2.66	2.89	3.06	3.18	3.27	3.33	

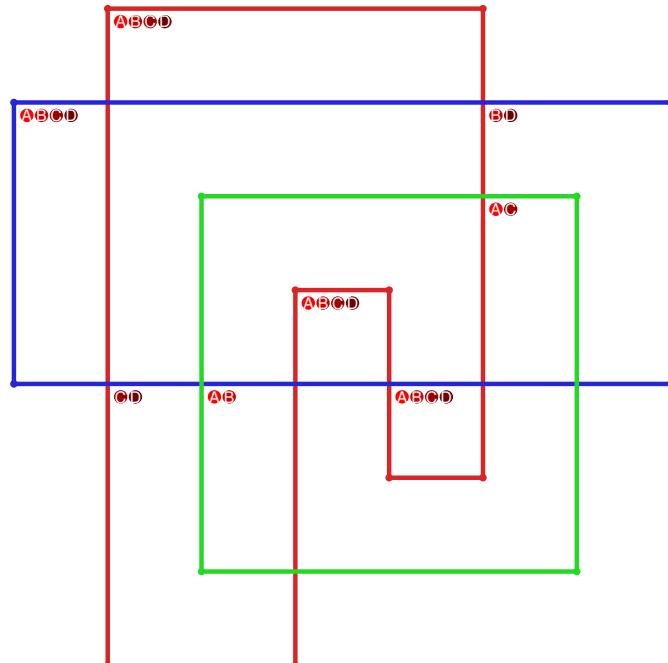


Figure 2185: SnapPy multiloop plot.

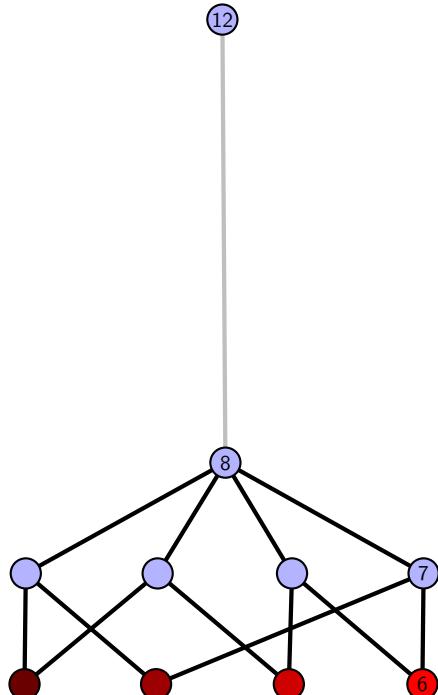


Figure 2186: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.796 [[6, 14, 1, 7], [7, 15, 8, 20], [5, 19, 6, 20], [13, 1, 14, 2], [15, 13, 16, 12], [8, 4, 9, 5], [18, 2, 19, 3], [16, 11, 17, 12], [3, 9, 4, 10], [10, 17, 11, 18]]

PD code drawn by `SnapPy`: [(7, 6, 8, 1), (13, 2, 14, 3), (18, 5, 19, 6), (1, 14, 2, 15), (11, 16, 12, 17), (17, 10, 18, 11), (4, 19, 5, 20), (15, 12, 16, 7), (3, 8, 4, 9), (9, 20, 10, 13)]

Planar representation generated by `plantri`: [[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 6, 4, 0], [1, 3, 7, 7], [1, 8, 8, 2], [2, 8, 9, 3], [4, 9, 9, 4], [5, 9, 6, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 3
 Total pinning sets: 176
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.34
 Average overall degree: 2.98

