

CS 2104 Homework Assignment 2

Problem 1. Individual work. 40 points. A *random walk* is a stochastic process in which a particle moves one step at a time from state to state in a structured space. For us, the state space will be \mathbb{Z} , the set of integers. The particle starts in an initial state $S_0 \in \mathbb{Z}$. If, after $i \geq 0$ steps, the particle is in state S_i , then in step $i + 1$, it moves to state $S_i + 1$ with probability p and to state $S_i - 1$ with probability q ; it cannot stand still. Of course, $p + q = 1$. If $S_0 = 5$ and $0 < p < 1$, then the sequence 5, 4, 3, 4, 3, 2, 3, 2, 3, 4 is a possible sequence of states for the particle if it moves 9 times.

The Assignment. This assignment is to be done by each student in class individually.

The assignment is to write a program that will simulate a random walk for a given number of steps and that will compute certain statistics for the random walk.

The parameters for a simulation come from standard input as a single line of parameters, consisting of (1) the initial state S_0 ; (2) the value of p ; and (3) the number of steps to simulate. For example, the parameter line

```
5 0.40 9
```

specifies a simulation starting at $S_0 = 5$ and running for 9 steps, with $p = 0.40$ and $q = 0.60$.

The output of the simulation goes to standard output. First, S_0 is printed. As the simulation proceeds, each new state is printed, one state per line. After that, the maximum state attained, the minimum state attained, and the average of all states (including the initial state) are printed, as in the following sample output:

```
5
4
3
4
3
2
3
2
3
4
Maximum 5
Minimum 2
Average 3.3
```

Random Numbers. To complete the program, you will need a source of random numbers. Each of the programming languages has at least one pseudo-random number generator, which you are welcome to use for this purpose.

Submission of problem I. The submission for this assignment must be the source file for your program. Each person uploads a single source file. The source file should be clearly commented and must include your name. Strictly follow the “Programming assignment

guidelines” on the course web-site. No credit will be given for code that does not compile and/or does not generate correct output.