University of Waterloo
CS240R & CS240E, Spring 2016
Assignment 0

Due Date: Wednesday, May 11, at 5:00pm

Please read http://www.student.cs.uwaterloo.ca/~cs240/s16/guidelines.pdf for guidelines on submission. For problems 1 – 6, submit your solutions electronically as a PDF file using MarkUs. This assignment is worth up to 6 bonus marks, which will be added to your total mark for assignment 1.

A0 is designed to introduce you to LATEX. We strongly encourage students to create all their assignment solutions using LATEX, as it will strongly benefit both you and your markers. Learning LATEX is a great asset to have for any course, and also especially for those of you planning to go into academia. LATEX, like HTML, is best learned by example. To complete the problems below, open the LATEX file used to make this PDF. Inside the file you will find the code used to write this file along with comments explaining the code to help you get through the assignment. If you get stuck there are also many on-line resources you can use. Searching for "fraction example LATEX" is acceptable. Searching for "LATEX proof of summation from 1 to n" is **not** acceptable. To compile the .tex file provided simply type "pdflatex a0.tex" in the school's Linux environment. LATEX compilers are also free to download on-line. **Submit both a0.pdf and a0.tex to Markus**.

Problem 1 - Assignment Guidelines

At tht top of this page is the URL to the assignment guidelines for CS240, it can also be found from the course webpage from the Assignments tab. Please answer the following questions about the assignment guidelines:

a) If an assignment question asks you to design an algorithm, what must you do in addition to describing/writing the pseudocode for the algorithm?

   Ans: We need to describe the main idea first if that is helpful, and then present a clearly written pseudocode (at a level of detail mimicking the style of the lectures, the model solutions, or the book), after that give a correctness proof/argument if it is not immediately obvious, and include an analysis (usually, of the running time).

b) For programming questions, which function can you use to read input? Which functions can you use to output the answer?

   Ans: Programs will read from the standard input stream (std::cin) and write to the standard output stream (std::cout).

Problem 2 - Mathematics

In CS 240, you will be using many mathematical concepts. It is important to be able to typeset mathematics in your assignments. This will include sums, fractions, subscripts & superscripts, etc.

Example:

$$\bar{f}(n) := \sqrt{\sum_{i=0}^{\lg n} 4^i \left(\frac{n_0}{2^i}\right)^{\theta}}.$$

In order to practice this skill, write a proof showing:

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

Proof : let

$$S = \sum_{i=1}^{n} i$$

since

$$S = 1 + 2 + \dots + (n1) + n$$

and

$$S = n + (n1) + \dots + 2 + 1$$

Then, we add this two equations together

$$S + S = (n+1) + (n+1) + \dots + (n+1)$$

$$2S = n(n+1)$$

$$S = \frac{n(n+1)}{2}$$

Thus, we showed that

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$$

Problem 3 - Trees

CS 240 introduces many tree data structures. Here is a balanced BST on 7 letters of the alphabet. Insert the first three letters of your first name into the tree (if your first name is shorter than 3 letters, simply insert all the letters), starting with the first letter of your name. If you are inserting duplicate letters:

a) Find the largest index of the letter you are inserting.

b) Insert your letter, with an index one larger than the index you found.

c) When comparing to an equal value, follow the left branch.

For example, if you were to insert a 'M' into the tree below, it would be entered as M_1 and it would become the right child of I_0. Only show the resulting tree.
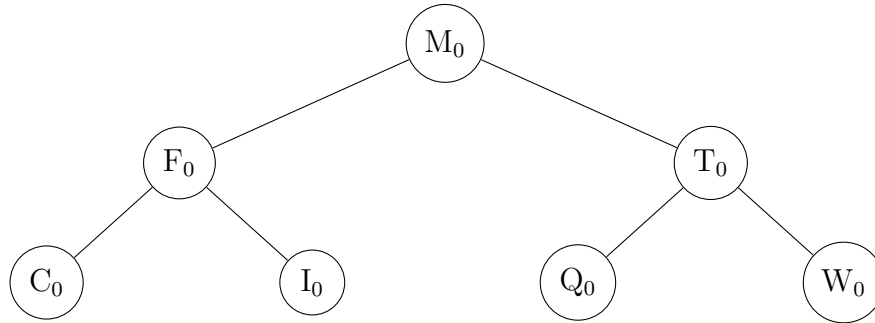

Hint: For nodes with only one child, you may wish to use "child[missing]" for the non-existent child.

Sol: My first three letters of first name are F, A, N.

1.Since there is a F_0 in the graph, by roles given by question, I need insert F_1 and it would become the right child of C_0.

