reverse([H|T], R) :- reverse(T, Y),
                    concat(Y, [H], R).

subse([], _).
subse(Xs, [_|Ys]) :- subse(Xs, Ys).
subse([X|Xs], [X|Ys]) :- subse(Xs, Ys).

concat([], L2, L2).
concat([H|T], L2, [H|L3])
                (T, L2, L3)
                ([], L2, L2)

double :

```
double([],[]).
double([H|T], [H|[H|T]]) :- double(
double([H|T], [H|[H|T]]) :- double(
double([H|T1], [H|[H|T2]]) :- double(T1,T2).
```

[1,2] . [1, 2, 3, 4]

||

$$[1|[2,3,4]] , [1|[1|[2,3,4]]]$$

T1 . T2

element at :

```
element_at( H, [H|_], 1).

element_of( X, [_|T], N) :- element_of(X,T,N1),
                                        N is N1+1.
```

Reverse

```
reverse([],[]).

reverse([H|T], R) :- reverse(T,Y),
                      concat(Y,[H], R
```

Membership

#
member(H, [H|_]).
member(X, [_|T]) :- member(X, T).

concat.

concat([], L2, L2).   (% base case)

concat([H|T], L2, [H|L3]) :- concat(T, L2, L3).

deletes.
deletes(H, [H|T], T).
deletes(X, [_|T], L3) :- deletes(X, T,
deletes(X, [Y|T], [Y|L1]) :- deletes(X, T, L1)

length:

len([], 0).
len([_|T], N) :- len(T, N1), N is N1+1.

sum:
sum([], 0).
sum([H|T], N) :- sum(T, N1), N is N1+H

add:

1, 2, 2

$\begin{vmatrix} 5, 2, 7 \\ 4, 2, 6 \\ 3, 2, 5 \end{vmatrix}$

add(0, X, X) :- isnumber(X)

add (s(X), Y, s(R)) :- add (X, Y, R).

$\dfrac{5, 3, 6}{8, 3, 5}$

sub:

sub (X, X, 0) :- isnumber(x)

sub (s(X), Y), s(R) :- sub(X, Y, R).

times:

times (0, X, 0) :- isnumber(x).

times (s(X), Y, R) :- times(X, Y, Z), add(Z, Y, R).

Pure Mathematics

\#

    isnumber(0).
    isnumber(s(x)) :- isnumber(x).

\#

    isequal(x,x) :- isnumber(x).
    isequal(s(x), s(y)) :- isequal(x,y).

\# le

    le(0,x) :- isnumber(x).
    le(s(x), s(y)) :- le(x,y).

\#

    ge(x,0) :- isnumber(x).
    ge(s(x), s(y)) :- ge(x,y).

\#

    iseven(0).
    iseven(s(s(x))) :- iseven(x) ; isnumber(x).

~~\# isodd(0)~~
\# isodd(s(0)).

    isodd(s(s(x))) :- isodd(x).

