Introduction

李宏毅

Hung-yi Lee

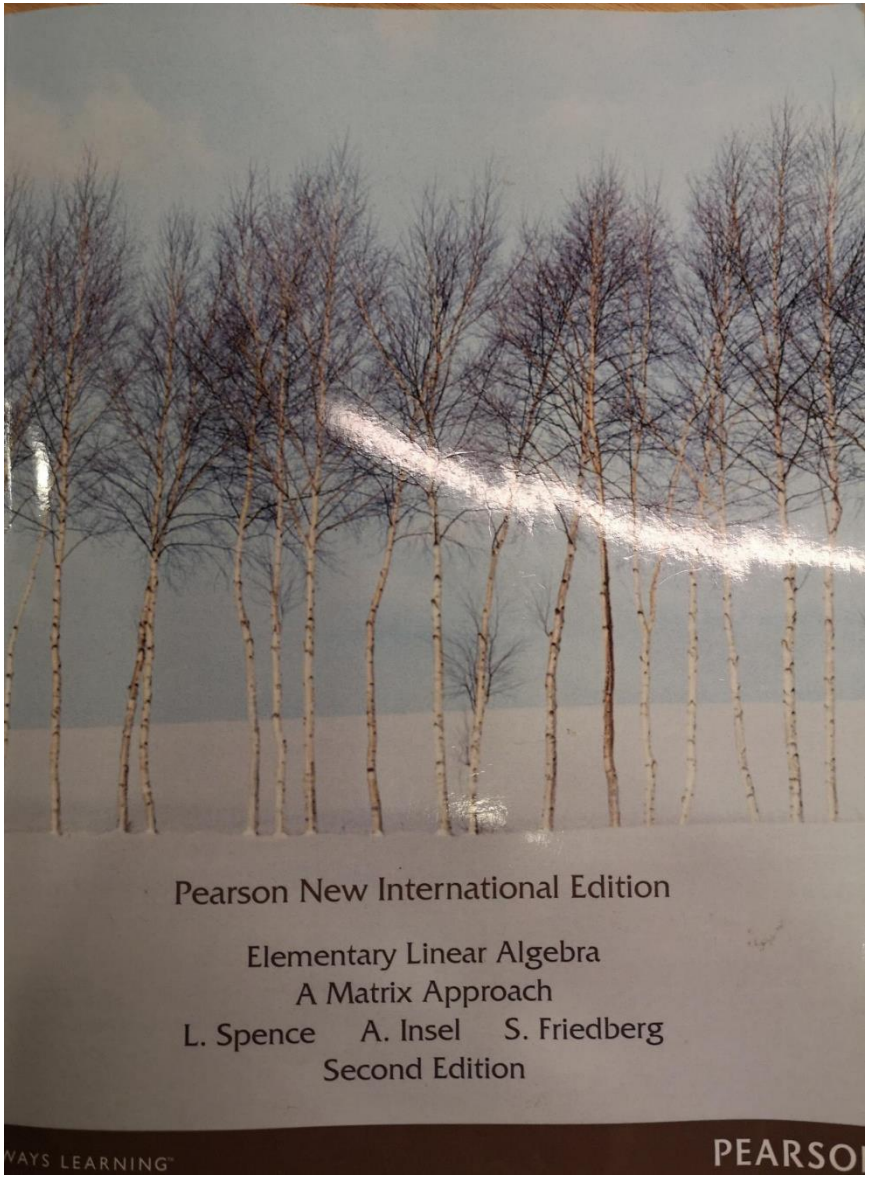
Course Information

課程資訊

- 上課時間：
  - 週三上午 9:10 – 10:00
  - 週五上午 10:20 – 12:10
- 上課地點：博理112
- 評量方式：
  - 期中考 (35%)
  - 期末考 (35%)
  - 六次作業 (每個作業 6%)
    - 取最高的五次計分

教科書

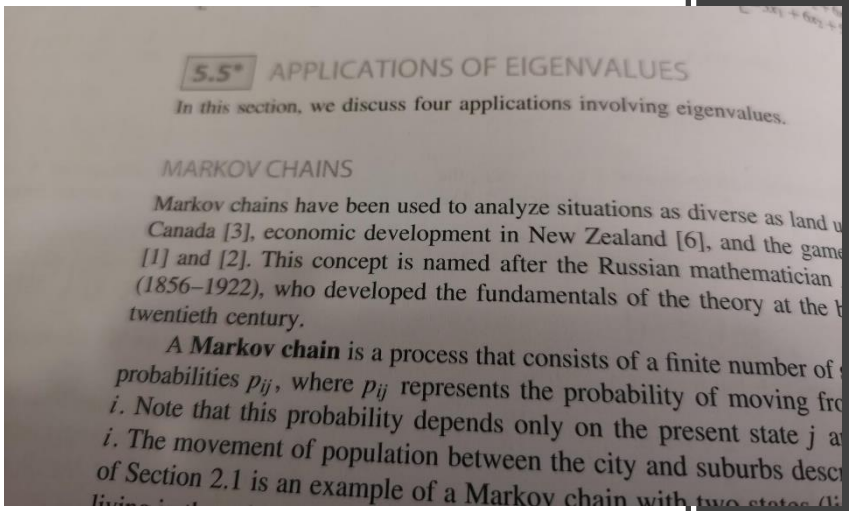
- Elementary Linear Algebra - A Matrix Approach, **2nd Ed**., by L. E. Spence, A. J. Insel and S. H. Friedberg



上課不完全按照教科書內容，但考試範圍都會講到

考試範圍

- 考試範圍：教科書所有未打星號* 章節



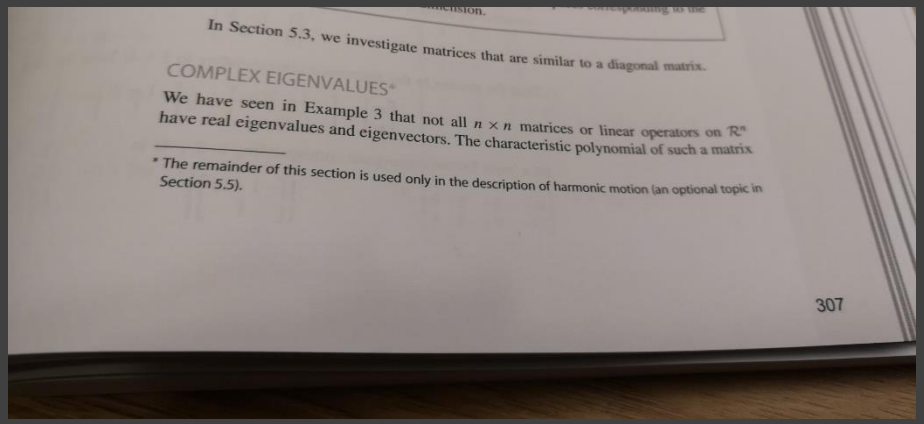
5.5* APPLICATIONS OF EIGENVALUES

In this section, we discuss four applications involving eigenvalues.

MARKOV CHAINS

Markov chains have been used to analyze situations as diverse as land u
Canada [3], economic development in New Zealand [6], and the game
[1] and [2]. This concept is named after the Russian mathematician
(1856–1922), who developed the fundamentals of the theory at the b
twentieth century.

