

Programme Code(s): DT228/TU856, DT282/TU858

Module Code: CMPU2016

CRN(s): 26462, 22399

# **TECHNOLOGICAL UNIVERSITY DUBLIN**

## **CITY CAMPUS**

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DT228/TU856 – BSc. (Honours) in Computer Science  
DT282/TU858 – BSc. (Honours) in Computer Science  
(International)

**Year 2**

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SEMESTER 2 EXAMINATIONS 2021/22

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### **Object Oriented Programming**

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#### ***Instructions:***

***THERE ARE 2 SECTIONS ON THE PAPER: SECTION A AND  
SECTION B. CANDIDATES MUST ANSWER TWO QUESTIONS  
OUT OF EACH SECTION. ANSWER FOUR QUESTIONS IN  
TOTAL. ALL QUESTIONS CARRY EQUAL MARKS.***

**SECTION A**  
**OO PROGRAMMING THROUGH PYTHON**

ANSWER ANY TWO QUESTIONS OF THE THREE QUESTIONS IN THIS SECTION

**Q1. (a)** Analyse the Python code below:

```
s = "spam"
new_str = s + s

print (new_str) # Line 1
print (new_str * 2) # Line 2
print (len(new_str)) # Line 3
```

(i) Explain how the operator + works with strings. What is the output of Line 1?

(1 mark)

(ii) Explain how the operator \* works when applied to an integer and a string. What is the output of Line 2?

(2 marks)

(iii) What does the method len() do when a string is passed? (2 marks)

(5 marks)

**(b)** Analyse the Python code below.

```
user_str = "abcdefg"
sub_str1 = user_str[:5]
sub_str2 = user_str[3:-2]
sub_str3 = user_str[:: -1]
print(sub_str1) # Line 1
print(sub_str2) # Line 2
print(sub_str3) # Line 3
```

What output is produced by # Line 1? (1 mark)

What output is produced by # Line 2? (2 marks)

What output is produced by # Line 3? (2 marks)

**(c)** Explain what the following Python code does and why it generates an error

```
def my_function (a_int):
    new_int = a_int
    print('new_int value (in function) is: ',new_int)

my_function(27)
print('new_int value is:', new_int)
```

(5 marks)

(d) Analyse the **class** student below:

```
class Student(object):
    def __init__(self, first='', last='', id=0):
        self.first_name_str = first
        self.last_name_str = last
        self.id_int = id
    def update(self, first='', last='', id=0):
        if first:
            self.first_name_str = first
        if last:
            self.last_name_str = last
        if id:
            self.id_int = id
    def __str__(self):
        return "{} {}, ID: {}".\
            format(self.first_name_str, self.last_name_str,
self.id_int)
```

- (i) Write the Python code to update the **instance** of this class below with the following information “Student name: ‘Nicest Student’, id: 2”. Write the python code to print the updated instance.

```
student1 = Student("Nice", "Student", 1)
```

(2 marks)

- (ii) Write the Python code to compare the two instances below and print which one has the highest id.

```
student2 = Student("Great", "Student", 2)
student3 = Student("Greatest", "Student", 3)
```

(2 marks)

- (iii) Write the Python code to define a new method for the Student class. This method should be named “\_\_eq\_\_”. It should overload the “=” operator and allow the comparison of two instances of Student. An instance is equal to another if they both have the same id, otherwise they are not equal.

(6 marks)

- Q2. (a)** Explain why the code below generates an error. Explain the Python concept that causes this error.

```
my_string = "Hello"
my_string[0] = "J"
```

(5 marks)

- (b) Given the **dictionary** variable `contacts` answer the following questions:

```
contacts = {'bill': '353-1234', 'rich': '269-1234', 'jane': '352-1234'}
```

- (i) Write a Python code to update bill's number to 555-1234
- (ii) Write a Python function that receives the variable `contacts` and prints the name and phone of contacts whose phone number contains "555"

(10 marks)

- (c) About exception handling:

- (i) Give two example of errors that can be handled by the **try-except** construct in Python

(4 marks)

- (ii) Write a Python **try-except** that avoids a crash for the code below. Instead, it prints a message explaining what caused the error

```
def division(n):  
    return (1/n)  
  
x = 10  
for i in range(x):  
    print(division(i))
```

(6 marks)

