

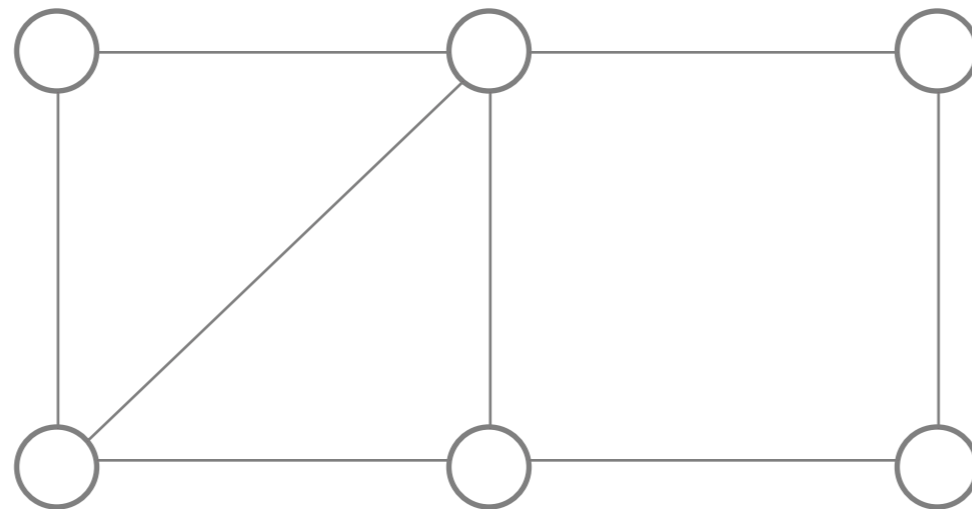
# Graph Coloring

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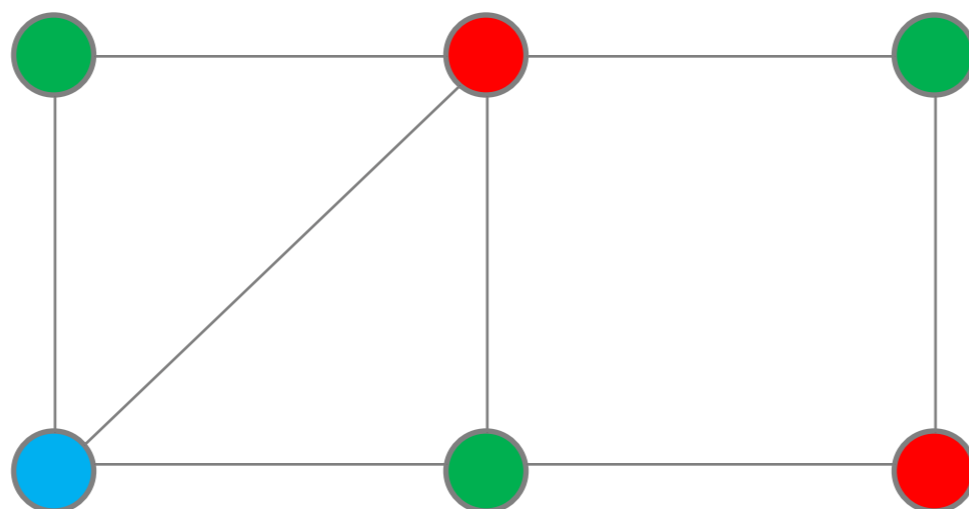
# Graph Coloring

- Given a graph with vertices (circles) connected by edges (lines)
- Color the vertices such that vertices connected by an edge are different colors



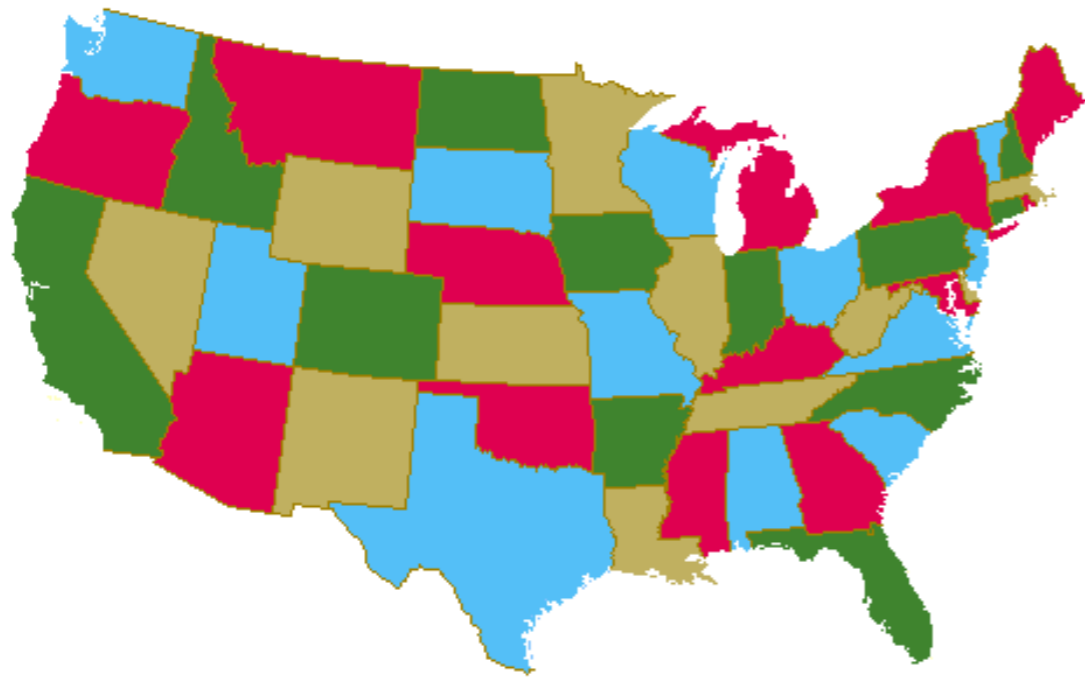
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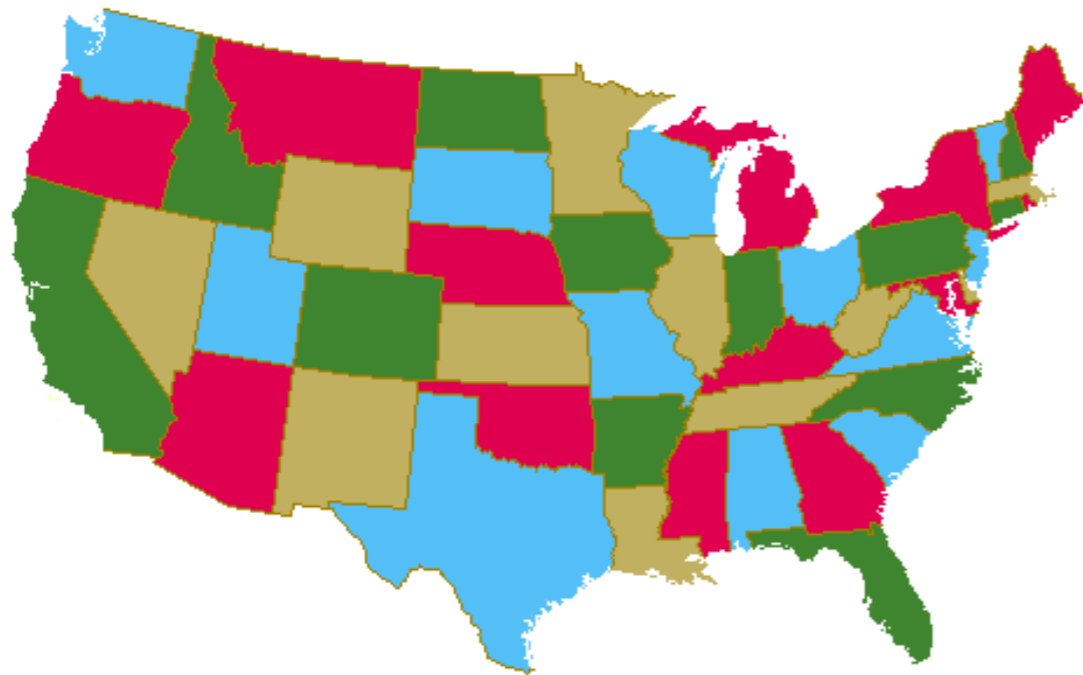
# Applications of Graph Coloring

