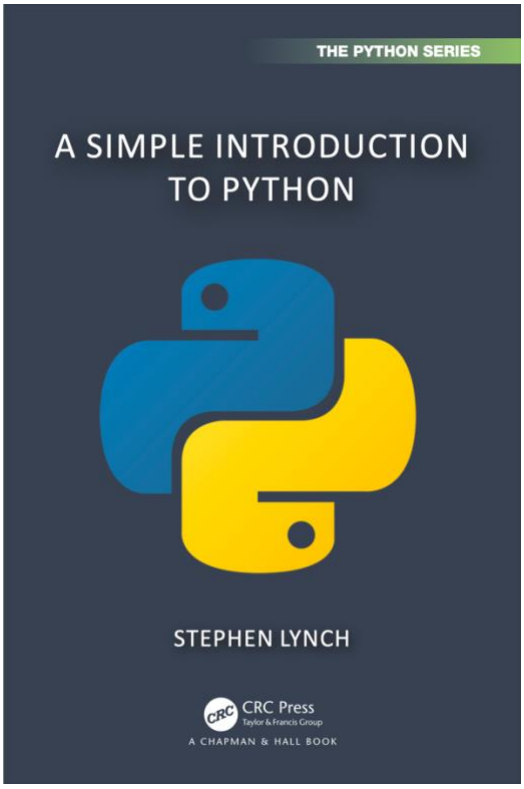
ASSESSMENT COVER SHEET

Unit Title:	A SIMPLE INTRODUCTION TO PYTHON
Assessment Set By:	Dr S Lynch NTF FIMA SFHEA
Assessment ID:	1CWK100
Assessment Weighting:	100%
Assessment Title:	COURSEWORK ASSESSMENT
Type:	Individual
Hand-In Deadline:	**Give students six-eight weeks to complete the coursework**
Hand-In Format and Mechanism:	You MUST create a **Google Colab** notebook and you MUST submit your work in electronic format as a **SINGLE PDF FILE** using the appropriate submission link on the VLE for that unit. Guidance on how to save a notebook as a pdf file will be posted on the unit Web pages. It is your responsibility to ensure that your work is legible.

Learning outcomes being assessed:

LO1 To use Python as a powerful calculator.
LO2 To produce colourful graphics and animations.
LO3 To use Python to solve problems in Computer Science.
LO4 To produce a professional looking Jupyter notebook.



1. Create a **Google Colab** notebook for your **6G3Z3107 1CWK100** submission. Use the title **StudentID_YourNumber** and save as a notebook (ipynb). Using Jupyter from Anaconda – upload the ipynb notebook, then download as html. You MUST save this notebook as a **pdf** for submission. Use Text Cells (and LaTeX if needed) to copy the questions (1 mark for each question), Code Cells to insert your Python code, and insert pictures if required.

   [10 Marks]

2. In a Jupyter notebook, compute the following:

   (a) $\frac{2}{5}+\frac{1}{4}\left(\frac{2}{7}-\frac{1}{3}\right)$, accurately;

   (b) $\cos\left(\frac{\pi}{5}\right)-\sin\left(\frac{\pi}{3}\right)$, to five decimal places.

   [5 Marks]

3. The logisitic map function, f say, is defined as:

   $f(x)=3.5x(1-x)$.

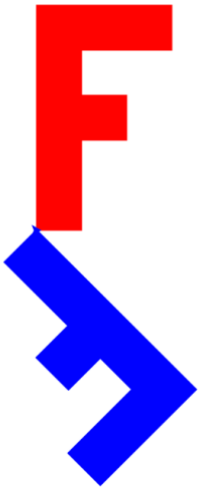
   Write a Python program that defines this function and use a loop to compute the first 20 iterates of:

   $x_{n+1}=f(x_n)$,

   given that $x_0=0.1$. Evaluate to 10 decimal places throughout and put the sequence of values in a list.

   [10 Marks]

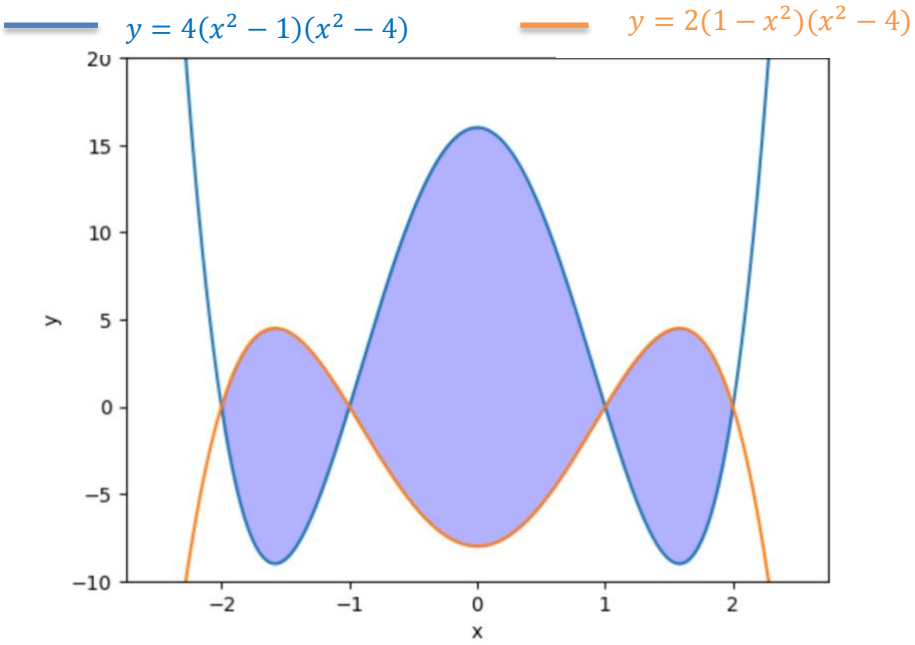
4. Use the turtle module to plot the figure on the right:

Use a notebook for this question and use lists of lists. The red "F" is plotted using a list of lists with eleven points (vertices). The blue "F" is the red "F" rotated by $\frac{3\pi}{4}$ radians, clockwise. You must use the rotation matrix: $\begin{pmatrix}\cos(\theta) & -\sin(\theta)\\ \sin(\theta) & \cos(\theta)\end{pmatrix}$, to rotate the image.	

[5 Marks, 5 Marks]

Continued

5. Use matplotlib to plot the figure below and determine the shaded area.



[15 Marks]

6. The Python program for animating the curve $y = \sin(\omega t)$, for $0 \leq \omega \leq 5$, is posted on Moodle (Animation.ipynb saved as Animation.pdf). Edit this program to produce an animation of the curve:

   $y = \cos(t + \phi)$, $0 \leq \phi \leq \pi$.

   Include comments in your program on how the animation works.

   [5 Marks , 5 Marks for Comments]

7. Research the *Playfair Cipher* on the Web. Use your first name and surname as the encryption/decryption key (without repetition of letters) and complete a 5×5 matrix table, missing out the letter J. For example, if your name is Bruce Wayne, your matrix might look like:

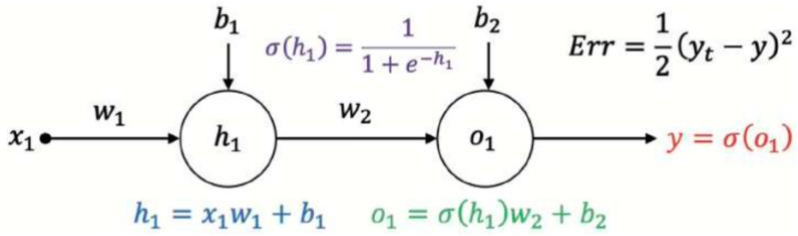
Matrix = $\begin{bmatrix} B & R & U & C & E \\ W & A & Y & N & D \\ Z & X & V & T & F \\ O & P & Q & S & G \\ M & L & K & I & H \end{bmatrix}$.	`Matrix $=\begin{pmatrix}`
	`B & R & U & C * E \\`
	`W & A & Y & N & D \\`
	`Z & X & V & T & F \\`
	`O & P & Q & S & G \\`
	`M & L & K & I & H`
	`\end{pmatrix}$.`

   Explain how the cipher works, given that the message is “I LOVE PYTHON.” Determine the encrypted message by hand. DO NOT WRITE A PYTHON PROGRAM FOR THIS QUESTION.

   [15 Marks]

Continued

8. Given that $x_1 = 0.5, b_1 = -0.2, b_2 = 0.4, w_1 = 0.2, w_2 = 0.8, y_t = 0.4$, the learning rate, $\eta = 0.1$, and the activation function, $\sigma(v) = \frac{1}{1+e^{-v}}$, using the artificial neural network (ANN) below (b_1, b_2 remain constant):



(a) use Python to compute the output of this ANN, $y = \sigma(o_1)$; [5 Marks]

(b) use Python to update the weights w_1 and w_2 after back-propagation. [5 Marks]

9. Use the Data-1-OCR.xlsx large data set for this question. Download from GitHub.

(a) Plot graphs to compare Regions and Life Expectancies at Birth in 1960 compared to 2000. What can you conclude? What do you think the results will be like in 2040?

[5 Marks]

(b) For each Region, see how Unemployment compares with GDP per Capita (US$). What can you conclude?

[5 Marks]

10. The following Python program shows a parent class “Pet” and child classes “Cat” and “Canary.”

```
class Pet:
    def __init__(self, legs):
        self.legs = legs

    def walk(self):
        print("Pet parent class. Walking...")

class Cat(Pet):
    def __init__(self, legs, tail):
        self.legs = legs
        self.tail = tail

    def meeow(self):
        print("Cat child class. A cat meeows but a canary can't. Meeow...")

class Canary(Pet):
    def chirp(self):
        print("Canary child class. A canary chirps but a cat can't. Chirp...")

Tom = Cat(4, True)
Cuckoo = Canary(2)
```

The objects Tom and Cuckoo have been declared. **Continued**

What output do the following lines give?

```
print(Tom.legs)
print(Tom.tail)
print(Cuckoo.legs)
Tom.meeow()
Cuckoo.chirp()
```

[5 Marks]

TOTAL MARKS = 100

End