Artificial Intelligence
Take Home Quiz 2

Important note

If something is not clear, make a reasonable assumption, state it and work on the assignment.

NB.

a) To get partial credit, all your formulas and calculations should be shown.

NAME:

Student ID:

QUESTION	TOPIC	POINTS	SCORE
1	**Adversarial Search**	25	
2	**Genetic Algorithms**	25	
	TOTAL	50	

Question 1: Adversarial Search

(a) Nim is a two-player game. The rules are as follows.

The game starts with a single stack of 7 tokens. At each move a player selects one stack and divides it into two non-empty, non-equal stacks. A player who is unable to move loses the game.

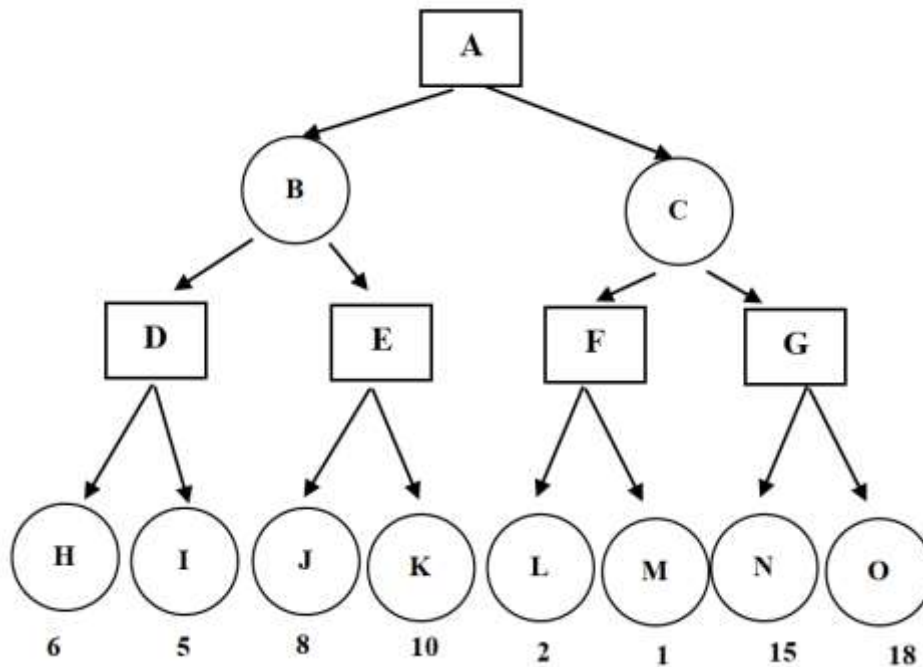Draw the complete search tree for nim (10 points).

(b) Assume two players, min and max, play nim (as described above). Min plays first.

If a terminal state in the search tree developed above is a win for min, a utility function of zero is assigned to that state. A utility function of 1 is assigned to a state if max wins the game.

Apply the minimax algorithm to the search tree to assign utility functions to all states in the search tree. (3)

(c) If both min and max play a perfect game, who will win? Explain your answer. (3)

(d) Given the following search tree, apply the alpha-beta pruning algorithm to it and show the search tree that would be built by this algorithm. Make sure that you show where the alpha and beta cuts are applied and which parts of the search tree are pruned as a result. (9)

Question 2: Genetic Algorithms

a) Given the following parents, P_1 and P_2, and the template T

P_1	A	B	C	D	E	F	G	H	I	J
P_2	E	F	J	H	B	C	I	A	D	G
T	1	0	1	1	0	0	0	1	0	1

Show how the following crossover operators work
- uniform crossover
- order-based crossover

with regards to genetic algorithms (**8**)

Use this problem description for parts b to e.
Assume we have the following function

$$f(x) = x^3 - 60 * x^2 + 900 * x + 100$$

where x is constrained to 0..31. We wish to maximize f(x) (the optimal is x=10)
Using a binary representation we can represent x using five binary digits.

b) Given the following four chromosomes give the values for x and f(x). (**2**)

Chromosome	Binary String
P_1	11100
P_2	01111
P_3	10111
P_4	00100

c) If P_3 and P_2 are chosen as parents and we apply one point crossover show the resulting children, C_1 and C_2. Use a crossover point of 1 (where 0 is to the very left of the chromosome)

Do the same using P_4 and P_2 with a crossover point of 2 and create C_3 and C_4 **(6)**

d) Calculate the value of x and f(x) for C_1..C_4. **(2)**

e) Assume the initial population was x={17, 21, 4 and 28}. Using one-point crossover, what is the probability of finding the optimal solution? Explain your reasons. **(7)**