Review, Latex and Anaconda

Week 1 Section B

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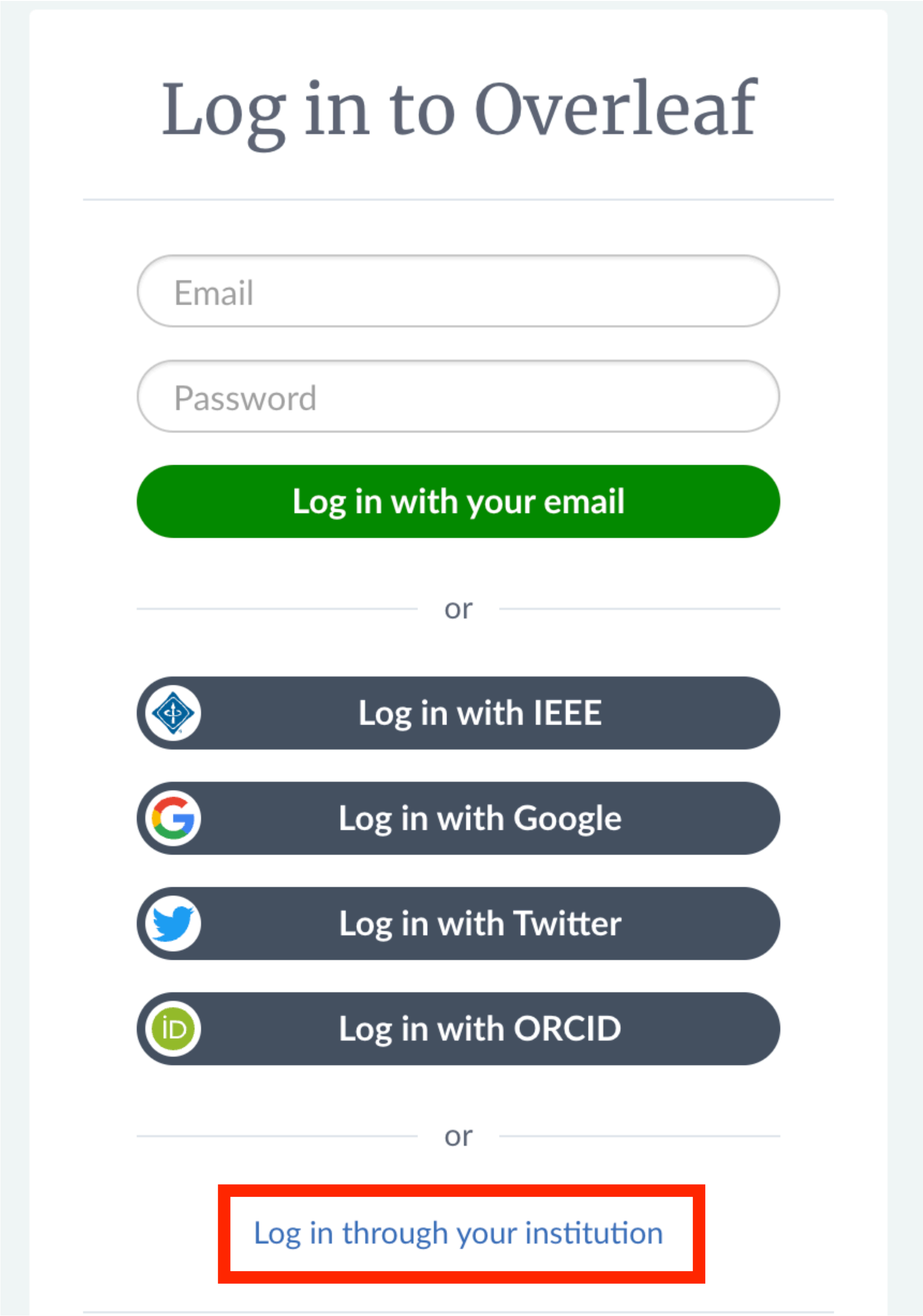
Outline

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

Overleaf (Latex)

- https://www.overleaf.com/



- 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 Rn is an ordered set of n real numbers.
  - e.g. v = (1,6,3,4) is in R4
  - "(1,6,3,4)" is a column vector: $\longrightarrow$ $\begin{pmatrix} 1 \\ 6 \\ 3 \\ 4 \end{pmatrix}$
  - as opposed to a row vector: $\longrightarrow$ $\begin{pmatrix} 1 & 6 & 3 & 4 \end{pmatrix}$
- m-by-n matrix is an object with m rows and n columns, each entry fill with a real number $\longrightarrow$ $\begin{pmatrix} 1 & 2 & 8 \\ 4 & 78 & 6 \\ 9 & 3 & 2 \end{pmatrix}$

