Linear Algebra
線性代數

Spring 2014

蘇柏青

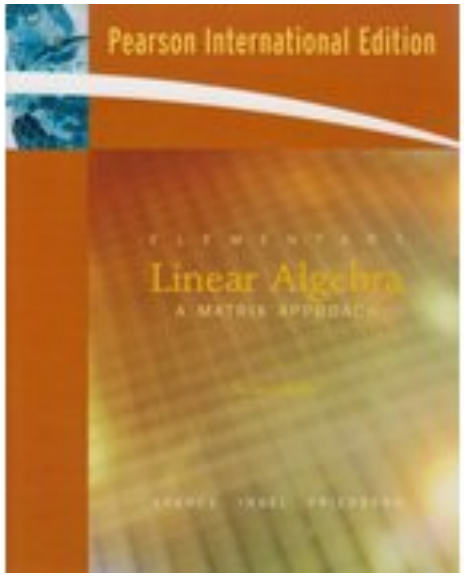
線性代數

- 時間：星期三上午10:20~12:10
  星期四下午1:20~2:10
- 教室：電二145教室
- 教師：蘇柏青 助理教授
  (borching@cc.ee.ntu.edu.tw)
  - Office Hour: 星期四上午10:00~12:00 或另約時間.
  - Office: 明達館516室, 02-3366-3720
- 助教: (TBA)
  - TA Hour: TBA.
  - TA Office: TBA

線性代數

- 教科書：
  ”Elementary Linear Algebra: A Matrix Approach”, 2nd. Ed.
  by L. E. Spence, A. J. Insel, and S. H. Friedberg,

  Pearson Education, Inc., 2008, 台北圖書公司代理



線性代數

- 課程網頁：
  - Ceiba
    - https://ceiba.ntu.edu.tw/1022la_su
  - 四班聯合網頁
    - TBA.
- 評分方式：
  - 平時成績: 10%
  - 小考(共兩次)：20% (暫訂3月20日、5月21日)
  - 期中考：35% (4月16日)
  - 期末考：35% (6月18日)

翻轉教室

- 本學期將第一次使用「翻轉教室」的上課方式。
- 一言以蔽之：「在家上課，到教室來寫作業。」

- 每週三上課以前(下週開始)，自己利用時間將當週課程的影片看完。

- 課堂的時間則進行
  - 問題討論: 影片中的問題解答。
  - 分組寫作業(三人一組)。

翻轉教室

- 好處：
  - 選擇你最有fu的時間及地點聽課
  - 已經會的部分可以快轉。
  - 聽不太懂的部分可以重複觀看。
  - 還是聽不懂的部分可以到教室來討論。
- 壞處：
  - 每週都有作業要交。
  - 花的總時間 “可能”比較多。
  - 上課方式尚為嘗試性，需要適應。

平時成績之計算

- 自第三週起除了Weeks 7, 9, 14, 18之外，各算1% (共12次)
- 12次取最佳的10次作平均
- 每一次的評量方式於上一週上課時宣佈
  - Week 3: 3/05~3/06 (1%)
  - Week 4: 3/12~3/13 (1%)
  - Week 5: 3/19 (3/20小考) (1%)
  - Week 6: 3/26~3/27 (1%)
  - Week 7: (春假)
  - Week 8: 4/9~4/10 (1%)
  - Week 9: (期中考)
  - Week 10: 4/23~4/24 (1%)
  - Week 11: 4/30~5/1 (1%)
  - Week 12: 5/7~5/8 (1%)
  - Week 13: 5/14~5/15 (1%)
  - Week 14: 5/22 (5/21小考)
  - Week 15: 5/28~5/29 (1%)
  - Week 16: 6/4~6/5 (1%)
  - Week 17: 6/11~6/12 (1%)
  - Week 18: (期末考)

本週的上課方式

- 今天:
  - 在上課時播放第一週的影片。
  - 撥不完的部分，或者你沒有馬上聽懂的部分，可以回家後再看一次。
    - 記下你聽不懂的地方，等待明天討論。
- 明天:
  - 問題與討論(第一週沒有作業)。
  - 下週的課程連結。

