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TE Comps Batch – C
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Experiment-6

Aim: To solve problems using Prolog Programming and solve the given 5 tasks that are list operations and Huffman coding.

Problem statements:

1) Create a family tree using PROLOG. It should have rules for father, mother, brother, sister, grandparent, uncle, aunt, predecessors, successors.

   Code:

```
parent(kamla,padmesh).
parent(chandru,padmesh).
parent(chandru,manoj).
parent(kamla,manoj).
parent(harsha, pranav).
parent(padmesh, pranav).
parent(shobha, rahul).
parent(murli, rahul).
parent(narayan, harsha).
parent(lakshmi, harsha).
parent(lakshmi, shobha).
parent(narayan, shobha).
parent(shobha, nikhil).
parent(murli, nikhil).
parent(harsha, shruti).
parent(padmesh, shruti).
female(kamla).
female(harsha).
female(shruti).
female(shobha).
female(lakshmi).
male(murli).
male(manoj).
male(padmesh).
male(nikhil).
male(pranav).
male(rahul).
male(narayan).
male(chandru).

%rules
predecessor(X, Y) :- parent(X, Y).
predecessor(X, Y) :- parent(X, A),predecessor(A, Y).
```

successor(X, Y):- son(X,Y).
successor(X, Y):- daughter(X, Y).
successor(X, Y):- son(X, A), successor(A, Y).
successor(X, Y):- daughter(X, A), successor(A, Y).

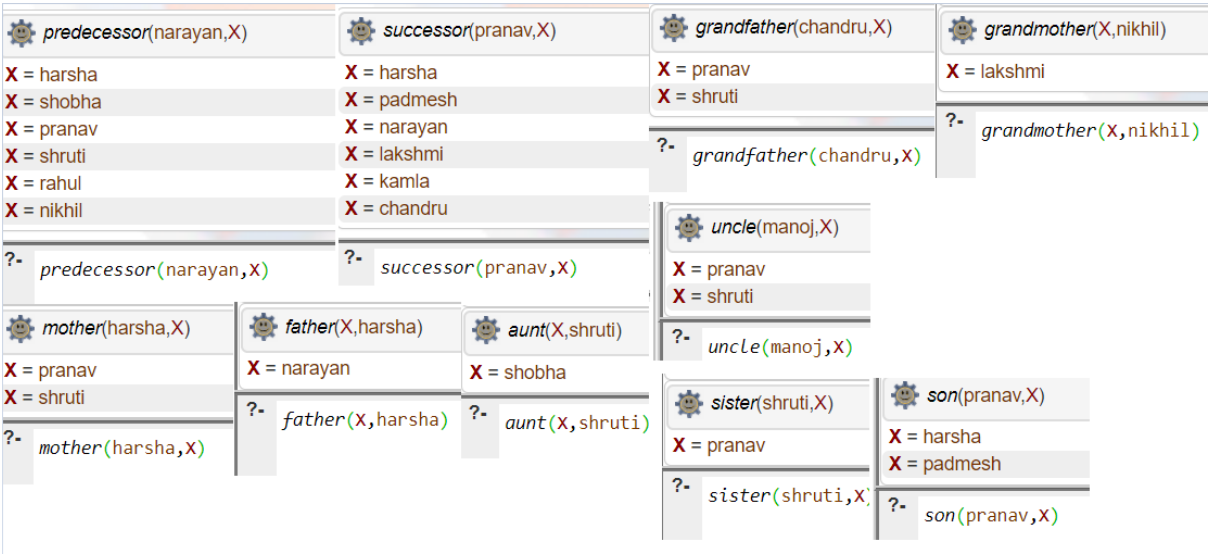
grandfather(X, Y):- parent(X, A), parent(A, Y), male(X).
grandmother(X, Y):- parent(X, A), parent(A, Y), female(X).

mother(X, Y):- parent(X, Y), female(X).
father(X, Y):- parent(X, Y), male(X).

aunt(X, Y):- sister(X, Z), parent(Z, Y).
uncle(X, Y):- brother(X, Z), parent(Z, Y).

sister(X, Y):- parent(A, X), parent(A, Y), female(X), X \= Y.
brother(X, Y):- parent(A, X), parent(A, Y), male(X), X \= Y.

son(X, Y):- parent(Y, X), male(X).
daughter(X, Y):- parent(Y, X), female(X).



