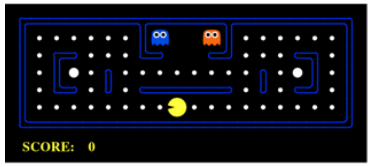
Solve a Maze via Search

An Intro-AI Exploration

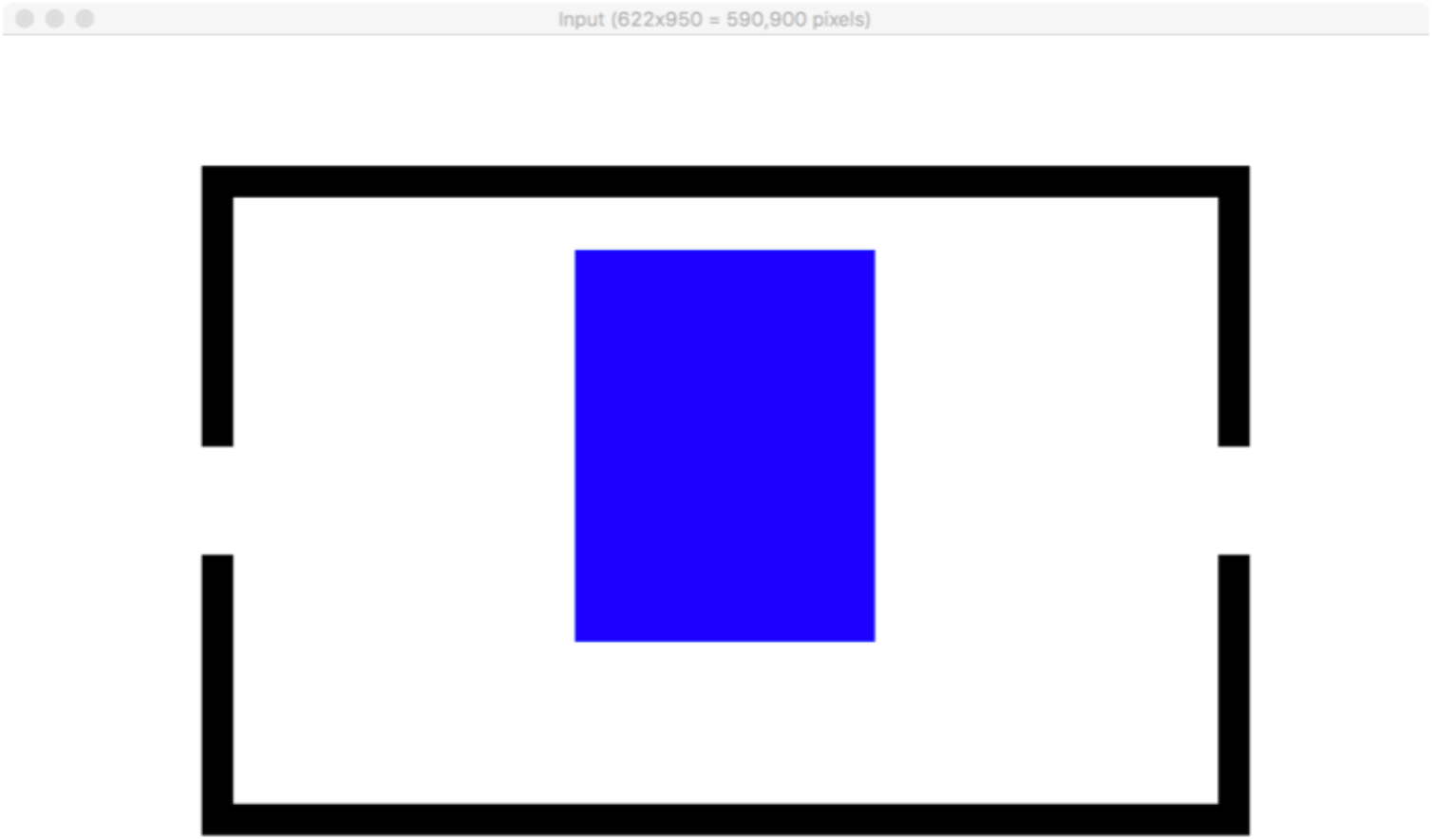
Context

- Intro AI end-of-course project
  - Used as "default" option for several semesters
    - And starter for undergrads interested in AI research!
  - End-to-end application with guidance & base
  - About 150 (well-written) lines

