**ECE 4094**

**Project A**

**Progress Report**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
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Contents

[**Introduction** 3](#_Toc505118655)

[**Objectives** 4](#_Toc505118656)

[**Progress to date** 5](#_Toc505118657)

[**Work to be completed** 6](#_Toc505118658)

# **Introduction**

This report is part of the required submissions for ECE4094 Project “A” and will contribute towards your final mark. There is only one report per project required, irrespective of how many people are working in the group. There are three (3) sections to fill in which are:

1. Objectives
2. Progress to date
3. Work to be completed

Each of these is located in a separate section of this document and has an explanation with it.

A brief description of the project;

* Logdet
* Sparse
* Positive semidefinite
* Motivation for the project
* Paper with original solution
* Shortcomings
* New implementation

# **Objectives**

|  |  |  |  |
| --- | --- | --- | --- |
| Objective Name | Brief Description | Completed | Realistic |
| Generate LPSDM using the method in “paper name”. | This is diagonally dominant, which is a special case of of the data we will be working with. It is easier to generate than a non-diagonally dominant matrix. | Yes | Yes |
| Implement method in “paper name” |  | Almost | Yes |
| Experiment 1 from “paper name” | Run code many times over datasets of varying sizes. Use algorithm form paper and cholesky decomposition and produce graphs similar to paper. | Yes | Yes |
| More advanced analaysis |  | No | No |
| Implement new method |  | No | Yes |
| Progress Report | See introduction to this document | In Progress | Yes |
| Design Specifications |  | In Progress | Yes |
| Some simple comparisons of old and new | Runtime, space, relative accuracy compared to exact method. | No | Yes |
| Paralellise new | Use MATLAB’s inbuild parallel toolbox to paralellise the new algorithm | No (S1) | Yes |
| Some simple comparisons of old and parallel new | Runtime, space, relative accuracy compared to exact method. | No (S1) | Yes |
| Some advanced comparisons of old and advanced new |  | No (S1) | Yes |
| Real world dataset analysis | Find real world data that can be converted to relevant format and be analysed by parallel new method for final results | No (S1) | Optional |
| More advanced dataset | Generate random dataset that is not diagonally dominant | No (S1) | Optional |
| GUI | Make a GUI that allowes user to get a visual indicator of the performance of the code | No (S1) | Optional |
| Final Report |  | No (S1) | Yes |
| Poster |  | No (S1) | Yes |
| Video |  | No (S1) | Yes |

# **Progress to date**

The initial part of project was to research various parts of the theory behind the project. While I was familiar with much of it beforehand, the refresher was very useful, and some fo the fields were new to me as well. Some of the fields I looked into are: (**a small description of each**)

* Positive Semi-Definite Matrix
* Sparse Matrix
* Matrix functions (polynomial function analogues)
* Cholesky decomposition
* Chebyshev approximation
* Gershgorin circle theorem

After ensuring that I had a solid grasp of the theory I began writign code to generate a dataset that could be used in testing and experimentation. The dataset needed to be in the form of a Large (Positive Semi-Definite Matrix (LPSDM) stored in sparse form. The primary MATLAB functions used in this section are kron, rand, randi and sparse.

Once I could reliable generate a LPSDM I began writing code to replicate the algorithm devised in “paper name”. This algorithm iterativley updates a guess for the logdet. It requires knowledge of the condition number of the matrix, which is approximated using Gershgorin Circle Theorem. The codition number is then fed into an equation which is then used to generate a chebyshev approximation for the log function used in the algorithm.

With the algorithm from “paper name” working I began working on replcating the first experiment performed in said paper. The experiment produces the following results;

* Runtime vs Matrix size graph (1e3 to 1e7)
* Relative accuracy compared to Cholesky decompostion, an exact method (1e3 to 3e4)
* Runtime comparison for cholesky decomposition vs algorithm
* Comparison to method used by Zhang & Leithead, 2007 using n = 1000

The final experiment still needs to be computed.

**The next stage is to begin implementing the new method**

**Then some comparisons of old and new**

# **Work to be completed**

|  |  |  |
| --- | --- | --- |
| **Tasks and expected time allotment** | | |
| **Task** | **Expected hours** | **Start week** |
| Some more advanced alalysis of old | 15 | 1 |
| Some simple comparisons of old and new | 5 | 1 |
| Parallelise new | 20 | 3 |
| Some simple comparisons of old and parallel new | 5 | 3 |
| Some advanced comparisons of old and parallel new (\*) | 15 | 5 |
| Real world dataset analysis (\*) | 20 | 8 |
| More advanced dataset (\*) | 20 | 8 |
| GUI (\*) | 25 | 10 |
| Poster | 15 | 7 |
| Final Report | 40 | 7 |
| Video | 10 | 7 |

\* optional goal for late stages of project

***Gaant Chart***