## CptS 121 - Program Design and Development

# Lab 2: Top-Down Design & Functional Decomposition

**Assigned:** Week of January 27, 2014
**Due:** At the end of the lab session

### I. Learner Objectives:

At the conclusion of this programming assignment, participants should be able to:

- Analyze a basic set of requirements for a problem and develop a representative structure chart
- Apply top-down design principles to a problem
- Utilize bottom-up C implementation for a problem
- Identify and implement programmer customized function prototypes, function definitions, and function calls
- Distinguish between formal parameters and actual arguments
- Apply appropriate actual arguments to function calls as test inputs

### II. Prerequisites:

Before starting this programming assignment, participants should be able to:

- Analyze a basic set of requirements for a problem
- Declare variables
- Apply C data types and associated mathematical operators
- Comment a program according to class standards
- Logically order sequential C statements to solve small problems
- Compose a small C language program
- Compile a C program using Microsoft Visual Studio 2012
- Execute a program
- Create basic test cases for a program

### III. Overview & Requirements:

This lab, along with your TA, will help you navigate through modularizing your C solutions to the provided problems. In this course we will use top-down design Recall that in computer science the concept of top-down design and functional decomposition refers to the process followed to manage the complexity of prob to understand, implement, and maintain.

Labs are held in a “closed” environment such that you may ask your TA questions. Please use your TAs knowledge to your advantage. You are required to move students in need when you are finished with a task. You may work in pairs if you wish. However, I encourage you to compose your own solution to each problem education in CptS 121 so work diligently.

**Tasks:** Design, implement, compile, and test C solutions to the following problems. You must use appropriate top-down design and functional decomposition w Note: a structure chart is a good way of determining appropriate functions for a problem. You should always have at least the following: one function that gath and one function that displays the result. Once you have completed a problem, demonstrate your solution to your TA.

**1.** Complete a programming project in chapter 3 of your of the Hanly & Koffman text. The problem states the following:

Write a program that outputs the equation of the perpendicular bisector of the line segment between two points. Your program should perform the followin

- Prompt the user for the coordinates of the two points
- Compute the slope of the line between those two points
- Compute the coordinates of the midpoint of the line segment between the two points by averaging the two x coordinates and the two y coordinates
- Compute the slope of the perpendicular bisector by taking the negative reciprocal of the slope of the line segment
- Compute the y intercept of the perpendicular bisector (you now have the slope *m* of the bisector and a point ($x_{mid}$, $y_{mid}$) on the bisector, so the y inter
- Output the labels of the original two points, and output in $y = mx + b$ format the equation of the perpendicular bisector.

Test your program on different pairs of points. Of course, there exist some pairs of points that will make your program not work. You do not have to check p

Be sure to use the guidance of your TA to determine appropriate functions for this problem!

**2.** Write a program to calculate your body mass index (BMI). The BMI is a measurement that uses your height and weight to determine if you are underweigh required to prompt the user for weight in pounds and height in feet. The height must then be converted to inches (recall: 1 foot = 12 inches). Once the Use the equation below to calculate the BMI.

BMI = ( (weight in pounds) / (height in inches)^2 ) * 703

**Note: a BMI of less than 18 indicates you are underweight, >= 18 and < 25 means you are at a healthy weight, >= 25 and < 30 means you are overw classify the BMI value in the program. This would require "if" statements, which you have not learned yet!**

Use functions where appropriate!

**3.** Write a program that calculates the Bowl Championship Series (BCS) score of a college football team. A college team's BCS ranking comprises 3 elements. Coaches Poll, and computer rankings. Each one of these is 1/3 the final ranking. A team's score in the Harris poll is divided by 2,850, which is the maximu voting members rank the same team as number 1. A team's score in the USA Today poll is divided by 1,475, which is the maximum number of points any te

team number 1. The computer rankings is calculated by magical formula that we are not concerned with. However, we know that this value is between 0
user for a team's score in the Harris Poll (a number between 1 and 2,850) and the Coaches Poll (a number between 1 and 1,475). Also, prompt the user fo
values divide the Harris Poll score by 2,850 (call the result harris_poll) and the Coaches Poll score by 1,475 (call the result coaches_poll) and print out the
determined by the following formula:

BCS_score = (harris_poll + coaches_poll + computer_ranking) / 3

Display the BCS total score. The number should be between 0 and 1. 1 would indicate a perfect score. Use functions where appropriate!

**IV. Submitting Labs:**

- You are not required to submit your lab solutions. However, you should keep them in a folder that you may continue to access throughout the semester.
on the Sloan 353 machines. These files are erased on a daily basis.

**V. Grading Guidelines:**

- This lab is worth 10 points. Your lab grade is assigned based on completeness and effort. To receive full credit for the lab you must show up on time and
dismissed you.

**Resources:**

- J.R. Hanly & E.B. Koffman, *Problem Solving and Program Design in C (7$^{th}$ Ed.)*, Addison-Wesley, 2013