- Coloring maps (no two adjacent states/countries may have same color)
- Scheduling exams (classes with the same student must have exams at different times)
- Compiling computer programs (register allocation)
- Parallel computers (scheduling tasks with shared data)



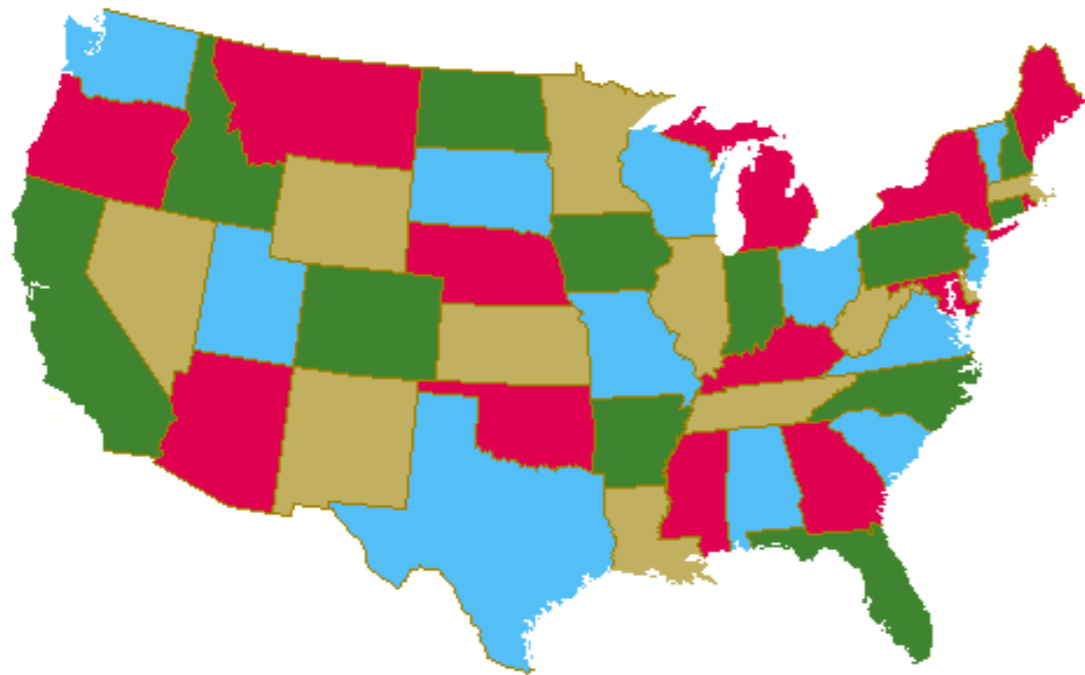
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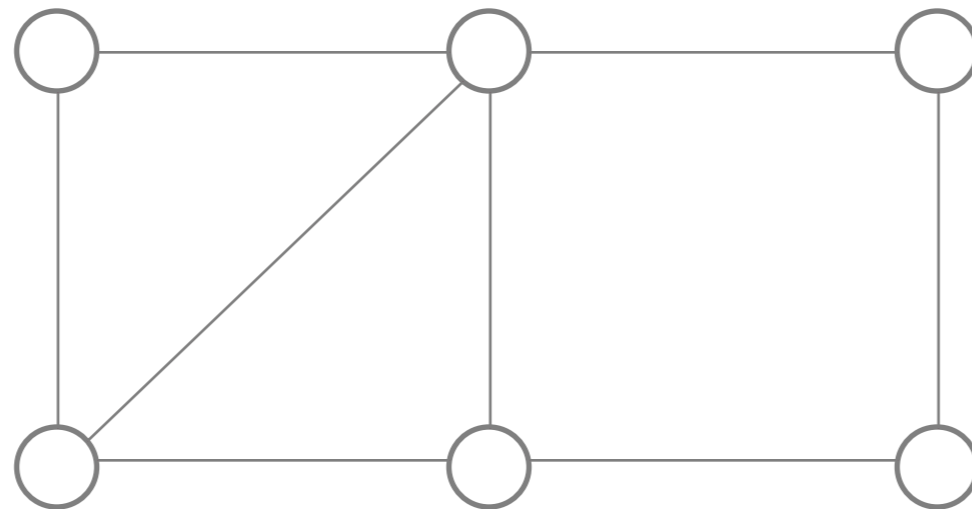
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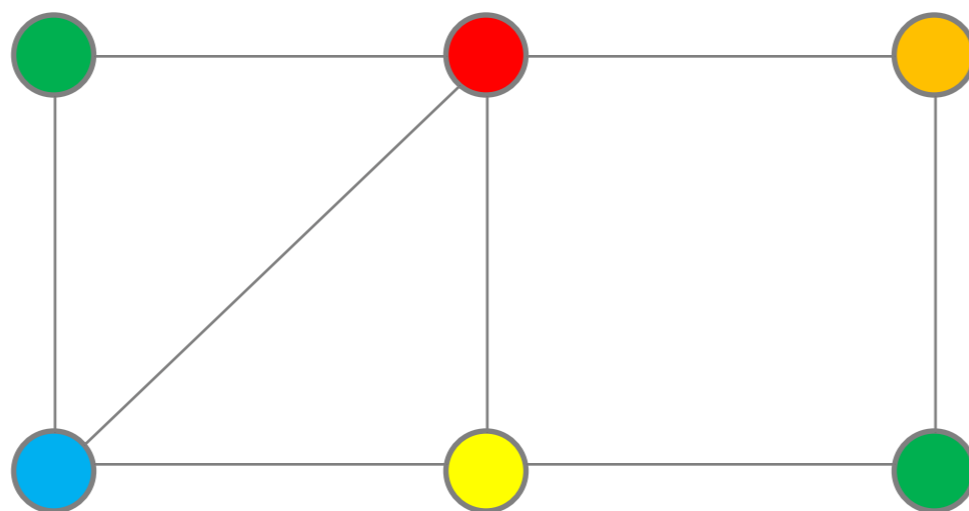
# Distance-2 Graph Coloring

- Given a graph with vertices (circles) connected by edges (lines)
- Color the vertices such that vertices connected by an edge or connected to the same neighbor are different colors



