6.2.5 Towards an Algorithm

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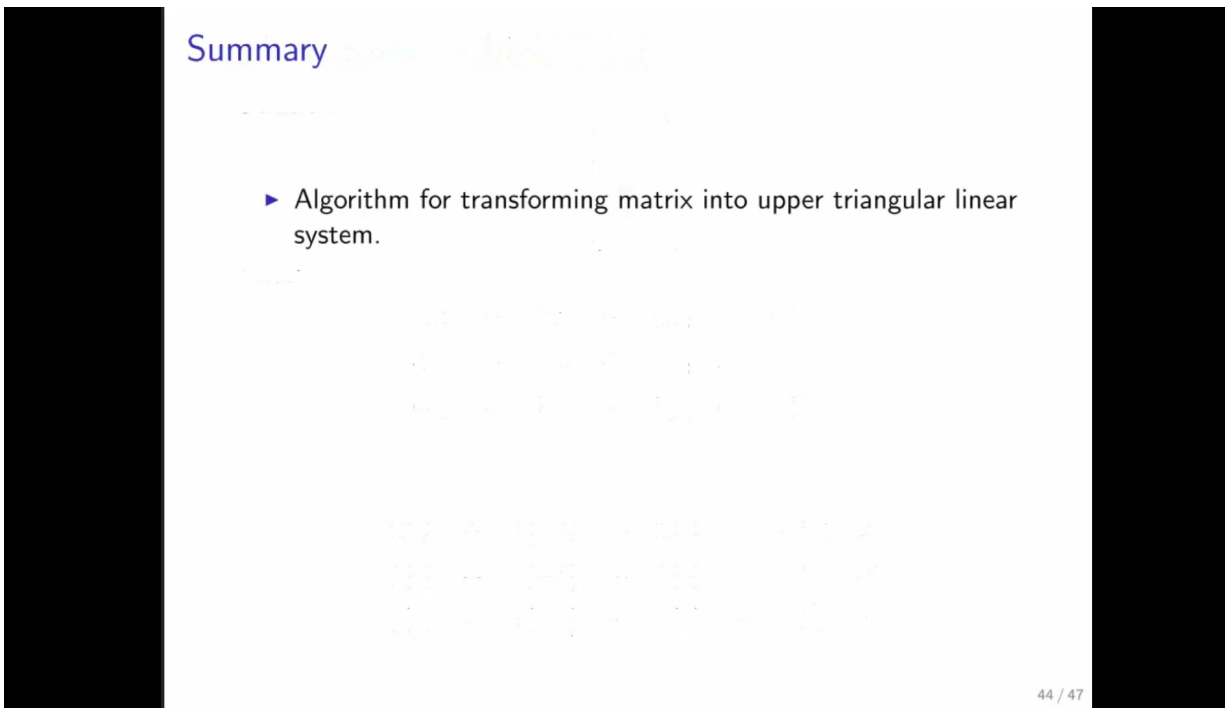
Week 6 due Nov 13, 2023 12:12 IST

6.2.5 Towards an Algorithm



12:33 / 13:10 2.0x

but we're using the multipliers that had been stored.

We can then use those to update the rest of our vector right there.

We performed that computation, we move forward, and so forth.

So here is the algorithm for performing forward substitution.

And then the back substitution is exactly as it was before.

And we'll look at an algorithm for doing that later in the week.

Always check your answers.

And let's summarize what we now have as an algorithm for transforming

a matrix into an upper triangular matrix.

We have an algorithm for forward substitution.

And if a new right-hand side came along at a later time,

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Reading Assignment

0 points possible (ungraded)

Read Unit 6.2.5 of the notes. [LINK]

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? Sorry if this is supposed to be obvious 4

I'm trying to make sure I'm learning what you want to make sure I'm learning as I go through these assignments. For example, for the GaussianEli...

Please help me with my code

Calculator

Dear staff, my spark code on Gaussian Elimination always shows error in line 5 "ABL, ABR] = FLA_Part_2x2(A, ..." and I don't know why. Line 5 ...

