Indian Institute of Engineering Science & Technology, Shibpur
Department of Computer Science & Technology
Artificial Intelligence Laboratory

PROLOG ASSIGNMENTS - 2

1. Write a Prolog program to determine whether a list is a sublist of another list.

2. Write Prolog programs to implement :
   a) Set membership
   b) Set Union
   c) Set Intersection
   d) Set Difference
   e) Symmetric Difference

   where 2 sets are represented in the form of a list.

3. Define a predicate to "flatten" a list by constructing a list containing no lists as elements, but containing all of the atoms of the original list. For example, consider the following goal and its corresponding answer.
   E.g : ?- flatten ([a, [b, c], [[d], [ ], e]], L).
   Output : {L= [a, b, c, d, e]}

4. Let L denote a list of integers.
   a) Write a Prolog program **sum (L, S)** that defines S to be the sum of all elements in L.
   b) Write a Prolog program **mean (L, X)** that defines X to be the mean value of elements in L, by referring to the already developed procedure **sum** and **length**.
   c) Write a Prolog program that performs the same task as the one in part (b) without explicitly referring to **sum** and **length**.

5. Let L1, L2 and L denote lists of terms. Write Prolog programs to realize the following :
   a) Interleave alternate elements of L1 and L2 into L. For example, if L1= [a, b, c] and L2= [1, 2], then L= [a, 1, b, 2, c].
   b) Transpose L1, L2 into L. That is, if L1= [a, b, c] and L2= [1, 2, 3], then L= [(a, 1), (b, 2), (c, 3)].
   c) Suppose that L1 and L2 are lists of numeric values. Write a prolog programs to determine the Inner_product (L1, L2, X) that defines X to be inner product of two vectors L1, L2.

6. The tower of Hanoi is a game played with three poles and a set of discs. The discs are graded in diameter, and fit onto the poles by means of a hole cut through the center of each disc. Initially all the discs are on the left-hand pole. The object of the game is to move all the discs onto the center pole. The right-hand pole can be used as a "spare" pole, a temporary resting place for discs. Each time a disc is moved from one pole to another, two constraints must be observed: only the top disc on a pole can be moved, and no disc may be placed on top of a smaller one. Write a Prolog program to implement the tower of Hanoi problem as stated above, i. e., given N, no of discs on the left pole, generate the moves that will ultimately transfer all N discs to the

center pole.

7. One way of representing the positive whole numbers is a Prolog terms involving the integer 0 and the successor functor s with one argument. Thus, we represent0 by itself, 1 by s(0), 2 by s(s(0)) and so on. Write definitions of standard arithmetic operations addition, multiplication and subtraction, given the above representation of numbers. For example, the predicate plus may be defined to exhibit the following behavior.
   E.g : ?- plus(s(s(0)), s(s(s(0))), X).
   Output : { X= s(s(s(s(s(0)))))}
   that is, 2+3 = 5. Also define the predicate “less than”. Also define arithmetic operations, like integer division, remainder of integer division, absolute value and square root.

8. Write PROLOG programs for:
   a) Merge Sort.
   b) Selection Sort.
   c) Bubble Sort.
   d) Insertion Sort.
   e) Permutation Sort.

9. Write PROLOG programs to :
   a) Determine whether an element is a member of a :
      1. Binary Tree.
      2. Binary Search Tree.
   b) Determine whether a tree is a :
      1. Binary Tree.
      2. Binary Search Tree.
   c) Determine minimum and maximum elements of a BST.
   d) Height of a Binary Tree.
   e) Insert an element in a Binary Search Tree.
   f) Delete a leaf node from a BST.
   g) Delete a node (any node) from a BST.

10. Write Prolog programs to implement preorder, inorder and postorder traversals of a binary tree.

11. Write Prolog programs for :
   a) Sort an unordered list into an ordered list using Tree Sort.
   b) Sort an unordered list into an ordered list by inserting the elements of the unordered list into a BST and then successively deleting minimum elements of BST and storing them in a list.