CSC 480 ARTIFICIAL INTELLIGENCE

MIDTERM EXAM

SECTION 1

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This is the midterm exam for the CSC 480 Artificial Intelligence class. You may use textbooks, course notes, or other material, but you must formulate the text for your answers yourself. The use of calculators or computers is allowed for numerical calculations, but not for the execution of algorithms or programs to compute solutions for exam questions. The exam time is 80 minutes.

Student Name:	**Student ID:**
Signature:	**Date:**

PART 1: MULTIPLE CHOICE QUESTIONS

Mark the answer you think is correct. Unless otherwise noted, there is only one correct answer. Each question is worth 2 points, for a total of 20 in Part 1.

a) Which statement is the best characterization of *cognitive modeling*?
- ❑ The formulation of algorithmic descriptions of building blocks for intelligent systems.
- ❑ The formal specification of abstract reasoning mechanisms for systems that represent and manipulate knowledge
- ❑ The construction of systems that exhibit behaviors necessary for solving tasks requiring intelligence.
- ❑ An attempt to describe the way the human mind functions.

b) Which event is considered the "birth" of the field of Artificial Intelligence?
- ❑ The formulation of the Turing test by Alan Turing in 1950.
- ❑ A workshop in the summer of 1956 at Dartmouth.
- ❑ The development of the Lisp programming language in 1958.
- ❑ The victory of the Deep Blue computer system over the chess world champion, Gary Kasparov, in 1998.

c) In which of the following areas is human intelligence still significantly superior to artificial intelligence?
- ❑ Exact retrieval of patterns like strings from large sets of examples (e.g. in the index of a search engine).
- ❑ Planning and scheduling of actions for intricate tasks (e.g. the assembly of automobiles).
- ❑ Identifying solutions to a problem from a collection of previous cases that describe solutions to similar problems (e.g. in a help desk application).
- ❑ Translation from one natural language into another.

d) What is an ideal rational agent?
- ❑ Conceptually, and all-knowing agent that could predict the outcome of any action.
- ❑ An agent that maximizes its performance metric for a given task, percept sequence, background knowledge, and configuration of the environment.
- ❑ An agent that can explain its choice of an action.
- ❑ An agent that is capable of predicting the actual outcome of an action.

e) In general, which of the following environments is the least challenging for agents?
- ❑ fully accessible, discrete, episodic, static
- ❑ static, non-episodic, continuous, partially accessible
- ❑ inaccessible, episodic, dynamic, continuous
- ❑ deterministic, non-episodic, dynamic, continuous

f) A problem in which the agent needs to receive some information through its sensors in order to decide which action to take is a
- ❑ single-state problem.
- ❑ multiple-state problem.
- ❑ contingency problem
- ❑ exploration problem

g) Which of the following issues depends on the distinction in desirability between different goals?
- ❑ completeness
- ❑ time complexity
- ❑ space complexity
- ❑ optimality

h) What is *time complexity* with respect to search algorithms?
- ❑ An estimate of how many search steps it takes to find a solution.
- ❑ An estimate of how much information the algorithm needs to store for finding a solution.
- ❑ Provided that a solution exists, the algorithm will find it.
- ❑ If there is a distinction between the quality of goal states, the agent will find the best one.

i) On the basis of the general search method as described in the text book, which simple strategy results in A* search?
- ❑ append newly generated nodes at the beginning of the search queue
- ❑ append newly generated nodes at the end of the search queue
- ❑ insert newly generated nodes in the search queue according to their path cost (lowest values first)
- ❑ insert newly generated nodes in the search queue according to their f-cost function (lowest values first)

j) Which of the following search methods has the lowest space complexity (worst-case)?
- ❑ depth-first
- ❑ breadth-first.
- ❑ bi-directional
- ❑ A*

PART 2: SHORT QUESTIONS

In this part of the exam, you must answer the questions in one or two paragraphs. Each question is worth 5 or 10 points, for a total of 30 in Part 2.

