

EECS 16B CSM

Bryan Ngo

Computer Science Mentors

2020-09-21

1 Vector Differential Equations

2 Change of Basis

3 Inductors (Preview)

Who am I?

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Vector
Differential
Equations

Change of
Basis

Inductors
(Preview)



- 2nd year majoring in EECS
- first time in CSM!
- took EECS 16B Spring 2020
- Pertinent fact: ate a chicken bake for lunch

Who are you?

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- Name
- Pronouns
- Year/Major
- Pertinent fact

Logistics

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- unexcused absences in first 3 weeks → **auto-dropped & NP**
- excused absences: email bryanngo@berkeley.edu & cc mentors@berkeley.edu with subject line [Request for Absence] <course>
- Slides available at <https://github.com/bdngo/16b-csm>

Expectations

Me to You

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- Be skeptical
- Constant feedback
- Become passionate about 16B

Expectations

You to Me

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Vector Differential Equations

General Form

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$$\frac{d}{dt}\mathbf{x}(t) = \mathbf{A}\mathbf{x}(t) + \mathbf{B}\mathbf{u}(t) \quad (1)$$

- if \mathbf{A} is diagonal, simply a bunch of exponential differential Equations
- if not, we can try to diagonalize

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Change of Basis

Motivation

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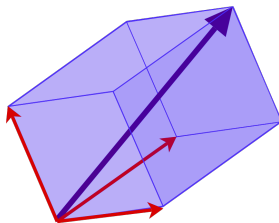
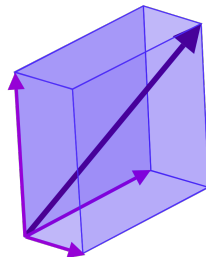
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- conversion from one linear coordinate system to another
- 3Blue1Brown video



A Visualization

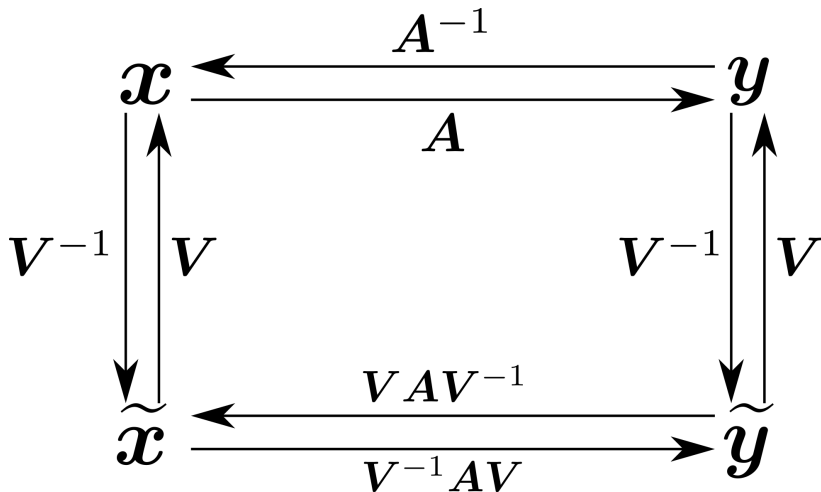
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Diagonalization

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(Preview)

- want the eigenvectors to be the basis for a vector space
- makes math way easier

Diagonalization

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- want the eigenvectors to be the basis for a vector space
- makes math way easier

$$\mathbf{V} = [\mathbf{v}_1 \quad \mathbf{v}_2 \quad \cdots \quad \mathbf{v}_n] \quad (2)$$

$$\mathbf{A}\mathbf{V} = [\lambda_1 \mathbf{v}_1 \quad \lambda_2 \mathbf{v}_2 \quad \cdots \quad \lambda_n \mathbf{v}_n] \quad (3)$$

$$= [\mathbf{v}_1 \quad \mathbf{v}_2 \quad \cdots \quad \mathbf{v}_n] \begin{bmatrix} \lambda_1 & 0 & \cdots & 0 \\ 0 & \lambda_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \lambda_n \end{bmatrix} \quad (4)$$

$$= \mathbf{V}\mathbf{\Lambda} \implies \mathbf{\Lambda} = \mathbf{V}^{-1}\mathbf{A}\mathbf{V} \quad (5)$$

Diagonalizing DEs

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$$\frac{d}{dt}\mathbf{x}(t) = \mathbf{A}\mathbf{x}(t) + \mathbf{B}\mathbf{u}(t) \quad (6)$$

$$\frac{d}{dt}\mathbf{V}\mathbf{z}(t) = \mathbf{A}\mathbf{V}\mathbf{z}(t) + \mathbf{B}\mathbf{u}(t) \quad (7)$$

$$\Rightarrow \frac{d}{dt}\mathbf{z}(t) = \mathbf{V}^{-1}\mathbf{A}\mathbf{V}\mathbf{z}(t) + \mathbf{V}^{-1}\mathbf{B}\mathbf{u}(t) \quad (8)$$

$$= \mathbf{\Lambda}\mathbf{z}(t) + \mathbf{V}^{-1}\mathbf{B}\mathbf{u}(t) \quad (9)$$

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Basic Properties

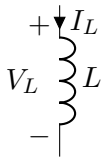
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$$V_L = L \frac{d}{dt} I_L \quad (10)$$

- like a capacitor but for magnetic fields
- resists instantaneous change in current

Basic Properties

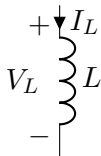
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$$V_L = L \frac{d}{dt} I_L \quad (10)$$

- like a capacitor but for magnetic fields
- resists instantaneous change in current
- what happens when $\omega = 0$? $\omega = \infty$?