Assignment 3 Software Design Document

CS2300 Section 1 Spring 2022

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Project Description

Describe the problem you are addressing in your own words.

Part1: I need to find the x vector that satisfies Ax = b.

Part2: I need to find eigen values and for each of those eigen values I need to find the normal eigenvectors. Then I need to find the eigen decomposition and compare it with original matrix.

Part3: I need to find the area of a triange from three points in either 2d or 3d. Then for 2d I need to create a line and find the distance from the third point to the line. Then for 3d I need to find the plane that bisects 2 points and then find the distance from the third point to the plane.

Approach

Describe how you solved the problem, providing an outline of the program logic.

Part1: I created a way to read the file and load it into an input matrix. Then I created a way to get the 2x2 matrix and the vector from the input matrix. From there I created methods to find the x vector that satisifies Ax = b;

Part2: I used the previous methods from part1 to read the file and load the values into an input matrix and get the vector and 2x2 matrix. Then I found the eigen values and put them into a diagonal matrix. Then I subtracted the diagonal matrix from the original matrix. Then I found the eigen vector for each eigen value and put them into a matrix. I then normalized each of the vectors and transposed that matrix. From their I then computed the eigen decomposition and compared it with the original 2x2 matrix.

Part3: I used the previous read file method and filled an array list with the values. Then I checked the count of the array list to find if it was a 3d input or a 2d input. If it was 2d then I load the matrix into a 2x3 matrix. If it was 3d then I load the matrix into a 3x3 matrix. For either 2d or 3d I found the area of the triangle. Then if it was 2d then I would create a line and use that line to find the distance from the third point to the line. If it was 3d then I would find the plane that bisects the first 2 points and then found the distance from the plane to the third point.

Detailed Design

Programming Language

Describe the programming language (and version, if relevant). If there are unique features of the language that are important to your approach, describe them.

I used C# as my programming language because I am more comfortable with it and I understand how to use the data structures better than other languages.

Modules

Provide a brief description of each module in your program, including the inputs, the outputs, and the actions that the module takes on the data.

Control: Controls whether to call 3d operations or 2d operations based on input structure size

CreateXVector: creates x vector from the inverse matrix and input vector

Determinant: find the determinant of a matrix

CreateMatrixInverseVector: takes matrix and computes the inverse vector

DeterminantIsZero: determines if determinant is zero and continues

CreateMatrix: Creates matrix from input matrix

LoadInputFiles: Loads input files into a string array

ReadFile: Reads file and fills the input structure

LoadVector: takes the vector at the end of the 2x2 matrix

Display: Displays matrix

Compare: Compares matrices values and determines if they are equal

EigenDecomp: computes eigen decompostion

CreateEigenVector: Creates eigen vector from a given eigen value

CreateEigenVectorMatrix: Creates a matrix of the eigen vectors

RowPivot: performs a row pivot on a matrix

ColumnPivot: performs a column pivot on matrix

GaussianElim: perfroms gaussian elimination to get 0 in place of c

Transpose: transposes a matrix

Normalize: Normalizes the eigen vector matrix

CreateEigenValueMatrix: creates a matrix with eigen values in the diagonals

CreateDiagMatrix: creates a diagonal matrix that contains eigen values

Quadratic: computes the quadratic formula on 3 values

MatrixDot:performs matrix dot product

CopyMatrix: copies content of a given matrix to another

ThreeD: runs 3d operations

TwoD: runs 2d operations

DistanceToPlane: Computes the distance from point to plane

ConstructPlane: Creates a plane that bisects 2 points and stores it in an array.

Midpoint: Finds the midpoint of 2 points

UnitLengthVector: Finds the unit length vector normal from 2 points

GetPoint: Takes col and rowsize and returns the point

associated with the col and checks if 2d or 3d

FormLine: Forms a line from given point and vector

DistanceToLine: Finds the distance to the line from a point

AreaOfTriangle: Computes the area of a triange in either 2d or 3d

GetVector: Takes 2 points and computes the vector

Cross: Computes the cross product of 2 vectors in 3d

VectorDot: Computes the dot product of 2 vectors

Load2DMatrix: Loads 2d matrix from input structure

Load3DMatrix: Loads 3d matrix from input structure

Flowcharts

Provide a flowchart describing how the modules interact. If you have only one module, then use the flowchart to describe its main logic.

Part1

Key Data Structures

Describe the data structures that are important to your approach.

ArrayList – arraylist that holds points

2d array – holds matrices or points or vectors

Test Description

Describe the input files used for testing your code, explaining why you're using each one for testing and how it shows your program is working correctly.

I used 5 input files that were 2d and 3d to test if my code was working properly to handle 3d or 2d. I then tested results by hand to confirm I had correct values in the code.