Inf-2101 - Algoritmer

Graph Search

John Markus Bjørndalen

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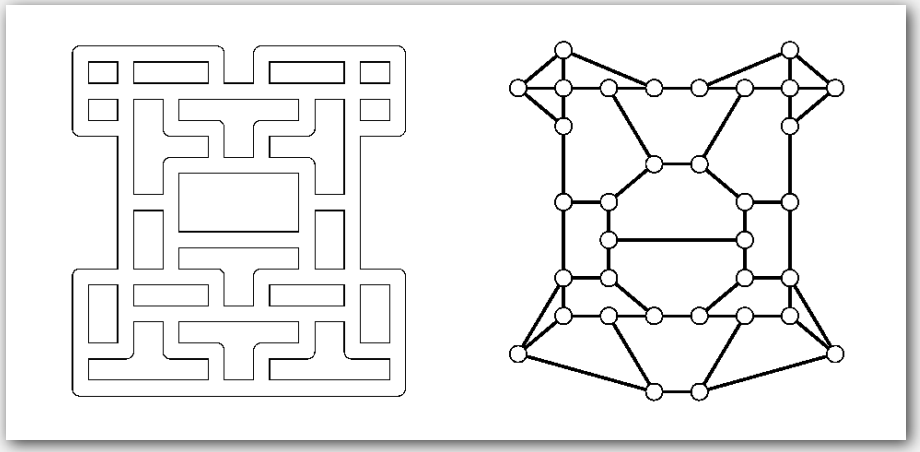
Some foils are adapted from the book and the book's homepage.

Maze exploration

Maze graphs.

- Vertex = intersection.
- Edge = passage.



Goal. Explore every passage in the maze.

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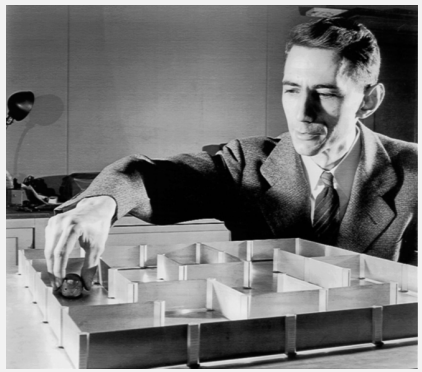
Foil from Sedgewick/Wayne

Trémaux maze exploration

Algorithm.

- Unroll a ball of string behind you.
- Mark each visited intersection by turning on a light.
- Mark each visited passage by opening a door.

First use? Theseus entered labyrinth to kill the monstrous Minotaur; Ariadne held ball of string.



Claude Shannon (with Theseus mouse)

