University of Colombo, Sri Lanka

University of Colombo School of Computing

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Second Year Examination - Semester II - UCSC AY20 [held in March/ April 2024]

SCS2211 — Laboratory II

(Two (2) Hours)

Answer ALL questions

Number of Pages = 15 Number of Questions = 4

231

To be completed by the candidate								
Index Number:								

Important Instructions to candidates:

I. Students should answer in the medium of English language only using the space provided in this question paper.

II. Note that questions appear on both sides of the paper. If a page or a part of this question paper is not printed, please inform the supervisor immediately.

III. Write your index number CLEARLY on each and every page of this question paper.

IV. This paper consists of 4 questions on **15** pages (including the Cover Page).

V. **Answer ALL questions.**

VI. Programmable Calculators and any electronic device capable of storing and retrieving text including electronic dictionaries, smart watches and mobile phones are **not allowed.**

VII. **Non-Programmable calculators** are **allowed.**

VIII. Do not tear off any part of this answer book. Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.

To be completed by the examiners

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Total	

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Question 1

(a) Write down the **four (04)** scales of measurements and briefly explain each with an example.

[06 Marks]

(b) Write a function in R named as " `prime_numbers( )` " to find the prime numbers up to a given number ***'n'***.
For example, if the function is called as " `prime_numbers(30)` " it should print the values **"2 3 5 7 11 13 17 19 23 29"** as the output.

[08 Marks]

(c) Briefly explain **Null Hypothesis** and **Alternative Hypothesis** with a suitable example.

[04 Marks]

(d) Explain how you can find the least squares regression line using the equations given below. Also explain how to predict an approximate value for an unseen event, using the least squares regression line.
You can use a suitable example to explain your thinking.

$$m = \frac{N\,\Sigma(xy) - \Sigma x\,\Sigma y}{N\,\Sigma(x^2) - (\Sigma x)^2}$$

$$b = \frac{\Sigma y - m\,\Sigma x}{N}$$

[06 Marks]

(e) Outline how the inbuilt help facility in R could be used.

[01 Mark]

Question 2

(a) All the employees of ***"ABC Company"*** have taken a skill assessment provided by a certain website. The **twelve (12)** employees of the company scored the following marks for the skills assessment.

Table Name: Skill Assessment Table

#	Name	Age	Marks
1	Alice	28	88
2	Bob	21	72
3	Charlie	32	90
4	David	24	81
5	Eva	23	78
6	Frank	28	88
7	Grace	31	90
8	Hank	15	48
9	Ivy	21	75
10	Jack	23	80
11	Ken	18	64
12	Liam	35	94

(i) Write the R code for creating a vector named **"marks"** to store the values given in the ***"Marks"*** column of the skill assessment table.

[01 Mark]

(ii) Write the R code for calculating the **sum, mean** and **median** of ***"marks"*** vector.

[03 Marks]

(iii) Mathematically compute the **variance (σ^2)** and **standard deviation (σ)** of ***"marks"*** to the nearest 3 decimal places.

[08 Marks]

(b) It was noticed that there is a linear correlation between ***Age*** and ***Marks*** obtained by the employees in *"ABC Company"*.

(i) Find the **explanatory variable** and **response variable** using the skill assessment table given above such that there is a correlation between these two variables.

[02 Marks]

(ii) Find the **correlation coefficient r**, using appropriate variables and the data provided in the skill assessment table above.
Use the following equation to find the **correlation coefficient r**.

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,][\, n\Sigma y^2 - (\Sigma y)^2 \,]}}$$

[10 Marks]

(iii) Interpret the relationship of correlation between the two variables.

[01 Mark]

Question 3

(a) Briefly explain **three (03)** features of GNU Octave.

[06 Marks]

(b) What are **scripts** in Octave and how can they be used in both **Octave** and **MATLAB**?

[04 Marks]

(c) Write the outputs of the Octave code fragments given below.

(i)
```
>> a = linspace (0,15,5)
```

[01 Mark]

(ii)
```
>> floor (5.6)
```

[01 Mark]

(iii)
```
>> s = ["Heal" 'The' "World"];
>> disp(s)
```

[01 Mark]