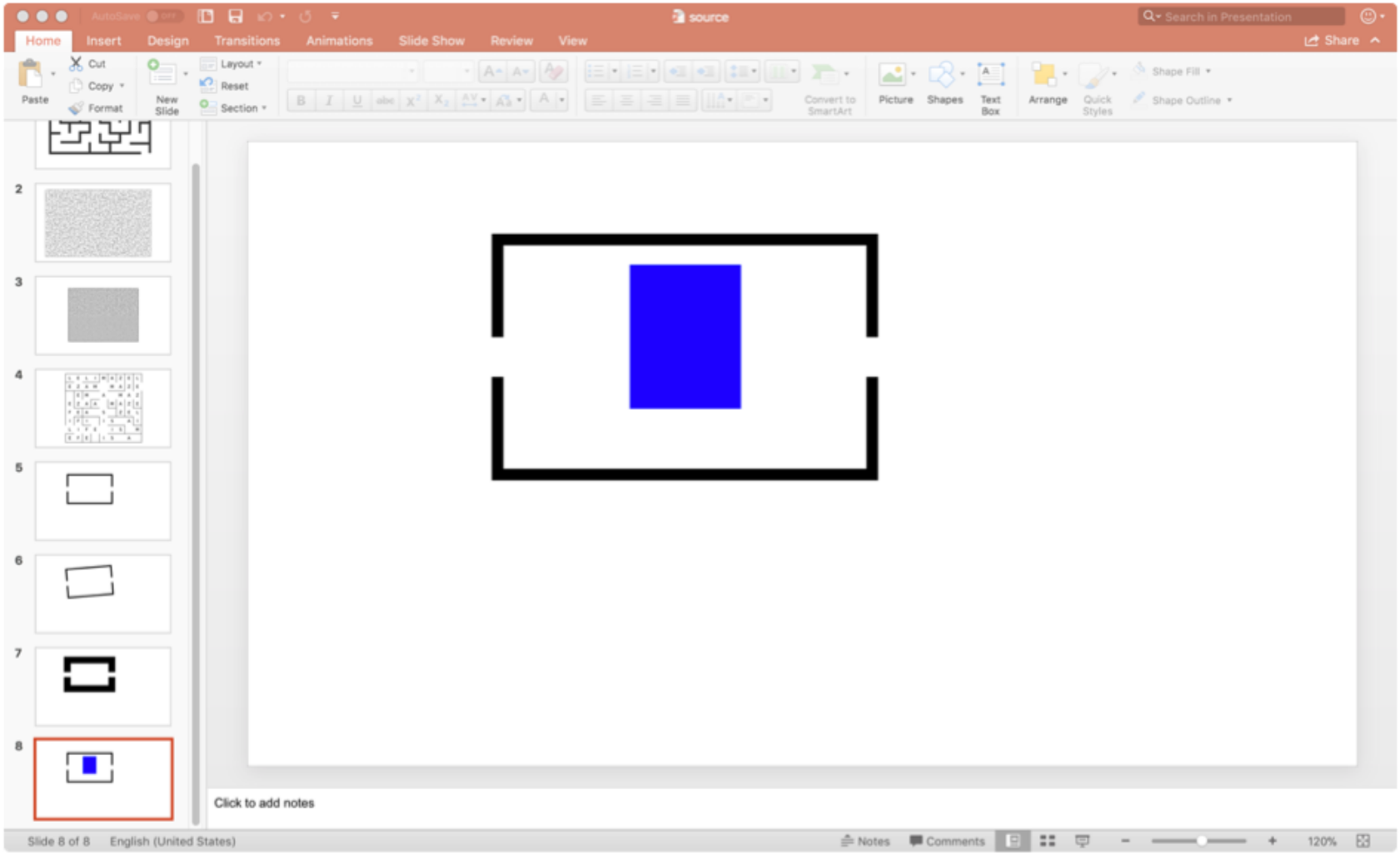
- Builds on Pacman Projects
  - While still maze-based, adds significant room for exploration/growth via OpenCV



Input: Image



Source: You!


source
Search in Presentation
Home
Insert
Design
Transitions
Animations
Slide Show
Review
View
Share
Paste
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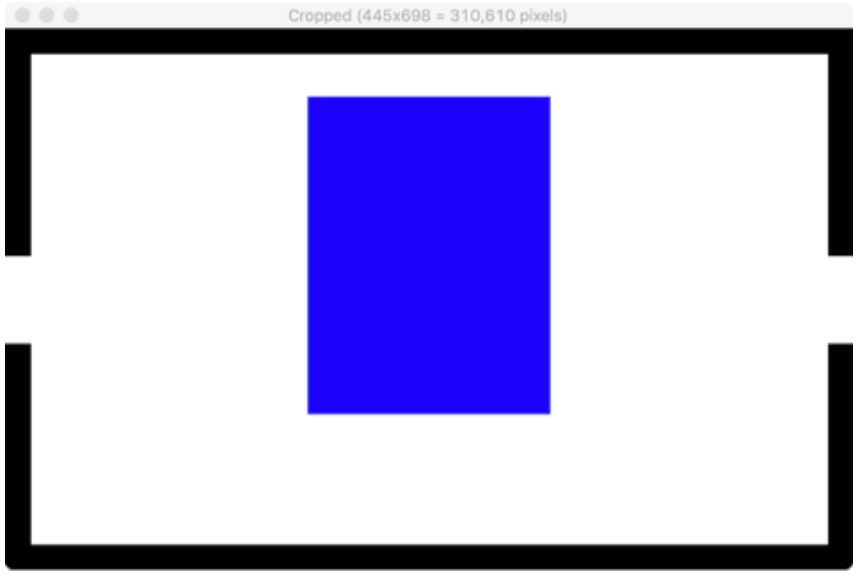
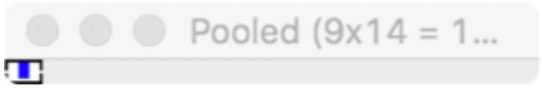
Copy
Format
New Slide
Layout
Reset
Section
Convert to SmartArt
Picture
Shapes
Text Box
Arrange
Quick Styles
Shape Fill
Shape Outline
Click to add notes
Slide 8 of 8
English (United States)
Notes
Comments
120%