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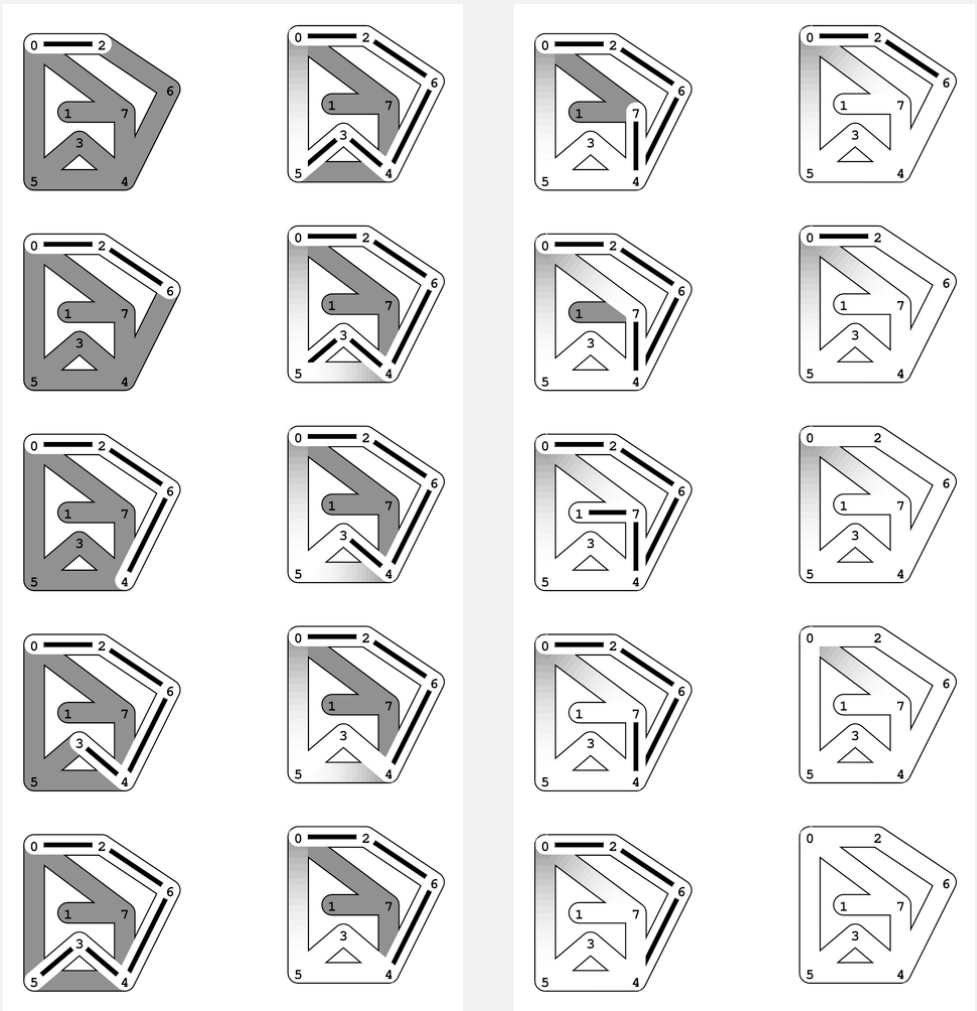
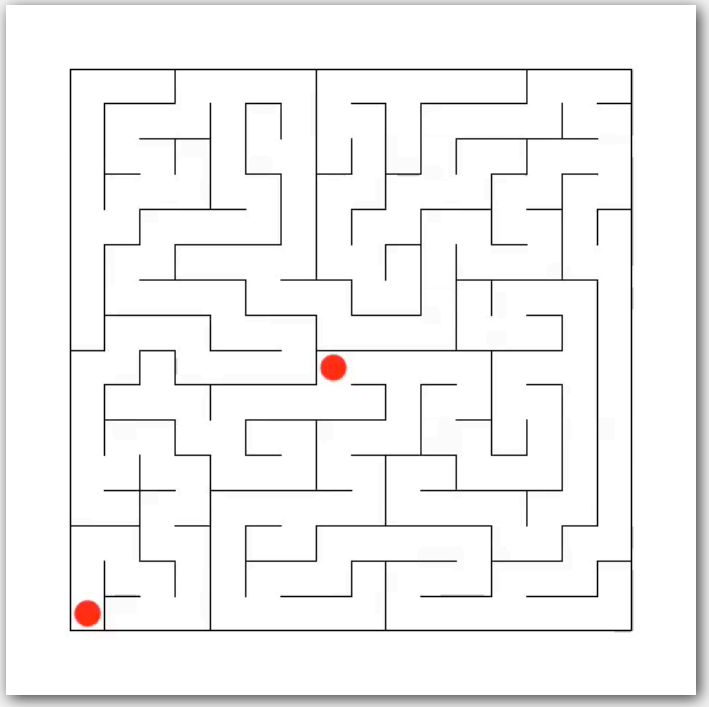
Foil from Sedgewick/Wayne



