CSE140: Introduction to Intelligent Systems
Midsem -22

Name: Roll No:

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1. Know your country!
   (a) Name the national game of INDIA ? **(None)**
   (b) Name the current Vice President of INDIA ? **(Shri Venkaiah Naidu)**
   (c) How many languages appear on a RBI issued bank note? **(17=15+2[Hindi,English])** 3 Points

2. Know your college/instructor!
   (a) Name the current registrar of IIITD ? **(Dr. Ashok K. Solanki)**
   (b) What is your IIS instructor's office number (not telephone!) ? 2 Points

3. Which among these is/are valid formulas
   (a) $(\neg p \leftrightarrow r \vee s)$ **NV**
   (b) $\neg((p \vee q) \wedge p)$ **V**
   (c) $(p \leftrightarrow \neg(r \vee s))$ **V**
   (d) $((((p \rightarrow q) \rightarrow \neg r) \leftrightarrow s) \vee (t \wedge u))$ **V** 2 Points

4. Let p = It is raining;
   Let q = Mary is sick;
   Express the following statements using propositional logic
   (a) It is not the case that Mary isn't sick $\neg\neg q$
   (b) It is raining and Mary is sick $p \wedge q$
   (c) It is not the case that both it is raining and Mary is sick
   (d) Mary is sick and it is not the case that it is raining $\neg p \wedge q$
   (e) It is not the case that if it is raining then Marry isn't sick $\neg(p \rightarrow \neg q)$ 5 Points

5. Express in terms of FOPL
   (a) All birds fly.
   (b) Every man respects his parent.
   (c) Some boys play cricket.
   (d) Not all students like both Mathematics and Science.
   (e) For every car, there is a driver who, if (s)he can start it, then (s)he can stop it. 4 + 2 Points

6. Which ones are declarative or non-declarative statements

   (a) That was a good movie. **ND**

   (b) He wanted to go to the grocery store, but she wanted to go to the bar. **CD: compound declarative**

   (c) Harrison loves to play outside, yet he hates the rain. **CD** 3 Points

7. Which of these statements are true

   (a) P and Q are logically equivalent if and only if $P \leftrightarrow Q$ is a tautology **True**

   (b) $[(p \wedge q) \rightarrow r] \rightarrow [\neg r \rightarrow (\neg p \vee \neg q)]$ is a tautology. **True**

   (c) $\neg(P \rightarrow Q) \equiv (P \wedge \neg Q)$ **True** 3 Points

8. Truth value (True/False)

   (a) Find C given the premises $\neg A \rightarrow (C \wedge D); A \rightarrow B; \neg B$ **True**

   (b) Find B given the premises $\neg(A \vee B) \rightarrow C; \neg A; \neg C$ **True**

   (c) Find $\neg D$ given the premises $(A \wedge B); A \rightarrow \neg(B \wedge C); D \rightarrow C$ **True** 3 Points

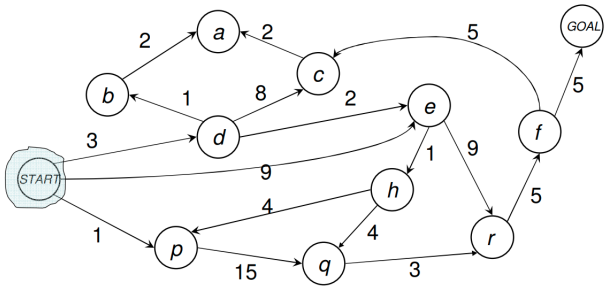
9. Which the expressions are equivalent or not-equivalent

   (a) $\forall_x(P(x) \vee Q(x)) \quad ? \quad \forall_x P(x) \vee \forall_x Q(x)$ **NE**

   (b) $\neg\forall_x(P(x) \rightarrow A) \quad ? \quad \exists_x(P(x) \wedge \neg A)$ **E**

   (c) $\neg\exists_x(P(x) \wedge A) \quad ? \quad \forall_x(P(x) \rightarrow \neg A)$, **E** 3 Points

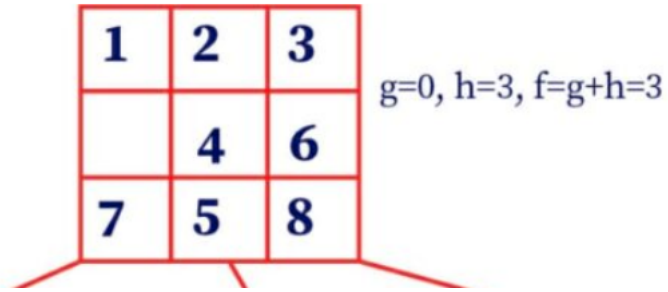
10. Write the order in which the nodes of the graph will be evaluated using BFS, DFS and UCS algorithms. You can also use the appropriate data structure and show its state at each step. For USC also write the total path cost.



1 + 1 + 2 points

UCS: S-D-E-H-Q-R-F-G cost-23

11. Recall the 8-square puzzle from Lecture 11. Complete the tree below for possible states and find the optimal path (if exists) using A* search given the initial state.
f-total cost; g-depth of node; h-heuristic cost: estimated distance from the current node to the goal node (Manhattan distance)



4 Points

12. Compare BFS and HC search in terms of: Space complexity, Time complexity, Completeness and Optimality of solution. 2 Points

13. Bonus: Let the expression you obtained in 5(e) is E. Using resolution and equivalences negate the expression i.e., find ¬E. Now express the obtained expression in English. 4 + 2 Points
Note: Wrong answer to this question will fetch -ive marks!
. *Correct answer will fetch bonus marks for Quiz 1 as well.*

$\exists_x(Car(x) \wedge \forall_y(Driver(y) \rightarrow (Start(x,y) \wedge \neg Stop(x,y))))$

There is a car such that every driver can start it and cannot stop it

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Ans 5:

1. All birds fly. In this question the predicate is "fly(bird)." And since there are all birds who fly so it will be represented as follows.
$\forall_x\ bird(x) \rightarrow fly(x)$.
2. Every man respects his parent. In this question, the predicate is "respect(x, y)," where x=man, and y= parent. Since there is every man so will use ∀, and it will be represented as follows:
$\forall_x\ man(x) \rightarrow respects(x, parent)$.
3. Some boys play cricket. In this question, the predicate is "play(x, y)," where x= boys, and y= game. Since there are some boys so we will use ∃, and it will be represented as:
$\exists_x\ boys(x) \rightarrow play(x, cricket)$.
4. Not all students like both Mathematics and Science. In this question, the predicate is "like(x, y)," where x= student, and y= subject. Since there are not all students, so we will use ∀ with negation, so following representation for this:
$\neg\forall_x[student(x) \rightarrow like(x, Mathematics) \wedge like(x, Science)]$.
5. $\forall_x(Car(x) \rightarrow \exists_y(Driver(y) \wedge (Start(x,y) \rightarrow Stop(x,y))))$.

Ans 11: