EAST WEST UNIVERSITY
Department of Computer Science and Engineering
B.Sc. in Computer Science and Engineering Program
Mid Term II Examination, Summer 2023 Semester

Course:	**CSE 366(4), ETE475 (4), ICE475 (4), ICE 476(4) Artificial Intelligence, Section-4**
Instructor:	**Dr Md Rifat Ahmmad Rashid, Assistant Professor, Department of CSE**
Full Marks:	**30**
Time:	**1 Hour and 20 Minutes**

Notes: There are FIVE questions, answer ALL of them. Course Outcome (CO), Cognitive Level (C), and Mark of each question are mentioned at the right margin.

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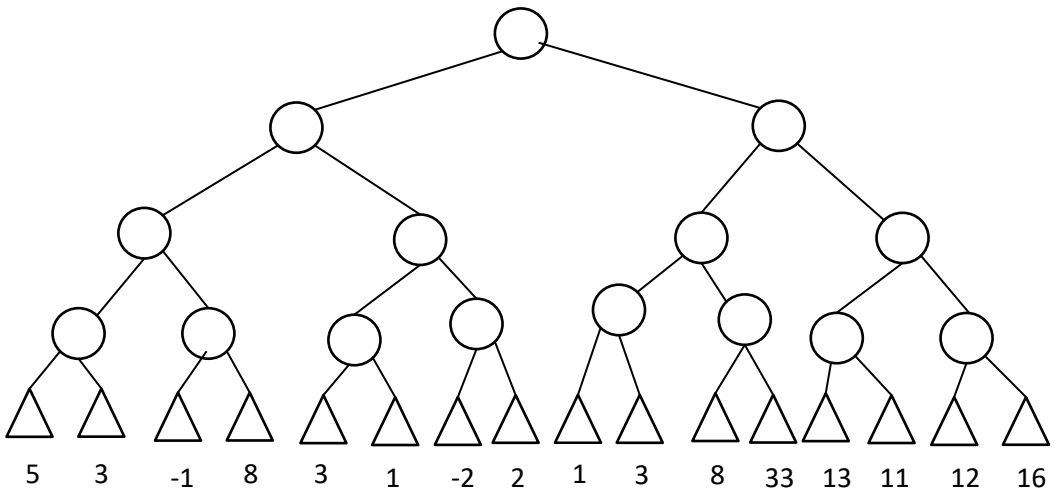
1. Let P(x) = "x is a hummingbird"; Q(x) = "x is large"; R(x) = "x live on honey"; S(x) = "x is richly colored". [CO2, C3 Marks: 6]
   Convert each of these statements into logical expressions using predicates, quantifiers, and logical connectives.
   a) All hummingbirds are richly colored.
   b) All large birds live on honey.
   c) Birds that do not live on honey are dull in color.
   d) Hummingbirds are small.
   e) Large birds live on honey may be richly colored.
   f) Hummingbirds live on honey.

2. The game tree below illustrates a position reached in the game. It is MIN's turn to move. [CO2, C3 Marks: 6]



Identify the minimax value of the root node for the above game tree. **Apply** alpha beta pruning on the above game tree and **redraw the entire game tree. Cross out the node(s)** whose values(s) the alpha-beta method never determines, assuming that it performs a depth-first search that always generates the right most child node first and a loss (and win) of MAX (and MIN) corresponds to a value of -∞ (and ∞, respectively). Determine the alpha and beta values of the remaining node(s).

3. a) Consider a scenario where you have three variables: A, B, and C. The domains for A and B are {1, 2, 3}, and for C, it's {2, 3, 4}. Additionally, the following constraints exist: A ≠ B, A < C, and B < C. Determine the values for A, B, and C considering the constraints. [CO2, C3 Marks: 6]

b) Solve the following crypto arithmetic problem:

$$\begin{array}{r} \text{S E N D} \\ +\ \text{M O R E} \\ \hline \text{M O N E Y} \end{array}$$

Consider following constraints: (i) no two letters have same value; (ii) sum of digit must be as shown in problem;(iii) there should be only one carry forward.

4. Consider the graph with 8 nodes A_1, A_2, A_3, A_4, H, T, F_1, F_2. A_i is connected to A_{i+1} for all i, each A_i is connected to H, H is connected to T, and T is connected to each F_i. Choose a constraint satisfaction problem (CSP) formulation. [CO2, C3 Marks: 6]

Find a 3-coloring of this graph by hand using the following strategy: intelligent backtracking, the variable order A_1, H, A_4, F_1, A_2, F_2, A_3, T, and the value order R, G, B.

5. The N-Queens problem involves placing N chess queens on an N×N chessboard in a way that no two queens threaten each other. Consider the case of solving the 8-Queens problem using genetic algorithm. [CO2. C3 Marks: 6]

Describe the steps involved in applying a Genetic Algorithm to solve this problem. Explain how solutions (queen placements) are **encoded**, how genetic operators (**selection, crossover, mutation**) are utilized, and how the **fitness function** is designed to evaluate solutions.