

**UNIVERSITY OF LAGOS**  
**FACULTY OF ENGINEERING**  
**DEPARTMENT OF SYSTEMS ENGINEERING**  
*First Semester Final Examination 2019/2020 SESSION SSG 503*  
*Instruction: Answer ANY THREE Questions; 120 Minutes*

**Question One (20 marks)**

- i. Define the following:  
a.) Pattern Recognition.      b.) Data      c.) Information (3 marks)
- ii. With the aid of diagram, discuss various steps involve in pattern recognition system. (5 marks)
- iii. Discuss at least FOUR different areas of pattern recognition. (4 marks)
- iv. Discuss the various models used in pattern recognition, stating their advantages and disadvantages. (8 marks)

**Question Two (20 marks)**

- i.) What is Entropy as applied to Information theory? (2 marks)
- ii.) Find the entropy of the following: (15 marks)

X	Y	$P_{xy}(X,Y)$
*	*	1/8
1	a	1/16
0	b	1/8
1	c	1/2
0	d	1/16
0	a	1/4
1	b	1/8
0	c	1/4
1	d	1/2

- iii.) Give three examples of self-organising systems and explain why each can be said to be a self-organising system. (3 marks)

**Question Three (20 marks)**

- i.) What is Crypt Arithmetic? (2 marks)
- ii.) Solve the following crypt Arithmetic problem: (8 marks)

BASE  
+BALL

-----  
GAMES

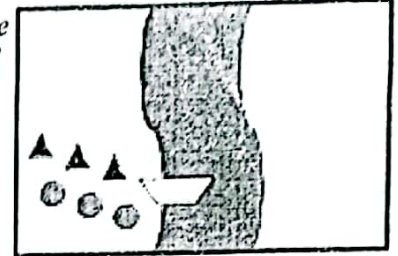
- iii.) Define Problem Solving. (1 mark)
- iv) How do you measure the performance of a problem-solving system. (4 marks)
- v) Identify a problem around you and using problem solving skill, proffer solution to such problem? (5 marks)

#### Question Four (20 marks)

- What is search technique? [1 mark]
- With the aid of diagram where applicable, discuss at least three search methods under each of the two major search techniques you know, stating their advantages and disadvantages. [12 marks]
- The Missionaries and Cannibals problem is a classic AI puzzle that can be defined as follows:

On one bank of a river are three missionaries and three cannibals. There is one boat available that can hold up to two people and that they would like to use to cross the river. If the cannibals ever outnumber the missionaries on either of the river's banks, the missionaries will get eaten.

How can the boat be used to safely carry all the missionaries and cannibals across the river? (7 marks)



#### Question Five (20 marks)

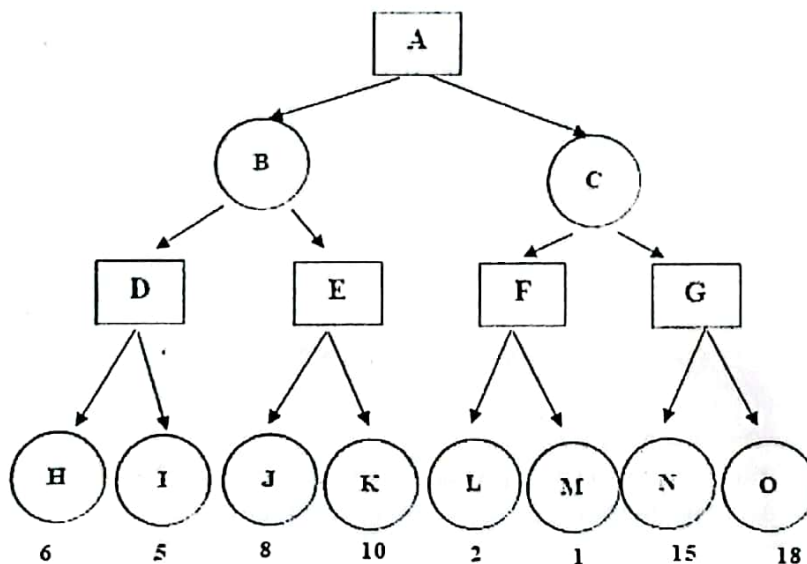
- Define minimax and alpha-beta pruning algorithm stating its usage and limitation. (5 marks)
- Nim is a two-player game, the rules are as follows.

