NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS
DEPARTMENT OF COMPUTER SCIENCE

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FIRST OPPORTUNITY 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 .... [25 points]

(a) Consider the blocks world. The blocks can be on a table or in a box. Consider three generic actions: a_0, a_1, and a_2 described as follows: [15]

a_0: when applied to a block, will keep it in the box;

a_1: when applied to a block, will move it on the table;

a_2: when applied to two blocks, will move the first one on top of the second one.

Consider the following four states in the system:

S_0: all blocks are in the box, no block is on the table;

S_1: only block B is on the table; all other blocks are in the box;

S_2: both blocks B and C are on the table, with C on top of B;

S_3: blocks B, C and D are on the table, with D on top of C and C on top of B.

Furthermore, additional information is provided in Table 1, where each state has a reward, possible actions and a transition model for each action. Note that for a given action, the probability values indicated in its transition model all sum up to 1.

Table 1: Additional information

State	Reward	Action	Transition Model
S_0	r_0	a_{0b}	$(1, S_0)$
		a_{1b}	$(p_0, S_0); (p_1, S_1)$
S_1	r_1	a_{0c}	$(1, S_1)$
		a_{1c}	$(p_0^1, S_1); (p_1^1, S_4); (p_2^1, S_2)$
		a_{2c}	$(p_0^2, S_1); (p_1^2, S_2);$
S_2	r_2	a_{0d}	$(1, S_2)$
		a_{1d}	$(p_0^3, S_2); (p_1^3, S_5); (p_2^3, S_3)$
		a_{2d}	$(p_0^4, S_2); (p_1^4, S_3);$
S_3	100	-	-

Assuming we model this problem as Markov Decision Process ($\mathcal{MDP}$) and consider a discount value σ, provide the utility of each of the states S_0, S_1 and S_2 for the first three iterations using the value iteration algorithm. Note that although the states S_4 and S_5 have not been defined, they should be assumed in the system.

(b) Consider the following policy, $\pi_0 = \{S_0 \mapsto a_{0b}, S_1 \mapsto a_{1c}, S_2 \mapsto a_{2d}\}$. Is π_0 optimal? Explain. [10]

Question 2 .... [15 points]

The diagram in Figure 1 represents the extensive form of a sequential game

1. Provide the strategic form associated with the game;
2. Does any player have a dominant strategy?
3. Is there a dominant strategy equilibrium?

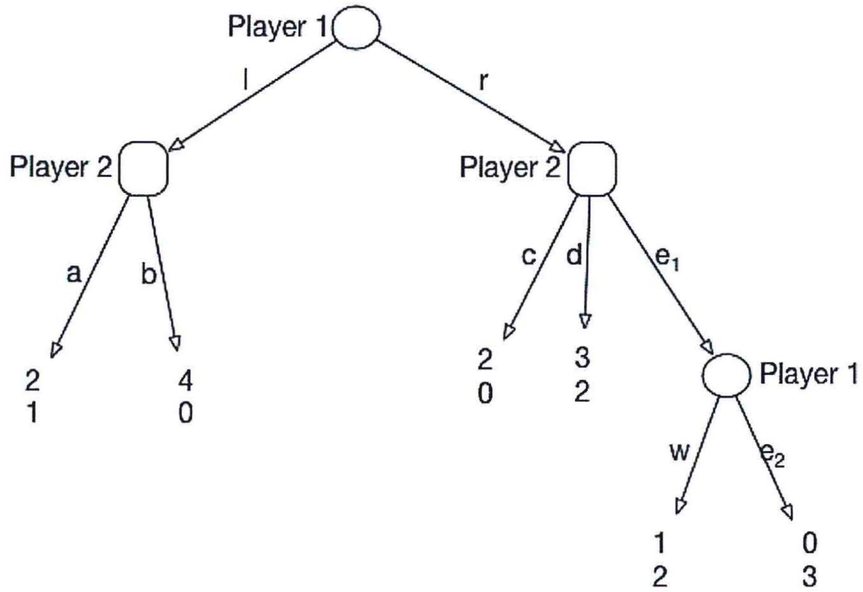

Figure 1: Sequential Game

4. What are the Nash equilibria?

Question 3 .... [15 points]

(a) Consider a game $\mathcal{G}$ whose strategic form is represented as follows: [2]

		Player2		
		$\imath_1$	$\jmath_1$	ℓ_1
Player1	$\imath_0$	$(7,2)$	$(2,5)$	$(6,3)$
	$\jmath_0$	$(2,2)$	$(6,5)$	$(4,8)$
	ℓ_0	$(3,1)$	$(2,7)$	$(4,9)$

Is there a dominated strategy for Player 2? If yes eliminate it;

(b) The resulting game is now called $\mathcal{G}'$. Is ℓ_0 a worse strategy for Player 1 than playing a mixed strategy of $\imath_0$ and $\jmath_0$ in $\mathcal{G}'$? [6]

(c) what is the payoff of each player when they play a mixed strategy with Player 1 eliminating ℓ_0 in $\mathcal{G}'$? [7]

Question 4 .... [20 points]

Consider the blocks world. Here we have seven (7) blocks: A, B, C, D, E, F and G. There is also a table with a capacity of three (3) blocks (i.e., three distinct blocks can lay on the table at any point in time simultaneously). It is assumed that a block can either be inside the box or outside. When outside the box, a block can either be on the table or on top of another block.

We have the following predicates:

$ontable(\mathtt{x})$: the block $\mathtt{x}$ is on the table;

$on(\mathtt{x}, \mathtt{y})$: the block x lays on top of the block y;

$clear(\mathtt{x})$: the block x is clear, i.e., there is nothing on top of it;

$inbox(\mathtt{x})$: the block x is inside the box.

Moreover, the following actions are introduced:

$pick(\mathtt{x})$: which picks a block from the box and drops it on the table;

$drop(\mathtt{x},\mathtt{y})$: which drops the block on either the table or another block.

Consider a partial plan Q containing two actions: a_0 and $a_\imath$, with $a_0 \prec a_\imath$. The action a_0 has the following effect:

$ontable(\mathsf{B}); ontable(\mathsf{C}); ontable(\mathsf{E}); clear(\mathsf{B}); clear(\mathsf{C}); clear(\mathsf{E}); inbox(\mathsf{D}); inbox(\mathsf{F}); inbox(\mathsf{G});$

The action $a_\imath$ leads to a goal state and has the following pre conditions:

$$ontable(\mathsf{F}); ontable(\mathsf{A}); clear(\mathsf{Table}); on(\mathsf{B}, \mathsf{A}); on(\mathsf{C}, \mathsf{B}); on(\mathsf{D}, \mathsf{C}); on(\mathsf{E}, \mathsf{F});$$

Modify Q to generate a complete and correct plan.