Prolog
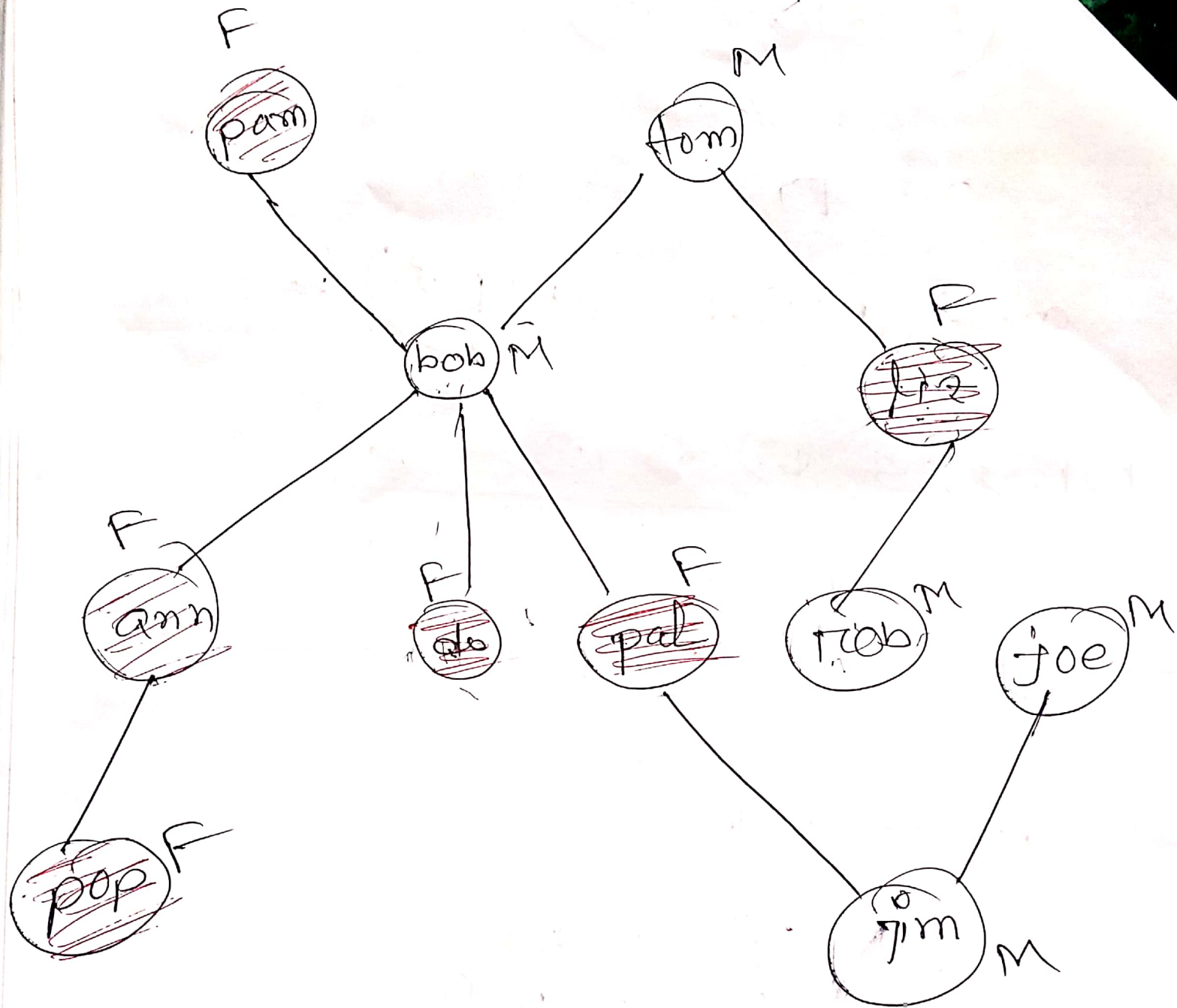
$$\Big([1, 2], [3, 4] \Big)$$

$$\text{'', } [1,$$

$$\text{concat} \Big([H \cdot 1T], L2, [H]1[3] \Big) : -$$

$$1, 2, 3, 5, 8, 13, 21,$$
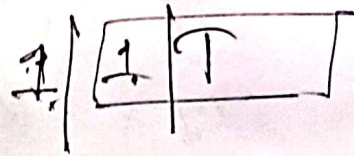
delete((2, [0, 2, 3]

1 2
↓ ↓
H T

7 | 1 | T

(2, [2, 3, 4])

time(2, 3, 6)

2×3,

S(X)

→ 6

add(3, 4, R)

.42 → 43

.49

R → (x, y, z)

6 7 42

S(X)

4, 7,

X

(. 49, 4 ; 8)

S.

0, X.X

add(

S(S(O))),

(. 2, 2 , 4)

S(X)   y

2 2 4

S(X) y S(z)

0, 2, 2

2 2 4

1 2 3

S(X) , y S(z)
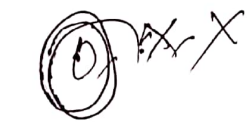
① member(x, [x|_]).
② member(X, [_|T]) :- member(X, T).

[1, 2, 3, 4]
w [3]

0th [1, 2, 3, 4]	1th [2, 3, 4]	2th [3, 4]
① Head = 1 Tail = 2, 3, 4 3 = 1? X ② whatever return next recursive	① Head = 2 Tail = 3, 4 3 = 2? (X) ② return next recursive	① Head = 3 Tail = 4 3 = 3? w return true

True

True

true

True

[1, 2, 3, 4]

① size([ ], 0)
② size([_|T], N) :- size(T, N1), N is N1+1

0th [1, 2, 3, 4]	1th [2, 3, 4]	2th [3, 4]	3th [4]	4th [ ]
① H = 1 T = 2, 3, 4 N = (N1)+1	② H = 2 T = 3, 4 N = (N1)+1	② H = 3 T = 4 N = (N1)+1	② H = 4 T = [ ] N = (N1)+1	① return

N = 3+1
 = 4

N = 2+1
 = 3

N = 1+1
 = 2

N = 0+1
 = 1

0

points

(1) member(x, [X|_]).
(2) member(x, [_|T]) :- member(X, T).