Table 1092: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

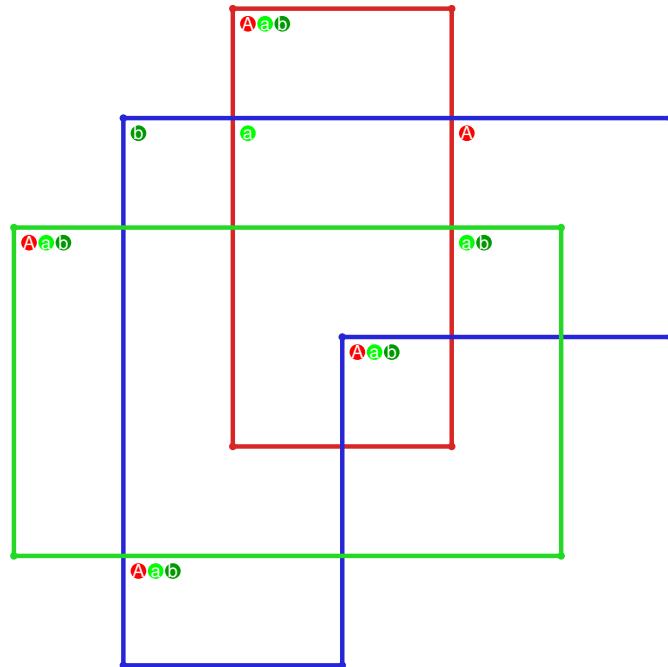


Figure 2187: `SnapPy` multiloop plot.

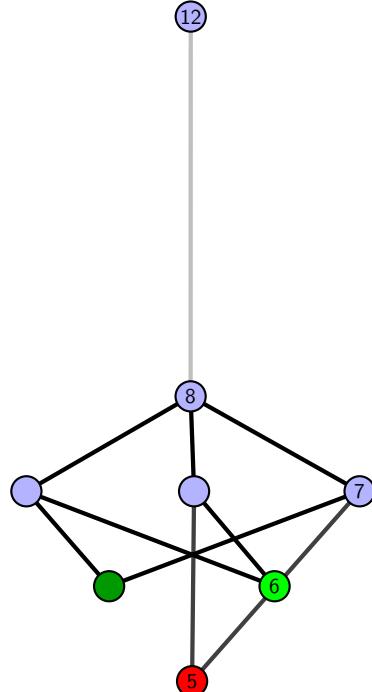


Figure 2188: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.797 $[[6, 14, 1, 7], [7, 15, 8, 20], [9, 5, 10, 6], [13, 1, 14, 2], [15, 13, 16, 12], [8, 19, 9, 20], [4, 18, 5, 19], [10, 3, 11, 2], [16, 11, 17, 12], [17, 3, 18, 4]]$

PD code drawn by `SnapPy`: $[(16, 1, 17, 2), (20, 3, 13, 4), (4, 17, 5, 18), (12, 5, 7, 6), (11, 18, 12, 19), (19, 10, 20, 11), (2, 13, 3, 14), (6, 7, 1, 8), (15, 8, 16, 9), (9, 14, 10, 15)]$

Planar representation generated by `plantri`: $[[1, 2, 3, 3], [0, 4, 5, 5], [0, 5, 6, 7], [0, 7, 4, 0], [1, 3, 8, 8], [1, 6, 2, 1], [2, 5, 9, 9], [2, 9, 8, 3], [4, 7, 9, 4], [6, 8, 7, 6]]$

Total optimal pinning sets: 2
 Total minimal pinning sets: 5
 Total pinning sets: 220
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.48
 Average overall degree: 2.98

Table 1093: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	13	45	65	55	28	8	1	215
Average degree	2.2	2.56	2.81	2.98	3.11	3.2	3.27	3.33	

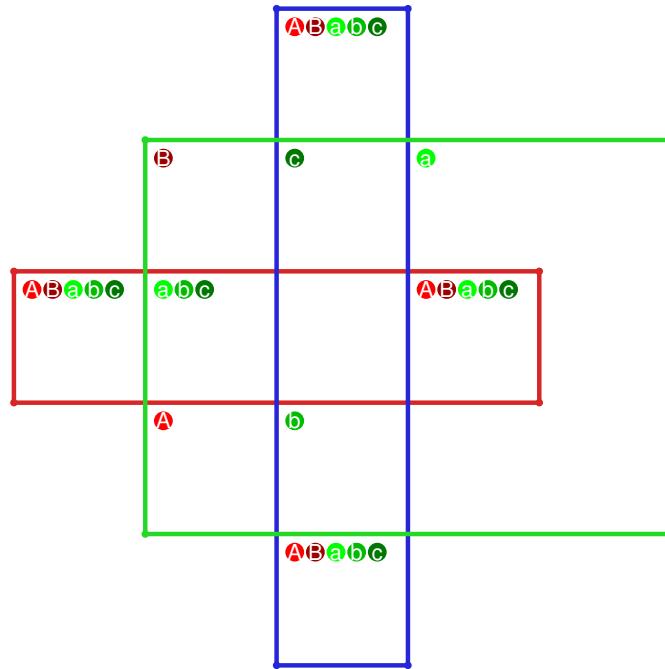


Figure 2189: `SnapPy` multiloop plot.