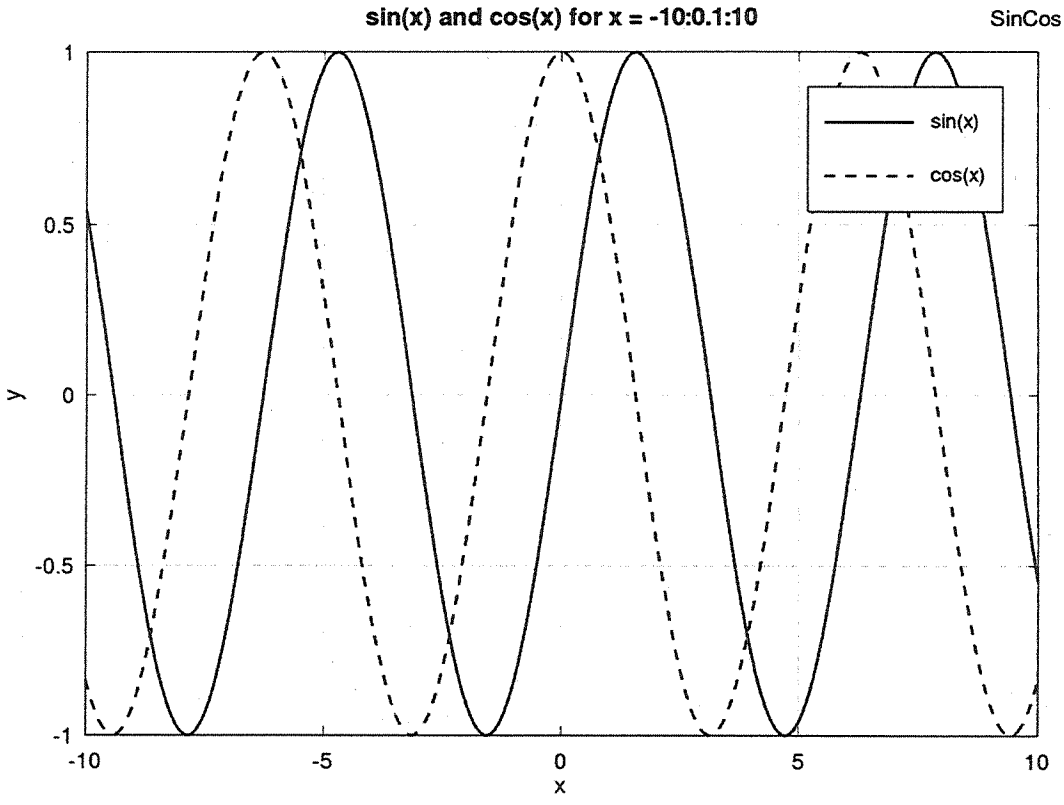
(iv)
```
>> a = [1,2,3; 4,5,6; 7,8,9];
>> flipud(a)
```

[01 Mark]

(v)
```
>> mycell = {'a' , {'b', 'c', 'd'}, 123, ['x', 'y']};
>> mycell{2}{2}
```

[01 Mark]

(d) Fill in the blanks in the following octave script to plot **y = sin(x)** and **y = cos(x)** lines in the same graph, such that the final output will be as follows.



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[10 Marks]

```
% Octave script for y = sin (x) and y = cos (x)

x = _____ : 0.1 : 10 ;
y_sin = _____ ;

% Plot sin(x) and hold the plot
_____ (x, y_sin, 'k', 'LineWidth', 1);  % 'k' for black
_____ ;

y_cos = _____  ;
% Plot cos(x)
plot(x, y_cos, ' _____ ', 'LineWidth', 1);
% 'k--' for black dashed line

_____  ("sin(x) and cos(x) for x = -10:0.1:10");
xlabel("x");
ylabel("y");
text(9, 1.1, " _____ ");
_____ ("sin(x)", "cos(x)");
_____  ; % Add gridlines

% Release the hold
hold off;

% End of the code
```

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Question 4

(a) Explain how you can scale your plots using **semilogx, semilogy** and **loglog** plots using a suitable diagram for each plot.

[06 Marks]

(b) **Newton Raphson Numerical Method** is a powerful technique for solving equations numerically. It is most commonly used for approximation of the roots of the real-valued functions. The general equation for the Newton Raphson method is as follows.

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

(i) It is given that $x^3 - 3 = 0$ has a root between 1 and 3. Explain how you can find the approximate root value to 3 decimal places using **Newton-Raphson numerical method** by assuming the initial value as **2**. Use the above equation and clearly show your calculations.

[08 Marks]

(ii) Explain how you can use GNU Octave to effectively obtain an accurate value for the root by writing a suitable Octave code segment for Newton Raphson Numerical Method.

[06 Marks]

(c) Suppose that you have a PNG image named as ***'rose.png'*** in your current working directory.

(i) Write the Octave code to **read the image** and **store the image details** in a variable named ***"Image".***

[02 Marks]

(ii) Suppose you need **several information** about the image such as **Filename, FileModDate, FileSize etc.** Write the Octave code to get this information displayed in the command window.

[02 Marks]

(iii) Write the Octave code to **visualize the image** named ***'rose.jpg'***.

[01 Mark]

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