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. Assume two players, min and max, play Nim. Min plays first. If a terminal state in the search tree developed 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 marks)

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

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 marks)





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DEPARTMENT OF SYSTEMS ENGINEERING  
FIRST SEMESTER FINAL EXAMINATION 2017/2018 SESSION

*SSG503: Artificial Intelligence*

Instruction: Answer Question 1 and any other three. Duration: 120 Mins

**Question 1 (34 Marks, compulsory question)**

- Define intelligence and thereby propose a definition for Artificial Intelligence
- Why do we need to take a cue from humans in solving some engineering problems?
- The question "How do you know?" can be answered in three primary ways.
  - Enumerate the three and explain which ones among them demand intelligence and why.
  - Draw a relationship between these three primary ways of knowing and the ways humans obtain information from the environment to make decisions and take actions.
  - Explain the above relationship in the light of the data – knowledge continuum.

**Question 2 (22 Marks)**

- Distinguish between speech recognition and voice recognition by explaining the acoustic features usually employed in each.
- The Mel Frequency Cepstral Coefficients (MFCC) is a feature vector. Explain the idea of a feature vector and the relevance of each of the four words that make up the terminology.
- Explain why engineers can view speech production as a problem in fluid mechanics.
- Distinguish between a phoneme and a diphone

**Question 3 (22 Marks)**

- What is Entropy as applied to Information theory
- Explain using sample numerical values why the entropy of a loaded coin is lower than that of a fair coin
- What is a self-organising system
- Give three examples of self-organising systems and explain why each can be said to be a self-organising system

**Question 4 (22 Marks)**

- What is a morpheme?
- Distinguish between a free morpheme and a bound morpheme



- c. Given the following list of words explain a simple algorithm that can automatically determine that "ing" is a morpheme in certain cases and is not in some other cases: [going, king, saying, looking, go, sing, singing, sting, look, say, bring]
- d. Explain why and how sentences are usually parsed to a noun phrase and a verb phrase.

**Question 5 (22 Marks)**

- a. Explain why certain engineering problems can be solved by devising an algorithm and others are solved only by machine learning.
- b. Define a concept and use your definition to explain how perceptrons work.
- c. Explain linear separability and why the XOR logic cannot be modelled by a perceptron.
- d. Given a set of objects that are linearly separable based on two attributes  $x_1$  and  $x_2$ , show that the line that separates them would have a slope of  $\frac{w_2}{w_1}$  and intercept  $\frac{w_0}{w_1}$  where  $w_0$  is the bias weight,  $w_1$  the weight of  $x_1$  and  $w_2$  the weight of  $x_2$ .

**Question 6 (22 Marks)**

- a. Describe Computational Complexity in the light of the resources consumed by algorithms
- b. Heuristic search is a quintuple. Explain the implications of this statement to the use of a search tree as a means of knowledge representation
- c. Write short notes on
  - i. Brute force Algorithm
  - ii. MiniMax Algorithm
  - iii. Alpha-Beta Pruning
  - iv. Best First Search Algorithm



Department of Systems Engineering

Faculty of Engineering

**UNIVERSITY OF LAGOS**

March 13th, 2013

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**B.Sc (Hons) Systems Engineering Degree**

**First Semester Examinations, 2012/2013 Session**

**SSG 503: Artificial Intelligence**

**TIME: 2Hours**

**INSTRUCTIONS:**

Answer Question 1 and any other three

Question 1 (compulsory question)

1)

- a. Despite the difficulty in defining intelligence, Computer Scientists, Cognitive Scientists and Engineers still have a great need to define Artificial Intelligence (AI). Explain how this problem is solved to facilitate a working definition for AI. Hence or otherwise, provide practical definitions for Intelligence and Artificial Intelligence.
- b. Humans can answer the questions "How do you know?" in three primary ways.
  - b.i. Enumerate the three primary ways, explaining which among them demand Intelligence.
  - b.ii. Relate these three primary ways of knowing to the ways humans interact with their environment to make decisions and take actions.
  - b.iii. Explain the above relationship in the light of the data - knowledge continuum. (34 Marks)

2)

- a. Describe the phenomenon of combinatorial explosion and explain its relevance to algorithms for problems that require intelligence.
- b. Certain Problems yield to closed-form algebraic solutions while another set are solved by numerical methods. However, problems that demand intelligence usually depend on search. Explain why such an approach may not always work and what is usually done to make the search approach a viable problem solving approach in AI.