課程規則

- ~~出席率、點名之原則：~~
  - ~~不點名，但絕不鼓勵同學蹺課。~~
  - ~~缺課者，對該次上課內容之學習需自行負責。~~
  - ~~考試(小考、期中考、期末考)缺席者，該次成績以零分計算(但不影響其他次考試成績)。~~
- 考試規則：「嚴禁作弊」
  - 除非生病(需醫師開立證明)，不得請假及要求補考。
  - 期中考或小考作弊者，**該次考試**以零分計。
  - 期末考作弊者，學期成績不及格。
  - 「考試作弊」的行為，發生第二次者，學期成績不及格。
- 其他
  - 不接受期末考之後以任何方式求情要求加分或使學期成績及格。

Linear Algebra

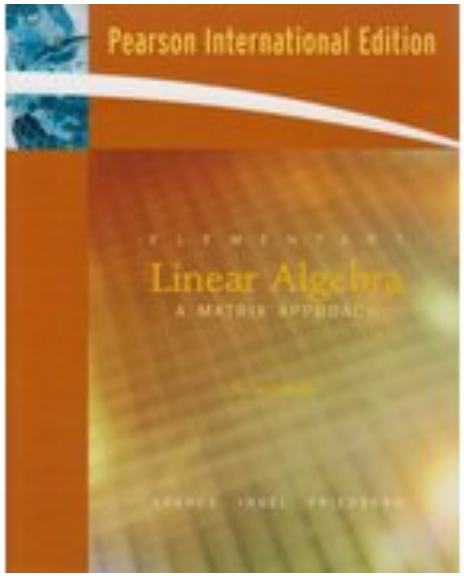
- **What** is Linear Algebra?
- **Why** are we studying Linear Algebra?
- **How** do we study Linear Algebra?
- **What** will be covered in this course?

What is Linear Algebra?

- A math course in which we deal with a lot of **vectors** and **matrices**?
- A math course in which we learn to systematically solve **linear equations**?
- A math course in which we calculate **eigenvalues** and **determinants** of matrices?
- A math course in which we play with **vector spaces**, **inner products**, and **linear transforms**?
- All of the above!!

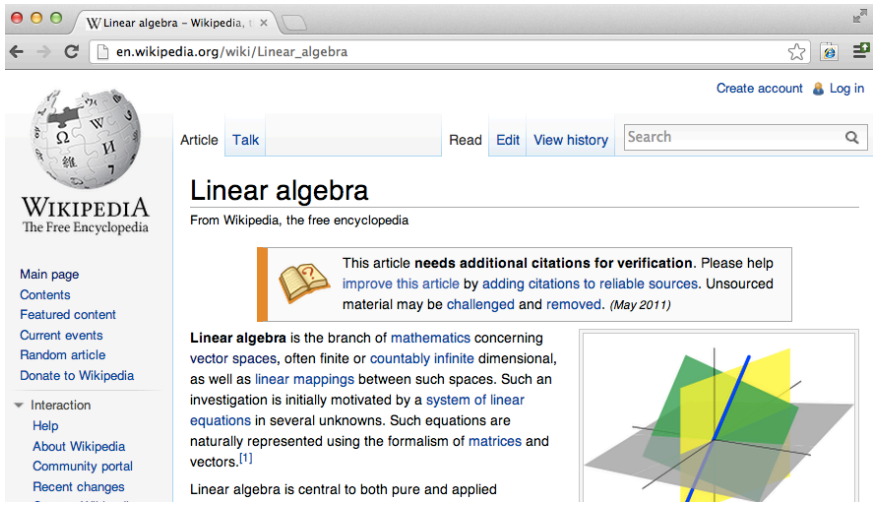
What is Linear Algebra?

- Textbook (page xvii):
  - **Linear algebra** is concerned with **vectors** and **matrices**, and with special **functions** called **linear transformations** that are defined on vectors.