# Graph Coloring

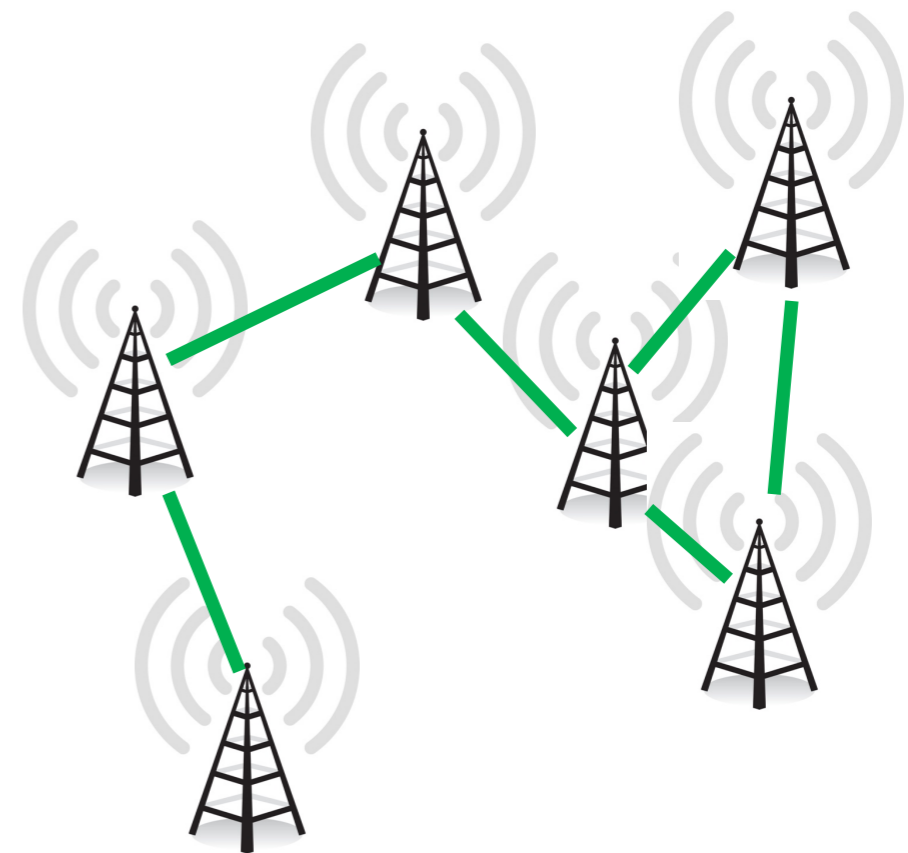
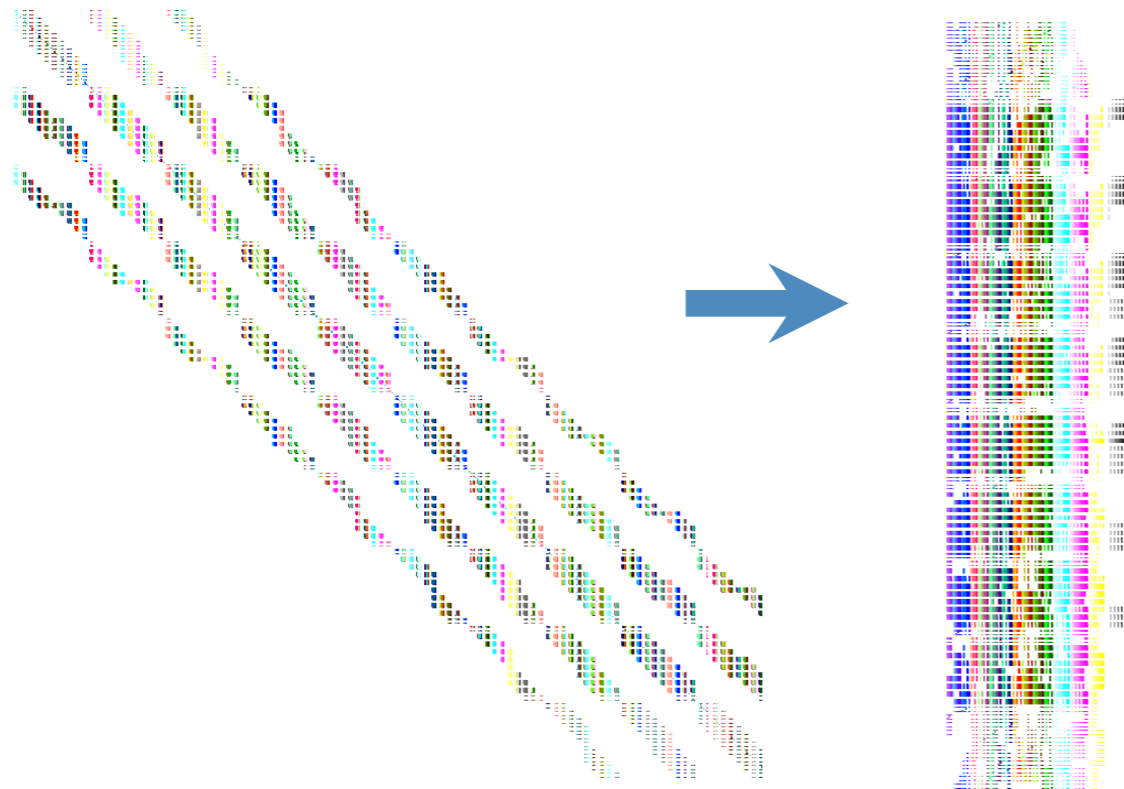
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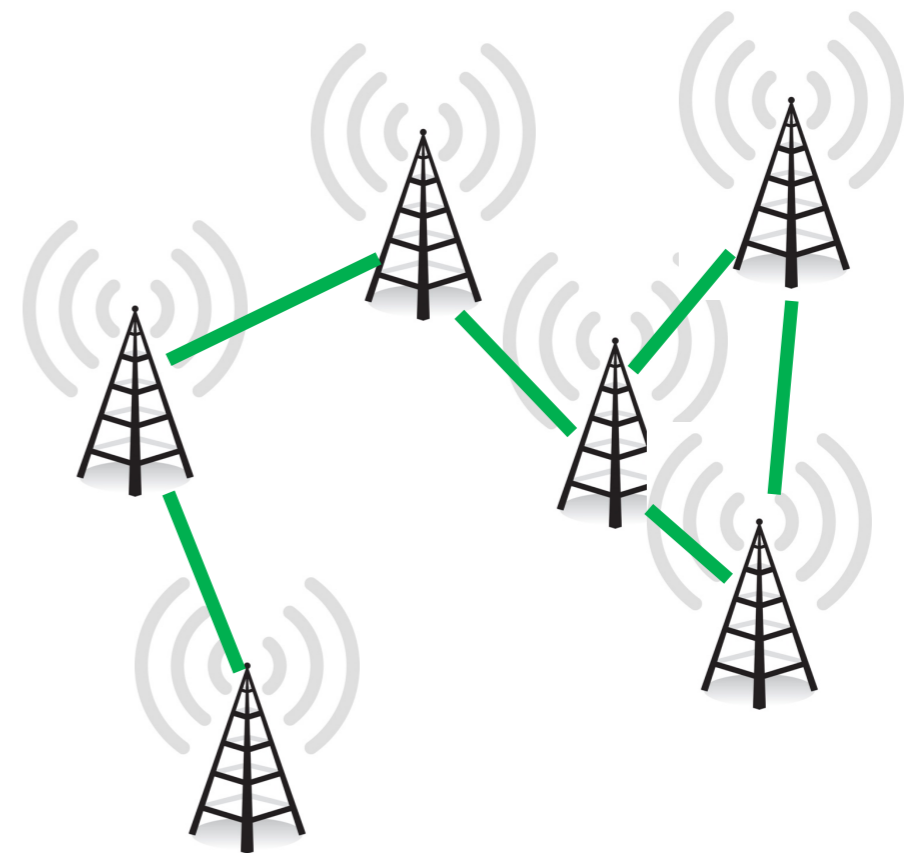
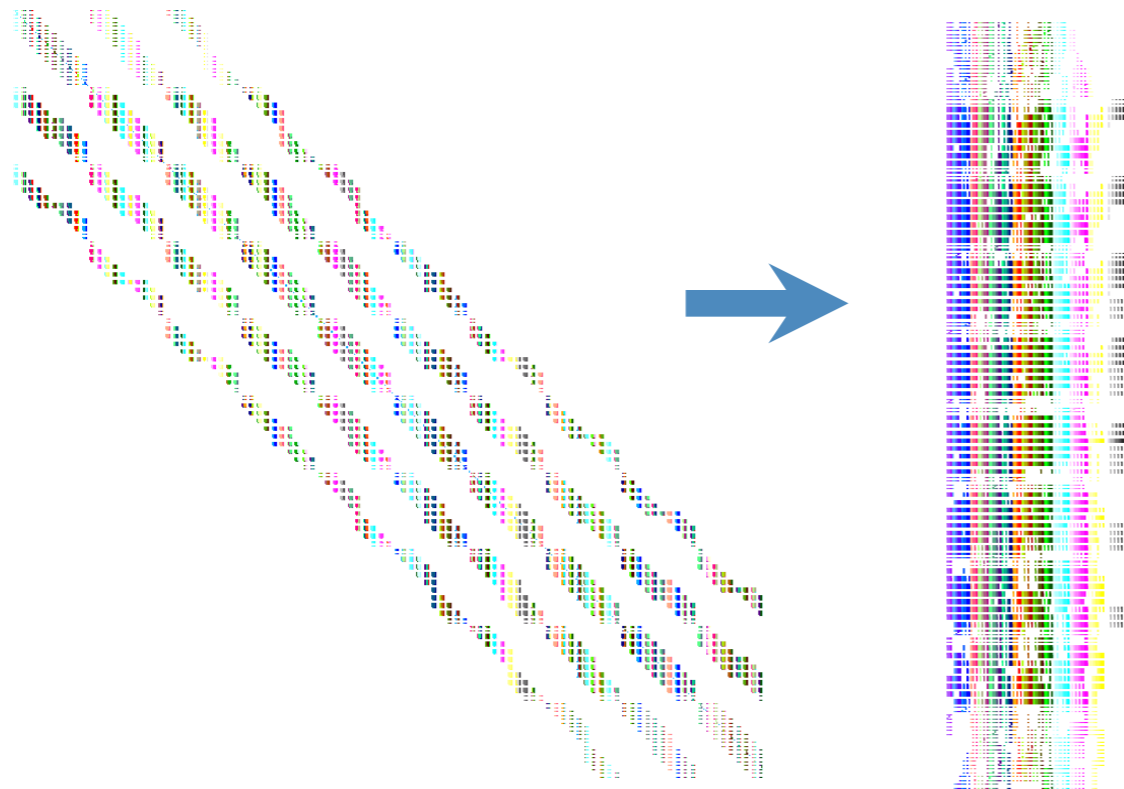
# Applications of Distance-2 Graph Coloring