2.Since there is no letter A in the graph and A is the first letter in the alphabet, I can insert A_0 and it would become the left child of C_0.
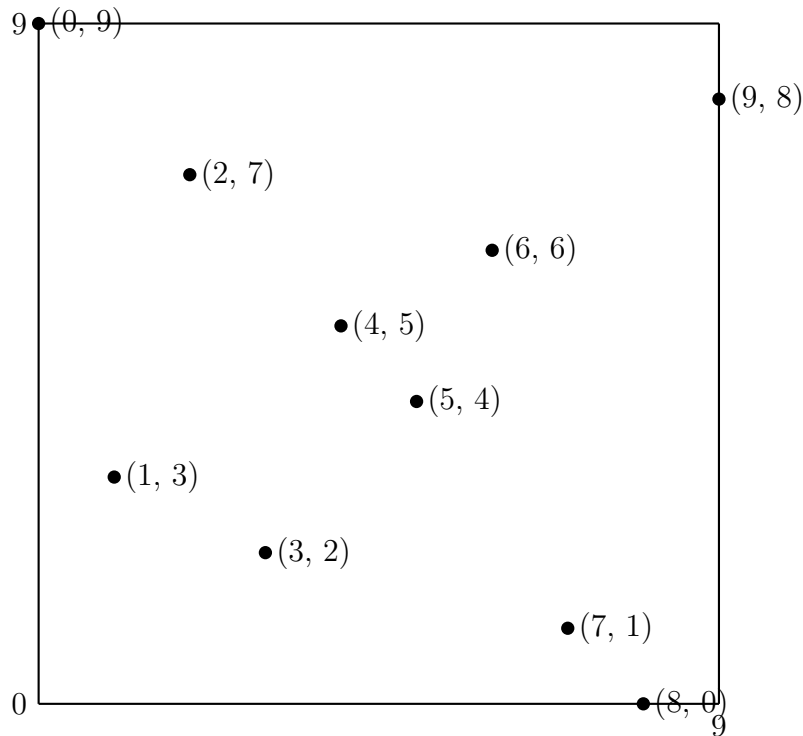
3.Since there is no letter N in the graph and N is followed by M in alphabet, I will insert N_0 to be the left child of Q_0.
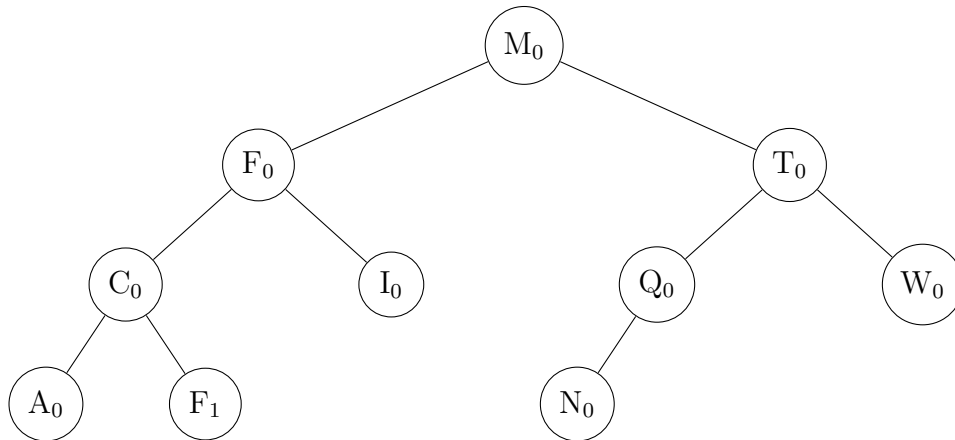
Problem 4 - Plots

CS 240 also deals with many graphs and plots. Plot the following points below, the first one has already been done for you. Only show the resulting plot.
Points: (2,7), (7,1), (4,5), (1,3), (3,2), (6,6), (0,9), (9,8), (8,0), (5,4)

Problem 5 - Tables

Occasionally, you may want to present information in a table. In LaTeX you can easily present data in well structured tables. Fill in the table below with any animal you like.

Animal's Name	Avg. Weight	Longevity	Avg. Temperature	Conservation Status
Polar Bear	350-700kg	25 years	37°C	Vulnerable
Siberian Husky	20-27kg	12-14years	38°C	Least Concern

Problem 6 - Images

You may find it too time consuming to do parts of your assignment in LaTeX, at which point you may want to include an image of your work. LaTeX also supports images. Please keep your image sizes small both for this assignment and future assignments; however, be sure that your images can be easily read by your markers, or you run the risk of losing marks.

Figure 1:   Polar bear

Figure 2:   Siberian Husky

For this question, include an image of the animal you entered in the table above.