Tutorial 1
Introduction to Python Programming

Learning Outcome

On successful completion of this practical, the students should be able to:

- Identify the different components of computer systems.
- Describe the background and characteristics of Python.
- Explain the writing, compilation and execution of a Python program.

1. List and describe the 5 major components of a computer system.

2. Compare and contrast 3 types of errors. Elaborate your answers by example.

3. [Group Discussion] Is there any errors in each of the following programs? What kind of errors (syntax, semantic or runtime) can you identify?

a)
```
print (Hello World)
```

b)
```
a = 3 + ( 5 + 9 )
```

c)
```
age = input("Enter your age: ")
print ("You are currently %s years old" age)
```

d)
```
print(1/0)
```

e)
```
x = input('enter first number: ')
y = input('enter second number: ')
sum = int(y + x)
print(sum)
```

f)
```
z = '6'
y = 2
val = z * y
print(val)
```

4. [Group Discussion] View this video https://www.youtube.com/watch?v=hxGB7LU4i1I and give some examples on what python can be used. Propose an application that you would like to build after you have learnt python programming.

-End-

Tutorial 2
Computational Thinking & Problem Solving

Learning Outcome

On successful completion of this practical, the students should be able to:

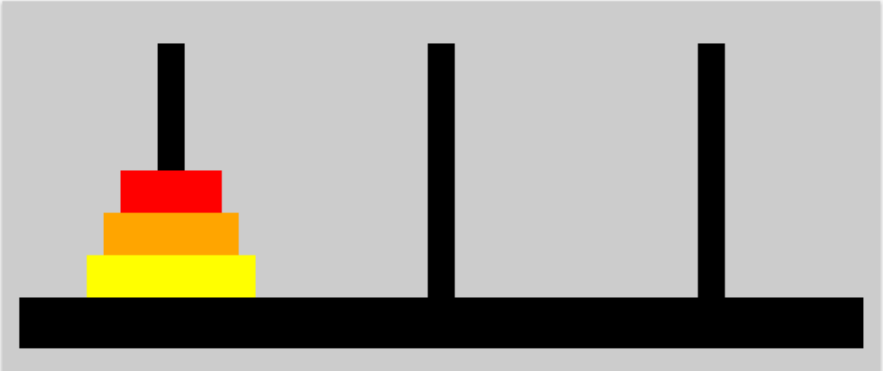
- Apply computational thinking concepts in solving a computational problem
- Apply pseudocode or flowchart to implement the logic of a software program

1. List and explain the 5 phases of the Program Development Lifecycle.

2. Tower of Hanoi is a classical mathematical puzzle. Your goal is to move the disk from one post to another. The rules that one need to follow are:

   a) Disks must be removed one at a time from the top of one tower and place onto the top of another tower.

   b) No disk can be larger than any disk below it.



How many moves are needed to move **64** disks from one post to another? To solve this problem, you will use **decomposition** to break down the problem to smaller chunks, and try to identify the patterns accordingly.

Head to https://www.mathsisfun.com/games/towerofhanoi.html and try to solve the puzzle with 3 disks, the number of minimum moves is 7. Next, try to solve with 4 disks, and the minimum moves required is 15. As you were moving those disks back and forth, you should feel like there was a pattern, even though you are unable to articulate what that pattern is.

Example moves for 3 tower puzzle

i. Tower A → C
ii. Tower A → B
iii. Tower C → B
iv. Tower A → C
v. Tower B → A
vi. Tower B → C
vii. Tower A → C

Based on the example moves above, identify which line does the pattern start over again? (You may consider A→B and B → A to be the same)

Finally, develop an algorithm based on this pattern you have gathered.

a) Move a disk between tower A and C

b)

c)

d) Repeat this process until the puzzle is solved.

3. A recent estimate of the number of different species of life on Earth is between 8 million and 9 million. If you are going to think of one of the species, and another person can only ask yes or no questions to try and guess the correct answer. How many questions do you think it would take to be able to confidently guess any species on Earth that you were thinking of?

   To solve this problem, let's apply decomposition to this problem by breaking down this large problem into a smaller problem. We shall start with a smaller example with only 8 species, try to guess with using only 3 questions (Hint: each question should help you to eliminate 50%)

   Does the species have _____?

   Does the species have _____?

   Does the species have _____?

   For 16 options, how many questions are needed to guess correctly? What about 32 options? Can you recognize a pattern and answer the question now? The ability to generalize the pattern found through experimentation into a general rule is known as abstraction.

