DESIGN AND ANALYSIS OF ALGORITHMS
EXPERIMENT 1A

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AIM:
TO IMPLEMENT VARIOUS FUNCTIONS E.G. LINEAR, NON-LINEAR,QUADRATIC, EXPONENTIAL, ETC.

THEORY:
A function is a process or a relation that associates each element 'a' of a non-empty set A , at least to a single element 'b' of another non-empty set B.
A relation f from a set A (the domain of the function) to another set B (the co-domain of the function) is called a function in math. f = {(a,b)| for all a ∈ A, b ∈ B}

- A relation is said to be a function if every element of set A has one and only one image in set B.
- A function is a relation from a non-empty set B such that the domain of a function is A and no two distinct ordered pairs in f have the same first element.
- A function from A → B and (a,b) ∈ f, then f(a) = b, where 'b' is the image of 'a' under 'f' and 'a' is the preimage of 'b' under 'f'.
- If there exists a function f: A → B, the set A is called the domain of the function f, and the set B is called its co-domain.

ALGORITHM:

STEP_1: Start.
STEP_2: Print the header row to make one column for input, ten columns for functions and last column for factorial of a number.
STEP_3: Start a for loop which will run from i=0 to 100 to find values of functions for all numbers from 0 to 100. In this loop:
(1) First print the input.
(2) Define function f1 as (3/2)^n. Print its value.
(3) Define function f2 as n^3. Print its value.
(4) Define function f3 as 2^(2^n). Print its value.
(5) Define function f4 as ln(ln(n)). Print its value.
(6) Define function f5 as n*(2^n). Print its value.
(7) Define function f6 as ln(n). Print its value.
(8) Define function f7 as 2^n. Print its value.
(9) Define function f8 as 2^(2^(n+1)). Print its value.
(10) Define function f9 as e^n. Print its value.
(11) Define function f10 as lg(n). Print its value.
(12) To print the factorial of first 20 numbers, put an if statement. Initialise fact=1, put fact=fact*i to calculate factorial and print its value.
STEP_4: Stop.

CODE:

```
#include <stdio.h>
#include <math.h>

int
main ()
{
  printf
    ("Input (3/2)^n       n^3     2^(2^n)          ln(ln(n))          n*(2^n)          ln(n)    2^n
          2^(2^(n+1))     e^n     lg(n)    Factorial\n");

  for (int i = 0; i <= 100; i++)
    {
      printf ("%d ", i);
      float f1 = pow ((float) 3 / 2, i);
      printf ("%f ", f1);
      float f2 = pow (i, 3);
      printf ("%f ", f2);
      float f3 = pow (2, pow (2, i));
      printf ("%f ", f3);
      float f4 = log (log (i));
      printf ("%f ", f4);
      float f5 = i * pow (2, i);
      printf ("%f ", f5);
      float f6 = log (i);
      printf ("%f ", f6);
      float f7 = pow (2, i);
      printf ("%f ", f7);
      float f8 = pow (2, pow (2, i + 1));
      printf ("%f ", f8);
      float f9 = pow (2.71, i);
      printf ("%f ", f9);
      float f10 = log (i) / log (2);
      printf ("%f ", f10);
      int fact = 1;
      if (i == 0)
           printf ("0 ");
      else if (i <= 20)
           {
             fact *= i;
             printf ("%d ", fact);
           }
      printf ("\n");
    }

  return 0;
}
```

OUTPUT:

