Principles of Programming languages TUTORIAL
PROLOG CS F301

1.Write the RECURRENCE RELATION of the following PROLOG PROGRAM and find the Output: (Assume that n is >= 0).

$**vi recur.pro [creating your prolog code]**

```
t(N,Ans) :- N=<2,Ans is ((7*N*N)+(16*N)-106).
t(N,Ans) :- N>2,N1 is N-1,
N2 is N-2,
N3 is N-3,
t(N1,Ans1),
t(N2,Ans2),
t(N3,Ans3),
Ans is ((2*Ans1)-Ans2+(2*Ans3)).
```

$**pl -o recur -c recur.pro [compiling your code]**
$**recur [execution of your code]**

Suggested answer

T(n) =

- **$7n^2 + 16n - 106$**, for n=0,1 or 2
- **2T(n-1) –T(n-2) + 2T(n-3)** for n > 2.

Prompt (inside prolog mode)	INPUT (typed by you)	OUTPUT (write answer in this column only)
?-	t(0,A).	A= -106
?-	t(1,B).	B=-83
?-	t(3,C).	C=-221

2. Acerman's function in PROLOG:

```
/*acerman.pro */
ack(0,N,Val) :- Val is N+1.
ack(M,0, Val) :- M > 0, M1 is M-1, ack(M1,1,Val).
ack(M,N,Val) :- M > 0, N > 0, M1 is M-1, N1 is N-1, ack(M,N1,Val1), ack(M1, Val1, Val).
```

A function of two parameters whose value grows very fast.

Formal Definition:

A(m, n) =

- **n+1**, for $m = 0 \ \& \ n \geq 0$
- **A(m-1, 1),** for $n = 0 \ \& \ m > 0$
- **A(m-1, A(m, n-1))**, for $m > 0 \ \& \ n > 0$.

m = 0	A(0, n) = n+1
m > 0, n = 0	A(m, 0) = A(m-1, 1)
m > 0, n > 0	A(m, n) = A(m-1, A(m, n-1))

Test Inputs & expected Results for your PICO LISP Program.

	N										
m	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
0	1	2	3	4	5	6	7	8	9	10	11
1	2	3	4	5	6	7	8	9	10	11	12
2	3	5	7	9	11	13	15	17	19	21	23
3	5	13	29	61	125	253	509	1021	2045	4093	8189

While running this code, it works well for m=0,1,2,3 and n=0,1,2,3,4.
For M > 3 and N > 4, it might give LOCAL STACK ERROR in some computers due to memory size.

3. /* Ancestor.pro */

```
/*  Note that ancestor(A, B) means hat A is an ancestor of B. */
ancestor(bob, susan).
ancestor(A, X) :- parent(A, X).
ancestor(A, X) :- parent(A, C), ancestor(C, X).
/* Note that parent(P, C) means that P is a parent of C. */
parent(fred, sally).
parent(tina, sally).
parent(sally, john).
parent(sally, diane).
parent(sam, bill).
```
