

Lab07

In this experiment, we suppose rand() can generate data with uniform distribution from 0 to RAND_MAX.

1. Homework I

- A. Write a program to simulate 10,000,000 rolls of six-sided die and output the frequency of each number.
- B. Charlie tosses a pair of six-sided dice. What number (sum of the face value of both dice) is most likely to thrown?
- C. Write a program to simulate throwing darts.

Use a random number generator to obtain 10,000,000 pairs of floating-point numbers (x, y) satisfying $0 < x < 1$, $0 < y < 1$, with the following process:

```
double seed;
const double mpy = 25173.0;
const double inc = 13849.0;
const double mod = 65535.0;
input variable "seed" then calculate the following formula:
seed = (seed * mpy + inc) % mod ; // fmode(seed * mpy + inc, mod)
```

Then, get one random number between 0~1 by using: seed/mod

Print the proportion P of throws that hit the dart board, that is, the proportion of pairs (x, y) that are inside the circle. Also print 4* P.

- D. Please enter one positive integer x from the keyboard and find out the square root (sr) of this positive integer. (Using Newton's method only, the difference between sr*sr and x should less than 10^{-6})

```
seed: 654321
===== Problem A =====
1:0.166911, 2:0.166837, 3:0.166421,
4:0.166670, 5:0.166656, 6:0.166505
===== Problem B =====
2:0.027785, 3:0.055581, 4:0.083314,
5:0.111169, 6:0.138908, 7:0.166561,
8:0.138879, 9:0.111110, 10:0.083376,
11:0.055487, 12:0.027831
===== Problem C =====
seed: 0.654321
pi/4: 0.785481, pi: 3.141925
===== Problem D =====
Input a positive integer x:3
The square root of 3 is 1.7320508
```

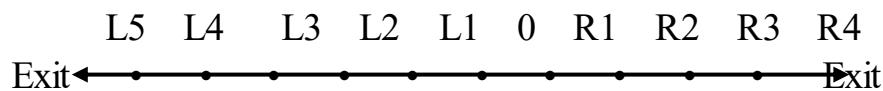
2. Homework II

A. A dog is lost in a tunnel at node 0 (see diagram). It can move one node at one time in either direction right or left with equal probability (1 = right, 2 = left). When the dog hits nodes L_2 however, a force of nature always propels it directly to node L_4 . The dog escapes from the tunnel when it either hits L_5 or R_4 . Restart the dog at node 0 **a thousand times** and count the number of times it escapes through R_4 or L_5 .

(1) What are the odds that it will exit from R_4 and from L_5 ?

Moreover, how long, on the average, the dog stays in the tunnel (each node takes one minute to cover)?

(2) Do the same problem as in (1), but let node L_2 propel the dog to L_4 only when traveling in a left direction. If node L_2 is reached when traveling to the right, the node L_2 has no effect.



B. Write a program that displays the name of a card randomly chosen from a complete deck of 52 playing cards. Each card consists of a rank (ace, 2,3,4,5,6,7,8,9,10, jack, queen, king) and suit (clubs, diamond, hearts, spades). Your program should display the complete name of the card, e.g. Queen of Spades, Ace of Diamonds, 2 of Hearts.

```
seed: 654321
===== Problem A =====
-----Case (1)-----
Exit from left: 0.652
Exit from right: 0.348
Average staying time: 9.990000 sec

-----Case (2)-----
Exit from left: 0.631
Exit from right: 0.369
Average staying time: 11.791000 sec

===== Problem B =====
4 of Spades
```

3. Understand the following method for generating random numbers

```
#include<stdio.h>
#include<stdlib.h>
#include<time.h>
int main()
{
    srand(time(NULL));
    int range=10000, x;
    int bound=(RAND_MAX+1)/range;
    do{
        x=rand();
    }while(x>=bound*range);
    printf("%d\n",x%range);
    return 0;
}
```

Using similar concept, Please generate 100 random numbers in the range from 0 to 10, the numbers should be **accurate to 3 digits after decimal point**, and they must be **uniformly distributed**. For example, 1.000 and 8.777 each is generated in the same probability.

```
seed: 654321
6.855  8.198  1.116  1.639  3.148  4.733  9.217  9.990  8.973  7.071
4.408  2.905  8.819  8.928  6.930  8.037  6.106  1.799  4.080  5.610
8.340  3.732  0.389  0.561  0.299  6.342  1.405  2.749  6.688  3.008
4.752  3.916  6.458  4.650  6.348  4.238  9.815  5.005  8.299  8.798
2.673  4.954  8.886  3.667  3.325  6.076  4.439  3.677  4.716  6.762
1.078  8.502  9.043  5.923  2.721  8.031  1.788  1.275  2.573  4.959
7.242  8.095  9.455  7.633  5.127  0.994  6.305  6.487  9.428  3.163
1.209  8.344  6.222  6.274  1.313  5.054  5.841  3.196  0.558  0.860
3.621  8.251  7.493  0.176  9.936  8.852  1.796  7.052  3.117  5.610
9.425  7.225  2.881  2.413  9.262  1.800  4.773  9.658  0.501  1.593
```

4. Understand the following two methods of random number generation.

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

int main()
{
    int x;
    int RANGE = 10000;
    srand (time (NULL));
    //method (a)
    x = rand()%RANGE;
    printf("x=%d\n",x);

    //method (b)
    int RAND_INV_RANGE=((int) ((RAND_MAX + 1) / (RANGE)));
    do {
        x = rand();
    } while (x >= RANGE * RAND_INV_RANGE);
    x /= RAND_INV_RANGE;
    printf("x=%d",x);

    return 0;
}
```

Write a program to randomly generate 10 random real numbers of which range is $[0, 1)$ with accurate to the fifth decimal point, i.e. 0.00001.

Please use the provided method to solve this problem.

seed: 654321

0.209220
0.644500
0.706520
0.586510
0.579070
0.744970
0.574390
0.211510
0.796780
0.429760