2) Given a list [a,a,a,a,b,b,b,c,c] write a function that does the following
rle([a,a,a,a,b,b,c,c],X) X: [a,b,c]

Code:

```
%stopping condition
remove_duplicates([X],[X]).

%if next element is same
remove_duplicates([H, H|T],X) :-
   remove_duplicates([H|T],X).

%if next element not same
remove_duplicates([H, P|T],[H|Y]) :-
   H\=P,
```

remove_duplicates([P|T],Y).

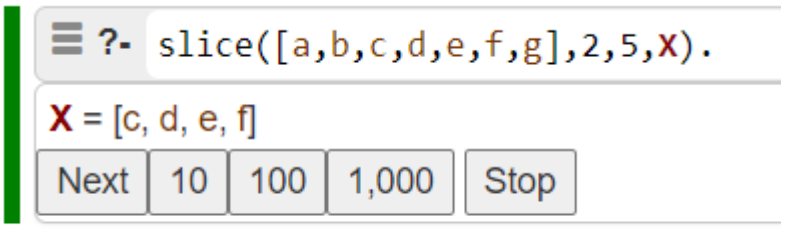
3) Given a list [a,b,c,d,e,f,g] write a function that does the following slice([a,b,c,d,e,f,g],2,5,X) X: [c,d,e,f]

Code:

```
% puts last value of slice in output list
slice([X|_], 0, 0, [X]).

% called until last slice index is reached
slice([X|T], 0, L, [X|T_new]) :- L >0, L_new is L - 1, slice(T, 0, L_new, T_new).

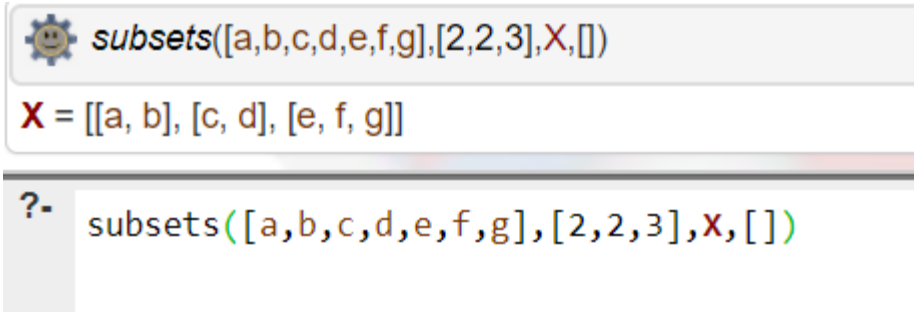
% called until initial slice index is reached
slice([_|T], F, L, Output) :- F > 0, F_new is F - 1, L_new is L - 1, slice(T, F_new, L_new,
Output).
```



4) Group list into sublists according to the distribution given For example subsets([a,b,c,d,e,f,g],[2,2,3],X,[]) should return X = [[a,b][c,d][e,f,g]] The order of the list does not matter

Code:

```
el(X,[X|L],L).
el(X,[_|L],R) :-
   el(X,L,R).
selectN(0,_,[]) :- !.
selectN(N,L,[X|S]) :-
   N > 0,
   el(X,L,R),
   N1 is N-1,
   selectN(N1,R,S).
subsets([],[],[],[]).
subsets(G,[N1|Ns],[G1|Gs],[]) :-
   selectN(N1,G,G1),
   subtract(G,G1,R),
    subsets(R,Ns,Gs,[]).
```



