ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

QUIZ 2 **WINTER SEMESTER, 2020-2021**

DURATION: 30 Minutes **FULL MARKS: 30**

CSE 4711: Artificial Intelligence

There are **2 (two)** questions. Answer **both** of them.

Figures in the right margin indicate marks.

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1. Consider that you are working for *Bingo*, a lottery insurance company that offers people flat payments in exchange for their lottery tickets. There's a lottery where people have $p\%$ chance of winning $\$M$ and $(100-p)\%$ chance of winning \$0. You are designing a system to determine the payment rate for people to persuade them to give up their lottery tickets. Using data mining techniques, you have determined their utility functions, $U(\$X)$, where X is the amount of money. Your system will be given the p, $U(\$X)$, and M for each person. It will output the minimum payment required to convince them to give up the lottery ticket. Assume that people are rational agents.

   a) [CO2, PO4] Model the system based on the given requirements. 10

   Solution: Let, L be the lottery event. Then,

   $$U(L) = \frac{p \times U(\$M)}{100} + \frac{(100-p) \times U(\$0)}{100}$$

   To convince a rational agent to give up the lottery ticket and accept flat payment, we need to pay more than $\$U(L)$.

   Rubric:

   - For correct probabilities: 4 points
   - For assuming that money is not equal to the utility of money: 4 points
   - For predicting that we need to give more than the utility of the lottery: 2 point

   b) [CO1, PO1] For each of the following scenarios, predict the amount of flat payment required to make people indifferent to playing the lottery and receiving the flat payment. 3×2

   i. $p = 0.5, M = 10^8, U(\$X) = \sqrt{X}$

   Solution: Using the formula from 1(a), we need to pay (in USD):

   $$\begin{aligned} U(L) &= \frac{0.5 \times U(10^8)}{100} + \frac{(100-0.5) \times U(0)}{100} \\ &= \frac{0.5 \times \sqrt{10^8}}{100} + \frac{99.5 \times \sqrt{0}}{100} \\ &= 50 \end{aligned}$$

   Rubric:

   - For placing correct values in equation/answer: 2 points
   - For predicting that we need to pay money equal to the utility of the lottery: 1 point

ii. $p = 30, M = 10^3, U(\$X) = X + 5$

Solution: Using the formula from 1(a), we need to pay (in USD):

$$\begin{aligned} U(L) &= \frac{30 \times U(10^3)}{100} + \frac{(100-30) \times U(0)}{100} \\ &= \frac{30 \times (10^3+5)}{100} + \frac{70 \times (0+5)}{100} \\ &= 305 \end{aligned}$$

Rubric:

- For placing correct values in equation/answer: 2 points
- For predicting that we need to pay money equal to the utility of the lottery: 1 point

2. Consider that a Pacman game is being played in the map shown below:

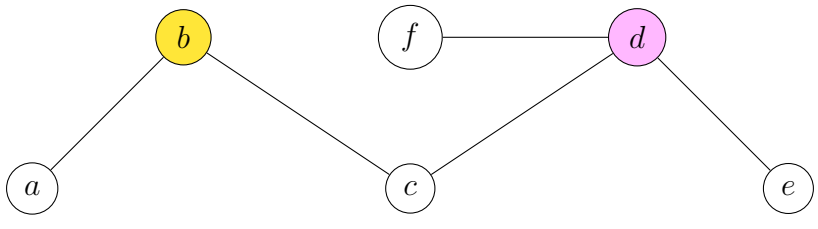
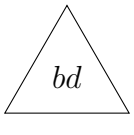


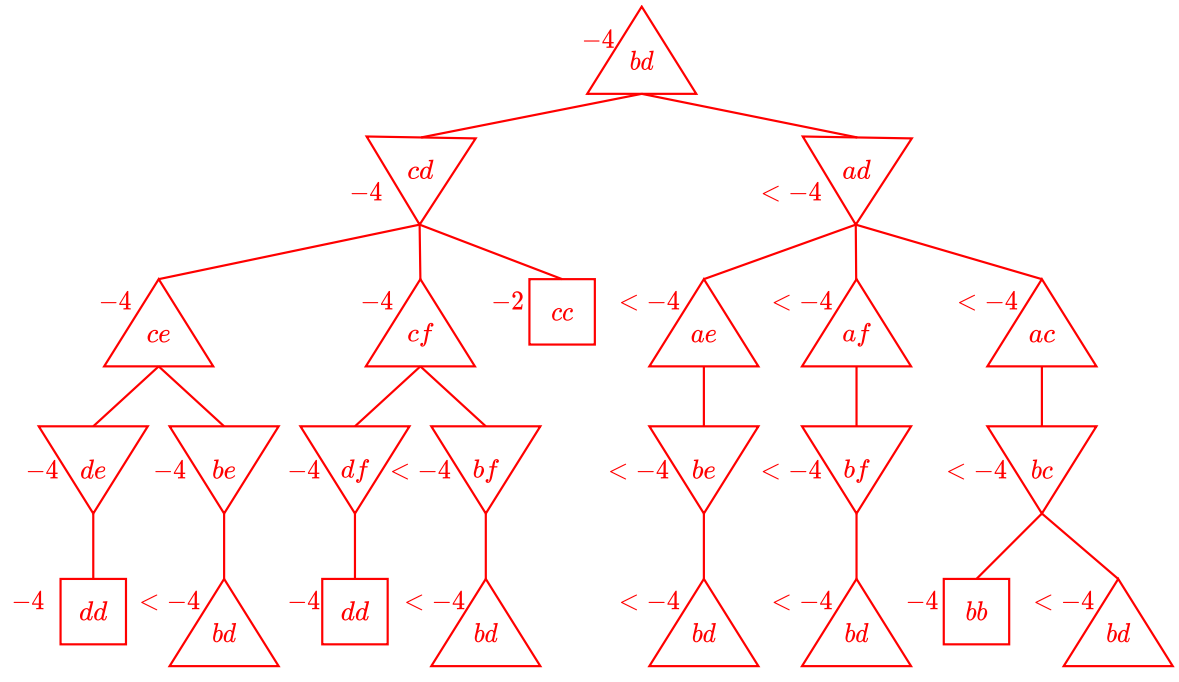
Figure 1: Pacman Game Map for Question 2

Initially, Pacman is in node b and the ghost is in node d. The ghost wants to catch Pacman, and Pacman wants to evade it. Pacman and the ghost will take turns moving from one node to another and Pacman moves first. In their turn, the player (Pacman/Ghost) must move to an adjacent node. The game ends when the ghost catches Pacman. Each edge requires 1 second to cross. The terminal payoff of the Ghost is negative of the total time taken.

a) [CO2, PO4] Draw the Minimax Tree up to depth 4 (maximum two moves for Pacman, and maximum two moves for Ghost). Use up triangles ($\triangle$) for maximizer nodes, down triangles ($\triangledown$) for minimizer nodes, and squares ($\square$) for terminal nodes. Denote each node in the Minimax Tree as pair of values, where the first value denotes the position of Pacman, and the second value denotes the position of the ghost at that state. For example, the root node will look like this: 12



Solution:



Rubric:

- 0.5 points for each correct node

b) [CO1, PO1] What is the maximum score the ghost can get if both play optimally? Provide a brief explanation. 2

Solution: From the top value of the Minimax Tree, the answer is -4.
Alternate solution: From the graph, it can be seen that the best the ghost can do is go towards Pacman. An optimal Pacman would try to run away from the ghost, but eventually it will be caught. It requires 4 steps to catch Pacman.

Rubric:

- 1 point for the correct answer
- 1 point for correct explanation.