BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF EDUCATIONAL TECHNOLOGY

BACHELOR OF SCIENCE EDUCATION IN COMPUTER SCIENCE

CS4I4/EDT414:: ARTIFICIAL INTELLIGENCE AND INTELLIGENT SYSTEMS

TIME: 3 HOURS

INSTRUCTIONS   ≡ JAN 2025

Answer **ALL the questions.** Each question carries **20** marks.
The question paper has **five** questions
Multiple Choice questions have **NO** part marks

Question 1

i.   Identify **any five** capabilities of Artificial intelligence (AI)   [5]

ii.   What is the difference between weak AI and Strong AI?   [3]

iii. Explain the problem that happen when Hill climbing enters the following regions:
                              a. Local maximum
                              b. Plateau
      : giving at least a way of overcoming the problem   [7]

iv.   Draw a state space diagram for Hill climbing showing different regions   [5]

Question 2

i.   A Water Jug Problem: You are given two jugs, a 4-gallon one and a 3-gallon one, a pump which has unlimited water which you can use to fill the jug, and the ground on which water may be poured. Neither jug has any measuring markings on it. How can you get exactly 2 gallons of water in the 4-gallon jug in 2 ways?

State: (x, y) x= 0, 1, 2, 3, or 4 y= 0, 1, 2, 3
x represents quantity of water in 4-gallon jug and y represents quantity of water in 3-gallon jug.

•**Start state:** (0, 0).

•**Goal state:** (2, n) for any n. Attempting to end up in a goal state.(since the problem doesn't specify the quantity of water in 3-gallon jug)

The production rules for this water jug problem are given as follows:

1. (x, y) If $x < 4$	$\rightarrow (4, y)$	Fill the 4-gallon jug
2. (x, y) If $y < 3$	$\rightarrow (x, 3)$	Fill the 3-gallon jug
3. (x, y) If $x > 0$	$\rightarrow (x - d, y)$	Pour some water out of the 4-gallon jug
4. (x, y) If $y > 0$	$\rightarrow (x, y - d)$	Pour some water out of the 3-gallon jug
5. (x, y) If $x > 0$	$\rightarrow (0, y)$	Empty the 4-gallon jug on the ground
6. (x, y) If $y > 0$	$\rightarrow (x, 0)$	Empty the 3-gallon jug on the ground
7. (x, y) If $x + y \geq 4, y > 0$	$\rightarrow (4, y - (4 - x))$	Pour water from the 3-gallon jug into the 4-gallon jug until the 4-gallon jug is full
8. (x, y) If $x + y \geq 3, x > 0$	$\rightarrow (x - (3 - y), 3)$	Pour water from the 4-gallon jug into the 3-gallon jug until the 3-gallon jug is full
9. (x, y) If $x + y \leq 4, y > 0$	$\rightarrow (x + y, 0)$	Pour all the water from the 3-gallon jug into the 4-gallon jug
10. (x, y) If $x + y \leq 3, x > 0$	$\rightarrow (0, x + y)$	Pour all the water from the 4-gallon jug into the 3-gallon jug
11. $(0, 2)$	$\rightarrow (2, 0)$	Pour the 2 gallons from the 3-gallon Jug into the 4-gallon jug
12. $(2, y)$	$\rightarrow (0, y)$	Empty the 2 gallons in the 4-gallon Jug on the ground

Trace of steps involved in solving the water jug problem using a table with the following headings: Number of Steps; Rules applied; 4-g jug; and 3-g jug
Note that two solutions are expected

[10,10]

Question 3

i. Define what it means for a search algorithm to be complete, and to be optimal. **[4]**

ii. Suppose you are given a map of Australia showing each of its states and territories (Figure 1). Your task is to colour each region either red, green, or blue in such a way that no neighbouring regions have the same colour.
   a. Formulate this as a Constraint Satisfaction problem (CSP) **[6]**
   b. State one possible solution **[2]**
   c. Evaluate the CSP against the state space searches **[3]**

iii. The following is the rule set of a simple weather forecast expert system:
   1: IF cyclone THEN clouds
   2: IF anticyclone THEN clear sky
   3: IF pressure is low THEN cyclone
   4: IF pressure is high THEN anticyclone
   5: IF arrow is down THEN pressure is low
   6: IF arrow is up THEN pressure is high

Use backward chaining to reason about the weather if the working memory contains the fact: clouds. Show your answer in a similar Table 1.

Table 1: Rule Firing procedure

Cycle	Working Memory	Conflict set	Rule fired
:	:	:	:

[5]

Question 4

i. Why are Bayesian networks important in AI? **[4]**

ii. Draw a clearly labelled diagram of a perceptron with n inputs **[10]**

iii. List **any four** capabilities of expert systems **[6]**

Question 5

i. Draw the structure of an expert system **[8]**

ii. Explain **any two** of the components in **i.** **[4]**

iii. In a study, physicians were asked what the odds of breast cancer would be in a woman who was initially thought to have a 1% risk of cancer but who ended up with a positive mammogram result (a mammogram accurately classifies about 80% of cancerous tumours and 90% of benign tumours.) 95 out of a hundred physicians estimated the probability of cancer to be about 75%. Do you agree? **[6]**

v. An AI application that has a higher level of intelligence and is capable of understanding open-ended questions and providing assistance in finding the most relevant replies beyond the pre-scripted responses it learns over time using NLP. It is ideal for dealing with customer support concerns, resolving typical issues, aiding account administration and offering general assistance. Which of the following applications can you relate to this?

(i) Automatic Number Plate Recognition   (ii) Alexa

(iii) Smart Chatbots   (iv) Spam filters   [2]

THE END OF EXAMINATION PAPER