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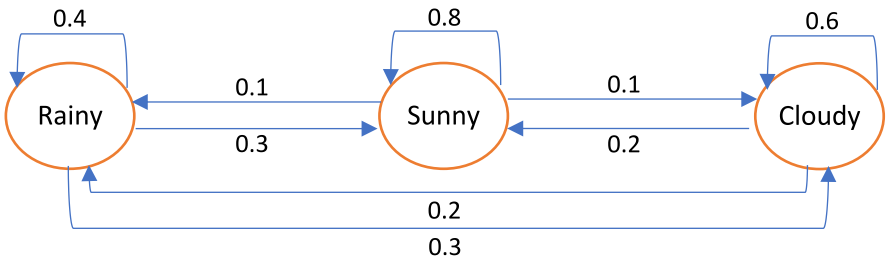
Department of Artificial Intelligence
Master 1 - AIBD
Final Examination – Artificial Intelligence: Principles and Applications/Correction
January 2025

Exercise N°1 (4.5 pts): The following Markov model is organized around 3 states that describe the weather conditions of a given day (rainy, cloudy, sunny):



Assuming today's weather is **sunny**, answer the following questions:

1) What will the weather be like tomorrow? **(01 pt)**

   80% of chance that the weather will be Sunny

2) What is the probability that the weather will be **rainy** the day after tomorrow? **(2.5 pts)**

	Tomorrow	After tomorrow	Probability
Case 1 (Path 1)	Sunny	Rainy	0.8 × 0.1 = 0.08
Case 2 (Path 2)	Cloudy	Rainy	0.1 × 0.2 = 0.02
Case 3 (Path 3)	Rainy	Rainy	0.1 × 0.4 = 0.04

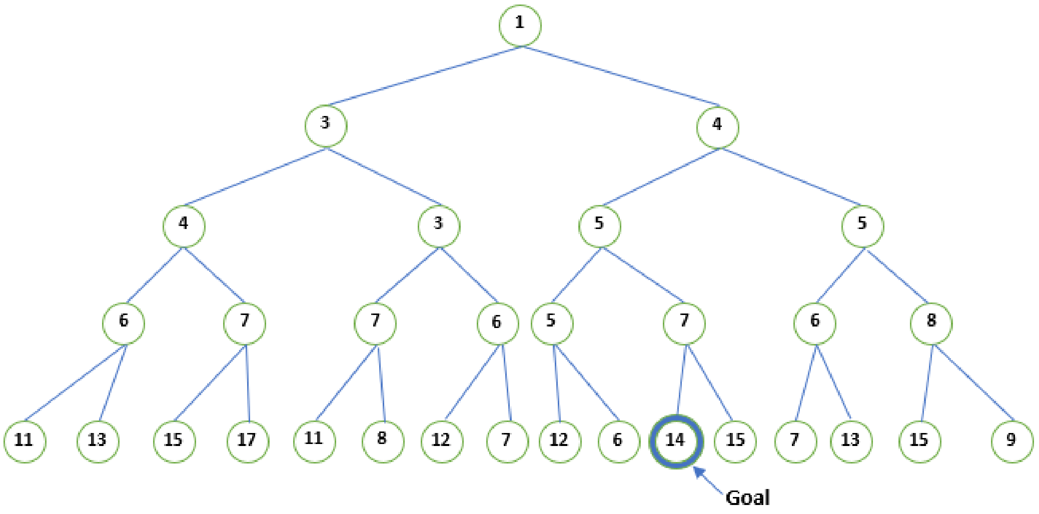
   P(Rainy/After-Tomorrow) = P(Path1) + P(Path2) + P(Path3) = 0.08+0.02+0.04 = 0.14

   14% of chance that the weather will be Rainy after tomorrow

3) What is the probability that the weather for the upcoming week will be: (sunny-sunny-rainy-rainy-sunny-cloudy-sunny)? **(01 pt)**

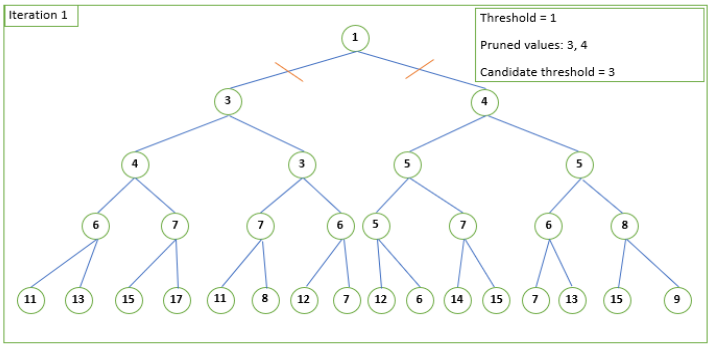
   P(Week)= 0.8 × 0.8 × 0.1 × 0.4 × 0.3 × 0.1 × 0.2 = 0.0001536 = 1.536×10^{-4}

Exercise N°2 (6.5 pts): We want to perform an Iterative Deepening A* (IDA*) algorithm on the following tree. Each node is labelled with a utility value.



