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ZIMBABWE OPEN UNIVERSITY

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ASSIGNMENT COVER

REGION: HARARE SEMESTER: 1 YEAR: 3

PROGRAMME: BACHELORS OF SOFTWARE ENGINEERING (HONS) INTAKE: 02

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COURSE NAME: ARTIFICIAL INTELLIGENCE COURSE CODE: BSEH 351

ASSIGNMENT NO. e.g. 1 or 2: 1 STUDENT'S SIGNATURE T. K. NDORO

DUE DATE: SUBMISSION DATE:

ASSIGNMENT TITLE: ARTIFICIAL INTELLIGENCE – BSEH 351

Instructions

Marks will be awarded for good presentation and thoroughness in your approach.

NO marks will be awarded for the entire assignment if any part of it is found to be copied directly from printed materials or from another student.

Complete this cover and attach it to your assignment. Insert your scanned signature.

Student declaration

I declare that:

- *I understand what is meant by plagiarism*
- *The implications of plagiarism have been explained to me by the institution*
- *This assignment is all my own work and I have acknowledged any use of the published or unpublished works of other people.*

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BSEH 351 ARTIFICIAL INTELLIGENCE - ASSIGNMENT 1

Question 1 Rule Based Systems

a. i. What do you understand is Artificial Intelligence (AI) [2]

Artificial Intelligence (AI) is an area of computer science that emphasizes the creation of intelligent machines that work and react like humans. Some of the activities that computers with artificial intelligence are designed for include speech recognition, learning, planning and problem solving.

ii. How is artificial intelligence different from conventional computing? [2]

The difference between artificial intelligence from conventional computing is that, Artificial Intelligence (AI) involves a computer that is able to teach itself and emulate an intelligent response to the use whereas a Conventional computer does what it is programmed to do or no more.

iii. Define an autonomous rational agent [2]

An autonomous rational agent in Artificial intelligence is an autonomous entity which observes through sensors and acts upon an environment using actuators (i.e. it is an agent) and directs its activity towards achieving goals which is being rational.

iv. List out the advantages of non-monotonic reasoning. [2]

- In a logic of non-monotonic some conclusions can be invalidated by adding more knowledge.
- The logic of definite clauses with negation as failure is non-monotonic
- The non-monotonic reasoning is useful for representing defaults. A default is a rule that can be used unless it overridden by an exception.

b. Translate the following sentences A to E below in to First Order Logic.

i. Every rose has thorn [4]

$\forall X\ [\text{rose}(X)\ \exists Y\ (\text{has}(X,Y \wedge \text{thorn}(Y))]$

ii.

Use only one logic sentence for each English sentence. Do not include any ground variables. Also you must use the following predicates

- pussyCat(X) - X is a pussy cat
- mickeyMouse(X) - X is a mickey mouse
- ate(X,Y) - X ate Y

A. All pussy cats eat mickey mice [2]

$\forall \text{ate}(\text{pussy cats, mickey mice})$

B. Tom is a pussy cat [2]

pussyCat (Tom)

C. Jerry is a mickey mouse [2]

mickeyMouse (Jerry)

D. **Some cat ate some mouse [2]**
$\exists X \exists Yate(cat(X), mouse(Y))$

E. **Tom ate Jerry [2]**
Ate(Tom, Jerry)

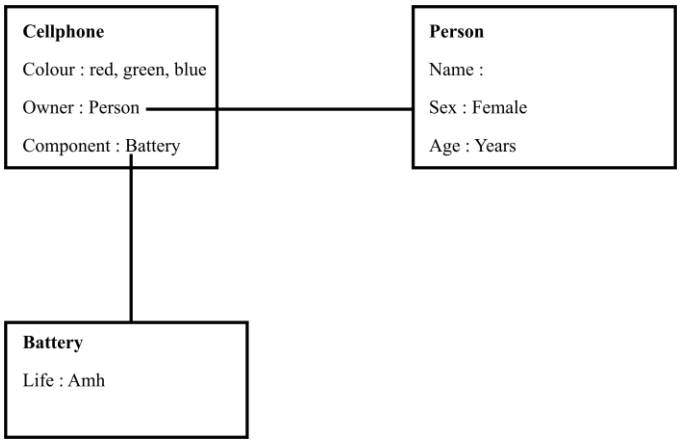
Question 2: Knowledge representation

a. **what is a Semantic Network? [2]**

Semantic Network is a technique of knowledge representation that is used for propositional information and sometimes called a propositional net. It represent knowledge in a form of graph.