- Scheduling exams (same as before, but with vertices for students and exams)
- Cellular tower frequency assignment (make sure that all neighbors of a tower use different frequencies)
- Compute mathematical derivatives faster



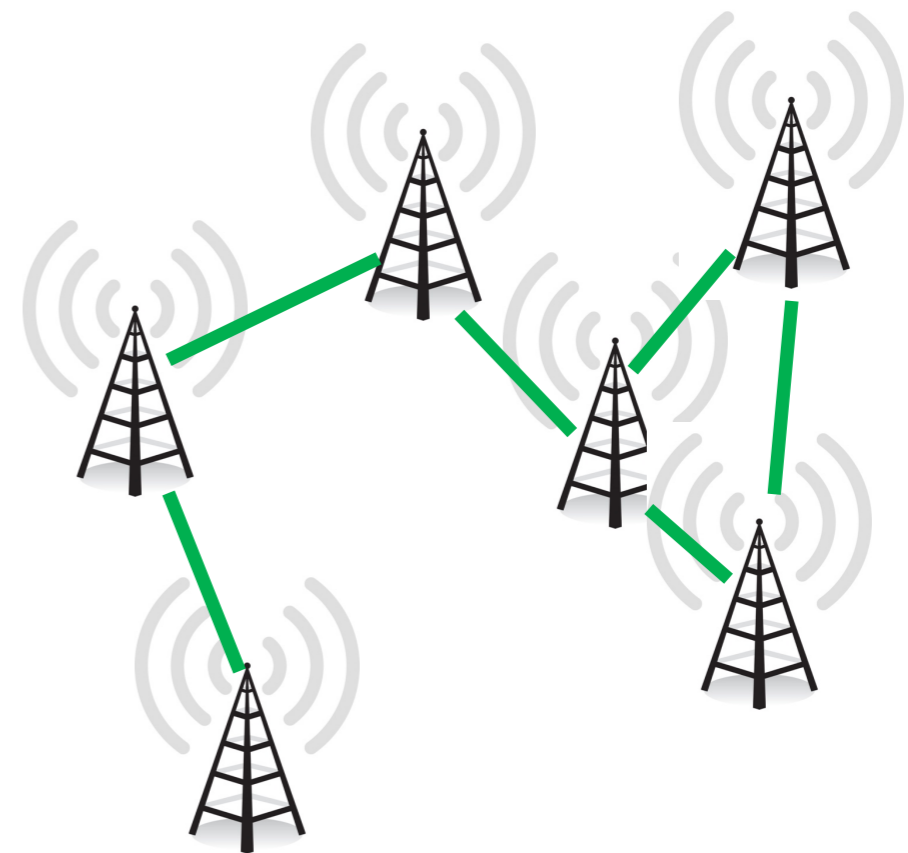
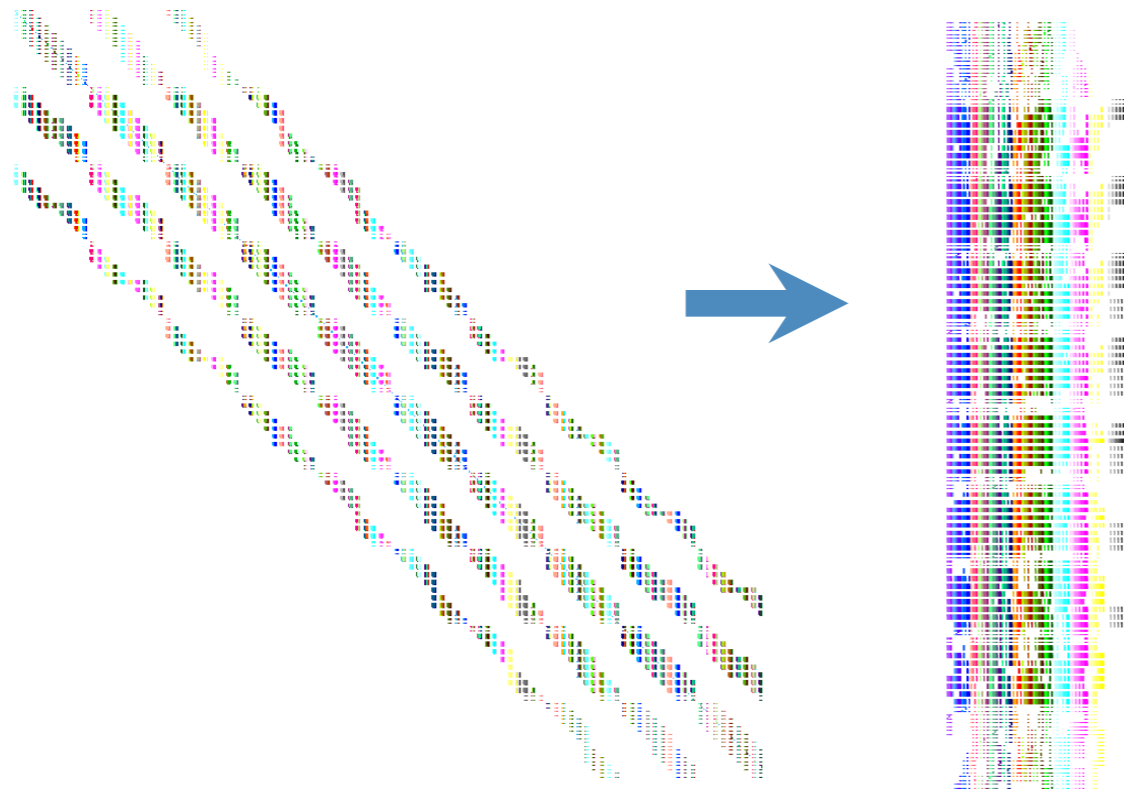
