CMSC 373 Artificial Intelligence
Exam 1 Review

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Question 1

1. This is based on the Imitation Game. **TURING TEST**
2. Using pattern matching rules, it generates responses to input sentences in English. **ELIZA**
3. Enables declarative Knowledge Representation & Reasoning. **FOPC**
4. Wffs are written as a disjunction of literals of which exactly one is positive. **DEFINITE CLAUSE FORM**
5. Acts in a blocksworld using procedural knowledge. **SHRDLU**
6. This is a representation of actions in a planning problem and specifies the preconditions, adds, and deletes for a given action. **STRIPS ORERATOR**
7. This refers to exaggerated optimistic claims about the success of AI. **AI HYPE**
8. This is defined by the number of successors of a state during search. **BRANCHING FACTOR**
9. This is a backward chaining expert system. **MYCIN**
10. This refers to the combinatorial explosion encountered in many AI algorithms. **COMPLEXITY BARRIER**
11. This search algorithm uses admissible heuristics to find the optimal path. **A***
12. This is the planning system used by SHAKEY. **STRIPS**
13. This is the first integrated AI robot. **SHAKEY**
14. This is mostly a pipe dream. **AGI**
15. This is a forward chaining expert system. **R1/XCON**

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Question 2

(1) What is the dichotomy of procedural and declarative knowledge. Give examples of systems we have studied that embody these forms of knowledge. Which one of these can be classified as symbolic knowledge?

Procedural knowledge is about how to do a task using procedures.
Declarative knowledge is about representing facts and doing reasoning with them

(2) Is MINIMAX a breadth-first search or a depth-first search algorithm? Why?

Minimax is a depth-first search algorithm. Upon expanding a state, it searches one of its neighbors all the way down before searching the other neighbors.

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Questions 3 & 4

Question 3. Which of the following state-space search methods are guaranteed to find an optimal cost (where optimal cost ≠ minimal path length) solution whenever any solution exists? Indicate your answers by writing "YES" or "NO" in the space provided.

- Depth-first Search **NO**
- Breadth-First Search **NO**
- Best-First Search **YES**
- A* Search **YES**

What is the worst-case complexity of Depth-First Search? $\boldsymbol{O}(\boldsymbol{b}^{\boldsymbol{d}})$

Question 4 Part A. A* search does not terminate until a goal node is selected (out of the FRONTIER) for examination. However, a path to a goal node might be reached long before that node is selected for examination. Why not terminate as soon as a goal node has been found? Explain.

Because, to guarantee an optimal path a path to the goal must be removed from the FRONTIER. Otherwise, a recently created partial path to the goal may not be optimum.

Question 4 Part B. What is the **STRIPS Assumption**? Provide a short and precise statement and describe why it is needed.

The STRIPS Assumption states that the only thing that changes in the environment when an action is performed are the adds and deletes specified in the action's (STRIPS Operator's) ADD/DELETE lists. It is needed to circumvent the Frame Problem.

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Question 5

The following data represents the list of all the states and their neighbors. Each line begins with the name of a state followed by its neighboring states.

Given the above represented as a graph, answer the following questions:

What is the smallest branching factor in the search trees of this graph? **0 (ZERO)**

What is the largest branching factor in the search trees of this graph? **8 (EIGHT)**

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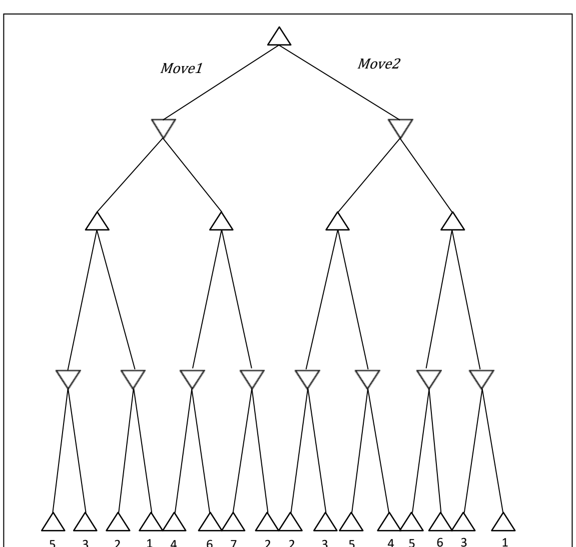
Question 6



Consider the game tree shown:
Conduct a **minimax search** of the tree above. Label the MIN/MAX levels as indicated by triangles. Darken/shade each terminal node examined (evaluated). For each branch show the progressive backed up value. Answer the following questions:

1. The final backed up value at the root is **4**
2. Which move will be chosen? **Move2**
3. How many static evaluations were performed? **16**
4. The average branching factor of this search tree is **2**

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Question 7

Part A. For a blocksworld domain, the following are known to be true: $block(A)$

- $block(B)$
- $block(C)$
- $clear(B)$
- $on(B, A)$
- $clear(C)$
- $on(A, Table)$
- $on(C, Table)$

Assuming the standard interpretation (as implied by relation names) draw a picture of the blocksworld represented by the above situation (in the space above).

Part B In addition to the facts above, add the following, *"If a block is on top of another block, then the latter block is not clear."* Write the FOPC representation of this statement below.

$\forall x \forall y[\boldsymbol{block}(x) \wedge \boldsymbol{block}(y) \wedge \boldsymbol{on}(x, y) \Rightarrow \neg \mathbf{clear(y)}]$

Using forward chaining inference, what additional fact(s) can be deduced from this rule, given the facts in **Part A**.

¬clear(A)

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Question 8

Mammals are animals.

$\forall x[\boldsymbol{Mammal}(x) \Rightarrow \mathbf{Animal(x)}]$

Collies are dogs.

$\forall x[\boldsymbol{Collie}(x) \Rightarrow \mathbf{Dog(x)}]$

Socrates is human.

$\boldsymbol{Human}(\boldsymbol{Socrates})$

Snoopy is a beagle.

$\mathrm{B}\boldsymbol{eagle}(\boldsymbol{Snoopy})$

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Question 9

Mammals are animals.

$\forall x[Mammal(x) \Rightarrow Animal(x)]$

`animal(X) :- mammal(X).`

Collies are dogs.

$\forall x[Collie(x) \Rightarrow Dog(x)]$

`dog(X) :- collie(X).`

Socrates is human.

$Human(Socrates)$

`human(socrates).`

Snoopy is a beagle.

$Beagle(Snoopy)$

beagle(snoopy).

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Question 9, *contd.*

Based on the above knowledgebase, how would you query the following in PROLOG?

Who are all the animals?

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?- animal(X).
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Who bites?

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?- bites(X).
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Who bites and walks?

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?- bites(X), walks(X).
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