Foil from Sedgewick/Wayne

Maze exploration



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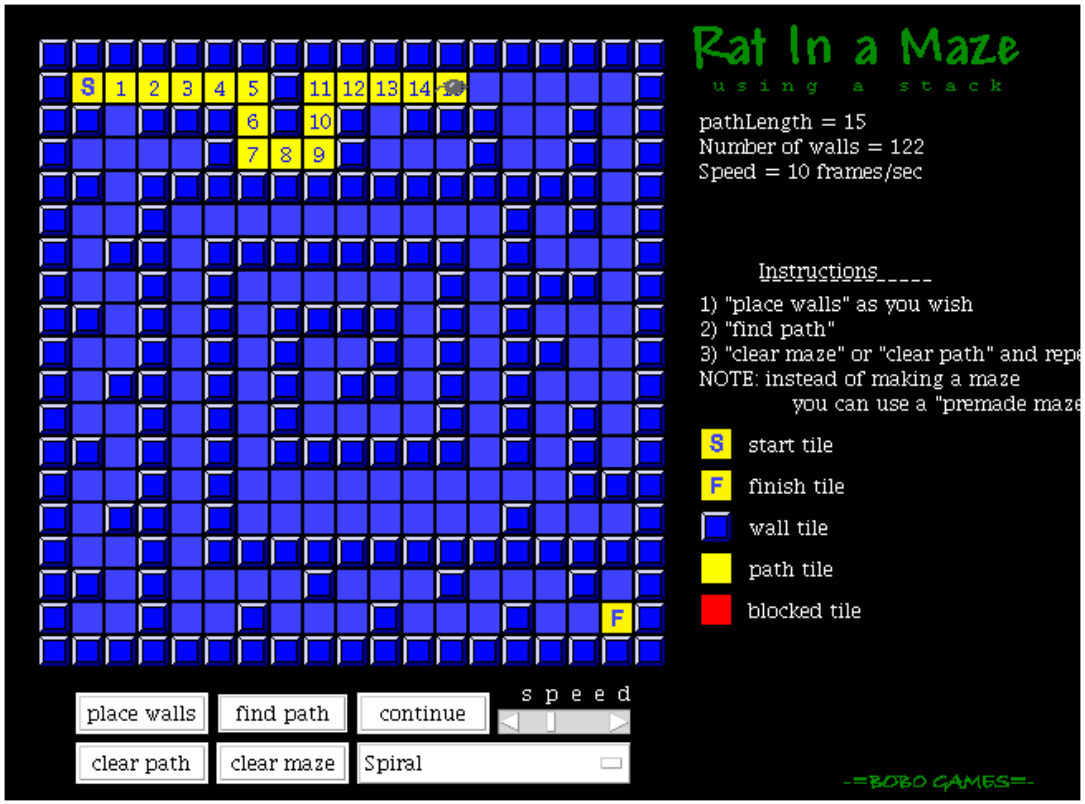
Foil from Sedgewick/Wayne

Maze



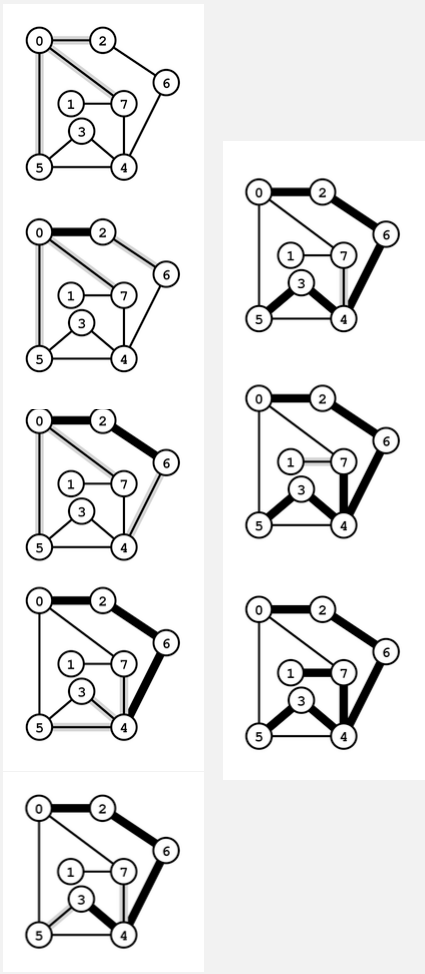
http://www.cs.princeton.edu/courses/archive/spring03/cs226/demo/ratmaze/maze.htm

Depth-first search

Goal. Systematically search through a graph.

Idea. Mimic maze exploration.

> *DFS (to visit a vertex s)*
>
> *Mark s as visited.*
> *Recursively visit all unmarked vertices v adjacent to s.*



Running time.

- O(E) since each edge examined at most twice.
- Usually less than V in real-world graphs.

- Typical applications.
- Find all vertices connected to a given `s`.
- Find a path from `s` to `t`.

Time for some code

Flood fill

Photoshop "magic wand"

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Graph-processing challenge 1

Problem. Flood fill.

Assumptions. Picture has millions to billions of pixels.

How difficult?