4. Design a program to solve the following problem:

   Write a program to calculate the GST amount after the user enters the total item price. The price includes a 7% tax. When the user enters $1605.00, the following is displayed on the computer screen:

   GST Amount: $105

Algorithm in pseudocode:

Algorithm in flowchart:

5. Write a program that will ask the user to enter the weight and height. The program should then calculate and display the Body Mass Index (bmi).

Algorithm in pseudocode:

Algorithm in flowchart:

-End-

Tutorial 3
Variables, Expression and Statements

Learning Outcome

On successful completion of this practical, the students should be able to:

- Explain the use of variables in a program
- Explain the use of expressions and statements in a program

1. Which of the following are legal identifiers?

	If illegal, give reason.
`3com`	
`an_apple`	
`Aug1965`	
`a*star`	
`let's go`	
`__hello`	
`first-name`	
`lastName`	
`class`	
`Mix#8`	

2. Find the incorrect assignment statements from the following:

	If incorrect assignment, give reason.
`var1 = '7689'`	
`var2 == 'Hi'`	
`var3 = Hello`	
`3 = var4`	
`'7'+3*'8'+'2'`	
`9.0/5.0*True`	
`False*'9'+2.0`	
`5//2*3/True`	

3. Write the statement to:

   a) create two variables named `width` and `length`. Assign the value of `4` to the variable `width` and value of `3` to the variable `length` declared.

   b) calculate area of rectangle using the variable `width` and `length`. Reassigned the value to variable `width`.

c) display the values referenced by the variables.

4. Given the following program, what value and type will be stored in `result` after each assignment statement of `result`:

```
p = 2.0
w = 5
x = 4
y = 'a'
z = True

result = 5/4*z

result = y*x

result = w+x+z
```

Answer:

5. A cookie recipe calls for the following ingredients
   - 1.5 cups of sugar
   - 1 cup of butter
   - 2 cups of flour

   The recipe produces 48 cookies with this amount of ingredients. Write a program that asks the user for the number of cookies he wants to make, and display the number of cups of each ingredient needed for the specified number of cookies.

   Discussion:

   What are the potential pitfalls of the suggested solution, and what enhancements can you suggest to improve your program?

-End-

Tutorial 4
Decision Control Structures

Learning Outcome

On successful completion of this practical, the students should be able to:

- Explain the use of Boolean operators in evaluating a Boolean expression
- Explain the structure of a conditional statement used in a control flow
- Apply conditional statement for decision making in a program to solve problem

1. Fill in the truth tables below:

x	Not x
True	
False	

x	y	x and y
True	True	
True	False	
False	True	
False	False	

x	y	x or y
True	True	
True	False	
False	True	
False	False	

2. Given these following declarations and initializations:

```
i = 1
j = 2
k = 4
f = 1.0
```

Indicate whether each expression is true (T) or false (F).

a) (i > j) and (k < f)	
b) (i != j) and (k != f)	
c) (i == 1) or (j == 2) or (k != 4)	
d) (i <= j) and (j >= k)	

3. What is the output of the following code?

```
temp = 34


if temp > 33:
    desc = "Hot"
if temp > 28:
    desc = "Warm"
if temp > 20:
    desc = "Cool"
else:
    desc = "Cold"

print(desc)
```

4. Given x = 1, and y = 2, what is the output of the following code?

a)
```
if x == y:
    print("Statement 1. ")
```

b)
```
if x == y:
    print ("Statement 1. ")
print ("Statement 2. ")
```

c)
```
if x == y:
    print("Statement 1. ")
    print("Statement 2. ")
```

d)
```
if x == y:
    print("Statement 1. ")
else:
    print("Statement 2. ")
```

e)
```
if x != y:
    print("Statement 1. ")
else:
    print("Statement 2. ")
    print("Statement 3. ")
```

f)
```
if x == y:
   print("Statement 1. ")
   if x < y:
    print("Statement 2. ")
else:
    print("Statement 3. ")
```

g)
```
if x == y:
   print("Statement 1. ")
else:
   if x < y:
    print("Statement 2. ")
```

5. The following codes read in a number from the keyboard. Write Python codes to print the statement "Zero" if the number entered is 0. Otherwise, print "Positive" or "Negative".

```
num = int(input("Enter Number:"))
```

