CS3243 : Introduction to Artificial Intelligence

Tutorial 5

NUS School of Computing

July 19, 2022

Admin

- Queries regarding midterm correction

Review

- Until now, we looked at single agent environments
- We now look at multi-agent environments
- Question arises : Using the search algorithms discussed before, can the agent still perform optimally?
- No, not really
- There are other agents in the environment, and their actions do matter in our search
- Their actions and motives might not be aligned with our agent's interests
- To perform optimally, the agent needs to take into consideration other's actions and moves
- Goal : To perform search to obtain an optimal solution (a strategy), user the assumption that the other agents perform rationally and optimally

Review

- The Game Tree Structure
- Action(s) : Since the game alternates between the actions of all agents, we consider actions in terms of 'turns' taken
- In the tree, we visualize this as levels from the root
- The state mutations that happen are subject to the player whose turn it is to play at that level

Review

- The utility function
- $\mathrm{UTILITY}(\mathrm{state}, \mathrm{player})$: To incorporate the knowledge of actions, we need to define how good a particular state is for either player
- For this class, we only consider 2 player zero-sum games
- By zero-sum, we mean that the moves of each player involved in the game are aligned towards their personal utlity maximizations
- Depending on the utility function, one player tries to maximize it, while the other tries to minimize it

Review

- Minimax algorithm
- $\alpha - \beta$ pruning

Tutorial Question 2

- Three targets : t_1, t_2, t_3
- Defender and Attacker roles
- Defender can guard two of the three targets
- Attacker can look at what the defender does
- Attacker payoff : $+1$ (if attacked); at the same time, Defender payoff : -1
- Model this as a minimax search problem

Tutorial Question 2

- The defender's payoff in the game is -1
- The action taken by the defender is to choose what two targets to defend; in other words, choose one target to not defend

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- The action taken by the defender is to choose what two targets to defend; in other words, choose one target to not defend
- Side question : What if the defender randomizes their choice, and the attacker can no longer observe the move? Can the defender do better?
- Any thoughts?

Tutorial Question 3

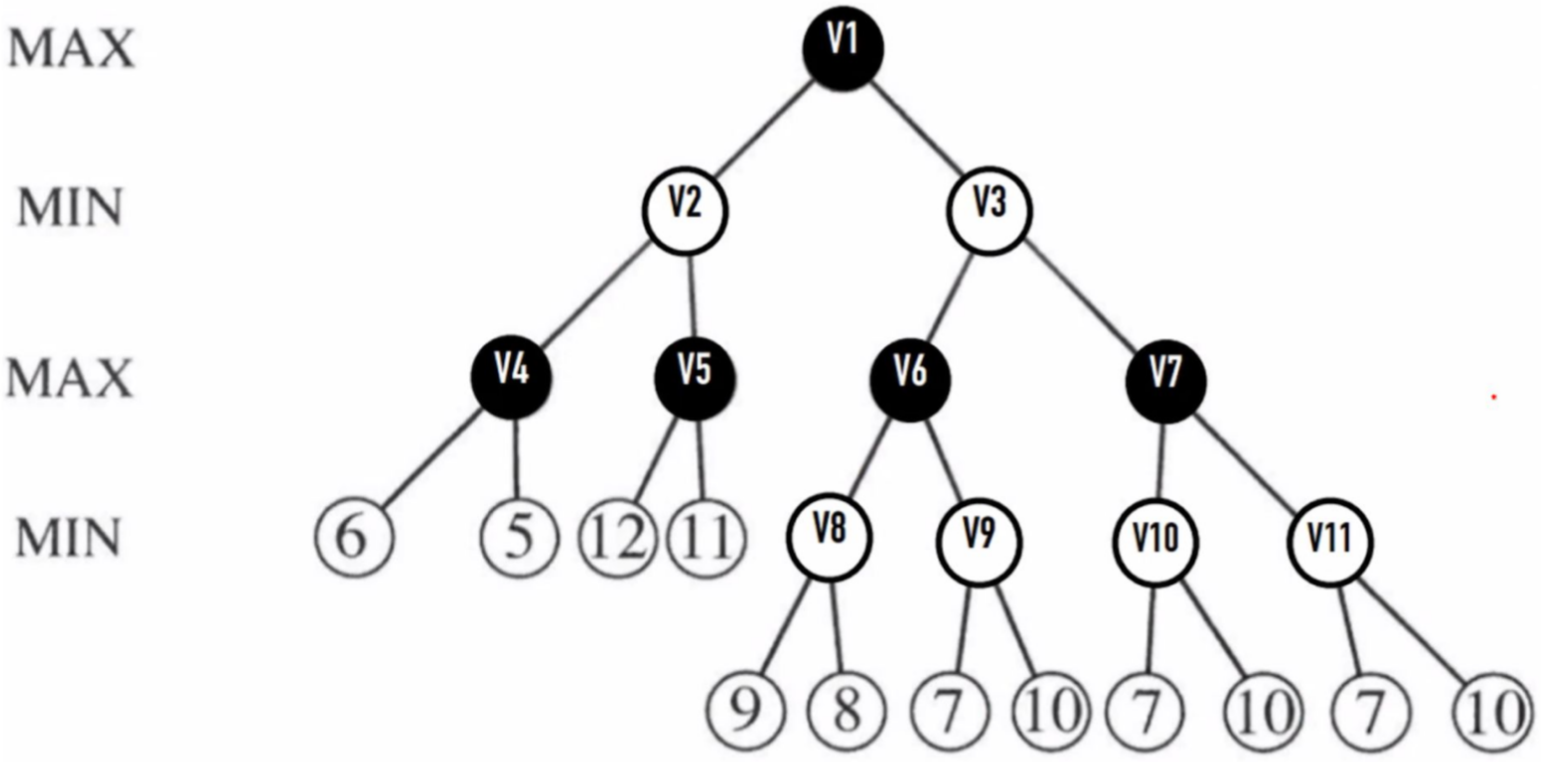
- Now, let's relax one of the conditions of the game and see
- What if the MIN player plays sub-optimally?
- Show that this escalades to the $\mathrm{MINIMAX}$ algorithm giving a sub-optimal solution

