

ELEN4020: DATA AND INTENSIVE COMPUTING LABORATORY EXERCISE 1

Timothy McBride (732037) Nabeel Vandayar (704528) Dane Slattery 789132

*University of the Witwatersrand, School of Electrical and Information Engineering,
Private Bag 3, 2050, Johannesburg, South Africa*

Abstract: Three procedures were created for an array of K dimensions the procedures use a one dimensional array to store the elements and use mathematical algorithms to dimensionally index the elements. The three procedures were required to operate on four different arrays and were implemented in the C programming language.

Key words: Open Mp, array, time complexity

1 INTRODUCTION

This main focus for this laboratory was to create a methodology to perform operations on multidimensional arrays of varying size. The exercise makes use of the C programming language to create three procedures that operate on K dimensional arrays with an N time complexity. These three procedures take as input; a K dimensional integral array, the dimensional bounds of that array and an integer for the total number of dimensions within the array. The purpose of the procedures are:

1. Set all elements in the array to zero.
2. Set ten percent of the elements in the array uniformly to one.
3. Select five percent of the elements in the array and then display their coordinates and value.

Additionally a main program is written to create four arrays, the procedures that are developed are run on each of these arrays.

2 THREADING COMPARISON

POSIX Threads, commonly referred to as Pthreads, is a library which is specified by the IEEE POSIX 1003.1c standard (1995) for the C Language only and is part of Unix/Linux operating systems. Pthreads provides very explicit parallelism; requires significant attention to detail by the programmer. A C program can use the POSIX library by including pthread.h and then explicitly assign tasks to threads.

OpenMP is the industry standard in parallel computing, jointly defined and endorsed by a group of major computer hardware and software vendors, organizations and individuals. OpenMP is a compiler directive based library which is portable and runs on multiple platforms, including Unix and Windows. OpenMP is available in C/C++ and Fortran implementations. OpenMP is simple to use because it provides for "incremental parallelism" and can begin with serial code.

3 PROBLEM SOLUTION

This problem was solved by operating on a one dimensional array which is mathematically manipulated to act as a multidimensional array. The array is created by allocating the equivalent memory required for the two dimensional array. The procedures are designed to take the one dimensional array as input and operate on it accordingly.

3.1 Procedure 1

Procedure one uses a standard loop to iterate through each element of the array and then sets the specific element to zero.

3.2 Procedure 2

Procedure two determines ten percent of the total elements of the array, this number is rounded off if it is a fraction. A bias is calculated to ensure that each of the ones generated is uniformly distributed across the array. A loop is used to assign a one to the element at the desired location determined by the bias.

3.3 Procedure 3

Procedure three determines the number of elements approximately equivalent to five percent of the total array. This value is used to iterate over a loop that many times. The program selects this many elements and determines the dimensional coordinates for the element. The coordinates and the value contained by the element are printed to the screen.

4 CONCLUSION

The problems assigned for the laboratory were solved using a one dimensional array. This method proved effective as iteration through the array has a maximum time complexity of n where n is the number of elements in the array. The problems were solved according to the specifications however the parameters for each of the procedures required an additional input, this was the number of dimensions within the bounds array.