A **Markov chain** is a process that consists of a finite number of
probabilities p_{ij}, where p_{ij} represents the probability of moving fro
i. Note that this probability depends only on the present state j a
i. The movement of population between the city and suburbs descr
of Section 2.1 is an example of a Markov chain with two states (li



In Section 5.3, we investigate matrices that are similar to a diagonal matrix.

COMPLEX EIGENVALUES*

We have seen in Example 3 that not all $n \times n$ matrices or linear operators on $\mathbb{R}^n$ have real eigenvalues and eigenvectors. The characteristic polynomial of such a matrix

* The remainder of this section is used only in the description of harmonic motion (an optional topic in Section 5.5).

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期中、期末考

- 期中和期末考則採各班統一時間舉行及命題
- 時間為期中考週和期末考週的週五
- 考試規則：
  - 除非生病(需醫師開立證明)，不得請假及要求補考
  - 考試作弊者，學期成績不及格
  - 不接受以任何方式求情要求加分或使學期成績及格

作業

- 作業不是勾課本習題 (課本習題請自行練習)
- 作業是線性代數的應用
- 需要使用 python
- 作業繳交日期和方式等細節另行公告

其他注意事項

- 上課投影片會放在李宏毅的個人網頁上
  - http://speech.ee.ntu.edu.tw/~tlkagk/courses_LA19.html
- FB 社團：NTUEE Linear Algebra (2019)
  - https://www.facebook.com/groups/667575690377769/
  - 歡迎討論任何和線性代數相關的問題
  - 請務必加入FB社團，重要訊息除了透過學校 ceiba 寄 e-mail 外，也會透過FB 社團公告
- 助教信箱：LinearAlgebraLee@gmail.com
- 有關加簽

What are we going to learn?

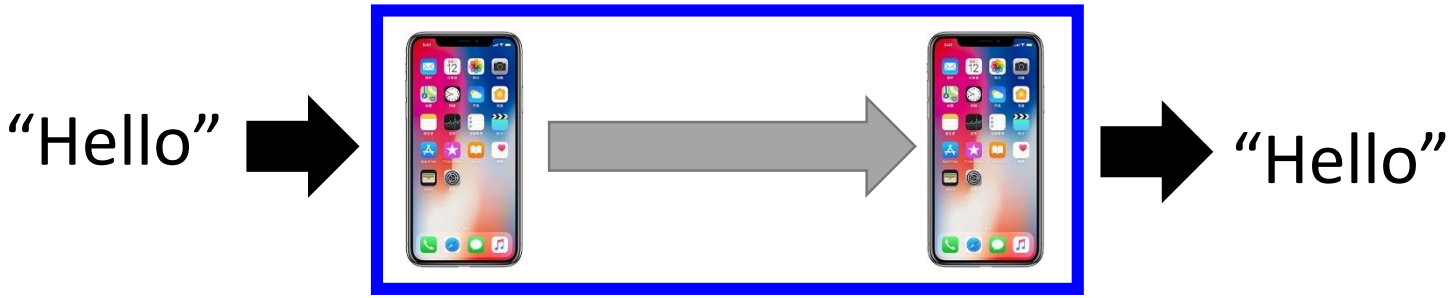
System

- A system has input and output (function, transformation, operator)

Speech Recognition System

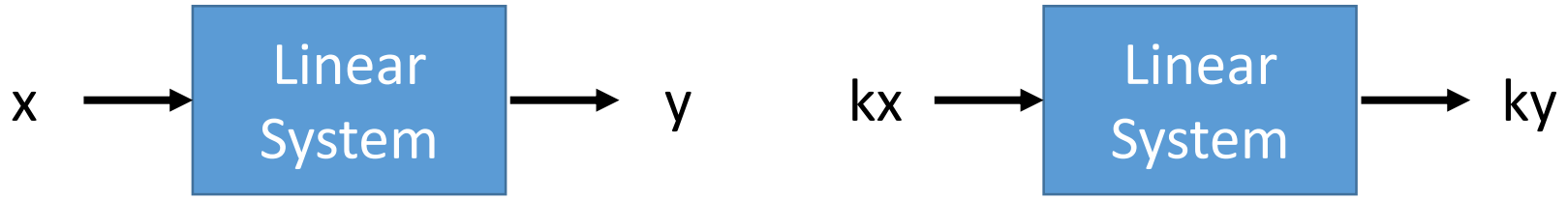
Dialogue System (e.g. Siri, Alexa)