- Q3. (a) Explain why the following Python code crashes. Write a new Python code that addresses the problem.

```
class Car(object):  
    def __init__(year='', model=''):  
        year_str = year  
        model_str = model  
  
my_car = Car("1964", "Old")
```

(5 marks)

- (b) Write the Python code of a **class** to represent a rectangle. Add to the class the methods "area" and "perimeter". Create an instance of this class and print its area and perimeter

(10 marks)

- (d) Analyse the code below:

```
class Robot(object):  
    def __init__(self):  
        pass
```

```

    def __str__(self):
        return "Robot"

class HelloRobot(Robot):
    def __init__(self):
        pass

    def __str__(self):
        return "Hello!"

class DummyRobot(Robot):
    def __init__(self):
        pass

robot = Robot()
hello_robot = HelloRobot()
dummy_robot = DummyRobot()

print(robot) # Line 1
print(hello_robot) # Line 2
print(dummy_robot) # Line 3

```

- (i) What is the output of # Line 1? Explain how it is reached (2 marks)
- (ii) What is the output of # Line 2? Explain how it is reached (4 marks)
- (iii) What is the output of # Line 3? Explain how it is reached (4 marks)

## SECTION B

### OO PROGRAMMING THROUGH JAVA

ANSWER ANY TWO QUESTIONS OF THE THREE QUESTIONS IN THIS SECTION

#### Question 4

- (a) Conway's Game of Life is an example of a *cellular automata*. What are *cellular automata*? Give one other example of a cellular automata in computer science.
- (5 marks)
- (b) Write a class called Board in Java to encapsulate the Game of Life board. Include in your solution:
- (i) Private fields.
  - (ii) A public constructor that takes two parameters: the size of the board and a reference to a PApplet.
  - (iii) A public accessor method to return the value held in a cell. This method should incorporate bounds checking.
  - (iv) A private method to count the alive cells around a cell.
  - (v) A public method to draw the board using the Processing libraries.

(5 x 4 marks)

#### Question 5

- (a) How is a Java program with source code in the *src* folder that requires a library called *core.jar* and outputs to the *bin* folder, compiled from the bash shell?
- (3 marks)
- (b) Figure 1 shows an extract from a CSV file containing data on stars within 10 parsecs of Earth.

```
Display Name,Xg,Yg
Sol,0,0
Rigel Kentaurus B,1,-0.9
Barnard's Star,1.5,0.9
```

*Figure 1*

Write a Java class called Star that encapsulates data from a single row from this file. In your solution, include:

- (i) Private fields.
- (ii) Public accessor methods for **one** of the fields.
- (iii) A parameterised constructor that takes initial values for the private fields.

- (iv) A parameterised constructor that takes a Processing TableRow object as a parameter.
- (v) A toString method.

(5 x 2 marks)

- (c) Declare an ArrayList to hold instances of the Star class you created in part (b).

(2 marks)

- (d) What will get printed in Figure 2? Assume the ArrayList `stars` has no elements to begin with. Explain why.

(6 marks)

```
Star s = new Star();
s.setDisplayName("DIT");
stars.add(s);
Star s1 = stars.get(0);
s1.setDisplayName("TU Dublin");
System.out.println(s);
System.out.println(stars.get(0));
System.out.println(s1);
```

*Figure 2*

- (e) Figure 3 shows an extract from code that plots the elements in the ArrayList from part (c) to the drawing window. In the code, how are `x` and `y` calculated? Assume the range of values for `xG` and `yG` is between -5 to +5.

(4 marks)

```
for (Star s:stars)
{
    float x = ???????;
    float y = ???????;
    line(x, y - 5, x, y + 5);
    line(x - 5, y, x + 5, y);
}
```

*Figure 3*

### Question 6

- (a) In relation to digital audio, explain the following terms: *sample rate*, *resolution*, *frame size*, *spectrum*, *channels*.  
(5 marks)
- (b) What does *forking* a git repository mean? How to you keep a forked repository in sync with the repository being forked?  
(4 marks)
- (c) What is a *merge conflict*? How would you resolve a merge conflict on:
- (i) A CSV file
  - (ii) An MP3 file
- (6 marks)
- (d) Explain *lerp* and *map* from the Processing library. Give an example of the usage of these functions.  
(6 marks)
- (e) What is an *interface* in Java? Give an example.  
(4 marks)