

Review, Latex and Anaconda

Week 1 Section B

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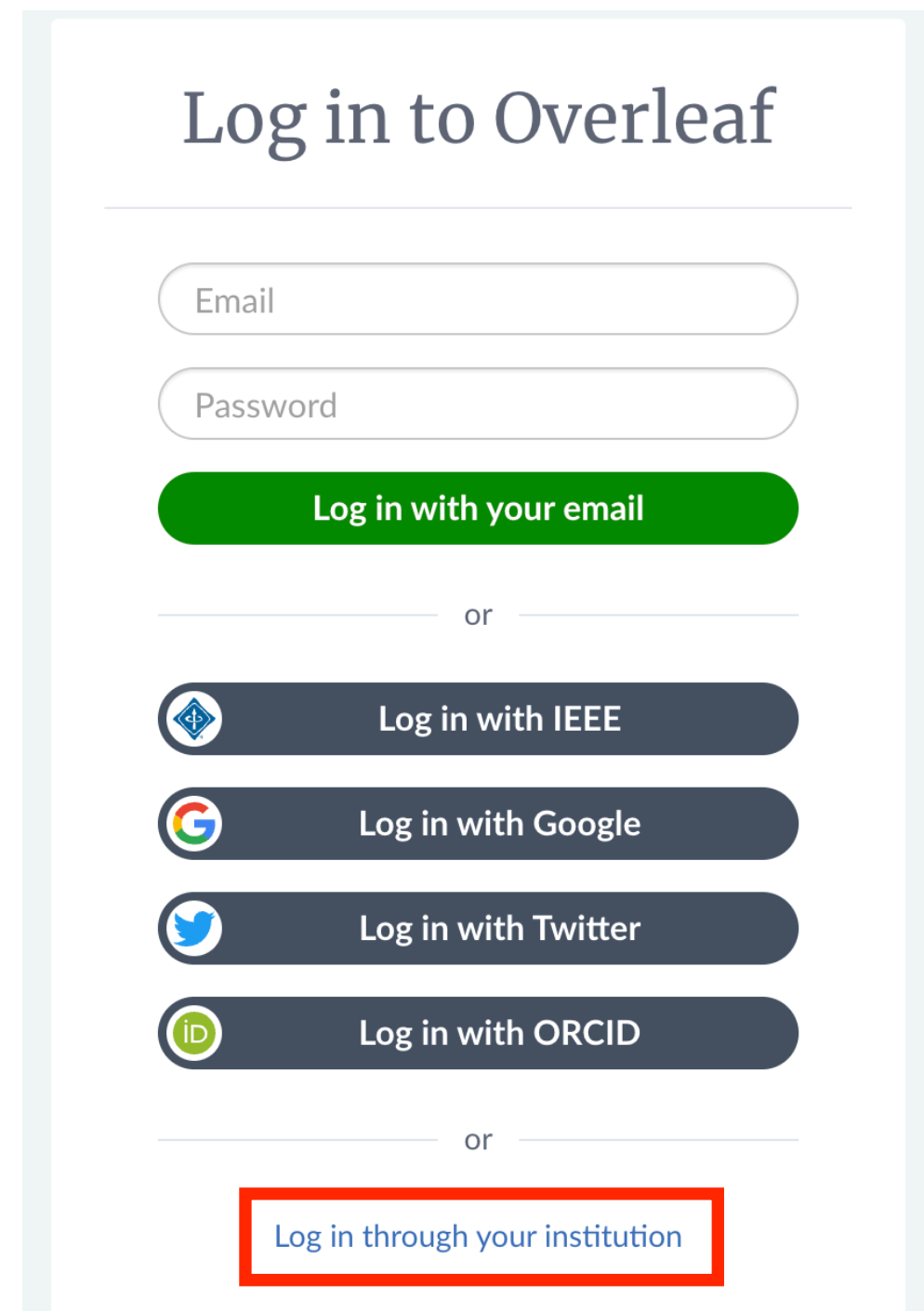
Outline

- ◆ **Overleaf (Latex)**
- ◆ **Anaconda installation**
- ◆ **Review of linear algebra**



Overleaf (Latex)

- <https://www.overleaf.com/>



The image shows the Overleaf login page. At the top, it says "Log in to Overleaf". Below this are two input fields: "Email" and "Password". Under the "Email" field is a green button that says "Log in with your email". Below this is a horizontal line with the word "or" in the center. Underneath are four buttons for social login: "Log in with IEEE" (with an IEEE logo), "Log in with Google" (with a Google logo), "Log in with Twitter" (with a Twitter logo), and "Log in with ORCID" (with an ORCID logo). Below these is another horizontal line with the word "or" in the center. At the bottom is a blue link that says "Log in through your institution", which is highlighted with a red rectangular border.

