İTÜ Computer Engineering Department **04/04/2007**

Lec. Binnur Kurt
Lec. Dr. Yaşar Erenler

BIL105E - INTRODUCTION TO SCIENTIFIC AND ENGINEERING COMPUTING

KEYS to MIDTERM EXAM

(There are 4 Questions. 2-Hour Exam)

Q.1) (30) Monte Carlo methods can be thought of as statistical simulation methods that utilize a sequence of random numbers to perform the simulation. The name "Monte Carlo'' was coined by Nicholas Constantine Metropolis (1915-1999) and inspired by Stanslaw Ulam (1909-1986), because of the similarity of statistical simulation to games of chance, and because Monte Carlo is a center for gambling and games of chance. In this question you will write a simple Monte Carlo simulation to approximate the value of π. It involves randomly selecting points $\left\{\left(x_i, y_i\right)\right\}_{i=1}^{n}$ in the unit square and determining the ratio $\rho = \frac{m}{n}$, where *m* is number of points that satisfy $x_i^2 + y_i^2 \leq 1$. You will read *n* from the keyboard, perform the simulation as explained above and print the ratio ρ to the screen.

```
#include <iostream>
#include <cstdlib>
#include <ctime>
using namespace std;

int main(){
   int n,m=0;
   cin >> n;
   srand(time(NULL));
   for (int i=0;i<n;++i){
       double x,y;
       x = 2.0*((double)rand()/RAND_MAX)-1;
       y = 2.0*((double)rand()/RAND_MAX)-1;
       if ((x*x+y*y)<=1.0) ++m;
   }
   cout << "pi is " << ((4.0*m)/n) ;
   return 0;
}
```

Q.2) (20) Write a function (**getSumOfOddDigits**) which takes an **unsigned long integer** and returns the sum of **only** its **odd** valued **digits**. Example: for n=2**3**4**5**6**79**8, the function should return 3+5+7+9=**24**.

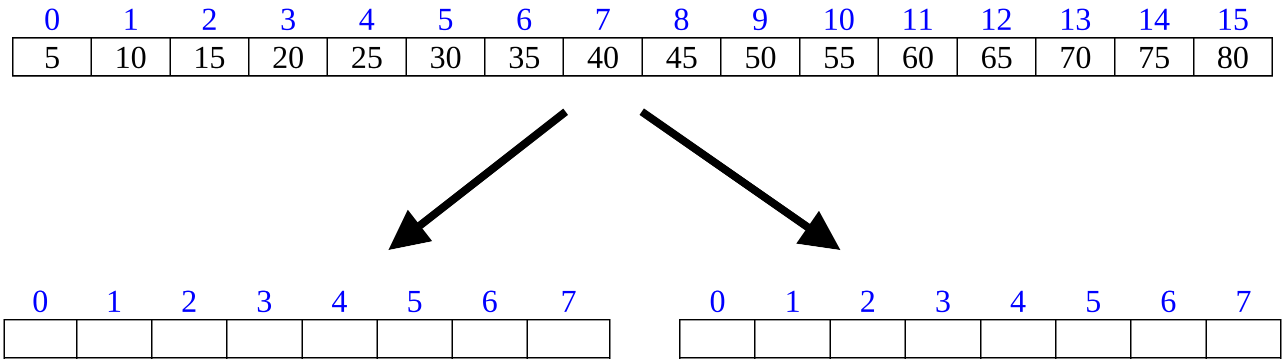
```
#include <iostream>
using namespace std;
```

```
int getSumOfOddDigits(unsigned long int n){
    int sum=0,dig;
    for (;n>0;n/=10)
      if ((dig=(n%10))%2) sum+=dig;
    return sum;
}
```

```
int main(){
   unsigned long int n=123456789;
   cout << getSumOfOddDigits(n) ;
   return 0;
}
```

Q.3) (30) Draw a flowchart and write a complete program which performs the following tasks:

- Initialize the original array as shown above.
- **Split** the original array **randomly** into **two other arrays** (the two new arrays should have almost equal lengths.) Then, display the contents of two new arrays.