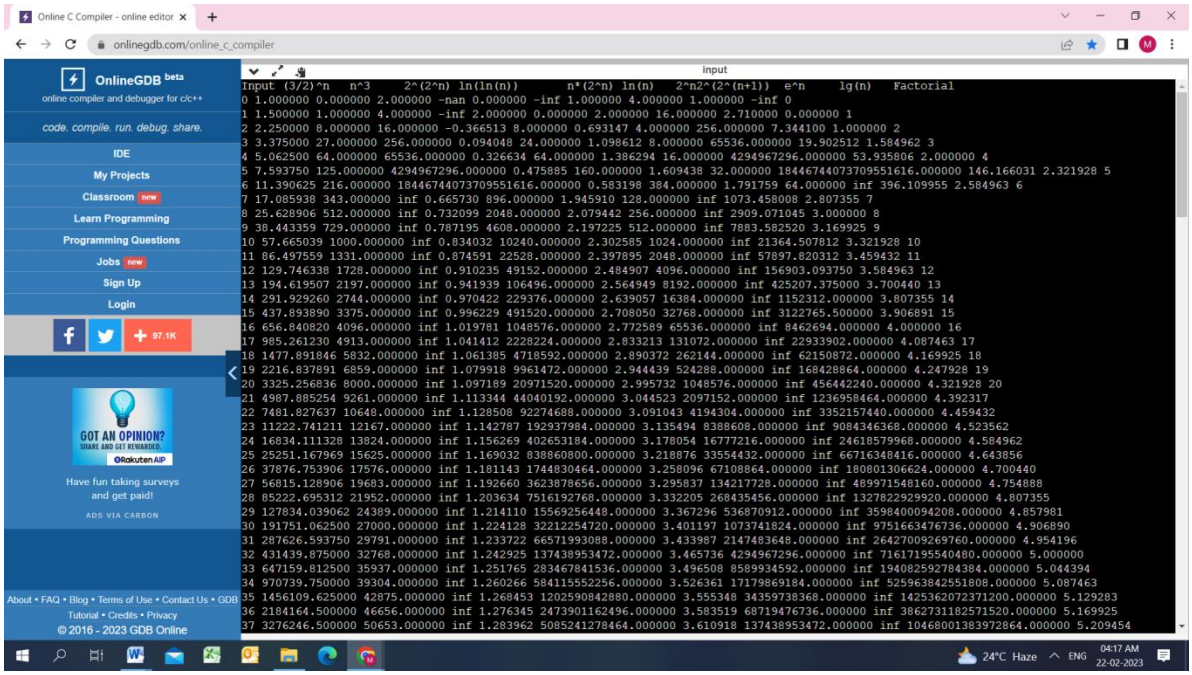


TABLE:

Input	(3/2)^n	n^3	2^(2^n)	ln(ln(n))	n*(2^n)	ln(n)	2^n2^(2^(n+1))	e^n	lg(n)	Factorial
0	1	0	2	#NAME?	0	#NAME?	1	4	1	#NAME?
0										
1	1.5	1	4	#NAME?	2	0	2	16	2.71	0
1										
2	2.25	8	16	-0.366513	8	0.693147	4	256	7.3441	1
2										
3	3.375	27	256	0.094048	24	1.098612	8	65536	19.902512	
1.584962			3							
4	5.0625	64	65536	0.326634	64	1.386294	16	4294967296		
53.935806			2	4						
5	7.59375	125	4294967296	0.475885	160	1.609438	32			
1.84467E+19			146.166031	2.321928	5					
6	11.390625	216	1.84467E+19	0.583198	384	1.791759	64			
inf		396.109955	2.584963	6						
7	17.085938	343	inf	0.66573896	1.94591128	inf	1073.458008			
2.807355			7							
8	25.628906	512	inf	0.732099	2048	2.079442	256	inf		
2909.071045			3	8						
9	38.443359	729	inf	0.787195	4608	2.197225	512	inf		
7883.58252			3.169925	9						