- **Tips:**

- **Equation:**

<https://latexeditor.lagrida.com/>

- **Table:**

<https://www.tablesgenerator.com/>


Latex Guide

1. Quick guide
2. Latex cheat sheet

Check the pdf files

(https://github.com/chen-zichen/cs111_s22/tree/main/week1)

Anaconda installation

- <https://www.anaconda.com/products/distribution#Downloads>
- **Option 1:** GUI installer 
- **Option 2:** Command line installer
- **Installing Document:**
- <https://docs.anaconda.com/anaconda/install/>

Anaconda Environment

- Create a **new environment** named "snakes" that contains Python 3.9:

```
conda create --name snakes python=3.9
```

- Activate the new environment:


```
conda activate snakes
```

Review of linear algebra - Basic concepts


- Vector in \mathbb{R}^n is an ordered set of n real numbers.

- e.g. $v = (1,6,3,4)$ is in \mathbb{R}^4


- “ $(1,6,3,4)$ ” is a column vector:


$$\begin{pmatrix} 1 \\ 6 \\ 3 \\ 4 \end{pmatrix}$$

- as opposed to a row vector:


$$(1 \ 6 \ 3 \ 4)$$

- m -by- n matrix is an object with m rows and n columns, each entry fill with a real number


$$\begin{pmatrix} 1 & 2 & 8 \\ 4 & 78 & 6 \\ 9 & 3 & 2 \end{pmatrix}$$

Review of linear algebra - Basic concepts

- **Transpose**: reflect vector/matrix on line

$$\bullet \begin{pmatrix} a \\ b \end{pmatrix}^T = (a \quad b) \quad \begin{pmatrix} a & b \\ c & d \end{pmatrix}^T = \begin{pmatrix} a & c \\ b & d \end{pmatrix}$$

- **Vector norms**:

- L_p norm of $v = (v_1, \dots, v_k)$ is $(\sum_i |v_i|^p)^{1/p}$
- Common norms: L_1 , L_2
- $L_{\text{infinity}} = \max_i |v_i|$

Review of linear algebra - Basic concepts

- **Vector dot product:**

- $u \bullet v = \begin{pmatrix} u_1 & u_2 \end{pmatrix} \bullet \begin{pmatrix} v_1 & v_2 \end{pmatrix} = u_1 v_1 + u_2 v_2$

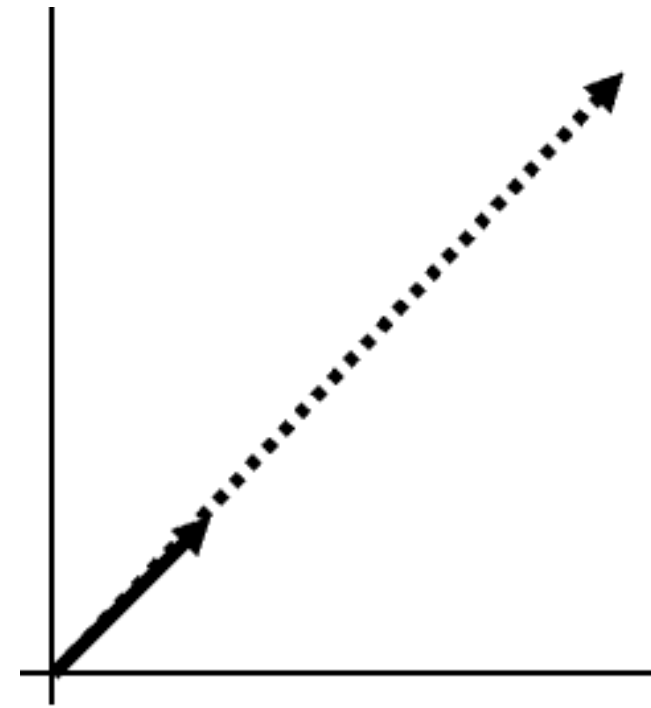
- **Matrix product:**

$$A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}, B = \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix}$$

- $AB = \begin{pmatrix} a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} \\ a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22} \end{pmatrix}$