Communication System

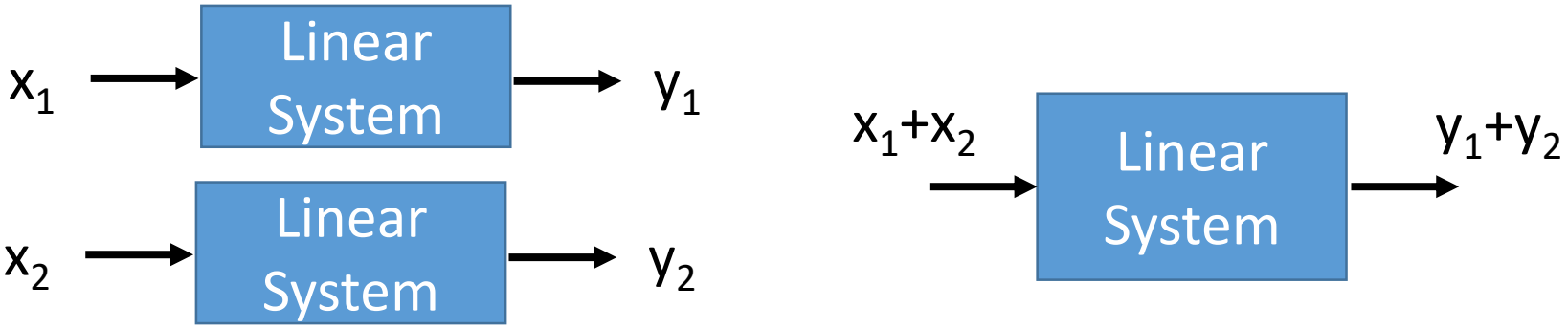


Linear System

- Linear system have two properties
  - 1. Persevering Multiplication

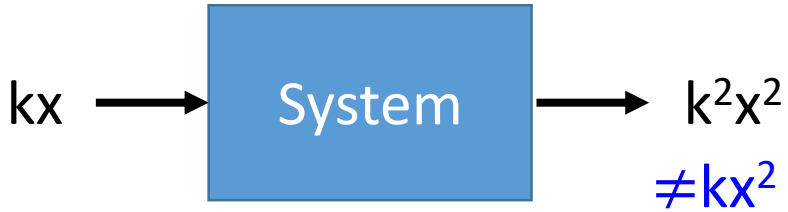


  - 2. Persevering Addition

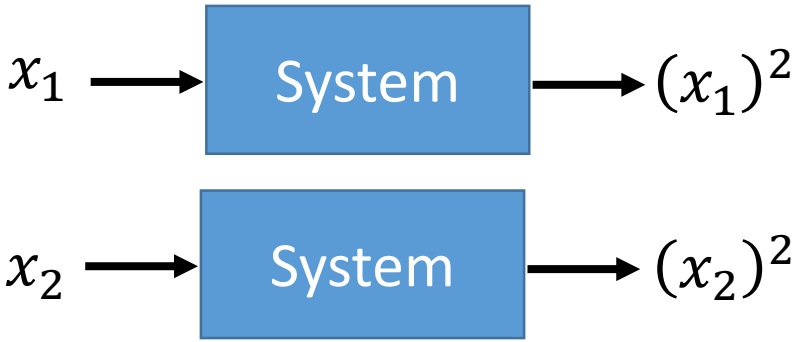


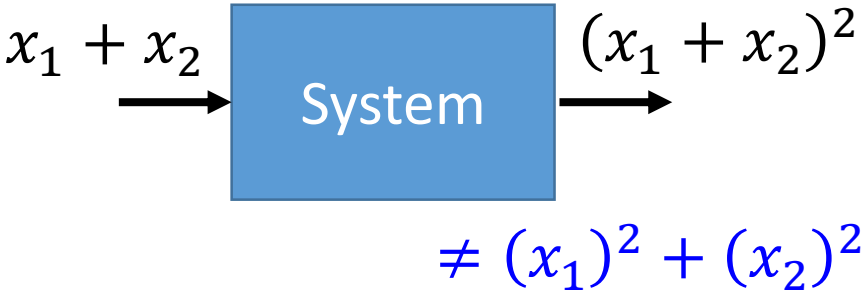
Linear?

- Linear system have two properties
  - 1. Persevering Multiplication



  - 2. Persevering Addition

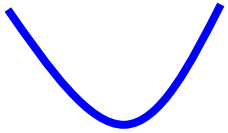




Linear?

- Derivative

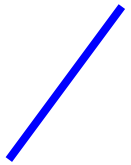
function f → Derivative → function f’



x^2

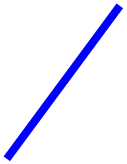
$f \to f'$

$g \to g'$



2x

$kf \to kf'$



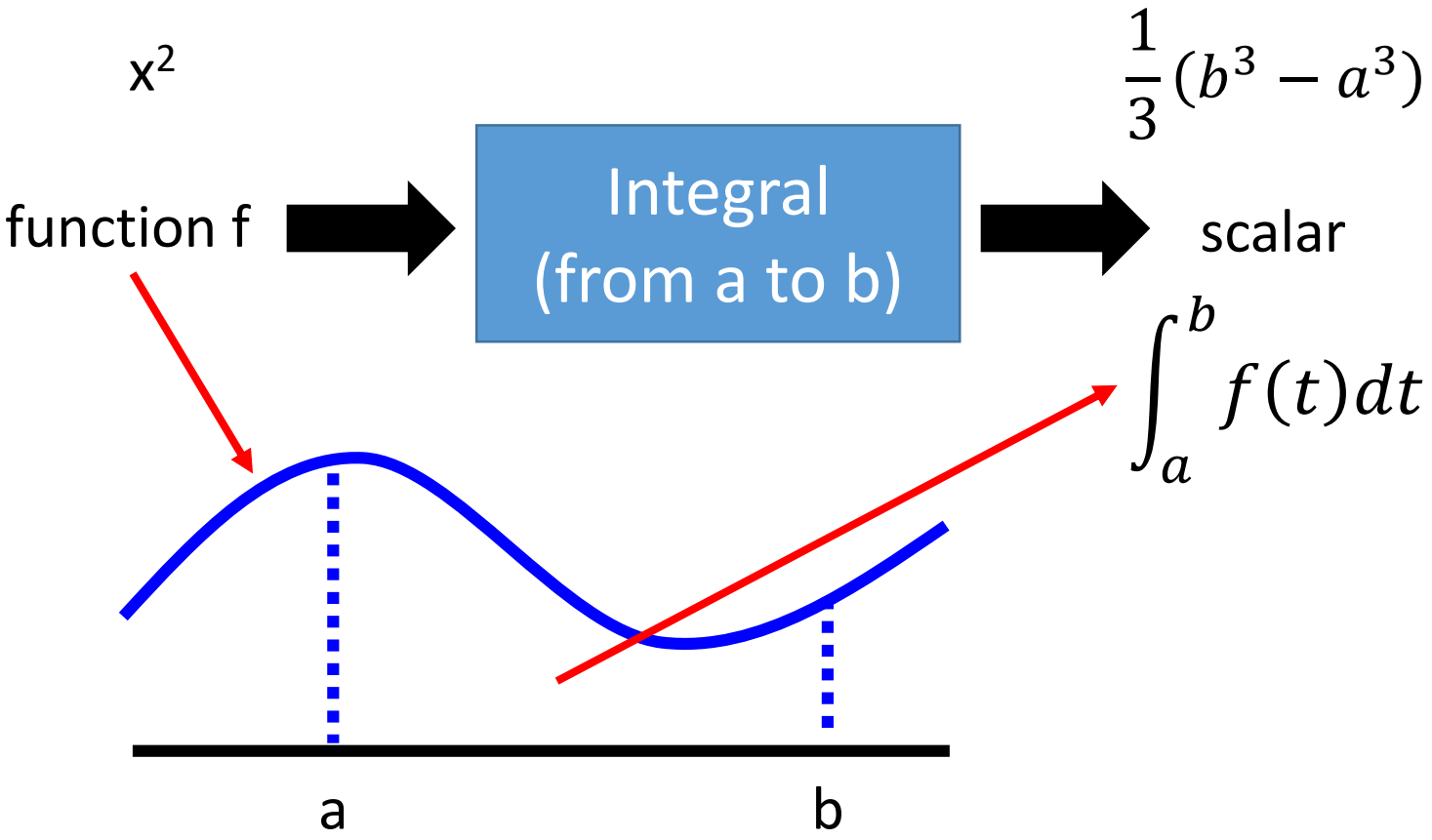
3x

$f + g \to f' + g'$

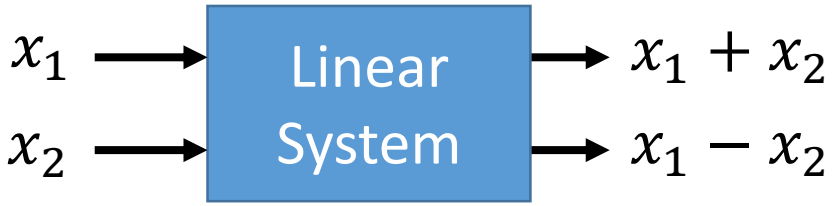
3

Linear?