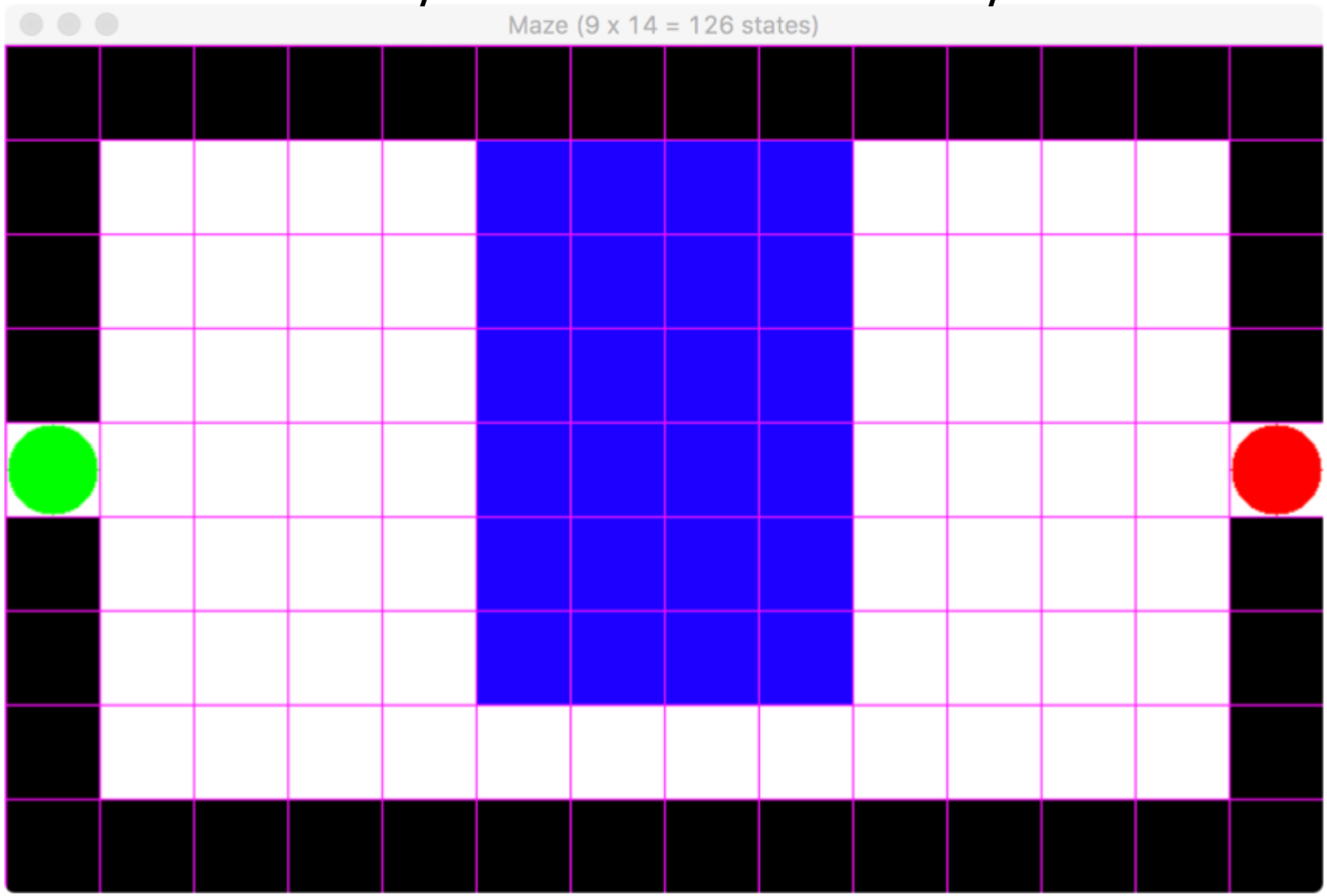
Preprocessing via OpenCV



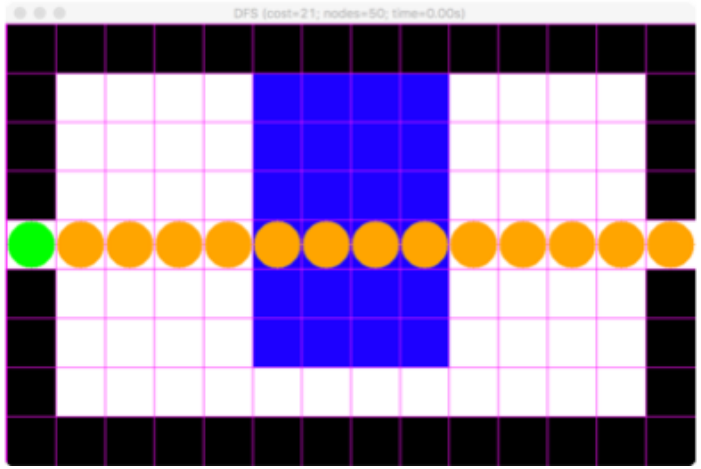


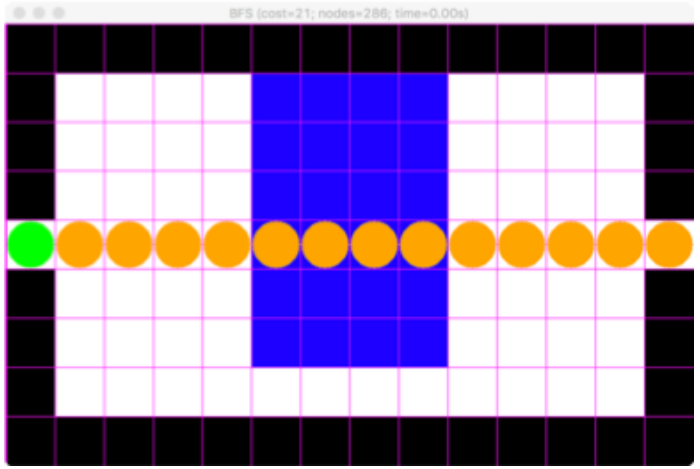
Grid via Nearest-Color

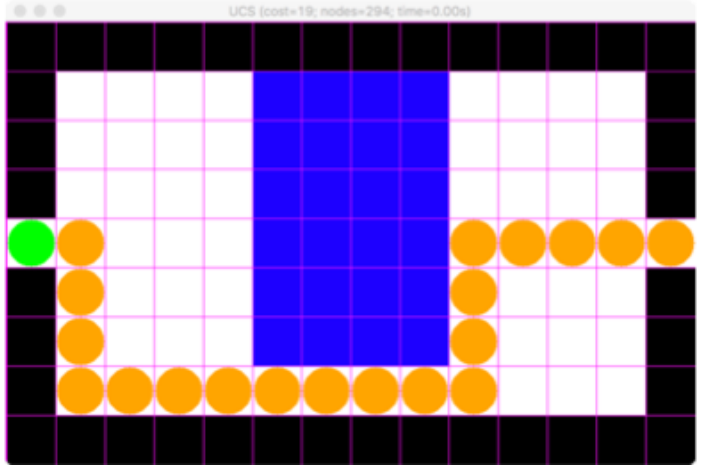