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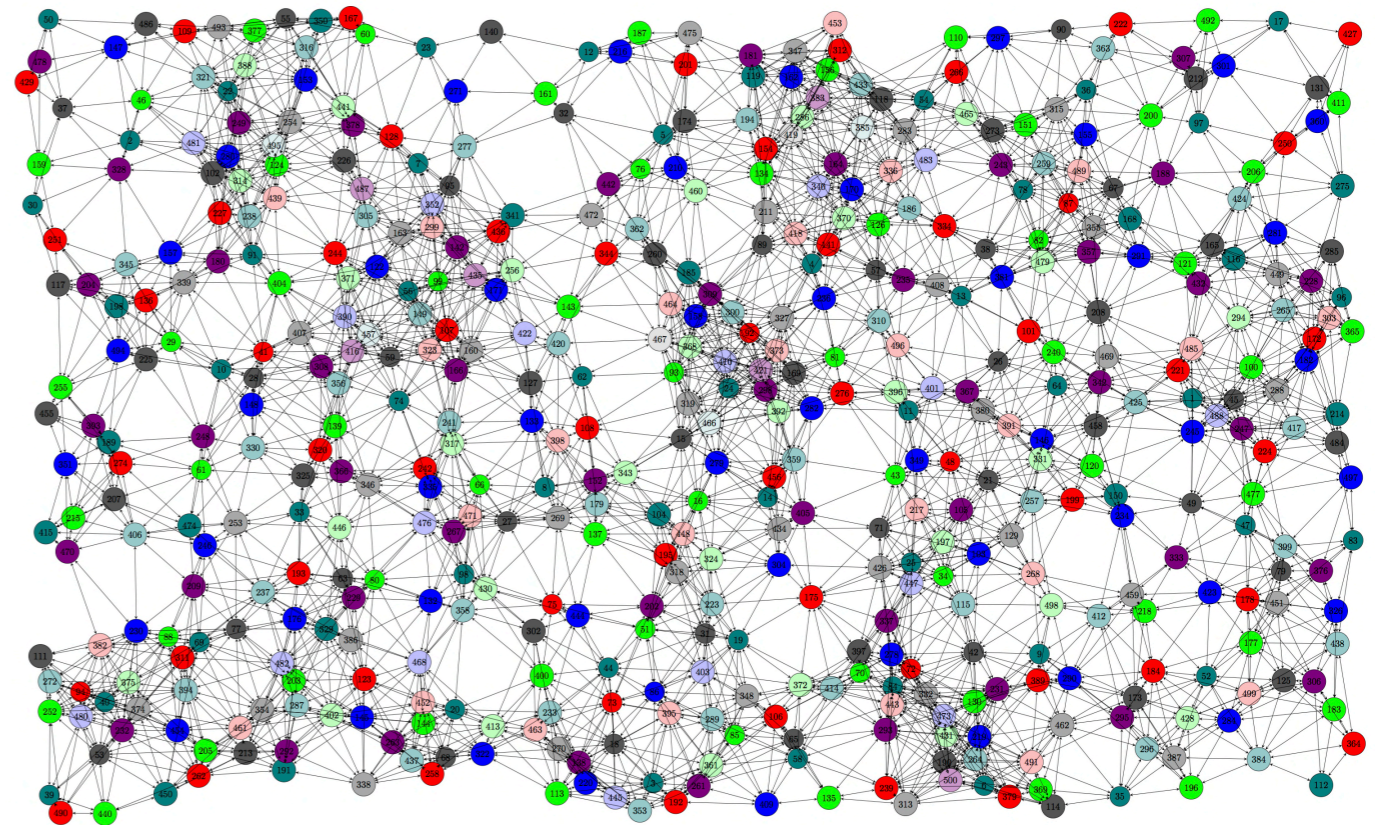
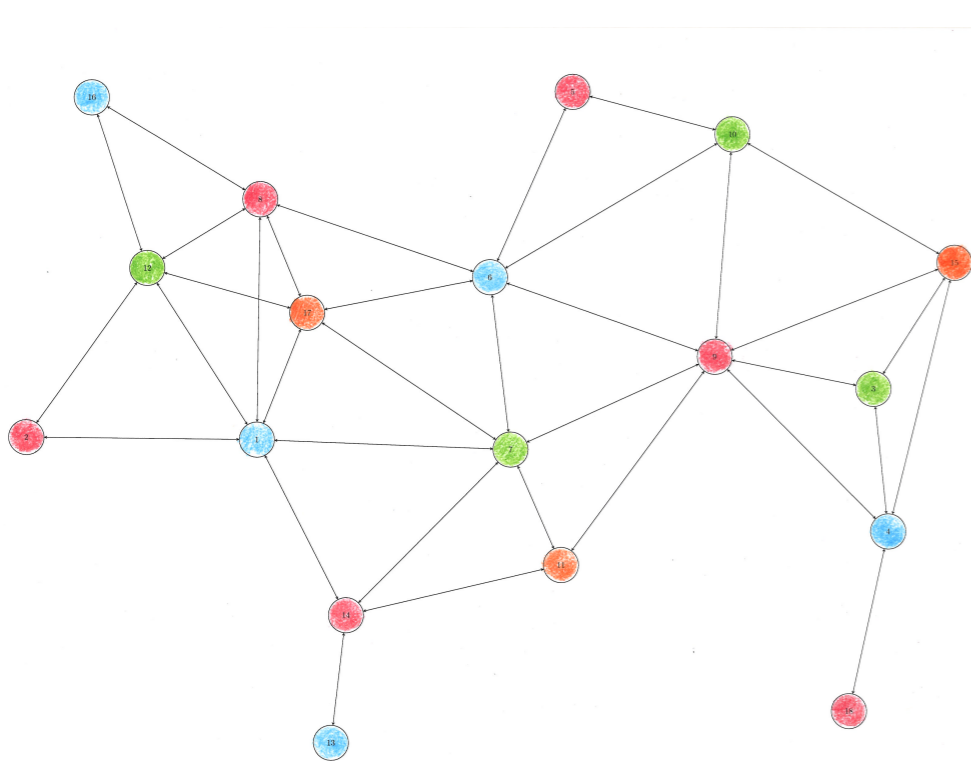
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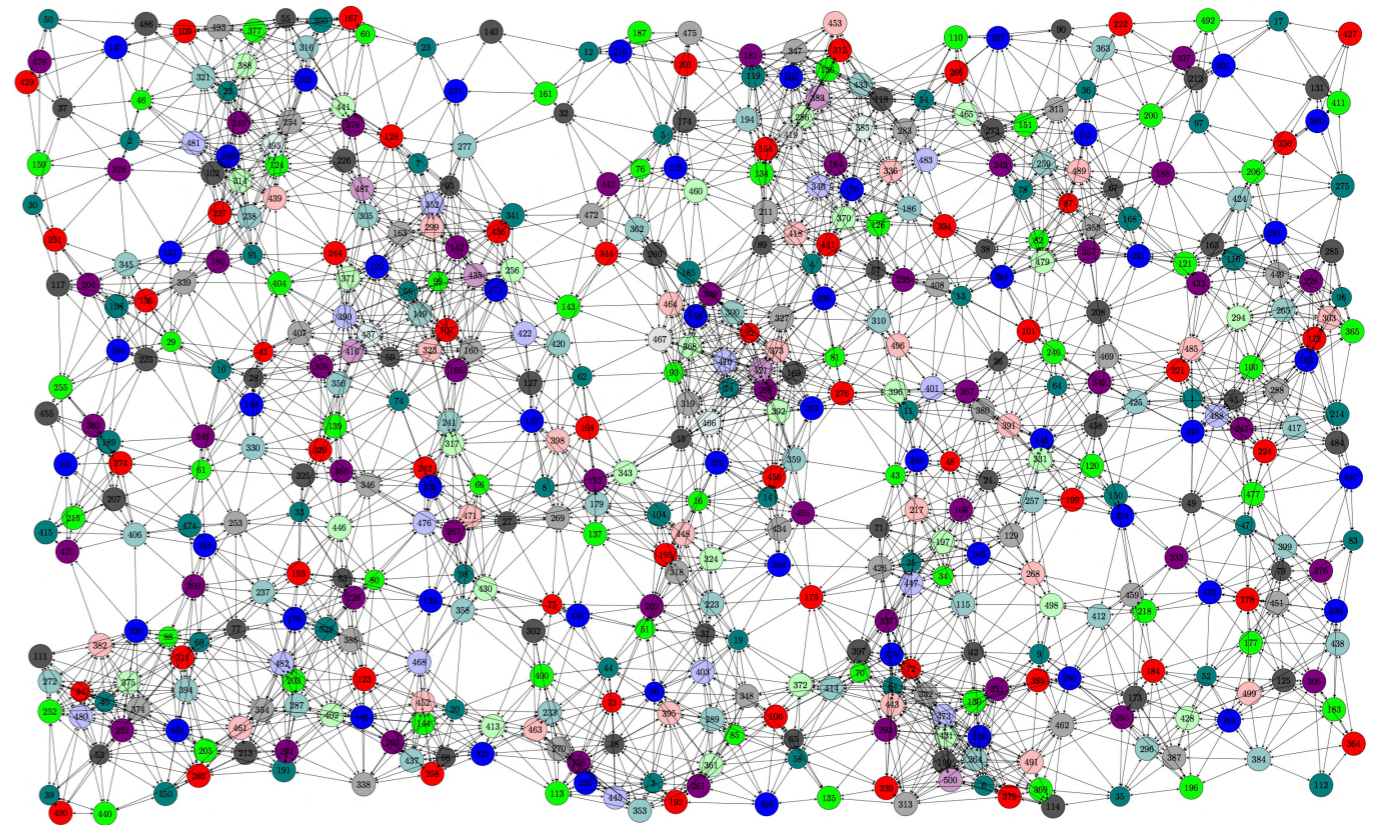
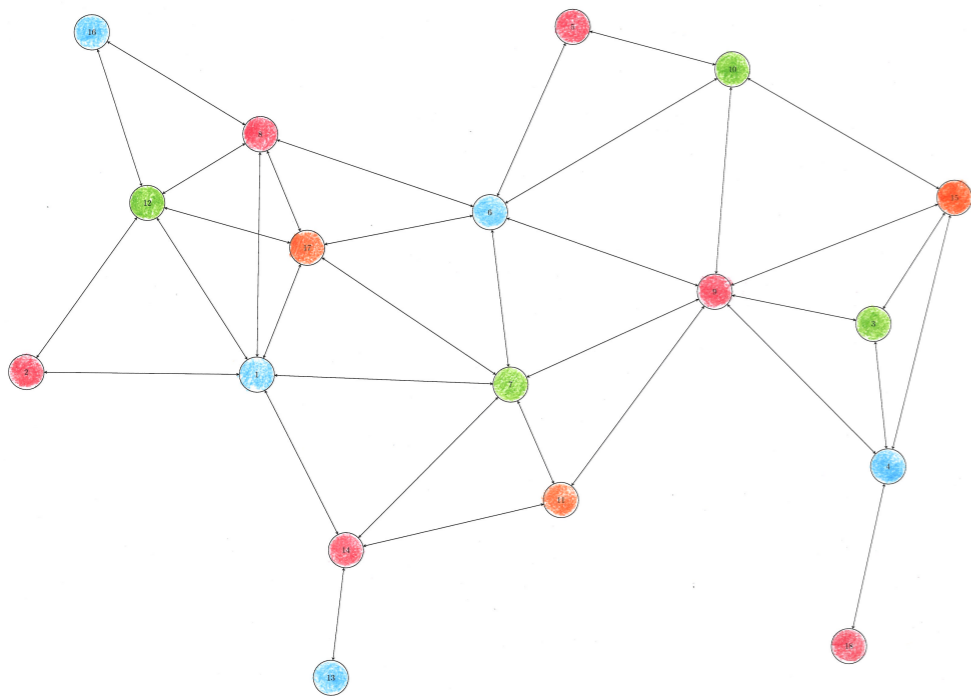
# Let's color some graphs!

