Shiraz University

Homework 2 – Report

University: Shiraz University
Course: Artificial intelligence – Spring 2025
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Assignment Title: Informed search, CSP, Adversarial Search
Due Date: God and TAs know

Q1:

a)

Problem Setup

- **Classes and Times**:
  1. C_1 Class 1: Computer Fundamentals (8:00 AM–9:00 AM)
  2. C_2 Class 2: Artificial Intelligence (8:30 AM–9:30 AM)
  3. C_3 Class 3: Natural Language Processing (9:00 AM–10:00 AM)
  4. C_4 Class 4: Machine Vision (9:00 AM–10:00 AM)
  5. C_5 Class 5: Machine Learning (9:30 AM–10:30 AM)
- **Professors and Capabilities**:
  - Professor A: Can teach Class 3, Class 4
  - Professor B: Can teach Class 2, Class 3, Class 4, Class 5
  - Professor C: Can teach all (Class 1, Class 2, Class 3, Class 4, Class 5)
- **Days**: Saturday, Sunday, Monday (we need to schedule all five classes across these days).
- **Constraints**:

  The constraints ensure that the assignments are valid, focusing on professor availability and time conflicts. There are two types of constraints:

- **Unary Constraints (Implicit in Domains)**:

- Each class must be assigned a professor who is qualified to teach it. This is already enforced by the domains defined above (e.g., C1 C_1 C1 can only be assigned to Professor C).

- **Binary Constraints (No Overlap)**:
  - No professor can teach two classes that overlap in time on the same day.

Step 1: Define Domains

- Class 1 (8:00–9:00 AM): Only Professor C can teach.
  $D(C_1)$: {(C, Sat), (C, Sun), (C, Mon)}.

- Class 2 (8:30–9:30 AM): Professors B, C.
  $D(C_2)$: {(B, Sat), (B, Sun), (B, Mon), (C, Sat), (C, Sun), (C, Mon)}.

- Class 3 (9:00–10:00 AM): Professors A, B, C.
  $D(C_3)$: {(A, Sat), (A, Sun), (A, Mon), (B, Sat), (B, Sun), (B, Mon), (C, Sat), (C, Sun), (C, Mon)}.

- Class 4 (9:00–10:00 AM): Professors A, B, C.
  $D(C_4)$: {(A, Sat), (A, Sun), (A, Mon), (B, Sat), (B, Sun), (B, Mon), (C, Sat), (C, Sun), (C, Mon)}. Same domain as Class 3.

- Class 5 (9:30–10:30 AM): Professors B, C.
  $D(C_5)$: {(B, Sat), (B, Sun), (B, Mon), (C, Sat), (C, Sun), (C, Mon)}.

Step 2: Identify Overlapping Classes

Classes overlap if their time intervals intersect on the same day. Let's check the time ranges:

- Class 1 (8:00–9:00) overlaps with Class 2 (8:30–9:30) because 8:30–9:00 intersects.

- Class 2 (8:30–9:30) overlaps with Class 3 (9:00–10:00) and Class 4 (9:00–10:00) because 9:00–9:30 intersects.

- Class 3 (9:00–10:00) overlaps with Class 4 (9:00–10:00) (same time) and Class 5 (9:30–10:30) because 9:30–10:00 intersects.

- Class 4 (9:00–10:00) overlaps with Class 5 (9:30–10:30) because 9:30–10:00 intersects.

- Class 5 (9:30–10:30) overlaps with Class 3 and Class 4.

Overlap pairs (same day constraint):

- Class 1 and Class 2

- Class 2 and Class 3

- Class 2 and Class 4

- Class 3 and Class 4

- Class 3 and Class 5
- Class 4 and Class 5

  If any of these pairs are scheduled on the same day, they cannot be assigned to the same professor.

  Binary Constraints: For each pair of classes that overlap, if they are scheduled on the same day, they must be assigned different professors. Formally, for each pair (C_i, C_j) where C_i and C_j overlap, the constraint is:

  - If $C_i = (P_i, D_i)$ and $C_j = (P_j, D_j)$, then:
    - $D_i \neq D_j$ (different days) **OR** $P_i \neq P_j$ (different professors).