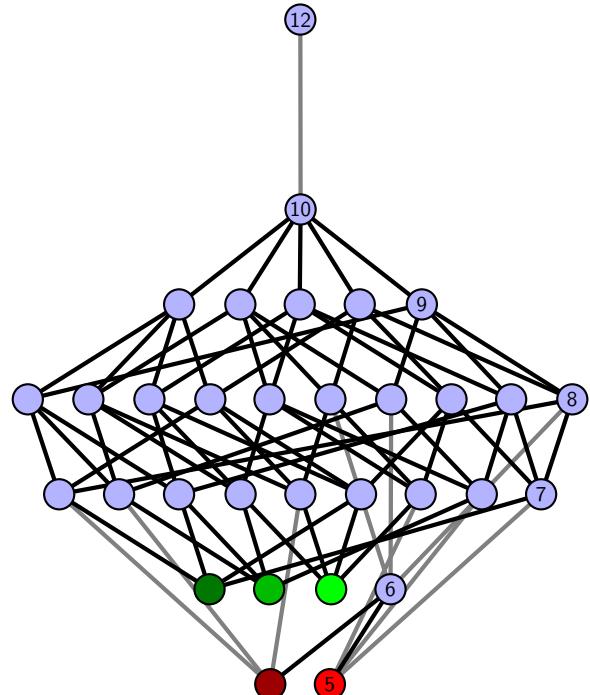


Figure 2190: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.798 [[13, 20, 14, 1], [12, 7, 13, 8], [19, 6, 20, 7], [14, 2, 15, 1], [8, 3, 9, 4], [18, 11, 19, 12], [5, 16, 6, 17], [2, 16, 3, 15], [9, 5, 10, 4], [10, 17, 11, 18]]

PD code drawn by SnapPy: [(6, 1, 7, 2), (2, 7, 3, 8), (17, 4, 18, 5), (10, 5, 11, 6), (16, 9, 17, 10), (13, 20, 14, 1), (3, 14, 4, 15), (8, 15, 9, 16), (11, 18, 12, 19), (19, 12, 20, 13)]

Planar representation generated by plantri: [[1, 2, 3, 3], [0, 4, 5, 2], [0, 1, 5, 6], [0, 7, 7, 0], [1, 7, 8, 8], [1, 9, 9, 2], [2, 9, 8, 7], [3, 6, 4, 3], [4, 6, 9, 4], [5, 8, 6, 5]]

Total optimal pinning sets: 1

Average optimal degree: 2.2

Total minimal pinning sets: 3

Average minimal degree: 2.34

Total pinning sets: 176

Average overall degree: 2.98

Pinning number: 5

Table 1094: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	2	0	0	0	0	0	0	2
Nonminimal pinning sets	0	7	30	51	49	27	8	1	173
Average degree	2.2	2.5	2.75	2.94	3.08	3.19	3.27	3.33	

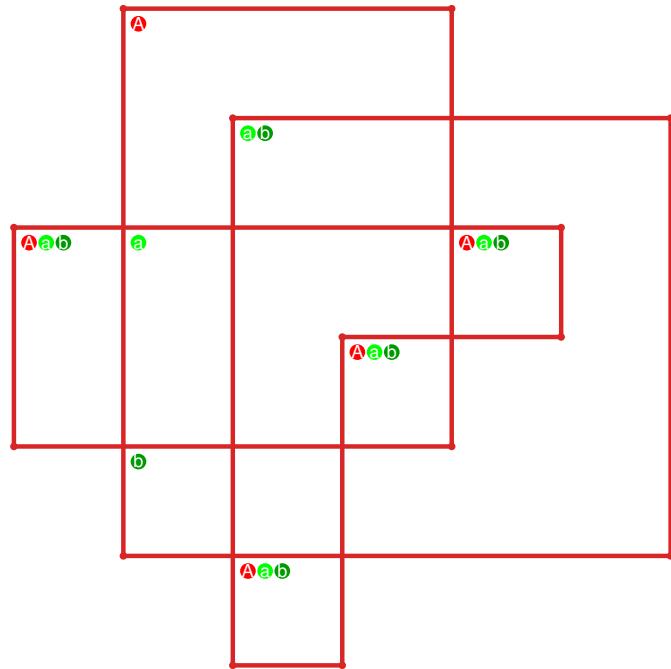


Figure 2191: SnapPy multiloop plot.