[1, 2, 3, 4]

w [3]

0th [1, 2, 3, 4] 1th [2, 3, 4] 2th [3, 4]

(1) Head = 1   (1) Head = 2   (1) Head = 3
                                             Tail = 4
Tail = 2, 3, 4   Tail = 3, 4   3 = 3? w
                      3 = 2? (X)
3 = 1? X   return true
                      (2) return
(2) whatever return   next recursive
next recursive

                                             True
                      true

True

[1, 2, 3, 4]

(1) size([], 0)
(2) size([_|T], N) :- size(T, N1), N is N1+1

0th [1, 2, 3, 4] 1th [2, 3, 4] 2th [3, 4] 3th[4] 4th [ ]

(1) H=1   (2) H = 2   (2) H = 3   (2) H = 4   (1)
T = 2, 3, 4   T = 3, 4   T = 4   T = [ ]   return
                                 N = N1+1   N = (N)+1
N = (N1)+1   N ≠ (N1)+1   N = 0+1
                                                                      = 1   0
N = 3+1   N = 2+1

Proolog Programming

Imran Hasan

→ Knowledge base → Facts / Universal truth.

4 Facts || No vs False?

likes (john , marry). # john likes marry.

relationship obj 1 obj 2

parameters

Ans
Yes/NO/else

i) every relationship/objects starts with small alphab

FactsNovsFalse. .pl {code>

sum

$$[1, 2, 3] \rightarrow 6$$

① sum([], 0)

② sum([H|T], N) :-
   sum(T, N1), N is N1+H

6th [1,2,3]	[2,3] ith	[9]

① H=1
T=[2,3]
N=N1+H
=N1+1
=5+1
=6

② H=2
T=3
N=N1+H
=N1+2
=3+2
=5

② H=3
T=[]
N=N1+H
=N1+3
=0
N=0+3
=3

① H=[]
·↑
return
0
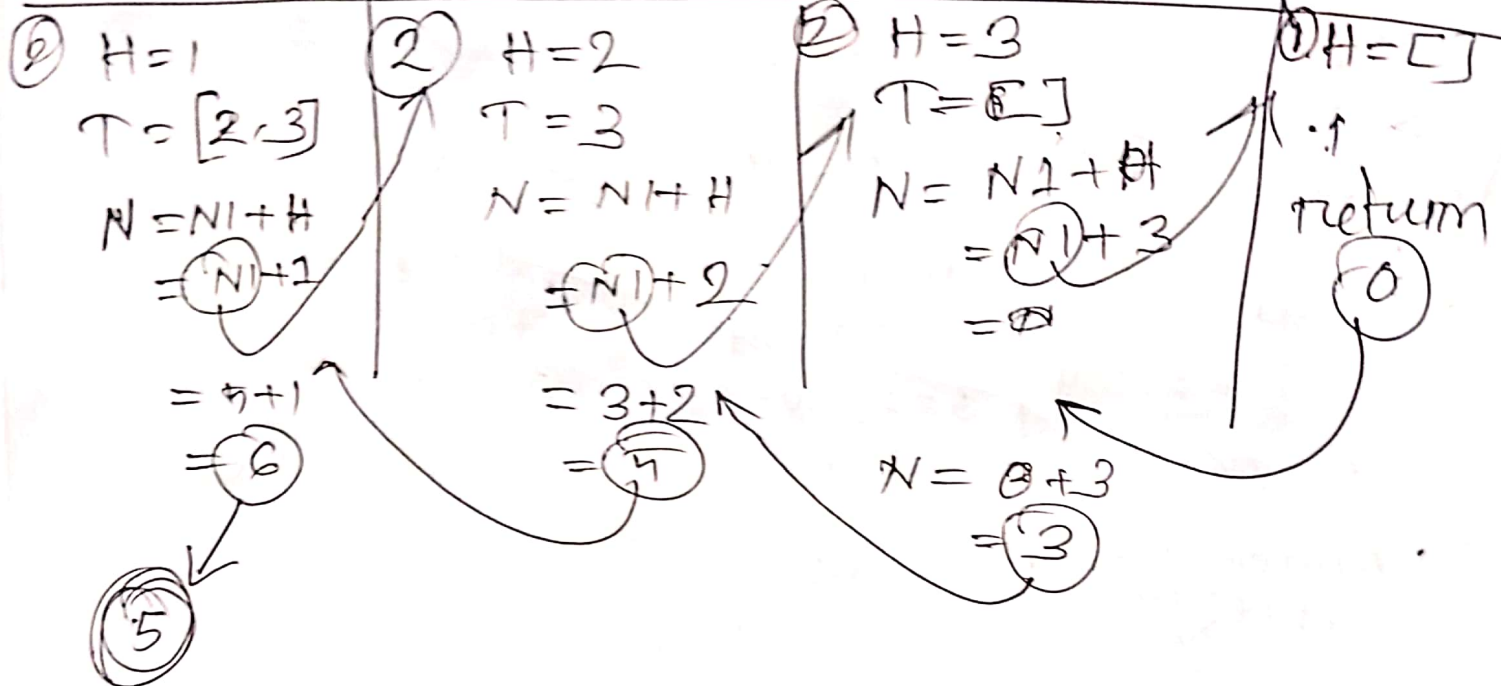
Sorting: [1,4,7,9]   sort in Accending