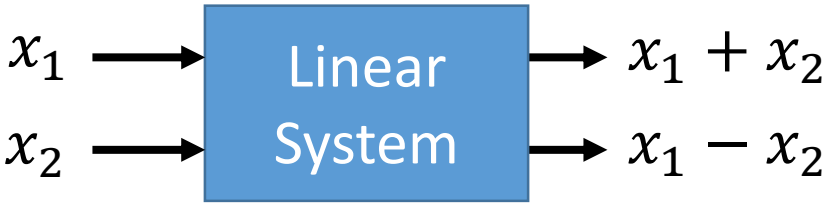
- Integral from a to b

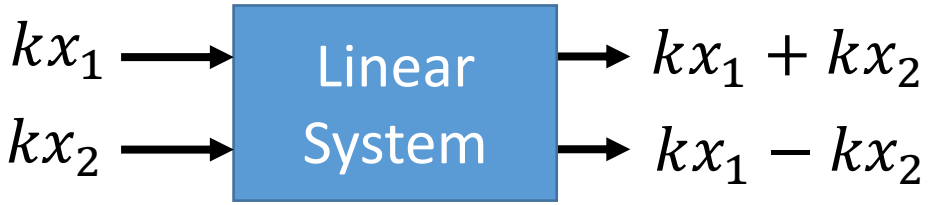


Linear System

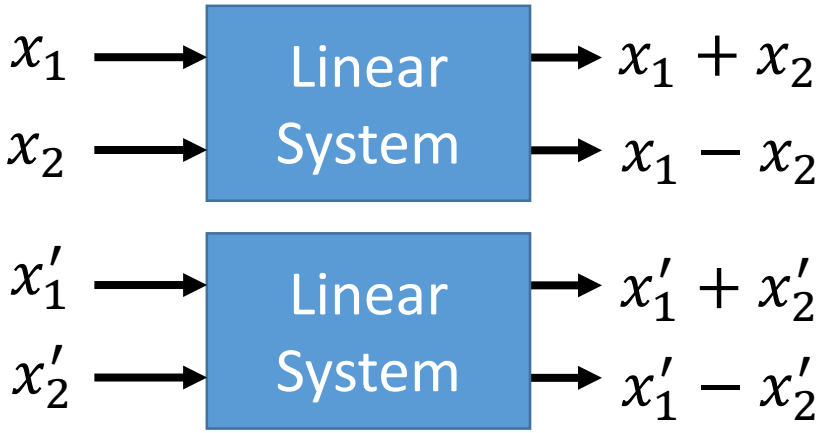


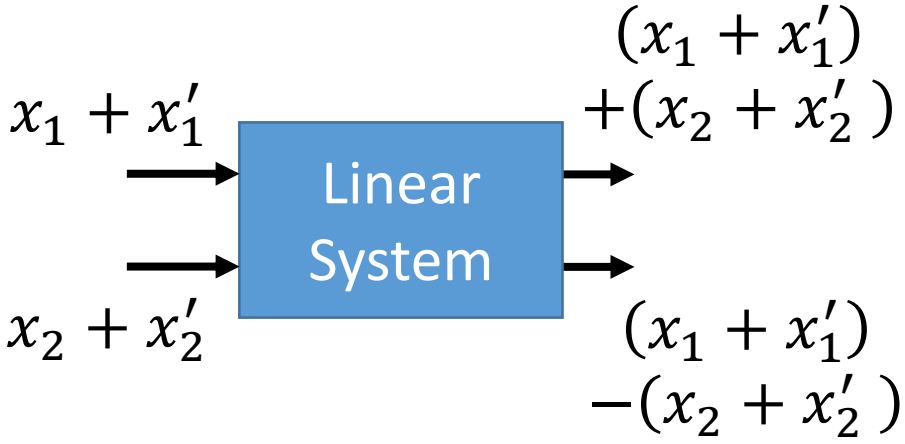
- Two properties
  - 1. Persevering Multiplication



