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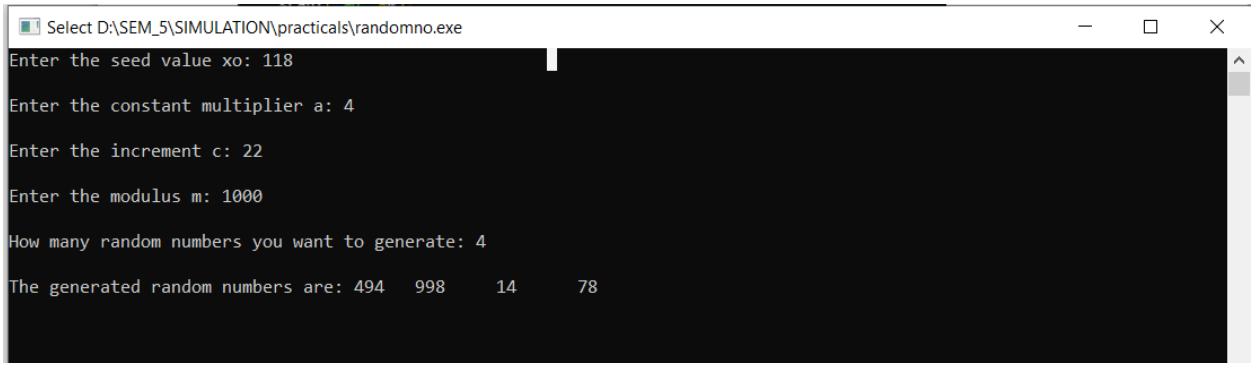
C Program of Linear Congruential Method

```
#include<stdio.h>
#include<conio.h>
int main()
{
	int xo,x1; /*xo=seed, x1=next random number that we will generate */
	int a,c,m; /*a=constant multiplier, c=increment, m=modulus */
	int i,n; /*i for loopcontrol, n for how many random numbers */
	int array[20]; /*to store the random numbers generated */
	printf("Enter the seed value xo: ");
	scanf("%d",&xo);
	printf("\n");
	printf("Enter the constant multiplier a: ");
	scanf("%d",&a);
	printf("\n");
	printf("Enter the increment c: ");
	scanf("%d",&c);
	printf("\n");
	printf("Enter the modulus m: ");
	scanf("%d",&m);
	printf("\n");
	printf("How many random numbers you want to generate: ");
	scanf("%d",&n);
	printf("\n");
	for(i=0;i<n;i++) /* loop to generate random numbers */
```

```
    {
        x1=(a*xo+c) %m;
        array[i]=x1;
        xo=x1;
    }
    printf("The generated random numbers are: ");
    for(i=0;i<n;i++)
    {
        printf("%d",array[i]);
        printf("\t");
    }
    getch();
    return(0);
}
```