10	57.665039	1000	inf	0.834032	10240	2.302585	1024	inf	21364.50781	3.321928	10
11	86.497559	1331	inf	0.874591	22528	2.397895	2048	inf	57897.82031	3.459432	11
12	129.746338	1728	inf	0.910235	49152	2.484907	4096	inf	156903.0938	3.584963	12
13	194.619507	2197	inf	0.941939	106496	2.564949	8192	inf	425207.375	3.7004413	
14	291.92926	2744	inf	0.970422	229376	2.639057	16384	inf	1152312	3.807355	14
15	437.89389	3375	inf	0.996229	491520	2.7080532768	inf	3122765.5	3.906891	15	
16	656.84082	4096	inf	1.019781	1048576	2.772589	65536	inf	8462694	4	16
17	985.26123	4913	inf	1.041412	2228224	2.833213	131072	inf	22933902	4.087463	17
18	1477.891846	5832	inf	1.061385	4718592	2.890372	262144	inf	62150872	4.169925	18
19	2216.837891	6859	inf	1.079918	9961472	2.944439	524288	inf	168428864	4.247928	19
20	3325.256836	8000	inf	1.097189	20971520	2.995732	1048576	inf	456442240	4.321928	20
21	4987.885254	9261	inf	1.113344	44040192	3.044523	2097152	inf	1236958464	4.392317	
22	7481.827637	10648	inf	1.128508	92274688	3.091043	4194304	inf	3352157440	4.459432	
23	11222.74121	12167	inf	1.142787	192937984	3.135494	8388608	inf	9084346368	4.523562	
24	16834.11133	13824	inf	1.156269	402653184	3.178054	16777216	inf	24618579968	4.584962	
25	25251.16797	15625	inf	1.169032	838860800	3.218876	33554432	inf	66716348416	4.643856	
26	37876.75391	17576	inf	1.181143	1744830464	3.258096	67108864	inf	1.80801E+11	4.70044	
27	56815.12891	19683	inf	1.192663623878656	3.295837	134217728	inf	4.89972E+11	4.754888		
28	85222.69531	21952	inf	1.203634	7516192768	3.332205	268435456	inf	1.32782E+12	4.807355	
29	127834.0391	24389	inf	1.2141115569256448	3.367296	536870912	inf	3.5984E+12	4.857981		
30	191751.0625	27000	inf	1.224128	32212254720	3.401197					

	1073741824	inf	9.75166E+12	4.90689			
31	287626.5938	29791	inf	1.233722	66571993088	3.433987	
	2147483648	inf	2.6427E+13	4.954196			
32	431439.875	32768	inf	1.242925	1.37439E+11	3.465736	
	4294967296	inf	7.16172E+13	5			
33	647159.8125	35937	inf	1.251765	2.83468E+11	3.496508	
	8589934592	inf	1.94083E+14	5.044394			
34	970739.75	39304	inf	1.260266	5.84116E+11	3.526361	
	17179869184	inf	5.25964E+14	5.087463			
35	1456109.625	42875	inf	1.268453	1.20259E+12	3.555348	
	34359738368	inf	1.42536E+15	5.129283			
36	2184164.5	46656	inf	1.276345	2.4739E+12	3.583519	
	68719476736	inf	3.86273E+15	5.169925			
37	3276246.5	50653	inf	1.283962	5.08524E+12	3.610918	
	1.37439E+11	inf	1.0468E+16	5.209454			
38	4914370	54872	inf	1.291321	1.04454E+13	3.637586	2.74878E+11
	inf	2.83683E+16	5.247928				
39	7371555	59319	inf	1.298436	2.14405E+13	3.663562	
	5.49756E+11	inf	7.68781E+16	5.285402			
40	11057332	64000	inf	1.305323	4.39805E+13	3.688879	
	1.09951E+12	inf	2.0834E+17	5.321928			
41	16585998	68921	inf	1.311994	9.016E+13	3.713572	
	2.19902E+12	inf	5.646E+17	5.357552			
42	24878998	74088	inf	1.318462	1.84718E+14	3.737674	1.39805E+12
	inf	1.53007E+18	5.392317				
43	37318496	79507	inf	1.324738	3.78232E+14	3.7612	8.79609E+12
	inf	4.14648E+18	5.426265				
44	55977744	85184	inf	1.330832	7.74056E+14	3.784191	1.75922E+13
	inf	1.1237E+19	5.459432				
45	83966616	91125	inf	1.336753	1.5833E+15	3.806663	
	3.51844E+13	inf	3.04522E+19	5.491853			
46	125949928	97336	inf	1.342513	3.23696E+15	3.828641	7.03687E+13
	inf	8.25253E+19	5.523562				
47	188924896	103823	inf	1.348112	6.61466E+15	3.850147	
	1.40737E+14	inf	2.23644E+20	5.554589			
48	283387328	110592	inf	1.353565	1.35108E+16	3.871201	
	2.81475E+14	inf	6.06074E+20	5.584962			
49	425080992	117649	inf	1.358877	2.75845E+16	3.891825	6.6295E+14
	inf	1.64246E+21	5.61471				
50	637621504	125000	inf	1.364055	5.6295E+16	3.912023	
	1.1259E+15	inf	4.45107E+21	5.643856			

