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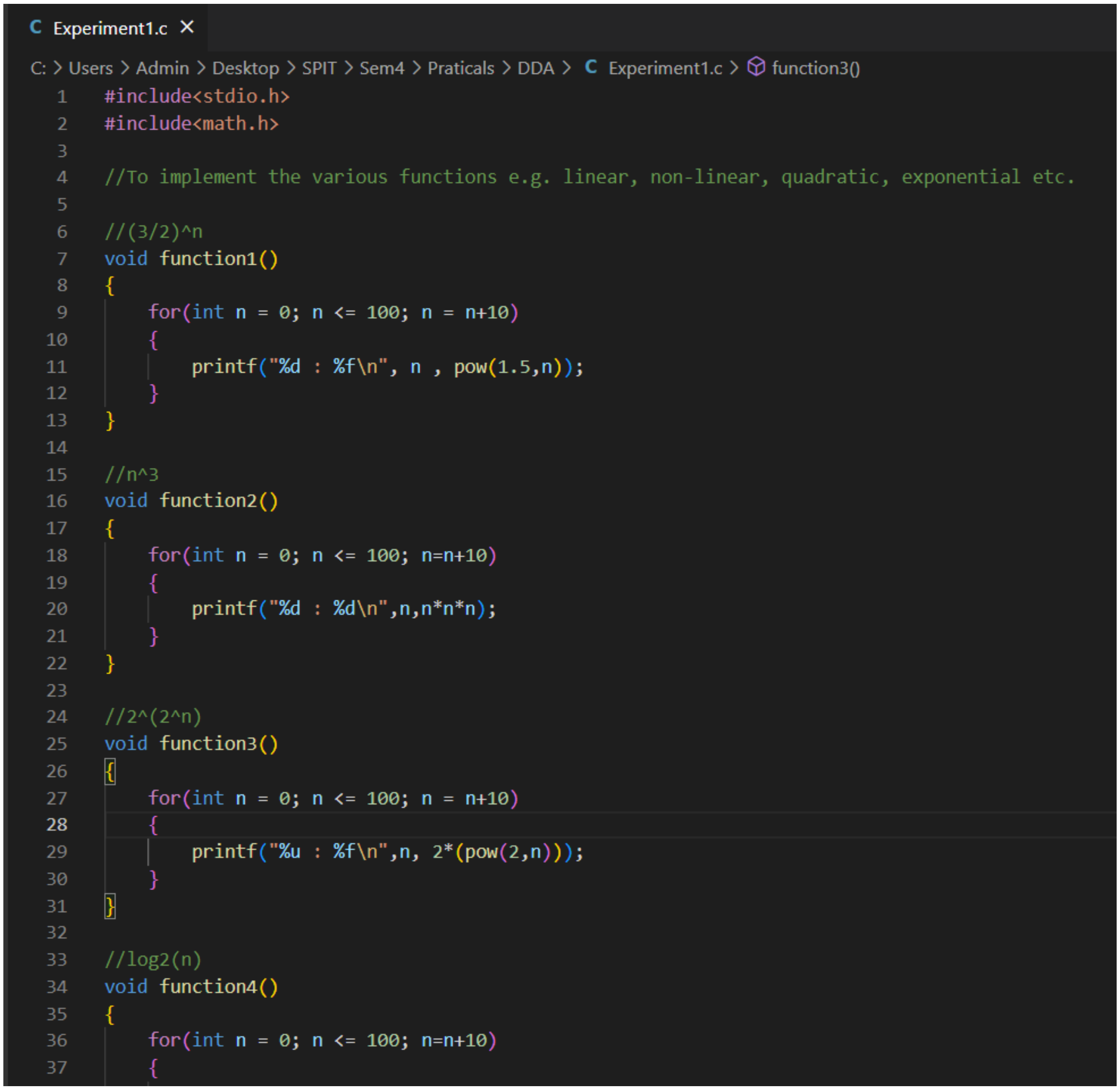
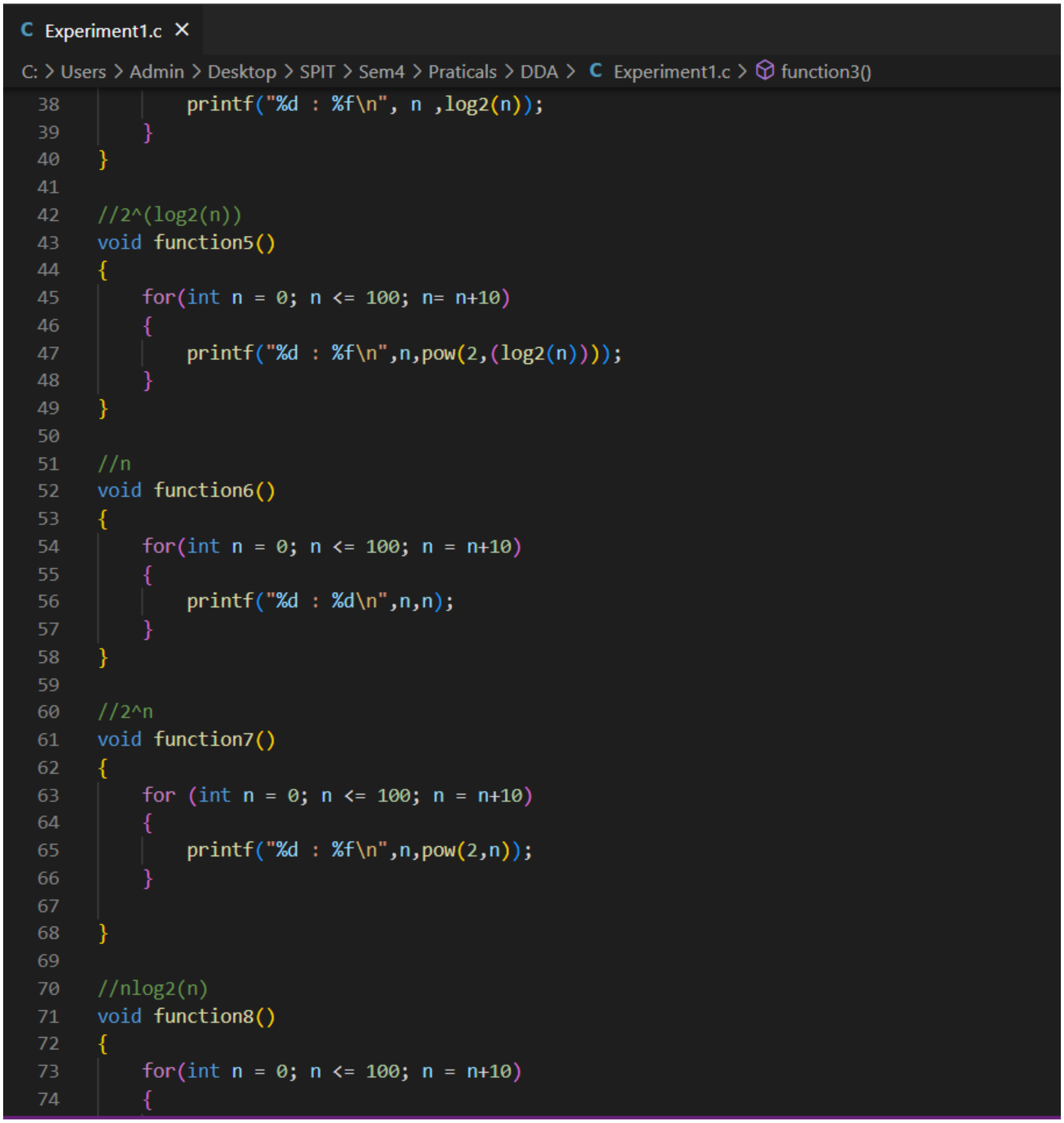
UID no.	202271009
Experiment No.	1

AIM:	Experiment on finding the running time of algorithms
Program 1	
PROBLEM STATEMENT :	To find the running time of various algorithms

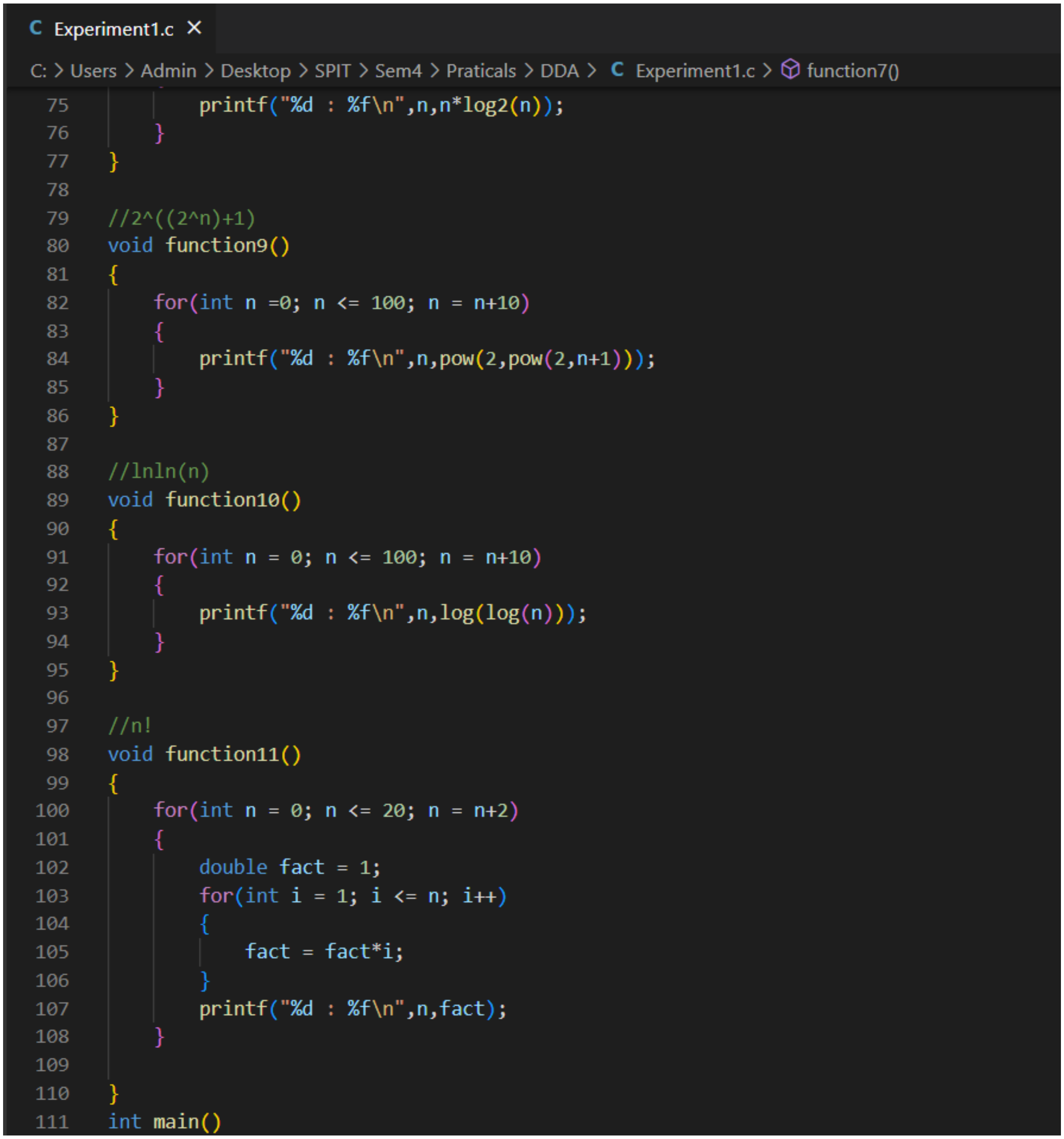
PROGRAM:


Experiment1.c ×
C: > Users > Admin > Desktop > SPIT > Sem4 > Praticals > DDA > Experiment1.c > function3()

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

//To implement the various functions e.g. linear, non-linear, quadratic, exponential etc.

