SET A

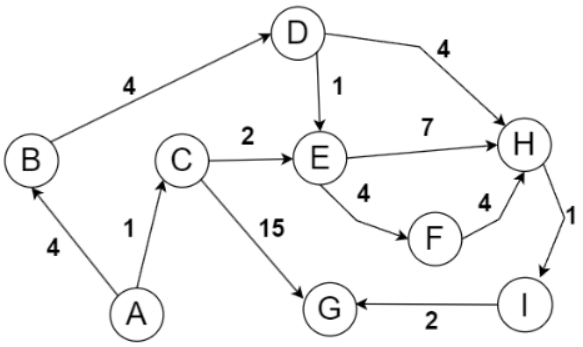
BRAC UNIVERSITY
Department of Computer Science and Engineering

Examination: Semester Final Total Mark: 40
Duration: 1 Hour 30 Minutes

CSE 422: Artificial Intelligence

Answer the following questions.
Figures in the right margin indicate marks.

1. CO1



states,n	$h_1(n)$
A	12
B	9
C	9
D	5
E	7
F	7
H	2
I	1
G	0

a. **Determine** a new heuristic h2(n) which is dominant to the given heuristic and also consistent. 5

b. **Perform** A* search on the $h_1(n)$ heuristic considering A as the start node alongside G as the goal node and comment if the optimal path is returned. Push Nodes alphabetically and in case of a tie during expansion, use FIFO approach. 3

c. **Comment** on the consistency of F and A for $h_1(n)$ 2

2. CO4

Student ID	Prior experience	Course Name	Course Time	Liked or Not
1	Yes	Mathematics	Night	No
2	Yes	Programming	Day	Yes
3	No	Machine Learning	Night	Yes
4	Yes	Machine Learning	Day	Yes
5	Yes	Mathematics	Day	Yes
6	Yes	Programming	Night	No
7	No	Programming	Night	No
8	No	Programming	Day	Yes
9	No	Mathematics	Night	No
10	Yes	Machine Learning	Night	Yes

a. If an event X has n possible outcomes each with probabilities p_1, p_2,...., p_n, then the entropy of X is defined as $H(X) = -p_1\log_2(p_1) -p_2\log_2(p_2)$ ..... $-p_n\log_2(p_n)$. If n = 8, what is the maximum possible value for H(X)? When does it happen? **Explain**. 2

b. **Build** a decision tree from the given information by ignoring the student ID column. The decision column is the column named "liked". Construct the root node only and 5

determine if any of the immediate children end up as a leaf node.

c. Considering a student has taken mathematics as a course, **calculate** the information gain of Course time. 3

3. CO3 a. Consider two medical tests, A and B, for a virus. Test A is 95% effective at recognizing the virus when it is present, but has a 10% false positive rate (indicating that the virus is present, when it is not). Test B is 90% effective at recognizing the virus, but has a 5% false positive rate. The two tests use independent methods of identifying the virus. The virus is carried by 1% of all people. Say that a person is tested for the virus using only one of the tests, and that test comes back positive for carrying the virus. Which test returning positive is more indicative of someone really carrying the virus? **Justify** your answer mathematically. 10

4.CO2 Suppose you have four variables A, B, C, and D. Now B, C, and D take in values ranging from 1 to 5, but A can only be assigned a value from 1 to 4. In addition, whatever values they are assigned, $A \neq B$, $A \neq C$, $B \neq C/2$, $B \neq 1$, D cannot be a multiple of B. Now you have to treat this problem as a constraint satisfaction problem and finalize a solution that satisfies the above-given scenario. 8

i. **Generate** the constraint graph for this CSP

ii. **Formulate** all the unary and binary constraints.

iii. **Solve** the problem by employing backtracking along with forward checking. In addition, you have to use heuristics (Variable and value ordering) wherever required to select which variable to work with, and what value to assign it.

a. Assume two variables X and Y. They can be assigned any value from 0 to 9. But, X has to be greater than Y. What would it mean for X to be arc-consistent with Y? And **propose** a solution such that X becomes arc-consistent with respect to Y. 2