- By hand (we have lots of crayons and uncolored graphs)
- Using a computer: two ways!
  - Fast methods that might not use the smallest possible number of colors
  - Slower methods that guarantee the smallest possible number of colors

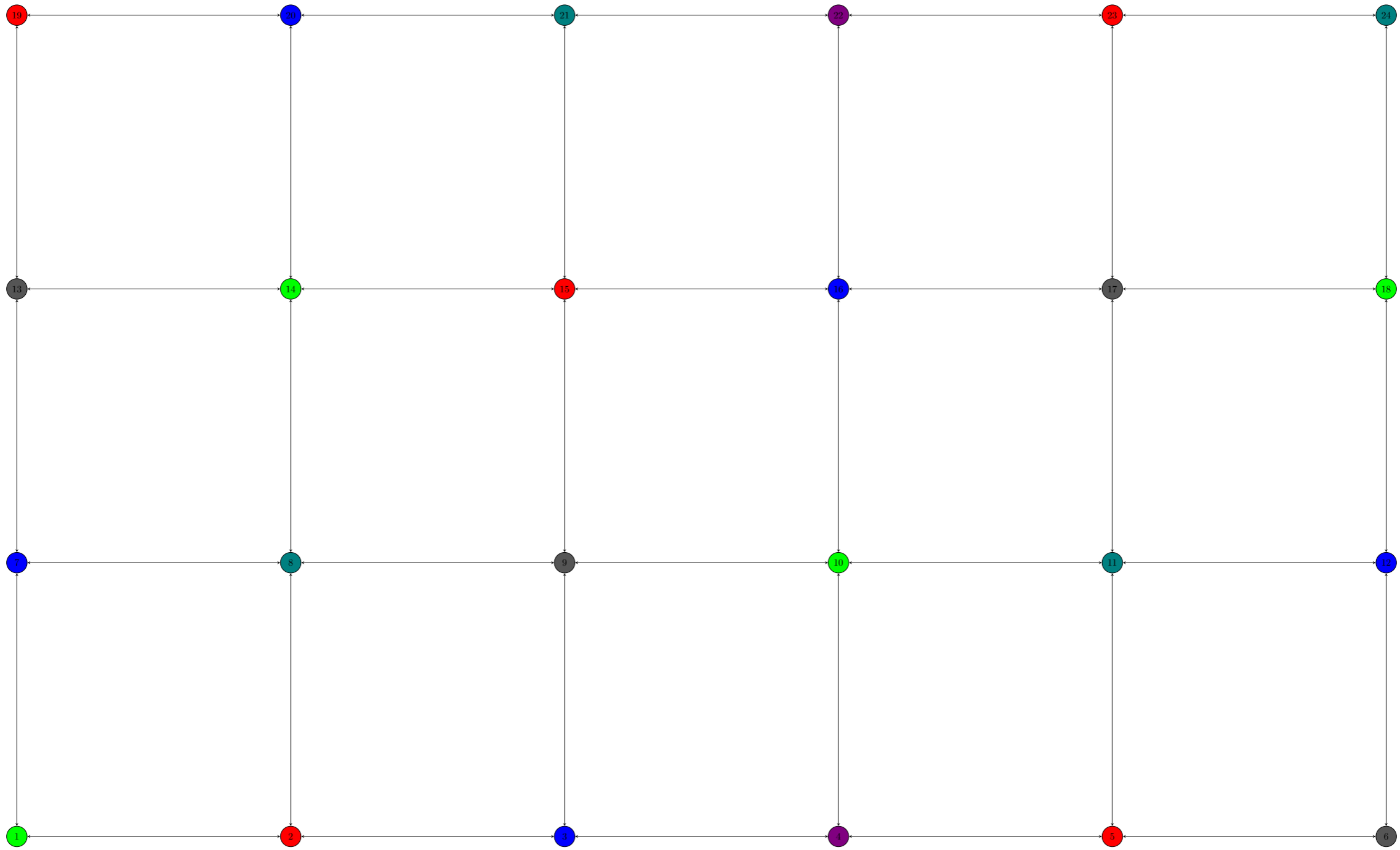


