

## Course Overview

Here are some questions for you:

1. What is AI?
2. What can AI do?
3. What do you want to learn from this course?

There are two types of discussion sections:

1. Regular Discussion
2. Exam Prep
3. LOST

There are 5 graded components:

1. Programming Assignments (25%)
2. Electronic Homework Assignments (10%)
3. Written Homework Assignments (10%)
4. Midterm (20%)
5. Check-in quizzes + Final exam (35%)

Check-in Quizzes boost: Your percentage grade on the final =  $\max(\text{percentage grade on the final}, 1/4 * \text{percentage grade on check-in quizzes} + 3/4 * \text{percentage grade on the final})$  For example, if you completed 80% of all check-in quizzes and got 60% on the final, your grade on the final will be  $1/4 * 80\% + 3/4 * 60\% = 65\%$ .

# Q1. Search

For this problem, assume that all of our search algorithms use tree search, unless specified otherwise.

- (a) For each algorithm below, indicate whether the path returned after the modification to the search tree is guaranteed to be identical to the unmodified algorithm. Assume all edge weights are non-negative before modifications.

- (i) Adding additional cost  $c > 0$  to every edge weight.

	Yes	No
BFS	<input type="radio"/>	<input type="radio"/>
DFS	<input type="radio"/>	<input type="radio"/>
UCS	<input type="radio"/>	<input type="radio"/>

- (ii) Multiplying a constant  $w > 0$  to every edge weight.

	Yes	No
BFS	<input type="radio"/>	<input type="radio"/>
DFS	<input type="radio"/>	<input type="radio"/>
UCS	<input type="radio"/>	<input type="radio"/>

- (b) For part (b), two search algorithms are defined to be **equivalent** if and only if they expand the same states in the same order and return the same path. Assume all graphs are directed and acyclic.

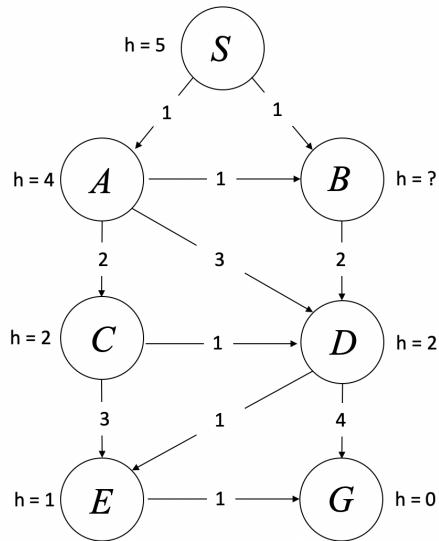
- (i) Assume we have access to costs  $c_{ij}$  that make running UCS algorithm with these costs  $c_{ij}$  equivalent to running BFS. How can we construct new costs  $c'_{ij}$  such that running UCS with these costs is equivalent to running DFS?

- $c'_{ij} = 0$         $c'_{ij} = 1$         $c'_{ij} = c_{ij}$   
  $c'_{ij} = -c_{ij}$         $c'_{ij} = c_{ij} + \alpha$        Not possible

- (ii) Given edge weight  $c_{ij} = h(j) - h(i)$ , where  $h(n)$  is the value of the heuristic function at node  $n$ , running UCS on this graph is equivalent to running which of the following algorithm on the same graph?

- DFS       BFS       Iterative Deepening  
 Greedy       A\*       None of the above.

(c) Consider the following graph.  $h(n)$  denotes the heuristic function evaluated at node  $n$ .



- (i) Given that  $G$  is the goal node, and heuristic values are fixed for all nodes other than  $B$ , for which values of  $h(B)$  will A\* tree search be guaranteed to return the optimal path? Fill in the lower and upper bounds or select "impossible."

\_\_\_\_\_  $\leq h(B) \leq$  \_\_\_\_\_  Impossible

- (ii) With the heuristic values fixed for all nodes other than  $B$ , for which values of  $h(B)$  will A\* graph search be guaranteed to return the optimal path? Either fill in the lower and upper bound or select "impossible."

\_\_\_\_\_  $\leq h(B) \leq$  \_\_\_\_\_  Impossible