QUIZ #1 – COMP 3106 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

OCTOBER 2, 2023
8:35AM – 9:55AM (80 MINUTES)
SOUTHAM HALL 416

Instructions

The quiz is open-book, and you may consult your notes and the textbook during quizzes. You may not use electronic devices (except non-programmable scientific calculators) during quizzes.

You must complete the quiz individually.

The quiz includes five multiple-choice questions and four written answer questions. Multiple-choice questions are worth 2 marks each. Written answer questions are worth 10 marks each.

For the multiple-choice questions, circle the correct answer. Justification of your answers is not required and will not be considered.

For the written answer questions, write your answer in the space provided below the question. You are not required to provide justification (unless specifically requested). However, if your final answer is incorrect, partial credit may be awarded for justification. If your final answer is incorrect and you do not provide justification, you may receive a grade of zero for that question.
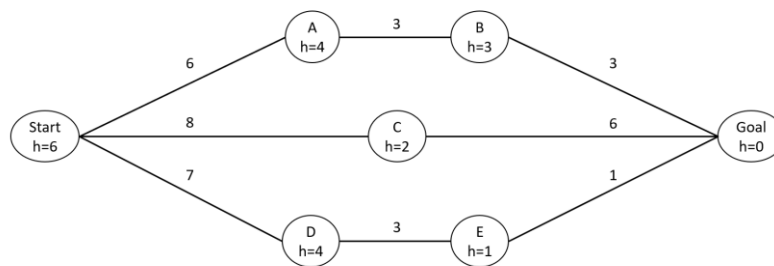
Question 1 [2 marks]

Consider an agent working in a restaurant environment. The agent delivers plated meals from a kitchen to customers throughout the dining room during dinner service. Which of the following is an appropriate performance measure for this task environment?

    a) Average number of meals carried at the same time
    b) Number of meals correctly delivered
    c) Number of meals dropped on the floor
    d) Number of times the kitchen is visited
    e) Total distance travelled

Question 2 [2 marks]

Consider the graph indicated below with start state "Start" and goal state "Goal", and bidirectional edges with edge weights indicated beside the edge. Heuristic values are indicated in each node. What is the cost of the path from "Start" to "Goal" that is found by uniform cost search?
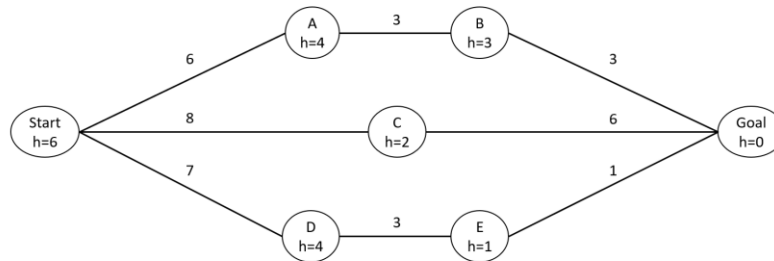

    a) 6
    b) 11
    c) 12
    d) 14
   e) 20

Question 3 [2 marks]

Consider the graph indicated below with start state "Start" and goal state "Goal", and bidirectional edges with edge weights indicated beside the edge. Heuristic values are indicated in each node. What is the cost of the path from "Start" to "Goal" that is found by greedy heuristic search?

a)   6
b)   11
c)   12
d)   14
e)   20

Question 4 [2 marks]

Consider the graph indicated below with start state "Start" and goal state "Goal", and bidirectional edges with edge weights indicated beside the edge. Heuristic values are indicated in each node. When uniform cost search is executed on this graph, all nodes are explored. When A* search is executed on this graph, not all nodes are explored. Which node in this graph is explored during uniform cost search but not during A* search?

a)   A
b)   B
c)   C
d)   D
e)   E
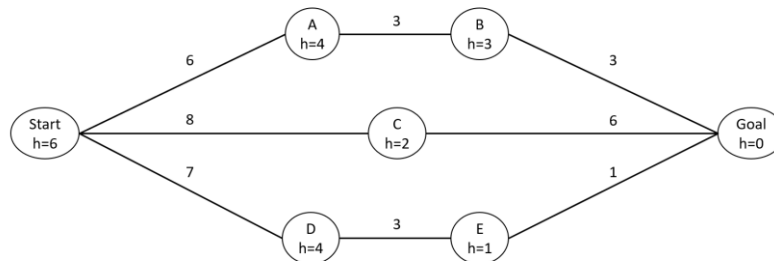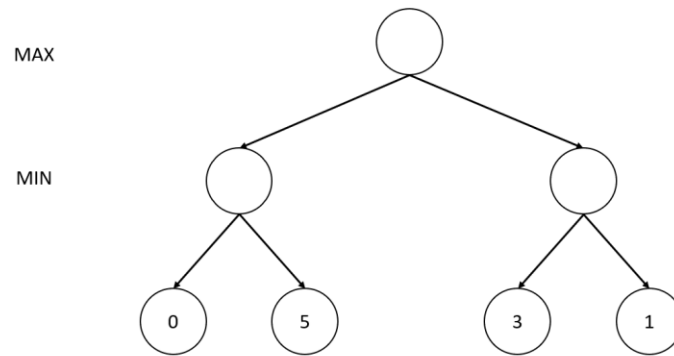
Question 5 [2 marks]

Consider an adversarial search on a turn-based two-player game illustrated below. Assume the first player wishes to maximize the score and the second player wishes to minimize the score. The score for each terminal state is indicated in each leaf node. What is the minimax value of the root node?

