

THE OPEN UNIVERSITY OF SRI LANKA
 B.Sc DEGREE PROGRAMME: LEVEL 05
 FINAL EXAMINATION: SEMESTER 2 - 2017/2018
 CSU5317/CSU5308: ARTIFICIAL INTELLIGENCE



DURATION: TWO HOURS (2 HOURS)

DATE: 05.04.2019

TIME: 2.00 p.m. to 4.00 p.m.

Answer FOUR Questions ONLY.

Q1.

- (a) Define the term **Artificial Intelligence (AI)**.
- (b) Give an example of system that:
 - (i) Think like humans
 - (ii) Thinks rationally
 - (iii) Act like humans
 - (iv) Acts rationally
- (c) What is the goal of the **Turing test**?
- (d)
 - (i) What is **reasoning**?
 - (ii) Compare and contrast **deterministic** and **non-deterministic** reasoning.
 - (iii) Explain seven types of reasoning techniques with suitable examples.

Q2.

- (a) Briefly explain the following terms.
 - (i) Tautology
 - (ii) Contradiction
 - (iii) Model assignment
 - (iv) Counter example
- (b) Draw the truth tables for the following propositional formulas, and indicate whether each statement is a tautology, a contradiction, or neither.
 - (i) $(P \vee \neg Q) \rightarrow (Q \wedge R)$
 - (ii) $((A \rightarrow B) \wedge (B \rightarrow \neg A)) \rightarrow A$
- (c) Translate the following English sentences into propositional logic formulas

- (i) Either the lift doors are open or the lift is moving and the lift doors are closed.
- (ii) Mathematics is easy or camping is fun, as long as it is sunny and the homework is done.
- (d) Define the **conjunctive normal form**.
- (e) Transform the following formulas into conjunctive normal form:
 - (i) $P \leftrightarrow Q$
 - (ii) $(P \wedge Q) \leftrightarrow (P \vee Q)$

Q3.

- (a)
 - (i) Differentiate between the **propositional logic** and the **predicate logic**?
 - (ii) Describe how predicate logic addresses the limitations of propositional logic.
- (b) Briefly explain the following terms in first-order logic.
 - (i) Variable
 - (ii) Predicate symbol
 - (iii) Constant
- (c) Translate the following sentences in first-order logic.
 - (i) Everyone loves Mary
 - (ii) Everyone loves someone
 - (iii) Every student who walks talks
- (d)
 - (i) What is meant by **prenex normal form**?
 - (ii) Find the prenex normal form of the following formulas:
 - a) $\neg \forall x [(\forall x P(x)) \rightarrow R(x)]$
 - b) $\forall x (\exists y R(x, y) \wedge \forall y \neg S(x, y) \rightarrow \neg (\exists y R(x, y) \wedge P))$

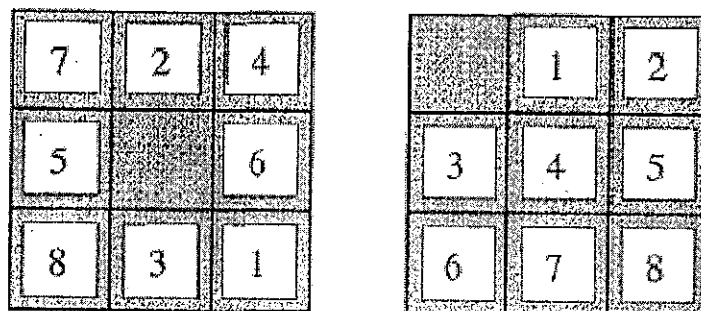
Q4.

- (a) Which instruments are used for perceiving and acting upon the environment?
- (b) What is meant by **rational agent**?
- (c) Briefly explain the following terms relating to the intelligent agent:

- (c) Briefly explain the following terms relating to intelligent agents:
- (i) Rationality
 - (ii) Autonomous
- (d) "When defining a rational agent, we had to specify the performance measure, the environment, and the agent's sensors and actuators." Write PEAS description for the following automated agents.
- (i) Taxi driver
 - (ii) Medical diagnosis system
- (e)
- (i) List some environmental properties that are important for intelligent agents.
 - (ii) Briefly explain two (02) properties given in the question (e)(i).
 - (iii) List two (02) environment properties for the following agents.
 - a) Vacuum cleaner
 - b) Taxi driver
- (f) Briefly explain the following agents, and give one example of agent for each.
- (i) Simple reflex agent
 - (ii) Model based reflex agent

Q5.

- (a) "Problem solving agents find some sequence of actions to achieve a goal state in a best way." How do they achieve a goal in a best way?
- (b) Consider the eight puzzles (8-puzzles) shown in the figure 1. Define the standard formulation for the problem under the following terms:
- States
 - Initial state
 - Successor function
 - Goal test
 - Path cost
- (c) What are the **Incremental formulation** and the **Complete-state formulation** of the eight queens problem?



Start state

Goal state

Figure 1: The typical instances of the 8-puzzles

- (d) Briefly explain the following search strategies.
- (i) Breadth-first search
 - (ii) Bidirectional search
- (e) State the completeness and the optimality of the search algorithms given in question (e).

Q6.

- (a)
- (i) Describe the difference between **Prolog** and **normal programming language**.
 - (ii) Explain the recursion in Prolog.
- (b) Suppose that you have the following family tree in Prolog.

```

male(buford).
male(ben).
male(larry).
male(jesse).
male(james).
male(benard).

female(latoya).
female(kamelia).
female(amelia).
female(amy).
female(bessie).
female(albertine).

parent(larry, latoya).
parent(larry, buford).
parent(larry, kamelia).
parent(jesse, larry).
parent(benard, ben).
parent(james, amelia).

```

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```
parent(amelia, latoya).
parent(amelia, buford).
parent(amelia, kamelia).
parent(amy, larry).
parent(bessie, amelia).
parent(albertine, ben).
```

- (i) Provide a definition for mother/2, and brother/2.

(Assume that, all these rules have the standard meanings as their names imply.)

- (ii) Further, you have the following recursive definition of "ancestor":

```
ancestor(X,X).
ancestor(X,Z) :- parent(X,Y), ancestor(Y,Z).
```

Then, consider the output of the following statement.

```
?- ancestor(A,B).
```

Each time that Prolog returns an answer, the user inputs ';' to ask it to look for another answer.

What answers does Prolog return, and in what order?

- (c) By using the following user defined member list predicate,

```
member(H, [H | _]).
member(H, [_ | T]) :- member(H, T).
```

Trace the output of the following statement.

```
?- member(Ringo, [John, Paul, Ringo, George])
```

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