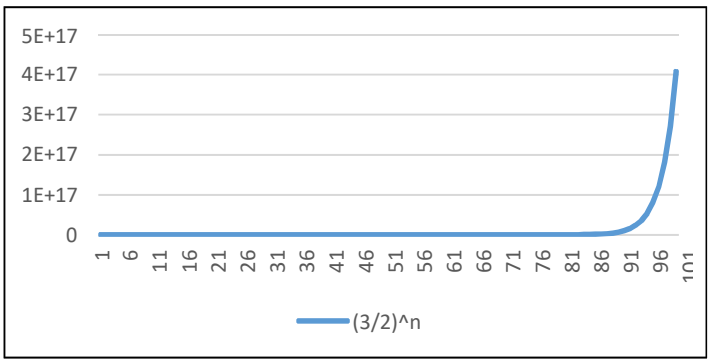
51	956432256	132651	inf	1.369104	1.14842E+17	3.931826	2.2518E+15	inf
1.20624E+22	5.672425							
52	1434648320	140608	inf	1.374032	2.34187E+17	3.951244	4.5036E+15	inf
3.26891E+22	5.70044							
53	2151972608	148877	inf	1.378844	2.77382E+17	3.970292	9.0072E+15	inf
8.85875E+22	5.727921							
54	3227958784	157464	inf	1.383537	9.72778E+17	3.988984	1.80144E+16	inf
2.40072E+23	5.754888							
55	4841938432	166375	inf	1.388126	1.98158E+18	4.007333	3.60288E+16	inf
6.50595E+23	5.78136							
56	7262907392	175616	inf	1.392612	4.03523E+18	4.025352	7.20576E+16	inf
1.76311E+24	5.807355							
57	10894361600	185193	inf	1.397	8.21457E+18	4.043051	1.44115E+17	inf
4.77804E+24	5.83289							
58	16341541888	195112	inf	1.401292	1.67174E+19	4.060443	2.8823E+17	inf
1.29485E+25	5.857981							
59	24512313344	205379	inf	1.405493	3.40112E+19	4.077538	5.76461E+17	inf
3.50904E+25	5.882643							
60	36768468992	216000	inf	1.409607	6.91753E+19	4.094345	1.15292E+18	inf
9.50949E+25	5.90689							
61	55152701440	226981	inf	1.413636	1.40656E+20	4.110874	2.30584E+18	inf
2.57707E+26	5.930737							
62	82729058304	238328	inf	1.417583	2.85925E+20	4.127134	4.61169E+18	inf
6.98387E+26	5.954196							
63	1.24094E+11	250047	inf	1.421453	5.81072E+20	4.143135	9.22337E+18	inf
1.89263E+27	5.97728							
64	1.8614E+11	262144	inf	1.425247	1.18059E+21	4.158883	1.84467E+19	inf
5.12902E+27	6							
65	2.79211E+11	274625	inf	1.428968	2.39808E+21	4.174387	3.68935E+19	inf
1.38997E+28	6.022368							
66	4.18816E+11	287496	inf	1.432618	4.86994E+21	4.189655	7.3787E+19	inf
3.76681E+28	6.044394							
67	6.28224E+11	300763	inf	1.436201	9.88745E+21	4.204693	1.47574E+20	inf
1.0208E+29	6.066089							
68	9.42336E+11	314432	inf	1.439718	2.00701E+22	4.219508	2.95148E+20	inf
2.76638E+29	6.087463							
69	1.4135E+12	328509	inf	1.443172	4.07304E+22	4.234107	5.90296E+20	inf
7.49689E+29	6.108524							
70	2.12026E+12	343000	inf	1.446565	8.26414E+22	4.248495	1.18059E+21	inf
2.03166E+30	6.129283							
71	3.18038E+12	357911	inf	1.449898	1.67644E+23	4.262682	2.36118E+21	

