School of Computing
National University of Singapore
Biometrics Course
July 2017

Assignment #1
Deadline: 2.00pm on 18 July 2017

Part I

Solve the questions below by writing a Python function or script.

Q1. Add up the numbers from 100 to 200 and output their sum, using `while` and `for` loops.(2)

Q2. Read a string from console and output its length, swap its cases, convert it to lower case and upper case, and reverse it. (Hint: try string slice with step -1) (3)

Q3. Read a string from console. Split the string on space delimiter (" ") and join using a hyphen ("-"). (Example: input the string "this is a string" and output as "this-is-a-string") (1)

Q4. Learn the Python list operations and follow the commands below: (4)

- Initialize an empty list L.
- Add 12, 8, 9 to the list.
- Insert 9 to the head of the list;
- Double the list. (**e.g.** change $L = [1, 2, 3]$ to $L = [1, 2, 3, 1, 2, 3]$)
- Remove all 8 in the list.
- Reverse the list.

Q5. A cryptarithmetic puzzle is shown below. Each letter represents a single numeric digit. The problem is to find what each letter represents so that the mathematical statement is true.

$$\begin{array}{cccc} & A & B \\ + & B & C \\ \hline A & X & Y \\ \hline \end{array}$$

In this example: $A = 1, B = 9, C = 5, X = 1, Y = 4$ is a solution to the puzzle. Other solutions are also possible, as you can easily determine.

Complete the definitions of `isPZCZ` and `isProductMUCHZ` below so that `S` will contain *all* the solutions of the following cryptarithmetic puzzle. Display `S`. (4)

$$\begin{array}{cccccc} & P & Z & C & Z \\ \times & & & 1 & 5 \\ \hline M & U & C & H & Z \end{array}$$

```
S = [(x,x*15) for x in range(1000,10000) if isPZCZ(x) and isProductMUCHZ(x,x*15)]

def isPZCZ(n):
    """Predicate to check that n, the input number,
    has the format PZCZ, i.e. the 2nd and 4th digits are equal.
    n: input number, assumed to be 4 digits

    Returns True if n has the format PZCZ, False otherwise."""
    # Insert your code here ...

def isProductMUCHZ(pzcz, product):
    """Predicate to check that product has the format MUCHZ.
    pzcz: input number, assumed to be in format PZCZ
    product: input number

    More precisely, this predicate checks 3 things:
    (i) that product has exactly 5 digits
    (ii) that the last digit of product is Z, the last digit of pzcz
    (iii) that the 3rd digit of product is C, the 3rd digit of pzcz.

    Returns True if product passes all 3 checks, False otherwise."""
    # Insert your code here ...
```

Q6. Your classmate, I.M. Smart, types the following into the Python interpreter. What the interpreter responds is indicated with >>>

```
L = [ [0]*2 ] * 3
L[0][0] = 1
L
>>> [[1, 0], [1, 0], [1, 0]]
```

(a) Draw a box-and-pointer diagram for `L`. (3)
(b) How would you re-define `L` so that `L[0][0] = 1` produces `[1,0], [0,0], [0,0]` ? (3)

Part II

This part is to acquaint you with basic Python matrix operation. It requires the Numpy library to be installed for Python. Do not submit this part.

1. To use functions from Numpy, you need to first import the library by

```
import numpy as np
```

2. Generate a matrix from a list.

```
M = np.array([1,1,1])
```

3. Convert a matrix to a list.

```
L = list(M)
```

4. Generate a random array.

```
M = np.random.randint(1,100,(100,100))
```

5. Display the size of a matrix

```
print(M.shape)
```

6. Perform a transpose.

```
M_transpose = M.transpose()
```

7. Traverse this matrix and compute the sum of all elements. (Hint: use `M.shape`)

8. Compute the sum of its $50th$ column and $50th$ row.

9. Multiply each element by 2.

10. Compare `M*M` and `M.dot(M)`.

What to submit

Submit, by the deadline stated above, all your code for Part I only. The code for each question should be in a separate file, named `Qn.py` where n is the question number. Zip all files into a single file and name it as `XXX_YYY_assignment1.zip`, where "XXX" is your IVLE account (beginning with "gstCN") and "YYY" is your name in English. Upload the zip file to the IVLE workbin folder "Submission for Assignment 1".

For Part I, Q6, submit a handwritten drawing of your box-and-pointer diagram to the TA separately.