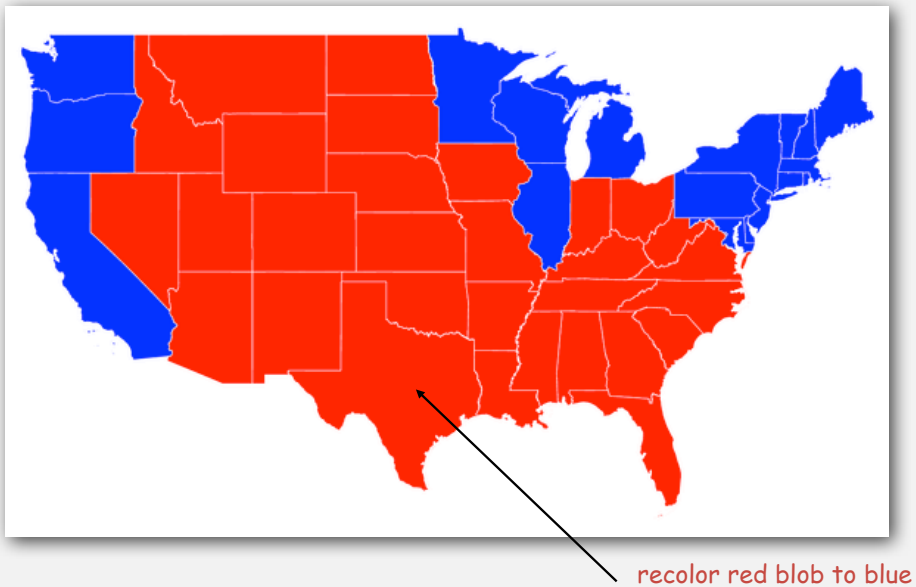
- Any COS 126 student could do it.
- Need to be a typical diligent COS 226 student.
- Hire an expert.
- Intractable.
- No one knows.
- Impossible.

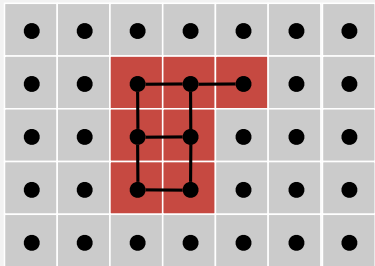
Connectivity application: flood fill

Change color of entire blob of neighboring red pixels to blue.

Build a grid graph.

- Vertex: pixel.
- Edge: between two adjacent red pixels.
- Blob: all pixels connected to given pixel.





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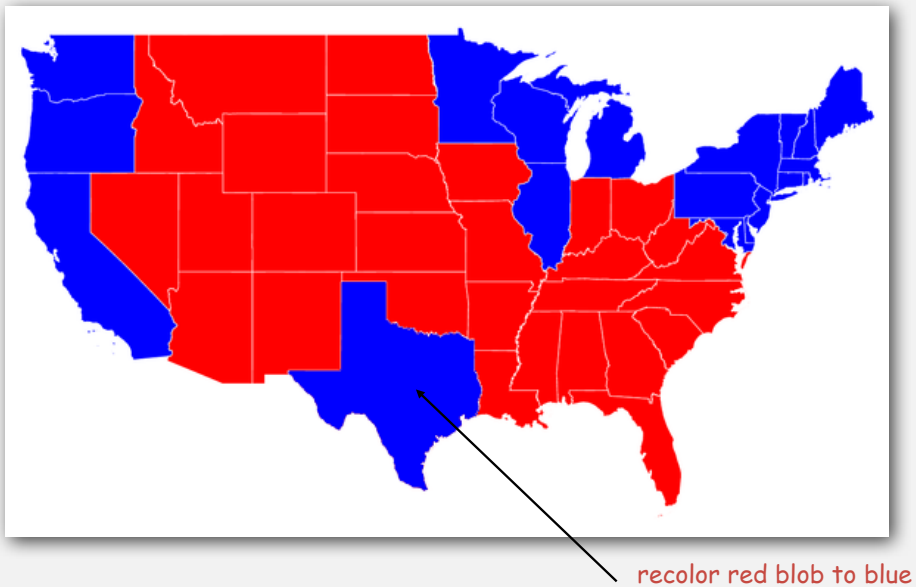
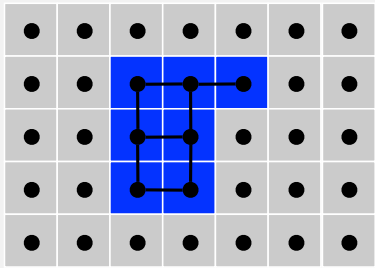
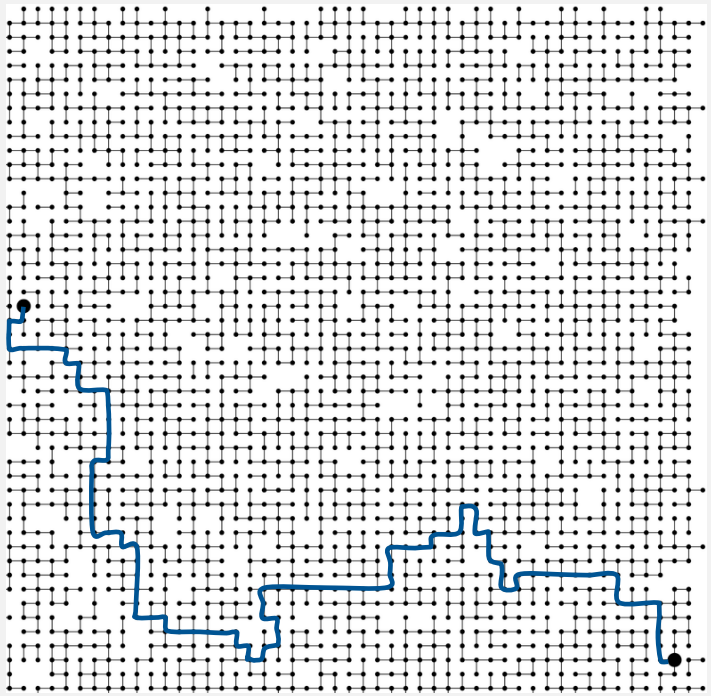




