The following problems should be done in julia. Type up the code you used to find your results and answer all questions. Submit your homework via Blackboard by uploading the ipynb file. This assignment should be submitted no later than 11:59pm on October 19, 2016.

1. In class we showed how to run a Monte Carlo simulation to develop the distribution on rolling 2 dice. We will do the same in this problem except that we will roll more that 2 dice.

    (a) Roll 3 dice and simulate this with 1,000,000 rolls. The resulting variable should be the sum of the 3 dice. Produce a histogram of this variable.

    (b) Use the simulated data in (a) to determine the fraction of the roll sums are 10 or less.

    (c) Use the simulated data in (a) to determine the fraction of the roll sums are even.

    (d) Roll 5 dice and simulate this will 1,000,000 rolls. Produce the output of the distribution as in (a). (Note: this is the first roll of a Yahtzee game.)

    (e) Use the simulated data in (d) to determine the fraction of roll sums that are odd.

    (f) Use the simulated data in (d) to determine the fraction of rolls that have all dies the same value. (For example, if all rolls are 1 or 3).

    (g) Use the simulated data in (d) to determine the fraction of rolls that have two dies the same and the other three dies the same. (Note: do not include rolls where all 5 dies are the same.)

    (h) Use the simulated data in (d) to determine the fraction of rolls that have no two common dies. (This means no pairs)

2. In class we developed the necessary code for simulating poker hands. Also, you can use the Wikipedia Poker Hand webpage for additional information. Use a simulation of 1,000,000 poker hands to estimate the probability of getting:

    (a) A flush

    (b) A straight

    (c) A straight flush

    (d) A royal flush

    (e) Two pair. (Hint: the hard part of this is to make sure that the 5th card is not one of the other pairs and also make sure that two pairs are not actually a 4-of-a-kind.

    (f) Discuss your results in comparison to the Wikipedia web page.

    For each of these, you should create a function to test for each as we did in class. For example, in (a), write a `is_a_flush` function that will take a `Hand` object and return true or false. Extend the module that we created in class to include all of these functions.

3. In this problem, we will create two new datatypes called `Point` and `Polygon` and create some functions that will calculate geometric properties of these.

    (a) Create a type called `Point` with two fields `x` and `y` that are `Number`s that correspond to a point in the coordinate plane. The type does not need any constructors.

    (b) Create a function called `distance`, which takes in two points and returns the distance between the two points.

    (c) Create a type called `Polygon` which is an array of `Point`s.

(d) Create a function called `perimeter` whose input is a `Polygon` and returns the total distance between the points in the order given.

(e) Create a function called `plot` that takes in a `Polygon` and plots the points using `Gadfly`.

(f) Provide some test cases for each of these functions.

(g) (Extra Credit) Create a function called `area` that takes in a `Polygon` and computes the area of the Polygon. Hint: to do this correctly, you will need to possibly reorder the points such that the order rotates either clockwise or counterclockwise around the center of mass of the polygon (mean of the x and y points). Then break the polygon into triangles or use other known methods. (Google away).