Homework 1

Out: 9.8.20
Due: 9.16.20

1. [Summations, 20 points]
   Provide a closed-form solution to the following expressions, along with a brief explanation. Show your work.
   a. $\sum_{i=10}^{n} 7^i$
   b. $\sum_{i=0}^{\infty} \frac{6}{17^i}$
   c. $\sum_{i=1}^{n} (i^2 + ni)$
   d. $\sum_{i=6}^{315} \frac{1}{i}$
   e. $\sum_{i=0}^{\infty} \frac{i-1}{2^i}$

2. [Exponents and logs, 20 points]
   Simplify the following expressions, and provide a brief explanation.
   a. $x^{11} \cdot x^{12} \cdot x^{13} \cdots x^{N}$
   b. $log_{99}(33 \cdot 33 \cdot 33 \cdot 33 \cdot 33)$
   c. $44^{log_{44}330}$
   d. $log_x((3x)^x)$
   e. $\sum_{i=1}^{5^N} log_{23} i$

3. [Combinatorics, 10 points]
   a. How many 6-digit decimal integers do not contain any digits smaller than 3?
   b. How many ways are there to pick 9 different numbers between 17 and 68 (inclusive)?

For all programming problems in this class:

- Your program must compile and run on the lab computers command-line interface as follows:
  > module load gcc
  > g++ -std=c++11 (-o myProgram) myFile.cpp
- Alternatively, you may download a VM, per the instructions on Blackboard, compile and run your program on it:
  > g++ -std=c++11 (-o myProgram) myFile.cpp

4. [Programming I, 25 points]
Write a C++ program which receives a file name as command line argument, reads all the lines of text in the input file, and prints out the longest line in the file. If there are multiple lines of the same length, the first longest line should be returned. That is, your program should have one single line of output, which is the longest line in the file. If the input file is empty (does not contain any lines) then your program should not print anything.

For example, suppose that you compile your program to the executable *Problem4*, your program should be run from the command line as follows:

> Problem4 TextFile.txt

For the provided sample input file, *TextFile.txt*, your program should print the following output:

> It then reads all the lines of text in the input file, and prints out the longest line in the file.

Submit your solution in a single file, *Problem4.cpp*.

5. [Programming II, 25 points]
A child is jumping up a flight of stairs. The child can jump either 1, 2, or 3 steps at a time. Implement the following recursive C++ function, that returns the number of different ways that the child can jump up a flight of n stairs:

int steps (n)

Your main function should receive an integer as a command-line argument, call the *steps* function with the provided integer as input, and print out the output returned by the function.

For example, suppose that you compile your program to the executable *Problem5*, for the integer 20, your program should be run as follows:
> Problem5 20

You MUST use only recursion for this problem. You may not use iteration (no for, while, or do-while loops).

Submit your solution in a single file, *Problem5.cpp*.