Graph-processing challenge 2

Problem. Find a path from s to t ?

Assumption. Any path will do.



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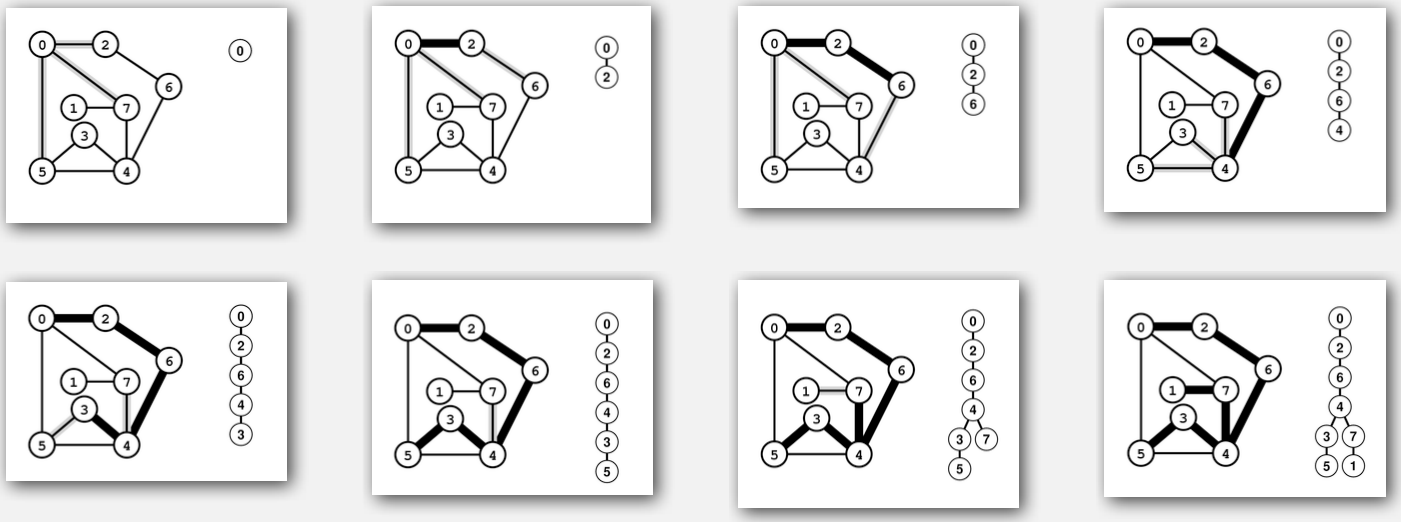
Keeping track of paths with DFS

DFS tree. Upon visiting a vertex `v` for the first time, remember that you came from `pred[v]` (parent-link representation).

Retrace path. To find path between `s` and `v`, follow `pred[]` back from `v`.



Challenge

- Use pygame for animation of graphs.
- Reconfig when adding and removing nodes and edges (use graphviz for layout).
- Show animation of algorithm.
- Use it to test out your understanding of the algorithms.