AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING

Department of Computers and Systems

Spring 2023	**Course Code: *CSE 472***	***Time allowed: 2 Hrs.***

Artificial Intelligence

The Exam Consists of **Seven** Questions in **Four** Pages. ***Maximum Marks: 60 Marks*** **1 / 4**

Important Rules:	**تعليمات هامة**
• Having a (mobile -Smart Watch- earphones) inside the examination hall is forbidden and is considered as a cheating behavior. • It is forbidden to have any references, notes, books, or any other materials even if it is not related to the exam content with you in the examination hall. • Answer the questions in order.	• حيازة (المجمول- الساعات الذكية - سماعة الأذن) داخل لجنة الامتحان يعتبر حالة غش تستوجب العقاب. • لايسمح بدخول أي كتب أو ملازم أو أوراق داخل اللجنة والمخالفة تعتبر حالة غش. • أجب على الأسئلة بالترتيب

Question 1: (5 marks)

Consider a software agent which performs the functions of a travel agent for airline reservations. The agent tries to find the best flights for a customer based on his/her requirements and the airline reservation databases at the lowest cost.

Specify the following attributes for this agent (full mark for any 5 correct items)

a. Type of the Agent:
b. Percepts:
c. Environment:
d. Observability:
e. Static/Dynamic:
f. Episodic:
g. Knowledge bases:
h. Actions:
i. Utility:

Question 2: Propositional Logic (5 marks)

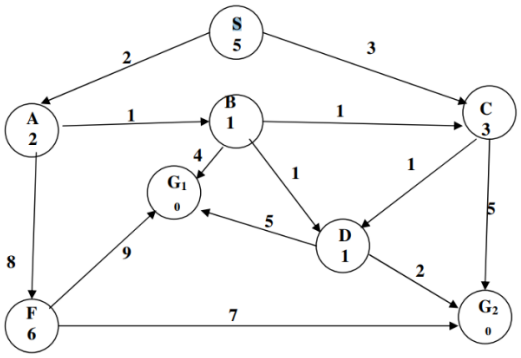
a. **C**onvert $(P \wedge R) \rightarrow (Q \rightarrow R)$ into Clause Form.
b. Use model checking to show whether $(A \wedge B) \rightarrow C \models (A \rightarrow C) \vee (B \rightarrow C)$.

Question 3: Search (15 marks)

Consider the search space below, where S is the start node and G1 and G2 are goal nodes. Arcs are labeled with the value of a cost function; the number gives the cost of traversing the arc. Nodes are labeled with the value of a heuristic function; the number gives the estimate of the distance to the goal. Assume that uninformed search algorithms always choose the left branch first when there is a choice. For each of the following search strategies:

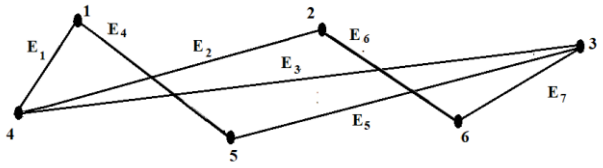
Depth-first (2 marks)
Iterative Deepening (3 marks)
Breadth-first (2)
Best first (4 marks)
A* (4 marks)

a. Find which goal state is reached first (if any) and the cost of the path.
b. List in order all the states that are explored until the goal is reached.



Question 4: Constraint Satisfaction (10 marks)

Consider the following graph with 6 vertices and 7 undirected edges. In this problem, you can color each *edge* using one color from the following set of 3 colors, {Red, Green, Blue}. You are asked to solve this edge-coloring problem as constraint satisfaction problem.



The edge-coloring of a graph is an assignment of colors to the *edges* of the graph so that no two adjacent *edges* have the same color. Let's call this constraint the “edge-coloring'' constraint. For example, E1 and E2 cannot have the same color because both are adjacent at vertex no 4. On the other hand, the graph doesn't restrict you to use the same color on E2 and E4 because they are not adjacent at any vertex.

a. Draw the constraint graph associated with your CSP.

b. Assume that you have not assigned any variables yet. List all variables that might be selected by the Degree Heuristic.

c. Consider the assignment below. E2 is assigned R. Cross out all the values that would be eliminated by forward checking.

E1	E2	E3	E4	E5	E6	E7
RGB	R	RGB	RGB	RGB	RGB	RGB

d. Now assume E1 is assigned R, E6 assigned G as shown, and constraint propagation has been done. If you have selected E5 as the next variable, list all values that might be selected by the Least Constraining Value Heuristic.

E1	E2	E3	E4	E5	E6	E7
R	RGB	RGB	RGB	RGB	G	RGB

Question 5 Genetic Algorithms (8 marks)

a. State two aspects of a GA's design that would cause a population to converge quickly? Refer to the two basic steps of GAs (selection and reproduction) in your answer. **(4 marks)**

b. Which of the following statements are true? **(4 marks)**
   i. Genetic algorithms are used for only minimization problems.
   ii. Genetic algorithms maintain several possible solutions with one solution.
   iii. Genetic algorithms maintain one solution throughout its search.
   iv. Genetic algorithms are not guaranteed to find the optimal solution.

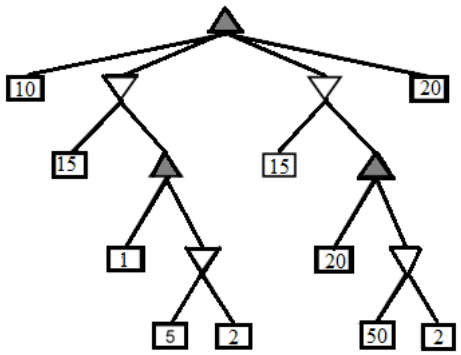
Question 6 Games (11 marks)

Consider the following minimax tree where the player at the root node is the maximizer.

a. What is the minimax value for the root? **(2 marks)**

b. Mark any nodes which will not be visited by alpha-beta pruning, and the nodes at which cutoff occurs assuming children are considered in left-to-right order.

c. Is there a different ordering for the children of the root for which more pruning results? If so, state the order. **(3 marks)**



Question 7 Neural Networks (6 Mark)

Consider using an artificial neural network (without hidden units) to learn, using the delta rule, the following examples:

k	input	output
1	0 1 0 1	1
2	1 1 0 1	0
3	1 0 0 1	1

a. Draw the network. Assume all weights are initially 0 and that the learning rate is 0.1.
b. Find the value of the weights after processing (once) each of the above three training examples. Use a Hard Limit unit as the activation function of the output unit.

Hint: Perceptron learning Rule:

$$w_{kj}(n+1) = w_{kj}(n) + \Delta w_{kj}$$

$$\Delta w_{kj}(n) = \eta \cdot e_k \cdot x_j(n)$$

Best wishes

Questions-LOs					
	LO1	LO2	LO3	LO4	LO5
Q1	•			•	
Q2		•			
Q3		•		•	
Q4		•		•	
Q5		•		•	•
Q6		•		•	
Q7		•	•		