	inf	5.50579E+30	6.149747					
72	4.77057E+12	373248	inf	1.453174	3.4001E+23	4.276666		
	4.72237E+21	inf	1.49207E+31	6.169925				
73	7.15586E+12	389017	inf	1.456394	6.89466E+23	4.290469	4.44473E+21	
	inf	4.04351E+31	6.189825					
74	1.07338E+13	405224	inf	1.459561	1.39782E+24	4.304065	1.88895E+22	
	inf	1.09579E+32	6.209454					
75	1.61007E+13	421875	inf	1.462674	2.83342E+24	4.317488		
	3.77789E+22	inf	2.96959E+32	6.228819				
76	2.4151E+13	438976	inf	1.465737	5.7424E+24	4.330733		
	7.55579E+22	inf	8.0476E+32	6.247928				
77	3.62265E+13	456533	inf	1.468751	1.16359E+25	4.343805		
	1.51116E+23	inf	2.1809E+33	6.266787				
78	5.43398E+13	474552	inf	1.471717	2.35741E+25	4.356709		
	3.02231E+23	inf	5.91023E+33	6.285402				
79	8.15097E+13	493039	inf	1.474637	4.77526E+25	4.369448		
	6.04463E+23	inf	1.60167E+34	6.303781				
80	1.22265E+14	512000	inf	1.477511	9.67141E+25	4.382027		
	1.20893E+24	inf	4.34054E+34	6.321928				
81	1.83397E+14	531441	inf	1.480342	1.95846E+26	4.394449		
	2.41785E+24	inf	1.17628E+35	6.33985				
82	2.75095E+14	551368	inf	1.483133	3.96528E+26	4.406719	4.8357E+24	
	inf	3.18773E+35	6.357552					
83	4.12643E+14	571787	inf	1.485877	8.02727E+26	4.418849	6.67141E+24	
	inf	8.63875E+35	6.37504					
84	6.18965E+14	592704	inf	1.488584	1.6248E+27	4.430817		
	1.93428E+25	inf	2.3411E+36	6.392317				
85	9.28447E+14	614125	inf	1.491251	3.28828E+27	4.442651		
	3.86856E+25	inf	6.34439E+36	6.409391				
86	1.39267E+15	636056	inf	1.493881	6.65393E+27	4.454347		
	7.73713E+25	inf	1.71933E+37	6.426265				
87	2.08901E+15	658503	inf	1.496473	1.34626E+28	4.465908		
	1.54743E+26	inf	4.65938E+37	6.442944				
88	3.13351E+15	681472	inf	1.499028	2.72347E+28	4.477337		
	3.09485E+26	inf	1.26269E+38	6.459432				
89	4.70026E+15	704969	inf	1.501549	5.50883E+28	4.488636		
	6.1897E+26	inf	inf	6.475733				
90	7.05039E+15	729000	inf	1.504035	1.11415E+29	4.499811	1.23794E+27	
	inf	inf	6.491853					
91	1.05756E+16	753571	inf	1.506488	2.25305E+29	4.510859		
	2.47588E+27	inf	inf	6.507795				

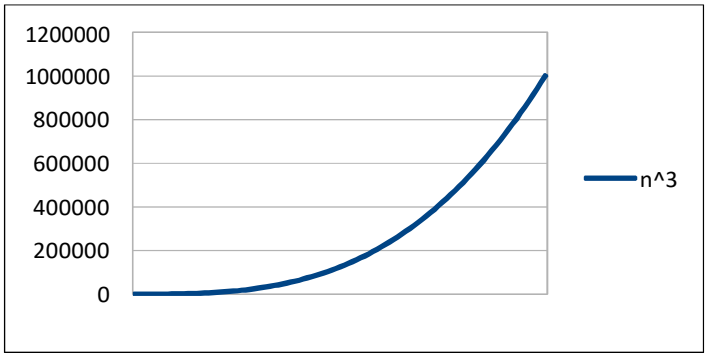
92	1.58634E+16	778688	inf	1.508908	4.55562E+29	4.521789
	4.95176E+27	inf	inf	6.523562		
93	2.37951E+16	804357	inf	1.511296	9.21027E+29	4.532599
	9.90352E+27	inf	inf	6.539159		
94	3.56926E+16	830584	inf	1.513652	1.86186E+30	4.543295
	1.9807E+28	inf	inf	6.554589		
95	5.35389E+16	857375	inf	1.515979	3.76334E+30	4.553877
	3.96141E+28	inf	inf	6.569856		
96	8.03084E+16	884736	inf	1.518276	7.6059E+30	4.564348
	7.92282E+28	inf	inf	6.584962		
97	1.20463E+17	912673	inf	1.520544	1.53703E+31	4.574711
	1.58456E+29	inf	inf	6.599913		
98	1.80694E+17	941192	inf	1.522783	3.10574E+31	4.584968
	3.16913E+29	inf	inf	6.61471		
99	2.71041E+17	970299	inf	1.524995	6.27487E+31	4.595126.33825E+29
	inf	inf	6.629356			
100	4.06561E+17	1000000		inf	1.527181.26765E+32	4.605171.26765E+30
	inf	inf	6.643856			

