NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS

DEPARTMENT OF COMPUTER SCIENCE

QUALIFICATION: BACHELOR OF COMPUTER SCIENCE	
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COURSE: ARTIFICIAL INTELLIGENCE	**COURSE CODE:** ARI711S
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SECOND OPPORTUNITY / SUPPLEMENTARY EXAMINATION QUESTION PAPER	
EXAMINER(S)	**Prof. JOSE QUENUM**
MODERATOR:	**Mr STANTIN SIEBRITZ**

INSTRUCTIONS
1. Answer ALL the questions. 2. Read all the questions carefully before answering. 3. Number the answers clearly

THIS QUESTION PAPER CONSISTS OF 3 PAGES
(Excluding this front page)

PERMISSIBLE MATERIALS

CALCULATOR

Question 1 .... [20 points]

The diagram in Figure 1 represents an adversarial game. Using the $\alpha - \beta$ pruning, solve the game. You will indicate the values of α and β at each node and where pruning occurs.

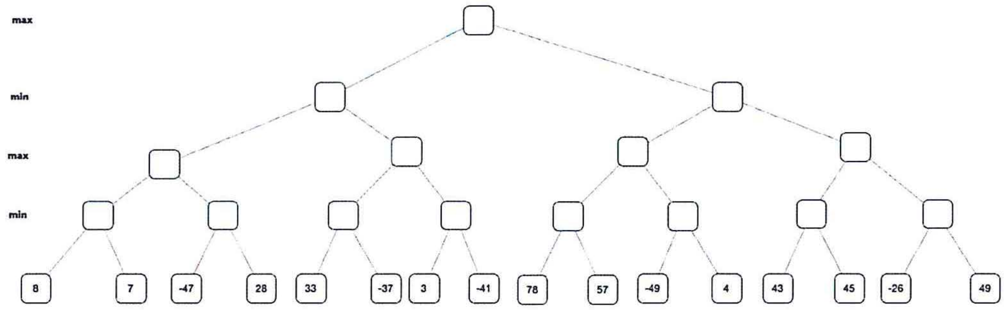

Figure 1: Adversarial Search Problem

Question 2 .... [35 points]

Figure 2: a: Initial configuration; b: Goal configuration

(a) The diagram in Figure 2a represents a grid. It contains four tiles, including an empty one. Each tile is located with row and column numbers and may contain a value. For example, the tile in row 2 and column 1 contains the value 1. In this problem, we wish to rearrange the tiles in the grid using a planning approach. The planner can execute four possible actions: [12]

- `left`: moving the empty tile to the left;
- `right`: moving the empty tile to the right;
- `up`: moving the empty tile up;
- `down`: moving the empty tile down.

Note that these actions can only be executed when possible. Note also that when moving the empty tile to a new location, it swaps its location with the one it is replacing. We provide the following predicates to represent the knowledge base:

- $above(x, y)$: tile x is located immediately above tile y;
- $is - left(x, y)$: tile x is located at the left of tile y
- $is - empty(x)$: tile x is empty;
- $value(x, y)$: tile x has value y;

- $coord(x, y, z)$: tile x is located at row y and column z.

Following the STRIPS notation, define the actions as operators for the planner.

(b) Express the goal (in Figure 2b) as a well-formed formula. [5]

(c) Using the Manhattan distance between tiles (the sum of the absolute values of the row difference and column difference) as a heuristic and the number of steps as path cost, generate the plan using the A* search strategy. You will explicitly indicate the evaluation step-by-step during the plan generation. [18]

Question 3 .... [20 points]

The Millionaire is your favourite TV show. It is a ten-round game. Except for the first round, the player can choose to play or quit at each round. When the player quits, the game ends, and s/he can collect the rewards that s/he has earned so far. When the player plays, s/he can succeed and move to the next round or fail, leading to the end of the game. Note that s/he loses all the rewards s/he has accumulated so far in the event of a failure. Note also that when the player reaches the last round, whether s/he plays or not the game ends with the appropriate reward.

Model this problem as a Markov Decision process and find the optimal policy using the value iteration approach. You will indicate the utility values during each iteration. You will use a discount factor of 0.95.

Table 1: Millionaire – Rewards and success probability

Round	Success Probability	Reward
1	0.99	10
2	0.9	50
3	0.8	100
4	0.7	500
5	0.6	1000
6	0.5	5000
7	0.4	10000
8	0.3	50000
9	0.2	100000
10	0.1	500000

Question 4 .... [18 points]

(a) `Company Z` operates near a river which it pollutes. This has harms the fishermen who fish from the river. `Company Z`'s profit is P. Normally, the fishermen get a profit of A. However, with the negative effect on the river, they now lose A_0 ($A > A_0$) from their profit. The fishermen and `Company Z` engage in litigation. Both teams will simultaneously indicate an amount. For `Company Z`, the amount represents their claim about the company's profit, while for the fishermen, the amount represents their profit loss. If the company's profit is less than the fishermen's lost profit, `Company Z` will shut down. Otherwise, it will pay a settlement to the fishermen corresponding to their lost profit [8] claim. Represent the strategic form of the game, describing the strategies and the payoff functions. Is it a dominant strategy for the fishermen to choose their actual loss? Why?

(b) Consider the game represented in Table 2. Determine the values of α_1 and β_1 such that the mixed strategy with Player 1 playing the strategy a_0 with a probability of $\frac{1}{2}$ and Player 2 playing the strategy b_0 with a probability of $\frac{3}{7}$ is a Nash equilibrium. [10]

Table 2: Game Board

		Player 2	
		b_0	b_1
	a_0	$2, 2$	α_1, β_1
Player 1	a_1	$6, 2$	$0, 4$