# CS 323: AI, QUIZ #3 (with solutions). Time 15 mts. DT. 20/02/2016, Maximum Marks = 14.5.

1. Given the following knowledge base for prolog, find a female descendant of 'george', by manually running the program in steps (if $X$ is descendant of $Y$ then $Y$ is ancestor of $X$). Lower case arguments are literals and uppercase are variables. [5]

```
parent(george,sam).
parent(george,andy).
parent(andy,mary).
male(george).
male(sam).
male(andy).
female(mary).
ancestor(X,Y) :- parent(X, Y).
ancestor(X,Z) :- parent(X,Y), ancestor(Y,Z).
```

**Ans:** The query / goal is: `ancestor(george,X),female(X)`. The only those rules have been shown which succeed (to limit the space on paper):

ancestor(george, X), female(X) → parent(george, Y), [ancestor(Y, mary)], female(mary) → parent(george, andy), [ancestor(andy, mary)], female(mary) → parent(george, andy), [parent(andy, mary)], female(mary)

So the female descendant is "mary". Note that, this application of rules can be also represented by a tree structure.

2. Select the correct answer in the following (For correct Ans: 1.5 pt, wrong -0.5)

   (a) The prolog language is:
   (A) Sound (B) Complete
   (C) Sound and Complete (D) Optimal

   **Ans: (A)**, Justification: Prolog uses depth-first search, where what ever solution it find, will be correct (sound), but there is not guarantee of finding the solution if it goes in infinite loops (hence not complete).

   (b) Which of the following is "optimal" search?
   (A) DFS (B) BFS
   (C) Both (D) None

   **Ans: (B)**. Optimal means least cost. It is BFS, since it searches all nearer nodes before searching farther nodes, so it will be optimal.

   (c) What is the correct order of memory requirements (maximum to minimum) in the state space searches?
   (A) DFS, BFS, DFID (B) BFS, DFID, DFS
   (C) BFS, DFS, DFID (D) DFID, BFS, DFS

   **Ans: (C)**. The maximum memory is required for BFS. Then DFS v/s DFID, the DFID may quickly locate the shallow goals, so average case is better than DFS.

3. Figure 1 shows a search tree with states $A$ to $O$ along with estimated distance from that state to the goal. The state with distance zero is goal itself. Make use of *DFS*, and show the steps along with the elements of Stack data structure as well the distance from goal, for each step. The algorithm terminates as soon as a goal is found. [5]

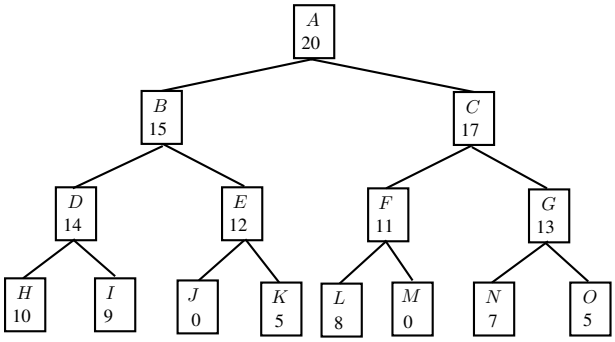


Figure 1: State - space tree.

**Ans:** The contents of stack will change progressively as per the following steps.

[Top of stack ——— Bottom of stack]

[(A, 20)]

[(B, 15), (C, 17)]

[(D, 14), (E, 12), (C, 17)]

[(H, 10), (I, 9), (E, 12), (C, 17)]

[(I, 9), (E, 12), (C, 17)]

[(E, 12), (C, 17)]

[**(J, 0)**, (K, 5), (C, 17)]; terminates at **(J, 0)** being the goal.