

End Semester Examination
Monsoon Semester 2020
(Pre Ph.D Computer Science)
Artificial Intelligence

Time: 2 hrs

Max Marks: 40

Note: All the questions are compulsory. Write the answers neatly on white sheets or note book pages. Mention your name and roll number on each page. Click the photo of all the pages and create a single pdf file and upload on the google classroom.

Question 1 (a): “If the unicorn is mythical, then it is immortal, but if it is not mythical, then it is a mortal mammal. If the unicorn is either immortal or a mammal, then it is horned. The unicorn is magical if it is horned”. Given this, can you prove that unicorn is mythical? How about that unicorn is magical?

(b) A valid sentence is the one which is true in all the models. What can you say about the validity and satisfiability of the following sentences?

(i) Smoke \rightarrow Smoke

(ii) Smoke \rightarrow Fire

(iii) (Smoke \rightarrow Fire) \rightarrow (\neg Smoke \rightarrow \neg Fire)

(iv) Smoke \vee Fire \vee \neg Fire

(v) (Smoke \rightarrow Fire) \rightarrow ((Smoke \wedge Heat) \rightarrow Fire)

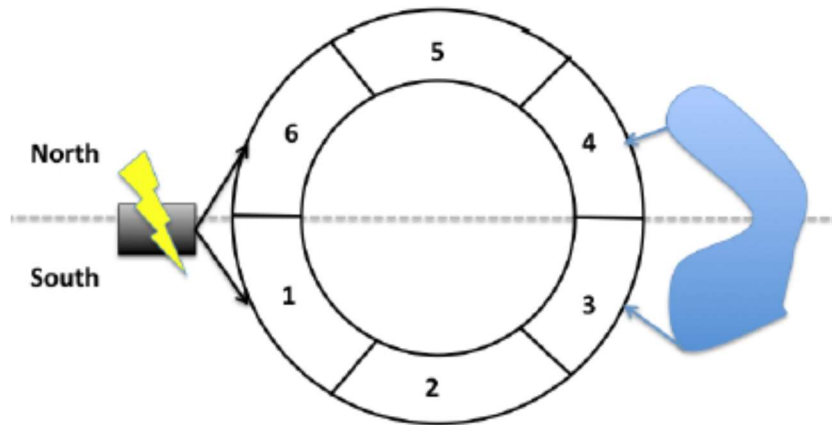
(c) Prove using resolution that

$(A \vee B) \wedge (\neg A \vee C) \wedge (\neg B \vee D) \wedge (\neg C \vee G) \wedge (\neg D \vee G)$

entails G.

[3+5+2=10 Marks]

Question 2: Apple's new circular campus is nearing completion. Unfortunately, the chief architect on the project was using Google Maps to store the location of each individual department, and after upgrading to iOS 6, all the plans for the new campus were lost. The following is an approximate map of the campus:



The campus has six offices, labelled 1 through 6, and six departments viz. Legal (L), Maps Team (M), Prototyping (P), Engineering (E), Tim Cook's office (T) and Secret Storage (S). The following are the constraints:

- (i) Legal wants a view of the lake to look for prior art examples.
- (ii) Tim Cook's office must not be across from Maps.
- (iii) Prototyping must have an electrical connection.
- (iv) Secret Storage must be next to Engineering.
- (v) Engineering must be across from Tim Cook's office.
- (vi) Prototyping and Legal cannot be next to one another.
- (vii) Prototyping and Engineering must be on opposite sides of the campus (if one is on the North side, the other must be on the South side).
- (viii) No two departments may occupy the same office.

(a) Find Unary constraints.

(b) How many edges are there in the constraint graph?

(c) Cross out all values that are eliminated by running Forward Checking after this assignment.

L			3	4		
M	1	2	3	4	5	6
P	1					
E	1	2	3	4	5	6
T	1	2	3	4	5	6
S	1	2	3	4	5	6

(d) Cross out the values after running Arc consistency on this assignment.

L			3	4		
M	1	2	3	4	5	6
P	1					
E	1	2	3	4	5	6
T			3			
S	1	2	3	4	5	6

[2+2+3+3=10 Marks]

Question 3: Consider a state space where start state is number 1 and each state k has two successors: number $2k$ and $2k+1$.

- Suppose goal state is 11. List the order in which nodes will be visited for breadth first search, depth limited search with limit 3 and iterative deepening search.
- Can bidirectional search be used to solve this problem? What will be the branching factor in each direction of the bidirectional search?

[6+4=10 Marks]

Question 4: (a) Explain problem decomposition and AND-OR graph in this context.

(b) What is Markov Decision Process (MDP)? Explain their relevance in connection with reinforcement learning.

[5+5=10 Marks]