

# CAP4630/CAP5605 Introduction to Artificial Intelligence

Fall 2013

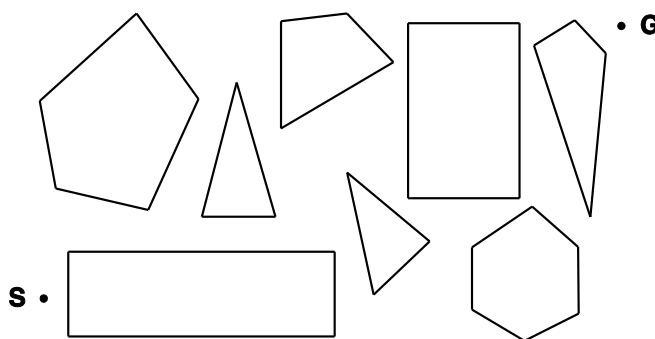
## Programming Assignment 1

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**Due: October 14 (Monday)**

**Total points: 100 (110)**

Consider the problem of finding the shortest path between two points on a plane that has convex polygonal obstacles as shown in the following figure. This is an idealization of the problem that a robot has to solve to navigate in a crowded environment.



- Suppose the state space consists of all positions  $(x, y)$  in the plane. How many states are there? How many paths are there to the goal? [5 points]
- Explain briefly why the shortest path from one polygon vertex to any other in the scene must consist of straight-line segments joining some of the vertices of the polygons. Define a good state space now. How large is this state space? [10 points]
- Define the necessary functions to implement the search problem, including an ACTIONS function that takes a vertex as input and returns a set of vectors, each of which maps the current vertex to one of the vertices that can be reached in a straight line. (Do not forget the neighbors on the same polygon.) Use the straight-line distance for the heuristic function. [10 points]
- Write a program to implement A\* search to find the shortest path from the start point to the goal. [75 points]
- [Graduate Students Only]** Supposed the robot is now navigating in the following environment: the percept will be a list of the positions, relative to the agent, of the visible vertices. The percept does not include the position of the robot. The robot must learn its own position from the map. [10 points]

Discuss how this environment changes the problem definition, and how to search for the shortest path.

Details about the program:

- The name of your program: **aixxx.java** (xxx are the last 3 digits of your n-number).
- Input: a text file containing the coordinates of start point, goal point, and vertices of all polygons.

For example, an input text file map1.txt contains:

1, 3                      ← (x, y) of the start point  
34, 19                   ← (x, y) of the goal point  
0, 14; 6, 19; 9, 15; 7, 8; 1, 9 ← vertices of the 1<sup>st</sup> polygon, separating by semicolons  
2, 6; 17, 6; 17, 1; 2, 1 ← vertices of the 2<sup>nd</sup> polygon, separating by semicolons

- Make sure your program can be compiled using the following command on osprey.unf.edu:

**javac aiaxxx.java**

- Your program will be tested on osprey as follows:

**java aiaxxx input\_map\_file.txt**

input\_map\_file: a text file similar to map1.txt

- Output: **a sequence of coordinates** showing the shortest path from the start point to the goal point.

### **Submission**

Materials that you are required to submit for this assignment include:

- aiaxxx.java
- a Microsoft word or pdf document containing answers to the questions in a, b, c for undergraduate and a, b, c, e for graduate.

All the files must be submitted through blackboard.unf.edu by the end of date on the due date.

### **Note**

You are allowed to write the program in a programming language other than Java, but you will be asked to demonstrate the program in person as part of your submission.