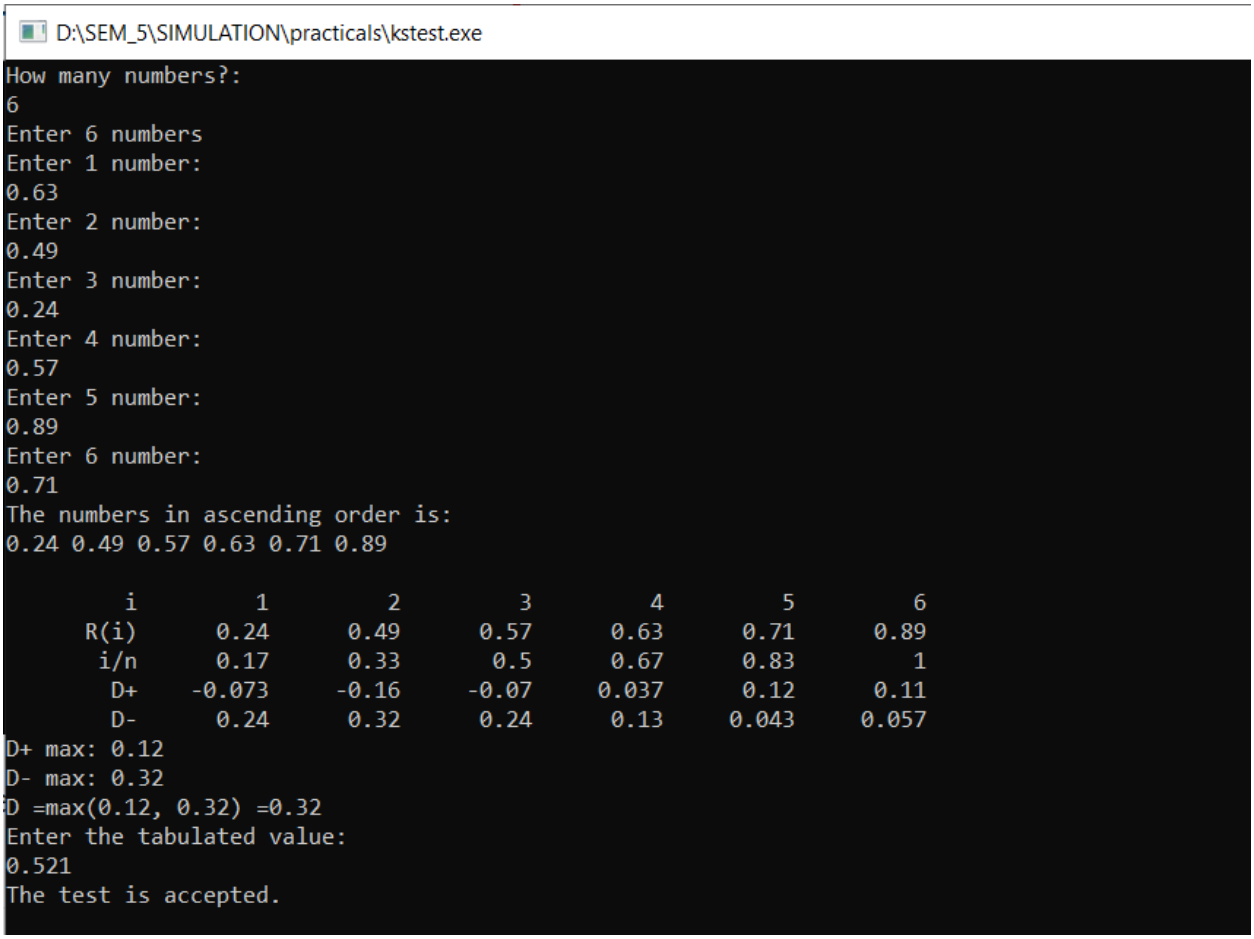
C++ Program of Kolmogorov Smirnovks (KS) Test

```
#include<iostream>
#include<conio.h>
#include<iomanip>
using namespace std;
class KS
{
private:
float numbers[20];
float D,tabulatedD;
float Dplusmax,Dminusmax;
float Dplus[20],Dminus[20];
float ratio[20],ratiominus[20];
int i,j,n;
public:
void getdata() //to get the random numbers
{
cout<<"How many numbers?:"<<endl;
cin>>n;
cout<<"Enter "<<n<<" numbers"<<endl;
for(i=0;i<n;i++)
{
cout<<"Enter "<<i+1<<" number:"<<endl;
cin>>numbers[i];
}
}
float BubbleSort() // arrange the number in increasing order
{
int i,j;
float temp;
for(i=0;i<n-1;i++)
{
for(j=0;j<n-i-1;j++)
{
if(numbers[j]>numbers[j+1])
{
temp=numbers[j];
numbers[j]=numbers[j+1];
numbers[j+1]=temp;
}
}
}
```

```
cout<<"The numbers in ascending order is:"<<endl;
for(i=0;i<n;i++)
{
cout<<setprecision(2)<<numbers[i]<<" ";
}
}
void calculate() // find D+, D-
{
for(i=0;i<n;i++)
{
int j;
j=i+1;
ratio[i]=(float)j/n;
ratiominus[i]=(float)i/n;
Dplus[i]=ratio[i]-numbers[i];
Dminus[i]=numbers[i]-ratiominus[i];
}
}
void display() // display the tabulated format and find D
{
cout<<endl;
cout<<endl;
cout<<setw(10)<<"i";
for(i=1;i<=n;i++)
{
cout<<setw(10)<<i;
}
cout<<endl;
cout<<setw(10)<<"R(i)";
for(i=0;i<n;i++)
{
cout<<setw(10)<<numbers[i];
}
cout<<endl;
cout<<setw(10)<<"i/n";

for(i=0;i<n;i++)
{
cout<<setw(10)<<setprecision(2)<<ratio[i];
}
cout<<endl;
cout<<setw(10)<<"D+";
for(i=0;i<n;i++)
{
cout<<setw(10)<<setprecision(2)<<Dplus[i];
}
cout<<endl;
```

```
cout<<setw(10)<<"D-";
for(i=0;i<n;i++)
{
cout<<setw(10)<<setprecision(2)<<D
minus[i];
}
cout<<endl;
Dplusmax=Dplus[0];
Dminusmax=Dminus[0];
for(i=1;i<n;i++)
{
if(Dplus[i]>Dplusmax)
{
Dplusmax=Dplus[i];
}
if(Dminus[i]>Dminusmax)
{
Dminusmax=Dminus[i];
}
}
cout<<"D+ max:
"<<Dplusmax<<endl;
cout<<"D- max:
"<<Dminusmax<<endl;
cout<<"D =max("<<Dplusmax<<",
"<<Dminusmax<<") =";
if(Dplusmax>Dminusmax)
{
D=Dplusmax;
}
else
{
D=Dminusmax;
}
cout<<D;
cout<<endl;
}
void conclusion() // asking tabulated
D and comparing it with
D(calculated)
{
cout<<"Enter the tabulated
value:"<<endl;
cin>>tabulatedD;
if(D<tabulatedD)
{
cout<<"The test is accepted."<<endl;
}
else
{
cout<<"The test is rejected."<<endl;
}
}
```

```
};

int main() //main function
{
KS ks1; //object of KS class
ks1.getdata(); //function calls
ks1.BubbleSort();
ks1.calculate();
ks1.display();
ks1.conclusion();
getch();
return(0);
}
```

