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ZIMBABWE OPEN UNIVERSITY

"Empowerment Through Open Learning"

ASSIGNMENT COVER

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

FULL NAME OF STUDENT: TRACEY K. NDORO PIN: P1669806Y

EMAIL ADDRESS: tkndoro@gmail.com

CONTACT TELEPHONE/CELL: 0772498056 ID. NO.: 07-107291-Q-07

COURSE NAME: ARTIFICIAL INTELLIGENCE COURSE CODE: BSEH 351

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

DUE DATE:______________ SUBMISSION DATE:________________________

ASSIGNMENT TITLE: ARTIFICIAL INTELLIGENCE – BSEH 351

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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.
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I declare that:

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BSEH 351 ARTIFICIAL INTELLIGENCE - ASSIGNMENT 2

Question 1 Rule Based Systems

a.

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

Artificial intelligence (AI) is a field that studies methods or ways for machines such as computers to act and do things like work and thinking similar to human beings.

Artificial intelligence (AI) is a term for simulated intelligence in machines. These machines are programmed to "think" like a human and mimic the way a person acts. The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal, although the term can be applied to any machine that exhibits traits associated with a human mind, such as learning and solving problems.

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

Conventional systems are rule based systems. Rules are clearly defined and implemented in the programming language as to how the system should function and behave in certain condition.

AI systems on the other hand are observation and learning based systems. They observe the surrounding ecosystem and the environment, the past data and how the system has responded in past to certain data. Based on this data, a pattern is established, rules are derived automatically and then systems follow these rules. The rules may evolve overtime based on the new data that system is constantly accumulating

iii. Define an autonomous rational agent [2]

In artificial intelligence, an intelligent **agent** (IA) 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 (i.e. it is "**rational**", as defined in economics)

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

Monotonic learning is when an agent may not learn the knowledge that contradicts with what it already known or exists, it will not replace a statement with its negation. Thus, the knowledge base may only grow with new facts in a monotonic fashion. The advantages of monotonic learning are:

1.greatly simplified truth-maintenance

2.greater choice in learning strategies

Non-monotonic learning is when an agent may learn the new knowledge that contradicts what it already known or existing. So it replaces the old knowledge with new if it believes there is sufficient reason to do so. The advantages of non-monotonic learning are:

1.increased applicability to real domains, 2.greater freedom in the order things are learned in

Question 2 Game Playing

i. Explain what you understand by Autonomous Agent [2]

Autonomous systems use information gathered from sensors to make independent decisions and then act on them using corresponding actuators. An autonomous agent is a “smart” agent operating on an owner’s behalf but without any interference of that ownership entity. A thermostat is an example of a very simple autonomous agent in that it senses the environment and acts to change the heater. An autonomous agent has the capacity to process information within a restricted domain giving it autonomy and then take an action based upon the rules it has been given or learned. Agency derives from the Latin “agere” meaning “to do” autonomous agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in so doing, employ some understanding or representation of the user’s goals or desires.

ii. Illustrate with a suitable example what is Alpha Beta pruning in search algorithms [3]

Alpha–beta pruning is a search algorithm that seeks to decrease the number of nodes that are evaluated by the minimax algorithm in its search tree. It is an adversarial search algorithm used commonly for machine playing of two-player games. It stops completely evaluating a move when at least one possibility has been found that proves the move to be worse than a previously examined move. Such moves need not be evaluated further. When applied to a standard minimax tree, it returns the same move as minimax would, but prunes away branches that cannot possibly influence the final decision.

The minimax algorithm is a way of finding an optimal move in a two player game. *Alpha-beta pruning* is a way of finding the optimal minimax solution while avoiding searching subtrees of moves which won't be selected. In the search tree for a two-player game, there are two kinds of nodes, nodes representing *your* moves and nodes representing *your opponent's* moves. Nodes representing your moves are generally drawn as squares (or possibly upward pointing triangles):

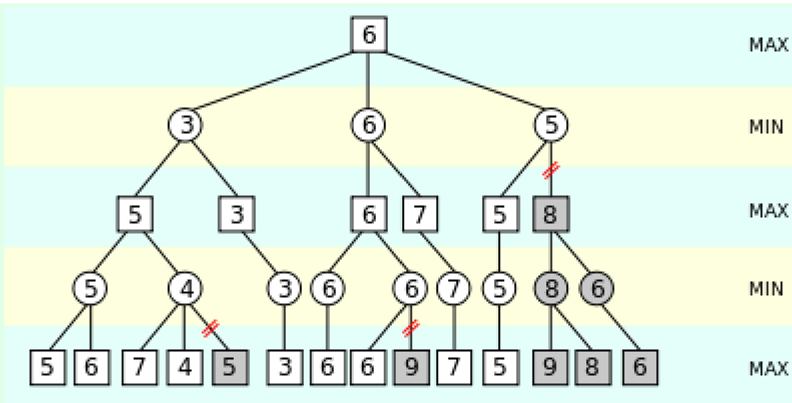
These are also called *MAX* nodes. The goal at a MAX node is to maximize the value of the subtree rooted at that node. To do this, a MAX node chooses the child with the greatest value, and that becomes the value of the MAX node.