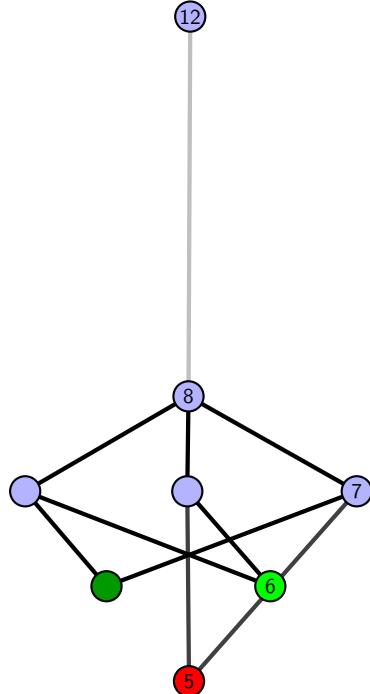


Figure 2192: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.799 [[9, 20, 10, 1], [19, 8, 20, 9], [10, 4, 11, 3], [1, 15, 2, 14], [18, 13, 19, 14], [7, 12, 8, 13], [4, 12, 5, 11], [2, 15, 3, 16], [6, 17, 7, 18], [5, 17, 6, 16]]

PD code drawn by `SnapPy`: [(1, 8, 2, 9), (17, 6, 18, 7), (9, 2, 10, 3), (5, 10, 6, 11), (16, 11, 17, 12), (12, 19, 13, 20), (20, 13, 1, 14), (14, 3, 15, 4), (4, 15, 5, 16), (7, 18, 8, 19)]

Planar representation generated by `plantri`: [[1, 1, 2, 3], [0, 4, 5, 0], [0, 6, 6, 7], [0, 7, 7, 4], [1, 3, 8, 5], [1, 4, 8, 6], [2, 5, 9, 2], [2, 9, 3, 3], [4, 9, 9, 5], [6, 8, 8, 7]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 2
 Total pinning sets: 192
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.2
 Average overall degree: 2.97

Table 1095: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

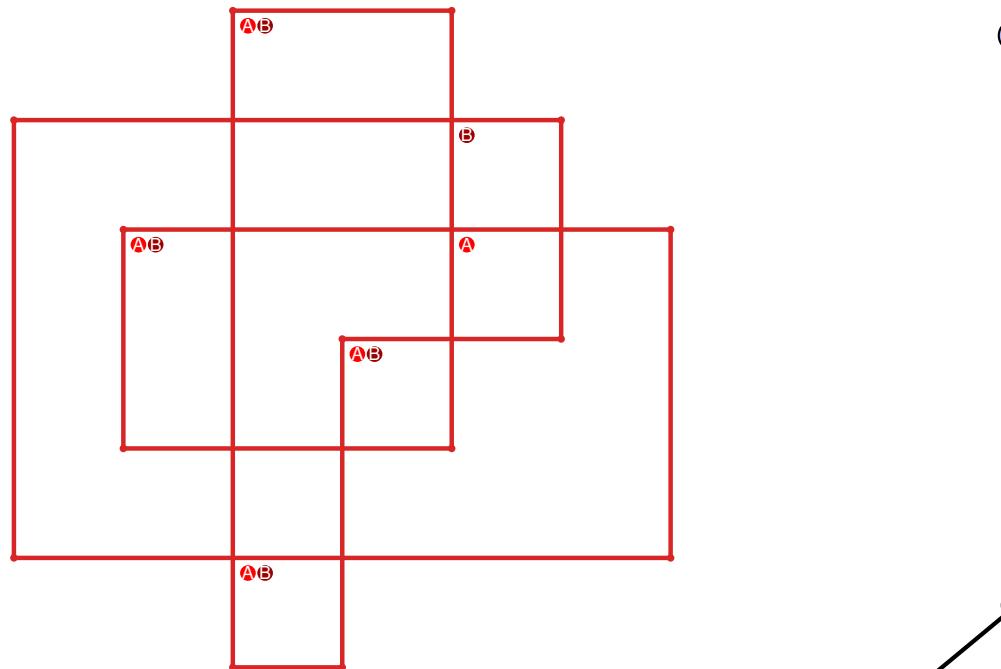


Figure 2193: `SnapPy` multiloop plot.

