Subroutine

01204111 Section 1

What is subroutine/function

- In Math, we use functions, i.e. sin(x), sqrt(x), f(x), … which they have been defined.
- In subroutine, or Python's function, we group up a number of statements/computations and then we give them a name.
  - Enable to reuse those statements
  - Program will be shorter, easier to understand, less error-prone.
- A function is like a mini-program within a program.

Start our first function!!

```
def hello():
      print('Hi there, CPE30!!')
      print('This is my first function.')
print("What's up")
hello()
hello()
```

- The first line is a `def statement` which defines a function named `hello()`.
- Function name follows the rules for creating an identifier.

Start our first function!!

```
def hello():
    print('Hi there, CPE30!!')
    print('This is my first function.')
print("What's up")
hello()
hello()
```

- The code block after the `def statement` is the body of the function.
- This code is executed when the function is called not when the function is first defined.

Start our first function!!

```
def hello():
      print('Hi there, CPE30!!')
      print('This is my first function.')
print("What's up")
hello()
hello()
```

- The `hello()` lines are function calls.
- When the program execution reaches these calls, it will jump to the top line in the function and begin executing the code there.
- When it reaches the end of function, the execution returns to the line that called and continues executing.

Passing Value

- When we call some function, we pass in values, called `arguments` or `parameters`, by typing them between the parentheses.

```
def functionName(arguments):
    code block
```

Passing Value

```
01: def printSquare(x):
02:     i = 0
03:     while i < x:
04:         j = 0
05:         while j < x:
06:             print('*', end='')
07:             j += 1
08:         i += 1
09:         print()
10: printSquare(5)
```

Passing Value

```
01: def isADividedByB(a,b):
02:     if b == 0:
03:         print('error: b equal zero')
04:     elif a % b == 0:
05:         print('%i is divided by %i' %(a,b))
06:     else :
07:         print('%d is not divided by %d' %(a,b))
08: isADividedByB(50,5)
09: isADividedByB(33,6)
```

Task: *print triangle*

- Writing the printTriangle(n) which passing x as integer and printing the triangle.

INPUT:

```
Input size: 3
```

OUTPUT:

```
  *
 ***
*****
```

INPUT:

```
Input size: 6
```

OUTPUT:

```
      *
     ***
    *****
   *******
  *********
***********
```

Task: *print triangle*

- **Hint:** If the problem cannot be solved as is, we rather decompose it into smaller parts and solve those smaller parts.
- Print N rows
  - Print spacebars
  - Print stars
  - Next row

```
def printTriangle(x) :
      row = 0
      while row < x :
            printSpace(???)
            printStar(???)
            print()
            row += 1
```

Task: *print triangle*

- Find the relationship of **row** and **space(dot)**

row	space	input = 7
0	6	.....*
1	5	.....***
2	4	....*****
3	3	...*******
4	2	..*********
5	1	.**********
6	0	**********

space = input - row -1

```
def printSpace(input,row) :
      space = input – row -1
      i = 0
      while i < space :
            print(' ',end='')
            i += 1
```

Task: *print triangle*

- Find the relationship of **row** and **star**

row	star	input = 7
0	1	......*
1	3	.....***
2	5	....*****
3	7	...*******
4	9	..*********
5	11	.**********
6	13	**********

```
star = row * 2 + 1
```

```
def printStar(row) :
    star = row * 2 + 1
    i = 0
    while i < star :
        print('*',end='')
        i += 1
```

Task: *print triangle*

```
def printSpace(input,row) :
        space = input – row -1
        i = 0
        while i < space :
                print(' ',end='')
                i += 1

def printStar(row) :
        star = row * 2 + 1
        i = 0
        while i < star :
                print('*',end='')
                i += 1
```

```
def printTriangle(x) :
        row = 0
        while row < x :
                printSpace(x,row)
                printStar(row)
                print()
                row += 1

a = int(input('Input size: '))
printTriangle(a)
```

Returning Value

- The value to which a function call evaluates and send back to the caller is called the return value of the function.
- The return statement consists the **return** keyword and the returning value or expression.

```
def functionName(arguments):
    code block
    return returningValue
```