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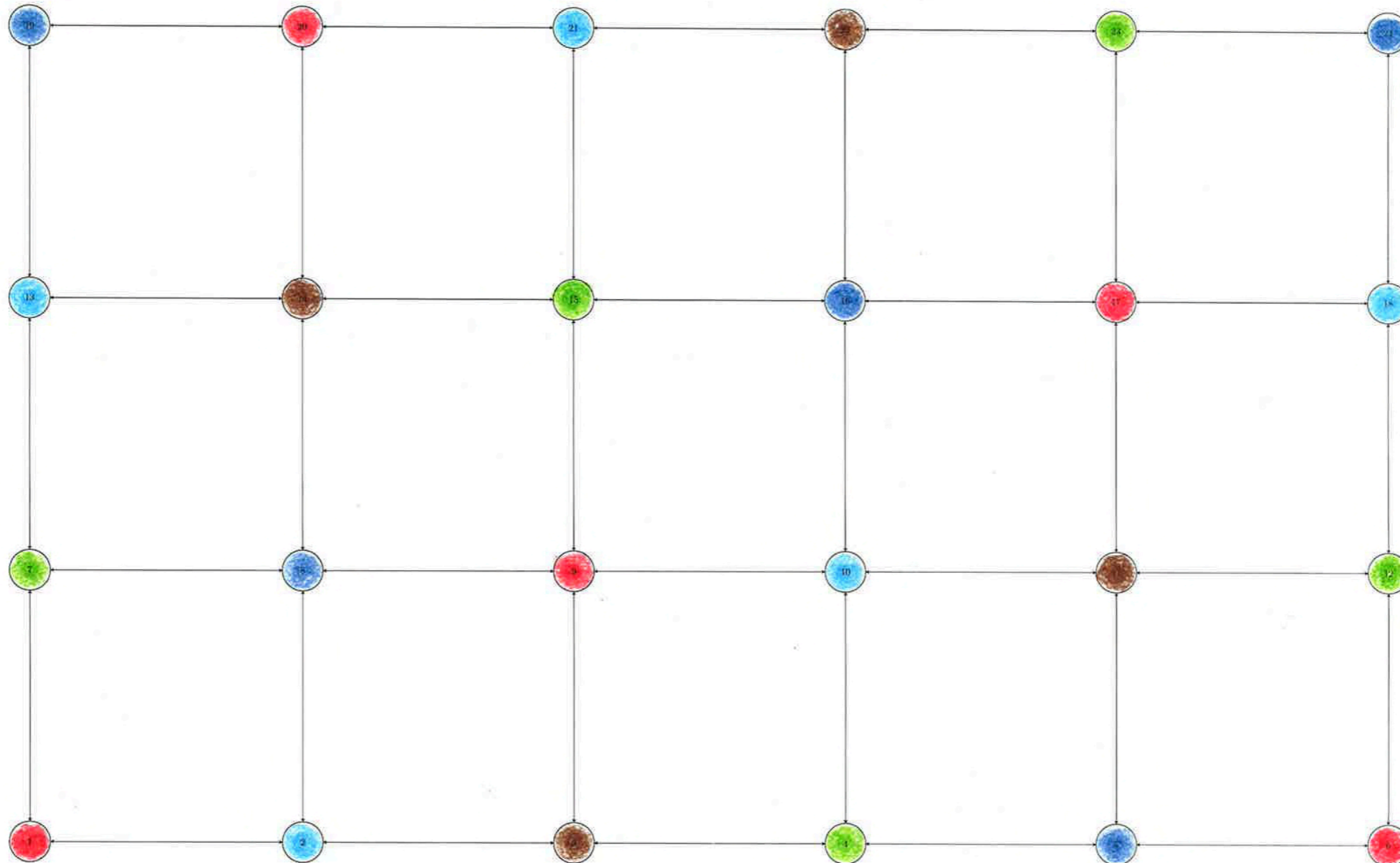
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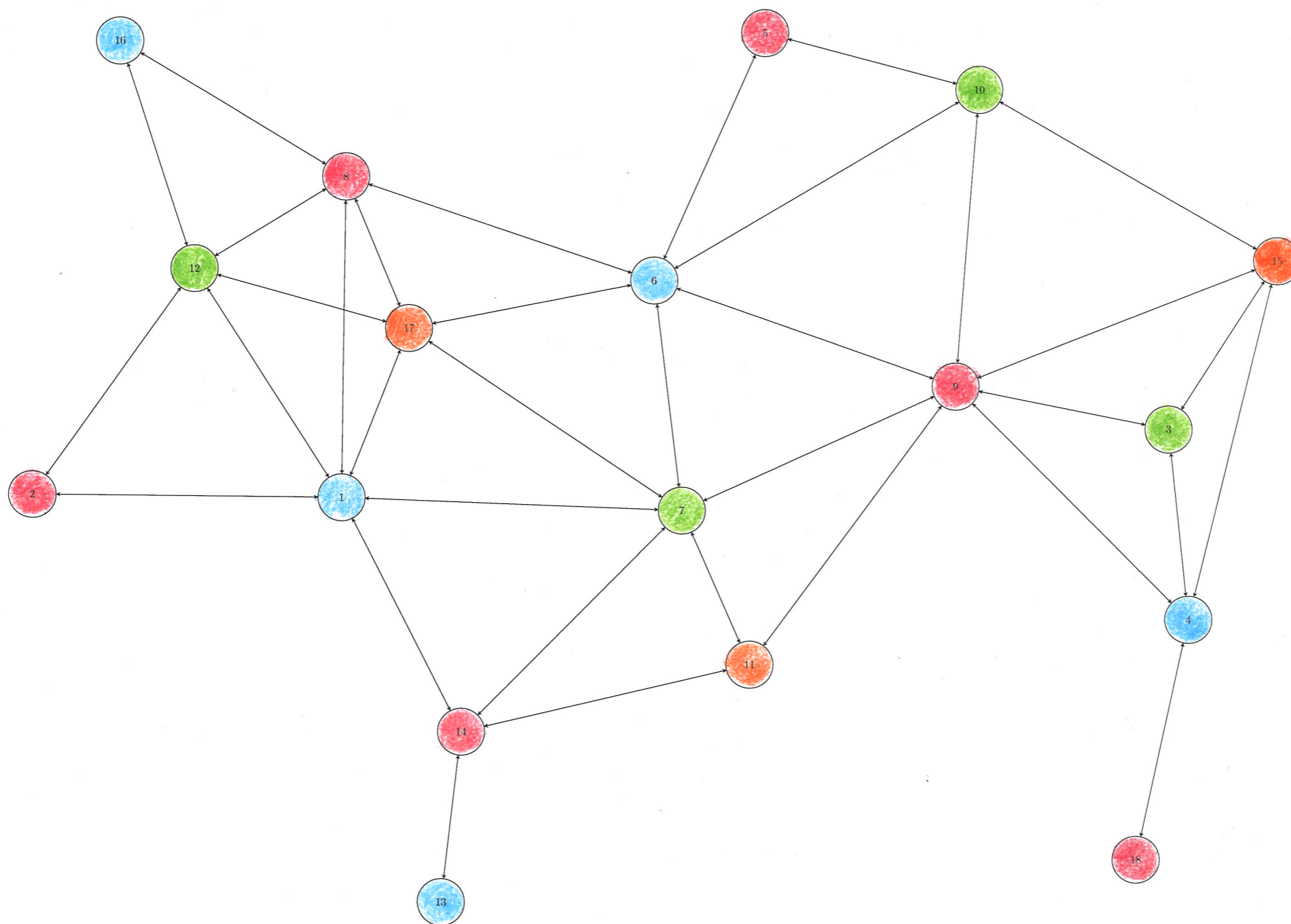
# Distance-2 Coloring by a Computer: .01 secs, 6 colors