Review of linear algebra - Basic concepts

- **Transpose**: reflect vector/matrix on line
- $\begin{pmatrix} a \\ b \end{pmatrix}^T = \begin{pmatrix} a & b \end{pmatrix}$ $\begin{pmatrix} a & b \\ c & d \end{pmatrix}^T = \begin{pmatrix} a & c \\ b & d \end{pmatrix}$
- **Vector norms**:
  - L_p norm of $v = (v_1,\ldots,v_k)$ is $(\Sigma_i |v_i|^p)^{1/p}$
  - Common norms: L_1, L_2
  - L_infinity = max_i |v_i|

Review of linear algebra - Basic concepts

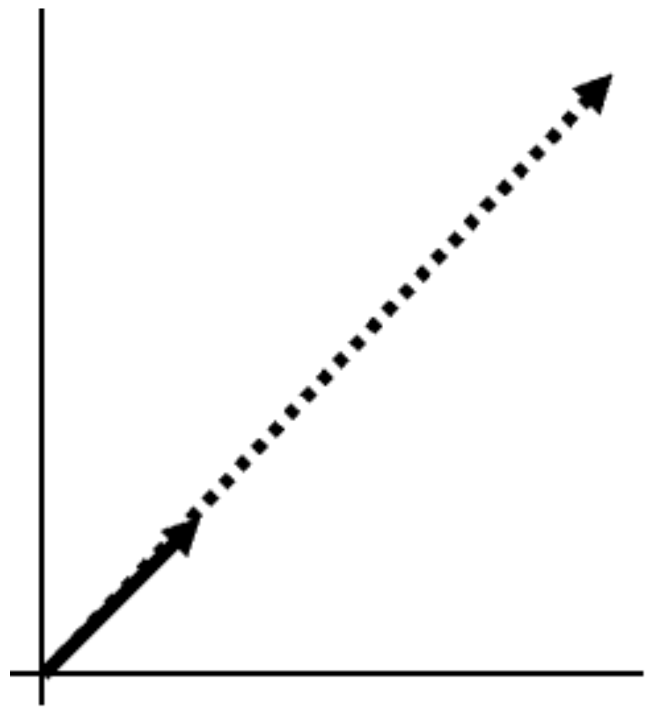
- **Vector dot product:**
  - $u \bullet v = \begin{pmatrix} u_1 & u_2 \end{pmatrix} \bullet \begin{pmatrix} v_1 & v_2 \end{pmatrix} = u_1 v_1 + u_2 v_2$
- **Matrix product:**