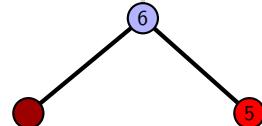


Figure 2194: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.800 [[20, 13, 1, 14], [14, 9, 15, 10], [12, 19, 13, 20], [1, 17, 2, 16], [8, 15, 9, 16], [10, 3, 11, 4], [4, 11, 5, 12], [5, 18, 6, 19], [17, 6, 18, 7], [2, 7, 3, 8]]

PD code drawn by `SnapPy`: [(8, 1, 9, 2), (15, 4, 16, 5), (20, 5, 1, 6), (12, 7, 13, 8), (2, 9, 3, 10), (18, 11, 19, 12), (6, 13, 7, 14), (14, 19, 15, 20), (3, 16, 4, 17), (10, 17, 11, 18)]

Planar representation generated by `plantri`: [[1, 2, 2, 3], [0, 4, 4, 5], [0, 6, 7, 0], [0, 8, 9, 4], [1, 3, 9, 1], [1, 9, 6, 6], [2, 5, 5, 7], [2, 6, 8, 8], [3, 7, 7, 9], [3, 8, 5, 4]]

Total optimal pinning sets: 2
Total minimal pinning sets: 2

Total pinning sets: 192

Pinning number: 5

Average optimal degree: 2.2

Average minimal degree: 2.2

Average overall degree: 2.97

Table 1096: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	13	36	55	50	27	8	1	190
Average degree	2.2	2.54	2.78	2.95	3.09	3.19	3.27	3.33	

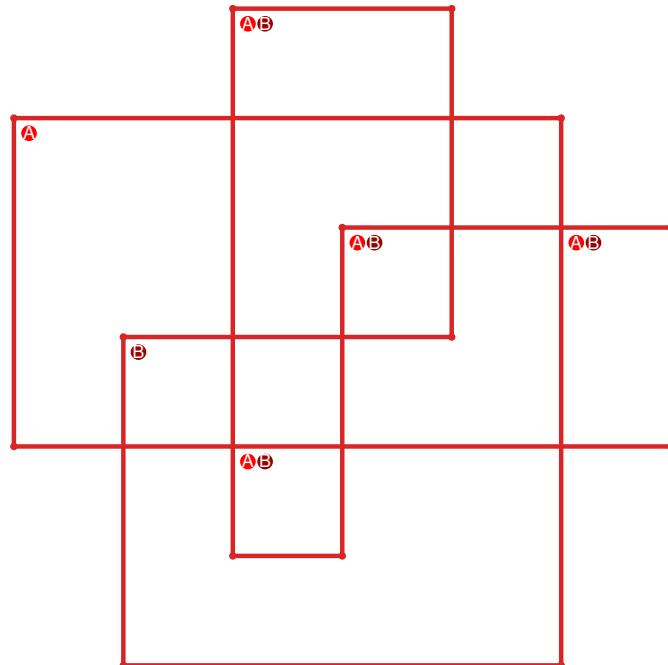


Figure 2195: `SnapPy` multiloop plot.

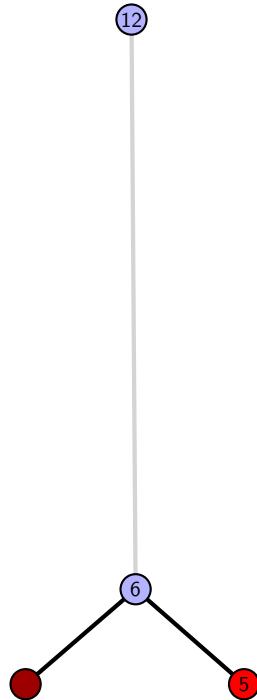


Figure 2196: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.801 $[[6, 20, 1, 7], [7, 14, 8, 15], [15, 5, 16, 6], [19, 1, 20, 2], [13, 8, 14, 9], [4, 12, 5, 13], [16, 3, 17, 2], [18, 9, 19, 10], [11, 3, 12, 4], [17, 11, 18, 10]]$