# Distance-2 Coloring by a Human: 10 minutes, 5 colors

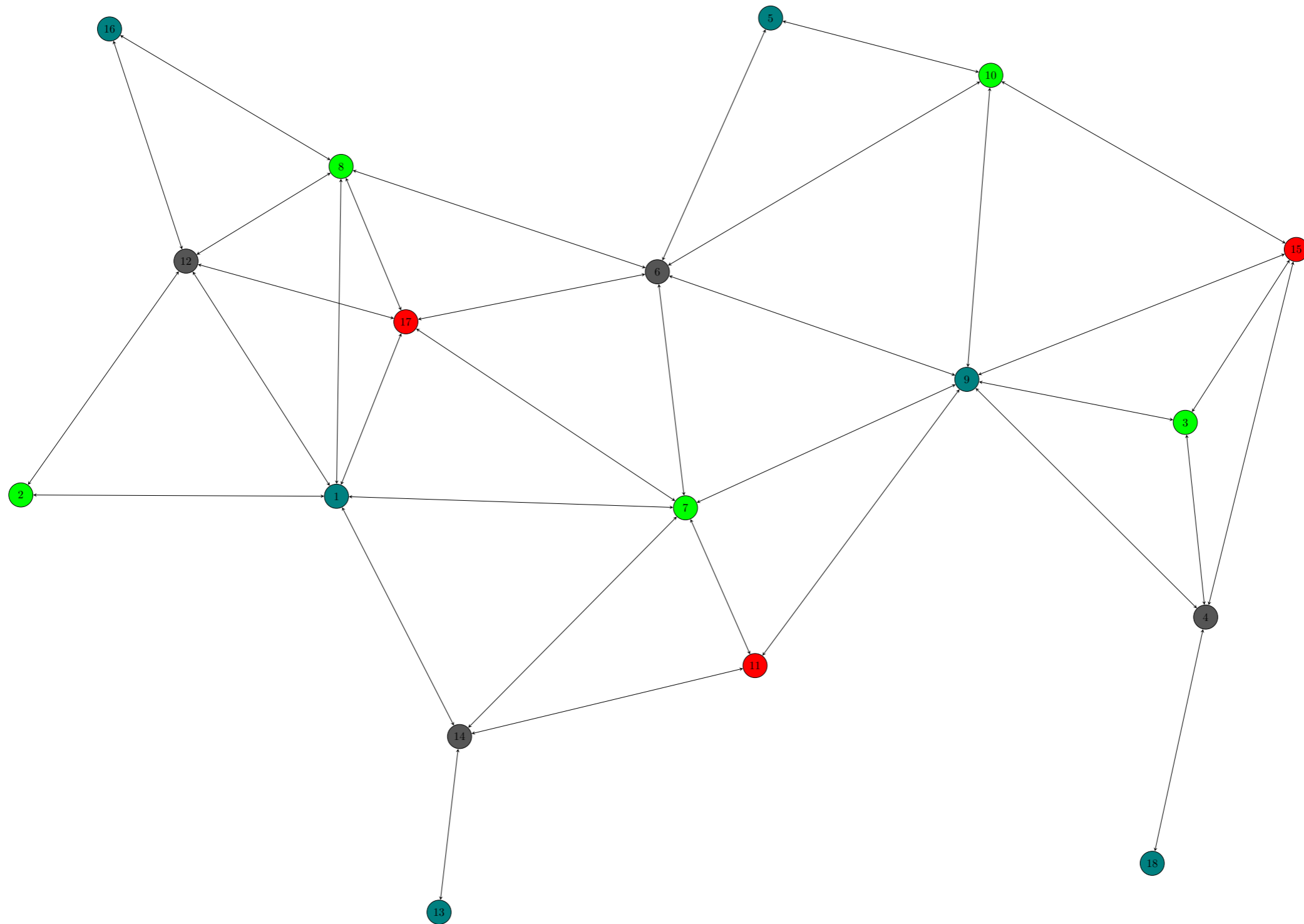


# Distance-1 Coloring by a Human: 10 minutes, 4 colors





# Distance-1 Coloring by a Computer: .01 secs, 4 colors



# Distance-1 Coloring by a Computer: .03 secs, 13 colors

