AMS213A Project 1

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1 Basic Module

Using the matrix A from Amat.dat, the trace is the sum of elements on the main diagonal of the matrix. The trace is of A = 2.0 + 3.0 + 9.0 + 8.0 = 22

$$A = \begin{bmatrix} 2.0 & 1.0 & 1.0 & 0.0 \\ 4.0 & 3.0 & 3.0 & 1.0 \\ 8.0 & 7.0 & 9.0 & 5.0 \\ 6.0 & 7.0 & 9.0 & 8.0 \end{bmatrix}$$

The norm of a vector is $L^2 - norm = |x|_2 = sqrt(x_1^2 + x_2^2 + ... + x_n^2)$.
For matrix A, we take the norm of each column vector. For column 1, the vector is:

$$V_1 = \begin{bmatrix} 2.0 \\ 4.0 \\ 8.0 \\ 6.0 \end{bmatrix}$$

The norm of V1 equals: $V_1 = sqrt(2.0^2 + 4.0^2 + 8.0^2 + 6.0^2) = 10.95445$
The norm values for each of the following column vectors are:
norm(V2) = 10.39230; norm(V3) =13.11488; norm(V4) = 9.48683

The solutions obtained in the F90 code show the same results.

```
Matrix =
 2.0  1.0  1.0  0.0
 4.0  3.0  3.0  1.0
 8.0  7.0  9.0  5.0
 6.0  7.0  9.0  8.0
Vector =
 1.0
 0.0
 1.0
 1.0
Trace of matrix =
 22.00000
Euclidian Norm of column           1
 10.95445
Euclidian Norm of column           2
 10.39230
Euclidian Norm of column           3
 13.11488
Euclidian Norm of column           4
  9.48683
```

Figure 1: F90 results

2 Gaussian Elimination

See LinAl fold in project1: https://github.com/jmspritze/AMS213A

3 LU Decomposition

See LinAl fold in project1: https://github.com/jmspritze/AMS213A

4 Basic Application

Using 3 data points A(1, 2, 3), B(3, 2, 5) and C(, e, 2)., compute the 3x3 symmetric matrix A whose entries are:

$$\begin{gathered}\Sigma[(xi)^2]\Sigma[(xi)*(yi)]\Sigma[(xi)*(zi)] \\ \Sigma[(xi)*(yi)]\Sigma[(yi)^2]\Sigma[(yi)*(zi)] \\ \Sigma[(xi)*(zi)]\Sigma[(yi)*(zi)]\Sigma[(z-z0)^2]\end{gathered}$$

solution vector x:

$$[\ \mathrm{A}\ \mathrm{B}\ \mathrm{C}\ ]_{\mathrm{T}}$$

Also compute the 3 element vector b:

$$\begin{gathered}-\Sigma[(xi)*(zi)] \\ -\Sigma[(yi)*(zi)] \\ -\Sigma[(zi)]\end{gathered}$$

Then solve Ax = b for the given A and b. The three components of the solution vector are the coefficients to the least-square fit plane a,b,c.
The matrix for the problem is:
Ax=b

$$\begin{bmatrix}1 & -3 & 1 \\ 2 & 2 & 1 \\ 3 & 5 & 1\end{bmatrix} * \begin{bmatrix}A \\ B \\ C\end{bmatrix} = \begin{bmatrix}\pi \\ e \\ -\sqrt{2}\end{bmatrix}$$

Final Image is wrong, possible projected 90o off.

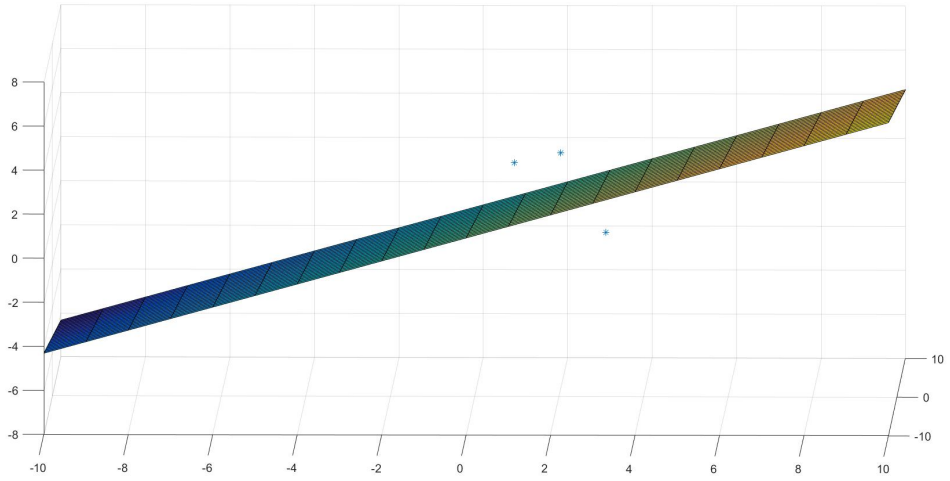

Figure 2: Plane through points, but off by 90 degrees