QCM (8 pts)

1. **C** – Help select the best possible decision
2. **C** – The selected criterion
3. **C** – One player's gain equals the other's loss
4. **C** – Assigns a numerical value to a position
5. **C** – Both players play optimally
6. **A** – Remove 2 matches
7. **A** – To limit computation time
8. **A** – Actions, states of nature, and payoffs
9. **A** – Difference between best payoff and chosen payoff
10. **A** – Best and worst outcomes
11. **B** – Maximin
12. **B** – Compiler
13. **B** – Forward chaining
14. **B** – May apply unnecessary rules
15. **B** – Performance
16. **B** – The alternative is exactly the ideal solution

Exercise 01 (4pts) – Decision under Uncertainty

Payoff Matrix (k$)

Action	s_1	s_2	s_3
a_1	120	60	20
a_2	90	70	30
a_3	50	40	10

1. Maximin Criterion (1pts)

Minimum payoff for each action:

- $a_1 \rightarrow$ min = **20**
- $a_2 \rightarrow$ min = **30**
- $a_3 \rightarrow$ min = **10**

Optimal decision: a_2 (maximum of minima = 30)

2. Minimax Regret (Savage) (1.5)

Best payoff per state:

- $s_1 \rightarrow 120$
- $s_2 \rightarrow 70$
- $s_3 \rightarrow 30$

Regret Matrix

Action	s_1	s_2	s_3	Max Regret
a_1	0	10	10	**10**
a_2	30	0	0	30
a_3	70	30	20	70

Optimal decision: a_1 (minimum regret = 10)

3. Hurwicz Criterion ($\alpha = 0.6$)(1.5)

Hurwicz = $\alpha \times \text{Max} + (1 - \alpha) \times \text{Min}$

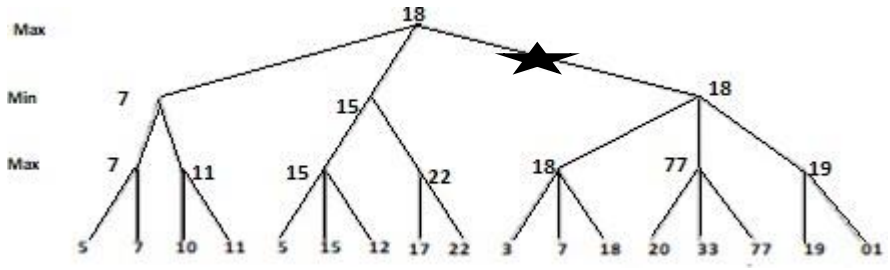
- $a_1 = 0.6 \times 120 + 0.4 \times 20 =$ **80**
- $a_2 = 0.6 \times 90 + 0.4 \times 30 =$ **66**
- $a_3 = 0.6 \times 50 + 0.4 \times 10 =$ **34**

Optimal decision: a_1

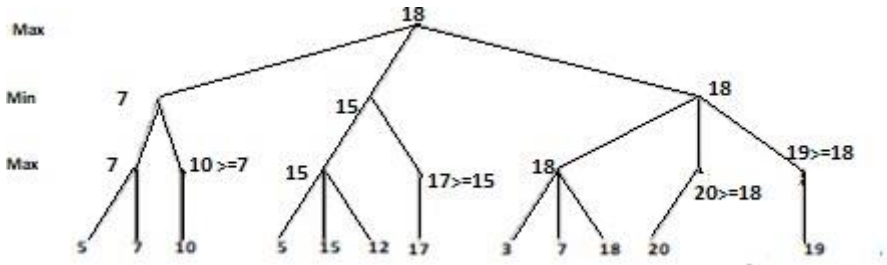
Exercise 02 (4.5pts)– Minimax & Alpha–Beta

It is necessary to mention the value of alpha and beta at each node.

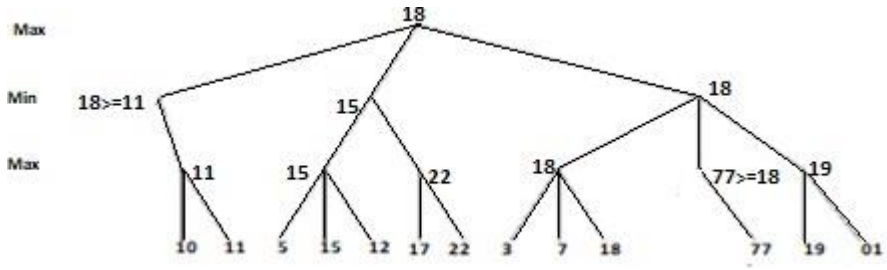
1. **Appliquez l'algorithme minimax à l'arbre précédent (0.5).**



2. **Appliquez l'algorithme α-β sur l'arbre de décision (exploration à gauche).**(1.5)



3. **Appliquez l'algorithme α-β sur l'arbre de décision (exploration à droite).(1.5)**



4. **Explain the results obtained. What do you conclude? (1)**

We observe that the two exploration orders do not yield the same results (in terms of subtree pruning). More generally, the order in which nodes are evaluated influences the performance of the alpha-beta algorithm (this opens the way to possible optimizations, particularly in the sorting of nodes during the construction of the game tree).

Exercise 03 (3.5pts)– MCDM (Weighted Sum Method)

Problem Context

You must choose the best car among **A, B, and C** based on **four criteria** with given weights.

Criteria and Weights

Criterion	Type	Weight
Price (kDA)	Cost	0.35
Fuel Consumption (L/100 km)	Cost	0.25
Comfort (/10)	Benefit	0.25
Safety (/10)	Benefit	0.15

Step 1: Initial Decision Matrix

Car	Price	Consumption	Comfort	Safety
A	250	5.5	8	9
B	300	4.8	9	8
C	220	6.0	7	7

Min and Max Values

Criterion	Min	Max
Price	220	300
Consumption	4.8	6.0
Comfort	7	9
Safety	7	9

Normalized Decision Matrix (on 10) (1.5pts)

Use formula:

For a Cost criterion:

$$\text{Normalized Score} = \frac{\text{Max value} - \text{Value}}{\text{Max value} - \text{Min value}} \times 10$$

For a Benefit criterion :

$$\text{Normalized Score} = \frac{\text{Value} - \text{Min value}}{\text{Max value} - \text{Min value}} \times 10$$

Car	Price (Cost)	Consumption (Cost)	Comfort (Benefit)	Safety (Benefit)
A	6.25	4.17	5.00	10.00
B	0.00	10.00	10.00	5.00
C	10.00	0.00	0.00	0.00

Step 5: Weighted Sum Method (WSM)(1.5pt)

WSM = Σ(weight × normalized score)

Calculations

- **Car A** (6.25×0.35)+(4.17×0.25)+(5×0.25)+(10×0.15)=)=5.98
- **Car B** (0×0.35)+(10×0.25)+(10×0.25)+(5×0.15)= =5.75
- **Car C** (10×0.35)+(0)+(0)+(0)=3.50

Final Ranking (0.5)

1. **1st: A, 2nd: B, 3rd: C**