1. Explain the difference between an ideal rational agent and an omniscient agent.

[10 points]

2. Give a short PAGE description for an agent residing in a personal computer system, with the task of identifying documents with similar contents.

[10 points]

Aspect	Description
P	
A	
G	
E	

3. What is the importance of using contours for the A* search method?

[5 points]

4. Under which circumstances will iterative deepening perform much worse than depth-first search?

[5 points]

PART 3: MAZE SEARCH

In this scenario, an agent is trying to traverse a maze from the starting point **S** to the goal point **G**. At each step, the agent can move in one of the four compass directions; each moves, independent of the direction, costs the agent one cost unit. The agent always considers alternative moves in the following order:

1. Move North
2. Move East
3. Move South
4. Move West

In the following parts, you need to apply different search algorithms to solve this navigation problem. Number the squares in the order the agents visits the squares, starting with 0 at the starting point. You do not need to re-expand nodes already visited; this means that you can "jump" from the current node to the next node in the queue.

In those algorithms that use it, calculate the path cost on the basis of one cost unit per move. The heuristics to use in the respective algorithms is the difference between the horizontal position of the current node and the goal node, plus the difference in the vertical position of the current node $[x_n,y_n]$ and the goal node $[x_g,y_g]$, adjusted by a small value to break symmetries:

$$h([x,y]) = (|x_g - x_n|) + 0.99(|y_g - y_n|)$$

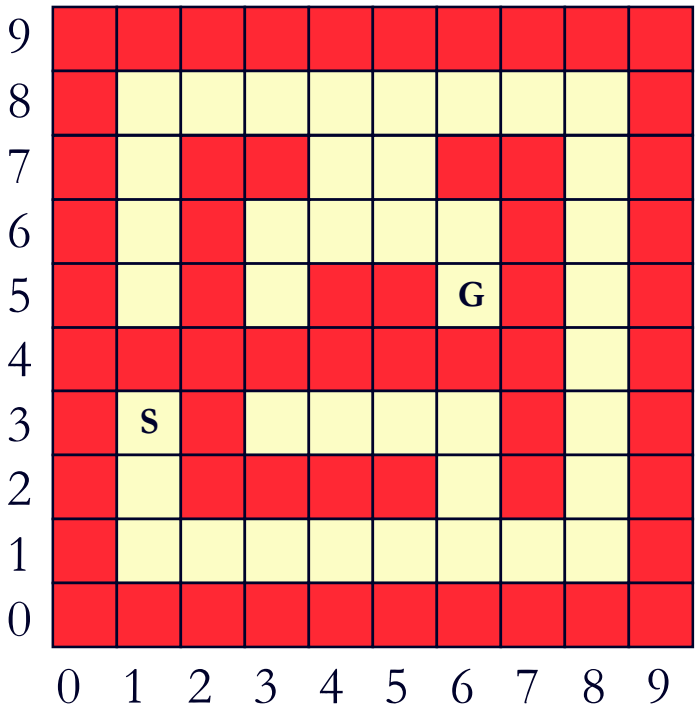
So, for the starting point, node [1,3], the heuristics with respect to the goal, node [6,5], is (6-1) + 0.99*(5-3) = 5 + 1.98 = 6.98.

For the following algorithms, you need to do the following tasks

- Mark the sequence in which the nodes are visited in the maze. You can do this directly in the copy of the maze for each algorithm.
- Draw the corresponding search tree. It might be advisable to draw the complete search tree first on a separate sheet of paper, and then draw the relevant parts next to / below the maze.
- Fill in the table with the information about the search trace. The size of the table does not necessarily relate to the number of steps in the algorithm. Extend the table if necessary.

a) Traverse the maze from the starting point **S** to the goal **G** according to the *Depth-First Search* method.

