LAB #7 – Practice Functions & Recursion

Remember, if you need to get Lab #6 graded, you need to show your programming part (4 pts) of Lab #6 **to the TAs within 10 minutes of getting to lab**, and you and your partner **will not receive lab credit if you do not get checked off** before leaving each lab. Once you have a zero on a lab, then it cannot be changed because we have no way of know if you were there or not!!!

New Labs: We are going to change the way we do labs by providing relevancy through videos and using larger group activities to encourage design, while utilizing a broader set of strengths. Each lab will begin with a 10-15 minute video shown on the TV by a TA, followed by a large group activity. The group activity requires design, input from everyone, and no computers!!!!

Learning to have a growth mindset…

You can learn anything:
https://www.youtube.com/watch?v=JC82Il2cjqA

https://www.youtube.com/watch?v=wh0OS4MrN3E

Practice Designing as a Group (NO Computers Allowed– 40 minutes max) (4 pts)

We need to get into a bigger group before you begin your paired-programming. Get into groups of 10 for a 30 person lab, i.e. 5 (or less) pairs in 3 different groups. Each group will have a dedicated TA as a project leader. The role of the TA is to make sure all members in the group are participating and that everyone understands the requirements of the problem being solved. In addition, your group might want to dedicate someone with good handwriting to capture your thoughts and design. Each group will begin by writing a flowchart for the solution, and then, write the pseudocode.

This is important because some students in the group are good at math and in disciplines where finding the area under functions is important. Use each other for your strengths!!!

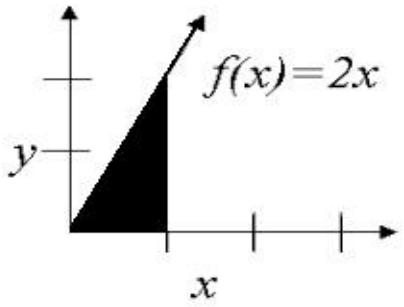
Integration Functions Explanation:

Your program should determine the area under the function specified in f(float x), which is **$f(x) = x^5 + 10$,** in this lab. You will calculate the area under a curve using the rectangle and trapezoid method. Therefore, you need an **integrate_rectangle()** and **integrate_trapezoid()** functions.

In addition, you will have recursive definitions for each integrate method (rectangle and trapezoid), which is 4 total, **e.g. rec_integrate_rectangle() and iter_integrate_rectangle().**

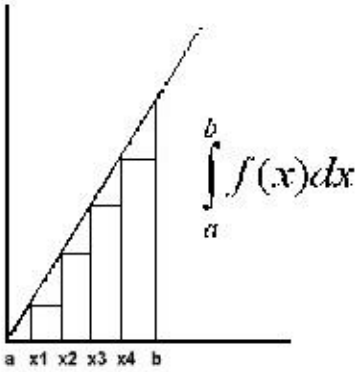
Don't freak out!!! Programming integration into the computer doesn't consist of calculus!!!!!! It is simple math, and these two methods only require summing the area of a certain number of rectangles or trapezoids under a specific curve, f(x).

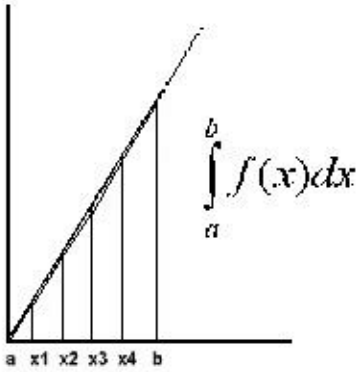
For Example, if your f(x) = 2x:



$$\int_0^1 2x\,dx$$

Basic Numerical Methods (Rectangle vs. Trapezoid):





n = number of rectangles and/or trapezoids
a = beginning x value
b = boundary for rectangles
width = width of each rectangle/trapezoid, (b-a)/n
f(x) = height of rectangle
(f(x1)+f(x2))/2 = height of trapezoid
Area = width * height

The functions are bounded by any interval on the x-axis, including both positive and negative values!!!.**You will design an iterative and recursive function for your integration.**

Your integration functions need:
User input starting and ending points for the area
User input of number of rectangles or trapezoids to use
Return the area calculated by the method

Here is an example run of your program:

Would you like to calculate the area using the rectangle, trapezoid, or both (1, 2, 3): **2**

How many trapezoids do you want? **1000**
Please select a starting point, a = **1**
Please select an ending point, b = **2**
The area under $\mathbf{x^5+10}$ between 1 and 2 is 20.5625
Show your project manager (TA) how given a and b values, you can calculate the area of f(x) **iteratively and recursively** using your **design** with functions. Trace the variables/values, as they are passed to functions and returned from functions.

Each Pair: Implement Your Group Design (6 pts)

We need to split back into pairs, and each of the 5 pairs in a group need to implement the design using functions. Different pairs will finish at different times. After you get checked off by your project manager, please help the other pairs in your group. After everyone in the group has completed the program, then let your project manager know. We are curious how design influences the time spent on implementation.

Run your **iterative** version for both rectangle and trapezoid for N = 10, 100, 1000, 10000
Run your **recursive** version for both rectangle and trapezoid for N = 10, 100, 1000, 10000

Show your project manager (TA) how given a and b values, you can calculate the area of f(x) **iteratively and recursively** using your **implementation** with functions.