//(3/2)^n
void function1()
{
    for(int n = 0; n <= 100; n = n+10)
    {
        printf("%d : %f\n", n , pow(1.5,n));
    }
}

//n^3
void function2()
{
    for(int n = 0; n <= 100; n=n+10)
    {
        printf("%d : %d\n",n,n*n*n);
    }
}

//2^(2^n)
void function3()
{
    for(int n = 0; n <= 100; n = n+10)
    {
        printf("%u : %f\n",n, 2*(pow(2,n)));
    }
}

//log2(n)
void function4()
{
    for(int n = 0; n <= 100; n=n+10)
    {
```


Experiment1.c
C: > Users > Admin > Desktop > SPIT > Sem4 > Praticals > DDA > Experiment1.c > function3()

```c
        printf("%d : %f\n", n ,log2(n));
    }
}

//2^(log2(n))
void function5()
{
    for(int n = 0; n <= 100; n= n+10)
    {
        printf("%d : %f\n",n,pow(2,(log2(n))));
    }
}

//n
void function6()
{
    for(int n = 0; n <= 100; n = n+10)
    {
        printf("%d : %d\n",n,n);
    }
}

//2^n
void function7()
{
    for (int n = 0; n <= 100; n = n+10)
    {
        printf("%d : %f\n",n,pow(2,n));
    }

}

//nlog2(n)
void function8()
{
    for(int n = 0; n <= 100; n = n+10)
    {
```


C Experiment1.c ×
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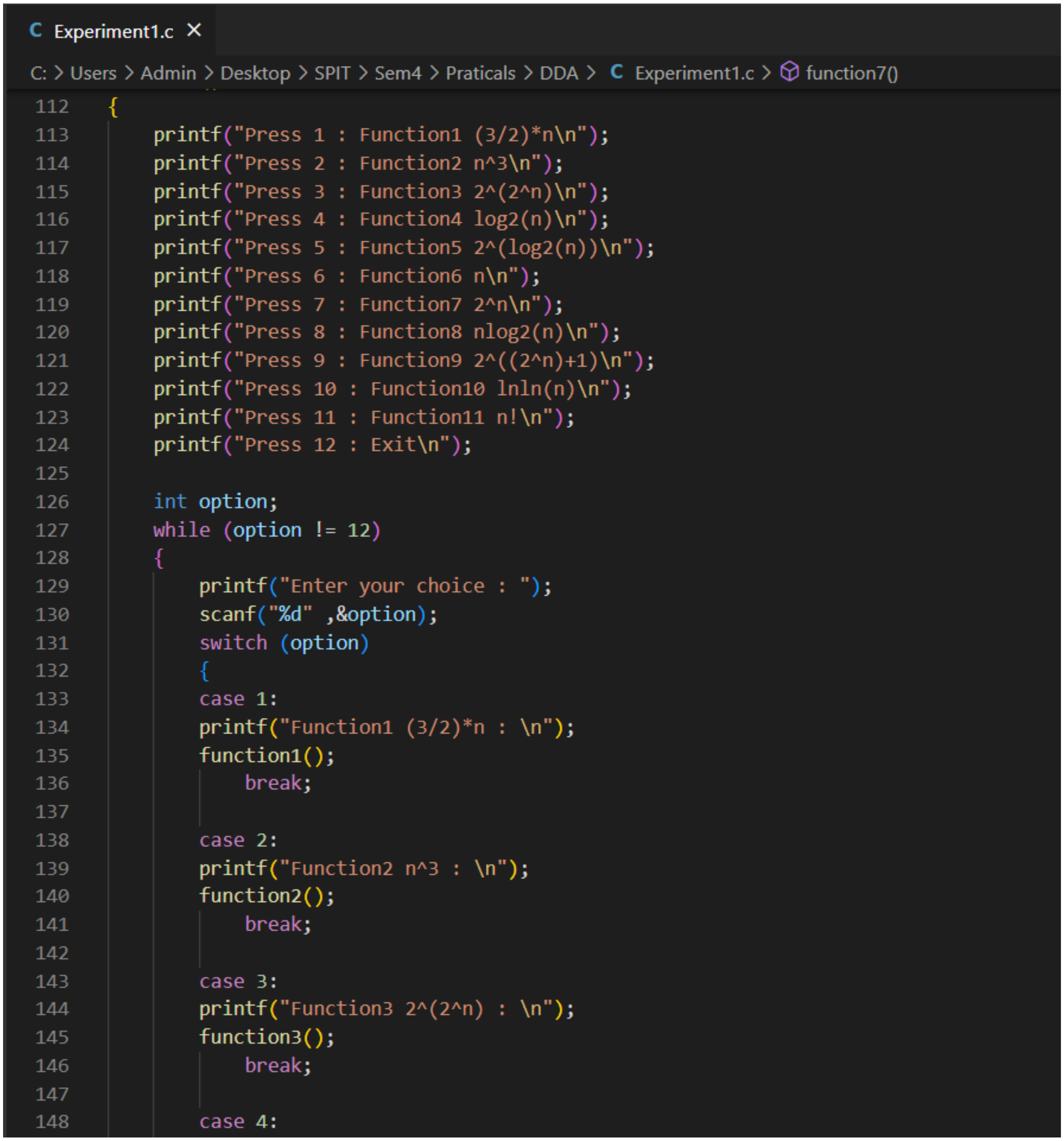
```
        printf("%d : %f\n",n,n*log2(n));
    }
}

//2^((2^n)+1)
void function9()
{
    for(int n =0; n <= 100; n = n+10)
    {
        printf("%d : %f\n",n,pow(2,pow(2,n+1)));
    }
}

//lnln(n)
void function10()
{
    for(int n = 0; n <= 100; n = n+10)
    {
        printf("%d : %f\n",n,log(log(n)));
    }
}

//n!
void function11()
{
    for(int n = 0; n <= 20; n = n+2)
    {
        double fact = 1;
        for(int i = 1; i <= n; i++)
        {
            fact = fact*i;
        }
        printf("%d : %f\n",n,fact);
    }

}
int main()
```


C Experiment1.c ×
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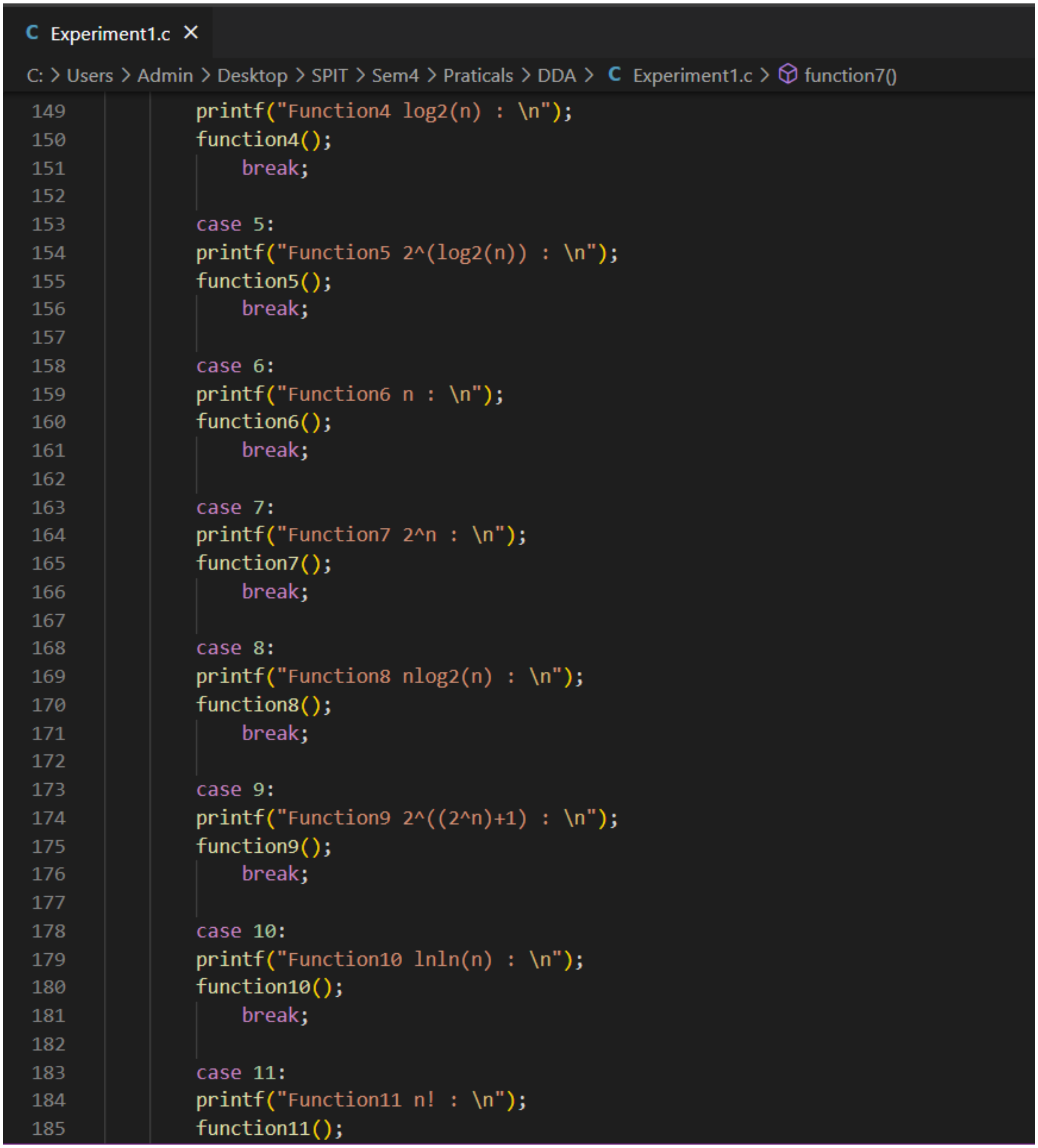
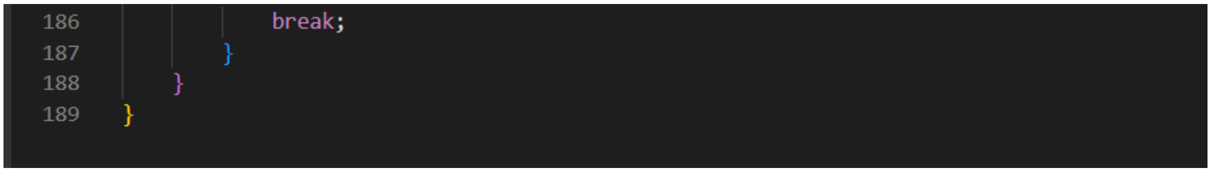
```c
{
    printf("Press 1 : Function1 (3/2)*n\n");
    printf("Press 2 : Function2 n^3\n");
    printf("Press 3 : Function3 2^(2^n)\n");
    printf("Press 4 : Function4 log2(n)\n");
    printf("Press 5 : Function5 2^(log2(n))\n");
    printf("Press 6 : Function6 n\n");
    printf("Press 7 : Function7 2^n\n");
    printf("Press 8 : Function8 nlog2(n)\n");
    printf("Press 9 : Function9 2^((2^n)+1)\n");
    printf("Press 10 : Function10 lnln(n)\n");
    printf("Press 11 : Function11 n!\n");
    printf("Press 12 : Exit\n");