(22 marks)

1

*Data  
Information  
Knowledge*

*continuum*

*1 + 11*

3)

- Describe three brute-force search algorithms
- Without necessarily solving the problem, draw a search tree for the solution of the following cryptarithmic problem:

RED  
+ ROE  
-----  
DEER

(22 marks)

4)

- Derive the worst case time complexity for the African game Mancala (Ayo, Awari etc). Explain why it may be necessary to consider the worst case.
- A common heuristic used in Mancala is to avoid a state with contiguous empty holes. Explain how this heuristic reduces the search space of the game.

(22 marks)

5) Write short notes on the following:

- Hill climbing
- Foot hills
- Plateaus
- Ridges
- Beam search
- Window search
- Best first search

(22 marks)

6) The chart below shows two dimensional plot of two features of leaves collected from the Unilag Botanical Garden. Classify the following samples using both the nearest neighbour and centroid methods.

- Feature1: 14mm, Feature2: 6.5mm
- Feature1: 10mm, Feature2: 13.5mm
- Feature1: 35mm, Feature2: 18mm

$$\mu = \frac{\sum x_i}{n}$$



UNIVERSITY OF LAGOS  
FACULTY OF ENGINEERING  
DEPARTMENT OF SYSTEMS  
FIRST SEMESTER 2014-2015 EXAMINATION  
SSG 503: ARTIFICIAL INTELLIGENCE

Answer Question 1 and any other three

Time allowed 3 hours

Question 1 (34 Marks, compulsory question)

1)

- a. Despite the difficulty in defining Intelligence, Computer Scientists, Cognitive Scientist and Engineers still have a great need to define Artificial Intelligence (AI). Explain how this problem is solved to facilitate a working definition for AI. Hence or otherwise, provide a practical definitions for Intelligence and Artificial Intelligence.
- b. Humans can answer the questions "How do you know?" in three primary ways.
  - i. Enumerate the three primary ways, explaining which among them demands Intelligence.
  - ii. Relate these three primary ways of knowing to the ways humans interact with their environment to make decisions and take actions.
  - iii. Explain the above relationship in the light of the data - knowledge continuum.
- c. Explain the difference between knowing and understanding

2) (22 marks)

- a. Describe the phenomenon of combinatorial explosion and explain its relevance to algorithms for problems that require Intelligence.
- b. Certain Problems yield to closed-form algebraic solutions while another set are solved by numerical methods. However, problems that demand intelligence usually depend of search. Explain why search may not always work and what is usually done to make the search approach viable.

3) (22 marks)

- a. Describe three brute-force search algorithms
- b. Without necessarily solving the problem, draw a search tree for the solution of the following cryptarithmic problem:

RED  
+ ROE  
DEER

4) (22 marks)

- a. Derive the worst case time complexity for the African game Mancala (Ayo, Awari etc). Explain why it may be necessary to consider the worst case.
- b. A common heuristic used in Mancala is to avoid a state with contiguous empty holes. Explain how this heuristic reduces the search space of the game.

$E+14E+112E$   
 $2E+3E$   
 $E \neq 8$

$E+14E+112E$   
 $2E+2$   
 $E \neq 8$   
949

$R+R+R$   
 $2R+2$   
 $2R+0$   
 $14 \neq 0$

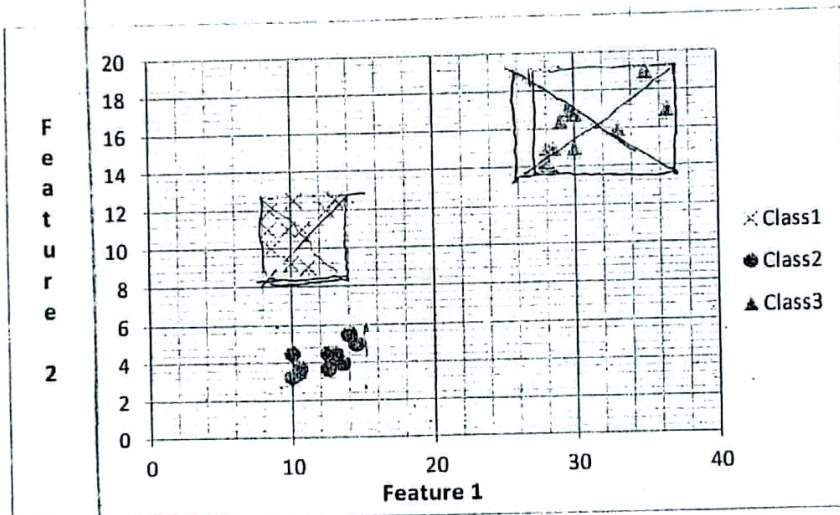
$E+14E$   
 $2E$   
 $E$

5) (22 marks) Write short notes on the following:

- a. Hill climbing
- ~~b. Foot hills~~
- ~~c. Plateaus~~
- ~~d. Ridges~~
- ~~e. Beam search~~
- f. Window search
- g. Best first search

6) (22 marks) The chart below shows the two dimensional plot of two features of samples of an object. Classify the following samples using both the nearest neighbour and centroid methods.

- a. Feature1: 14mm, Feature2: 6.5mm
- b. Feature1: 10mm, Feature2: 13.5mm
- c. Feature1: 35mm, Feature2: 18mm



6.1  
2.1  
13.6





## Department of Systems Engineering

Faculty of Engineering

UNIVERSITY OF LAGOS

First Semester Examinations, 2015/2016 Session

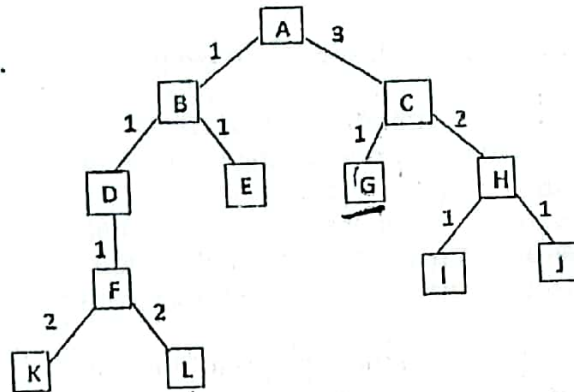
SSG 503: Artificial Intelligence

Answer Question 1 and any other three

Time Allowed: 3 Hours

### QUESTION 1

Consider the tree shown below. The numbers on the arcs are the arc lengths.



Assume that the nodes are expanded in alphabetical order when no other order is specified by the search, and that the goal is state G. No visited or expanded lists are used. What order would the states be expanded by each type of search? Stop when you expand G. Write only the sequence of states expanded by each search.

### QUESTION 2

Explain briefly the difference between:

- Depth-first search and iterative deepening search.
- State space search and game tree evaluation.

### QUESTION 3

- Define in your own words: artificial intelligence and agent.
- Explain the difference between weak and strong AI

### QUESTION 4

- Explain what a stochastic search technique is, and why it is useful.
- Write short notes on the following
  - Narrow Intelligent
  - Turing Test for Machine Intelligence