A cell phone can be coloured i.e. red, blue, green etc. People own cell phones. A person can be identified by name, sex and age. The battery is a component of cell phone. The battery life is measured in mAh i.e. milli Ampere Hours

b. **Represent this information using semantic Frames [5]**



c. **Write a prolog representation of this network [5]**

Cellphone

coloured(Cellphone, red).
coloured(Cellphone, green).
coloured(Cellphone, blue).

has_battery(Cellphone).
has_life(Battery).
measured_in(Battery, Amh).

owns(Person, cellphone).

identified_by(Person, Name).
identified_by(Person, Sex).
identified_by(Person, Years).

d. Write short notes on Hidden Markov Models (HMM) [6]

Hidden Markov Model (HMM) is a statistical model in which the system modelled is assumed to be a process with unobserved or hidden states. It is a model in which you observe a sequence of emissions, but do not know the sequence of states the model went through to generate the emissions. Analyses of hidden Markov model seek to recover the sequence of states from the observed data. HMMs allows us to make assumptions about things we cannot see based on things we can see.

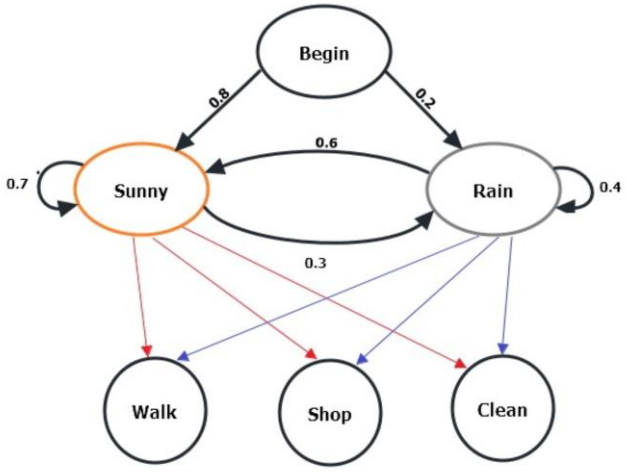
The idea behind the model is simple such that you can imagine your system can be modeled as a Markov chain and the signals emitted by the system depend only on the current state of the system. If the state system are not visible and what you can observe are only the emitted signals, then this is a Hidden Markov model.

A simple example of HHM is like, imagine you have a friend in another country whose activities depend on the weather. According to the weather conditions she is more likely to do some activities instead of others. However, by assuming you have no a smartphone you cannot observe the weather in her country and you only have a report of sequence of activities.

In this, there are three top problems you might want to solve which are:

- Given the parameters, calculate the probability of a certain sequence of activities on the report.
- Given the parameters, calculate the most likely occurring sequence.
- Given a sequence or a set of sequences, find the parameters

Below is a graph of HMMs illustrating the activities of the above given example:



e. Explain how the Hidden Markov Model be used in a speech recognition system or hand writing annotation system. [4]

The Hidden Markov Model is used in a speech recognition system or hand writing annotation system in the states of phonemes which is a small number of basic sounds that can be produced.

The observations are frames of audio which are represented using the Mel Frequency Cepstral Coefficients (MFCCs). MFCCs are a feature widely used in automatic speech and speaker recognition. Given a sequence of MFCCs i.e. the audio, we want to know what the sequence of phonemes was. Once we have the phonemes we can work out words using a phoneme to word dictionary.