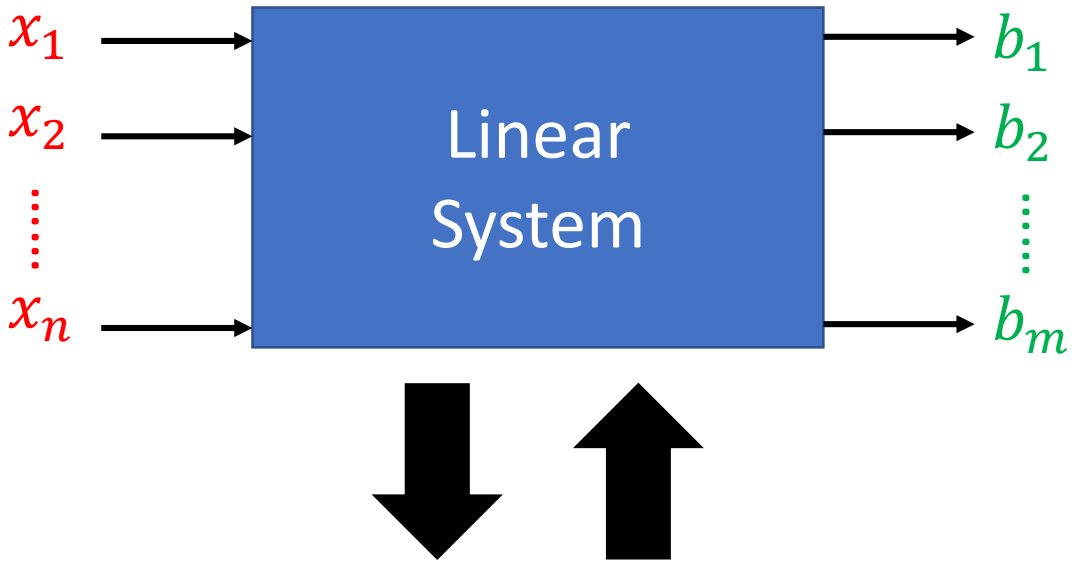


  - 2. Persevering Addition





Linear System v.s. System of Linear Equations

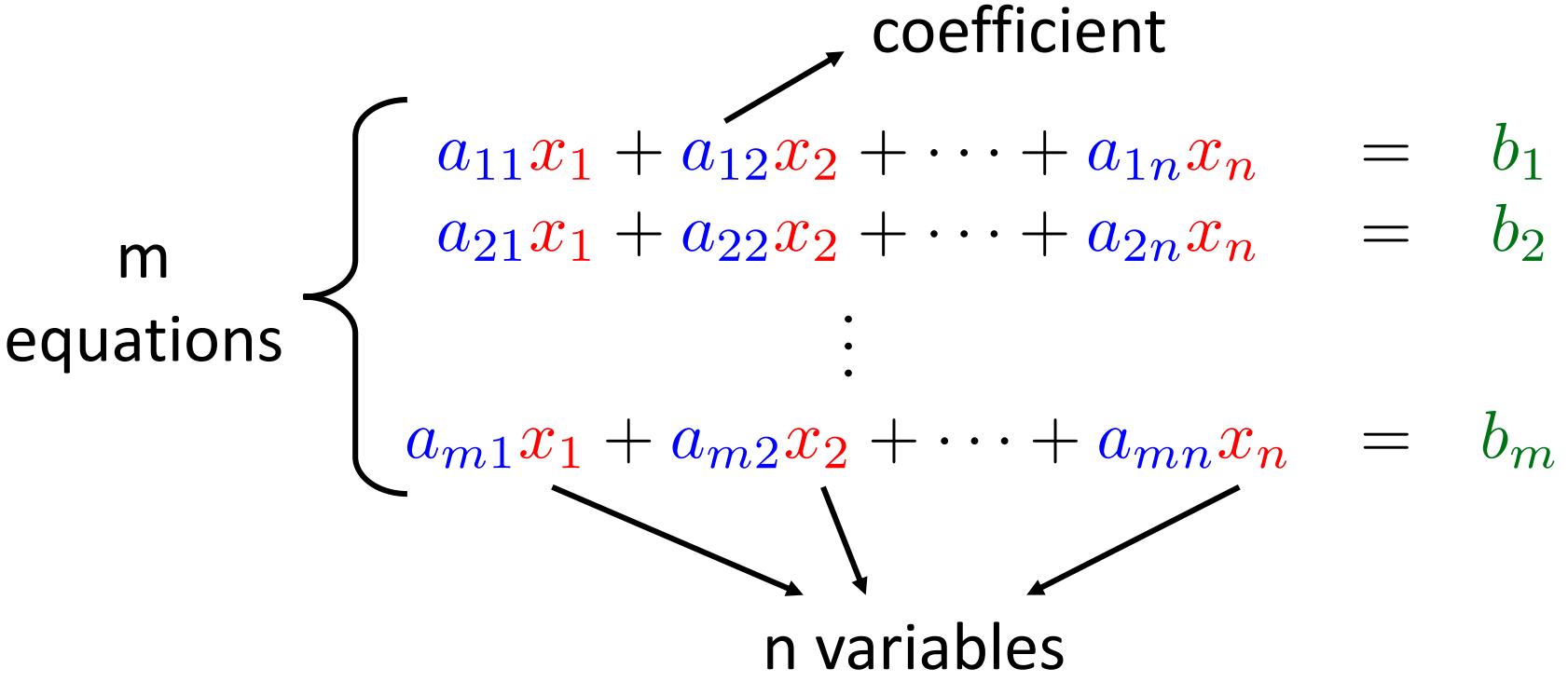


$$
\begin{aligned}
a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n &= b_1 \\
a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n &= b_2 \\
&\vdots \\
a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n &= b_m
\end{aligned}
$$

System of Linear Equations

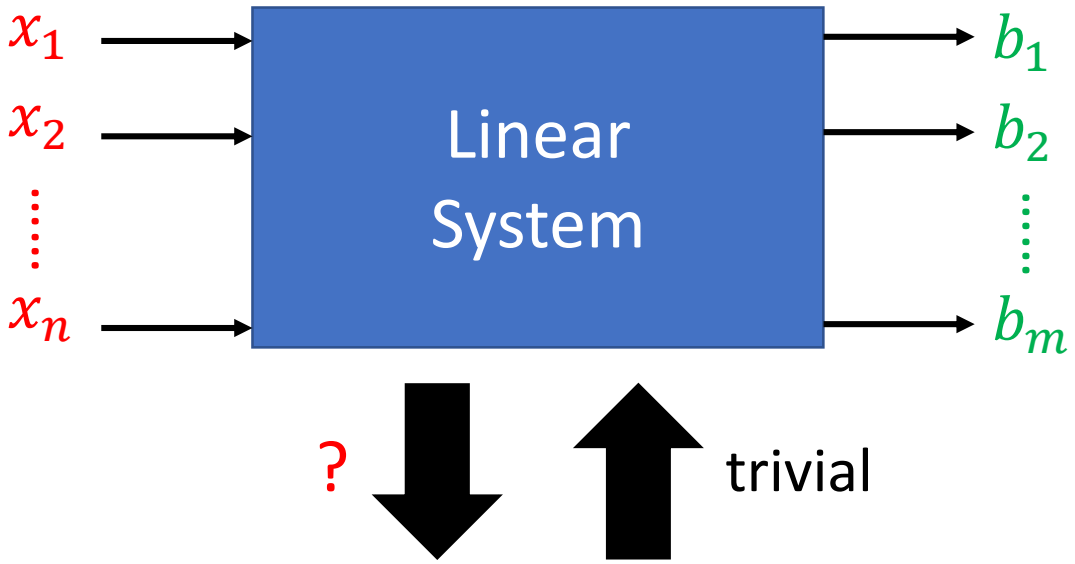
多元一次聯立方程式

- I believe you know it.



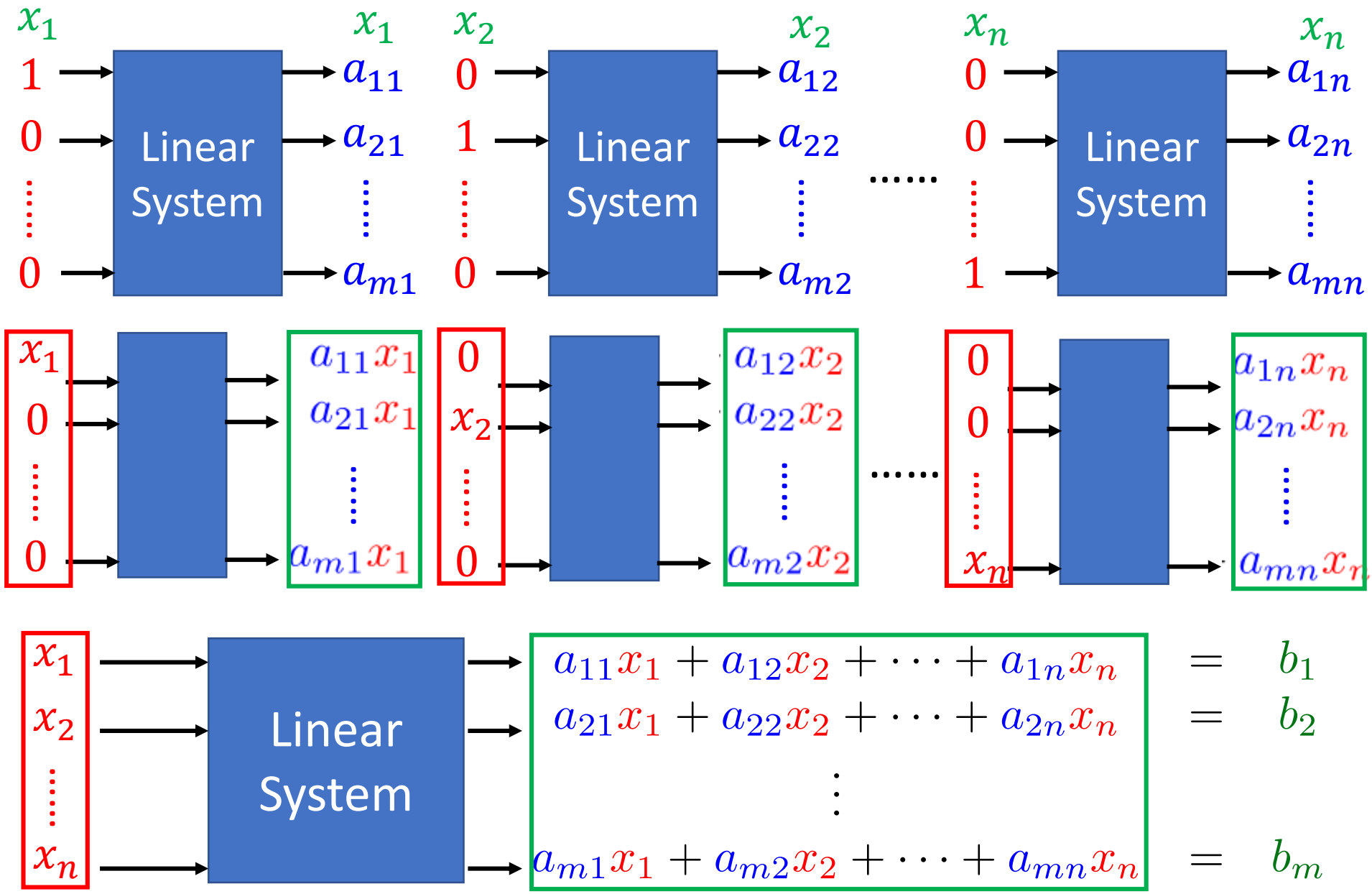
In this course, m and n can be large

Linear System v.s. System of Linear Equations



$$
\begin{aligned}
a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n &= b_1 \\
a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n &= b_2 \\
&\vdots \\
a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n &= b_m
\end{aligned}
$$