PD code drawn by SnapPy: $[(10, 1, 11, 2), (14, 3, 15, 4), (4, 11, 5, 12), (20, 5, 7, 6), (13, 18, 14, 19), (19, 12, 20, 13), (6, 7, 1, 8), (16, 9, 17, 10), (2, 15, 3, 16), (8, 17, 9, 18)]$

Planar representation generated by plantri: $[[1, 2, 3, 3], [0, 4, 4, 2], [0, 1, 5, 6], [0, 6, 7, 0], [1, 7, 5, 1], [2, 4, 8, 8], [2, 8, 9, 3], [3, 9, 9, 4], [5, 9, 6, 5], [6, 8, 7, 7]]$

Total optimal pinning sets: 6
 Total minimal pinning sets: 6
 Total pinning sets: 252
 Pinning number: 5

Average optimal degree: 2.33
 Average minimal degree: 2.33
 Average overall degree: 2.97

Table 1097: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	6	0	0	0	0	0	0	0	6
Minimal (suboptimal) pinning sets	0	0	0	0	0	0	0	0	0
Nonminimal pinning sets	0	27	56	70	56	28	8	1	246
Average degree	2.33	2.65	2.86	3.0	3.11	3.2	3.27	3.33	

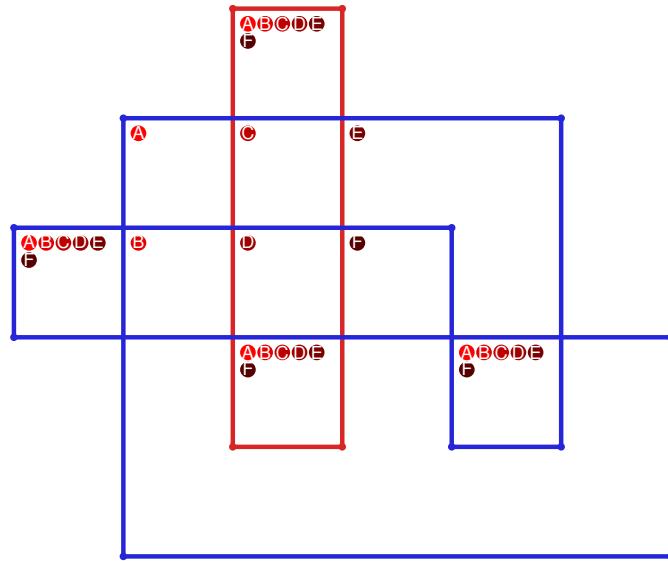


Figure 2197: SnapPy multiloop plot.

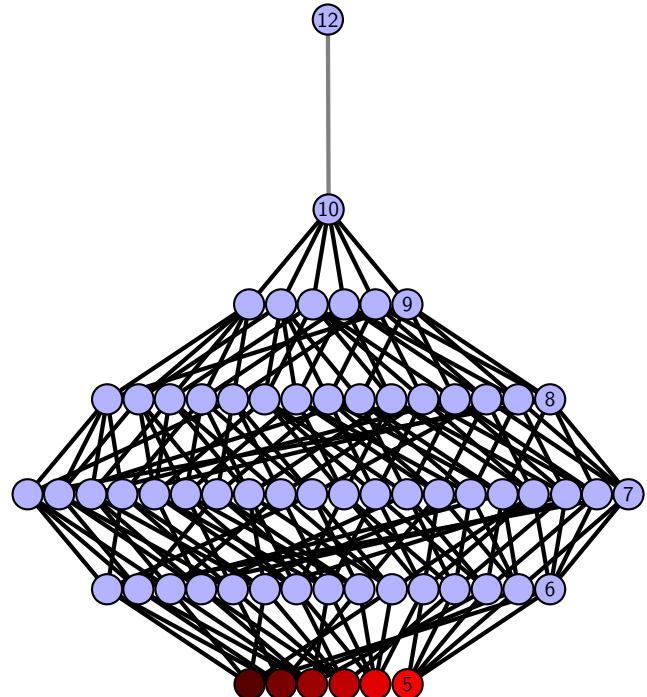


Figure 2198: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.802 [[20, 15, 1, 16], [16, 3, 17, 4], [12, 19, 13, 20], [7, 14, 8, 15], [1, 8, 2, 9], [9, 2, 10, 3], [17, 5, 18, 4], [18, 11, 19, 12], [13, 6, 14, 7], [10, 6, 11, 5]]