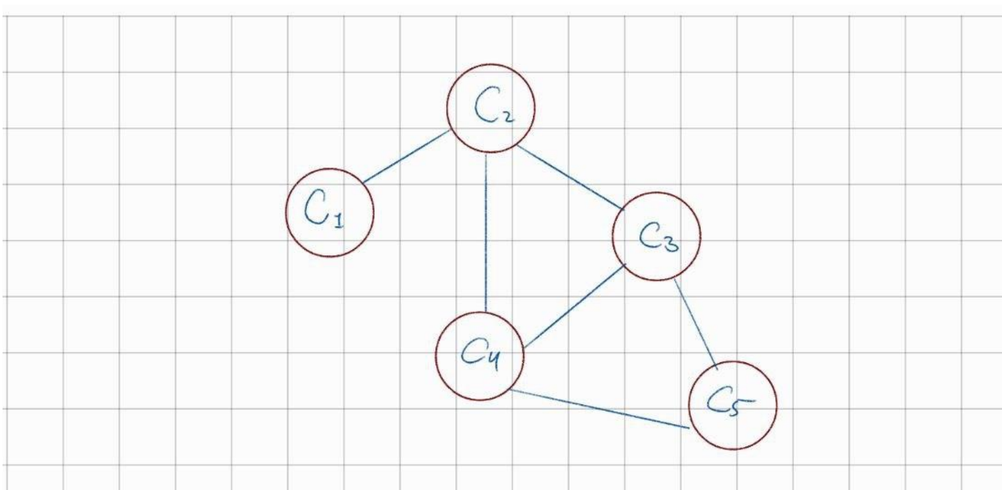
  The overlapping pairs and their constraints are:

- (C1, C2): If C1 = (P1, D1), C2 = (P2, D2), then D1 ≠ D2 ∨ P1 ≠ P2.
- (C2, C3): If C2 = (P2, D2), C3 = (P3, D3), then D2 ≠ D3 ∨ P2 ≠ P3.
- (C2, C4): If C2 = (P2, D2), C4 = (P4, D4), then D2 ≠ D4 ∨ P2 ≠ P4.
- (C3, C4): If C3 = (P3, D3), C4 = (P4, D4), then D3 ≠ D4 ∨ P3 ≠ P4.
- (C3, C5): If C3 = (P3, D3), C5 = (P5, D5), then D3 ≠ D5 ∨ P3 ≠ P5.
- (C4, C5): If C4 = (P4, D4), C5 = (P5, D5), then D4 ≠ D5 ∨ P4 ≠ P5.

  Implicit Constraint:

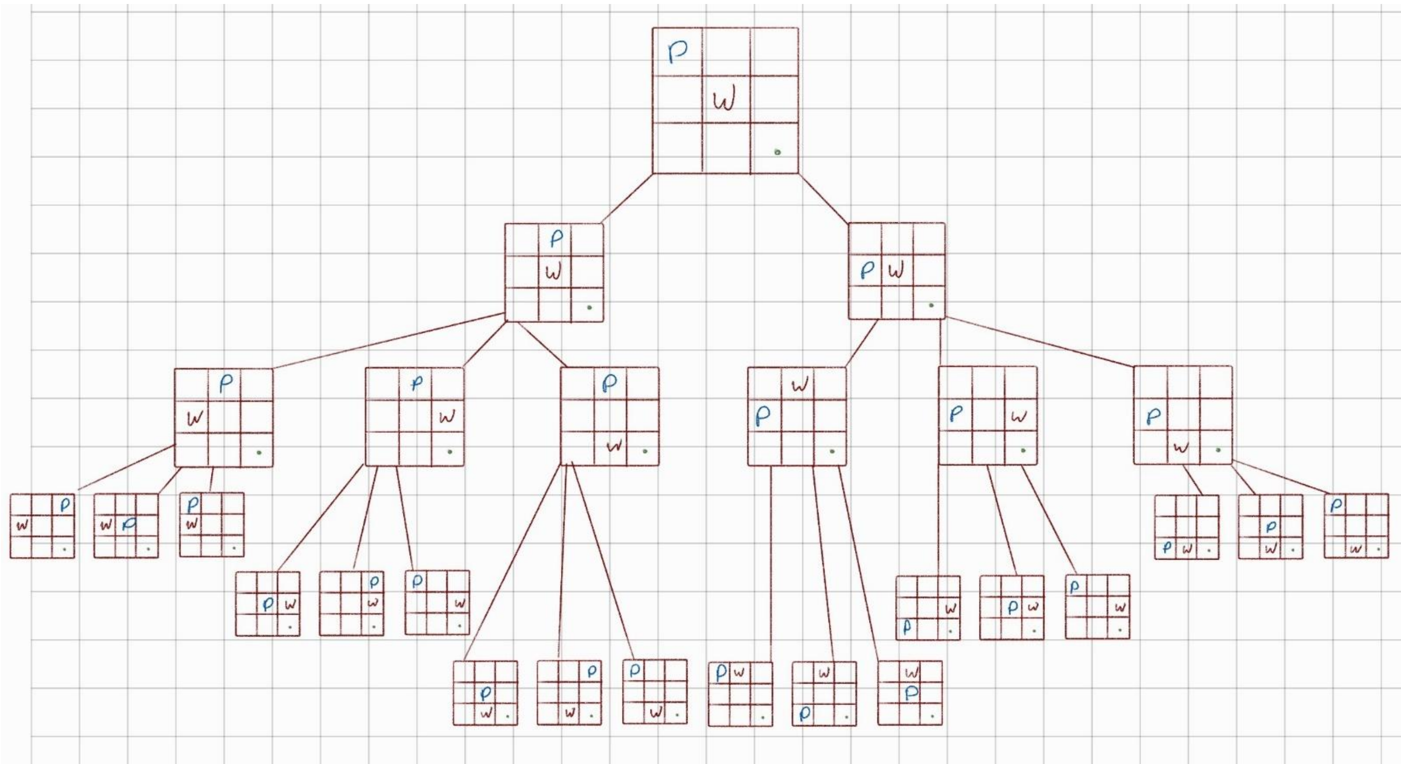
- All classes must be scheduled (i.e., each variable C_i must be assigned a value from its domain). This is ensured by the CSP solving process, which seeks a complete assignment.

b)



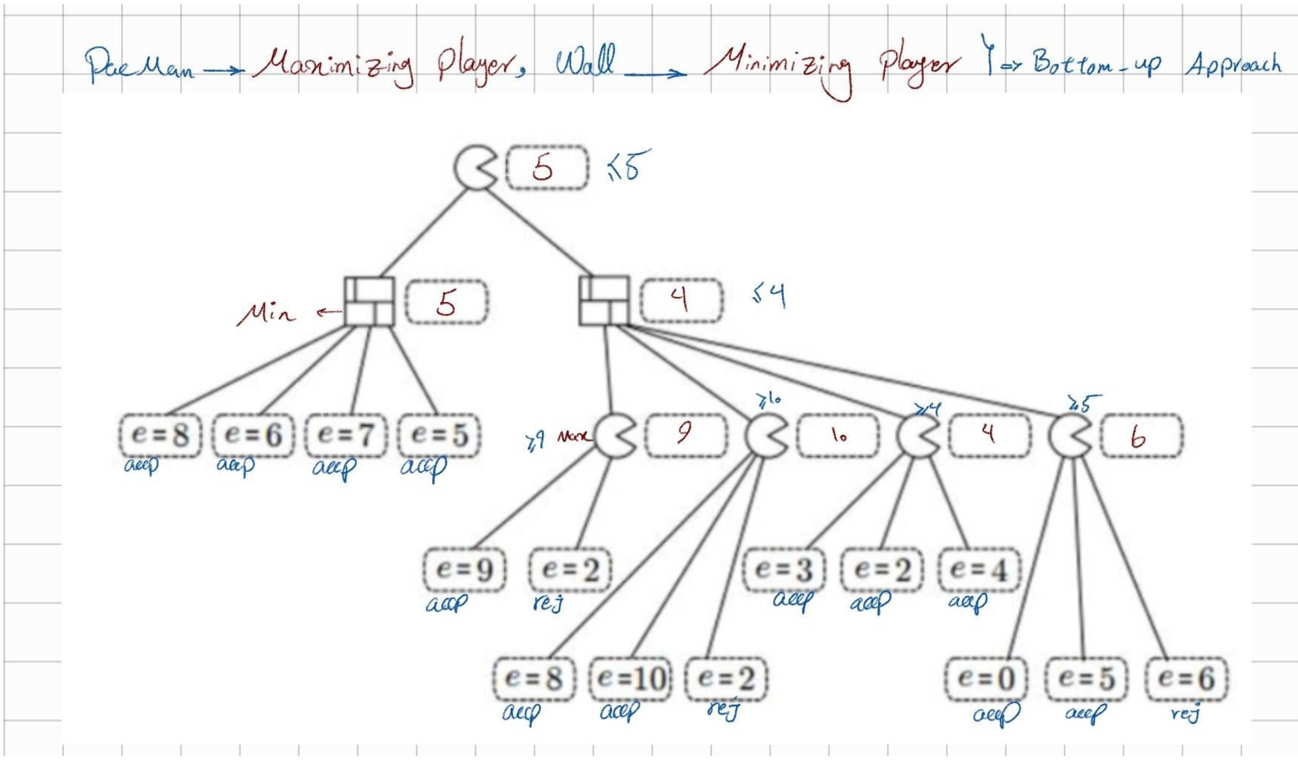
Q2:

a)



Game Tree Depth: 3, **Game Value: 0** (Pacman Only moved twice and couldn't reach the goal)

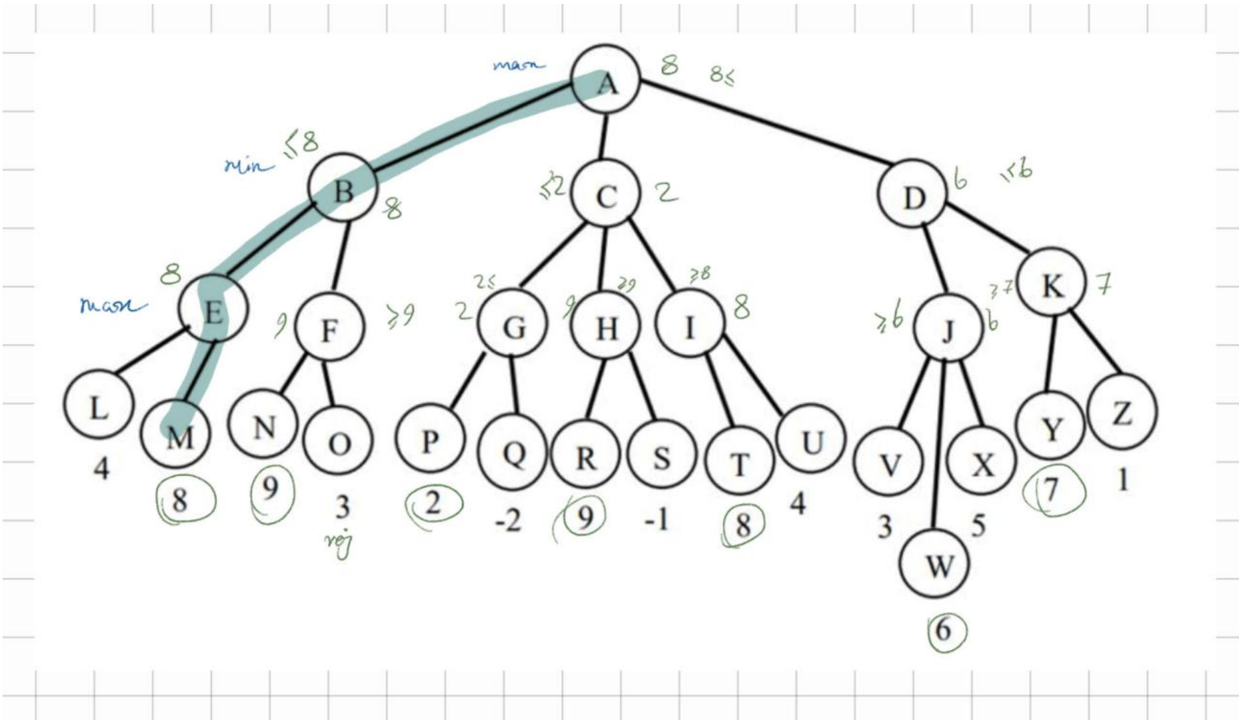
b)