k k k k

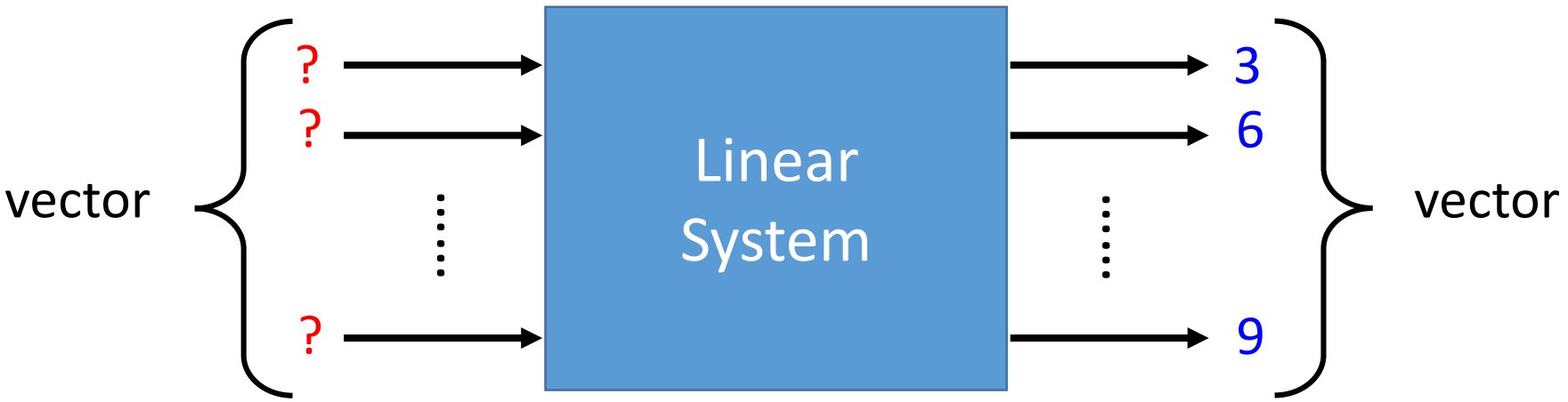


A linear system is described by a system of linear equations

What are we going to learn?

Chapter 1, Chapter 2, Chapter 3

Beyond vector in Chapter 6



Does it have solution?

Does it have unique solution?

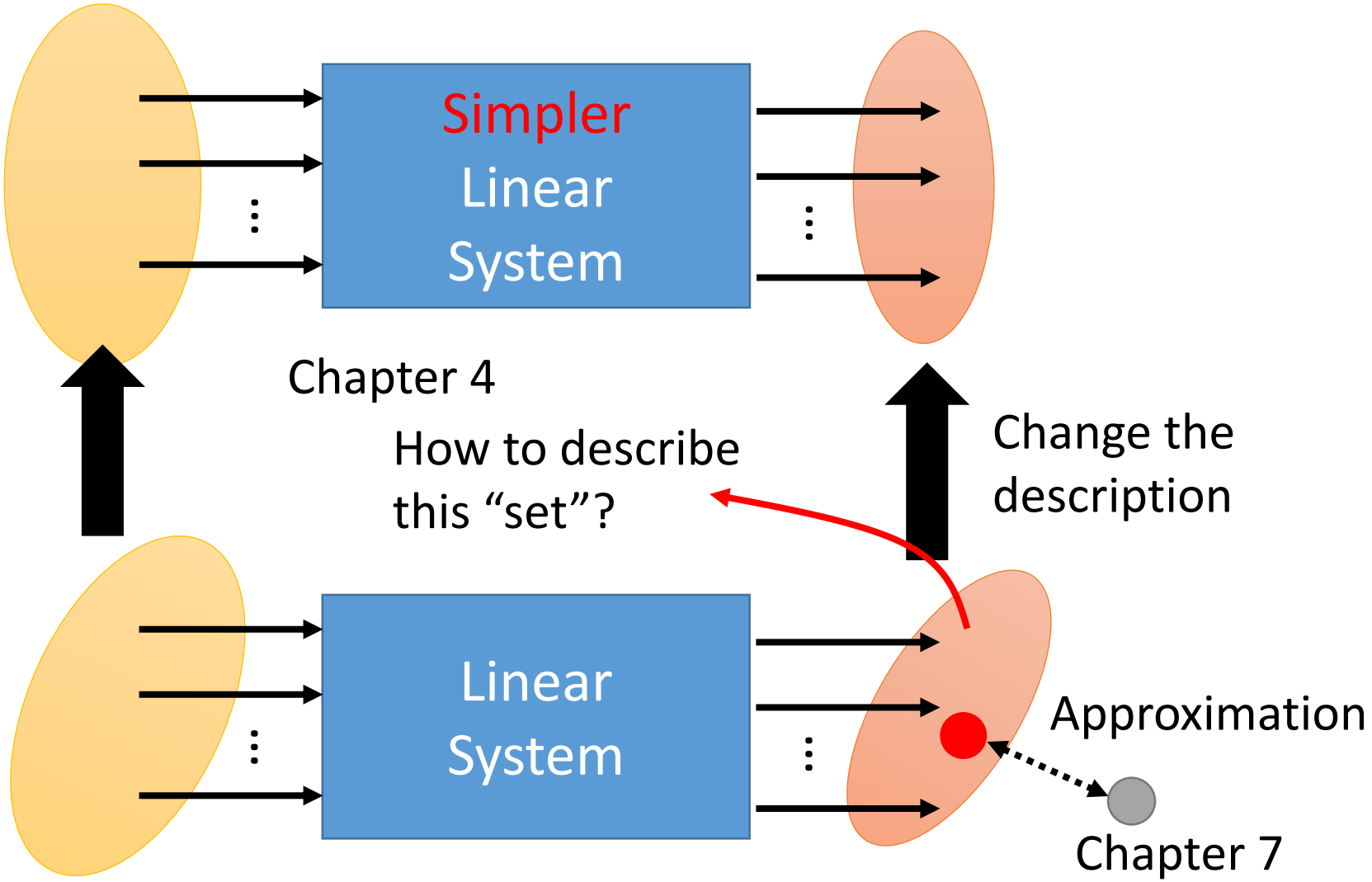
How to find the solution?