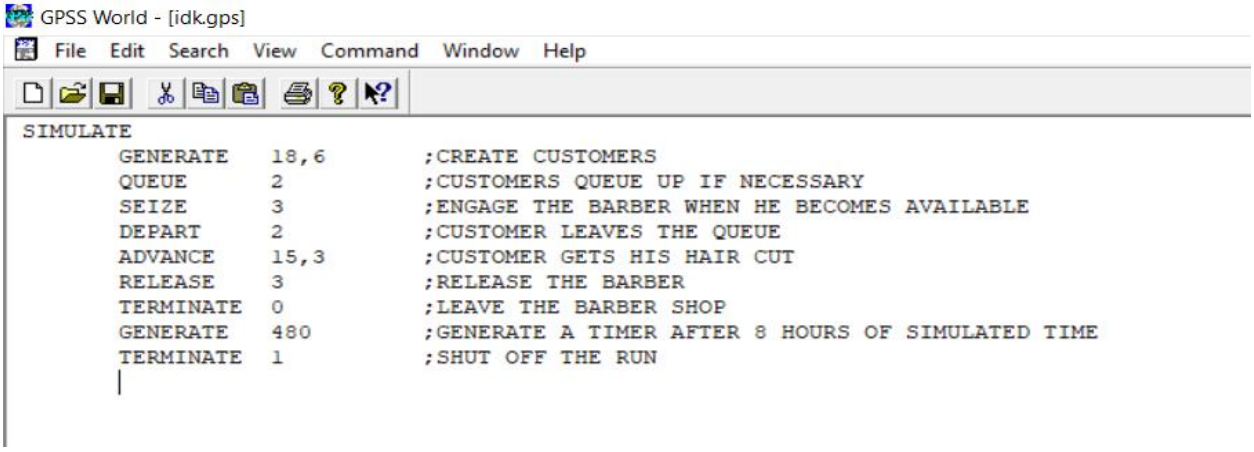


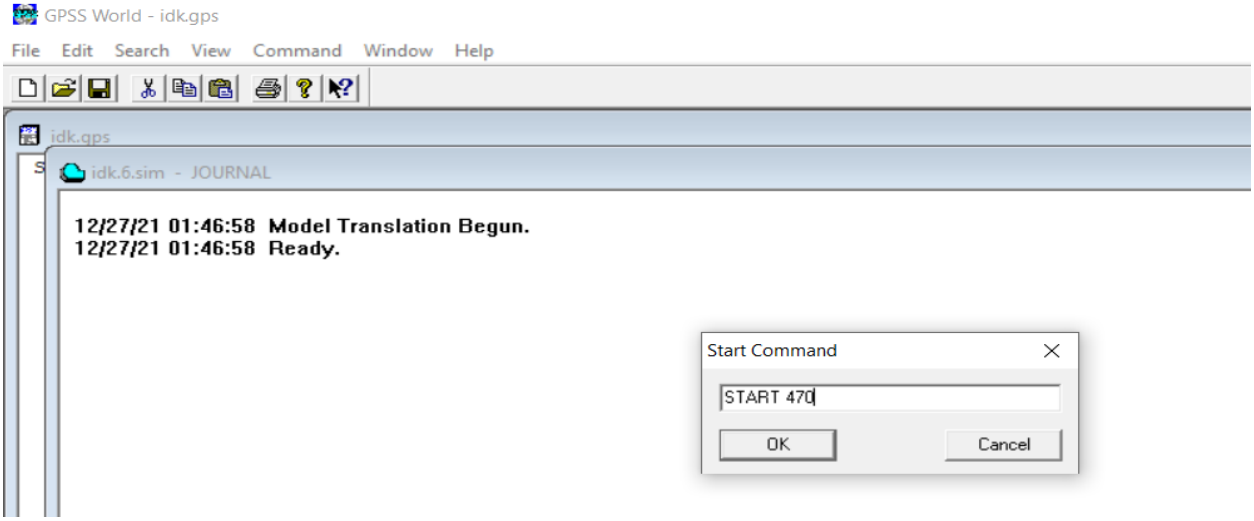
Estimate the value of PI using Monte Carlo Method

