Handout 7

Using psuedorandom numbers

7.1 Basics

- We use the function `drand48()` that produces a pseudorandom `double`. This is not a "high quality" generator, but OK for our purposes.

- To get a different number each time, we seed the function with the current time. The library `time.h` contains the function `time()`. The command `time(NULL)` returns the current time in seconds that has elapsed since 1970-01-01 00:00:00 +0000 (UTC). The "NULL" input tells the computer that we don't want to store this time value anywhere.

The following program generates and then print a pseudorandom number:

```
/*
my first pseudorandom numbers
*/

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

int main()
{
  srand48(time(NULL));  // seed generator; do this only once

  double prn;
  prn = drand48();
  printf("Output = %lf\n",prn);
}
```

Add a loop to the code so that it prints out 10 pseudorandom numbers.

7.2   Digital die

The function `drand48()` always gives a number between zero and one.

- Modify the code above so that the outputs range from 0 to 6.

- Then modify the code above so that the possible output are 0, 1, 2, 3, 4, 5.

- Finally, modify the program so that the outputs are 1, 2, 3, 4, 5, 6.

You have made a dice-rolling simulator!

7.3   Practice problems

- Write a program `decide.c` that prints out "Yay! Go for it!" half of the time and prints out "Don't do it!" the other half the time.

- Modify your code to write a program `decide2.c` that

  - 50% of the time prints out "Yay! Go for it!"
  - 40% of the time prints out "Don't do it!"
  - 10% of the time prints out "What?! Are you crazy?"

- Write a program `flipacoin.c` that takes in a number N from the user and "flips a coin" that many times. Have your program report how many times the coin came up "heads" and how many times it came up "tails." Then modify your program so that it reports the percentage of the times the coin came up "heads."

7.4   Homework: `circle-area.c`

Write a program `circle-area.c` that uses the following procedure to approximate the area of the unit circle.

- Use pseudorandom numbers to choose a point (x, y) in the first quadrant square $0 \leq x \leq 1$, $0 \leq y \leq 1$.

- Determine whether the point is inside the circle or not.

- Repeat a million times, computing the percentage of time the point is inside the circle.

- The percent approximates the area of the first quadrant part of the circle. (Why?)

- Multiplying by 4 gives an approximation of the area of the unit circle.

7.5   Challenge problems

1. Estimate the area of the region inside the unit circle that is above the parabola $y = x^2$.

2. Write a program the (virtually) flips a coin 500 times and counts how many times there are 6 or more "heads" in a row. Are you surprised by the result?