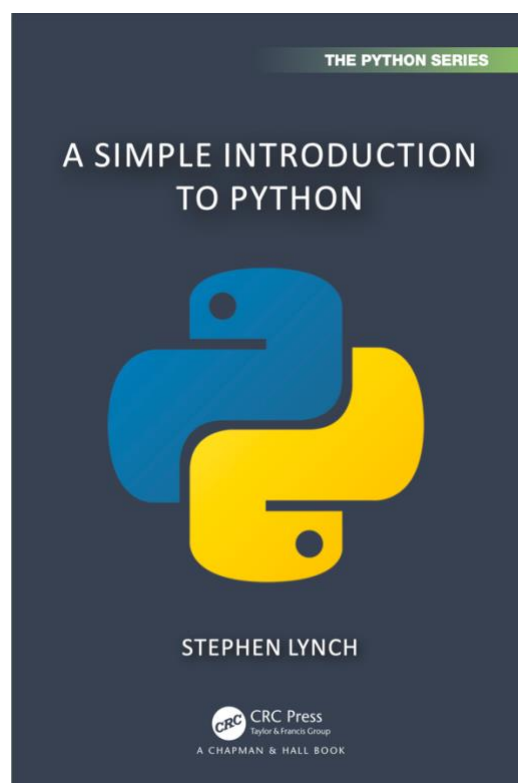


ASSESSMENT COVER SHEET

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 **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.

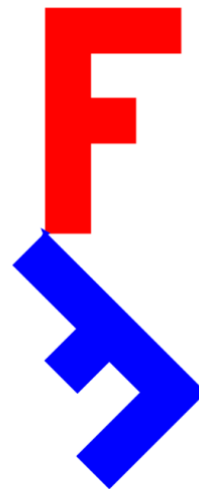
The red “F” is plotted using a list of lists with eleven points (vertices).

The blue “F” is the red “F” rotated by $\frac{3\pi}{4}$ radians, clockwise.

You must use the rotation matrix:

$$\begin{pmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{pmatrix},$$

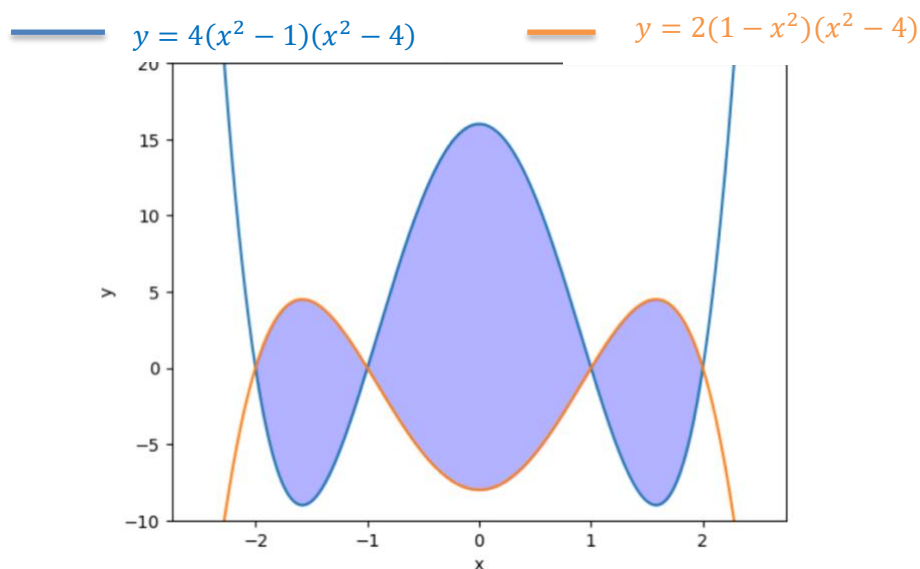
to rotate the image.



[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 given in this URL:

[https://drstephenlynch.github.io/webpages/Python for A Level Mathematics and Beyond.html](https://drstephenlynch.github.io/webpages/Python%20for%20A%20Level%20Mathematics%20and%20Beyond.html)

Edit this program to produce an animation of the curve:

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

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:

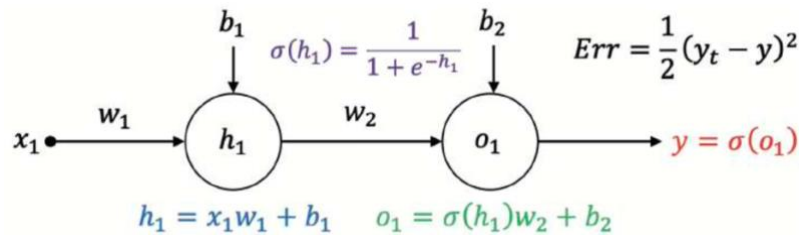
Matrix =	$\begin{bmatrix} B & R & U & C & E \\ W & A & Y & N & D \\ Z & X & V & T & F \\ O & P & Q & S & G \\ M & L & K & I & H \end{bmatrix}$	<pre>Matrix \$=\begin{pmatrix} B & R & U & C & E \\ W & A & Y & N & D \\ Z & X & V & T & F \\ O & P & Q & S & G \\ M & L & K & I & H \end{pmatrix}\$.</pre>
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Explain 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 meow(self):
        print("Cat child class. A cat meows but a canary can't. Meow...")

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