0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80

0	1	2	3	4	5	6	7

0	1	2	3	4	5	6	7

```
#include <iostream>
#include <cstdlib>
#include <ctime>
using namespace std;

void printArray(int array[], int length){
   for (int i=0;i<length-1;++i)
        cout << array[i] << "," ;
   cout << array[length-1] << endl ;
}
int main(){
   int array[16]={5};
   for (int i=1;i<16;++i)
       array[i]=array[i-1]+5;
   printArray(array,sizeof(array)/sizeof(int));
   srand(time(0L));
   int k= rand()%16;
   int leftArray[8]={0},rightArray[8]={0};
   for (int i=k,j=0;i<(k+8);++i,++j)
       leftArray[j]=array[i%16];
   printArray(leftArray,sizeof(leftArray)/sizeof(int));
   for (int i=k+8,j=0;i<(k+16);++i,++j)
       rightArray[j]=array[i%16];
   printArray(rightArray,sizeof(rightArray)/sizeof(int));

   return 0;
}
```

Another solution

```
#include <iostream>
#include <cstdlib>
#include <ctime>
using namespace std;

void printArray(int array[], int length){
   for (int i=0;i<length-1;++i)
        cout << array[i] << "," ;
   cout << array[length-1] << endl ;
}
int main(){
   int array[16]={5};
   for (int i=1;i<sizeof(array)/sizeof(int);++i)
       array[i]=array[i-1]+5;
   printArray(array,sizeof(array)/sizeof(int));
   srand(time(0L));
   int leftArray[8]={0},rightArray[8]={0};
   int left=0,right=0;
   for (int i=0;i<sizeof(array)/sizeof(int);++i){
        int k= (int)((double)rand()/RAND_MAX+0.5);
      if (left==sizeof(leftArray)/sizeof(int)) k=1;
      if (right==sizeof(rightArray)/sizeof(int)) k=0;
      switch(k){
         case 0:
               leftArray[left++]= array[i];
               break;
         case 1:
               rightArray[right++]= array[i];
               break;

       }

   }
   printArray(leftArray,sizeof(leftArray)/sizeof(int));
   printArray(rightArray,sizeof(rightArray)/sizeof(int));

   return 0;
}
```

Yet another solution

```
#include <iostream>
#include <cstdlib>
#include <ctime>
using namespace std;

void printArray(int array[], int length){
   for (int i=0;i<length-1;++i)
        cout << array[i] << "," ;
   cout << array[length-1] << endl ;
}
int main(){
   int array[16]={5};
   for (int i=1;i<sizeof(array)/sizeof(int);++i)
       array[i]=array[i-1]+5;
   printArray(array,sizeof(array)/sizeof(int));
   srand(time(0L));
   int leftArray[8]={0},rightArray[8]={0};
   int left=0,right=0;
   for (int i=0;i<sizeof(array)/sizeof(int);++i){
        int k= (int)((double)rand()/RAND_MAX+0.5);
      if (left==sizeof(leftArray)/sizeof(int)) k=1;
      if (right==sizeof(rightArray)/sizeof(int)) k=0;
      switch(k){
         case 0:
               do {
                      int j=rand()%8;
                  if (leftArray[j]==0){
                     leftArray[j]= array[i];
                   ++left;
                   break;
                  }
               } while(true);
               break;
         case 1:
               do {
                      int j=rand()%8;
                  if (rightArray[j]==0){
                     rightArray[j]= array[i];
                   ++right;
                   break;
                  }
               } while(true);
               break;
       }

   }
   printArray(leftArray,sizeof(leftArray)/sizeof(int));
   printArray(rightArray,sizeof(rightArray)/sizeof(int));

   return 0;
}
```

All other solutions are welcome.

Q.4) (20) Draw a flowchart and write a complete program which performs the following tasks:

- Read values from keyboard for the coefficients *A*, *B*, *C*, *D*, *E*, *F* of the equations of two straight lines.

$$Ax + By = C$$

$$Dx + Ey = F$$

- Then determine whether the lines are parallel (their slopes are equal) or the lines intersect.
- If they intersect, determine whether the lines are perpendicular (the multiplication of their slopes is equal to -1).

```
#include <iostream>
using namespace std;

int main(){
   double A,B,C;
   double D,E,F;

   cin >> A >> B >> C ;
   cin >> D >> E >> F ;
   double slope1= -A/B;
   double slope2= -D/E;

   if (slope1==slope2)
      cout << "Two lines are parallel." << endl ;
   else
   if ((slope1*slope2)==-1.)
      cout << "Two lines are perpendicular." << endl ;

   return 0;
}
```