Determinants (行列式)

Beyond 3 X 3

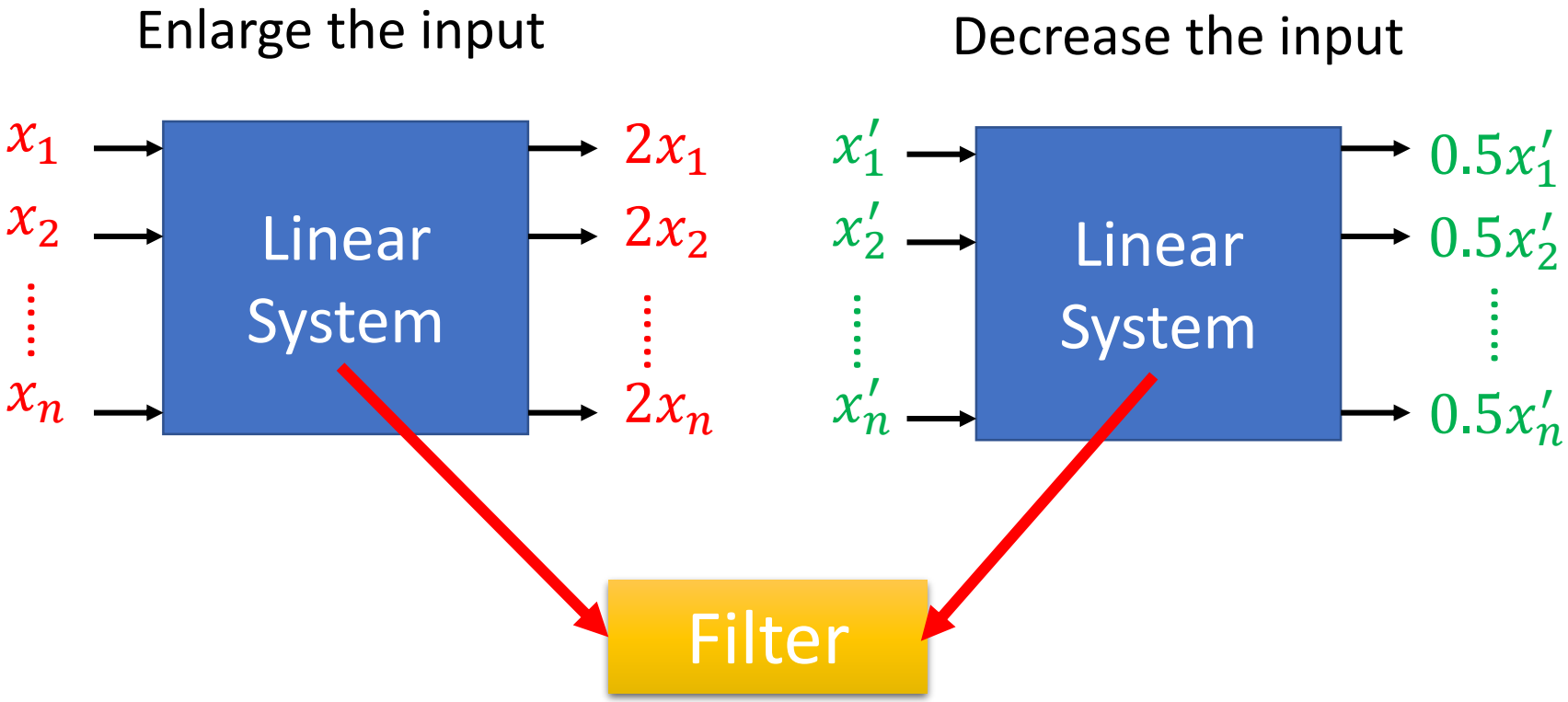
Different view from high school

What are we going to learn?



What are we going to learn?

- Chapter 5: EigenXXX

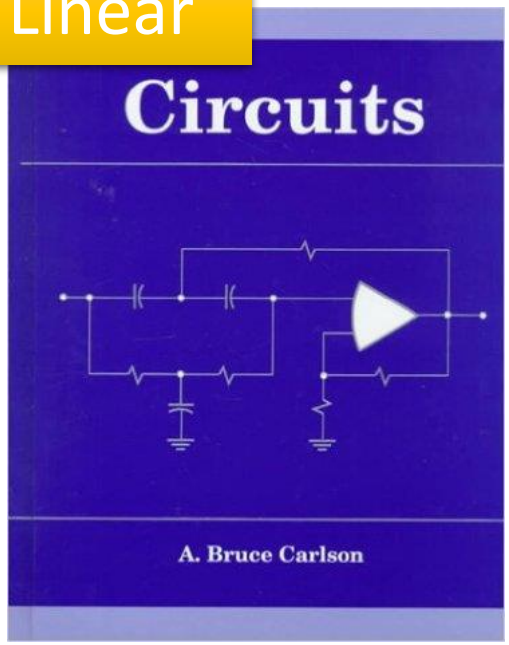


Application

Applications

Most system are (assumed to) be linear

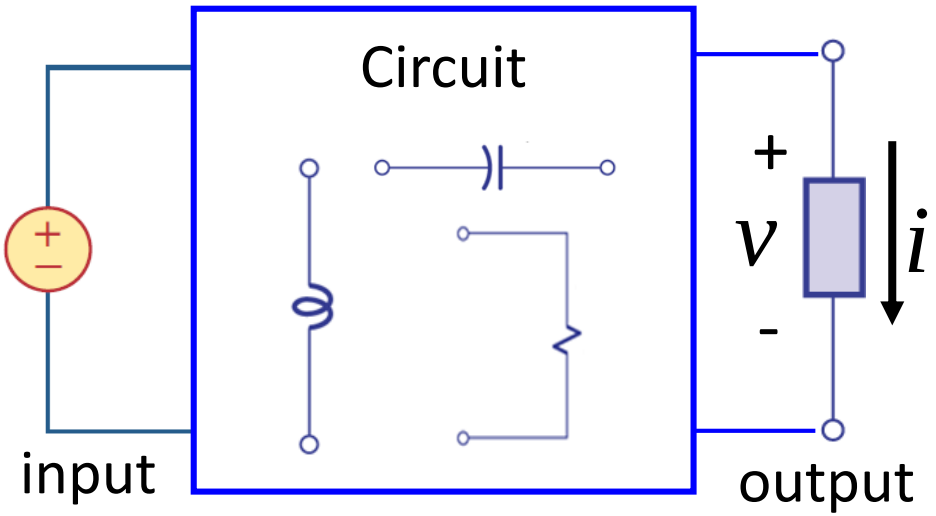
Linear



(大一必修)

Input: voltage source, current source

output: voltage and current on the load (燈泡、引擎)