PD code drawn by SnapPy: [(7, 20, 8, 1), (14, 1, 15, 2), (2, 15, 3, 16), (3, 8, 4, 9), (11, 4, 12, 5), (19, 6, 20, 7), (16, 9, 17, 10), (5, 12, 6, 13), (18, 13, 19, 14), (10, 17, 11, 18)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 7, 7, 8], [0, 8, 8, 4], [0, 3, 5, 5], [1, 4, 4, 9], [1, 9, 7, 1], [2, 6, 9, 2], [2, 9, 3, 3], [5, 8, 7, 6]]

Total optimal pinning sets: 2
 Total minimal pinning sets: 6
 Total pinning sets: 228
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.51
 Average overall degree: 2.98

Table 1098: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	2	0	0	0	0	0	0	0	2
Minimal (suboptimal) pinning sets	0	4	0	0	0	0	0	0	4
Nonminimal pinning sets	0	13	48	68	56	28	8	1	222
Average degree	2.2	2.57	2.82	2.99	3.11	3.2	3.27	3.33	

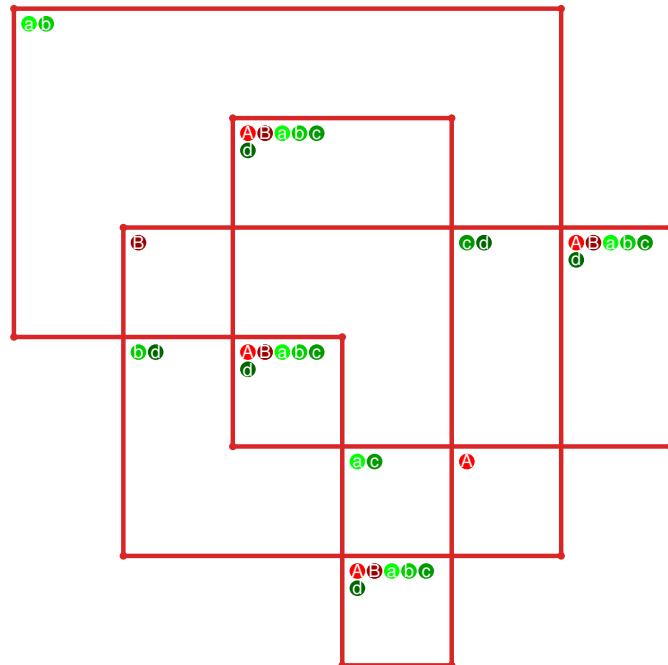


Figure 2199: SnapPy multiloop plot.

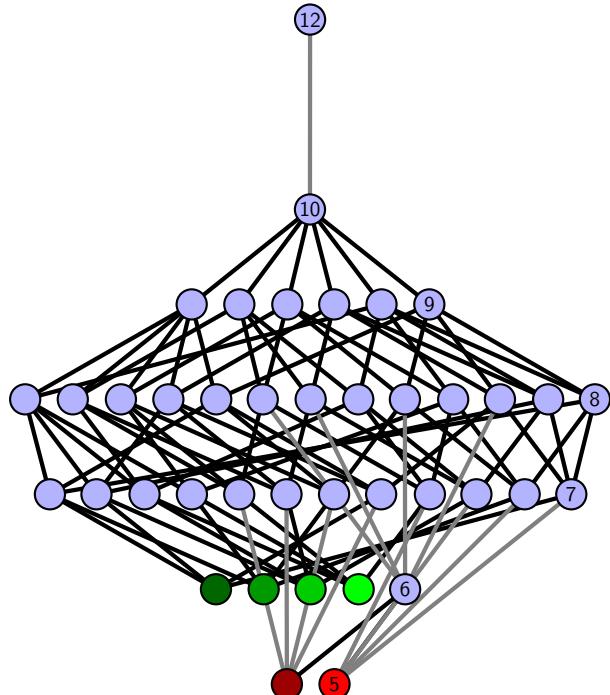


Figure 2200: Minimal join sub-semi-lattice of minimal pinning sets.