Start/Stop via Border Assumptions

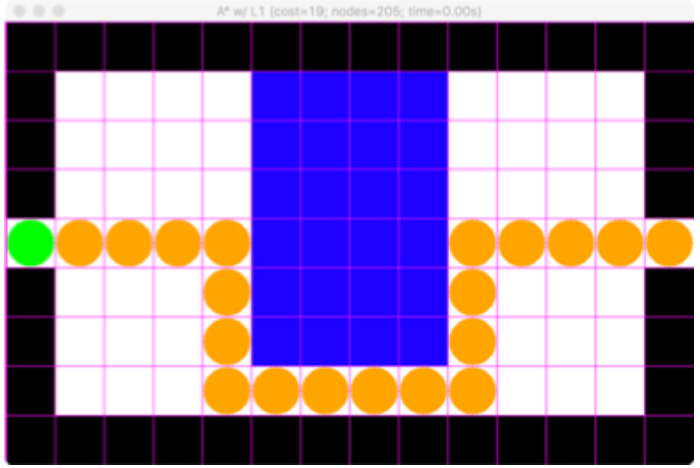


Solve via DFS, BFS, UCS, A*

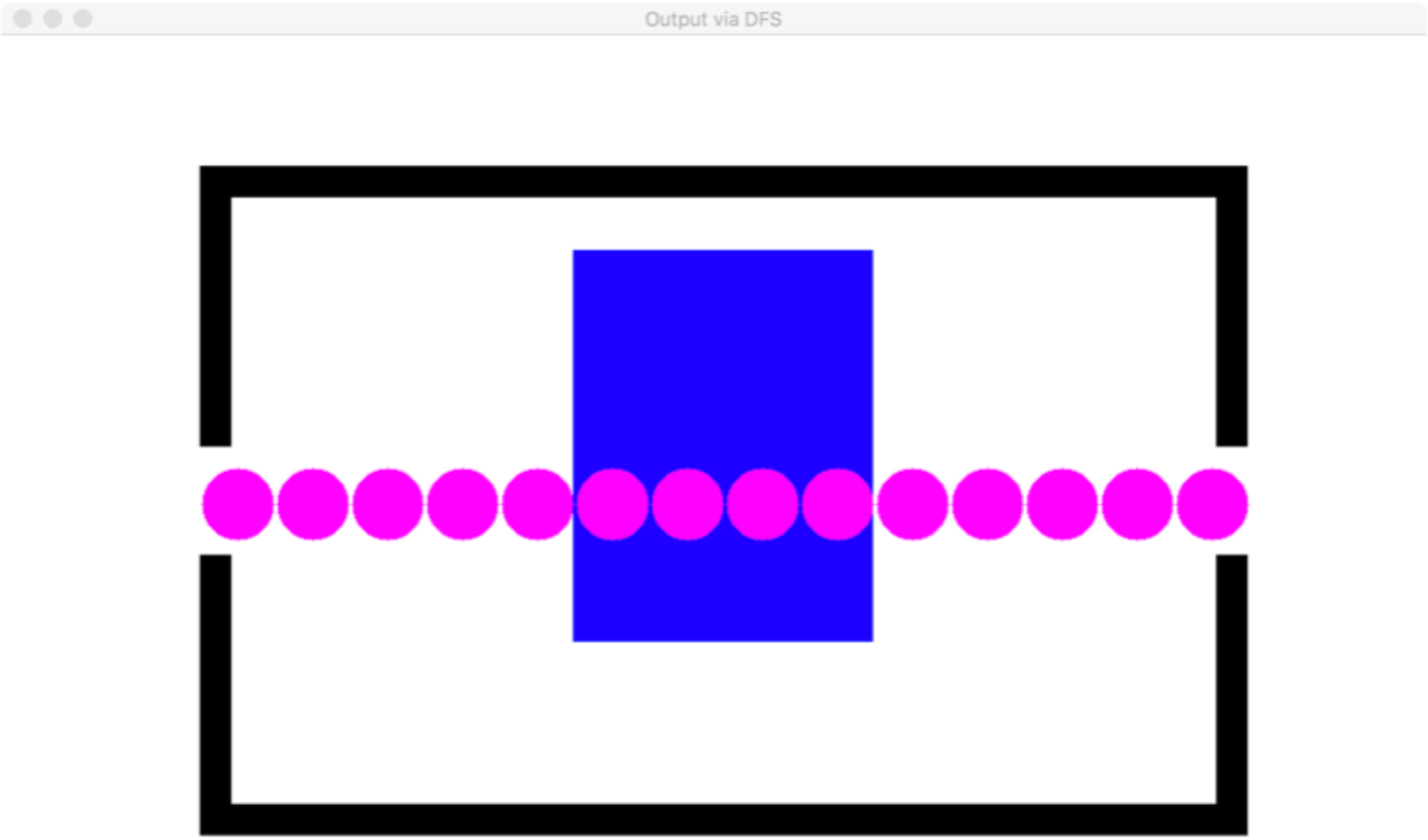




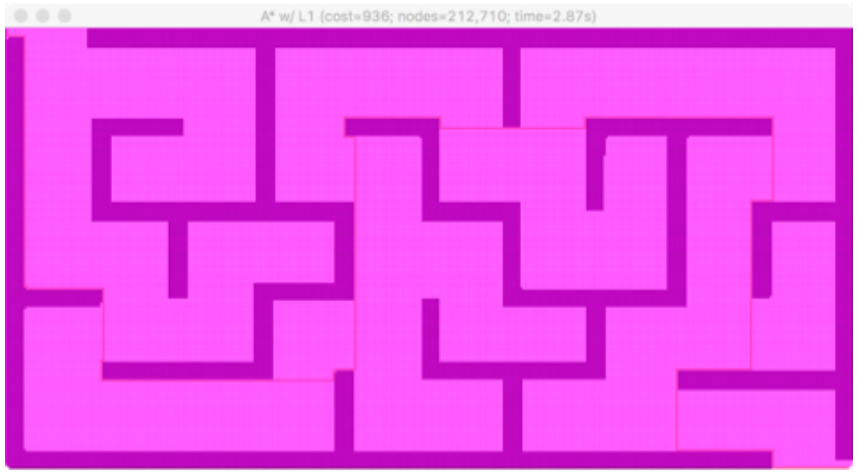


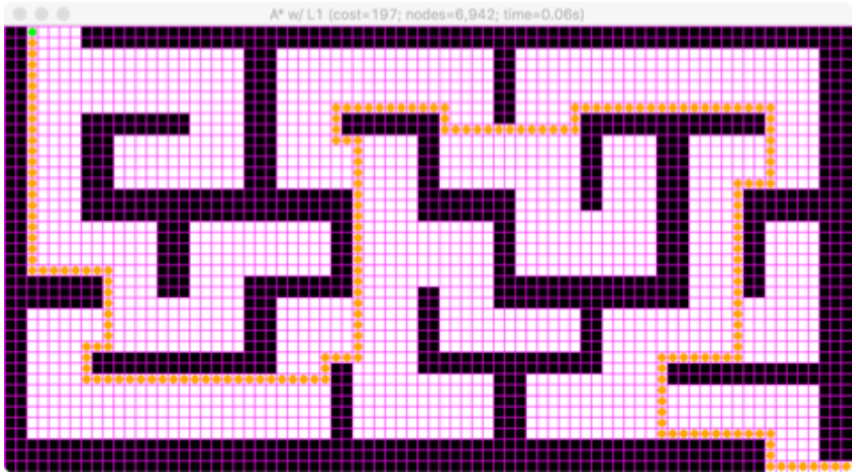


Overlay on Original

