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## 2. Review: Fundamental matrices

Fundamental matrix review 1

1/1 point (graded)

Assume that in each matrix, the columns are solutions to one system of ODEs.

Which of the following matrices could be fundamental matrices?

$$egin{array}{ccc} & & & & \sin(t) \ -\sin(t) & & \cos(t) \ \end{array} oldsymbol{\checkmark}$$

$$egin{array}{ccc} egin{array}{ccc} e^t & e^{2t} \ -2e^t & -2e^{2t} \ \end{array}$$

$$\begin{pmatrix}
e^{-5t} & e^t & e^t \\
0 & e^t & 0 \\
0 & 0 & e^t
\end{pmatrix}
\checkmark$$

$$egin{pmatrix} igwedge e^{it} & e^{-it} \ -ie^{it} & ie^{-it} \end{pmatrix}$$
  $m arphi$ 



**Solution:** 

X

We only need to check that  $\mathbf{X}(0)$  is invertible! Let us first proceed in order of the choices:

$$ullet \left. egin{pmatrix} \cos(t) & \sin(t) \ -\sin(t) & \cos(t) \end{pmatrix} 
ight|_{t=0} = I$$
 is invertible

$$ullet \left. egin{pmatrix} e^t & e^{2t} \ -2e^t & -2e^{2t} \end{pmatrix} 
ight|_{t=0} = egin{pmatrix} 1 & 1 \ -2 & -2 \end{pmatrix}$$
 is singular.

$$ullet \left. egin{pmatrix} e^{-5t} & e^t & e^t \\ 0 & e^t & 0 \\ 0 & 0 & e^t \end{pmatrix} 
ight|_{t=0} = egin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \ ext{is invertible}.$$

$$ullet \left. egin{pmatrix} e^{it} & e^{-it} \ -ie^{it} & ie^{-it} \end{pmatrix} 
ight|_{t=0} = egin{pmatrix} 1 & 1 \ -i & i \end{pmatrix}$$
 is invertible.

Any of the invertible matrices above could be a fundamental matrix given an appropriate systems of ODEs.

Submit

You have used 3 of 3 attempts

**1** Answers are displayed within the problem

## Fundamental matrix review 2

1/1 point (graded)

We also use the terms **fundamental matrix of a single higher order ODE** to mean a fundamental matrix of its companion system.

Determine which of the following second order ODEs or system of ODEs has the following fundamental matrix:

$$egin{pmatrix} \cos(t) & \sin(t) \ -\sin(t) & \cos(t) \end{pmatrix}$$

$$\vec{x} + x = 0$$

$$\dot{\mathbf{x}} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \mathbf{x} \checkmark$$

$$\mathbf{\dot{x}} = \begin{pmatrix} 0 & 1 \\ -1 & 1 \end{pmatrix} \mathbf{x}$$



## **Solution:**

Each system is the companion matrix of one of the second order ODEs, so we only need to check the systems. Inspection shows that

$$rac{d}{dt}igg(egin{array}{ccc} \cos(t) & \sin(t) \ -\sin(t) & \cos(t) \ \end{array}igg) = igg(egin{array}{ccc} 0 & 1 \ -1 & 0 \ \end{array}igg)igg(egin{array}{ccc} \cos(t) & \sin(t) \ -\sin(t) & \cos(t) \ \end{array}igg)$$

Thus both  $\ddot{x}+x=0$  and its companion matrix  $\dot{\mathbf{x}}=\begin{pmatrix}0&1\\-1&0\end{pmatrix}\mathbf{x}$  have a fundamental matrix  $\begin{pmatrix}\cos(t)&\sin(t)\\-\sin(t)&\cos(t)\end{pmatrix}$ .