    int option;
    while (option != 12)
    {
        printf("Enter your choice : ");
        scanf("%d" ,&option);
        switch (option)
        {
        case 1:
        printf("Function1 (3/2)*n : \n");
        function1();
            break;

        case 2:
        printf("Function2 n^3 : \n");
        function2();
            break;

        case 3:
        printf("Function3 2^(2^n) : \n");
        function3();
            break;

        case 4:
```

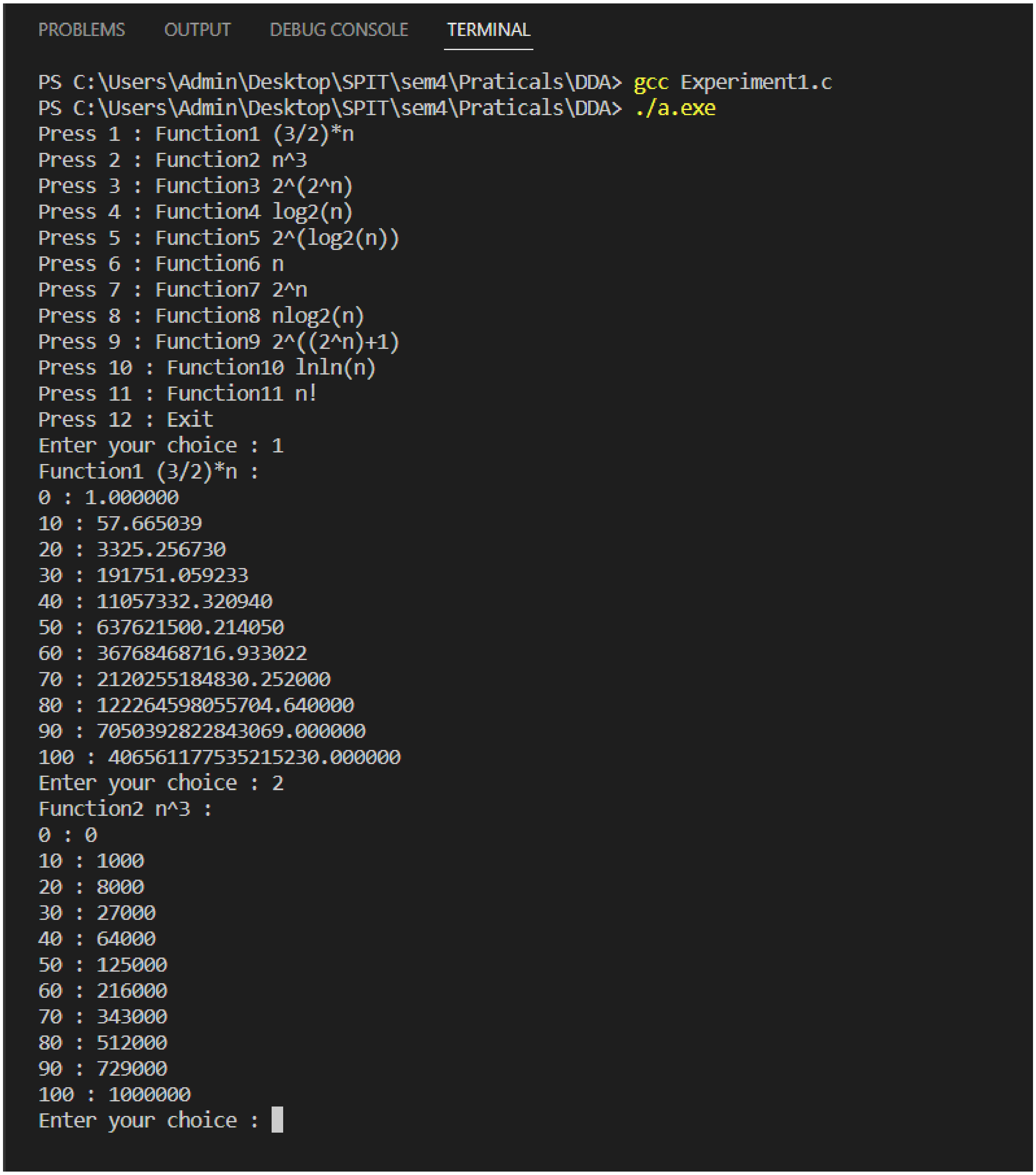

Experiment1.c
C: > Users > Admin > Desktop > SPIT > Sem4 > Praticals > DDA > Experiment1.c > function7()

```
        printf("Function4 log2(n) : \n");
        function4();
            break;

        case 5:
        printf("Function5 2^(log2(n)) : \n");
        function5();
            break;

        case 6:
        printf("Function6 n : \n");
        function6();
            break;

        case 7:
        printf("Function7 2^n : \n");
        function7();
            break;

        case 8:
        printf("Function8 nlog2(n) : \n");
        function8();
            break;

        case 9:
        printf("Function9 2^((2^n)+1) : \n");
        function9();
            break;

        case 10:
        printf("Function10 lnln(n) : \n");
        function10();
            break;

        case 11:
        printf("Function11 n! : \n");
        function11();
```

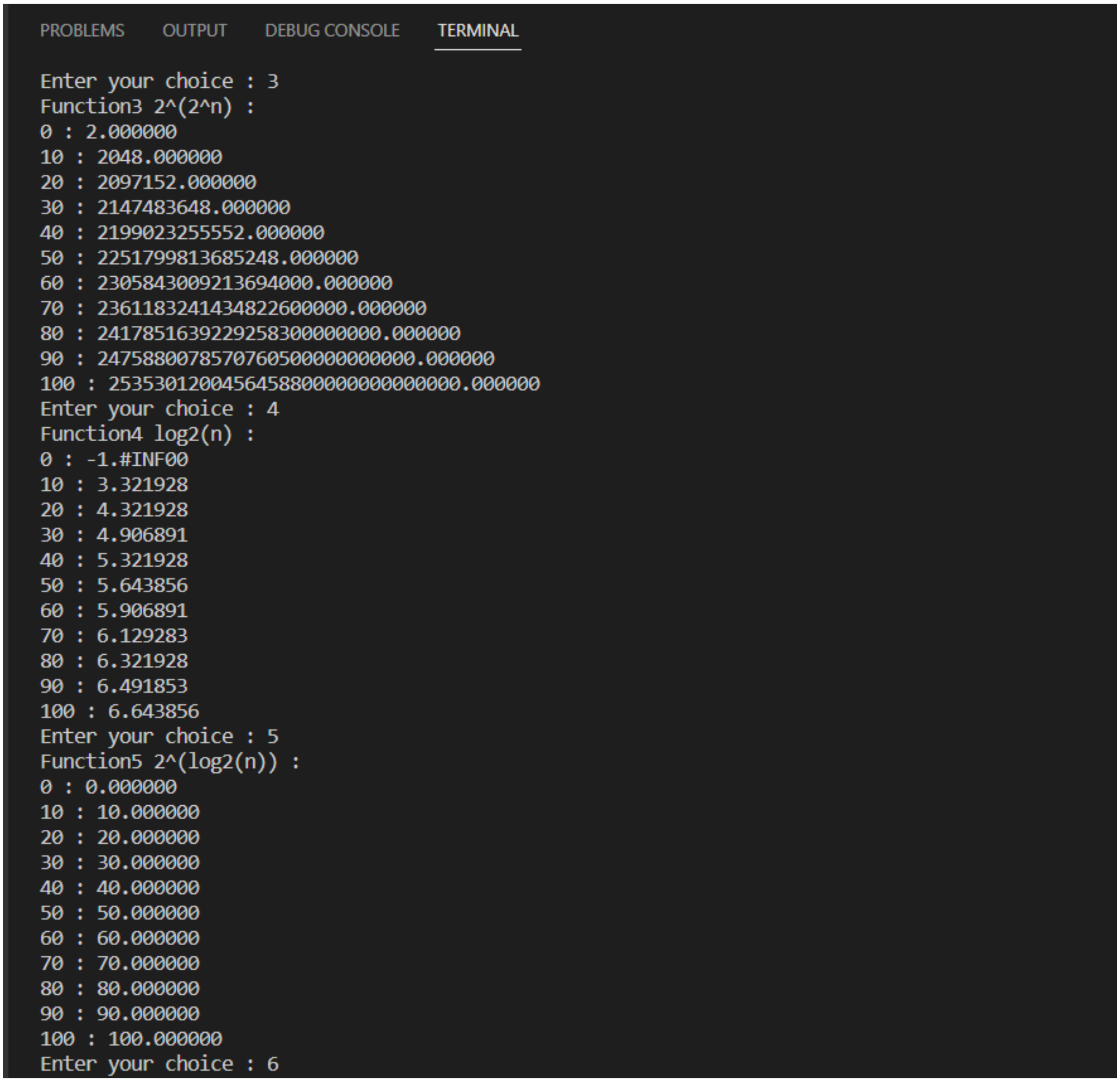