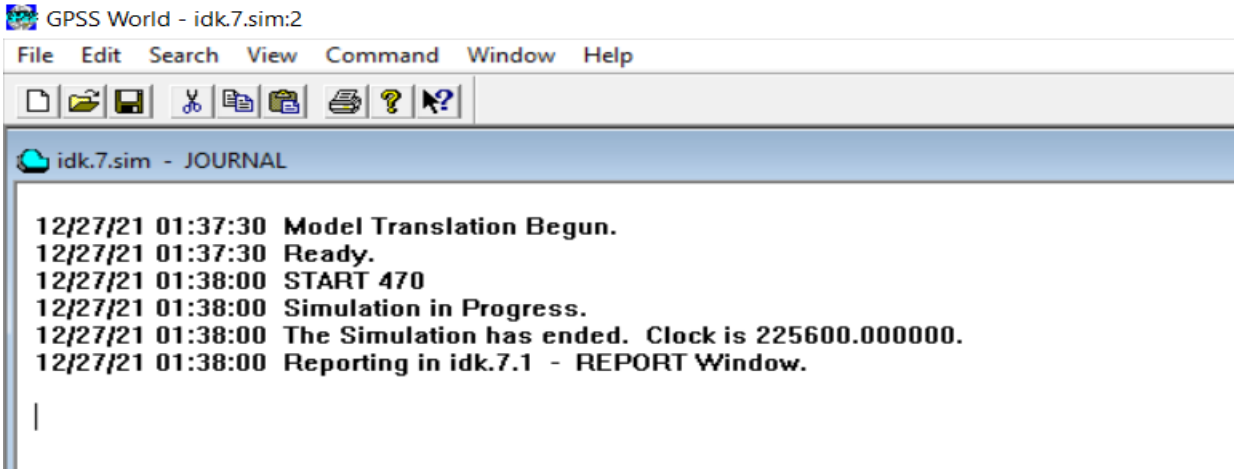
```
import random
INTERVAL= 1000
circle_points= 0
square_points= 0

# Total Random numbers generated= possible x
# values* possible y values
for i in range(INTERVAL**2):

    # Randomly generated x and y values from a
    # uniform distribution
    # Range of x and y values is -1 to 1
    rand_x= random.uniform(-1, 1)
    rand_y= random.uniform(-1, 1)

    # Distance between (x, y) from the origin
    origin_dist= rand_x**2 + rand_y**2

    # Checking if (x, y) lies inside the circle
    if origin_dist<= 1:
        circle_points+= 1

    square_points+= 1

    # Estimating value of pi,
    # pi= 4*(no. of points generated inside the
    # circle)/ (no. of points generated inside the square)
    pi = 4* circle_points/ square_points

## print(rand_x, rand_y, circle_points, square_points, "-", pi)
## print("\n")

print("Final Estimation of Pi=", pi)
```

```
PS C:\xampp\htdocs\RANJAN> & C:/Users/Asus/AppData/Local/Microsoft/WindowsApps/python3.9.exe d:/SEM_5/SIMULATION/practicals
/pi.py
Final Estimation of Pi= 3.140708
```

GPSS Barber Shop Simulation







GPSS World - [idk.7.1 - REPORT]

File Edit Search View Command Window Help

```
              GPSS World Simulation Report - idk.7.1


                   Monday, December 27, 2021 01:38:00

           START TIME           END TIME  BLOCKS  FACILITIES  STORAGES
                0.000         225600.000     9         1          0


 LABEL              LOC  BLOCK TYPE     ENTRY COUNT CURRENT COUNT RETRY
                    1    GENERATE         12526              0       0
                    2    QUEUE            12526              0       0
                    3    SEIZE            12526              0       0
                    4    DEPART           12526              0       0
                    5    ADVANCE          12526              1       0
                    6    RELEASE          12525              0       0
                    7    TERMINATE        12525              0       0
                    8    GENERATE           470              0       0
                    9    TERMINATE          470              0       0


FACILITY          ENTRIES  UTIL.   AVE. TIME AVAIL. OWNER PEND INTER RETRY DELAY
 3                 12526    0.831      14.962  1    12996    0    0     0      0


QUEUE               MAX CONT. ENTRY ENTRY(0) AVE.CONT. AVE.TIME   AVE.(-0) RETRY
 2                    2    0  12526   8601     0.046      0.828      2.643   0


FEC XN    PRI         BDT      ASSEM  CURRENT  NEXT  PARAMETER    VALUE
 12996     0       225610.223   12996      5      6
 12997     0       225612.209   12997      0      1
 12998     0       226080.000   12998      0      8
```