Task: *isPrime*

- Writing the isPrime(x) which passing x as integer and returning True when x is prime number and returning False when x is not.

```
Input integer: 70
```

```
70 is not a prime number.
```

```
Input integer: 23
```

```
23 is a prime number.
```

Task: *isPrime Ver.1*

```
01: a = int(input('Input integer: '))
02: i = 2
03: while i < a / 2:
04:         if a % i == 0:
05:                 print('%d is not a prime number' %a)
06:                 break
07:         i += 1
08: if i == a:
09:         print('%d is a prime number' %a)
```

Task: *isPrime Ver.2*

```
a = int(input('Input integer: '))
check = True
i = 2
while i < a / 2:
        if a % i == 0:
                check = False
                break
        i += 1
if check:
        print('%d is a prime number' %a)
else:
        print('%d is not a prime number' %a)
```

Task: *isPrime Ver.3*

```
01: def isPrime(x):
02:         check = True
03:         i = 2
04:         while i < x / 2:
05:             if x % i == 0:
06:                 check = False
07:                 break
08:             i += 1
09:         return check
10: a = int(input('Input integer: '))
11: check = isPrime(a)
12: if check:
13:         print('%d is a prime number' %a)
14: else:
15:         print('%d is not a prime number' %a)
```

Task: *isPrime Ver.4*

```
01: def isPrime(x):
02:         i = 2
03:         while i < x / 2:
04:                 if x % i == 0:
05:                         return False
06:                 i += 1
07:         return True
08: a = int(input('Input integer: '))
09: if isPrime(a):
10:         print('%d is a prime number' %a)
11: else :
12:         print('%d is not a prime number' %a)
```

Returning Value

- For Python, we can return multiple value at the same time.

```
def plusMinus(a,b):
     return a+b,a-b
x=5;y=7
plus,minus = plusMinus(x,y)
print('%i+%i=%i\n%i-%i=%i',%(x,y,plus,x,by,minus))
```

Task: *Triangle Area(Heron)*

- In geometry, Heron's formula gives the area of a triangle by requiring three sides of the triangle

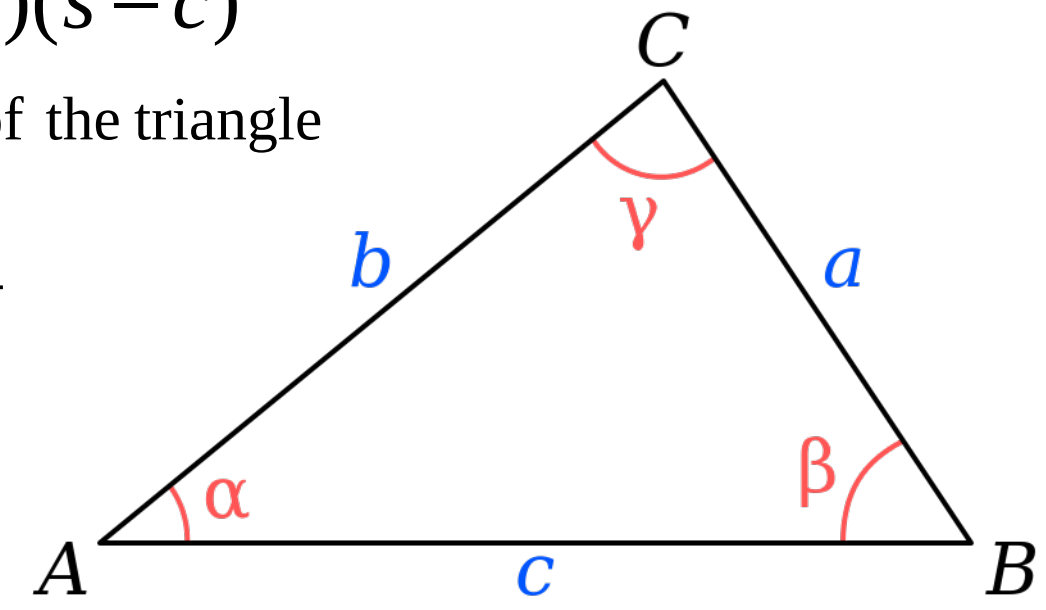
$$area = \sqrt{s(s-a)(s-b)(s-c)}$$

$$;a,b,c \text{ are length of three sides of the triangle}$$

$$s = \frac{a+b+c}{2}$$

```
Input a: 6.8
Input b: 3.7
Input c: 4.6
```

```
Area: 8.02
```