```
            break;
        }
    }
}
```

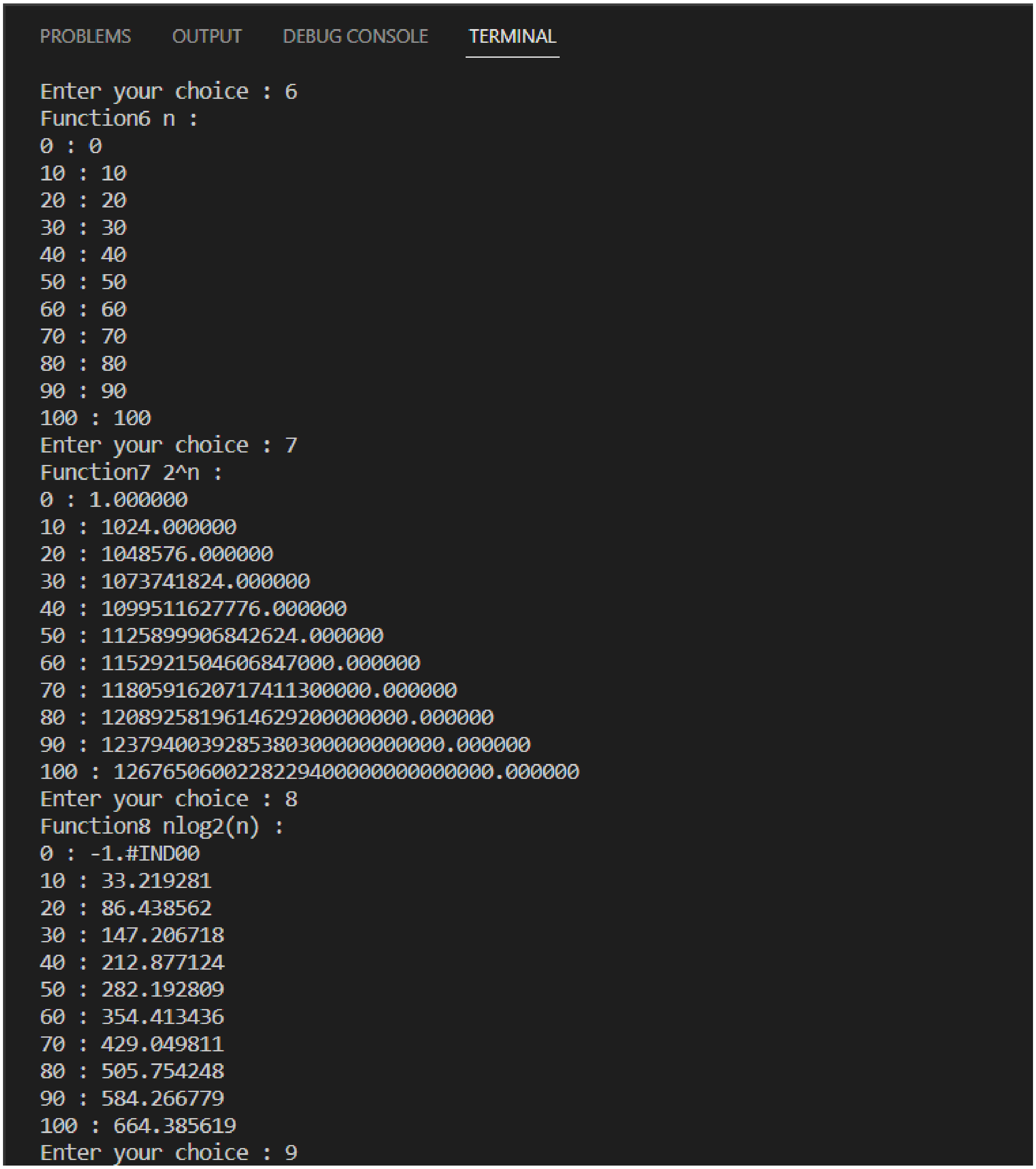
OUTPUT:



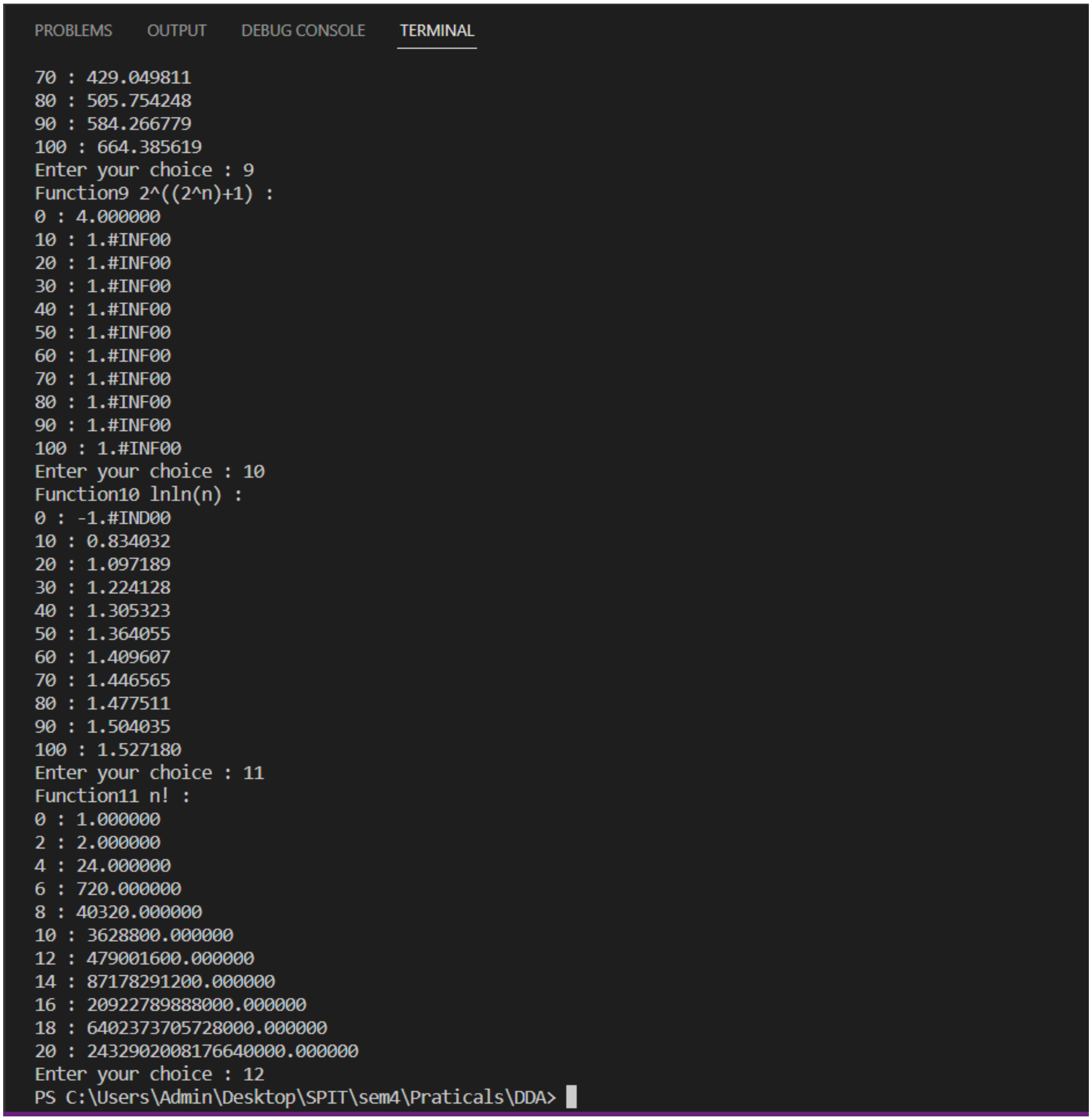
```
PS C:\Users\Admin\Desktop\SPIT\sem4\Praticals\DDA> gcc Experiment1.c
PS C:\Users\Admin\Desktop\SPIT\sem4\Praticals\DDA> ./a.exe
Press 1 : Function1 (3/2)*n
Press 2 : Function2 n^3
Press 3 : Function3 2^(2^n)
Press 4 : Function4 log2(n)
Press 5 : Function5 2^(log2(n))
Press 6 : Function6 n
Press 7 : Function7 2^n
Press 8 : Function8 nlog2(n)
Press 9 : Function9 2^((2^n)+1)
Press 10 : Function10 lnln(n)
Press 11 : Function11 n!
Press 12 : Exit
Enter your choice : 1
Function1 (3/2)*n :
0 : 1.000000
10 : 57.665039
20 : 3325.256730
30 : 191751.059233
40 : 11057332.320940
50 : 637621500.214050
60 : 36768468716.933022
70 : 2120255184830.252000
80 : 122264598055704.640000
90 : 7050392822843069.000000
100 : 406561177535215230.000000
Enter your choice : 2
Function2 n^3 :
0 : 0
10 : 1000
20 : 8000
30 : 27000
40 : 64000
50 : 125000
60 : 216000
70 : 343000
80 : 512000
90 : 729000
100 : 1000000
Enter your choice :
```



```
Enter your choice : 3
Function3 2^(2^n) :
0 : 2.000000
10 : 2048.000000
20 : 2097152.000000
30 : 2147483648.000000
40 : 2199023255552.000000
50 : 2251799813685248.000000
60 : 2305843009213694000.000000
70 : 2361183241434822600000.000000
80 : 2417851639229258300000000.000000
90 : 2475880078570760500000000000.000000
100 : 2535301200456458800000000000000.000000
Enter your choice : 4
Function4 log2(n) :
0 : -1.#INF00
10 : 3.321928
20 : 4.321928
30 : 4.906891
40 : 5.321928
50 : 5.643856
60 : 5.906891
70 : 6.129283
80 : 6.321928
90 : 6.491853
100 : 6.643856
Enter your choice : 5
Function5 2^(log2(n)) :
0 : 0.000000
10 : 10.000000
20 : 20.000000
30 : 30.000000
40 : 40.000000
50 : 50.000000
60 : 60.000000
70 : 70.000000
80 : 80.000000
90 : 90.000000
100 : 100.000000
Enter your choice : 6
```

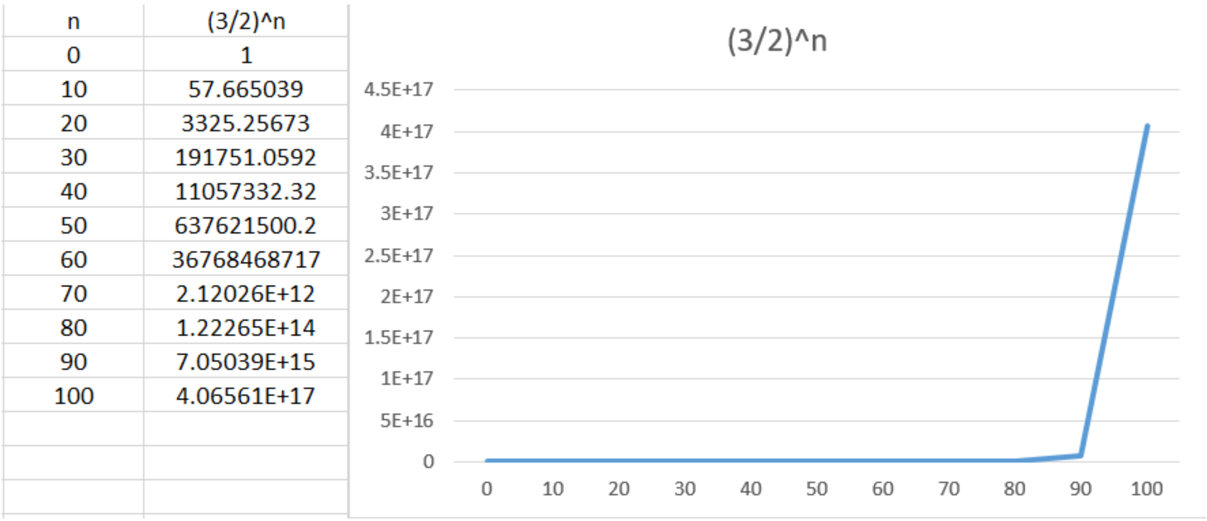


