Birla Institute of Technology & Science, Pilani
Work-Integrated Learning Programmes Division
Second Semester 2018-19
Mid Semester Examination(Regular)

Course No.	: DSECL ZG557
Course Title	: Artificial & Computational Intelligence
Nature of Exam	: Open Book
Weightage	: 40%
Duration	: 2.5 Hours
Date of Exam	: 10 / 11 / 2019, AN

No. of Pages = 3
No. of Questions = 4

Time of Exam: 2:00 PM to 4:30 PM

Note:

1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered only in the page ranges mentioned against each question
3. *Assumptions made if any, should be stated clearly at the beginning of your answer.*

Answer all the questions

Question -1 [2.5 + 2.5 + 2 + 3 =10 M] **[Page 03 - 07]**

(1-a) Show that in uniform cost search as well as A ∗ search, applying goal test as soon as a node is brought into the fringe can potentially lead to a suboptimal solution.
(1-b) Algorithm A* does not terminate until a goal node is selected for expansion. However the path to the goal node might be available in the fringe (frontier data structure) long before its chosen for expansion. Why not terminate the node as soon as a goal node has been found? Explain with an example.
(1-c) Draw two different graphs, indicating the start and goal nodes, for which forward search is better in one and backward search is better in the other.
(1-d) Bidirectional search must be able to determine when the frontiers intersect. Assume the forward search uses Iterative deepening search and the backward search uses depth limited search. How do you find when the frontiers intersect in this case. Detailed solution expected.

Question -2 [3+5 = 8 M] **[Page 08 - 15]**

Consider that you run a bakery store which offers the following products with the product code

Product Code	Product Name	Calorie Kcal
C-1	Choco Nugget	100
C-2	Truffle bite	80
P-1	Crunchy treat	90
J-3	Jelly Belly	50
S-1	Soan Papdi	60
S-2	Chikki	70
S-3	Sandesh	80

You are creating a gift box which needs to meet the following requirements:

Sweet Requirement: Any 2 of the S series product needs to be included
Chocolate Requirement: At least one of the C series products need to be included
Count Requirement: Exactly 4 products in the box
Calorie Requirement: Max calories for the box cannot exceed 280 Kcal
Compatibility Restriction: Jelly Belly cannot be packaged with Truffle bite and Crunchy Treat cannot be packaged with Chikki
a) Model the problem as a CSP and list out the variables, their domains and the constraints.
b) Find the set of goods that fulfill all the requirements using most constrained/constraining variable heuristic to proceed (You can use any algorithm). Indicate which constraints were violated and heuristic choices at each iteration of your algorithm.

Question -3 [2+2+2+2+2 = 10 M] **[Page 16 - 22]**

Consider the following CNF statements S1 and S2. The statements use variables x and z . The constants Nono, West and M1 are used below.

S1: $\neg$Missiles(x) $\vee$ $\neg$Owns(Nono, x) $\vee$ Sells(West, x, Nono)
S2: $\neg$Sells(West, M1, z) $\vee\neg$Hostile(z)

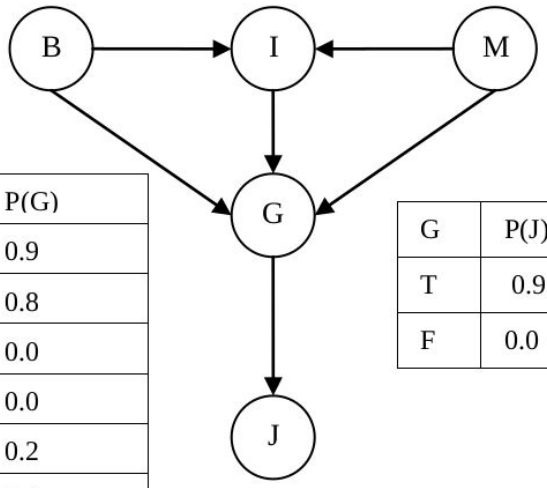
Answer the following questions.
(a) Which of the S1 and S2 are Horn clauses? Which of these are the definite clauses?
(b) What is the resolvent clause if resolution technique is used for the knowledge base S1 Λ S2.
(c) Which unifier is used to get the resolvent clause in (b)?
(d) What will be the values of SUBST(θ , S1) and SUBST(θ , S2) where is the unifier mentioned in (c)?
(e) Design an appropriate data structure to store the sentences for identifying suitable unifiers. Explain the usage of data structure for answering the query Hostile(Nono).

Question -4 [2+2+2+2+2 = 10 M] **[Page 23 - 27]**

(4-a) Consider the following Bayesian network with boolean variables B (Broke Election Law), I (indicted), M(Politically motivated prosecutor), G(Found guilty) and J(Jailed). The Conditional probability tables are associated with the dependent variables and the notations used are same as discussed in the class.

B	M	P(I)
T	T	0.9
T	F	0.5
F	T	0.5
F	F	0.1

P(B) = 0.9



P(M) = 0.1

B	I	M	P(G)
T	T	T	0.9
T	T	F	0.8
T	F	T	0.0
T	F	F	0.0
F	T	T	0.2
F	T	F	0.1
F	F	T	0.0
F	F	F	0.0

G	P(J)
T	0.9
F	0.0

(a) Is the statement "***J is conditionally independent of B, I and M given G***" true? Give reasons.
(b) What is the Markov blanket of the variable I?
(c) Compute the probability that a person is indicted P(I). Write all the necessary expressions and explain the computation process in detail.
(d) Compute the joint probability P(B, ¬M, J). Write all the necessary expressions and explain the computation process in detail.
(e) Compute the conditional probability P(B | J). Write all the necessary expressions and explain the computation process in detail.