STAT535: Statistical Computing **Spring 2020**

Problem Set 6: Computational Complexity

Objective

Collaboration You may work with other students. However, each student must writeup and hand in their assignment individually. Be sure to indicate whom you worked with in the comments of your submission.

Readings

Logistics

1. (10 points) **Power Function** At the start of the semester, you were given a problem set that asked the following question to test your knowledge of python. The problem set asked you to compute x raised to the y power. Now, you will implement the algorithm used for computing the power in an efficient way.

   The previous problem set was:

   > Write a program that does the following in order:
   >
   > 1. Asks the user to enter a number "x"
   > 2. Asks the user to enter a number "y"
   > 3. Prints out number "x", raised to the power "y"
   > 4. Prints out the log (base 2) of "x"
   >
   > Use Spyder to create your program, and save your code in a file named 'ps0.py'. An example of an interaction with your program is shown below. The words printed in bold are ones the computer should print, based on your commands, while the words in regular are an example of a user's input.
   > **Enter number x:** 2
   > **Enter number y:** 3
   > **X**y** = 8
   > **log(x)** = 1

   (a) Suppose $x = 2$ and $y = 4$. You could compute x^y as $x^{y/2} \cdot x^{y/2}$. Now, if you called the function `power`(x,y), you could compute it as `power`(x,y) = `power`(x, y/2)*`power`(x,y/2). When you are able to divide a problem into subproblems that themselves look just like the original with different inputs, what kind of algorithm is used?

   (b) What is the base case?

   (c) Write a simple recursive formulation of the `power` function.

(d) Refactor your simple recursive formulation to a memoized dynamic programming formulation.

(e) Refactor your simple recursive formulation to a bottom-up(iterative) dynamic programming formulation.