Artificial Intelligence - Numerical & Logical Questions with Answers

Q1. (Genetic Algorithm) Given chromosomes 01101, 11000, 01000, 10011. The fitness function is f(x) = x^2 and selection strength Sf(x) = f(x)/Σf(x). Compute Sf for chromosome 11000.
Solution:
- Convert binary to decimal: 11000 → 24.
- f(x) = 24^2 = 576.
- Other fitness values: 01101→13^2=169, 01000→8^2=64, 10011→19^2=361.
- Σf(x) = 1170.
- Sf = 576 / 1170 ≈ 0.492 (49.2%).

Q2. (Genetic Algorithm) Given population values {1.5, 2.0, 3.0, 4.5} and fitness function f(x) = x^2 - 4x + 4. Which individual has maximum fitness?
Solution:
- f(1.5) = 1.5^2 - 6 + 4 = 0.25.
- f(2.0) = 0.
- f(3.0) = 9 - 12 + 4 = 1.
- f(4.5) = 20.25 - 18 + 4 = 6.25.
Maximum fitness = 6.25 at x=4.5.

Q3. (Game Playing) Apply MiniMax on the following tree: Root has two children: Left→values [3, 5], Right→values [2, 9]. Show the propagated values.
Solution:
- Left child (MIN node): min(3,5)=3.
- Right child (MIN node): min(2,9)=2.
- Root (MAX node): max(3,2)=3.
Final value at root = 3.

Q4. (Game Playing) Apply Alpha-Beta pruning on the following tree: Root (MAX) → Left MIN { [8, 6] }, Right MIN { [5, 9] }.
Solution:
- Left MIN: min(8,6)=6. So alpha=6.
- Right MIN: while exploring, find 5. Since 5 < alpha(6), prune remaining nodes.
- Root: max(6,5)=6.
Pruning saved evaluation of last leaf (9).

Q5. (Heuristic Search) Perform A* search for the following graph: Start→A (g=2,h=4), Start→B (g=1,h=6), Goal heuristic=0. Compute f=g+h and find path.
Solution:
- Node A: f=2+4=6.
- Node B: f=1+6=7.
- Expand A first (lowest f).
- If A connects to Goal with g=2+3=5, h=0 → f=5.
- Path: Start→A→Goal.

Q6. (Prolog/Logic) Convert English statements to Prolog: 1. John is a man. 2. All men are mortal. 3. Is John mortal?
Solution:
- man(john).
- mortal(X) :- man(X).
- Query: ?- mortal(john).
Answer: Yes.

Q7. (Resolution in Predicate Logic) Prove that Socrates is mortal using facts: 1. All men are mortal. 2. Socrates is a man.

Solution:

- Facts: man(socrates), $\forall x(man(x) \rightarrow mortal(x))$.
- Resolution: man(socrates) matches antecedent $\rightarrow$ mortal(socrates).

Therefore, Socrates is mortal.