12.2.2 Simple Examples

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Week 12 due Dec 29, 2023 10:42 IST Completed

12.2.2 Simple Examples

Video 12.2.2 Part 1

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0:00 / 0:00 2.0x

Dr. Robert van de Geijn: As we have often done in the past

we will start by looking at some simple examples.

Go and do this homework.

In the homework what I want you to do is I

want you to identify eigenvalues, lambda, and corresponding

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Reading Assignment

0 points possible (ungraded)

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Homework 12.2.2.1

10.0/10.0 points (graded)

Which of the following are eigenpairs (λ, x) of the 2×2 zero matrix:

$$\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix} x = \lambda x,$$

where $x \neq 0$.

(Mark all correct answers.)

- [ ] $(1, \begin{pmatrix} 0 \\ 0 \end{pmatrix})$.
- [x] $(0, \begin{pmatrix} 1 \\ 0 \end{pmatrix})$.
- [x] $(0, \begin{pmatrix} 0 \\ 1 \end{pmatrix})$.
- [x] $(0, \begin{pmatrix} -1 \\ 1 \end{pmatrix})$.
- [x] $(0, \begin{pmatrix} 1 \\ 1 \end{pmatrix})$.
- [ ] $(0, \begin{pmatrix} 0 \\ 0 \end{pmatrix})$.

Answers 2., 3., 4., and 5. are all correct, since for all $Ax = \lambda x$.

Answers 1. and 6. are not correct because the zero vector is not considered an eigenvector.

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Answers are displayed within the problem

Video 12.2.2 Part 2

do

is you subtract lambda from the diagonal elements.

And if you then ask the question, when is this matrix singular?

What you conclude is that lambda is equal to 0.

And then once you actually plug that in, you end up with the matrix 0, 0, 0, 0.

And you ask yourself the question, for what x is this true?

And you end up again with the span of the unit basis vectors.

So let's move on to something a little bit more difficult.

Why don't you contemplate wha

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eigenvalues and eigenvectors.

of this matrix might be?

You will see me in the next video.

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Homework 12.2.2.2

1/1 point (graded)

Which of the following are eigenpairs (λ, x) of the 2×2 zero matrix:

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} x = \lambda x,$$

where $x \neq 0$.

(Mark all correct answers.)

- [ ] $(1, \begin{pmatrix} 0 \\ 0 \end{pmatrix})$.
- [x] $(1, \begin{pmatrix} 1 \\ 0 \end{pmatrix})$.
- [x] $(1, \begin{pmatrix} 0 \\ 1 \end{pmatrix})$.
- [x] $(1, \begin{pmatrix} -1 \\ 1 \end{pmatrix})$.
- [x] $(1, \begin{pmatrix} 1 \\ 1 \end{pmatrix})$.
- [ ] $(-1, \begin{pmatrix} 1 \\ -1 \end{pmatrix})$.

Answers 2., 3., 4., and 5. are all correct, since for all $Ax = \lambda x$.

Answer 1. is not correct because the zero vector is not considered an eigenvector. Answer 6. is not correct because it doesn't satisfy $Ax = \lambda x$.

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Answers are displayed within the problem

Video 12.2.2 Part 3

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Dr. Robert van de Geijn: OK.

So again, we may want to do this by examination.

We know that the identity times x is always equal to x.

And we think of that as the scale of 1 times the vector x.

And what you notice is, therefore, that 1

seems to be an eigenvalue of the

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Homework 12.2.2.3

3/3 points (graded)

Let $A = \begin{pmatrix} 3 & 0 \\ 0 & -1 \end{pmatrix}$.

- $\begin{pmatrix} 3 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} = 3 \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ so that $(3, \begin{pmatrix} 1 \\ 0 \end{pmatrix})$ is an eigenpair.

  TRUE ✓ Answer: TRUE

  Just multiply it out.

- The set of all eigenvectors associated with eigenvalue 3 is characterized by (mark all that apply):

  - [x] All vectors $x \neq 0$ that satisfy $Ax = 3x$.
  - [x] All vectors $x \neq 0$ that satisfy $(A - 3I)\,x = 0$.
  - [x] All vectors $x \neq 0$ that satisfy $\begin{pmatrix} 0 & 0 \\ 0 & -4 \end{pmatrix} x = 0$.
  - [ ] $\left\{ \begin{pmatrix} \chi_0 \\ 0 \end{pmatrix} \middle| \chi_0 \text{ is a scalar} \right\}$

  ✓

  True: this is the definition of an eigenvector associated with an eigenvalue.

  True: this is an alternate condition.

  True: $(A - 3I) = \begin{pmatrix} 0 & 0 \\ 0 & -4 \end{pmatrix}$ in this case.

  False: the zero vector is in this set.

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$\begin{pmatrix} 3 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 0 \\ 1 \end{pmatrix} = -1 \begin{pmatrix} 0 \\ 1 \end{pmatrix}$ so that $(-1, \begin{pmatrix} 0 \\ 1 \end{pmatrix})$ is an eigenpair.

TRUE ✔ Answer: TRUE

True: Just multiply it out.

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Answers are displayed within the problem

Video 12.2.2 Part 4

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Dr. Robert van de Geijn: So this time it might actually

be useful to just go ahead and subtract lambda times

the identity from the matrix.

And then you end up with this right here.

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