5) Huffman Code We suppose a set of symbols with their frequencies, given as a list of fr(S,F) terms. Example: [fr(a,45),fr(b,13),fr(c,12),fr(d,16),fr(e,9),fr(f,5)].
Our objective is to construct a list hc(S,C) terms, where C is the Huffman code word for the symbol S. In our example, the result could be Hs =[hc(a,'0'), hc(b,'101'), hc(c,'100'), hc(d,'111'), hc(e,'1101'), hc(f,'1100')].
The task shall be performed by the predicate huffman/2 defined as follows: % huffman(Fs,Hs) :- Hs is the Huffman code table for the frequency table Fs

Code:

```
huffman(Fs,Cs) :-
   initialize(Fs,Ns),
   make_tree(Ns,T),
   traverse_tree(T,Cs).

initialize(Fs,Ns) :- init(Fs,NsU), sort(NsU,Ns).

init([],[]).
init([fr(S,F)|Fs],[n(F,S)|Ns]) :- init(Fs,Ns).

make_tree([T],T).
make_tree([n(F1,X1),n(F2,X2)|Ns],T) :-
   F is F1+F2,
   insert(n(F,s(n(F1,X1),n(F2,X2))),Ns,NsR),
   make_tree(NsR,T).

insert(N,[],[N]) :- !.
insert(n(F,X),[n(F0,Y)|Ns],[n(F,X),n(F0,Y)|Ns]) :- F < F0, !.
insert(n(F,X),[n(F0,Y)|Ns],[n(F0,Y)|Ns1]) :- F >= F0, insert(n(F,X),Ns,Ns1).

traverse_tree(T,Cs) :-
    traverse_tree(T,'',Cs1-[]), sort(Cs1,Cs),
    write(Cs).

traverse_tree(n(_,A),Code,[hc(A,Code)|Cs]-Cs) :-
    atom(A).

traverse_tree(n(_,s(Left,Right)),Code,Cs1-Cs3) :-
   atom_concat(Code,'0',CodeLeft),
   atom_concat(Code,'1',CodeRight),
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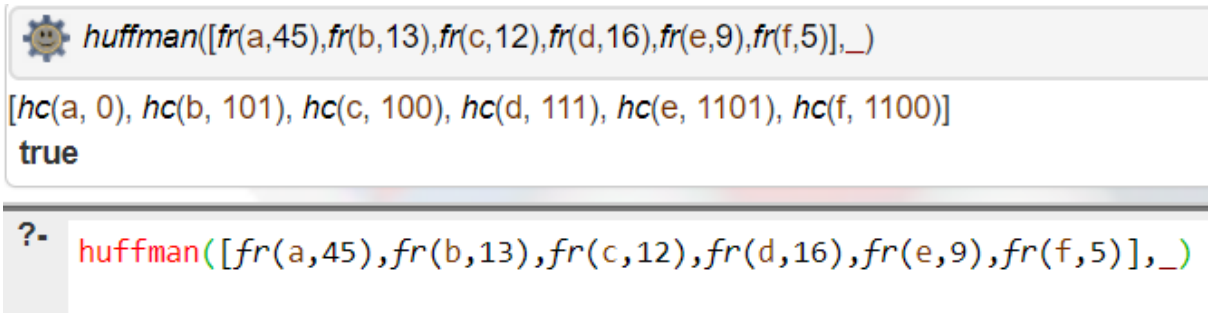
traverse_tree(Left,CodeLeft,Cs1-Cs2),
traverse_tree(Right,CodeRight,Cs2-Cs3).



Conclusion:

In this experiment, the aim was to learn prolog programming and to perform the 5 tasks thar were list operations like removing duplicates, slicing, subsets, huffman coding and also creating family tree and answering few queries. Huffman coding is a lossless data compression algorithm. The idea is to assign variable-length codes to input characters, lengths of the assigned codes are based on the frequencies of corresponding characters. The most frequent character gets the smallest code and the least frequent character gets the largest code. Basically the three basic contructs of Prolog are rules,facts and queries. The Prolog programs are basically knowledge bases, consisting of rules, facts and queries are asked to which the answer is seeked from this knowledge base and a boolean value is sent. The reason why Prolog is used in AI is because the language allows for easy management of recursive methods, and pattern matching.

GitHub: https://github.com/pranav567/AI-ML-Lab/tree/master/experiment-6