· 6th [1,4,7,9]   [4,7,9]   [7,9]   [9]

③ X=1
Y=4
T=[7,9]
X≤Y=True

③ X=4
Y=7
T=[9]
X≤Y=True

③ X=7
Y=9
T=[]
X≤Y=True

②
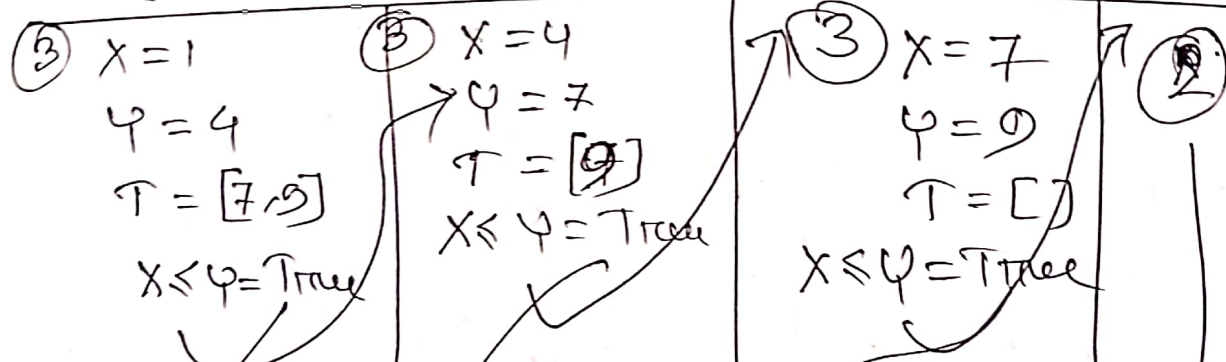
Sub :

$$\text{sub}(5, 5, 0) \rightarrow \text{result}.$$

$$\text{sub}(5, 0, 5)$$

$$s(x), \quad 4, \quad s(z)$$

$$\text{sub}(9, 5, 4) \longrightarrow \text{sub}(x, y, z)$$

$$\text{sub}(x, x, 0).$$

$$(8, 5, 3)$$

$$(7, 5, 2)$$

$$(6, 5, 1)$$

$$(5, 5, 0)$$

add

add(0, ⑤→5) result↑

add (9, 5, 14) → add(X, Y, Z)

     s(X)   4   s(Z)

(8, 5, 13)

(7, 5, 12)

(6, 5, 11) s(X̶)

(5, 5, 10) add(s(X), Y̶, s(Z)) :—

(4, 5, 9) add (X, Y, Z).

(3, 5, 8)

(2, 5, 7)

(1, 5, 6)

(0, 5, 5) True

concat()

~~append([], b)~~

append([], l2, l2)

append([H|T], l2, [H|L3]) :- append(T, l2, l3).

L1   L2

[1, 2, 3] , [a, b]

[H | 2, 3] , [a, b] => R = [1, 2, 3, a, b,]

[2 | 3] , [a, b] => R = [2, 3, a, b,]
H T

[3 |] , [a, b] => R = [3, a, b, ... ,]
H T

[ ] , [a, b] , => R = [a, b]
H

---

concat([], L2, L2)

concat([H|T], L2, [H|L3]) :- concat(T, L2, l3)

$$s(x),\ \overset{\text{क}}{\text{क}},\ k\ \underline{20,5}\ 2\overline{5}$$
$$\boxed{\text{क}}$$

$$0$$
$$0,\ \text{क},\ 0\ \rightarrow\ times(0, X, 0)$$

s(x)	y	R
क ,	क ,	2क → R ← क
4 ,	क	20
3 ,	क ,	15
2 ,	क ,	10
1 ,	क ,	5
0 ,	क ,	0	— base

क
क
5
5

R
0 , 4, (4)

R
|
(16) 4, 20

2, y, R
0 4 4

$$s(x),\ y,\ s(R)\ s(s(s(s(s(2)))))\ \rightarrow (x, y, 2)$$

$$s(x), y, (R)$$

$$\boxed{\text{क} , 4 , 20} \rightarrow (x, y, R)$$
s(x) y R   4 4

$$\downarrow$$

5 , (4) ,   8 (20) ← R   (4)

4   4   (16) _____ (4)

4   12 ____

3   4   8

2   4   4 ____   (4)

1   4

0   4   0 ___ base