Due date: Thursday, Feb 27, 2020, by midnight, upload in home folder of class

Please put your full name on the assignments and all other papers you submit! Notes for programming assignment submissions:

All your files for an assignment should be in a subdirectory in your home directory. The subdirectory will be named "assignmentX' where X is the assignment number. Examples - assignment1, assignment2, assignment3, etc. Xu will pick up files from this subdirectory after the deadline for the assignment.

Put a README file in the assignment directory with instructions for compiling and running the program for the programming exercises. You may also include some test input data for which your program works. Your program should compile in the computers in the CSC lab (Ungar Room 426). You are required to submit source code and data files. Executable files or any other binary files will not be accepted.

Exercise 3.1

Write three functions in C or C++: one that declares a large array statically, one that declares the same large array on the stack, and one that creates the same large array on the heap. Call each of the subprograms a large number of times (at least 100,000) and output the time required by each. Explain the results.
[9 points]

Exercise 3.2

Consider the following skeletal Ada program:

```
procedure Main is
  X : Integer;
  procedure Sub3; -- This is a declaration of Sub3
            -- It allows Sub1 to call it
  procedure Sub1 is
    X : Integer;
    procedure Sub2 is
      begin  -- of Sub2
      …
      end;   -- of Sub2
    begin  -- of Sub1
    …
    end;   -- of Sub1
  procedure Sub3 is
    begin  -- of Sub3
    …
    end;   -- of Sub3
  begin  -- of main
  …
  end;   -- of main
```

Assume that the execution of this program is in the following unit order:

Main calls Sub1
Sub1 calls Sub2
Sub2 calls Sub3

Assuming static scoping in the following, which declaration of X is the correct one for a reference to X in each of the following subprograms?

[3 points]

a. Sub1 (which declaration of X does Sub1 refer to?)

b. Sub2 (which declaration of X does Sub2 refer to?)

c. Sub3 (which declaration of X does Sub3 refer to?)

Explain your answers.

Repeat the above (a, b, c), but assume dynamic scoping.

[3 points]

Exercise 3.3

a. Regarding string mutability: what happens in Python and in Ruby when defining a string and changing one of its values? Try running this in Python and Ruby, and write down the code and the result. Also, does this have implications in terms of reliability?
Python should be available on the lab accounts (type python from the terminal). Ruby should also be available from your lab accounts (type irb from the terminal). For Python and Ruby, if you don't have it installed on your computer, you can also run it in your browser via: http://jupyter.org or https://colab.research.google.com

[2 points]

b. Compare C++, Ruby and Python in terms of what happens when attempting to access an array element out of range. Try running these and report the code and result.

[3 points]