Assignment - HPC 1

* Title & Problem Statement: a) Implement Parallel Reduction using min, max, sum & average operation b) Write a CUDA program that given an N-element vector, find the maximum, minimum element, as well as arithmetic mean, and standard deviation.

* OBJECTIVES: i) To understand parallel reduction operations
ii) To understand vector operations.

* OUTCOMES: Understood the parallel reduction operations as well as vector operations.

* SOFTWARE & HARDWARE REQUIREMENTS: OPENMP (C++ library), g++, Google colab, CUDA, Any CPU i3 or higher processor, 8GB RAM, 1TB HDD.

* THEORY:

a) CUDA (compute Unified Device Architecture) is a parallel computing platform & application programming interface model created by NVIDIA.
- It allows software developers & engineers to use CUDA enabled graphics processing unit for general purpose processing.
- Languages C, C++, Fortran can be used with CUDA.
- It also supports programming frameworks.

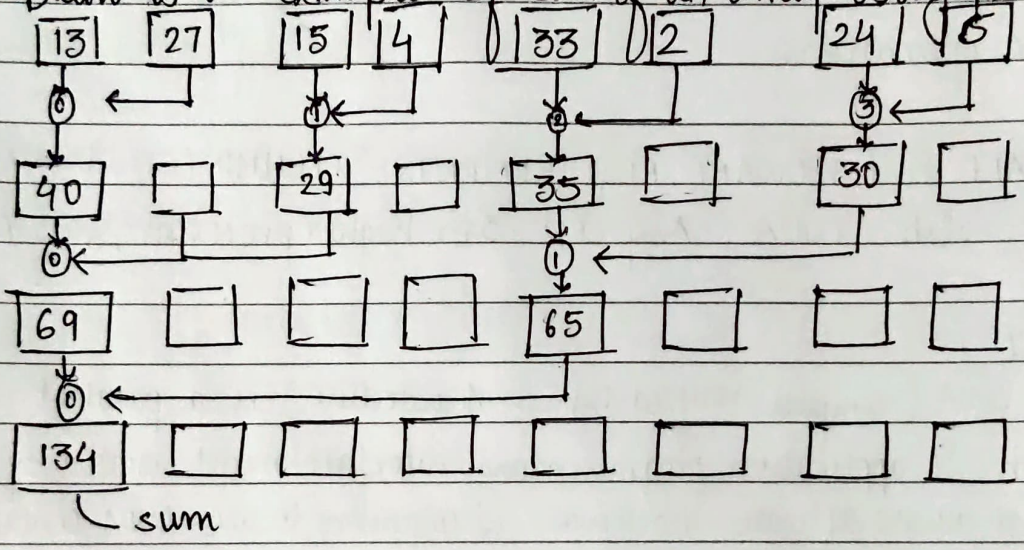
b) MIN-MAX Operations:
i) MAX method: returns the larger element of a,b. Compare function can be omitted
Syntax: max (object_type a, object_type b, compare ()).
ii) Min method: Returns smaller element of a,b. Same rule applies for comparison as well as max function

iii) Arithmetic mean: It is calculated as sum of all elements divided by total no. of elements. Also referred as 'average'.

iv) Standard Deviation(σ): is a measure used to quantify the amount of variation of a set of data values.

v) Parallel Reduction:

- Reduction operations are those which reduce a single collection of values to a single value. It can be associative & commutative.
- Some of them are: Addition, multiplication, bitwise AND, OR, XOR, etc.
- Computation complexity itself likely to be O(log n)
- Below is an example of sum of an array using parallel reduction.



* CONCLUSION:

I have studied parallel reduction using min, max, avg. sum; and CUDA program that given an N element array finds max, min, mean, standard deviation parallely and serially.
Both programs executed successfully and gave expected values.