Digital Design Verification

Lab # 04

ARRAYS

Release Date: 30-July-2024

NUST Chip Design Centre (NCDC), Islamabad, Pakistan

Revision History

Revision Number	Revision Date	Revision By	Nature of Revision	Approved By
1.0	30/07/2024	Dr. Abid	Complete manual	-
1.1	06/08/2024	Engr Hira	Revision in manual	

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Objective

The objective of this lab is to enable students to answer following questions:

- How arrays help us in organizing data?
- How to perform operations on arrays?
- How arrays store data?
- How to represent 2D arrays?
- How to apply these concepts to real-world applications

Tools

- GNU debugger
- GC compiler

Lab Task # 01

Take an input sentence (maximum length N = 100) and perform the following operations on the sentence.

a. Length of the sentence
b. Sentence in lowercase
c. Sentence in uppercase
d. Number of words in the sentence
e. Number of vowels
f. Frequency of the vowels

Flow Chart: 20 Minutes **Code:** 20 Minutes

Scientific Computing - Linear Algebra Operations

At the core of all scientific computations for nuclear simulation, weather modeling or circuit simulation is linear algebra. In linear algebra, there are typically three levels of operations that are the most common which usually involve arrays.

S.No.	Basic Linear Algebra Subroutine (BLAS Level)	Operations	
1.	Level 1 (Vector- Vector operations)	axpy	**ax + by**
		dot product	$\mathbf{x}^T\mathbf{y}$
2.	Level 2 (Matrix - Vector operations)	matrix vector multiplication	**y = Ax**
3.	Level 3 (Matrix - Matrix operations)	matrix multiplication	**C = AB**

Lab Task # 02

Level 1 Operations - axpy (ax + by)

Write a program which takes inputs a, **x,** b and **y** from the user (**x**, **y** are vectors of size N) and a and b are scalars. Your program should then compute the above operation.

Flow Chart: 15 Minutes **Code:** 15 Minutes

Lab Task # 03

Write a program that declares an integer array of size 10. Initialize the array element with random numbers in the range 1-20 and graph the information as a histogram as shown:

Element	Value	Histogram
0	3	***
1	5	*****
2	8	********
3	11	**********
. . .		

Flow Chart: 25 Minutes **Code:** 20 Minutes

Lab Task # 04

Level 3 Operations - Matrix Multiplication (C=AB)

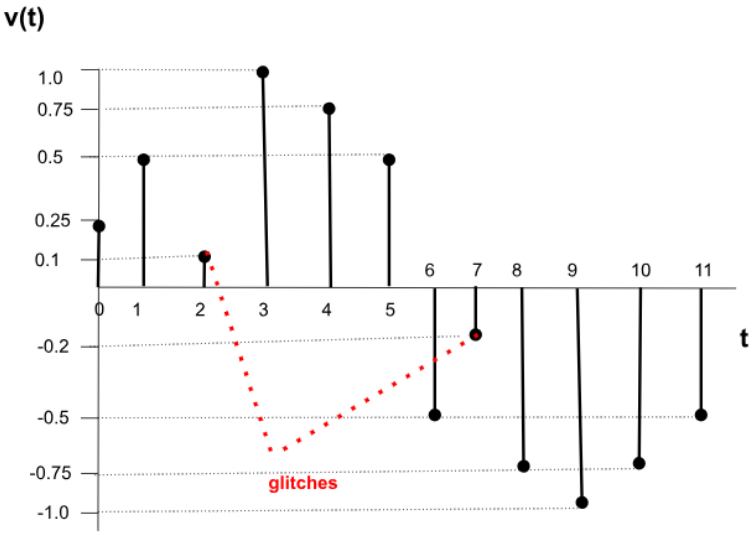
Write a program which takes inputs A and B from the user (A is of size M x N, B is of size NxK) and compute the matrix matrix multiplication.

Flow Chart: 30 Minutes Code: 30 Minutes

Lab Task # 05

Signal Processing

Consider a 1D AC sinusoidal voltage signal that is digitized and is stored in the computer.



i. What data type will be used to store **v(t)** for these values of **t**? Initialize **v(t)** as well.

ii. Write a program (flow chart) to compute the DC (average) value of the sinusoidal signal.

iii. Modify the program to detect when the signal crosses the x-axis.

iv. Modify the program to detect the glitches in the signal.

Submission:

Please submit .c files of all the tasks along with the screenshots of outputs on LMS in a proper report. Add snaps of all the flow charts in your report.