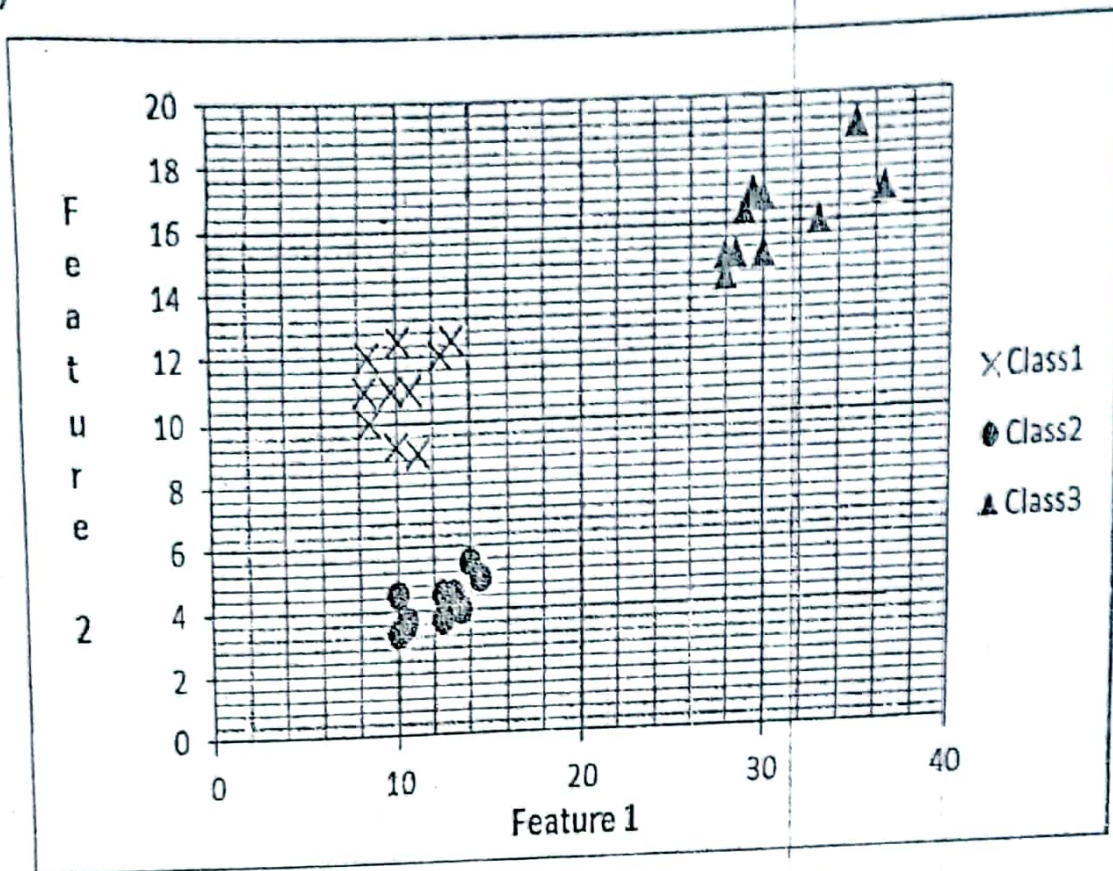
### QUESTION 5

- a) Write Describe the brute-force search algorithms
- b) Discuss Highlight on the steps involved in the implementation of brute-force algorithm.
- c) Discuss the phenomenon of combinatorial explosion and NP completeness

### QUESTION 6

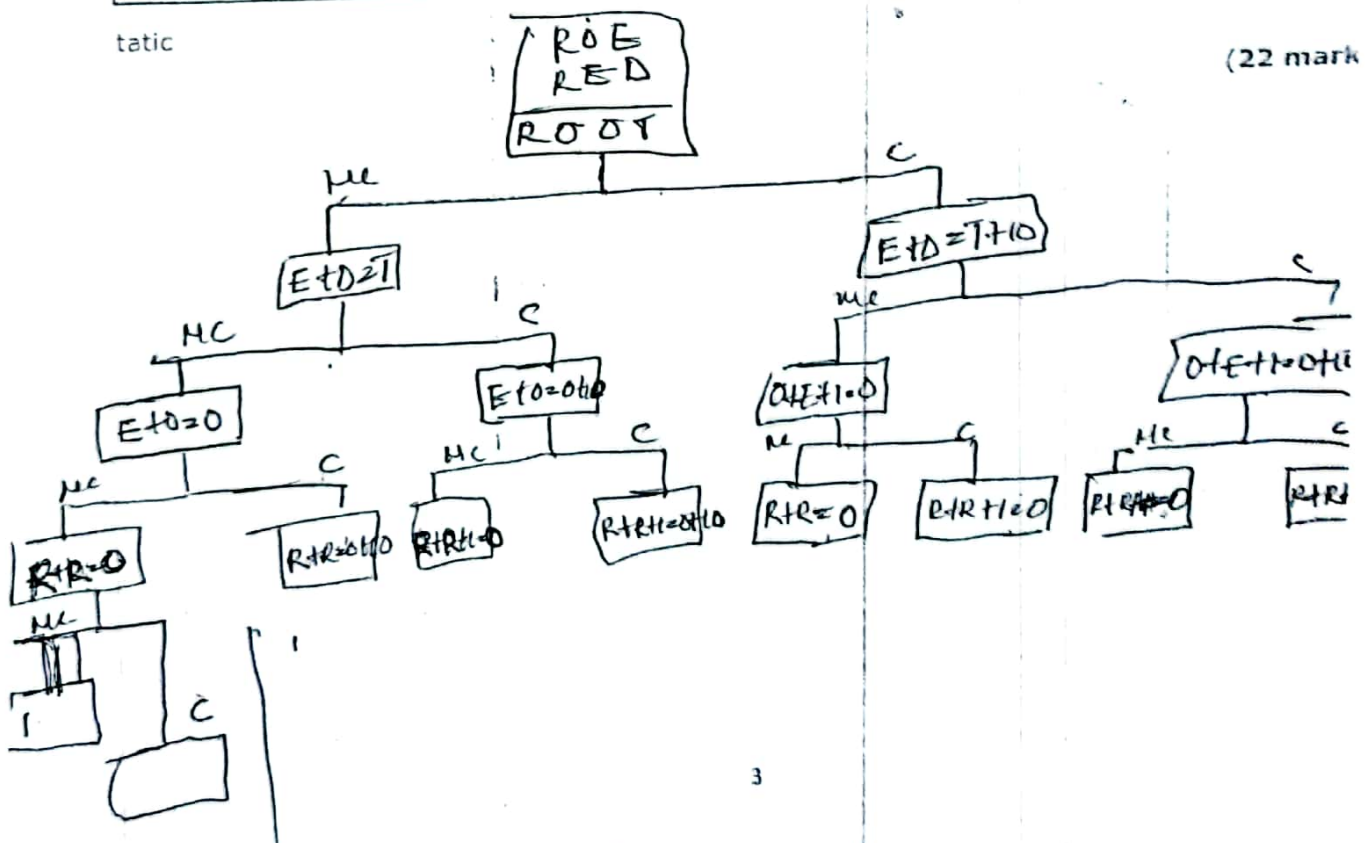
Give a brief answer to each of these questions