GRAPHS:

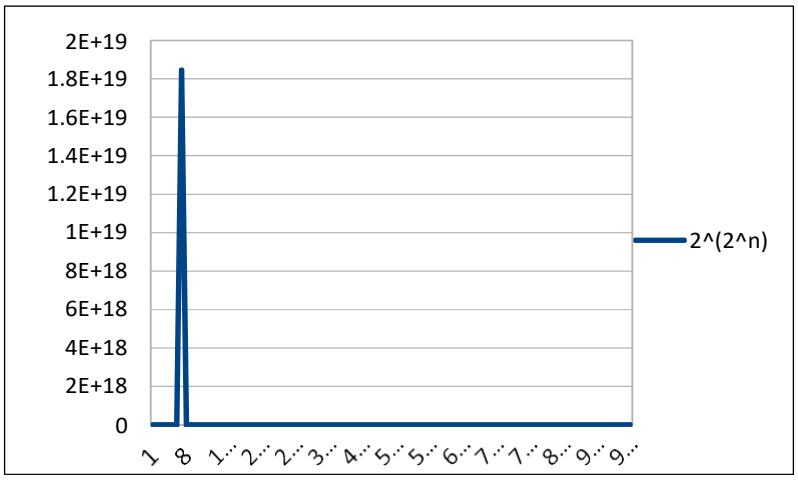
OBSERVATION_(1) (3/2)^n: The values of the function are gradually increasing. At n=83 there is a sudden rise in value after which the result tends to infinity.



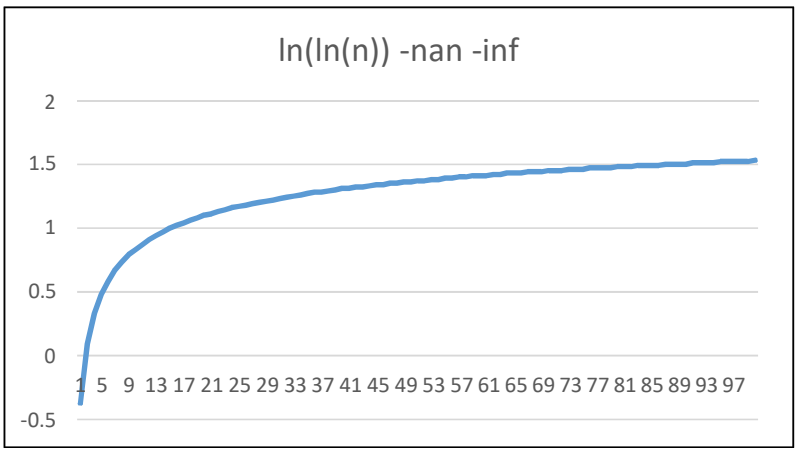
OBSERVATION_(2) n^3: This function has a U shaped graph which starts from 0 and gradually increases to infinity.



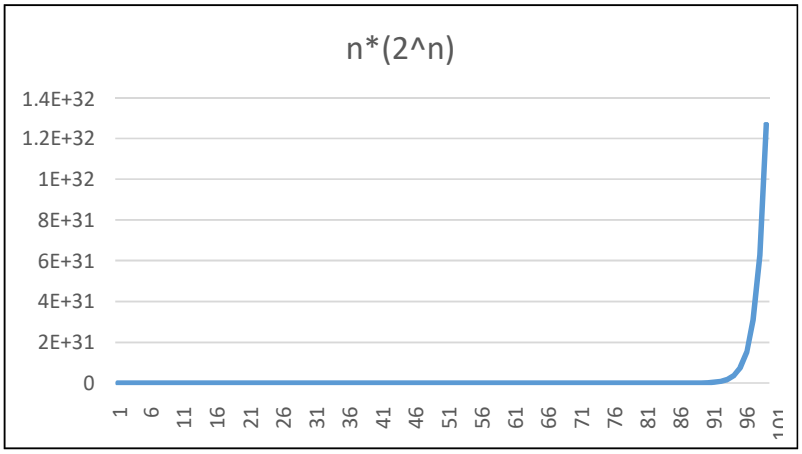
OBSERVATION_(3) 2^(2^n): After n=8, the graph of this functions tends to infinity.