Nodes representing your opponent's moves are generally drawn as circles (or possibly as downward pointing triangles):

These are also called *MIN* nodes. The goal at a MIN node is to minimize the value of the subtree rooted at that node. To do this, a MIN node chooses the child with the least (smallest) value, and that becomes the value of the MIN node.

Alpha-beta pruning gets its name from two bounds that are passed along during the calculation, which restrict the set of possible solutions based on the portion of the search tree that has already been seen. Specifically,

A game can be thought of as a tree of possible future game states. For example, in Gomoku the game state is the arrangement of the board, plus information about whose move it is. The current state of the game is the root of the tree (drawn at the top). In general this node has several children, representing all of the possible moves that we could make. Each of those nodes has children representing the game state after each of the opponent's moves. These nodes have children corresponding to the possible second moves of the current player, and so on. The leaves of the tree are final states of the game: states where no further move can be made because one player has won, or perhaps the game is a tie. Actually, in general the tree is a graph, because there may be more than one way to get to a particular state. In some games (e.g., checkers) it is even possible to revisit a prior game state.



Jealous Husbands problem

Three married couples want to cross a river in a boat that is capable of holding only two people at a time, with the constraint that no woman can be in the presence of another man unless her (jealous) husband is also present. How should they cross the river with the least amount of rowing?

a. Represent this problem as a search space with node representing the states of the problem after each boat transition. [10]

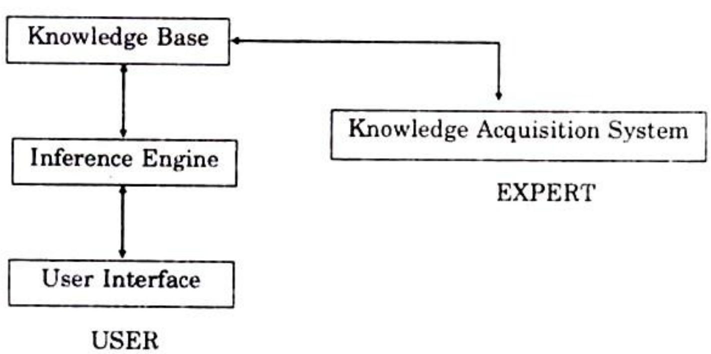
b. What are the states and operators in this search? [5]

c. Using depth first search on the tree, illustrate how a solution can be found [5]

d. Represent solution to this problem as graph path [5]

Question 4

What are the components of an expert system [5]



Expert System Component # 1. Knowledge Acquisition Subsystem:

Knowledge represented in the knowledge base has to be acquired from the expert.

This is the job of the knowledge engineer.
As this is a skilled & time consuming operation, it is often this which limits the designing and functioning of expert system in a commercial environment.
Knowledge Acquisition program is used by an individual, who has expertise in the problem to, creates, add to or change the knowledge base. Potential sources of knowledge include human expert, research reports, textbooks, databases and the user's own experience. Experts make decisions based on qualitative & quantitative information. The system engineer has to translate the standard procedures into the form suitable for the expert system. Acquiring the knowledge from experts is a complex task that often is a bottleneck in expert system construction.

The state of the art today requires a knowledge engineer to interact with one or more human experts in building knowledge base. Typically, the knowledge engineer helps to expert structure of the problem area by interrupting & integrating human answer to questions, by drawing analogies, posing counter examples, and bringing to light conceptual difficulties.

Expert System Component # 2. Knowledge Base:

This is the most important element of an expert system since it holds the expert's problem solving knowledge. It is where the knowledge elicited from the expert is stored. It contains rules, facts and descriptions of objects etc.
With newer expert system products, the knowledge base is always stored in data. The information in knowledge base is everything that is necessary for understanding & formulating the problem & then solving it.
The key to knowledge base is how the knowledge is represented. The knowledge acquired from the expert has to be represented formally. Such knowledge representation deals with the structuring of the information, manipulation of information, and knowledge acquisition. The power of a system tends to be r elated from all sides of the knowledge in the knowledge base.

Expert System Component # 3. Interference Engine:

The interference engine is that part of the program which regains & determines how to apply the knowledge in the knowledge base to the facts & premises presented at the user interface. It performs this task in order to deduce new facts which are subsequently used to draw further conclusions. The interference engine is the active component of an expert system. It is the Brain of the expert system.
Interference engine is also known as the control structure or the rule interpreter. This component is essentially a computer program that processes the knowledge base to achieve the goal stipulated by the user, who is communicating with the system via the user interface. It provides a methodology for reasoning about information in the knowledge base & for formulating conclusions.

Expert System Component # 4. User Interface:

Expert system contains a language processor for friendly problem oriented-communications between the manager-user & the computer. This communication is best carried out in a natural language and in some cases; it is supplemented by the graphics.

