6.3.2 Solving Lz = b (Forward substitution)

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Week 6 due Nov 13, 2023 12:12 IST

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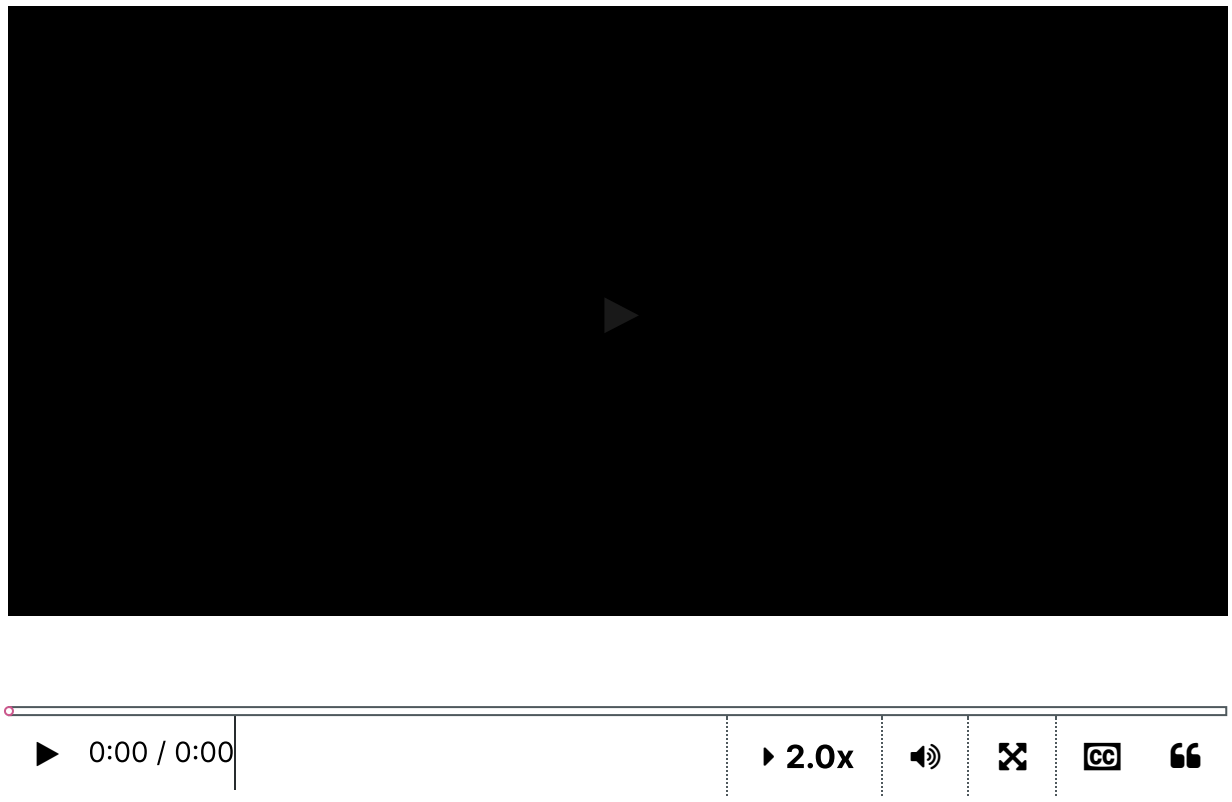
Start of transcript. Skip to the end.



Dr. Robert van de Geijn: We're going to come up

with an algorithm for solving Lz equals b,

where L is a unit lower triangular matrix.

Why is this interesting?

Well, remember that we were trying to

0:00 / 0:00 2.0x

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Reading Assignment

0 points possible (ungraded)

Read Unit 6.3.2 of the notes. [LINK]

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? Confused by final step in generating algorithm 3

I'm able to follow the reasoning just fine up to the point where we say that: L22 z2 = b2 - zeta1 l21 But I'm having a very hard time seeing how w...

Another way of looking at how you get to this algorithm 2

Calculator

Homework 6.3.2.1

1/1 point (graded)

Algorithm: $[b] := \text{LTRSV\_UNB\_VAR1}(L, b)$

Partition $L \rightarrow \left(\begin{array}{c|c} L_{TL} & 0 \\ \hline L_{BL} & L_{BR} \end{array}\right)$, $b \rightarrow \left(\begin{array}{c} b_T \\ \hline b_B \end{array}\right)$

where L_{TL} is 0×0, b_T has 0 rows

while $m(L_{TL}) < m(L)$ **do**

Repartition

$$\left(\begin{array}{c|c} L_{TL} & 0 \\ \hline L_{BL} & L_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c|c|c} L_{00} & 0 & 0 \\ \hline l_{10}^T & \lambda_{11} & 0 \\ \hline L_{20} & l_{21} & L_{22} \end{array}\right), \left(\begin{array}{c} b_T \\ \hline b_B \end{array}\right) \rightarrow \left(\begin{array}{c} b_0 \\ \hline \beta_1 \\ \hline b_2 \end{array}\right)$$

$b_2 := b_2 - \beta_1 l_{21}$

Continue with

$$\left(\begin{array}{c|c} L_{TL} & 0 \\ \hline L_{BL} & L_{BR} \end{array}\right) \leftarrow \left(\begin{array}{c|c|c} L_{00} & 0 & 0 \\ \hline l_{10}^T & \lambda_{11} & 0 \\ \hline L_{20} & l_{21} & L_{22} \end{array}\right), \left(\begin{array}{c} b_T \\ \hline b_B \end{array}\right) \leftarrow \left(\begin{array}{c} b_0 \\ \hline \beta_1 \\ \hline b_2 \end{array}\right)$$

endwhile

Write the routine Ltrsv_unb_var1(L, b) that solves $\boldsymbol{Lx} = \boldsymbol{b}$, overwriting $\boldsymbol{b}$. /p>

- `[ b_out ] = Ltrsv_unb_var1( L, b )`

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

- test_Ltrsv_unb_var1.m (In `LAFF-2.0xM/Programming/Week06/`)

Unfortunately, PictureFLAME does not work for this problem.

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 = LU_unb_var5( A )
```

Next, it solves $\boldsymbol{Lz} = \boldsymbol{b}$ with the right-hand size vector

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

by calling

```
z = Ltrsv_unb_var1( LU, b )
```

Finally, it extract upper triangular matrix $\boldsymbol{U}$

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

Calculator

and solves $Ux = z$ with the intrinsic operation

```
x = U \ z
```

We can the check if this solves $Ax = b$ by computing

```
b - A * x
```

which should yield a zero vector.

- [x] Done/Skip

✔

Here is our implementations of the function:

- Ltrsv_unb_var1.m

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Answers are displayed within the problem

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