ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF **IS**LAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION	**SUMMER SEMESTER, 2022-2023**
DURATION: 1 HOUR 30 MINUTES	**FULL MARKS: 75**

CSE 4617: Artificial Intelligence
Programmable calculators are not allowed. Do not write anything on the question paper.
Answer **all 4 (four)** questions. Figures in the right margin indicate full marks of questions with
corresponding COs and POs in parentheses.

1. a) In the movie, Colossus – The Forbin Project, a US defense computer tasked with ensuring peace and security encounters a Soviet computer with the same goal. They exchange information and decide that the goal is better achieved by jointly controlling all nuclear weapons and using threats of destruction to force humans to drop all aggressive war plans.

   In another movie, Transcendence, a professor of Artificial Intelligence (AI) is gunned down by anti-AI terrorists. Before he dies, his brain is uploaded to a supercomputer that was designed to integrate all human emotions with the accumulated knowledge of humanity. The machine becomes conscious and begins to quickly outrun the human race, threatening to take over the world.

   In light of the recent developments in the field of Artificial General Intelligence, provide your recommendations on how these situations mentioned above can be avoided. Your discussion should identify the common cause behind the problematic situations, what we should do when developing the agents, and what the agents should do.

   7
   (CO3)
   (PO3)

   b) Consider that we formulate a scenario as an AI problem where the performance measure is concerned with just the first T time steps of the environment and ignores everything thereafter. Show how that affects the decision made by a rational agent using example(s).

   5
   (CO2)
   (PO2)

2. Consider the problem of moving $k (k \geq 1)$ knights from k starting squares $s_1, ..., s_k$ to k goal squares $g_1, ..., g_k$ on a chessboard with infinite size. Here, no two knights can occupy the same square at the same time. The goal is to transfer all the knights using the fewest possible actions.

   The scenario can be formulated as a search problem in two ways:

   - F_1: An action involves moving at most k knights simultaneously at a time step.
   - F_2: An action involves moving only one knight at a time step.

   Now, we consider designing a heuristic for the given scenario. Assume that h_i is an admissible heuristic for a relaxed problem where we move the ith knight to goal g_i by itself, ignoring the other $(k-1)$ knights. Also we have three proposed heuristics for the given scenario:

   - $h_{min} = \min\{h_1, ..., h_k\}$
   - $h_{max} = \max\{h_1, ..., h_k\}$
   - $h_{sum} = \sum_{i=1}^{k} h_i$

   For **each** of the possible formulations of the given scenario, answer the following questions:

   a) Evaluate the admissibility of each of the proposed heuristics.

   2×12
   (CO3)
   (PO3)

   b) Recommend the most suitable one among the three proposed heuristics with proper justification.

   2×3
   (CO3)
   (PO3)

3. As shown in Figure 1, Sulawesi, an Indonesian island, is divided into six provinces: Gorontalo (*G*), West Sulawesi (*WS*), South Sulawesi (*SS*), Central Sulawesi (*CS*), Southeast Sulawesi (*SES*), and North Sulawesi (*NS*).

Figure 1: A Simplified Map of Sulawesi for Question 3

We want to color each province either red, green, or blue in such a way that no two neighboring regions (provinces that share their borders) have the same color.

a) Formulate the scenario as a Constraint Satisfaction Problem (CSP) by identifying the variables, their possible values, and the constraints. Also, draw the constraint graph.   15 + 7
(CO2)
(PO2)

b) Identify the possible cutset(s) of the constraint graph for converting it to a tree.   3
(CO1)
(PO1)

4. Consider that people are given a choice between lotteries A and B and then between C and D, which have the following prizes:

$$A = [0.80, \$4000; 0.20, \$0]$$
$$B = [1.00, \$3000; 0.00, \$0]$$
$$C = [0.20, \$4000; 0.80, \$0]$$
$$D = [0.25, \$3000; 0.75, \$0]$$

Most people consistently prefer B over A, and C over D.

a) Given $U(\$0) = 0$, show that the preferences exhibited by most people violate how a rational agent should act.   4
(CO1)
(PO1)

b) Does the outcome in Question 4.a prove that humans are irrational? Justify your answer.   4
(CO3)
(PO3)