[15 points]



Step	*Current Node*	*Path Cost*	*Heuristic*	*F-Cost*	*Queue*
0	**S**				
1					
2					
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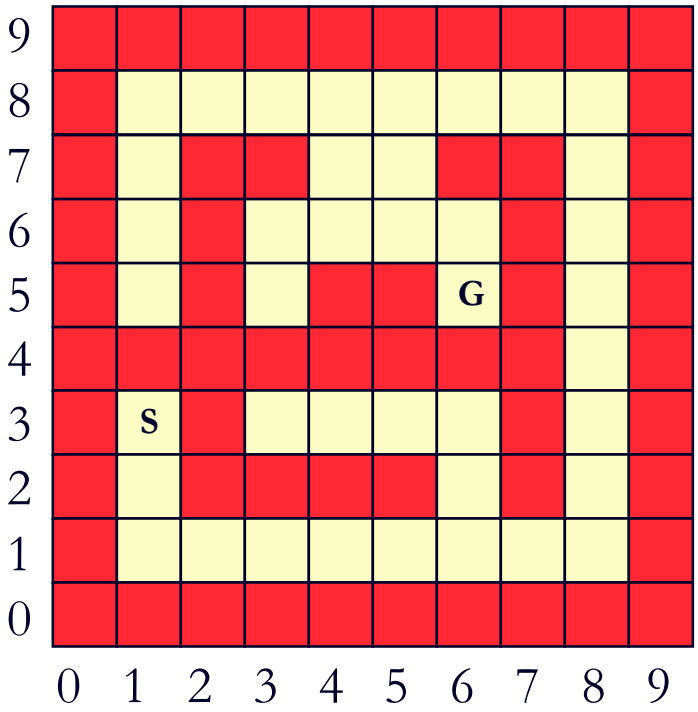
b) Traverse the maze from the starting point **S** to the goal **G** according to the *Greedy Search* method.

[15 points]



Step	*Current Node*	*Path Cost*	*Heuris-tic*	*F-Cost*	*Queue*
0	**S**				
1					
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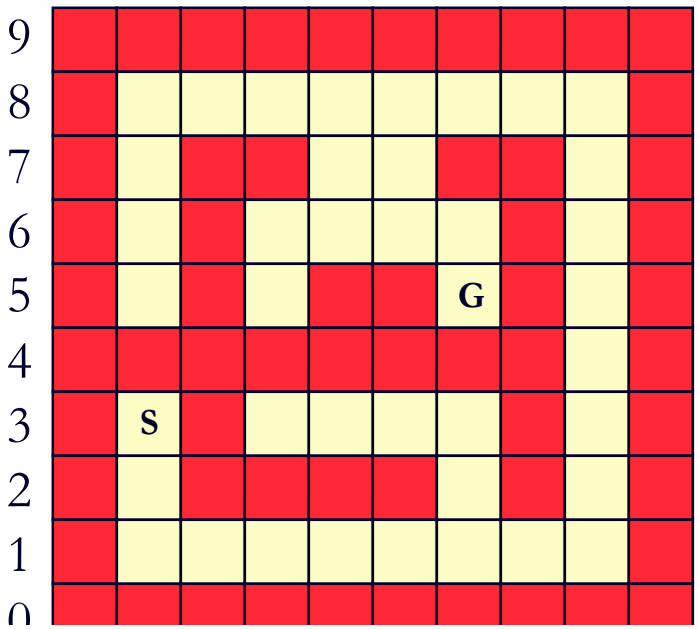
c) Traverse the maze from the starting point **S** to the goal **G** according to the *A* Search* method. Use the simple addition f(n) = g(n) + h(n) to calculate the f-cost for the A* algorithm, with path cost and heuristic as defined earlier.

[17 points]



Step	*Current Node*	*Path Cost*	*Heuris-tic*	*F-Cost*	*Queue*
0	**S**				
1					
2					
3					
4					
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d) Is the simple addition f(n) = g(n) + h(n) to calculate the f-cost for the A* algorithm a good choice for this problem? Explain your answer.

[3 points]

Total Points: