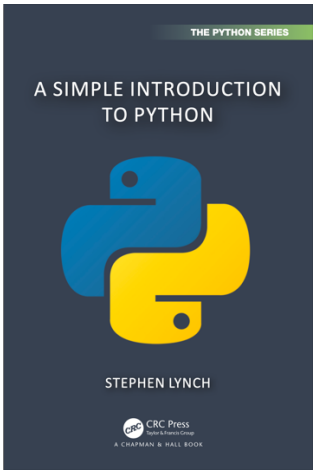


A SIMPLE INTRODUCTION TO PYTHON

EXEMPLAR EXAMINATION PAPER

DURATION: **2 HOURS**

TO BE SAT IN A COMPUTER LABORATORY WITH ACCESS TO AN APPROPRIATE PYTHON IDE

SAVE YOUR WORK REGULARLY

1. Python as a Powerful Calculator

   (a) Compute: $2 - 2(2 - 2 \times 2 - 5)$.

   (b) Accurately calculate: $\frac{1}{3} - \frac{1}{5}\left(\frac{2}{7} - \frac{3}{4} \times 9\right)$.

   (c) Evaluate: $2^6 \times 4^5 - 2^8 \div 3^4$, to 4 decimal places.

   (d) Determine the highest common factor of 34563 and 43652.

   (e) Find $\sqrt{\sin\left(\frac{\pi}{4}\right)}$, to 4 significant figures.

   [10 Marks]

2. Simple Programming

   Write a program that prints the first 100 terms of the sequence $a_n = 2 + 3(n - 1)$, in a list, and sum the first 50 terms, given that n is a natural number.

   [10 Marks]

3. The Turtle Library

   Using comments, explain each line of the following Python code and describe the figure plotted:

```
import turtle
my_pen = turtle.Turtle()
for i in range(5):
  my_pen.forward(100)
  my_pen.right(144)
turtle.done()
```

   [10 Marks]

CONTINUED

4. NumPy and MatPlotLib

   Given that $a = 0.2, b = 1.1 \times 10^6, r = 8, s = 16$, plot the curve,

   $$y = bx^r e^{-sx} - ax,$$

   for $0 \leq x \leq 2$.

   [10 Marks]

5. SymPy

   Given, $A = \begin{pmatrix} 3 & -1 & 2 \\ 4 & 0 & 1 \\ -3 & 2 & 2 \end{pmatrix}$:

   (a) Determine A^3.
   (b) Find the determinant of A.
   (c) Compute the inverse of A.
   (d) Evaluate the eigenvalues and eigenvectors of A.

   [10 Marks]

6. Mathematics

   Given that, $f(x) = \frac{2x-1}{x-4}$:

   (a) Determine $f(-1)$.
   (b) Find $f\big(f(-1)\big)$.
   (c) Compute $f^{-1}(x)$.
   (d) Find $\frac{df}{dx}$.

   [10 Marks]

7. Cryptography

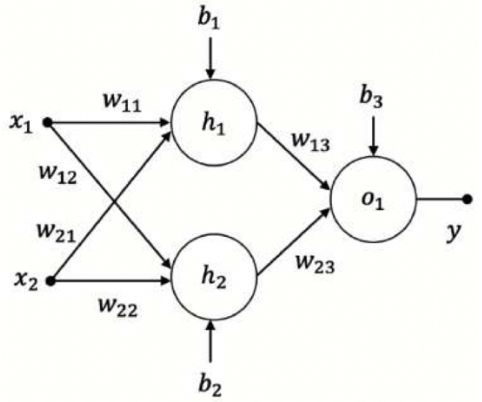
   Write a program to encrypt a REVERSE CIPHER. For example, HELLO would be encrypted as OLLEH.

   [10 Marks]

CONTINUED

8. Artificial Intelligence

The ANN for an XNOR logic gate and its truth table are shown below:



XNOR Gate Truth Table

x_1	x_2	y
0	0	1
0	1	0
1	0	0
1	1	1

Given that, $w_{11} = 60, w_{12} = 80, w_{21} = 60, w_{22} = 80, w_{13} = -60, w_{23} = 60$, and $b_1 = -90, b_2 = -40, b_3 = -30$, write a program to show that this ANN does act as a good approximation of the XNOR gate.

[10 Marks]

9. Data Science

Load the LDS "Data-1-OCR.xlsx" using the following code:

```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
df = pd.read_excel("Data-1-OCR.xlsx" , sheet = "Data")
df.info()
```

Plot a Box and Whisker plot for "unemployment (%)" by "Region" and comment on your results.

[10 Marks]

10. Object Oriented Programming

(a) Explain each line of the following code:

```
class Dog:
        def __init__(self , name , age):
                self.name = name
                self.age = age
        def bark(self):
                print("woof woof")
        def birthday(self):
                self.age += 1
ozzy = Dog("Ozzy" , 2)
wilson = Dog("Wilson" , 4)
```

[6 Marks]

CONTINUED

(b) What output do the following lines give?

```
print(ozzy.age)
ozzy.bark()
wilson.birthday()
print(wilson.age)
```

[4 Marks]

END