```
Enter your choice : 6
Function6 n :
0 : 0
10 : 10
20 : 20
30 : 30
40 : 40
50 : 50
60 : 60
70 : 70
80 : 80
90 : 90
100 : 100
Enter your choice : 7
Function7 2^n :
0 : 1.000000
10 : 1024.000000
20 : 1048576.000000
30 : 1073741824.000000
40 : 1099511627776.000000
50 : 1125899906842624.000000
60 : 1152921504606847000.000000
70 : 1180591620717411300000.000000
80 : 1208925819614629200000000.000000
90 : 1237940039285380300000000000.000000
100 : 1267650600228229400000000000000.000000
Enter your choice : 8
Function8 nlog2(n) :
0 : -1.#IND00
10 : 33.219281
20 : 86.438562
30 : 147.206718
40 : 212.877124
50 : 282.192809
60 : 354.413436
70 : 429.049811
80 : 505.754248
90 : 584.266779
100 : 664.385619
Enter your choice : 9
```



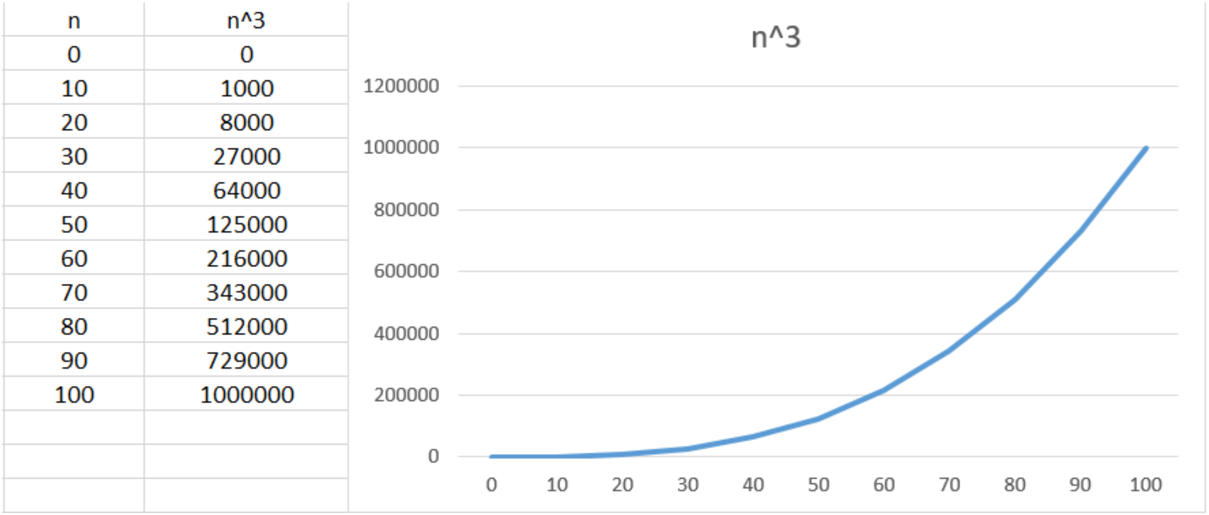
```
70 : 429.049811
80 : 505.754248
90 : 584.266779
100 : 664.385619
Enter your choice : 9
Function9 2^((2^n)+1) :
0 : 4.000000
10 : 1.#INF00
20 : 1.#INF00
30 : 1.#INF00
40 : 1.#INF00
50 : 1.#INF00
60 : 1.#INF00
70 : 1.#INF00
80 : 1.#INF00
90 : 1.#INF00
100 : 1.#INF00
Enter your choice : 10
Function10 lnln(n) :
0 : -1.#IND00
10 : 0.834032
20 : 1.097189
30 : 1.224128
40 : 1.305323
50 : 1.364055
60 : 1.409607
70 : 1.446565
80 : 1.477511
90 : 1.504035
100 : 1.527180
Enter your choice : 11
Function11 n! :
0 : 1.000000
2 : 2.000000
4 : 24.000000
6 : 720.000000
8 : 40320.000000
10 : 3628800.000000
12 : 479001600.000000
14 : 87178291200.000000
16 : 20922789888000.000000
18 : 6402373705728000.000000
20 : 2432902008176640000.000000
Enter your choice : 12
PS C:\Users\Admin\Desktop\SPIT\sem4\Praticals\DDA>
```

1. (3/2)^n



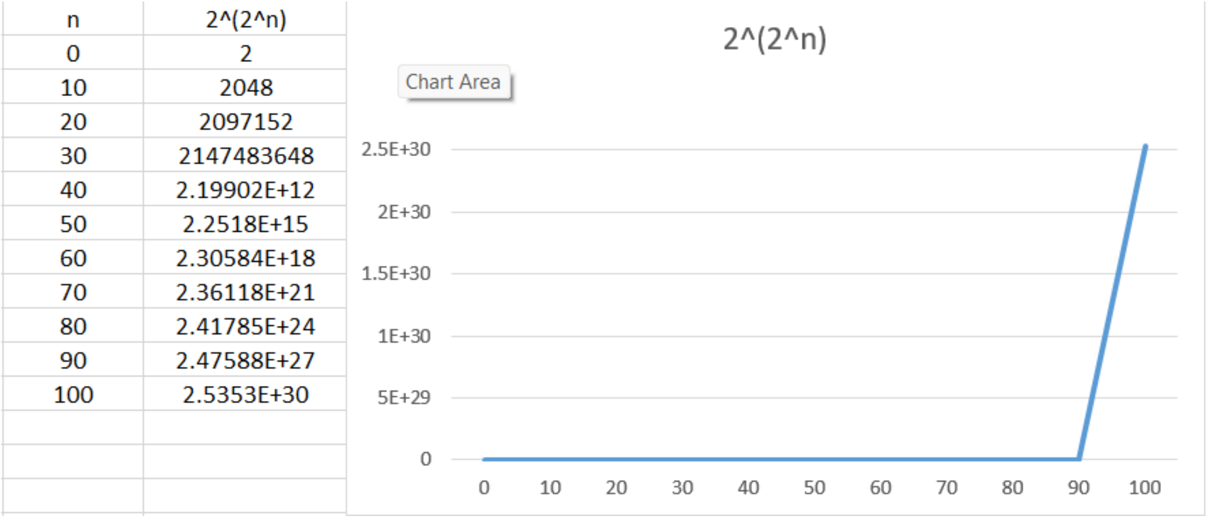
n	(3/2)^n
0	1
10	57.665039
20	3325.25673
30	191751.0592
40	11057332.32
50	637621500.2
60	36768468717
70	2.12026E+12
80	1.22265E+14
90	7.05039E+15
100	4.06561E+17

2. n^3



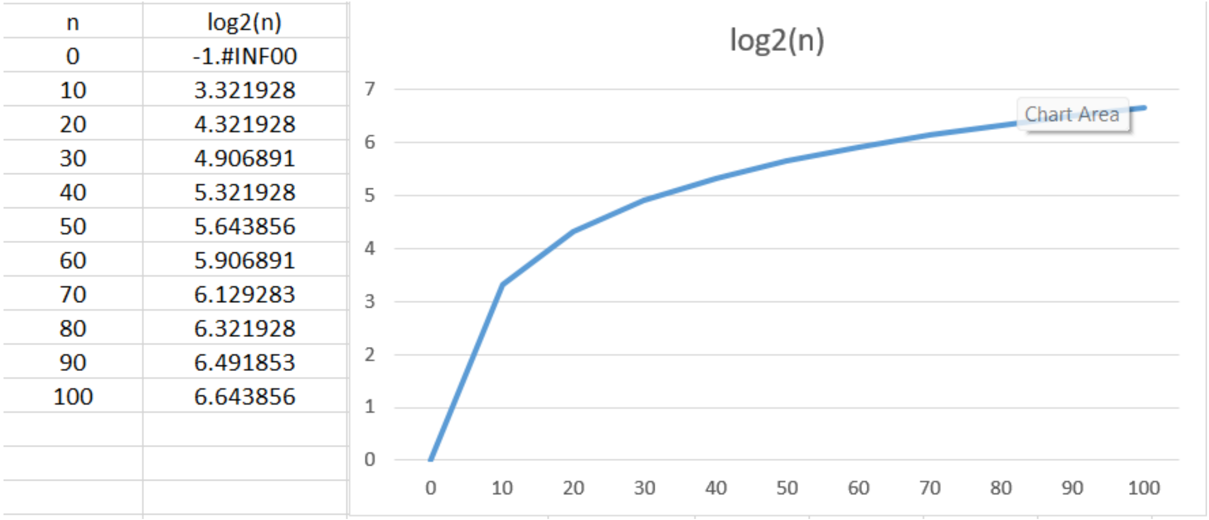
n	n^3
0	0
10	1000
20	8000
30	27000
40	64000
50	125000
60	216000
70	343000
80	512000
90	729000
100	1000000

3. 2^(2^n)



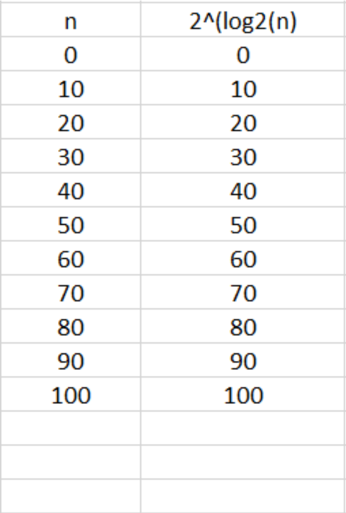
n	2^(2^n)
0	2
10	2048
20	2097152
30	2147483648
40	2.19902E+12
50	2.2518E+15
60	2.30584E+18
70	2.36118E+21
80	2.41785E+24
90	2.47588E+27
100	2.5353E+30

4. Log2(n)

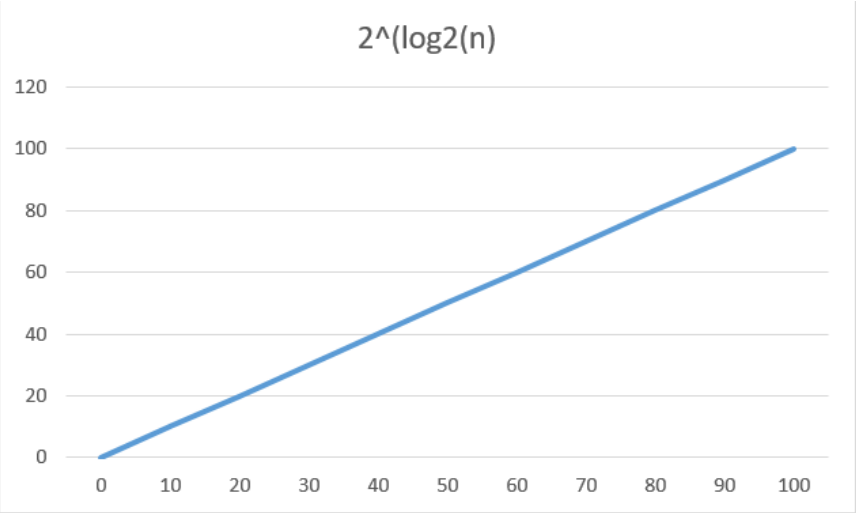


n	log2(n)
0	-1.#INF00
10	3.321928
20	4.321928
30	4.906891
40	5.321928
50	5.643856
60	5.906891
70	6.129283
80	6.321928
90	6.491853
100	6.643856

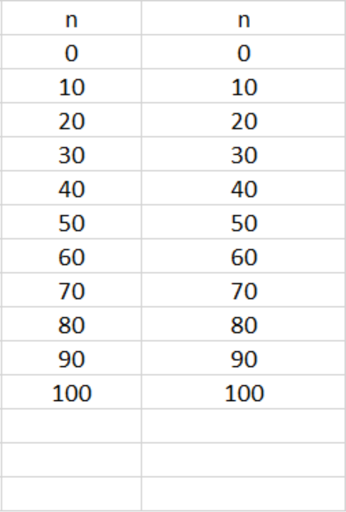
5. 2^(log2(n))



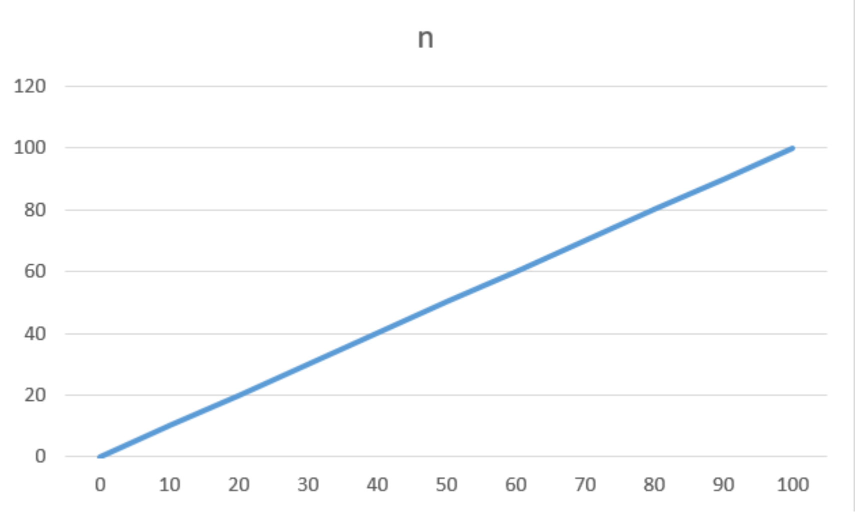
n	2^(log2(n)
0	0
10	10
20	20
30	30
40	40
50	50
60	60
70	70
80	80
90	90
100	100



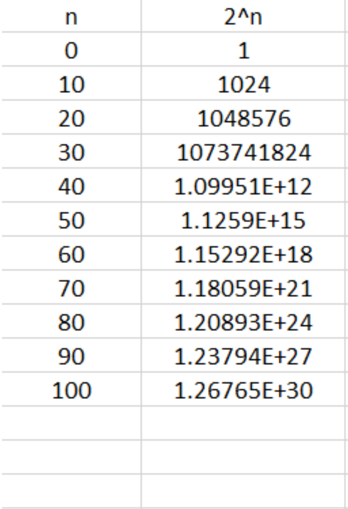
6. n



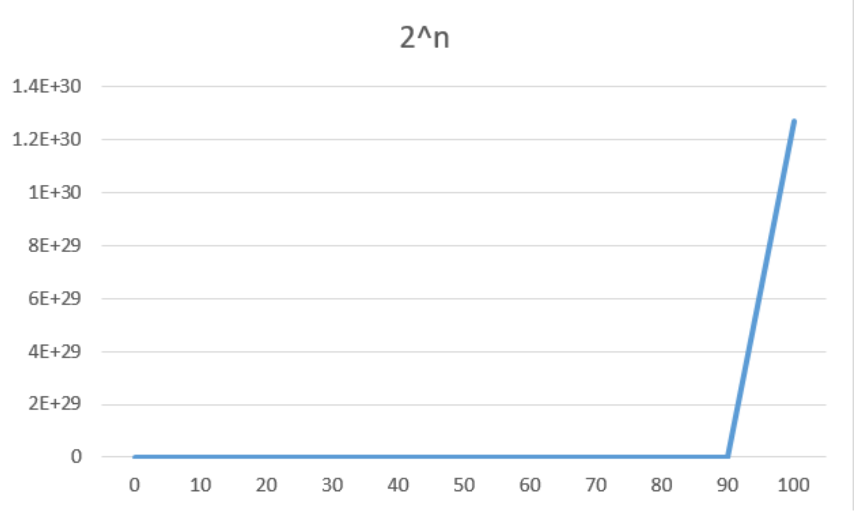
n	n
0	0
10	10
20	20
30	30
40	40
50	50
60	60
70	70
80	80
90	90
100	100



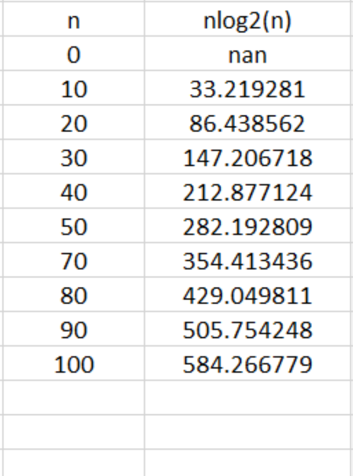
7. 2^n



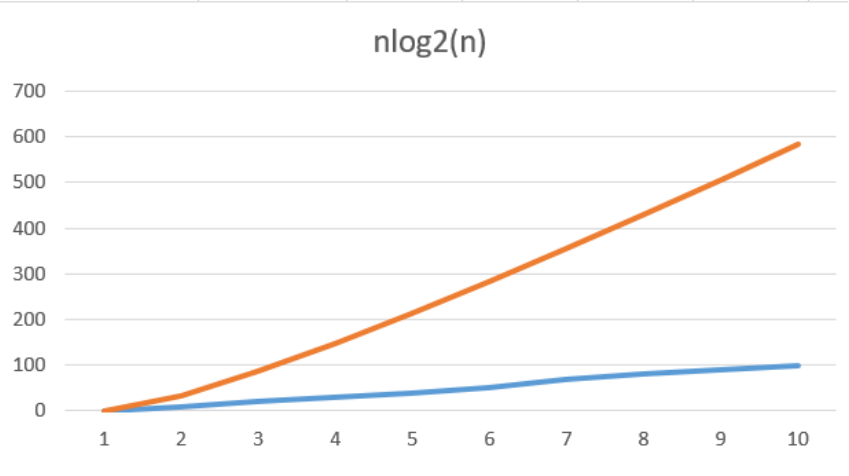
n	2^n
0	1
10	1024
20	1048576
30	1073741824
40	1.09951E+12
50	1.1259E+15
60	1.15292E+18
70	1.18059E+21
80	1.20893E+24
90	1.23794E+27
100	1.26765E+30



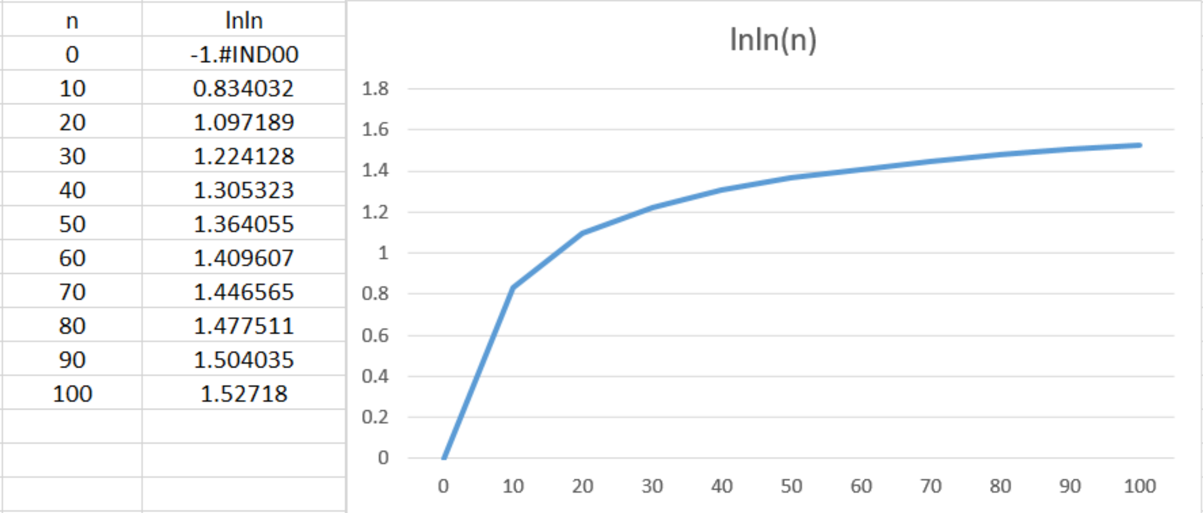
8. nlog2(n)



n	nlog2(n)
0	nan
10	33.219281
20	86.438562
30	147.206718
40	212.877124
50	282.192809
70	354.413436
80	429.049811
90	505.754248
100	584.266779

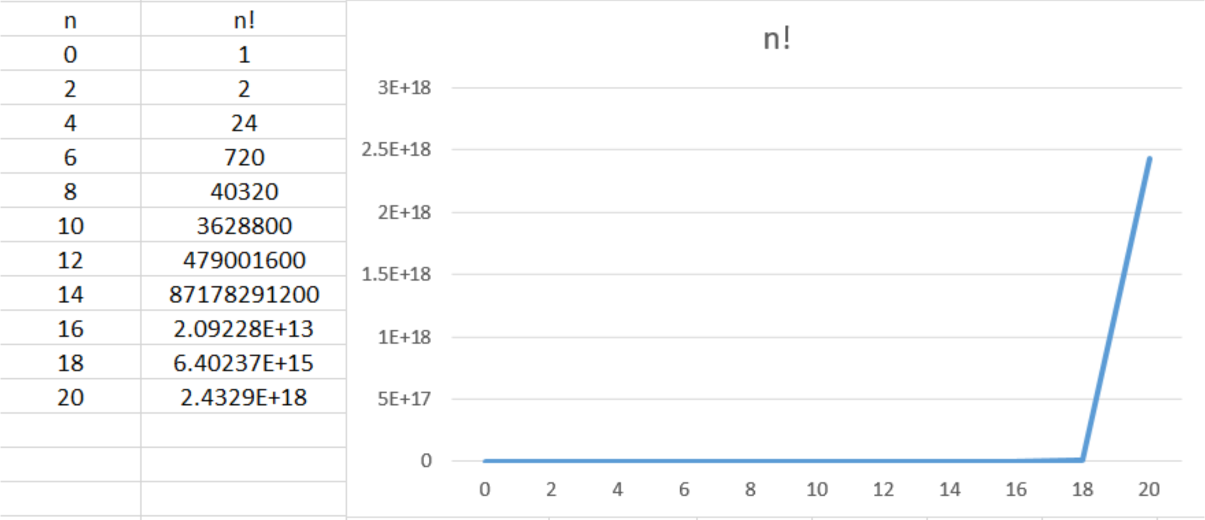


10. lnln(n)



n	lnln
0	-1.#IND00
10	0.834032
20	1.097189
30	1.224128
40	1.305323
50	1.364055
60	1.409607
70	1.446565
80	1.477511
90	1.504035
100	1.52718

11. n!



n	n!
0	1
2	2
4	24
6	720
8	40320
10	3628800
12	479001600
14	87178291200
16	2.09228E+13
18	6.40237E+15
20	2.4329E+18

Program 2	
PROBLEM STATEMENT :	Implement two sorting algorithms namely Insertion and Selection sort methods. Compare these algorithms based on time and space complexity.

ALGORITHM/ THEORY:

Insertion Sort

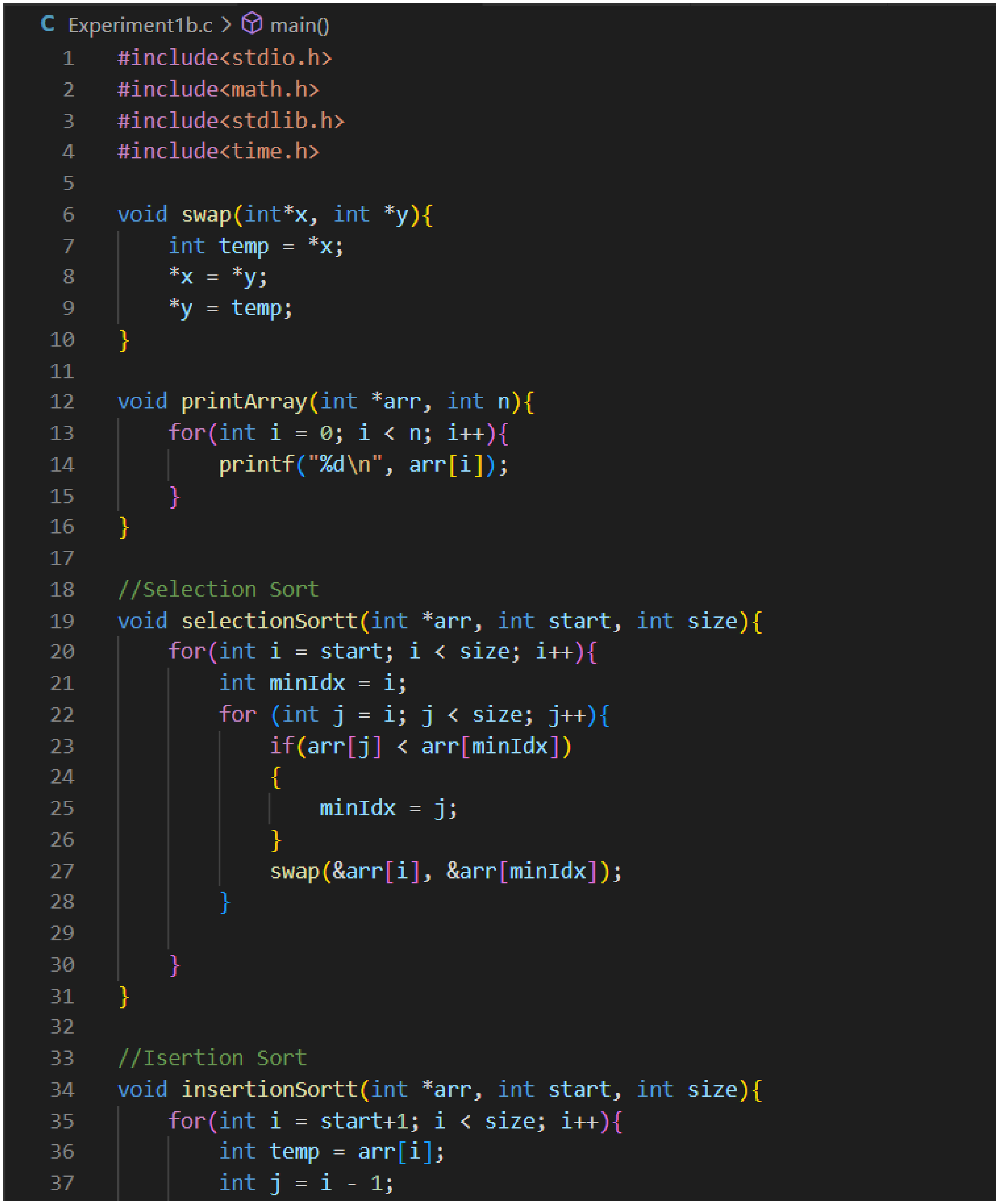
```
procedure insertionSort( A : array of items )
   int holePosition
   int valueToInsert
   for i = 1 to length(A) inclusive do:
      /* select value to be inserted */
      valueToInsert = A[i]
      holePosition = i
      /*locate hole position for the element to be inserted */
      while holePosition > 0 and A[holePosition-1] > valueToInsert do:
         A[holePosition] = A[holePosition-1]
         holePosition = holePosition -1
      end while

