University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

SEMESTER 2 EXAMINATIONS

ACADEMIC YEAR 2018/2019

COMP10020
Introduction to Programming 2

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Time Allowed: 1 Hour

Instructions for Candidates

Answer **Question 1** and any **two** other questions.
The value of each part of each question is
shown in brackets next to it.
This is a Closed Book/Notes exam. Students are **not** permitted to
bring materials to the Exam Hall.

Instructions for invigilators

This is a Closed Book/Notes exam.
Students are **not** permitted to bring materials to the Exam Hall.
Students are permitted to use a calculator.

1. **(a)** What is the output of `print(str[2:9])` if `str = 'University College Dublin'`?

(4)

(b) Only one of the following Python variable names is valid:

- `__var`
- `my.function`
- `3rd_prize`
- `for`

Identify the valid variable name and explain what is wrong with each of the others.

(4)

(c) Suppose the following code is used to create a dictionary:

```
d = {"frank":88.1, "catherine":99.7}
```

What happens when the following code is executed?
```
d["audrey"] = "C+"
```

(4)

(d) What is the difference between a *list* and a *set* in Python?

(4)

(e) What value is printed after the following code is executed?

```
x = y = 4
y += x + x * 6
print(y)
```

(4)

(f) Write a python function, `centimetres_to_feet_and_inches`, to convert a person's height given in centimetres to feet and inches.
(**Note:** there are 2.54 centimetres in an inch, and 12 inches in a foot.)

(4)

(g) Suppose that
```
address = "UCD, Belfield, Dublin 4"
```

What does the following statement return?
```
address.split(',')
```

(4)

(h) What is output by the following Python code snippet?

```python
counter = 0

while counter <= 12:

    if counter%2 == 0:

        print("Even")

        if counter > 8:

            print("Big")

    elif counter%3 == 0:

        print("3")
    counter += 3
```

(4)

(i) Fill in the code to complete the following function for computing the *factorial* of an integer.

Note: The factorial of an integer is the product of the integer and all integers below it; e.g. factorial four (*4!*) is equal to 4*3*2*1 = 24 and factorial six (6!) is equal to 6*5*4*3*2*1 = 720

```python
def factorial(n):
    if n == 0:
        return 1
    else:
        _____    # Complete this line
```

(4)

(j) Suppose that

```python
s1 = {1, 1, 3, 4, 4}
```
and
```python
s2 = {6, 5, 4, 2}
```

What is the value of the expression **s1.difference(s2)** ?

(4)

2. The following Python code declares a class used to represent a Citizen object.

```python
# A class to represent a citizen
class Citizen:
    def __init__(self, name, dob, country):

        # Name stored as a string
        self.name = name
        # Date of birth stored as a string in the
        # form "dd/mm/yyyy"
        self.dob = dob
        # Country of citizenship
        self.country = country
        # Visas for other countries held
        self.visas = dict()


    # Add visa
    def add_visa(self, country, start_year, expiry_year):

        _


    # A method to print the details of the citizen
    def show(self):
        print(self.name + " (" + self.dob + "), "  /
                                    + self.country)
```

(a) Write Python code to create two citizens with the following attribute values:

| Name:	Usain	Name:	Sonia
Country:	Jamaica	Country:	Ireland
Dob:	21/08/1986	Dob:	28/11/1969

Also call the **show** method for each object created.

(3)

(b) The **add_visa** method in the **Citizen** class should add a new visa object to the visas list stored in a Citizen object.

   (i) Write a new python class, **Visa**, to store visa objects. The attributes of a visa object are the country for which it is held, the year in which it comes into effect and the year in which it expires. The only methods in the **Visa** should be its constructor and a show method which prints the details of the visa.

   (12)

   (ii) The **add_visa** method of the citizen class doesn't currently do anything. Write a new version that creates a new visa object based on the parameters provided adds this to the list stored in the **visas** attribute.

