1. In class we used Matlab's `rand` command to generate random numbers between 0 and 1. Write a program to generate a large number of random values and test to see if the numbers are from a uniform distribution. For example, you could put the numbers into, say 10, bins and see if approximately the same number of points fall into each bin. Comment on whether or not the distribution is uniform, and give some sort of qualitative justification for your claim.

2. The mean value of a function over the interval $[a, b]$ is defined as $\bar{f} = \dfrac{1}{b-a}\displaystyle\int_a^b f(x)\,dx$. However the mean value can also be estimated by taking a large sample of function values over the interval and calculating the average, $\bar{f} \approx \dfrac{1}{n}\displaystyle\sum_{i=1}^{n} f(x_i)$. Equating these two, we see that

$$\int_a^b f(x)\,dx \approx \left(\frac{b-a}{n}\right)\sum_{i=1}^{n} f(x_i)\,. \tag{1}$$

   In other words, one can estimate the value of a definite integral using a sample of values from the interval.

   Write a program to estimate $\displaystyle\int_a^b f(x)\,dx$ using (1). When we test this program, we will use a function file named `MyFunc.m` containing the following code:

```
function y = MyFunc(x)
y = x^2
```

   although the actual function may vary. Your program should ask the user for the values of a and b, and print out the estimate for the integral value.

   As you write up this problem, be sure to comment on how many samples must be taken to correctly estimate the integral value to, say 4, significant figures. Also, pick a few $f(x)$ functions with known integral values to test your program.

3. Assume a guy enters a bar, walks straight in a distance D, and encounters a woman. After his best attempt at conversation, he is rebuffed and moves off in a random direction a distance D where he encounters another woman. Again he is rebuffed, moves another distance D in a random direction, and so on. If he is rebuffed 10 times, he will be completely demoralized and remove himself from the scene. Also, if he "leaves" by passing back through the front wall, he is out of the game.

   You are sitting opposite the entrance, at the far end of the bar. What fraction of guys actually make it to your end of the bar if the bar is $3D$ deep? How about $5D$ deep? How about $10D$ deep? Continue this investigation until you can determine the nature of the relationship between the depth of the bar and the fraction of guys that can make it all the way across the bar to the far side. Make a hand drawn or MatLab plot of your results (fraction versus bar depth).

   Your program should ask the user how deep the bar is in multiples of D. For example, if the bar is 3D deep, the user should input 3. The program should print out the percentage of successes.

4. A fine arts major enrolled for a class that meets in the Engineering building. Immediately after the first class, the student leaves the classroom and panics because they are, as one might say, "like totally out of their comfort zone." At the first intersection of hallways (which are all aligned in the N, S, E or W directions) the student turns in a random direction and

runs to the next intersection. Again they randomly select a direction and run to the next intersection. At some point the student emerges from the building. If the student emerges on the W side of the Engineering building, it is a success because they can clearly see their way back to the more familiar W side of campus. If they emerge on the N, S, or E side of the building, it is a failure.

Traditional dictates that the floor plan of any Engineering building be approximated as a square, containing, for example, three interior N-S hallways and three interior E-W hallways, for a total of nine interior hallway intersections. If the student starts their escape from the Engineering building at each of the nine interior intersections, determine the probability of emerging on the W side of the building.

Run your simulation about 10,000 times for each interior intersection. Report your results on a (hand drawn) 5 by 5 grid where the probability is 0 for all the N, S, and E exterior exits, and the probability is 1 for all the W exits.

When you write your program, refer to the intersections using a cartesian coordinate scheme (i,j) where i and j refer to the i-th N-S hallway, and the j-th E-W hallway, respectively. For example, the southwest corner of the building is (0,0) and the northeast corner is (5,5). Also, write your program so that it can *easily* be extended to a building with more hallways in either the E-W or N-S directions.

Your program should ask the user to input the coordinates of the intersection and print out the probablility of success for that particular intersection.

Please observe the following guidelines for homework submission as well as any other requirements posted on the course web page.

Submitted homework should:

- be turned in at the beginning of class on the due date.
- have all pages stapled together. (We will deduct points for unstapled papers.)
- contain a clear statement of the problem, in your own words.
- as appropriate, contain a clear discussion of the results of the problem/program. (Do the results make sense? Are they reasonable? Why, or why not? Do you *trust* the results of your program? Does one method seem to work better than another?)
- contain a copy of the code and a sample of the output.

Electronic homework should:

- have all code and any output inside a directory (folder) named `yourLastNameHW04` This directory should be "zipped" in an archive file named `yourLastNameHW04.zip` and submitted by 11:59 PM on the due date to *adam@colorado.edu*. You must use `APPM 3050 HW04` as the subject line of the email—no more, no less. As much as I would like to, I can't afford to go looking for stray email subject lines.
- contain the following comment lines at the beginning of each file, (with the appropriate information filled in):

```
% My file with important calculations
x=a;
```

- contain comments to clearly explain what is being done at various points in the program.