INDRAPRASTHA INSTITUTE *of*
INFORMATION TECHNOLOGY **DELHI**

CSE643 – Artificial Intelligence

Monsoon 2021 session

Quiz-2

20-Oct-2021

Time: 1:30pm to 2:30pm (including time to upload your answers)

Max marks: 10 (will be scaled down to 5 marks)

Deadline to upload your answers: 20-Oct-21, 2:30 pm (no extensions)

INSTRUCTIONS: You will have to create a PDF file with your answers, name the file as AI-Q2-<Name>-<RollNo> and upload it on the classroom page. In the answer sheet write your name and roll number. In case you choose to have hand-written answers then those pages can be scanned and uploaded (make sure that it is clearly readable).

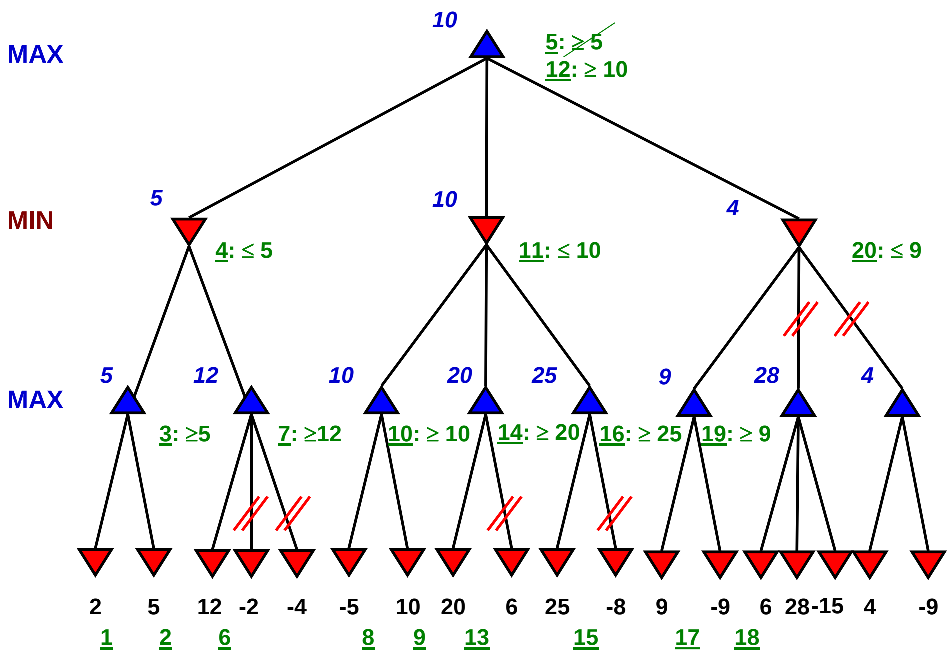
Q1: (4 marks)

Ram and Vinay decide to play a game with Ram starting first. Ram realizes that he has 3 possible options called {(a), (b), (c)}. If Ram chooses move (a) then Vinay has 2 possible options {(d), (e)}. If Ram chooses (b) or (c) then Vinay has three options {(f), (g), (h)} or {(i), (j), (k)} respectively. If Vinay chooses (d) then Ram has two options {(l) with gain value 2, (m) with gain value 5}. If Vinay chooses (e) then Ram has three options {(n) with gain value 12, (o) with loss value 2, (p) with loss value 4}. If Vinay choses (f) then Ram has two options {(q) with loss 5, (r) with gain 10}. If Vinay choses (g) then Ram has two options {(s) with gain 20, (t) with gain 6}. If Vinay choses (h) then Ram has two options {(u) with gain 25, (v) with loss 8}. If Vinay choses (i) then Ram has two choices {(w) with gain 9, (x) with loss 9}. If Vinay choses (j) then Ram has three choices {(y) with gain 6, (z) with gain 28, (z1) with loss 15}. If Vinay choses (k) then Ram has two choices {(z2) with gain 4, (z3) with loss 9}.

i) Draw a game tree and show the minmax evaluation on that tree.
ii) Do alpha-beta pruning and show the result of the game tree.

Answers

Let Ram's choices be represented by Blue upright triangles (Max nodes) and Vinay's choices be represented by Red inverted triangles (Min nodes).



i) We can see that Ram will choose option (b) as that has the Max value of 10 for his play.

ii) The Alpha-beta pruning has pruned out nodes {o, p, t, v, j, k}.

Q2: (3 marks)

i) Does Alpha-beta pruning algorithm do depth-first search or breadth-first search?

ii) Can Alpha-beta pruning algorithm do breadth-first search and get optimal answer? Explain why or why not?

Answers

i) Alpha-beta pruning algorithm does depth-first search.

ii) No, the Alpha-beta pruning algorithm cannot do breadth-first search and get an optimal answer as the min-max procedure needs to examine the game-tree nodes below the current node in order to assign a value to that node. Since alpha-beta pruning uses the min-max values from one of the left-most sub-trees to decide which nodes to prune in the right sub-trees, it needs to do depth-first search to get optimal answer.

Q3: (3 marks)

An airline wants to schedule pilots for its flights. All pilots can fly for a maximum of 8 hours in a day. A junior co-pilot needs a senior pilot scheduled in the same flight. Pilots need to have a license for the aircraft they are flying. No pilot can operate more than 1 flight a day. Formulate this as a CSP problem.

Answers

Variables

{Pilots, PilotLevel, FlightFlyingTime, FlightNum, FlightNumAircraftType, PilotLicenseAircraftType, PilotOperatedFlightInADay}

Domain

$D_{Pilot} = \{P_1, P_2, ..., P_n\}$ N-pilots

$D_{PilotLevel} = \{Senior, Junior\}$

$D_{FlightFlyingTime} = \{F_{1t}, F_{2t}, ..., F_{mt}\}$ Duration of M-Flights

$D_{FlightNum} = \{F_1, F_2, ..., F_m\}$ M- Flights

$D_{FlightNumAircraftType} = \{Ft_1, Ft_2, ..., Ft_k\}$ K- types of aircrafts

$D_{PilotLicenseAircraftType} = \{Pt_{xz}\}$ 1 <= x <= n; 1 <= z <= k

$D_{PilotOperatedFlightInADay} = \{Fo_{xy}\}$ 1 <= x <= n; 1 <= y <= m

Constraints (note these are not logical statements but constraints)

No pilot can operate more than 1 flight a day.

$C1 = \{ \forall x \forall y: P_x \wedge (|Fo_{xy}| \leq 1) \}$

All pilots can fly a maximum of 8 hours in a day

$C2 = \{ \forall x \forall y \forall t: P_x \wedge F_y \wedge (|Fo_{xy}| > 0) \wedge (F_{yt} \leq 8) \}$

Pilots need to have a license for the aircraft they are flying

$C3 = \{ \forall x \forall y \forall z: P_x \wedge F_y \wedge (|Fo_{xy}| > 0) \wedge (Ft_z = Pt_{xz}) \}$

A junior co-pilot needs a senior pilot scheduled in the same flight.

$C4 = \{ \forall x \forall y \forall z: P_x \wedge P_y \wedge F_z \wedge (|Fo_{xz}| > 0) \wedge (|Fo_{yz}| > 0) \wedge (PilotLevel_x \neq PilotLevel_y) \}$