Challenge

6. In certain countries, different tax rates are used depending on the taxpayer's marital status and taxable income. An example of the tax table is as shown:

If your status is Single and if the taxable income is	the tax is	of the amount over
at most $32,000	10%	$0
Over $32,000	$3,200 + 25%	$32,000
If your status is Married and if the taxable income is	the tax is	of the amount over
at most $64,000	10%	$0
Over $64,000	$6,400 + 25%	$64,000

Design a program to compute the tax:

- Draw the complete flowchart of this program
- Implement the flowchart by writing the python codes

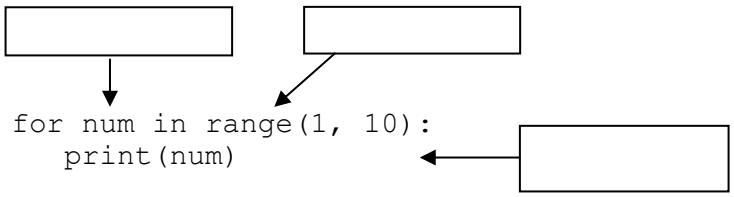
Discussion: What are the possible solutions to this question? Hint: Logical operator

-End-

Tutorial 5a
Loops and Iterations

1. A loop has the following construct:
   Variable
   Sequence
   Statements

   a) For the following code fragment, label the part of the construct listed above.



   b) What is the output of the above code fragment?

   c) Convert the `for` loop to `while` loop.

2. What is the output of the following code segment? Rewrite the codes with its for/while equivalent.

(a) `for i in range(1, 6, 2):` `  print(i)` `print("End")`	
(b) `for i in range(5, 1, -1):` `  print(i);` `  print("End")`	
(c) `for i in [10,8,6,4,2,0]` `  print(i);`	
(d) `for country in['Sin', 'USA', 6]:` `  print(country);`	
(e) `i = 1;` `while (i > 0):`	

`print("Nevermore")` `i=i-1`	
(f) `i = 1;` `while (i > 0):` `print("Nevermore")`	

3. Write the Python codes to print the following statements (using for loops):

```
Line 50
Line 52
Line 54
…
…
Line 100
The End
```

Rewrite the program using while loop.

4. Given the output, complete the program of the following code segment:

(a) `while__________:` `choice = input('Continue? (Y/N): ')` `if choice == 'N':` `break`	Output: `Continue? (Y/N): Y` `Continue? (Y/N): Y` `Continue? (Y/N): N`
(b) `for character in 'Python':` `if _____________:` `continue` `print(character, end='')`	Output: `Pyton`
(c) `num = random.randint(0,4)` `count = 1` `while _____________ :` `guessNum = int(input('Enter your guess:'))` `if guessNum == num:` `print('bingo')` `__________` `if count == 3:` `print('The number is ', num)` `count +=1` `print('End of game')`	Output 1: `Enter your guess:1` `Enter your guess:2` `Enter your guess:3` `The number is 4` `End of game` Output 2: `Enter your guess:4` `Enter your guess:3` `bingo` `End of game`
(d) `sum = 0` `for i in range(11):` `if _____ == 0:` `_____`	Output: `Sum of odd numbers from 0 to 10 is 25`

`` sum +=i print("Sum of odd numbers from 0 to 10 is ", sum)```	

-End-

Tutorial 5b
Loops and Iterations

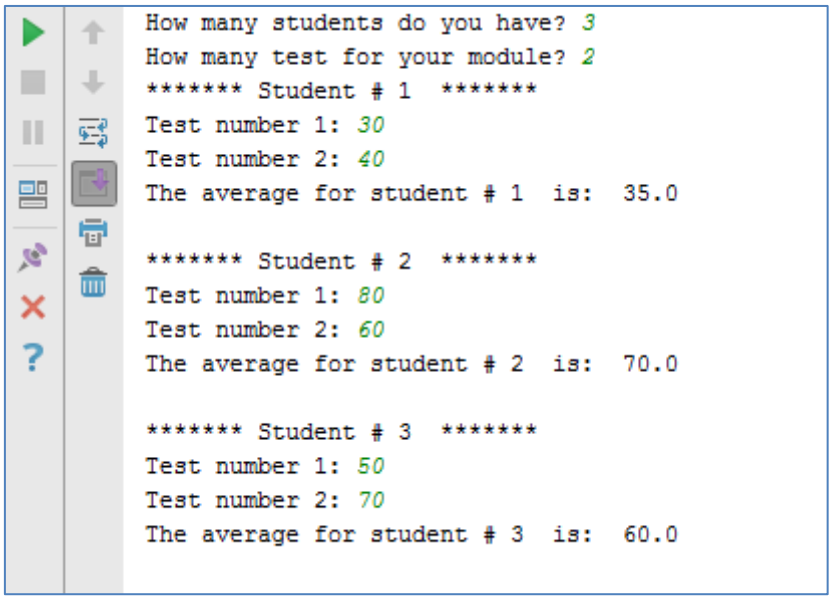
1. The following code segment prompts the user continuously to enter the day of week until a valid value is entered. Assume valid values are numbers 1 to 7. Complete the program:

```
day = int(input("Enter day of week (1-7): "))

while (_____________________) :

    ___________________________________
```

