1. 15 points
Propose an admissible (and not trivial, i.e. \( h(n) = 0 \) is not a valid answer) heuristic for the Missionaries and Cannibals problem. Assume there is one boat which can carry a maximum of 2 people, and that in the initial state the same number of missionaries and cannibals are on one side of the river. Explain why your heuristics is admissible.

2. 15 points
Suppose you want to use A* with a heuristic function \( h(n) \) which may underestimate or overestimate the true cost of reaching the goal from state \( n \). You know, however, that any overestimate is limited to no more than 10% of the true cost. Is there anything you can do to guarantee that the algorithm will find the optimal solution (if a solution exist)? If yes, explain how. If not, explain why not. Be precise.

3. 20 points
Answer these questions on search algorithms:

1. What kind of search does Greedy Best-First Search emulate when used with \( h(n) = -2 \times g(n) \)? Explain your reasoning. Show how the search works using a simple example.

2. Can you make A* behave like Breadth-First Search? If yes, explain how. If not, explain why not. Be precise and explain what you will use for \( g(n) \) and for \( h(n) \).

4. 15 points
Answer these questions briefly but precisely.

1. Would using a pattern database be a reasonable heuristics for solving Traveling Salesperson Problems? Explain why (or why not)

2. How would simulated annealing work if the temperature \( T \) is always fixed at 0?

3. Explain briefly how a ridge in the search space may appear to be a local maximum to a hill-climbing algorithm.
5. 10 points
Write a function, add-dupl, to duplicate all occurrences of a given element in a list. It should work like this:

(add-dupl 3 '(2 3 4 1 3)) ==> (2 3 3 4 1 3 3)
(add-dupl 3 '(2 3 3 1)) ==> (2 3 3 3 3 1)
(add-dupl 5 '(2 3 4 1 3)) ==> (2 3 4 1 3)

Assume the list is a flat list, and the element to be duplicated is atomic (either a number or a symbol).