The human computer interface or user interface technology allows users to interact with the system. The user presents the problem and has the conclusions presented to him. A significant feature of some expert systems is that they can justify the conclusions reached as well as explain why certain options were used or discarded.
There are different ways in which the initiative can be shared between the system and the user. The most straight forward method is that in which the system determines the flow of the interactive session by prompting the user with questions and asking for data, to be inputted. In this instance, the user can not volunteer information.

In systems, where the initiative is shared, the whole decision making process is shared between user and system. In a diagnostic system, the users can select a hypothesis and at each stage comment as to whether to continue along the same route or change it. Obviously, this type of system is much more complex to design.
The ultimate interface would be one allowing the user to take all of the initiative; to be able to input any number of suggestions in a natural language form. This is highly complex and is under constant development.

Components of an Expert System[edit] An expert system is typically composed of at least three primary components. These are the **inference engine**, the **knowledge base**, and the **User interface**.

Knowledge Base[edit]

The knowledge base is a collection of rules or other information structures derived from the human expert. Rules are typically structured as If/Then statements of the form:

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IF <antecedent> THEN <consequent>
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The **antecedent** is the condition that must be satisfied. When the antecedent is satisfied, the rule is triggered and is said to "fire". The **consequent** is the action that is performed when the rule fires.

Inference Engine[edit]

The inference engine is the main processing element of the expert system. The inference engine chooses rules from the agenda to fire. If there are no rules on the agenda, the inference engine must obtain information from the user in order to add more rules to the agenda. It makes use of knowledge base, in order to draw conclusions for situations. It is responsible for gathering the information from the user, by asking various questions and applying it wherever necessary. It seeks information and relationships from the knowledge base and to provide answers, predictions and suggestions the way a human expert would.

User Interface[edit]

A user interface is the method by which the expert system interacts with a user. These can be through dialog boxes, command prompts, forms, or other input methods. Some expert systems interact with other computer applications, and do not interact directly with a human. In these cases, the expert system will have an interaction mechanism for transactions with the other application, and will not have a user interface.

Define

a. inference [1]

An inference is a process of drawing conclusions based on the evidence. On the basis of some evidence or a “premise,” you infer a conclusion.

Inference is the act or process of deriving a *conclusion* based on what one already knows or on what one assumes. The statement(s) given as evidence for or that supposedly lead to the conclusion are known as *premise(s).*

Inference is studied within several different fields.

b. deductive reasoning [2]

Deductive reasoning is a logical process in which a conclusion is based on the concordance of multiple premises that are generally assumed to be true.

Deductive reasoning is sometimes referred to as top-down logic. Its counterpart, inductive reasoning, is sometimes referred to as bottom-up logic. Where deductive reasoning proceeds from general premises to a specific conclusion, inductive reasoning proceeds from specific premises to a general conclusion.

deduction or **deductive reasoning** is inference in which the premises, if true, purport to guarantee the truth of the conclusion, as opposed to abductive and inductive reasoning, where the premises are offered as giving some evidence for the conclusion, but not guaranteeing its truth.

c. forward chaining [2]

orward chaining is the logical process of inferring unknown truths from known data and moving forward using determined conditions and rules to find a solution.

In artificial intelligence (AI), forward chaining is used to help an AI agent solve logic problems by inspecting rules and previous learning to deduce ways to find solutions. An AI might use forward chaining to explore the available information, answer a question or solve a problem. Forward chaining is used to break down the logic sequence and work through it from beginning to end by attaching each step after the previous one is solved.

Forward chaining and its counterpart backward chaining represent deductive logic. In contrast, backward chaining moves backward from a conclusion to find the rules or conditions from which it resulted

d. backward chaining [2]

Backward chaining is the logical process of inferring unknown truths from known conclusions by moving backward from a solution to determine the initial conditions and rules. Backward chaining is often applied in artificial intelligence (AI) and may be used along with its counterpart, forward chaining.

In AI, backward chaining is used to find the conditions and rules by which a logical result or conclusion was reached. An AI might utilize backward chaining to find information related to conclusions or solutions in reverse engineering or game theory applications. Backward chaining is used in automated theorem proving tools, inference engines, proof assistants and other artificial intelligence applications.

What is an expert system shell [3]

Shells − A **shell** is nothing but an **expert system** without knowledge base. A **shell**provides the developers with knowledge acquisition, inference engine, user interface, and explanation facility.

Shells − A shell is nothing but an expert system without knowledge base. A shell provides the developers with knowledge acquisition, inference engine, user interface, and explanation facility. For example, few shells are given below −

- Java Expert System Shell (JESS) that provides fully developed Java API for creating an expert system.
- *Vidwan*, a shell developed at the National Centre for Software Technology, Mumbai in 1993. It enables knowledge encoding in the form of IF-THEN rules.

Using Exsys Corvid or prolog build an expert system to address an area of your choice. You should have at least five rules in the inference engine. For example you can make an expert system for car diagnostics to mimic a mechanic or a healthy expert. [20]