4.9.803 [[20, 7, 1, 8], [8, 3, 9, 4], [12, 19, 13, 20], [13, 6, 14, 7], [1, 14, 2, 15], [15, 2, 16, 3], [9, 5, 10, 4], [18, 11, 19, 12], [5, 16, 6, 17], [10, 17, 11, 18]]

PD code drawn by SnapPy: [(20, 5, 1, 6), (9, 2, 10, 3), (16, 3, 17, 4), (14, 7, 15, 8), (17, 10, 18, 11), (1, 12, 2, 13), (6, 13, 7, 14), (8, 15, 9, 16), (11, 18, 12, 19), (4, 19, 5, 20)]

Planar representation generated by plantri: [[1, 2, 3, 4], [0, 5, 6, 6], [0, 7, 7, 3], [0, 2, 8, 4], [0, 3, 5, 5], [1, 4, 4, 8], [1, 8, 9, 1], [2, 9, 9, 2], [3, 9, 6, 5], [6, 8, 7, 7]]

Total optimal pinning sets: 1
 Total minimal pinning sets: 4
 Total pinning sets: 184
 Pinning number: 5

Average optimal degree: 2.2
 Average minimal degree: 2.38
 Average overall degree: 2.98

Table 1099: Pinning sets/average degree by cardinal

Cardinal	5	6	7	8	9	10	11	12	Total
Optimal pinning sets	1	0	0	0	0	0	0	0	1
Minimal (suboptimal) pinning sets	0	3	0	0	0	0	0	0	3
Nonminimal pinning sets	0	7	33	54	50	27	8	1	180
Average degree	2.2	2.5	2.76	2.95	3.09	3.19	3.27	3.33	

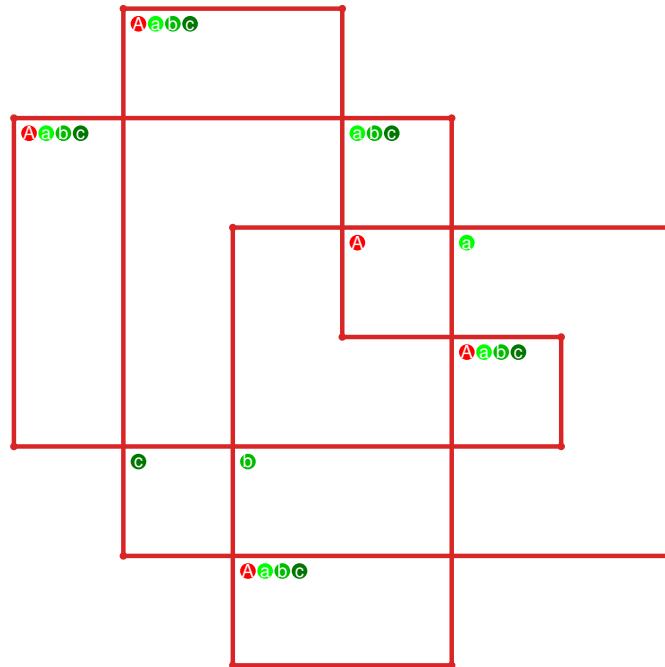


Figure 2201: SnapPy multiloop plot.

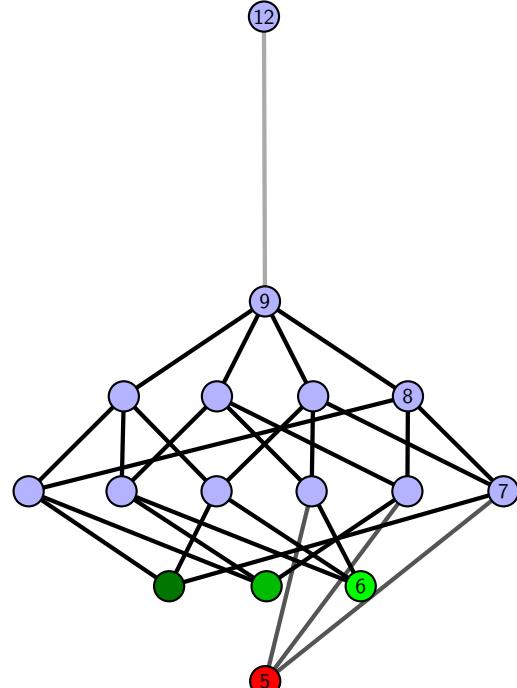


Figure 2202: Minimal join sub-semi-lattice of minimal pinning sets.