Spring 2022

Artificial Intelligence – A12002

Assignment – 3

Total Points = 100

Question 1 : (15 marks)

Suppose we have a binary constraint network having 4 variables: A1, A2, A3, A4, having domains:

D1 = {1, 2, 3, 4} and D2 = {3, 4, 5, 8, 9} and D3 = {2, 3, 5, 6, 7, 9} and D4 = {3, 5, 7, 8, 9}

The constraints for this problem are: **A1 ≥ A2, A2 > A3 or A3 − A2 = 2** and **A3 un-equal to A4**.

(a) You need to draw the constraint graph. Also write constraints in relational form.
(b) Do you think that this network is arc-consistent ? If it is not, then calculate arc-consistent network.

Question 2 : (30 marks)

You need to create menu for an event. So there are many choices, choices are represented as variable: (A)ppetizer, (B)everage, main (C)ourse, and (D)essert.

Domains are as follows:

A: (v)eggies, (e)scargot

B: (w)ater, (s)oda, (m)ilk

C: (f)ish, (b)eef, (p)asta

D: (a)pple pie, (i)ce cream, (ch)eese

As your guests will be having the same menu, so following dietary constraints should be met:

(i) Vegetarian options: appetizer must be veggies or main course must be pasta or fish (or both).
(ii) Total budget: If you serve the escargot, you cannot afford any beverage other than water.
(iii) Calcium requirement: You must serve at least one of milk, ice cream, or cheese.

Now answer the following questions

(a) Draw constraint graph over the variables A, B, C, and D
(b) Suppose we first assign A=e. Then Cross out eliminated values in order to show the domains of the variables after forward checking.
(c) Now Again imagine that we first assign A=e. Then Cross out eliminated values in order to show the domains of the variables after arc consistency has been enforced.
(d) Give solution for this Constraint satisfiability problem or state that none exists.

(e) For general Constraint satisfiability problems, will enforcing arc consistency after an assignment always prune at least as many domain values as forward checking? Briefly explain why or why not.

Question 3 : (15 marks)

Every letter in this crypt-arithmetic puzzle represents a different digit (0-9), and none of the numbers use leading zeros. Find digits for given problems. Show some working/reasoning as well.

```
  TEN
  TEN
+ FORTY
 SIXTY
```

```
  FORTY
  FIFTY
   ZERO
+  ZERO
 NINETY
```

```
    AB
 ×   C
 AAA
```

Question 4 : (10 marks)

Below table shows number of bikes from different vendors classified by type and color. If a bike is randomly selected, what is the probability of :

a) It is blue given that it is a Suzuki
b) It is a Honda given that it is black

	Honda	Yamaha	Suzuki	SuperStar	Total
Black	35	10	25	15	85
White	10	15	20	5	50
Blue	15	15	5	30	65
Total	60	40	50	50	200

Question 5: (10 marks)

80% employees of xyz company are satisfactory (S) and 20% are unsatisfactory (S'). Records show that 75% of the satisfactory workers had previous work experience (E) in the job they are now doing, while 30% of the unsatisfactory workers had no work experience (E') in the job they are now doing. If one person having no previous work experience is hired, what's approximate empirical probability of this person to be a satisfactory employee?

Question 6: (10 marks)

Two students are caught breaking the Discipline rules and now they are called by the DC Committee. Each student is in solitary confinement with no means of communicating with the other. The Committee lack sufficient evidence to convict the pair on the principal charge. They hope to get both sentenced a semester freeze for 1 year as penalty on a lesser charge. Simultaneously, the committee offer each student a bargain. Each student is given the opportunity either to betray the other by testifying that the other broke the rule, or to cooperate with the other by remaining silent. The offer is:

a) If A and B each betray the other, each of them serves 2 years' semester freeze penalty
b) If A betrays B but B remains silent, A will be set free and B will serve 3-years penalty (and vice versa)
c) If A and B both remain silent, both will only serve 1-year semester freeze penalty (on the lesser charge)

Now choose the best strategy for Student A using Min-Max concept and provide reasoning for your choice. Define properly how you generated utility values based on which the result/ strategy has been figured.

Question 7: (10 marks)

A game is played between max and min. Draw a tree considering MIN as a first player and branching factor is 2. Given terminal values below, show backed up values, best decision available at the root and branches that will get pruned (explain why they are getting pruned if any)?

2, 7, 1, 4, 5, 4, 13, 1, -14, -10, -25, -31, 7, 8, 9, 20