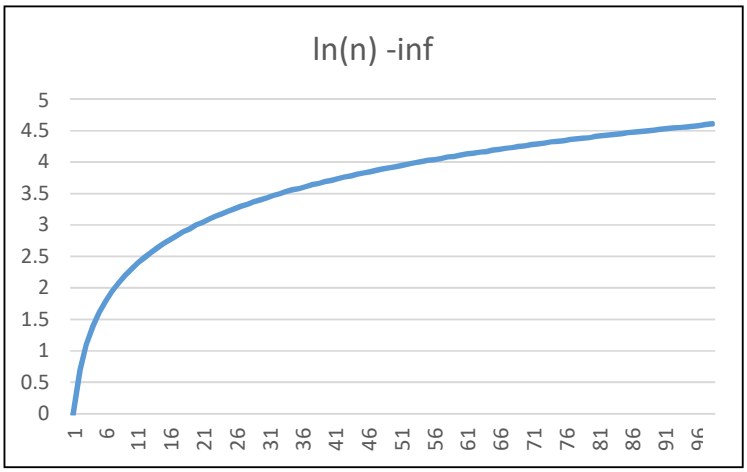
OBSERVATION_(4) ln(ln(n)): This function has a negative value at n=2. The graph has sudden increase at first but then gradually acquires a lesser slope.



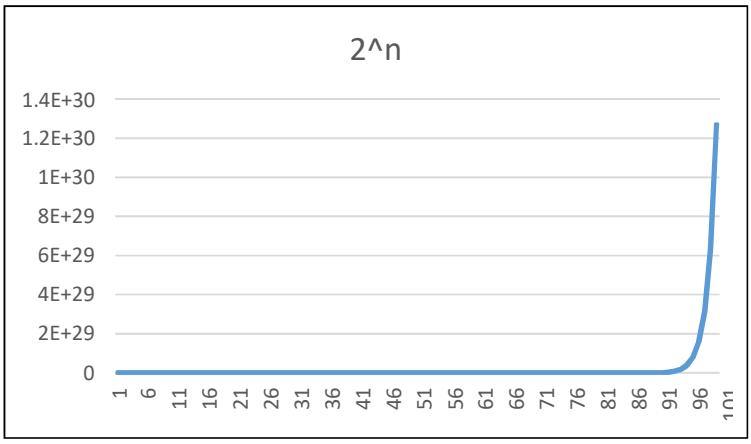
OBSERVATION_(5) n*(2^n): This function has a sudden rise in value at n=92 after which it tends to infinity.



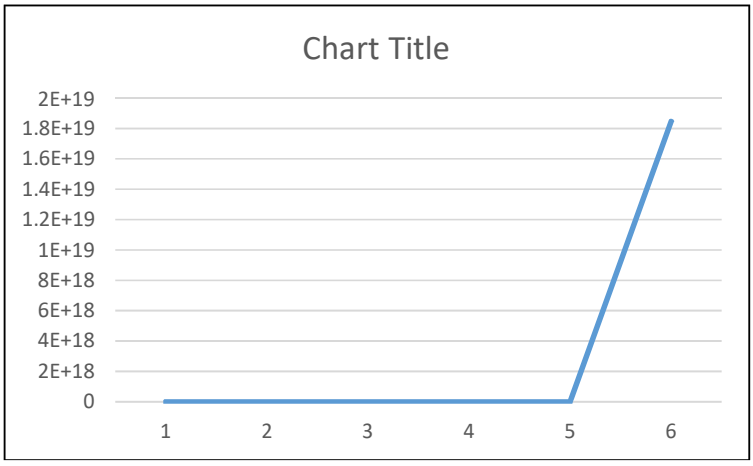
OBSERVATION_(6) ln(n): The graph starts from ln(1)=0. It first increases steeply and then becomes gradual for higher values of n.



