spring19-se201-week-01

March 2, 2019

1 Week 01 (19/2/25 - 19/3/1)

- Lecture
- Introduction to vectors and linear equations
- Elimination method
- Recitation
- Introduction to Python programming.
- Installing Python IDEs.

1.1 Lecture 01 (19/2/25)

1.1.1 To Do

- Overview syllabus
- Emphasize homework policy
- Explain the purpose of the project
- Checking roster
- Split recitation classes
- Check available time

1.1.2 Contents (1.1 - 1.4)

- Notations
- Define vector notations: tuple, column, or row representations.
- Define matrix addition, multiplication, scalar multiplications.
- Upshots for using row / column reprensetations of vectors.
- System of linear equations
- Example:

$$\begin{aligned} 2u + v + w &= 5 \\ 4u - 6v &= -2 \\ -2u + 7v + 2w &= 9 \end{aligned}$$

- Finding solution(s)

- Elimination method converts to:

$$\begin{aligned} 2u + v + w &= 5 \\ -8v - 2w &= -12 \\ w &= 2 \end{aligned}$$

- Define **pivots**.
- Matrix representation $Ax = b$ where

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 4 & -6 & 0 \\ -2 & 7 & 2 \end{bmatrix}, \quad x = \begin{bmatrix} u \\ v \\ w \end{bmatrix}, \quad b = \begin{bmatrix} 5 \\ -2 \\ 9 \end{bmatrix}$$

- Geometric meaning of system of linear equations with 3 variables.
  - Definition: **Singular, nonsingular** systems.
  - **Q** Classify the geometric position of planes in three cases: (1) there is a unique solution, (2) there are infinitely many solutions, (3) no solution
- Vector representation
  - Let $A = \begin{bmatrix} a_1 & a_2 & a_3 \end{bmatrix}$, and write $Ax = b$ as

$$a_1 u + a_2 v + a_3 w = b$$

  - **Q** In what condition(s) of a_1, a_2, a_3, and b is there a unique solution to the system? (Similarly for infinitely many solutions and no solution)

1.1.3 Timeline

- (0 ~ 10 min) Syllabus
- (10 ~ 15 min) Roster and recitation availability check
- (15 ~ 55 min) Lecture on main contents (English)
- (55 ~ 75 min) Discussion on questions (Korean)

1.2 Lecture 02 (19/2/28)

1.2.1 To Do

- Review previous lecture
- Check roster
- Recitation announcement
- Announce homework assignment #01

1.2.2 Contents (1.5)

- Elimination by matrix multiplication
- Example:

$$A = \begin{bmatrix} 2 & 1 & 1 \\ 4 & -6 & 0 \\ -2 & 7 & 2 \end{bmatrix}$$

- Elemetary row operations $E_{ij}(c)$
- Upper / lower triangular matrices
  - **Q** Show that the multiple of two lower (or upper) triangular matrices is also lower (or upper) triangular.
- Row echelon form
- Inverse matrix
- Find x satisfying $Ax = b$ in terms of b.
- Definition of inverse matrix
  - Uniqueness
  - The left and right inverse coincide.
  - **Q** Show that if A has a left (or right) inverse, then it has a right (or left) inverse.
- ~~Gauss-Jordan elimination.~~
- LU (and LDU) decomposition.
- LU decompoisition for $A = \begin{bmatrix} 2 & 1 & 1 \\ 4 & -6 & 0 \\ -2 & 7 & 2 \end{bmatrix}$.
- ~~Permutation~~
  - ~~Example:~~
    $$A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 3 \\ 2 & 5 & 8 \end{bmatrix}$$
  - ~~**Q** Show that if A is nonsingular, then there exists a permutation matrix P such that $PA = LU$.~~
- ~~Uniqueness: if $A = L_1DU_1 = L_2DU_2$, then $L_1 = L_2$ and $U_1 = U_2$.~~
- ~~Transpose and symmetric matrices~~
- ~~Property : $(AB)^T = B^TA^T$, $(A^{-1})^T = (A^T)^{-1}$~~
- ~~LDU factorization of symmetric matrix: LDL^T~~

1.2.3 Timeline

- (0 ~ 5 min) Review
- (5 ~ 10 min) Questions, roster
- (10 ~ 55 min) Lecture on contents (English)
- (55 ~ 75 min) Discussion (Korean)

1.3 Recitation 01 (19/2/28)

1.3.1 Contents

- Course GitHub
- How to read homework file.
- Encode latex equation using MathJax (need chrome extension)
- Read from Jupyter Notebook files directly from GitHub.
- Python, Jupyter Notebook
- Install Anaconda or equivalent module.
- Use Colab for online Jupyter Notebook environment
- Introduction to Python