

In the first hands-on lab, you will:

- access your Linux account and change your password
- learn the features of Python
- practice programming with Jupyter Notebook

## **Task I: Linux Environment settings**

Login to a Linux workstation and do the following steps:

- Type CTRL-ALT-T to open a terminal. On the left sidebar, right click the Terminal icon and choose "Add to Favorites".
- Inside the terminal window, type the following command to install qiskit tools:  
`pip3 install qiskit qiskit-aer`
- Inside the terminal window, type the command "yppasswd" to change your password. Please remember your new password! Next, type "ssh grail" to login to the server grail using your new password to make sure it works. Then, type "exit" to logout grail and return back.

## **Task II: python3**

Perform the following steps:

- In the terminal window, use the commands below to create a sub-directory QC (i.e. a folder) and change your current working directory to it :  
`mkdir QC`  
`cd QC`
- Use the following command to copy a sample python/qiskit program to the current directory:  
`cp ~cis492s/pub/Hgate.py .`  
(Note: Don't forget the dot (.) at the end. In Linux, the dot means the current directory.)
- To run the sample program program, type:  
`python3 Hgate.py`

## **Task III: jupyter notebook**

Do the following experiments:

### **Experiment 1**

- Use CTRL-ALT-T (or middle click the terminal icon on the left side bar) to open a second terminal. In the second terminal window, type  
`cd QC`  
to change the current directory. Then, use  
`jupyter notebook`  
to launch the Jupyter Notebook App. You will find that the jupyter notebook is inside a web browser.
- Inside the browser, click "New" and choose "Python 3 (ipykernel)". You will see an entry box beginning with "In [ ]:" which we call it a cell.
- In the cell, type the following lines of python code:

```
a = 5
b = 7
print(a,b)
```

(Note: Do NOT type any spaces or tabs at the beginning of each line above). Next, press SHIFT-Enter (or click "Run") to execute the code in the cell. Record the output result.

## Experiment 2

- After you run the cell, you will have a new empty cell. Type

```
a,b = b,a
print(a,b)
```

to exchange two variable values without using a third temporary variable. Run the code and record the result.

## Experiment 3

- Python uses indentation (i.e. the spaces at the beginning of a line) to indicate a block of code. In the third cell, type

```
if a > b :
    c = a + b
    d = a - b
    print(c,d)
else:
    x = a * b
    y = a / b
    print(x,y)
```

In C/C++ or Java, a block of statements should be included in a pair of curly braces. Run the code and record the result.

## Experiment 4

- Click the first cell and change variable a's value to 9. Click the menu "Cell" and choose "Run All". Record the result changed in each cell.

## Experiment 5

- Python "for" loop can iterate over a range of numbers, lists, or strings. In a new empty cell, type

```
def foo(n):
    print('i   j   k')
    for i in range(n):
        for j in ['Hello', 'World']:
            for k in "XYZ":
                print(i,j,k)

foo(2) ## call the function
```

Run the code and record the result of the nested loops.

## Experiment 6

- In Python, we can perform the bitwise Exclusive OR operation (i.e. XOR) using the ^ symbol. In a new empty cell, type

```
for i in [0,1]:
    for j in [0,1]:
        p, q = i, j
        p = p ^ q
        q = p ^ q
        p = p ^ q
        print("in p, q:",i,j, " out p, q:", p,q)
```

Run the code and record the result. Explain what the three sequential statements containing the XOR operator do.

## Experiment 7

- Python's dictionary (also know as an associative array) is a data structure which consists of a collection key-value pairs. The feature is that the array index (i.e. the key) can be a string. Type

```
counts = {} # initialize counts as a dictionary
counts['00'] = 477
counts['11'] = 522
counts['00'] += 1
print(counts)
```

Run the code and record the result.

## Experiment 8

- In a new empty cell, type

```
%load Hgate.py
```

and click "Run" to load the sample program into the cell. Click to select the cell and then click "Run" to execute the sample program. Record the result of total counts.

## Turnin

Click "File" and choose "Save as". Type "lab1" in the entry box and click "Save" to save your work today into the file lab1.ipynb. To turn in your file, use CTRL-ALT-T to open a terminal and type

```
ssh grail
```

and type your password to login to the server grail. Then, type

```
cd QC
```

```
turnin -c cis492s -p lab1 lab1.ipynb
```

to electronically submit your file lab1.ipynb.

To shutdown the jupyter notebook, hit CTRL-C in the terminal window which you launch the jupyter notebook. Type y and press Enter.

To log out from Ubuntu desktop session, go to the top right corner, click to select "Power Off / Log Out", and choose "Log Out", or simply use the keyboard shortcut CTRL + ALT + DEL and click "Log Out".

**Hand in your hard-copy lab report before your leave.**