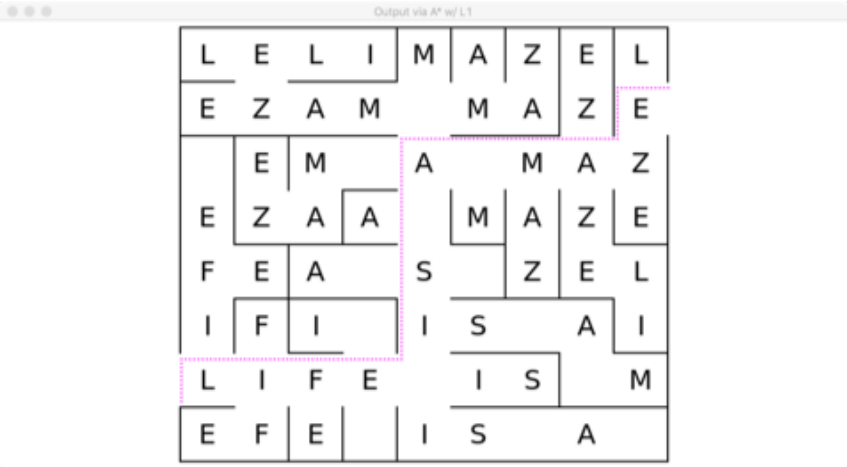


Representation/Performance





Scaling Up


Output via A* w/ L1
L E L I M A Z E L
E Z A M M A Z E
E M A M A Z
E Z A A M A Z E
F E A S Z E L
I F I I S A I
L I F E I S M
E F E I S A