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

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

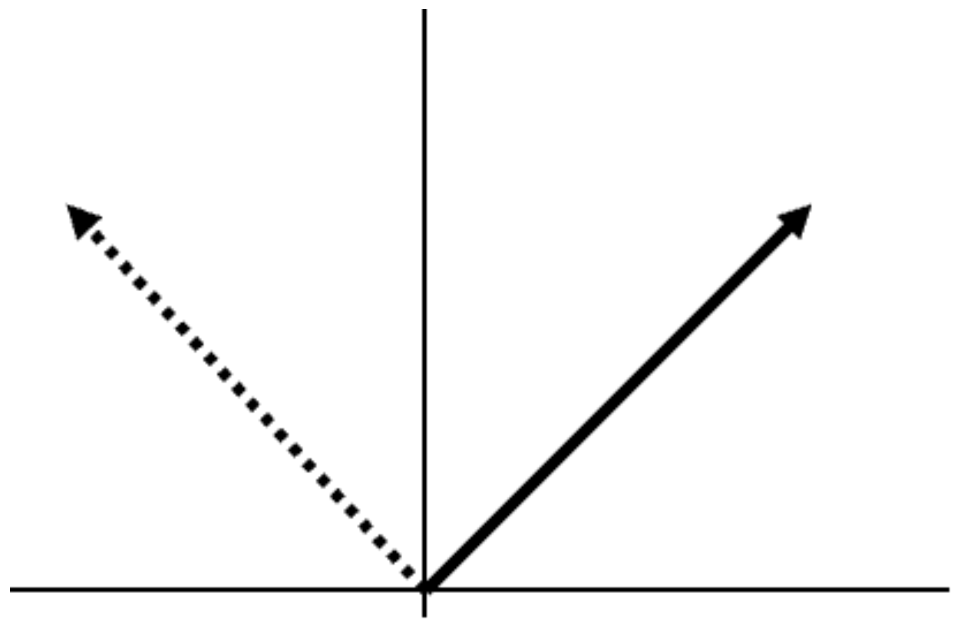
Matrices as linear transformations

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



stretching

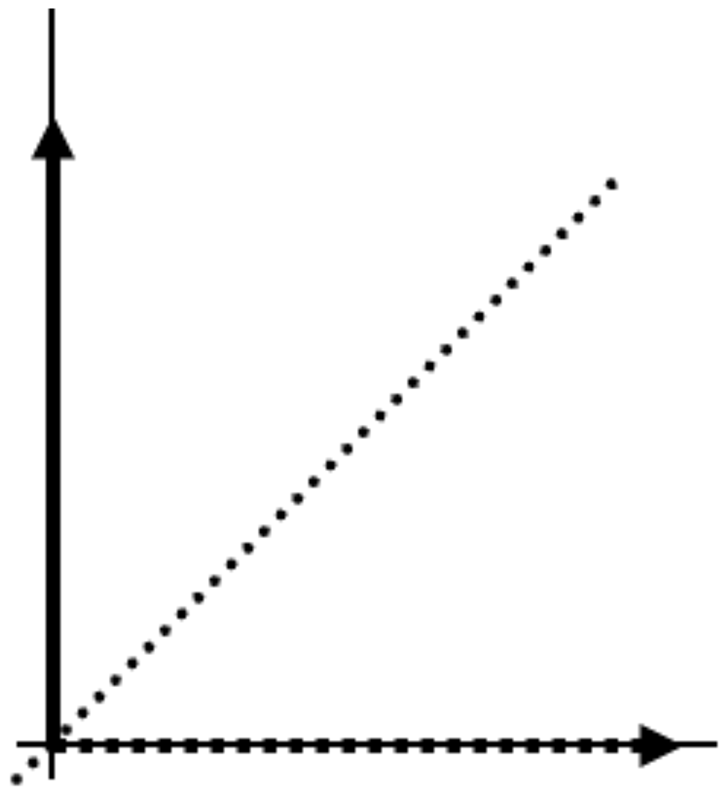
- $$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$$



rotation

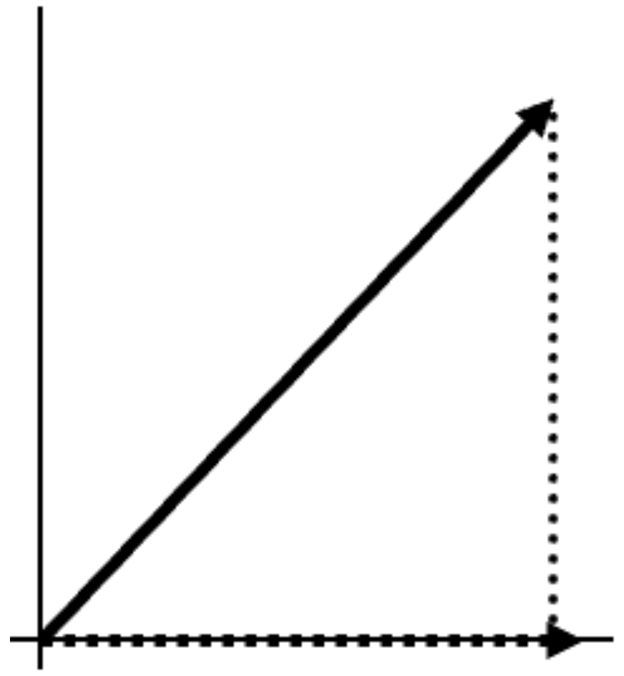
Matrices as linear transformations

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



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
  - $$\begin{pmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{pmatrix}$$
- Tri-diagonal
  - $$\begin{pmatrix} a & b & 0 & 0 \\ c & d & e & 0 \\ 0 & f & g & h \\ 0 & 0 & i & j \end{pmatrix}$$
- I (identity matrix)
  - $$\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$
- Upper-triangular
  - $$\begin{pmatrix} a & b & c \\ 0 & d & e \\ 0 & 0 & f \end{pmatrix}$$
- Lower-triangular
  - $$\begin{pmatrix} a & 0 & 0 \\ b & c & 0 \\ d & e & f \end{pmatrix}$$

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) ≠ 0, then A is **invertible**.