E1.2.6 Sample Question 6

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6. Consider the MATLAB (M-script) code

```
function [ y_out ] = foo( A, x, y )

n = size( A, 1 );
for j = 1:n
    for i = 1:j
         y( i ) = A( j,i ) * x( j ) + y( i );
    end
    for i = j+1:n
         y( i ) = A( i,j ) * x( j ) + y( i );
    end
end

y_out = y;

return
end
```

(If you have a hard time interpreting this algorithm, you may want to consider the algorithm typeset with FLAME notation at the end of this exam.)

Mark which operation this implements (check all correct answers):

- ☐ $y := Lx + y$, where L is a lower triangular matrix, stored only in the lower triangular part of array `A` .
- ☐ $y := Ux + y$, where U is a upper triangular matrix, stored only in the lower triangular part of array `A` .
- ☐ $y := Ax + y$, where A is symmetric, stored only in the lower triangular part of array `A` .
- ☐ $y := Ax + y$, where A is symmetric, stored only in the upper triangular part of array `A` .
- ☐ The equivalent of `y = ( tril( A ) + tril( A, -1 )' ) * x + y` in MATLAB's M-script.
- ☐ The equivalent of `y = ( triu( A ) + triu( A, 1 )' ) * x + y` in MATLAB's M-script.

Algorithm typeset using FLAME Notation:

Algorithm: $y := \text{FOO}(A, x, y)$

Partition $A \rightarrow \left(\begin{array}{c|c} A_{TL} & A_{TR} \\ \hline A_{BL} & A_{BR} \end{array}\right)$,
$x \rightarrow \left(\begin{array}{c} x_T \\ \hline x_B \end{array}\right)$, $y \rightarrow \left(\begin{array}{c} y_T \\ \hline y_B \end{array}\right)$
where A_{TL} is 0×0, x_T, y_T are 0×1

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

Repartition

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

$$\left(\begin{array}{c} x_T \\ \hline x_B \end{array}\right) \rightarrow \left(\begin{array}{c} x_0 \\ \hline \chi_1 \\ \hline \end{array}\right), \left(\begin{array}{c} y_T \\ \hline y_B \end{array}\right) \rightarrow \left(\begin{array}{c} y_0 \\ \hline \psi_1 \\ \hline \end{array}\right)$$

Calculator

where α_{11}, χ_1, and ψ_1 are scalars

$$y_0 := \chi_1 (a_{10}^T)^T + y_0$$
$$\psi_1 := \chi_1 \alpha_{11} + \psi_1$$
$$y_2 := \chi_1 a_{21} + y_2$$

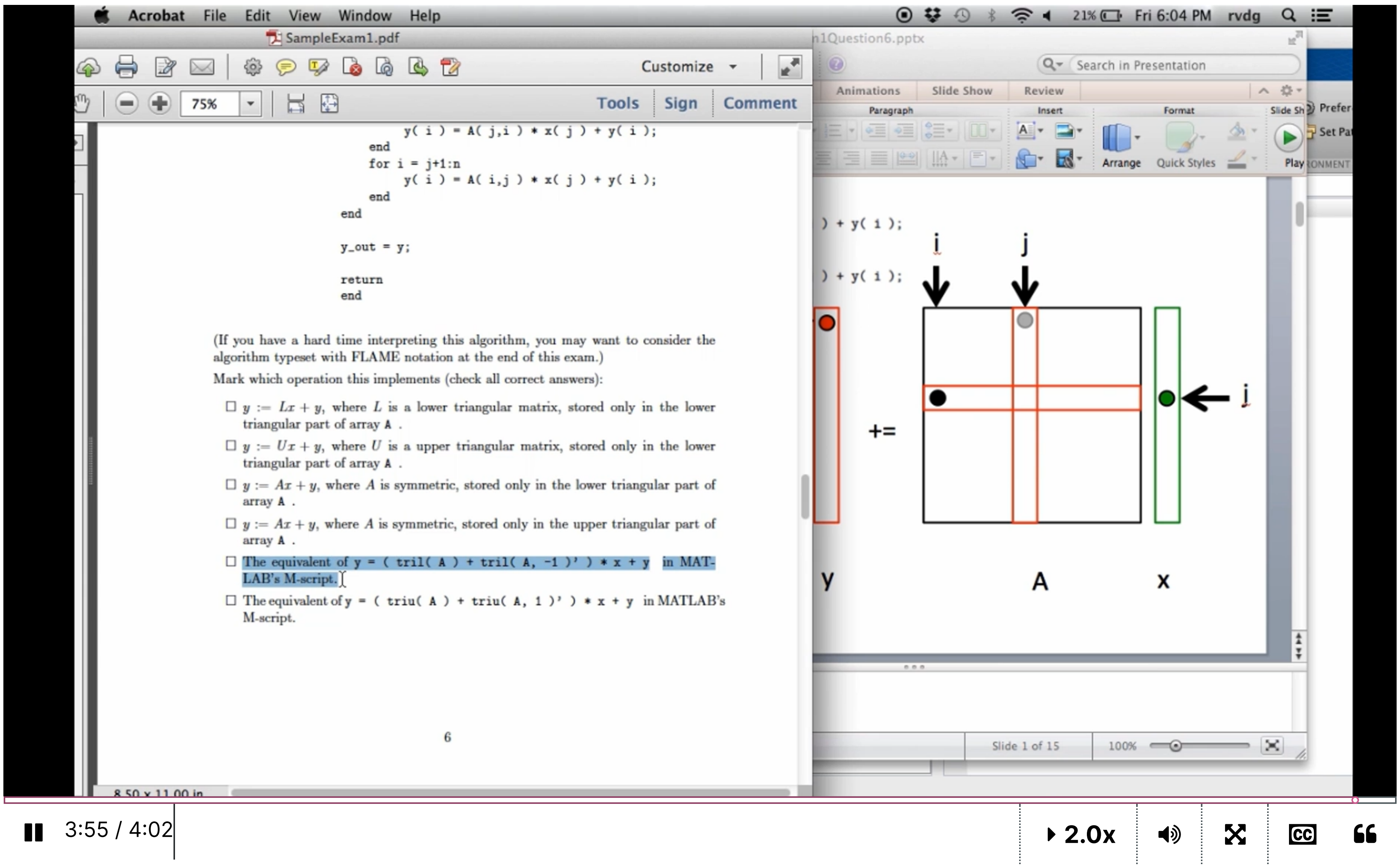
Continue with

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

$$\left(\begin{array}{c} x_T \\ \hline x_B \end{array}\right) \leftarrow \left(\begin{array}{c} x_0 \\ \hline \chi_1 \\ \hline x_2 \end{array}\right), \left(\begin{array}{c} y_T \\ \hline y_B \end{array}\right) \leftarrow \left(\begin{array}{c} y_0 \\ \hline \psi_1 \\ \hline y_2 \end{array}\right)$$

endwhile

Answer Video



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Calculator

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Conventional gotcha! Why is n assigned the row size of A i.e., n = size (A, 1)? 2

On first blush From the get go, the algorithm seems to obfuscate the fact that we're dealing with a symmetric matrix (or submatrix in a fat m...

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