- I. According to the Turin Test, we would have a true AI if:
- II. Imagine a backtracking depth-first search. It searches the tree in a depth-first manner, but only generates one child for each node. When it reaches a dead end, it backtracks to the last node that has unchecked children (deleting all lower nodes), generates the next child, and goes down that branch. The tree it is searching has a branching factor of  $b$ , a maximum depth of  $m$ , and the first goal node reached is at depth  $d$ . What is the space complexity of the backtracking depth-first search?
- III. Why are greedy search algorithms prone to ending in local optimums rather than the global optimum of the search space?



tatic

(22 mark





**UNIVERSITY OF LAGOS**  
**FACULTY OF ENGINEERING**  
**DEPARTMENT OF SYSTEMS ENGINEERING**  
**First Semester Final Examination (2016/2017 Session)**  
**SSG 503: Artificial Intelligence**

**INSTRUCTION: Answer Question 1 and any other three    DURATION: 3 hours**

**Question 1 (34 Marks, compulsory question)**

- (a) What is intelligence?
- (b) Data, information and knowledge are three related but distinct terms. Explain the relationship between these terms and relate them to the three mental processes involved in knowing.
- (c) What is a concept? Explain how it is used in achieving cognitive efficiency.
- (d) Write short notes on the following:
  - (i) Narrow Intelligence
  - (ii) Artificial Intelligence
  - (iii) Intelligent Behaviour
  - (iv) Turing Test for Machine Intelligence

**Question 2 (22 marks)**

- a. Heuristic search is a quintuple. Explain the implications of this statement for the use of a search tree as a means of knowledge representation.
- b. Describe three brute-force tree searching algorithm and explain the differences between each of them.
- c. Write short notes on
  - c.i. Minimax Algorithm
  - c.ii. Alpha-Beta Pruning
  - c.iii. Hill Climbing
  - c.iv. Best First Search

**Question 3 (22 marks)**

- (a) Derive the worst case time/space complexity of the African game Macala (Ayo, Awari, Okweetc).
- (b) Explain why it may be necessary to consider the worst case.
- (c) Without necessarily solving the problem, draw a search tree for the solution to the following cryptarithmic problem, explaining in details the basis for the branching at each level:

$$\begin{array}{r} \text{RED} \\ + \text{ROE} \\ \hline \text{DEER} \end{array}$$

**Question 4 (22 marks)**

- (a) Define an algorithm and describe the two main resources consumed by algorithms
- (b) Explain the notion of algorithmic complexity
- (c) Describe combinatorial explosion and relate it to the challenge of achieving artificial intelligence
- (d) What is the tyranny of combinatorial explosion?

**Question 5 (22 Marks)**

- a. Describe the three main characteristics of a problem that can be solved using the perceptron algorithm?
- b. Explain Linear Separability and describe how pattern recognition can be applied to data that may not be linearly separable.
- c. Derive the slope and intercept of a straight line that can be used to categorise objects from two classes that are linearly separable.

**Question 6 (22 Marks)**

- a. What is Entropy as applied to Information theory
- b. Explain using sample numerical values why the entropy of a loaded coin is lower than that of a fair coin
- c. What is a self-organising system  
Give three examples of self-organising systems and explain why each can be said to be a self-organising system