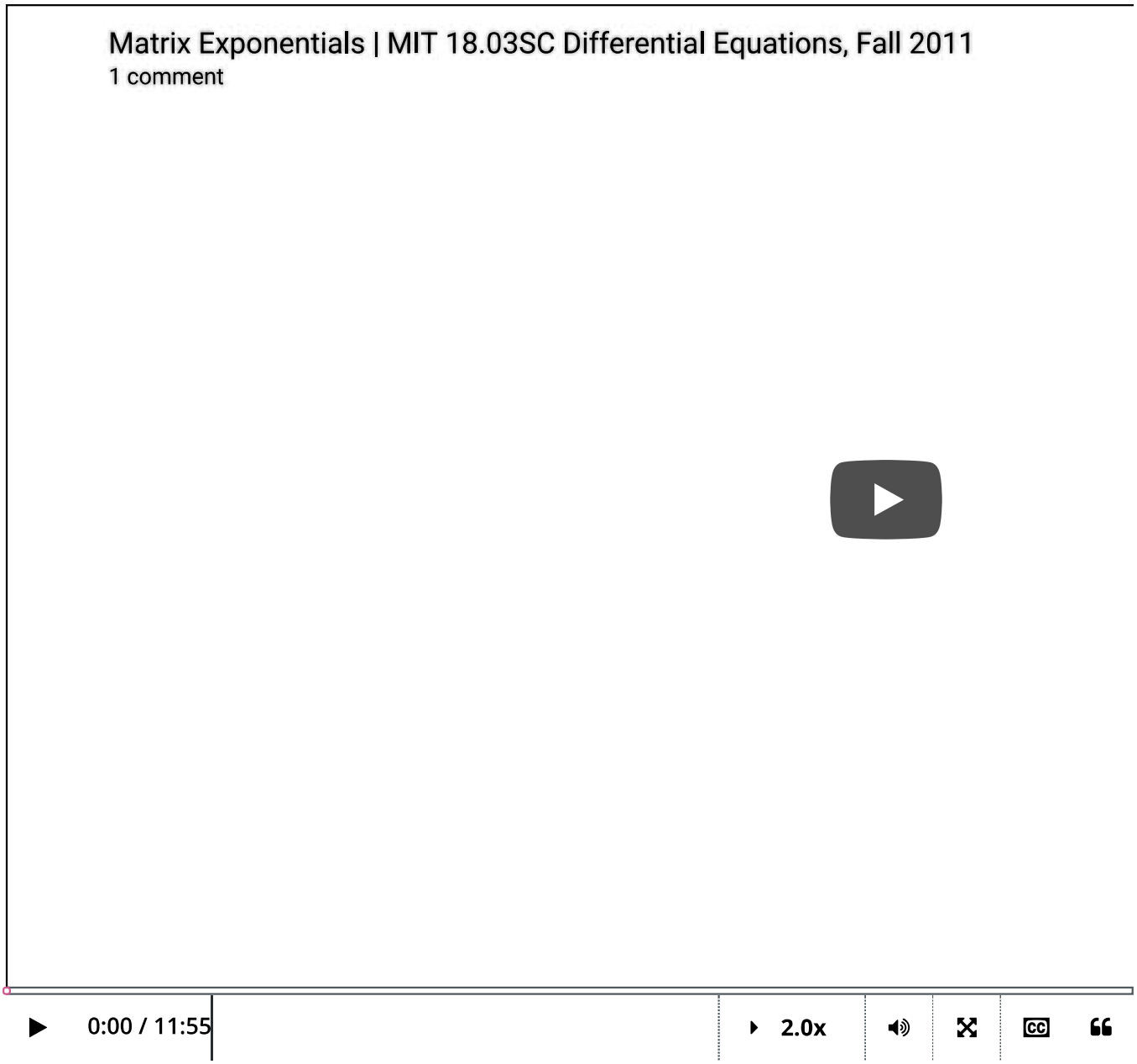
16. Worked example
Worked example: matrix exponential



Review

0 points possible (ungraded)

Which of the following matrices could be an exponential matrix of the form $e^{\mathbf{A}t}$?

(Choose all that apply.)

- [x] $\begin{pmatrix} \cos(t) & \sin(t) \\ -\sin(t) & \cos(t) \end{pmatrix}$ ✔

- $\begin{pmatrix} e^{t} & e^{2t} \\ -2e^{t} & -2e^{2t} \end{pmatrix}$
- $\begin{pmatrix} e^{-3t} & e^{t} & te^{t} \\ 2e^{-3t} & 0 & 0 \\ 0 & e^{t} & e^{t} \end{pmatrix}$
- $\begin{pmatrix} e^{-3t} & e^{t} & e^{t} \\ 0 & e^{t} & 0 \\ 0 & 0 & e^{t} \end{pmatrix}$
- $\begin{pmatrix} e^{it} & e^{-it} \\ -ie^{it} & ie^{-it} \end{pmatrix}$

✔

Solution:

We need to check that $\mathbf{X}(0) = \mathbf{I}$. We identified $\mathbf{X}(0)$ in a previous concept check:

- $\begin{pmatrix} \cos(t) & \sin(t) \\ -\sin(t) & \cos(t) \end{pmatrix}\Big|_{t=0} = I$
- $\begin{pmatrix} e^{t} & e^{2t} \\ -2e^{t} & -2e^{2t} \end{pmatrix}\Big|_{t=0} = \begin{pmatrix} 1 & 1 \\ -2 & -2 \end{pmatrix}$
- $\begin{pmatrix} e^{-3t} & e^{t} & te^{t} \\ 2e^{-3t} & 0 & 0 \\ 0 & e^{t} & e^{t} \end{pmatrix}\Big|_{t=0} = \begin{pmatrix} 1 & 1 & 0 \\ 2 & 0 & 0 \\ 0 & 1 & 1 \end{pmatrix}$
- $\begin{pmatrix} e^{-3t} & e^{t} & e^{t} \\ 0 & e^{t} & 0 \\ 0 & 0 & e^{t} \end{pmatrix}\Big|_{t=0} = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$
- $\begin{pmatrix} e^{it} & e^{-it} \\ -ie^{it} & ie^{-it} \end{pmatrix}\Big|_{t=0} = \begin{pmatrix} 1 & 1 \\ -i & i \end{pmatrix}$

The only potential exponential matrix is the first one.

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Answers are displayed within the problem

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