Output via A* w/ L1

Given

Assignment Write-up

- Software installation
  - OpenCV in 1-3 lines
- Pointers to concepts/ tutorials/documentation
- Sequencing + examples with invocation/images
- Ideas for extension

Starter Code

- Extracted portions of Pacman (w/ license)
- Scaffolding, utility code
- Fill-in-the-code with comments
- Example inputs, PowerPoint for more

1. Visualize a Maze (~15 lines)

- Given TXT, output a visual representation

- Encourages familiarity with OpenCV data structures and functions + modular programming

```
(4, 0)
(4, 13)
KKKKKKKKKKKKK
KWWWWBBBBWWWK
KWWWWBBBBWWWK
KWWWWBBBBWWWK
WWWWWBBBBWWWW
KWWWWBBBBWWWK
KWWWWBBBBWWWK
KWWWWWWWWWWWK
KKKKKKKKKKKKK
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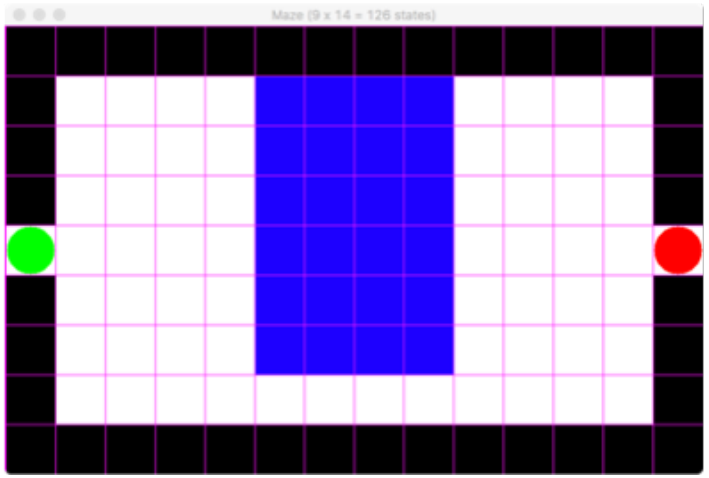
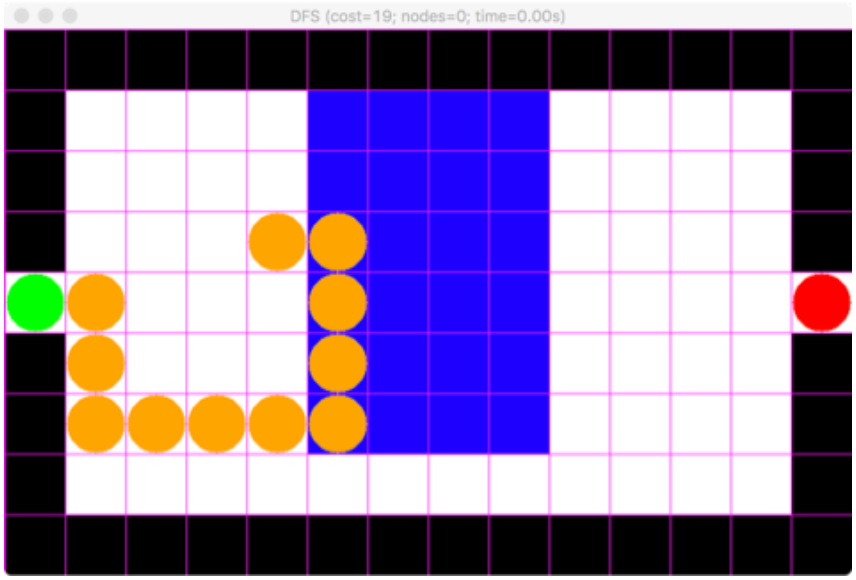


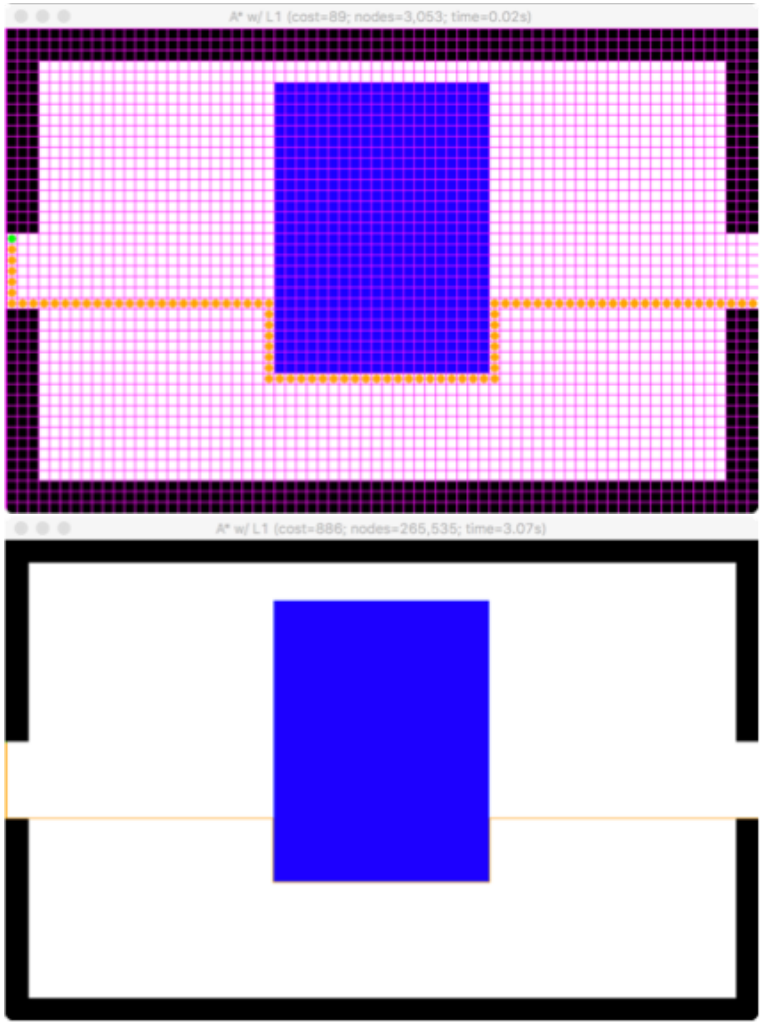
2. MazeProblem w/ Viz (~25 lines)