2. What is the output of the following code segment?

(a) `for i in range(1,5):` `  for j in range(3):` `  print(j, end='')`	Output:
(b) `for i in range(1,5):` `  for j in range(i):` `  print(j, end='')` `  print('')`	Output:
(c) `for i in range(2,10):` `  prime = True` `  for d in range(2, i):` `  if i%d == 0:` `  prime = False` `  break` `  if prime:` `  print(i,"is a prime number")`	Output:

3. Write a program that calculate the average test scores per student. The program should read in the number of students taking the module and the number of tests as show in the sample below:



4. Write a program that read in the user input and terminate when encounter a vowel in the input. Enhance your program that display the position of all vowel in the input.

Suggested solution for group submission on P5a and P5b will be discussed too.

-End-

Tutorial 6
Strings

Learning Outcome

On successful completion of this practical, the students should be able to:

- Explain the use of common string functions to make modification to string
- Apply string slicing techniques to manipulate strings

1. What is the expected output of the following?

```
Given txt = 'Python is fun'
```

	Output
`len(txt)`	
`txt[0]`	
`txt[13]`	
`print(txt[10:20])`	
`txt[-3:]`	
`txt[:6]`	
`txt[0::2]`	
`txt[1:10:-1]`	
`txt[12:1:-2]`	
`txt[1] = 'j'`	
`txt.replace('y', 'j')`	
`txt.swapcase()`	
`txt.rfind("n")`	
`txt.islower()`	
`txt.endswith("fun")`	

2. Write a Python program that turn a string containing a ten-digit phone number (such as "+6565501687") into a more readable string with spaces, like this:
"(+65) 6550 1687"

3. Given 2 strings, write a Python program that swap the last character of each string
   - Sample String: 'abc', 'xyz'
   - Expected result: 'abz' , 'xyc'

4. Used string methods to write a Python program to ask user to enter a string and then display the messages about a string.

Sample output:

```
Enter a string:ABC123
Length of String:  6
string contains alphanumeric
the letter in the string are all uppercase


Enter a string:123
Length of String:  3
string contains only digits

Enter a string:abc
Length of String:  3
string contains only alphabetic characters
the letter in the string are all lowercase
```

5. Write a Python program that convert the even characters in the given string to uppercase.
   - Sample String: 'programming'
   - Expected result: 'PrOgRaMmInG'

-End-

Tutorial 7
Lists, Tuples and Dictionaries

Learning Outcome

On successful completion of this practical, the students should be able to:

- Explain the various types of sequential data types such as list, tuple and dictionary used in a program
- Apply sequential data types in a program to solve problem

1. What are the differences between List, Tuple and Dictionaries?

2. Given the following values in a list `odd_numbers`:

`odd_numbers`	1	3	5	7	9

   a) Write the codes to print all elements of the list. Give 3 different solutions.

   b) Write the statement to print out the 1st, 6th and last element of the list

   c) What is the output of the following statements?

```
odd_numbers[-3:]
odd_numbers[: : 2]
odd_numbers[4: : -1]
odd_numbers[1:4:2]
```

   d) What is the content of the list `list1, even_numbers and odd_numbers` after the following statements are executed?

```
even_numbers = [2, 4, 6, 8]
list1 = odd_numbers + even_numbers

odd_numbers.append(11)
even_numbers.append(odd_numbers)
```

   e) Write the codes to display the number of element (length) of `list1`

   f) Write the codes to display all the elements of the `list1` in ascending order.

   g) Write the codes to sum up all the elements of the `list1`

3. Given the following values in a tuple `my_tuple`:

```
my_tuple = (('Physics', 'Chemistry'), 2016, 2017, (78.5, 82.9))
```

a) How to print 'Chemistry' from the tuple?

b) Use `reverse()` to reverse order the items in the tuple. What is the expected output?