MAX

MIN

0   5   3   1

a) 0
b) 1
c) 3
d) 5
e) 9

Question 6 [10 marks]

Consider a task environment for an agent that picks up trash from a park, with the following assumptions:

 i. The park is divided into 25 square areas.
 ii. The trash bin is located in the bottom-right area.
 iii. The agent can only sense whether there is trash in the current square.
 iv. The agent can only clean up trash in the current area.
 v. After cleaning a square, the agent must return to the trash bin to empty its bag before cleaning any other square.
 vi. Trash appears randomly in each area of the park with small chance at every point in time.
 vii. The agent cannot tell exactly which square it is in but can tell which directions it is able to move.
 viii. The agent knows its left/right and up/down orientation.

Fully describe this task environment by specifying each of the following.

   a) Performance measure
   b) Environment
   c) Actuators
   d) Sensors

Characterize the task environment according to each of the following properties. For each property, provide a brief justification.

   e) Fully observable vs. partially observable
   f) Single agent vs. multiple agent
   g) Deterministic vs. stochastic
   h) Static vs. dynamic
   i) Sequential vs. episodic
   j) Discrete vs. continuous

(Note: there are many ways to answer this question; your answer should show you understand the properties of task environments; if you make any additional assumptions about the environment, state your assumptions)

Question 7 [10 marks]

Consider a task environment for an agent that picks up trash from a park, with the following assumptions:

i.   The park is divided into 25 square areas.
ii.   The trash bin is located in the bottom-right area.
iii. The agent can only sense whether there is trash in the current square.
iv.   The agent can only clean up trash in the current area.
v.   After cleaning a square, the agent must return to the trash bin to empty its bag before cleaning any other square.
vi.   Trash appears randomly in each area of the park with small chance at every point in time.
vii. The agent cannot tell exactly which square it is in but can tell which directions it is able to move.
viii. The agent knows its left/right and up/down orientation.

				Trash bin

Suggest, at a high level, how each of the following types of agents might be implemented in this task environment.

a) Simple reflex agent
b) Model-based reflex agent
c) Goal-based agent (describe the goal state)
d) Utility-based agent (describe the utility function)

(Note: there are many ways to answer this question; your answer should show you understand how each type of agent works; if you make any additional assumptions about the environment, state your assumptions)
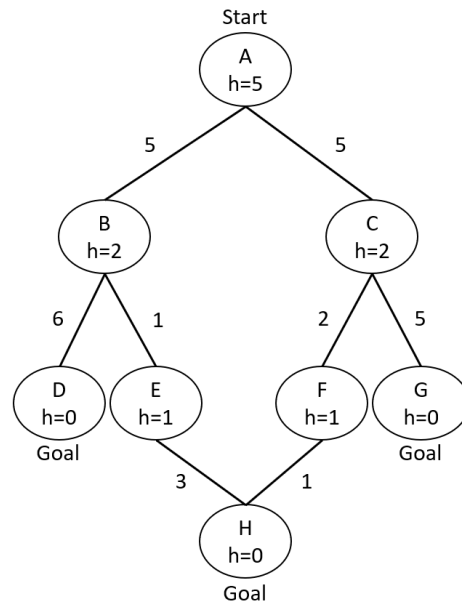
Question 8 [10 marks]

Perform A* search on the following graph to find the optimal path from the Start state to a Goal state (note there may be multiple goal states). Assume all edges are bidirectional. The edge weights are indicated beside each edge. The value of the heuristic function h(n) is indicated inside each node. Break any ties by first exploring the node that is first alphabetically. Note that there are multiple goal states.

In your answer, state the following:
   a)   The optimal path
   b)   The optimal path cost
   c)   The list of nodes explored during search, in order

Question 9 [10 marks]

Consider playing the adversarial game illustrated by the graph below. Assume the score associated with the terminal state is indicated in each of the leaf nodes in the graph.

What is the optimal move the first player (MAX) should take to maximize the score, given the adversary makes the optimal moves to minimize the score? Use minimax search with alpha-beta pruning. Traverse child nodes in left-to-right order.
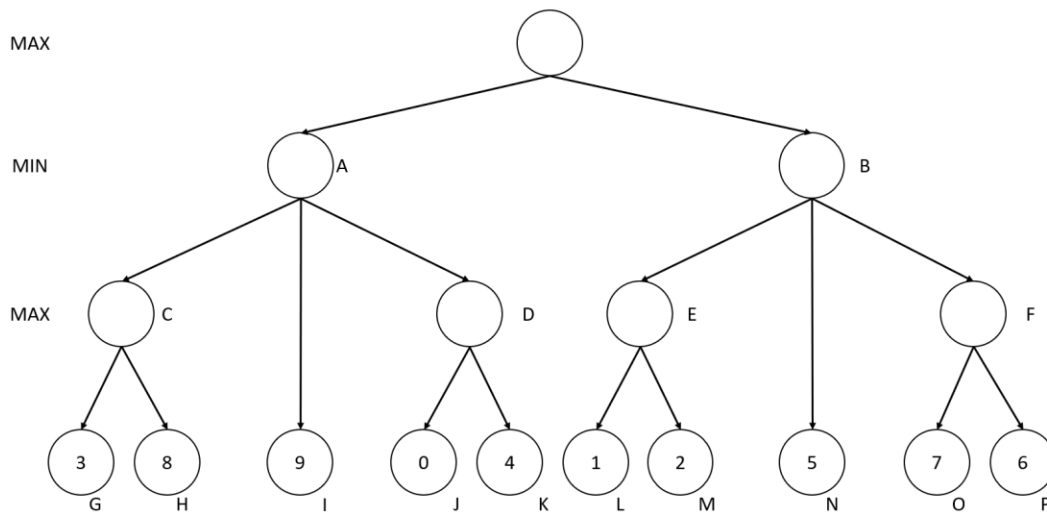
In your answer, state the following:
  a) The minimax value for the root node
  b) The optimal move the first player should take in their first ply
  c) The list of nodes pruned during search (i.e. nodes not examined)