GPSS World - [idk.7.sim:3 - BLOCK ENTITIES]

File Edit Search View Command Window Help

Location | Find | Continue | Halt | Step | Place | Remove

Loc	Block Type	Current Count	Entry Count	Retry Chain	Line Number	Include-file
1 GEN	GENERATE	0	12526	0	2	0
2 QUE	QUEUE	0	12526	0	3	0
3 SEI	SEIZE	0	12526	0	4	0
4 DEP	DEPART	0	12526	0	5	0
5 ADV	ADVANCE	1	12526	0	6	0
6 REL	RELEASE	0	12525	0	7	0
7 TER	TERMINATE	0	12525	0	8	0
8 GEN	GENERATE	0	470	0	9	0
9 TER	TERMINATE	0	470	0	10	0

M-M-1 Queue Simulation

```
import numpy as np
import queue
import copy
import matplotlib.pyplot as plt
# Input Parameters
total_time = int(input("Enter time
for simulation (Hours): "))
IAT_rate = int(input("Enter Job
Arrival Rate (/Hour): "))
ST_rate = int(input("Enter Job
Service Rate (/Hour): "))
rho = IAT_rate/ST_rate
# Initialize Parameters
qu = queue.Queue()
curr_process = None
IAT = []
ST = []
AT = []
wait_time = []
server_busy = False
list_wait = []
list_delay = []
num_processes =
int(np.random.poisson(IAT_rate)*
total_time)
num_processes_served = 0
# Populate Inter-Arrival-Times (IAT)
for i in range(num_processes):
    temp =
np.random.exponential(1/IAT_rate)*60*
60
    if i==0:
        IAT.append(0)
    else:
        IAT.append(int(temp -
temp%1))
# Populate Service-Times (ST) (where
ST[i]!=0)
while not len(ST) == num_processes:
    temp =
np.random.exponential(1/ST_rate)*60*6
0
    if not int(temp- temp%1)<1:
        ST.append(int(temp - temp%1))
# Save a copy of ST
ST_copy = copy.deepcopy(ST)
# Get Arrival-Times (AT) from IAT
starting at t=0
# and initialize Waiting-Times to 0
for i in range(num_processes):
    if i == 0:
        AT.append(0)
    else:
        AT.append(AT[i-1] + IAT[i])
    wait_time.append(0)
# Simulation of M/M/1 Queue (i
represents current time)
for i in range(total_time*60*60):
    if server_busy:
        for item in list(qu.queue):
            wait_time[item] =
wait_time[item] + 1
        ST[curr_process] =
ST[curr_process] - 1
        if ST[curr_process] == 0:
            server_busy = False
            num_processes_served =
num_processes_served + 1
    for j in range(num_processes):
        if i== AT[j]:
            qu.put(j)
    if not server_busy and not
qu.empty():
        curr_process = qu.get()
        server_busy = True
    sum_wait = 0
    sum_delay = 0
    for i in
range(num_processes_served):
        sum_wait = sum_wait +
wait_time[i]
        sum_delay = sum_delay +
wait_time[i] + ST_copy[i]
    if num_processes_served == 0:
```

```
        list_wait.append(0)
        list_delay.append(0)
    else:
        list_wait.append(sum_wait/(nu
m_processes_served*60*60))
        list_delay.append(sum_delay/(
num_processes_served*60*60))
```

```
plt.plot([i+1 for i in
range(total_time*60*60)], list_wait)
plt.ylabel("Avg Wait Times")
plt.show()
plt.plot([i+1 for i in
range(total_time*60*60)], list_delay)
plt.ylabel("Avg Delay Times")
plt.show()
```

```
PS C:\xampp\htdocs\RANJAN> & C:/Users/Asus/AppData/Local/Microsoft/WindowsApps/python3.9.exe c:/xampp/htdocs/RANJAN/lab/mm1
.py
Enter time for simulation (Hours): 1
Enter Job Arrival Rate (/Hour): 60
Enter Job Service Rate (/Hour): 75
```