Tutorial Question 3

- Illustration

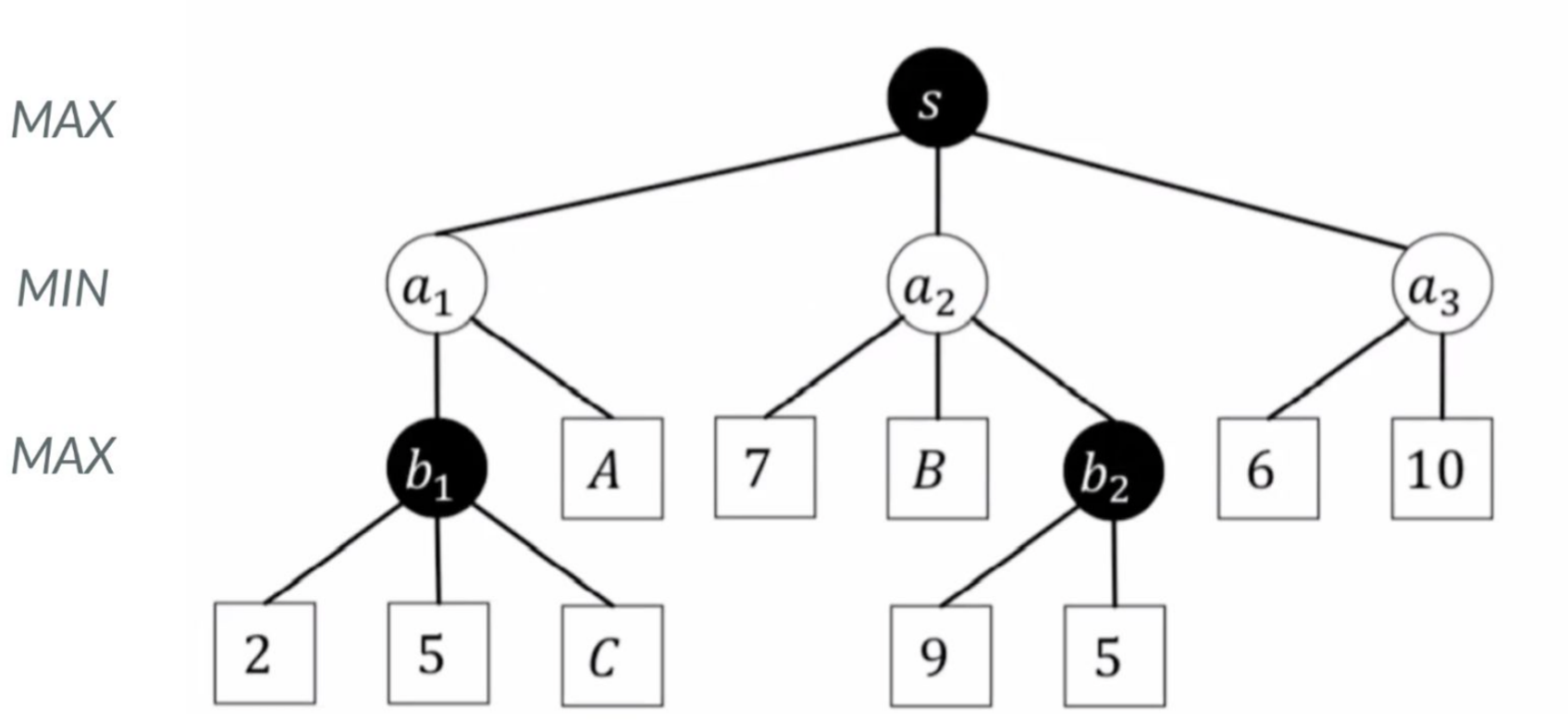
Extra Question 1

- Show which of the arcs are pruned in the game tree if $\alpha - \beta$ pruning is used with left-to-right iteration of nodes



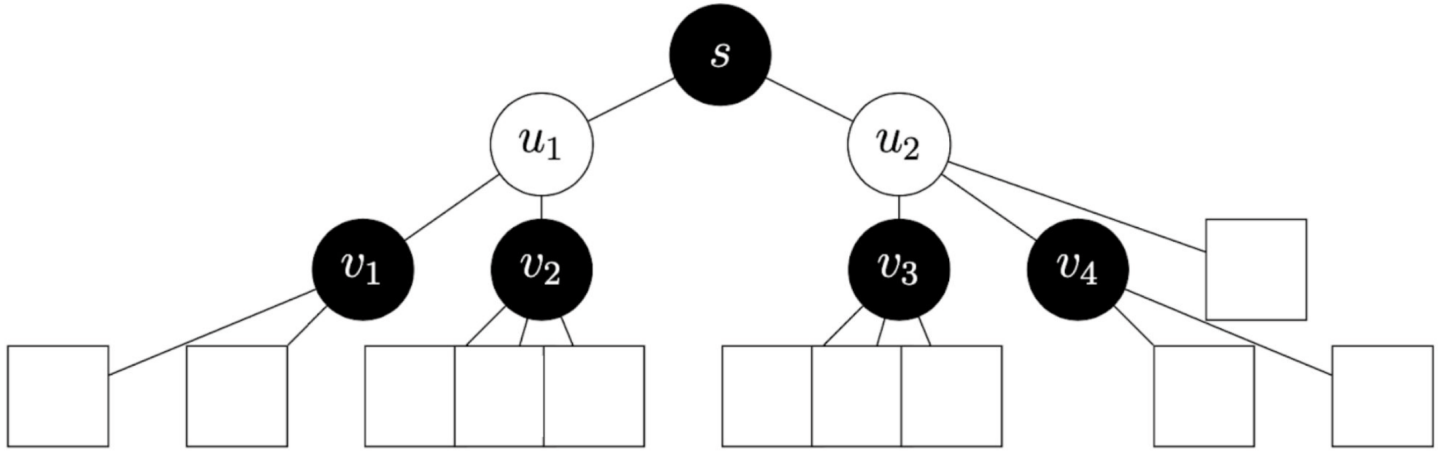
Extra Question 2

- Upon iterating over the nodes from right-to-left, find the values to ensure no arcs are pruned by $\alpha - \beta$ pruning
- A $>$ __
- B $>$ __
- C $<$ __



Extra Question 3

- Find values for all the leaves so that there will be maximum pruning



Thank you!

If you have any questions, please don't hesitate. Feel free to ask!
We are here to learn together!