? Should we be using spark for these questions? **2**

My practice so far has been to use spark to generate the boiler plate code and then fill out the operations as indicated in the algorithm. This res...

☑ Flame notation: current diagonal element **2**

? Rationale for storing the multiplier numbers w/o the signs **2**

I'm not sure whether there is any efficiency argument to avoid storing the multipliers as (-2, -3) (around 2:10)? I wonder also how we do this wh...

? Partition function **2**

Where is the function "FLA_Part_2x2()" stored? I keep getting the error message that the function is not recognized.

Homework 6.2.5.1

1/1 point (graded)

Algorithm: $A := \text{GAUSSIAN\_ELIMINATION}\ (A)$

Partition $A \rightarrow \left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right)$

where A_{TL} is 0×0

while $m(A_{TL}) < m(A)$ **do**

Repartition

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c|c|c} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ \hline A_{20} & a_{21} & A_{22} \end{array}\right)$$

$a_{21} := a_{21}/\alpha_{11} \quad (= l_{21})$

$A_{22} := A_{22} - a_{21}a_{12}^T \quad (= A_{22} - l_{21}a_{12}^T)$

Continue with

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right) \leftarrow \left(\begin{array}{c|c|c} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ \hline A_{20} & a_{21} & A_{22} \end{array}\right)$$

endwhile

Algorithm: $b := \text{FORWARD\_SUBSTITUTION}(A, b)$

Partition $A \rightarrow \left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right), b \rightarrow \left(\begin{array}{c} b_T \\ \hline b_B \end{array}\right)$

where A_{TL} is 0×0, b_T has 0 rows

while $m(A_{TL}) < m(A)$ **do**

Repartition

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c|c|c} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ \hline A_{20} & a_{21} & A_{22} \end{array}\right), \left(\begin{array}{c} b_T \\ \hline b_B \end{array}\right) \rightarrow \left(\begin{array}{c} b_0 \\ \hline \beta_1 \\ \hline b_2 \end{array}\right)$$

$b_2 := b_2 - \beta_1 a_{21} \quad (= b_2 - \beta_1 l_{21})$

Continue with

$$\left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right) \leftarrow \left(\begin{array}{c|c|c} A_{00} & a_{01} & A_{02} \\ \hline a_{10}^T & \alpha_{11} & a_{12}^T \\ \hline A_{20} & a_{21} & A_{22} \end{array}\right), \left(\begin{array}{c} b_T \\ \hline b_B \end{array}\right) \leftarrow \left(\begin{array}{c} b_0 \\ \hline \beta_1 \\ \hline b_2 \end{array}\right)$$

endwhile

Implement the described Gaussian Elimination and Forward Substitution algorithms

- `[ A_out ] = GaussianElimination( A )`
- `[ b_out ] = ForwardSubstitution( A, b )`

You can check that they compute the right answers with the following script:

- `test_GausianElimination.m` (In `LAFF-2.0xM/Programming/Week06/`)

Unfortunately, PictureFLAME may not work for this problem, since a zero may appear on the diagonal, causing a divide by zero.

This script exercises the functions by factoring the matrix

```
A = [
     2     0     1     2
    -2    -1     1    -1
     4    -1     5     4
    -4     1    -3    -8
]
```

by calling

```
LU = GaussianElimination( A )
```

Next, solve $Ax = b$ where

Calculator

```
b = [
     2
     2
    11
    -3
]
```

by first apply forward substitution to b, using the output matrix LU:

```
bhat = ForwardSubstitution( LU, b )
```

extracting the upper triangular matrix U from LU:

```
U = triu( LU )
```

and then solving $Ux = \hat{b}$ (which is equivalent to backward substitution) with the intrinsic function:

```
x = U \ bhat
```

Finally, check that you got the right answer:

```
b - A * x
```

(the result should be a zero vector with four elements).

Done/Skip

- GausianElimination.m
- ForwardSubstitution.m

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