<u>**Work to do:**</u>

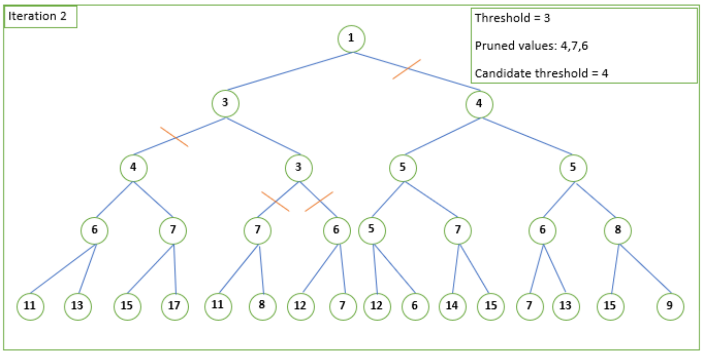
- Illustrate each iteration with an independent tree
- Indicate for each iteration: Current Threshold, Pruned values, Candidate Threshold



Threshold = 1

Pruned values: 3, 4

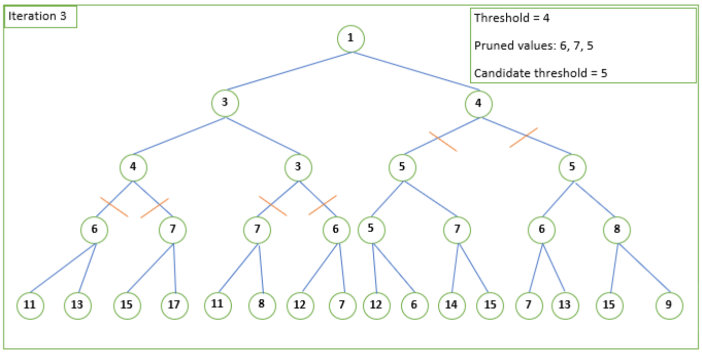
Candidate threshold = 3



Threshold = 3

Pruned values: 4,7,6

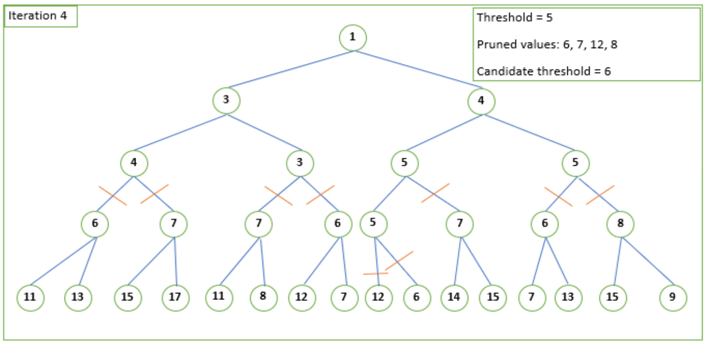
Candidate threshold = 4



Threshold = 4

Pruned values: 6, 7, 5

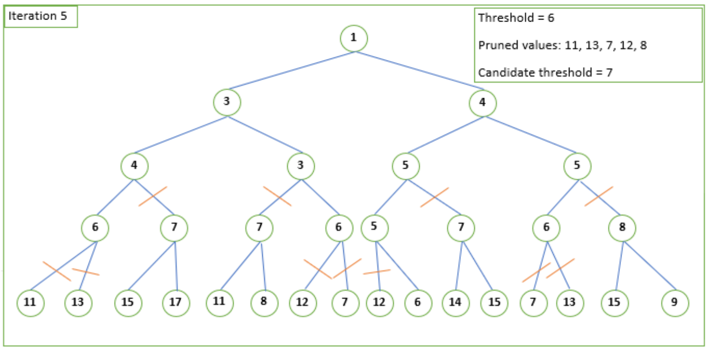
Candidate threshold = 5



Threshold = 5

Pruned values: 6, 7, 12, 8

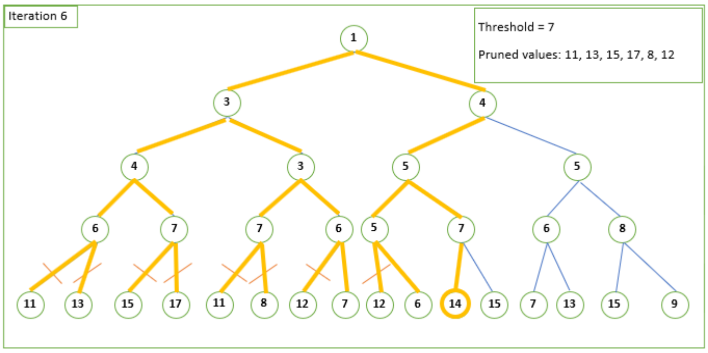
Candidate threshold = 6



Threshold = 6

Pruned values: 11, 13, 7, 12, 8

Candidate threshold = 7

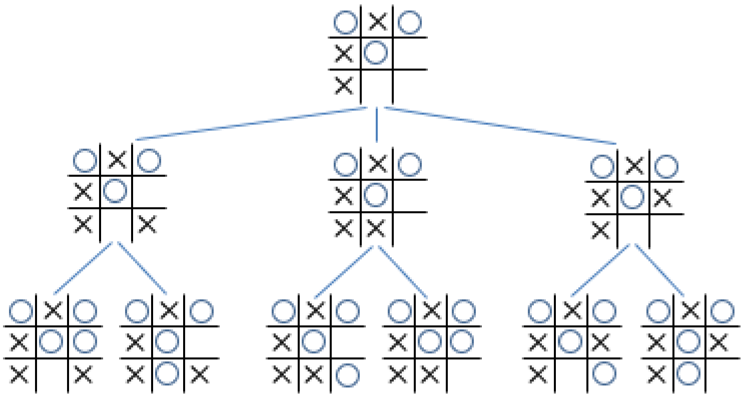


Threshold = 7

Pruned values: 11, 13, 15, 17, 8, 12

Exercise N°3 (6.5 pts): Consider the following Tic-Tac-Toe game tree