Task: *Triangle Area(Heron)*

```
a = float(input('Input a: '))
b = float(input('Input b: '))
c = float(input('Input c: '))

s = (a+b+c)/2
area = (s*(s-a)*(s-b)*(s-c))**0.5
print('Area: %.2f' %area)
```

```
def getInput() :
      a = float(input('Input a: '))
      b = float(input('Input b: '))
      c = float(input('Input c: '))
      return a,b,c
def getArea(a,b,c) :
      s = (a+b+c)/2
      return (s*(s-a)*(s-b)*(s-c))**0.5
def printFormat(area) :
      print('Area: %.2f' %area)
      return
a,b,c = getInput()
area = getArea(a,b,c)
printFormat(area)
```

Task: *BMI and Weight Status*

- Write a program receive height(cm.) and weight(kg.) then calculate the Body-Mass Index (BMI) and show the weight status.

$$BMI = \frac{weight(kg)}{(height(m))^2}$$

```
Enter weight(kg.): 70
Enter height(cm.): 2
```

```
BMI is 17.50, weight status: underweight
```

BMI	Weight Status
BMI < 18.5	Underweight
18.5 ≤ BMI < 25.0	Normal
25.0 ≤ BMI < 30.0	Overweight
BMI ≥ 30.0	Obese

Task: *BMI and Weight Status Ver.1*

```
weight = float(input('Enter weight(kg.): '))
height_cm = float(input('Enter height(cm.): '))
height_m = height_cm / 100
bmi = weight / (height_m**2)
status = ''
if bmi < 18.5 :
      status = 'underweight'
elif bmi < 25.0 :
      status = 'normal'
elif bmi < 30.0 :
      status = 'overweight'
else :
      status = 'obese'
print('BMI is %.2f, weight status: %s' %(bmi,status))
```

Task: *BMI and Weight Status Ver.2*

```
weight = float(input('Enter weight(kg.): '))
height_cm = float(input('Enter height(cm.): '))
height_m = cm_to_m_converter(height_cm)
bmi = bmi_calculator(weight, height_m)
status = get_bmi_status(bmi)
print('BMI is %.2f, weight status: %s' %(bmi,status))
```

Try writing these function by yourself:

```
cm_to_m_converter(cm)
bmi_calculator(w,m)
get_bmi_status(bmi)
```

Task: *BMI and Weight Status Ver.2*

```
def cm_to_m_converter(cm) :
      return cm / 100
def bmi_calculator(weight, height_m) :
      return weight / (height_m**2)
def get_bmi_status(bmi) :
      if bmi < 18.5 :
            return 'underweight'
      elif bmi < 25.0 :
            return 'normal'
      elif bmi < 30.0 :
            return 'overweight'
      else :
            return 'obese'
```

Task: *BMI and Weight Status Ver.3*

```
01: def get_bmi_with_status(height_cm,weight) :
02:         height_m = height_cm / 100
03:         bmi = weight / (height_m**2)
04:         if bmi < 18.5 :
05:                 return bmi , 'underweight'
06:         elif bmi < 25.0 :
07:                 return bmi , 'normal'
08:         elif bmi < 30.0 :
09:                 return bmi , 'overweight'
10:         else :
11:                 return bmi , 'obese‘
12: weight = float(input('Enter weight(kg.): '))
13: height_cm = float(input('Enter height(cm.): '))
14: bmi , status = get_bmi_with_status(height_cm,weight)
15: print('BMI is %.2f, weight status: %s' %(bmi,status))
```

Conclusion Function Declaration

Function Definition Keyword

Function Name

```
def functionName(...) :
    code block
    return ...
```

Arguments / Parameters

ex.

( ) , (x) , (x,y) , (x,y,z) , ...

Return Statement

ex.

```
return
return x
return x + y
return x , y
return x , y , z
```