      /* insert the number at hole position */
      A[holePosition] = valueToInsert
   end for
end procedure
```

Selection Sort

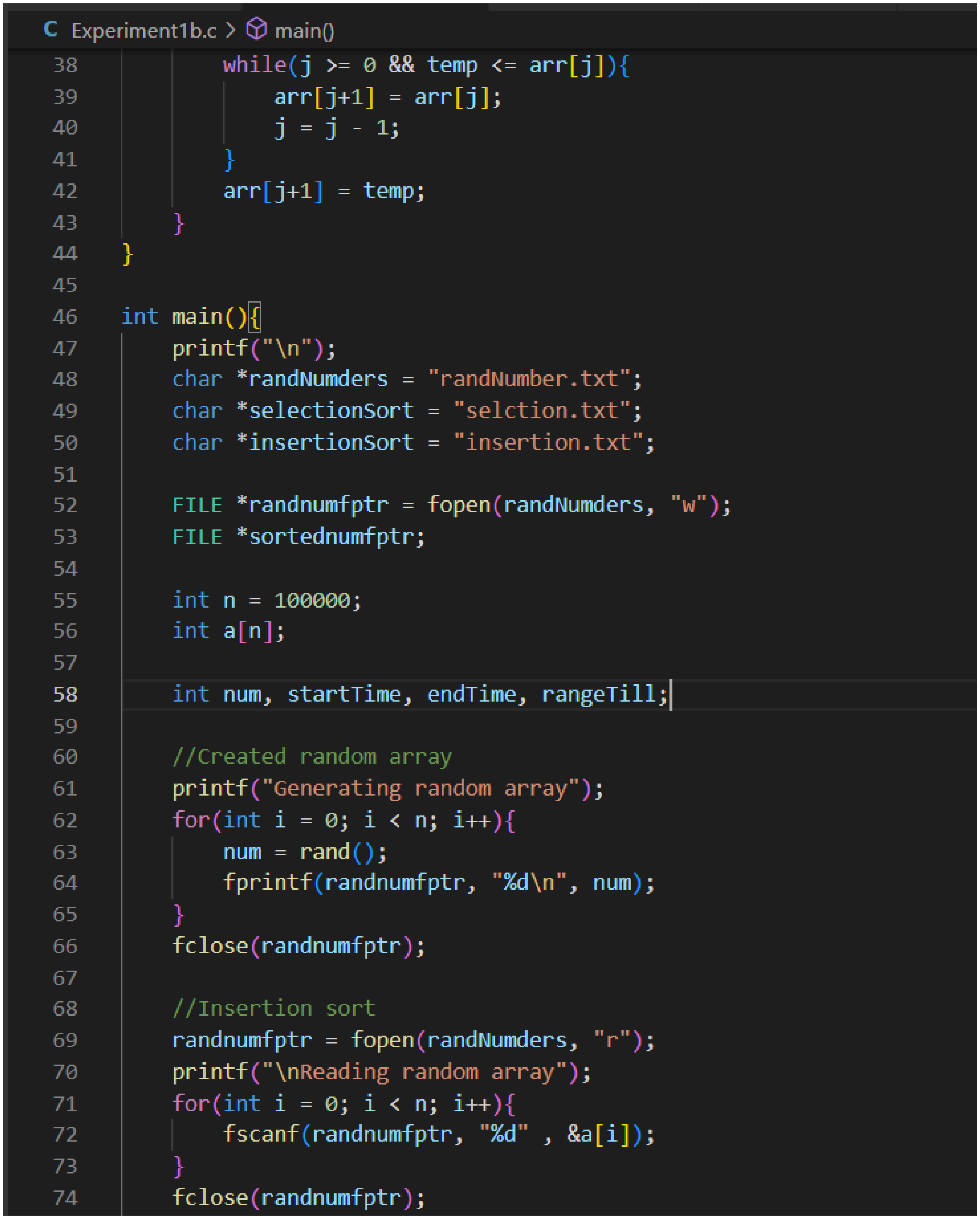
```
procedure selection sort
   list : array of items
   n : size of list
   for i = 1 to n - 1
      /* set current element as minimum*/
      min = i
      /* check the element to be minimum */
      for j = i+1 to n
         if list[j] < list[min] then
            min = j;
         end if
      end for
      /* swap the minimum element with the current element*/
      if indexMin != i then
```