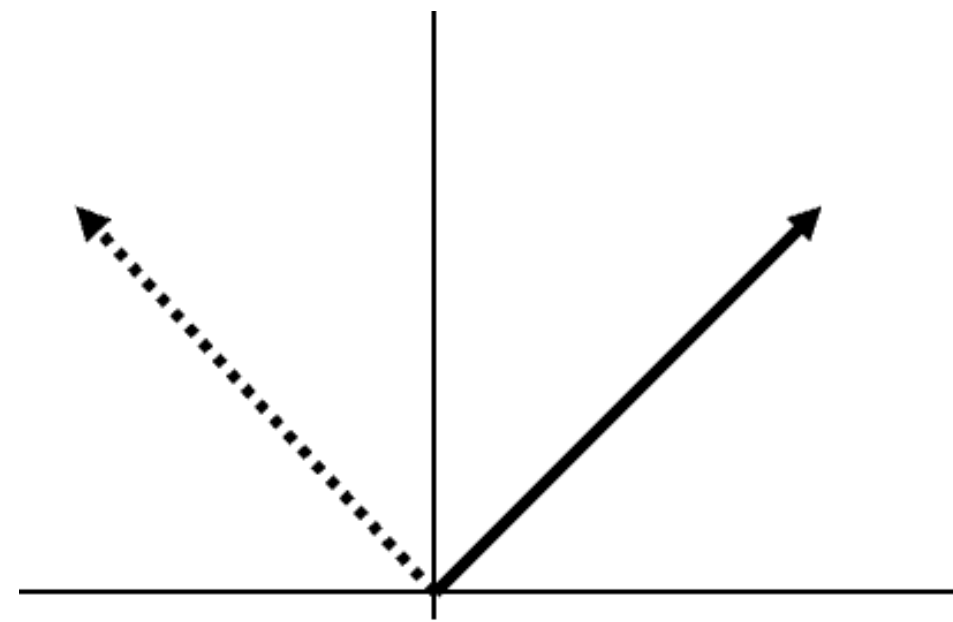
Matrices as linear transformations

- $\begin{pmatrix} 5 & 0 \\ 0 & 5 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 5 \\ 5 \end{pmatrix}$



stretching

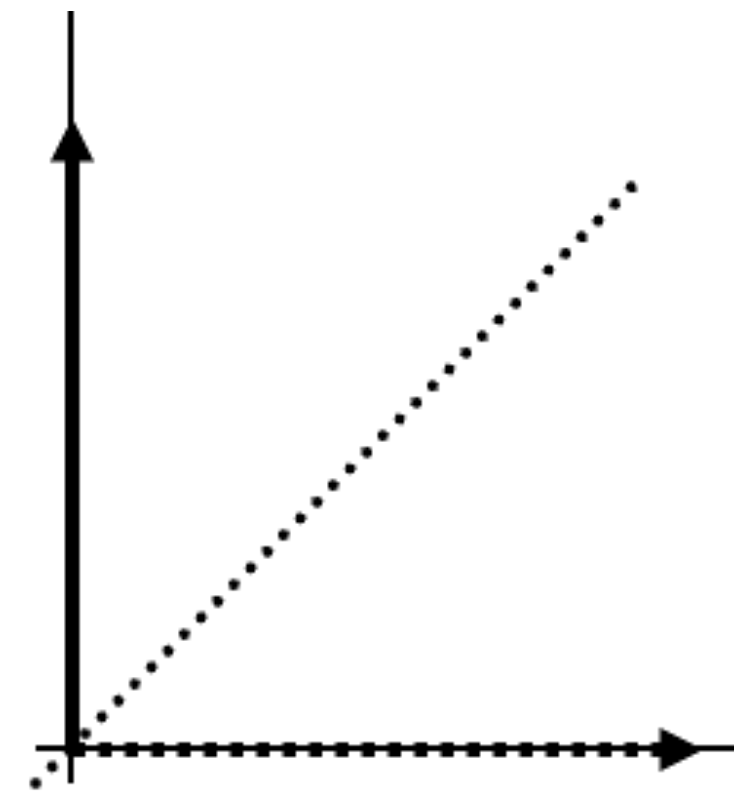
- $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$



rotation

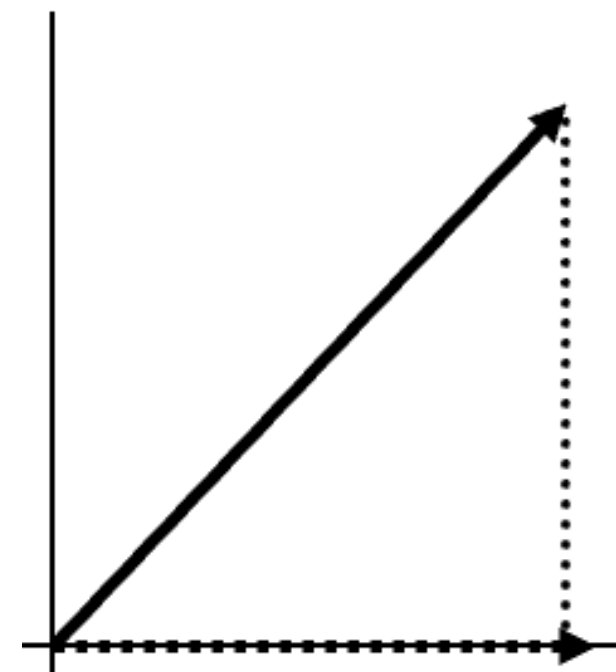
Matrices as linear transformations

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



reflection

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



projection

Special matrices

- Diagonal

- $$\begin{pmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{pmatrix}$$

- Upper-triangular

- $$\begin{pmatrix} a & b & c \\ 0 & d & e \\ 0 & 0 & f \end{pmatrix}$$

- Tri-diagonal

- $$\begin{pmatrix} a & b & 0 & 0 \\ c & d & e & 0 \\ 0 & f & g & h \\ 0 & 0 & i & j \end{pmatrix}$$

- Lower-triangular

- $$\begin{pmatrix} a & 0 & 0 \\ b & c & 0 \\ d & e & f \end{pmatrix}$$

- I (identity matrix)

- $$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

Determinants

- **To compute:**

- Simple example:

- $\det \begin{pmatrix} a & b \\ c & d \end{pmatrix} = ad - bc$

- If $\det(A) = 0$, then A is **singular**.
- If $\det(A) \neq 0$, then A is **invertible**.