Question 3: Search Strategies

i. define a Heuristic function? [1]

Heuristic function is a way to inform the search about the direction to a goal. It provides an informed way to guess which neighbor of a node will lead to a goal. It must use only information that can be readily obtained about a node.

ii. What do you understand is the travelling salesman problem? [2]

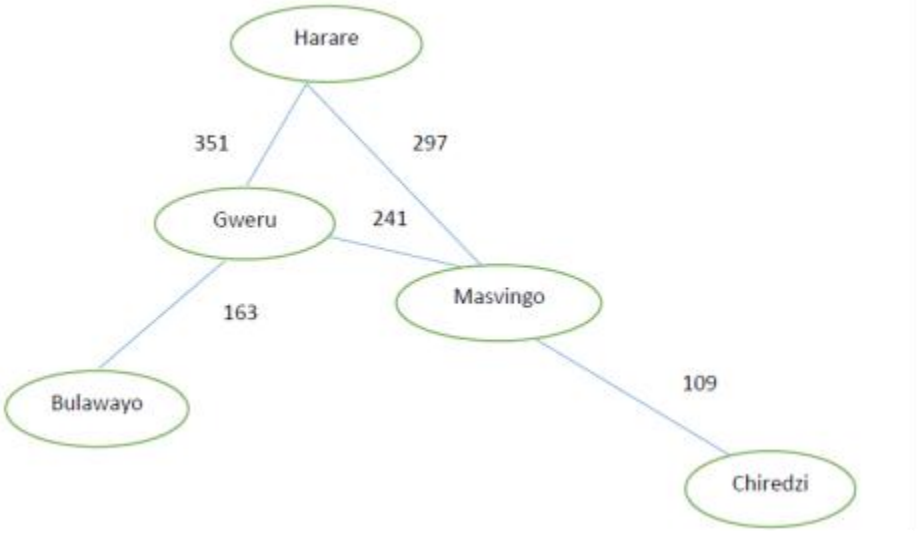
The Traveling salesman problem (TSP) is a popular mathematics problem that asks for the most efficient trajectory or route possible given a set of points and distances that must all be visited.

In artificial intelligence, the TSP problem can be applied to the most efficient route for data to travel between various nodes.

iii. Why would you think the Hill-climbing Algorithm is best to deal the travelling salesman problem? [2]

The Hill-climbing Algorithm is a mathematical optimization technique which belongs to the family of local search. The Hill-climbing algorithm is best to deal the travelling salesman problem because it is easy to find an initial solution that visits all the cities. The algorithm starts with such a solution and makes small improvements to it, such as switching the order in which two cities are visited. Eventually, a much shorter route is likely to be obtained.

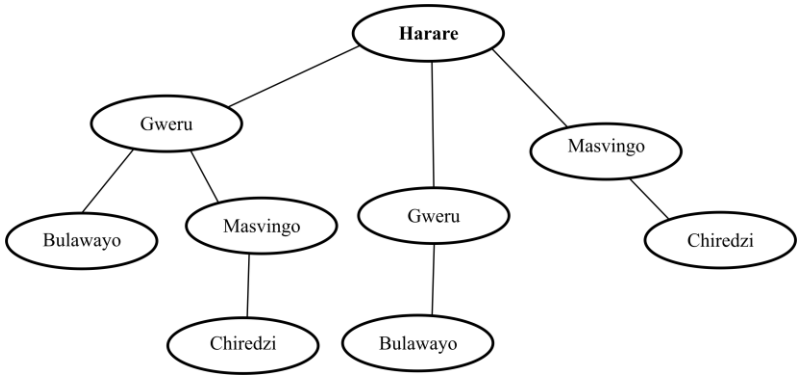
A wandering traveller is located in Harare lost on his way to Chiredzi. The navigator software application reveals the following map



Using the following algorithms show how the navigator able to find a route to destination. Your illustration should clearly label the start and goal states.