```
swap list[min] and list[i]
end if
end for
end procedure
```

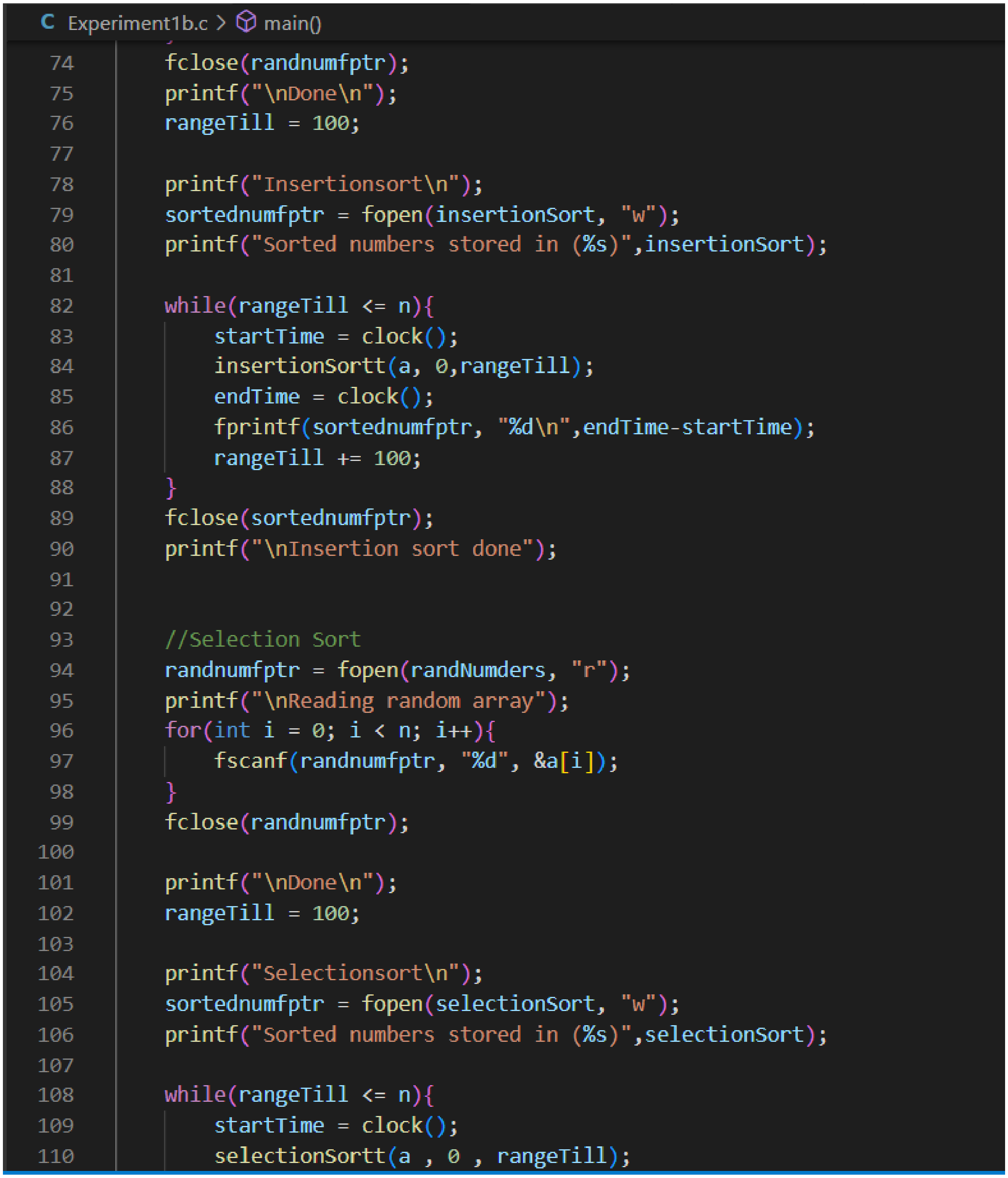
PROGRAM:



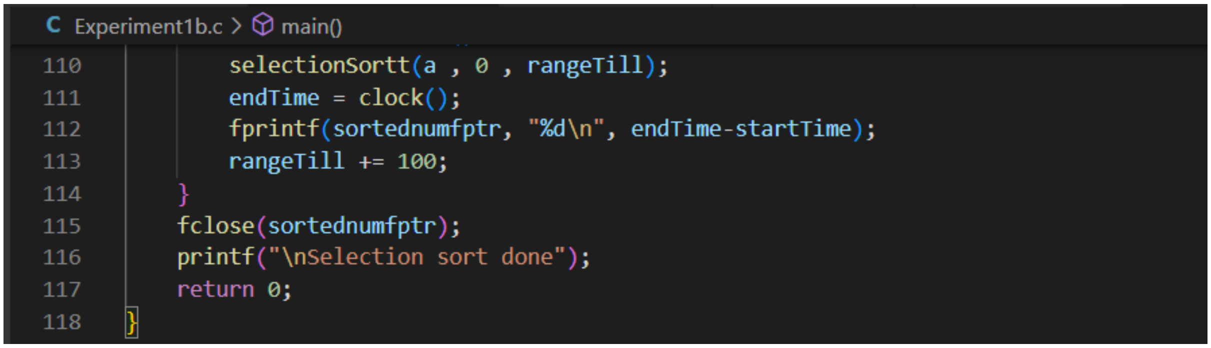
```c
#include<stdio.h>
#include<math.h>
#include<stdlib.h>
#include<time.h>