Challenge

4. Create a dictionary `namelist` which store a collection of name and NRIC:

Name	NRIC
Mary Tan	S1234567A
Steve Lim	S2340986T
David Koh	T0276482Y
Jared Kuok	T0109845V
Yeo Ming Ming	S6734278E
James Sim	T007129K
Aaron Smith	G7878439K

a) Identify the key and the value

b) Add `Lam Lin Shan` with `NRIC S4456223G` to the dictionary

c) Iterate over the dictionary to print the value associate with the key

d) Search for the name with NRIC G7878439K. Display Record not found if the NRIC is not found in the dictionary.

e) Write codes to identify and display the name who are born on or after millennium. Hint: NRIC starts with T.

5. Land Transport Authority (LTA) would like to maintain vehicle records in Singapore. A record should consist of vehicle registration number, registered owner name and registration date.

What would you recommend to LTA? Justify your answer.

-End-

Tutorial 8
Functions & Modules

Learning Outcome

On successful completion of this practical, the students should be able to:

- Explain the use of common built-in functions in a program
- Construct user-defined functions and modules in a program to solve problem

1. Given the program below:

```
Line 1      def main():
Line 2          value = 5
Line 3          print('in main() - the value is', value)
Line 4          changeValue(value)
Line 5          print('in main() - the value is', value)

Line 6      def changeValue(value):
Line 7          print('This function will change the value')
Line 8          value = 49
Line 9          print('Now the value is', value)

Line 10     main()
```

a) How many function in this program?

b) Identify the function parameters. What is the different between function parameter and argument?

c) Identify the function definition and function call.

d) What is the output of the program?

e) Modify the program that the value will be changed in main() after the function call.

2. Given the program below:

```
import random

def quiz(num1, num2):
    answer = int(input('What is the sum of ' + str(num1) + ' and ' + str(num2) + ' ? '))
    if answer == num1 + num2:
        print('Congratulations! You have gained 1 point!')
    else:
        print('Sorry, your answer is incorrect')

def main():
    x = random.randint(0,100)
    y = random.randint(0,100)
    quiz(x,y)

main()
```

a) Understand the program and explain the limitation of the program?

b) Extend this program to allow addition, subtraction, multiplication and divisions

3. Given the functions in the module calculator.py, spot the errors in the calling program?

```
# calculator.py
# input : height in cm and weight in kg
# return : string to indicate the various classification
def get_bmi_classification(height, weight):
    classification = ''
    bmi = weight / height ** 2
    if bmi < 18.5:
        classification = 'underweight'
    elif bmi < 25:
        classification = 'normal weight'
    elif bmi < 30:
        classification = 'overweight'
    else:
        classification = 'obese'
    return classification

# input : height in cm and wieght in kg
# return : bmi value in float
def calculate_bmi(height, weight):
    bmi = weight / height ** 2
    return bmi
```

4. Given the following program that uses the functions from the converter module (converter.py), complete the module functions in converter.py accordingly.

```
# Spot the errors and correct them accordingly
use calculator

weight = input('Enter your weight (kg) : ')
height = input('Enter your height (cm) : ')

bmi = calculate_bmi(height, weight)
print('Your BMI is', bmi)

classification = get_bmi_classification(bmi)
print('You are', classification)
```

```
import converter

degree = float(input('Enter temperature in degree celsius:
'))

fahrenheit = converter.convert_degree_celsius(degree)

print('The temperature in fahrenheit is', fahrenheit)

km = float(input('Enter distance in km'))

miles = converter.convert_km_miles(km)

print('Distance in miles is', miles)
```

converter.py

```
# converter.py contains useful conversion functions

# This function converts temperature from degree celsius to
# fahrenheit
# the formula is fahrenheit = degree * 9 / 5 + 32


# This function converts distance from km to miles
```

5. Given the metric conversion module named metric.py. The module will provide easy conversion for the following:

- Kg to Pound
- Meter to Feet

a) Complete the metric.py module

```
# pound = 2.204 * kg
def kg_to_pound(kg):
    return 2.204 * kg
```

b) Complete the given test program to test your conversion module:

```
_____________________________________

print('100 Kg is', _____________________, 'pounds')

print('100 m is', _____________________, 'feet')
```

-End-