CSCI 1300 CS1: Starting Computing
Ashraf, Fleming, Correll, Cox, Fall 2019
Homework 1
Due: Saturday, September 7th, by 6 pm
(5 % bonus on the total score if submitted by 11:59 pm Sep. 6th)

Algorithm and Pseudocode

For the following problems, write the algorithm using the building blocks discussed in the Representations document listed on Moodle for week one. In your algorithms, **use indentation** to show that a line in the algorithm is inside of a loop or a conditional.

For example:

if x equals y
      output(x)

The line output(x) only executes if x equals y is true and is therefore it is indented under the if statement.

Note:
1. Please make sure that what you submit it is not code in any language (cpp, python, etc), but that it follows pseudocode or algorithm rules.
2. Examples of good pseudocode: here.
3. Your work should be **typed**. Submit your assignment as a **PDF** to Homework 1 submission on Moodle.

Problem Set

1. (15 points) The U.S. Census provides information about the current U.S. population as well as approximate rates of change. Using those rates and the current US population, write an algorithm to calculate the U.S. population in exactly one year (365 days). Your algorithm should output the result of your calculations. Three rates of change are provided:
   A. There is a birth every 8 seconds
   B. There is a death every 12 seconds
   C. There is a new immigrant every 27 seconds
Current U.S. population: 328,441,687

2. (15 points) A day has 86,400 seconds (24×60×60). Given a number of seconds in the range of 0 to 1,000,000 seconds, output the time as days, hours, minutes, and seconds for a 24 hour clock. For example, 70,000 seconds is 0 days, 19 hours, 26 minutes, and 40 seconds. Your program should have user input that is the number of seconds to convert, and then use that number in your calculations. If your results are W, X, Y, and Z, then your output should be displayed as : The time is W days, X hours, Y minutes, and Z seconds.

3. (25 points) In text-based choose-your-own-adventure games, the game player is presented with choices throughout the game and then the game responds based on the user's choice. Write an algorithm for a choose-your-own-adventure superhero game where the user has three choices:
  A. Fight the villain
  B. Save the citizen
  C. Return to secret base

The game should repeatedly ask the user which of the three options they want to do until the user says "Return to secret base". When "Return to secret base" is selected, the loop should exit, which effectively ends the game. If the user selects "Fight the villain", the algorithm should output "You win!". If "Save the citizen" is selected, the algorithm should output "You saved the citizen". If "Return to secret base" is selected, the algorithm should output "Who will save the world?".

You can set up your algorithm to check for the user's input in any way you like. Checking for the actual words, such as "Save the citizen" is one option. If you want to assign a number to each option and check for the number, that also works.

4.A. (15 points) A bank account has an initial deposit of $10,000. Every month $500 is withdrawn to meet college expenses. After the money is withdrawn, an interest is computed at the rate of 6 percent per annum (0.5 percent per month). This interest is compounded monthly. Write an algorithm to find how many years it takes for the account balance to become $0.

Hint: Create a table with money that is getting compounded and the money that is withdrawn and calculate by hand the what happens in the first 5 months. Then use the pattern to help you figure out the algorithm.

4.B. (10 points) Make changes to the algorithm to ask the user to input the values for principal, rate and monthly expenditure. Is there a scenario where the algorithm will not terminate (maybe enter an infinite loop)? If so, make changes to the algorithm so that it always terminates.

5. (10 points) Write an algorithm that will ask the user to enter 10 characters. Letters 'a', 'e', 'i', 'o', 'u' in the English alphabet are vowels. The algorithm should then **count** and **display** the total number of vowels among the 10 characters entered by the user.

6. (10 points) In thermodynamics, the Carnot efficiency is the maximum possible efficiency of a heat engine operating between two reservoirs at different temperatures. The Carnot efficiency is given as

$$\eta = 1 - \frac{T_C}{T_H}$$

, where T_C and T_H are the absolute temperatures at the cold and hot reservoirs, respectively. Write an algorithm that computesT the Carnot efficiency.

Grading Rubric

Criteria	Pts
Question 1	15
Question 2	15
Question 3	25
Question 4.a	15
Question 4.b	10
Question 5	10
Question 6	10
Recitation attendance (Week 2, Sep 2)*	-30
Total	100

* If your attendance is not recorded, you will lose points. Make sure your attendance is recorded on Moodle.