$e = 2$, $e = 6$ are not examined by the Alpha-Beta Pruning

Q5:

a)



b)

First move of max will be **A** to **B**

c)

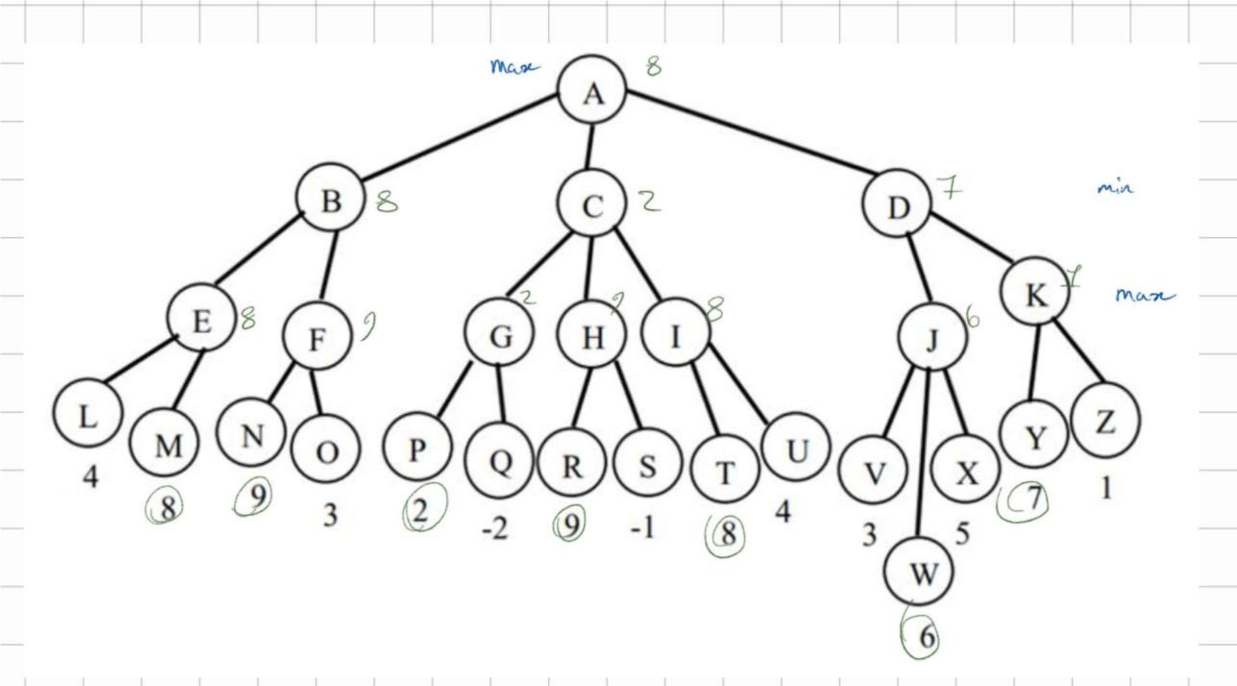
In F sees the N and it matches with condition so O is pruned. With this logic all the pruned nodes will be: {O, H, I, R, S, T, U, X, K, Y, Z}

d)

1. **Minimax value at the root** does *not* change. Alpha-beta always computes the same minimax value, regardless of child-visit order.

2. **Number of prunings can change.** A better (or worse) move ordering can lead to more (or fewer) cut-offs.

e)



all nodes traversed