   (10)

   (iii) Write a new version of the **print** method from the **Citizen** class that also prints the details of the visas that a citizen holds.

   (5)

3. (a) Describe, using pseudo-code and diagrams where appropriate, the **insertion sort** algorithm.

   (15)

(b) Show the steps the **insertion sort** algorithm would take to sort the following list:

   ```
   [56, 17, 72, 8]
   ```

   (10)

(c) It is said that when designing good algorithms a trade-off between *correctness*, *efficiency*, and *simplicity* is required. Using appropriate examples explain what this means.

   (5)

4. (a) The image below shows a **scatter plot matrix** (SPLOM) of a dataset that describes the players on a soccer team. The variables included are players' height, weight, and age; and the average number of metres run by a player per game. Describe the relationships between these four variables that are apparent from this data visualisation.
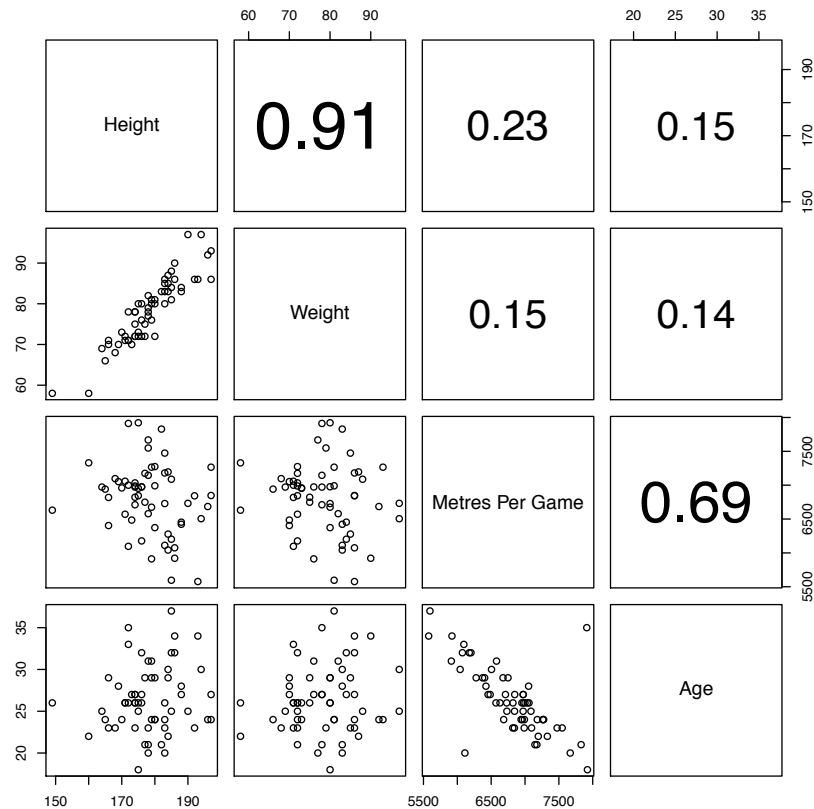
(10)

(b) The following simple **pandas data frame** is stored in the Python object **teams** and stores the name of teams in a league, the division in which they play, the points the team have scored (*For*) and the points scored against the team (*Against*).

Team	Division	For	Against
Kildare	A	62	24
Dublin	B	54	76
Donegal	A	33	11
Cork	B	45	81
Mayo	B	17	33
Laoise	A	74	87

Write Python code (**using the pandas library**) to perform the following operations:

(i) Select only the **Team** and **Against** columns from the data frame.

(4)

(ii) Calculate the **minimum** value for the **For** and **Against** columns of the data frame.

(4)

(iii) Select only the rows from the data frame that describe **teams in division A**.

(4)

(iv) Create a new column in the data frame called **Points Difference** that contains the difference between the points scored for the team and the points scored against the team.

(4)

(v) Select only the rows from the data frame that describe **teams in division A** with a **positive points difference**.

(4)