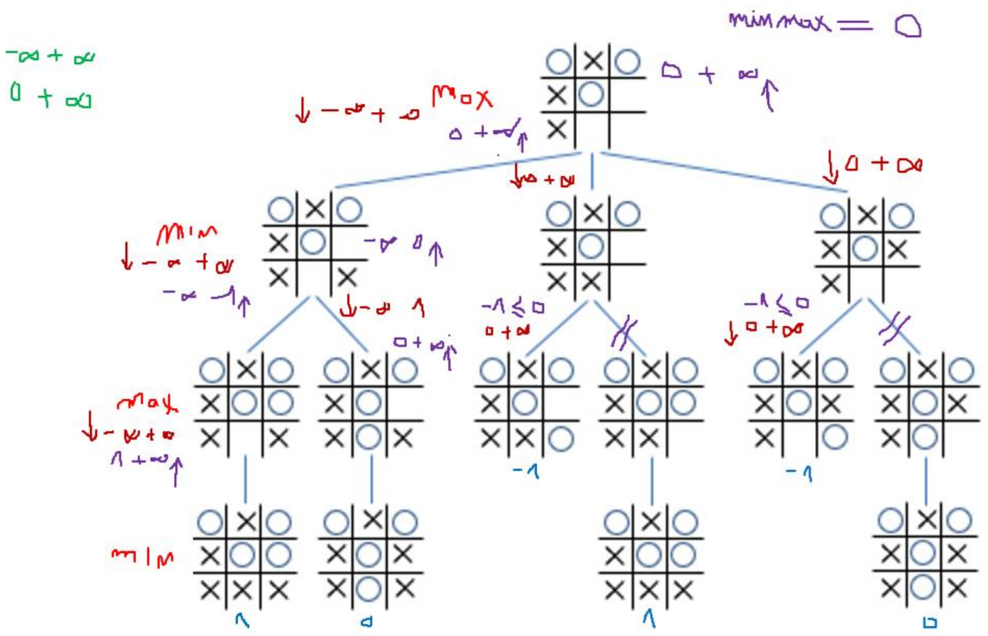
1) Complete the tree by the missing nodes and then label the final nodes as follows:
   +1 for a win for Max, -1 for a loss for Max, 0 for a draw.
2) Use Alpha-Beta Pruning to cut unnecessary branches if they exist.



Solution tree:

(Missing nodes: 01) (Game interval: 0.5) (Returned value: 0.5) (Utility values: 1.5) (Cuts: 1.5)

(Cuts conditions: 0.5) (Nodes' intervals: 01) (False cut: -0.5)



Exercise N°4 (2.5 pts): match each element of a learning-based agent (left) with the appropriate concepts implemented in a backpropagation algorithm (right). (**Note:** -0.5 for every false matching):

Learning-based agent	**Backpropagation**
• Performance standard	• Input neurons
• Critic	• Forward-Backward propagation
• Learning element	• Actual output
• Sensors	• Loss
• Problem generator	• Test