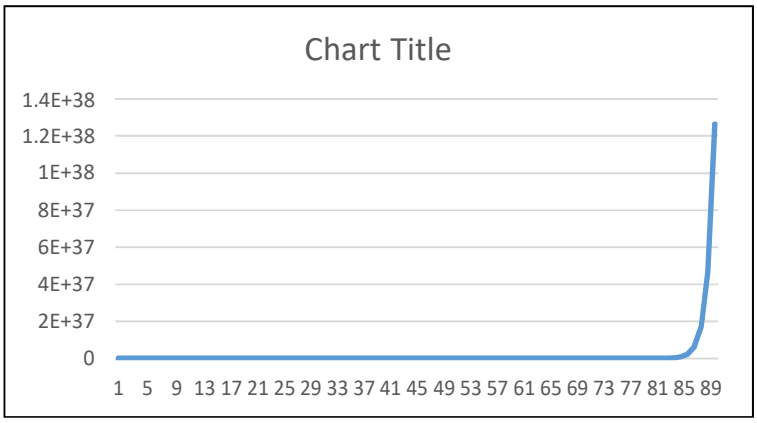
OBSERVATION_(7) 2^n: This function has a sudden rise in value at n=92 after which it tends to infinity.



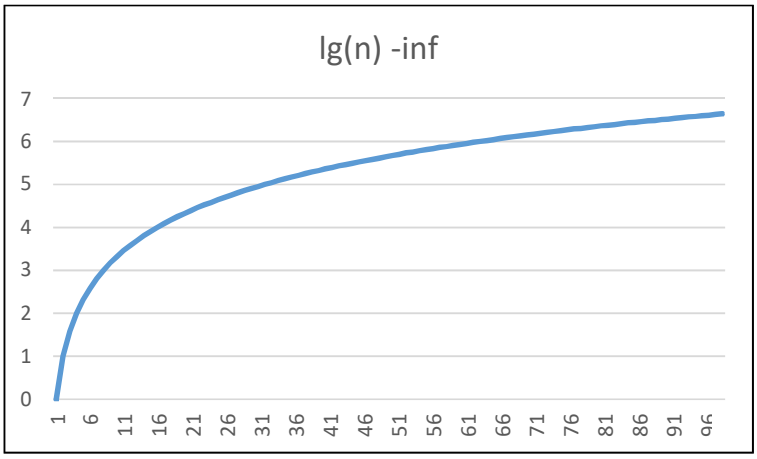
OBSERVATION_(8) 2^(2^(n+1)): The graph has gradual increase in its values from n=0 to 5, at n=5 there is a sudden increase and the function gradually tends to infinity.



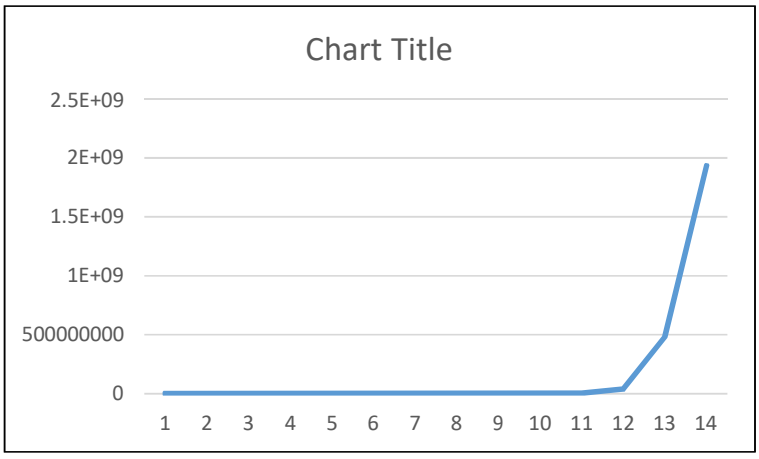
OBSERVATION_(9) e^n: The values of the function are gradually increasing. At n=83 there is a sudden rise in value after which the result tends to infinity.



OBSERVATION_(10) lg(n): The graph starts from lg(1)=0. It first increases steeply and then becomes gradual for higher values of n.



OBSERVATION_(11) Factorial: The value of factorial keeps on increasing as n increases. There is a sudden rise in value at n=13.



CONCLUSION:

From this experiment I learnt how to implement various functions in C Programming language for values of n varying from 0 to 100, and also understood how the graph of each function is affected as value of n changes.