Submit

You have used 1 of 3 attempts

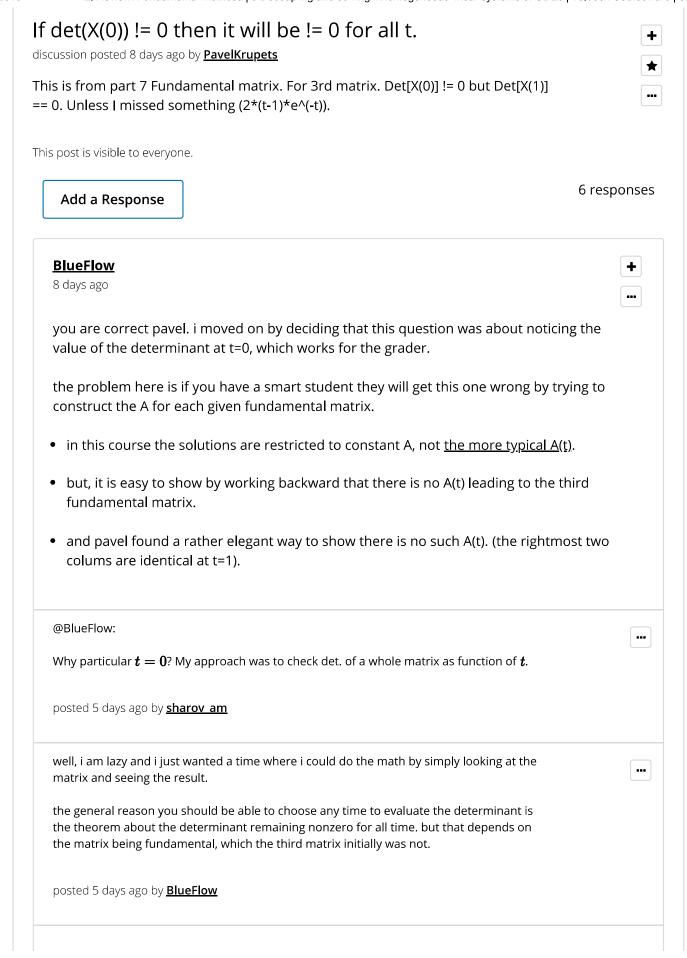
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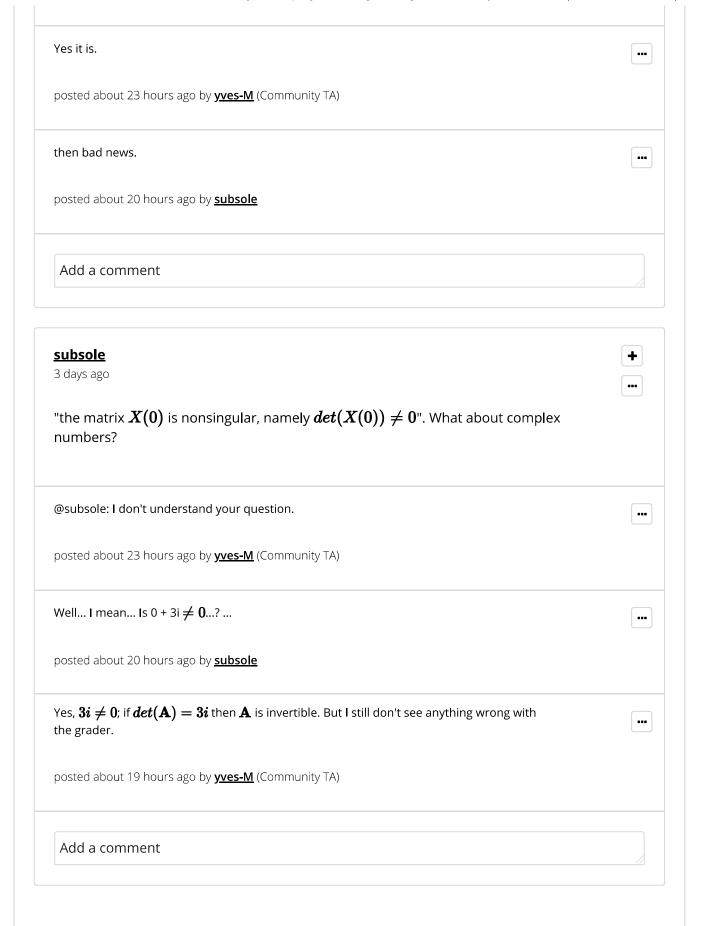
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Add a comment <u>JohnFMayne</u> 6 days ago Is the third matrix problematic? I have a red x on this one with one attempt left and I still can't figure out why my first attempt was wrong. Visually, it is not linear, so how can it be linearly independent? Also, as noted, there is a t where the determinant = 0. Add a comment **jfrench** (Staff) + 6 days ago Sorry, we found this bug in beta testing, and I evidently failed to fix it! I'll fix and regrade in a way that doesn't hurt those who have gotten full points already. Good luck...:) ••• posted 6 days ago by **yves-M** (Community TA) ? So some people have the green check while some other don't even though they submit ••• the same answer? posted 3 days ago by **subsole** Add a comment subsole 3 days ago Is the grader okay now? I can't tell...



		•••
I still don't see why my equal to zero. Why wro	$ au$ answer is wrong. I want the matrices that have determinant $n_{0}$ ong?	ot
You probably have done a	mistake in your calculations. The solution is fine.	
posted about 19 hours ago	by <u>yves-M</u> (Community TA)	
I agree with the grader rattempt.	now. If I remember correctly it didn't perform this way in my first	•••
posted about 16 hours ago	by <u>subsole</u>	
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