void swap(int*x, int *y){
    int temp = *x;
    *x = *y;
    *y = temp;
}

void printArray(int *arr, int n){
    for(int i = 0; i < n; i++){
        printf("%d\n", arr[i]);
    }
}

//Selection Sort
void selectionSortt(int *arr, int start, int size){
    for(int i = start; i < size; i++){
        int minIdx = i;
        for (int j = i; j < size; j++){
            if(arr[j] < arr[minIdx])
            {
                minIdx = j;
            }
            swap(&arr[i], &arr[minIdx]);
        }

    }
}

//Isertion Sort
void insertionSortt(int *arr, int start, int size){
    for(int i = start+1; i < size; i++){
        int temp = arr[i];
        int j = i - 1;
```



```c
        while(j >= 0 && temp <= arr[j]){
            arr[j+1] = arr[j];
            j = j - 1;
        }
        arr[j+1] = temp;
    }
}

int main(){
    printf("\n");
    char *randNumders = "randNumber.txt";
    char *selectionSort = "selction.txt";
    char *insertionSort = "insertion.txt";

    FILE *randnumfptr = fopen(randNumders, "w");
    FILE *sortednumfptr;

    int n = 100000;
    int a[n];

    int num, startTime, endTime, rangeTill;

    //Created random array
    printf("Generating random array");
    for(int i = 0; i < n; i++){
        num = rand();
        fprintf(randnumfptr, "%d\n", num);
    }
    fclose(randnumfptr);

    //Insertion sort
    randnumfptr = fopen(randNumders, "r");
    printf("\nReading random array");
    for(int i = 0; i < n; i++){
        fscanf(randnumfptr, "%d" , &a[i]);
    }
    fclose(randnumfptr);
```

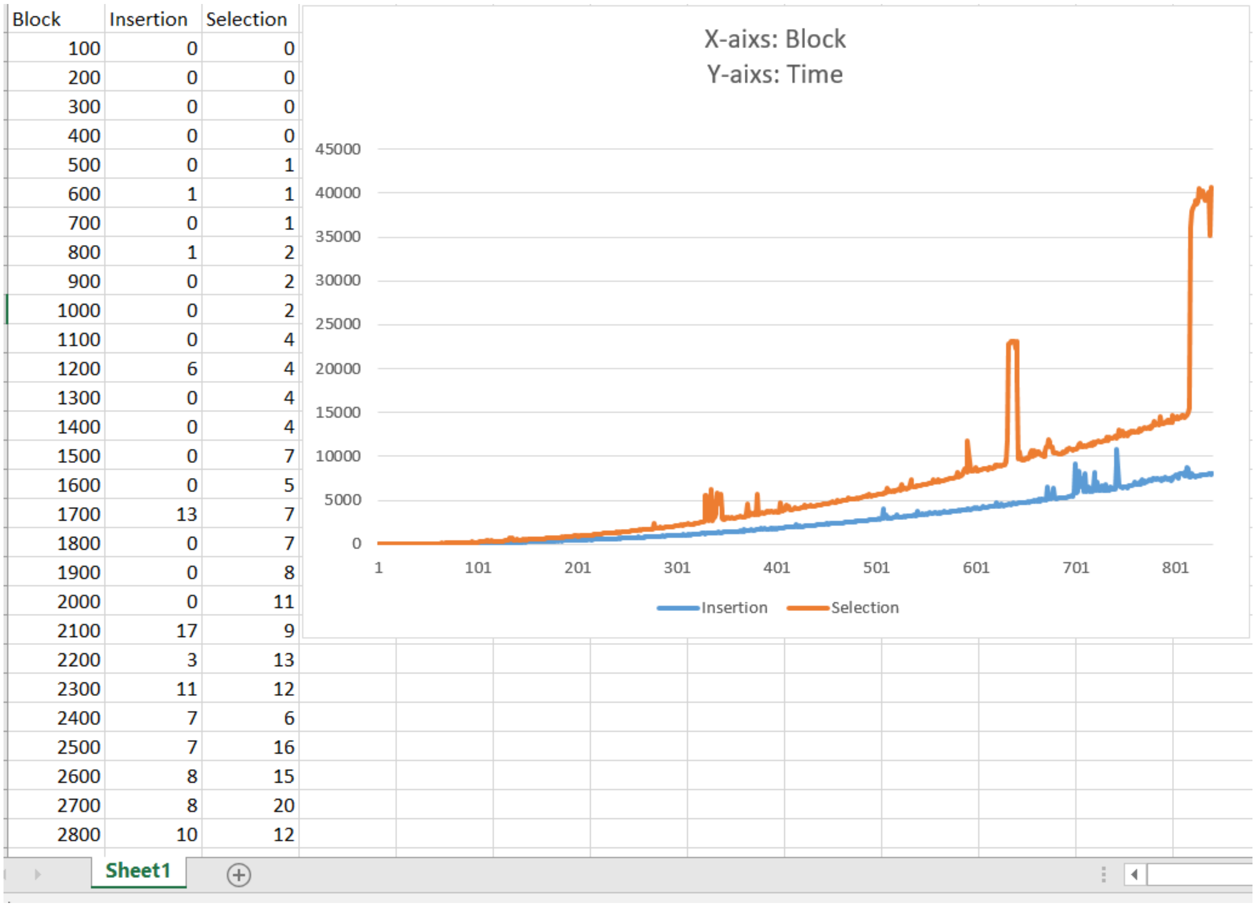


```c
    fclose(randnumfptr);
    printf("\nDone\n");
    rangeTill = 100;

    printf("Insertionsort\n");
    sortednumfptr = fopen(insertionSort, "w");
    printf("Sorted numbers stored in (%s)",insertionSort);

    while(rangeTill <= n){
        startTime = clock();
        insertionSortt(a, 0,rangeTill);
        endTime = clock();
        fprintf(sortednumfptr, "%d\n",endTime-startTime);
        rangeTill += 100;
    }
    fclose(sortednumfptr);
    printf("\nInsertion sort done");


    //Selection Sort
    randnumfptr = fopen(randNumders, "r");
    printf("\nReading random array");
    for(int i = 0; i < n; i++){
        fscanf(randnumfptr, "%d", &a[i]);
    }
    fclose(randnumfptr);

    printf("\nDone\n");
    rangeTill = 100;

    printf("Selectionsort\n");
    sortednumfptr = fopen(selectionSort, "w");
    printf("Sorted numbers stored in (%s)",selectionSort);

    while(rangeTill <= n){
        startTime = clock();
        selectionSortt(a , 0 , rangeTill);
```



```c
        selectionSortt(a , 0 , rangeTill);
        endTime = clock();
        fprintf(sortednumfptr, "%d\n", endTime-startTime);
        rangeTill += 100;
    }
    fclose(sortednumfptr);
    printf("\nSelection sort done");
    return 0;
}
```

GRAPH:



Block	Insertion	Selection
100	0	0
200	0	0
300	0	0
400	0	0
500	0	1
600	1	1
700	0	1
800	1	2
900	0	2
1000	0	2
1100	0	4
1200	6	4
1300	0	4
1400	0	4
1500	0	7
1600	0	5
1700	13	7
1800	0	7
1900	0	8
2000	0	11
2100	17	9
2200	3	13
2300	11	12
2400	7	6
2500	7	16
2600	8	15
2700	8	20
2800	10	12

CONCLUSION:

In this experiment, we implemented, calculated & analyzed the runtime of various functions by plotting their outputs in range 0-100 with increment of 10.
Also, we calculated & analyzed the time consumed by insertion & selection sorting algorithms