GMRES Project

Applied Linear Algebra

Duc Phan

March 12, 2019

**Abstract**

This project objective is to create a set of tools to that mainly help with operating and manipulating on sparse matrices in compressed sparse row (CSR) format. The library I chose to implement cover most of the basic operations, which will be discussed later in this paper, for *Vectors*, *Dense Matrices* and *CSR Matrices*. The focus of this project and paper is the Generalized Minimal Residual (GMRES) method/algorithm. This paper is an overview of the tool set mentioned above, the implementation of GMRES and some statistics produced by GMRES.

1. **Introduction**

This project is implemented mostly in Java for the *Vector, Dense/CSR Matrix* operations and NodeJS for data and stats graphing.

Some libraries I used in my program are:

* Java:

|  |
| --- |
| //For parsing String into json  import com.google.gson.Gson;  //IO handler  import java.io.File;  import java.io.FileNotFoundException;  import java.io.PrintStream;  import java.util.Scanner;  //Number handler - This will support number with a lot of decimals  import java.math.BigDecimal;  import java.math.MathContext;  import java.math.RoundingMode;  //Database  import java.util.LinkedList; |

* NodeJS:

|  |
| --- |
| require('fs'); //For file reading/writing  require('path'); //For file searching  require('plotly'); //For graphing |

The code and some sample results can be found at my GitHub repository:

<https://github.com/ptmdmusique/Vector_Dense-CSR-Matrix_Operations>

1. **Acceptable Inputs**

The program will be able to take and parse input of string type in multiple format:

* A string of numbers separated by single space for different columns and newline character (‘\n’) for different rows:

A vector or matrix can be constructed directly using:

1. the object’s constructor *Vector(String input)* or *Matrix(String input)* or *CSRMatrix(String input)*.
2. the *TakeInput(String input)* method.

Example:

|  |
| --- |
| //This will create a vector with entries 1, 2, 3, 4, 5  Vector myVector = new Vector("1 2 3 4 5");  /\* This will create a 2x4 matrix:  1 2 3 4  5 6 7 8  (extra spaces after the last and before the first numbers of each row can lead to bugs!)  \*/  Matrix myMatrix = new Matrix("1 2 3 4\n5 6 7 8");  CSRMatrix myCSRMatrix = new CSRMatrix("1 2 3 4\n5 6 7 8"); |
|  |

* [Matrix Market Exchange Format:](https://math.nist.gov/MatrixMarket/formats.html#mtx)

The CSR Format taken from Matrix Market can be