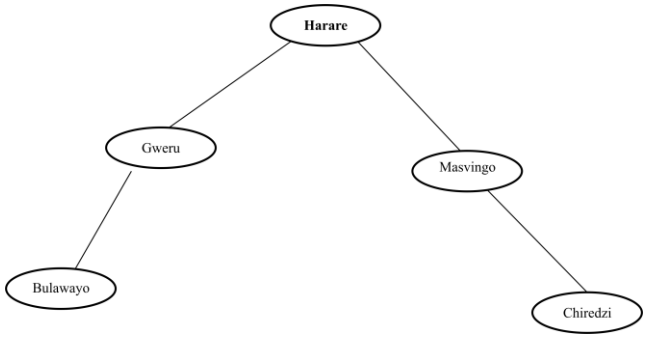
1. British Museum [5]

The British Museum algorithm is a general approach to find a solution by checking all possibilities one by one, beginning with the smallest. The term refers to a conceptual, not a practical, technique where the number of possibilities is enormous.



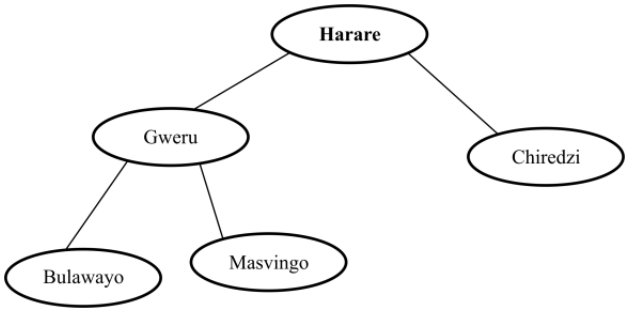
2. Breadth first Search [5]

The Breadth First Search (BFS) is a simple strategy in which the root node is expanded first, then all the successors of the root node are expanded next, then their successors and so on until the best possible path has been found. BFS is also classified as an uninformed or blind search.



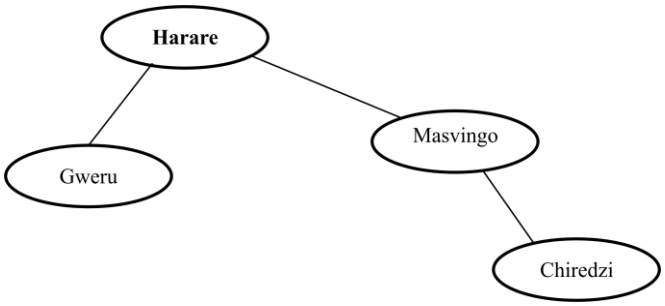
3. Iterative deepening [5]

Iterative deepening search or more specifically iterative deepening depth-first search is a state space or graph search strategy in which a depth-limited version of depth-first search is run repeatedly with increasing depth limits until the goal is found.



4. Hill-Climbing [5]

Hill-climbing is an iterative algorithm that starts with a random solution to a problem and attempts to find a better solution by changing a single element of the solution incrementally. If the change produces a better solution, an incremental change is taken as a new solution. This process is repeated until there are no further improvements.



Question 3 Game Playing

i. Explain the terms

a. Rational Agent [2]

A Rational Agent is an agent which has clear preferences and models uncertainty through expected values. It can be anything that makes decision, typically a person, firm, machine or software. A rational agent always perform right action, where the right action means that the action that causes the agent to be most successful in given percept sequence. It is capable of taking best possible action in any situation.

Example of rational action performed by any intelligent agent: An automated Taxi driver:

Performance measure:		Fast, safe, legal, comfortable trip, maximize profits.
Environment	:	Roads, other traffic, customers.
Actuators	:	Steering wheel, accelerator, brake, signal, horn.
Sensors	:	Cameras, speedometer, GPS, engine sensors, keyboard, odometer, sonar.

b. MinMax principle [3]

MinMax principle (MM) is a decision rule used in artificial intelligence, decision theory, game theory, statistics and philosophy for minimizing the possible loss for worst case (maximum loss) scenario. When dealing with gains, it is referred to as maxmin – which is to maximize the minimum gain.

The MinMax principle is the most well-known strategy of play of two-player, zero-sum games. It is a strategy of always minimizing the maximum possible loss which can result from a choice that a player makes.