What is Linear Algebra?

- Wikipedia:
  - **Linear algebra** is the branch of **mathematics** concerning **vector spaces**, often finite or countably infinite **dimensional**, as well as **linear mappings** between such spaces.
  - Such an investigation is initially motivated by a **system of linear equations** in several unknowns. Such equations are naturally represented using the formalism of **matrices** and **vectors**.



Why Studying Linear Algebra?

- Fundamental knowledge for a wide variety of real-life applications.
  - Electrical networks
  - Communication systems
  - Google searches
  - Computer graphics
  - Economics
  - Physics
  - Biology
  - Statistics
  - Population change
  - A lot, a lot, … more…..

How do we study Linear Algebra?

- What do you need to be familiar with in advance?
  - Algebra (代數； 國中~高中)
  - Concept of Set Theory, functions, etc.
    - Read "Appendix A – Sets", "Appendix B – Functions" when necessary.
- The following materials are auxiliary but not required.
  - Analytic geometry (解析幾何；高二)
  - Trigonometry (三角函數: 國中~高中)
  - Calculus.

How do we study Linear Algebra?

- What should you do to learn Linear Algebra well?
  - Carefully read each section ***before*** the classroom discussion occurs.
  - Prepare regularly for each class.
  - Ask questions of yourself and others.
  - Review often.

How do we study Linear Algebra?

- How will I teach Linear Algebra?
  - Mostly powerpoint slides each lecture to show key concepts.
  - Sometimes blackboard writing for arithmetic derivation and theorem proofs.
  - **Definitions** of key concepts in Linear Algebra.
    - All definitions of key concepts will be taught and tested in English.
  - Proof of **theorems**. (lemmas, corollary, properties, propositions, etc.)
  - **Examples** to illustrates the ideas.

- How do we study Linear Algebra?
  - Understand the definitions clearly.
  - Practice to come up with proofs of theorems.

What will be covered in this course?

- Course outline
  - Chapter 1. Matrices, Vectors, and Systems of Linear Equations
  - Chapter 2. Matrices and Linear Transformations
  - Chapter 3. Determinants
  - Chapter 4. Subspaces and Their Properties
  - Chapter 5. Eigenvalues, Eigenvectors, and Diagonalization
  - Chapter 6. Orthogonality
  - Chapter 7. **Vector Spaces (Linear Spaces)**

LINEAR ALGEBRA

This course will cover:

1. Matrices, Vectors, and Systems of Linear Equations

   1.1 Matrices and vectors
   1.2 Linear combination, matrix-vector products, and special matrices
   1.3 Systems of linear equations
   1.4 Gaussian elimination
   1.6 The span of a set of vectors
   1.7 Linear dependence and linear independence

2. Matrices and **Linear Transformations**

   2.1 Matrix multiplication
   2.3 Invertibility and elementary matrices
   2.4 The inverse of a matrix
   2.7 Linear transformations and matrices
   2.8 Composition and invertibility of linear transformations

3. Determinants

3.1 Cofactor expansion
3.2 Properties of determinants

4. Subspaces and Their Properties

4.1 Subspaces
4.2 Basis and dimension
4.3 The dimension of subspaces associated with a matrix
4.4 Coordinate systems
4.5 Matrix representations of linear operators

5. Eigenvalues, Eigenvectors, and Diagonalization

5.1 Eigenvalues and eigenvectors
5.2 The characteristic polynomial
5.3 Diagonalization of matrices

6. Orthogonality

6.1 The geometry of vectors
6.2 Orthogonal vectors
6.3 Orthogonal projections
6.4 Least-squares approximation and orthogonal projection matrices
6.5 Orthogonal matrices and operators
6.6 Symmetric matrices

7. Vector Spaces

7.1 Vector spaces and their subspaces
7.2 Linear transformations
7.3 Basis and dimension
7.4 Matrix representation of linear operators
7.5 Inner product spaces