- Implement MazeProblem start, goalTest, successor (ala Pacman)
- Visualize path
  - Dummy solution provided to test



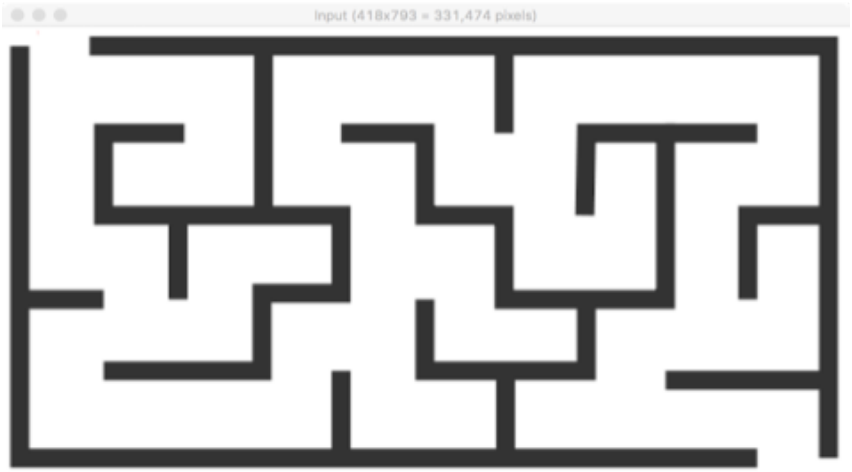
3. GraphSearch + Analysis (~15 lines)

- Encourages unified graphSearch
  - ala AI:MA
- Encourages data collection for a set of supplied mazes
  - Some are known to be identical with different representation



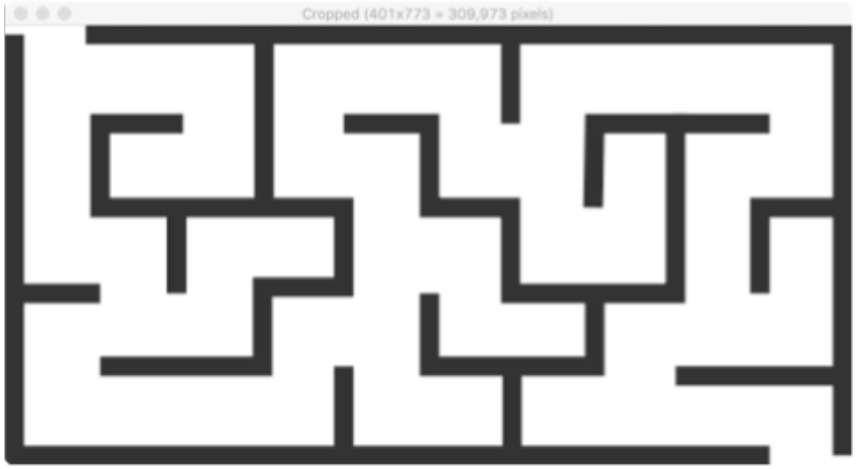
4a. Show Input Image (~5 lines)

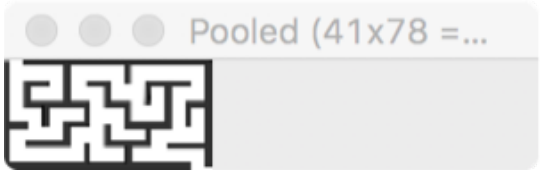
- Given PNG, present image in a window with size information
- Scaffolding provided, including show window and wait for key press



4b. Preprocess (~40 lines)

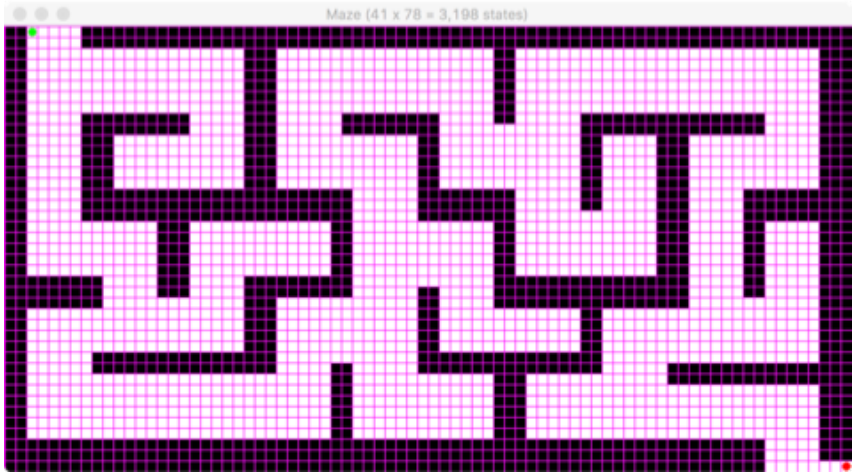
- Assume axis-aligned + black border
- Crop via Gaussian Blur + threshold
- Pool via user-supplied multiplier





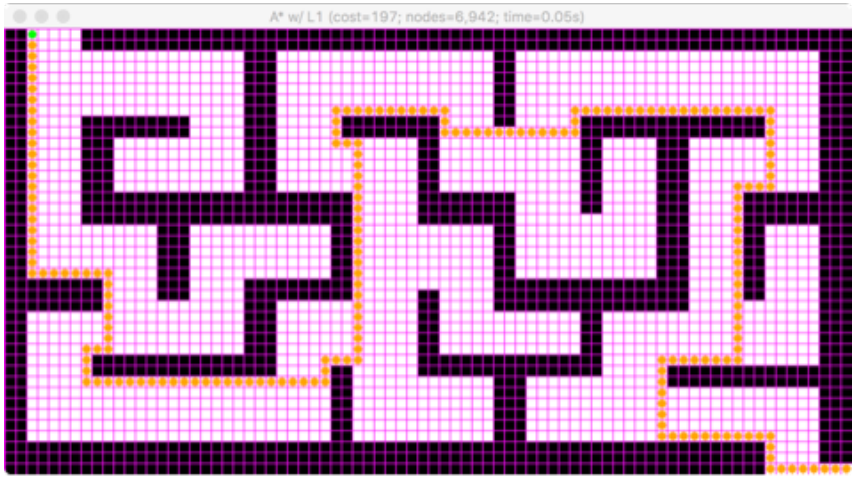
4c. Extract Maze (~30 lines)

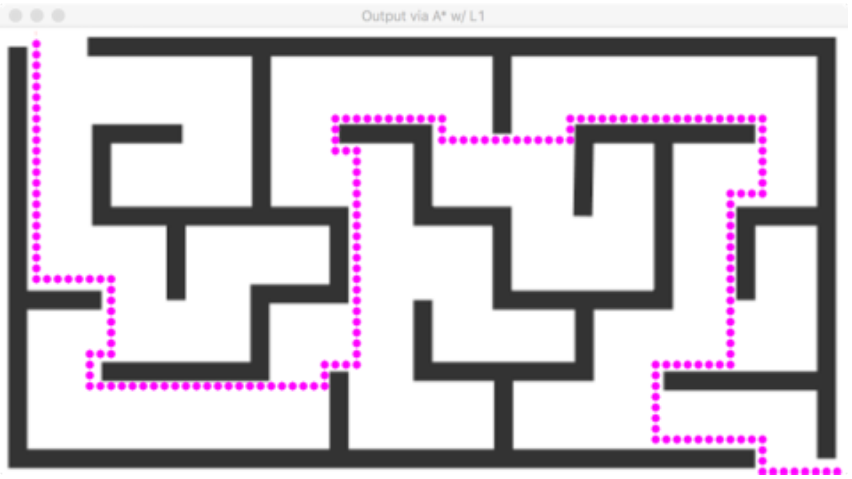
- Using distance to closest known color, extract row-of-rows
- Using simplifying assumptions, detect reasonable start/ finish locations
- Visualize!



4d. Solve! (~10 lines)

- Solve using #3
  - Loop through methods unless supplied a method
- Given cropping offset, overlay solution path on original image
- Analyze methods w.r.t. optimality, performance





Extra-Credit Exploration

- Different maze shapes
- Maze rotation
- Video

…

Strengths

- Integration with Pacman Projects
- Easy OpenCV setup across platforms
  - Anaconda (+ 1-3 lines)
- PowerPoint method for maze creation
- Representation vs performance analysis
- In the past, student teams have surprised me with their quality of work

Weaknesses

- No auto-grading
  - But emphasis on intermediate visualization
- This=Python3, Pacman=Python2
- Similar search problem to Pacman
- Limited image/vision aspects

Thank You :)

Questions?