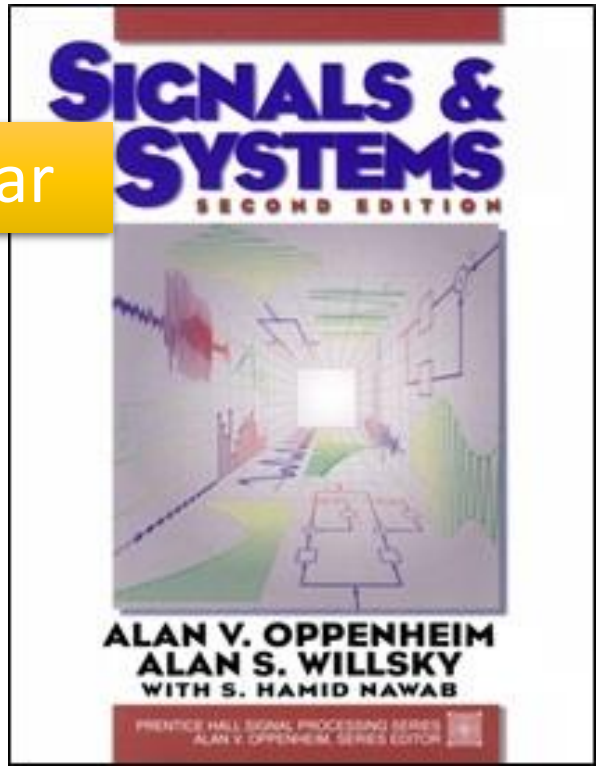


Linear System

Applications

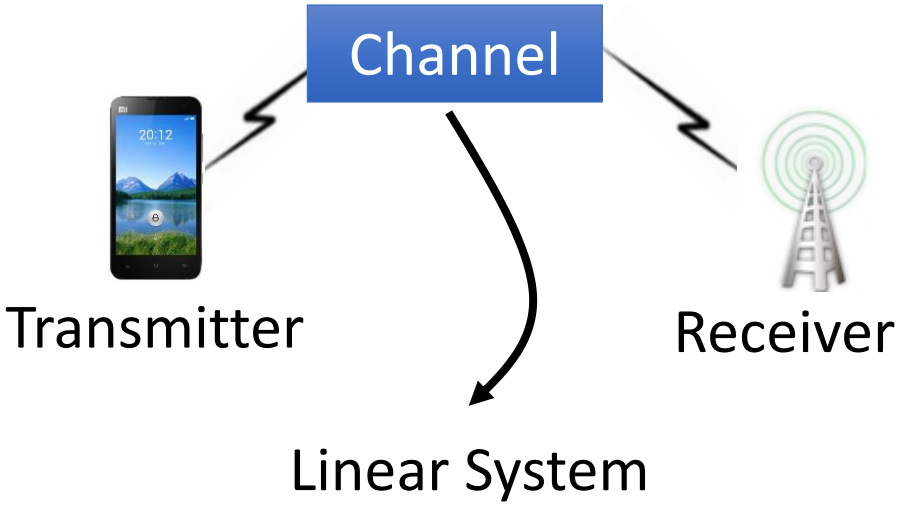
Most system are (assumed to) be linear

Linear

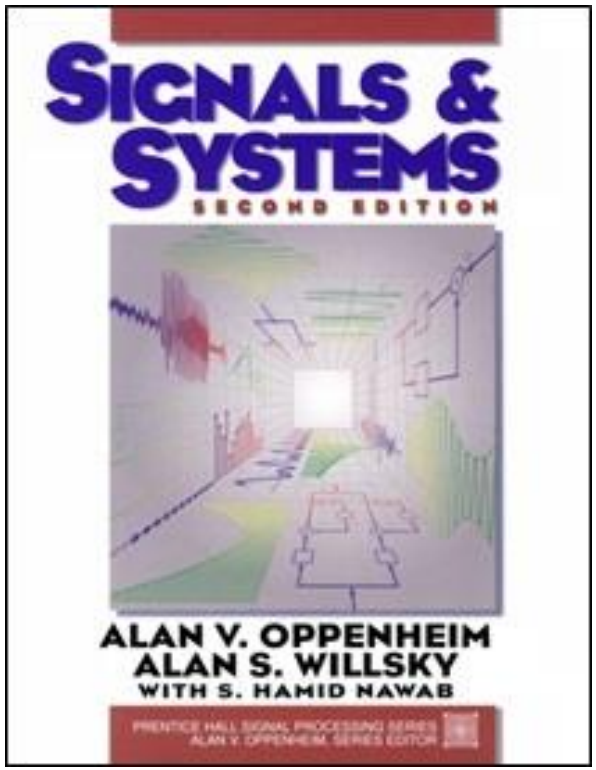


(大二必修)

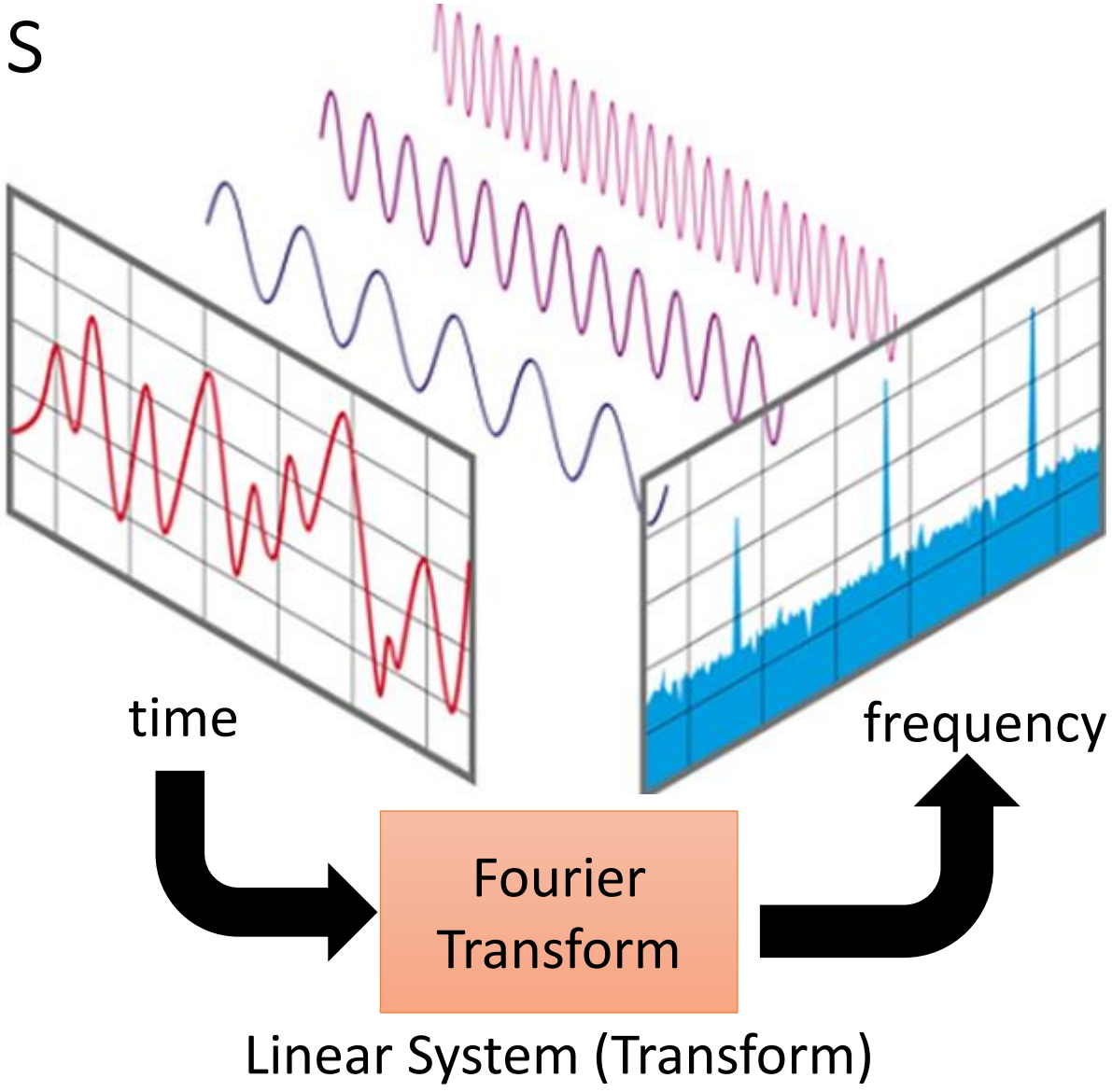
Communication System



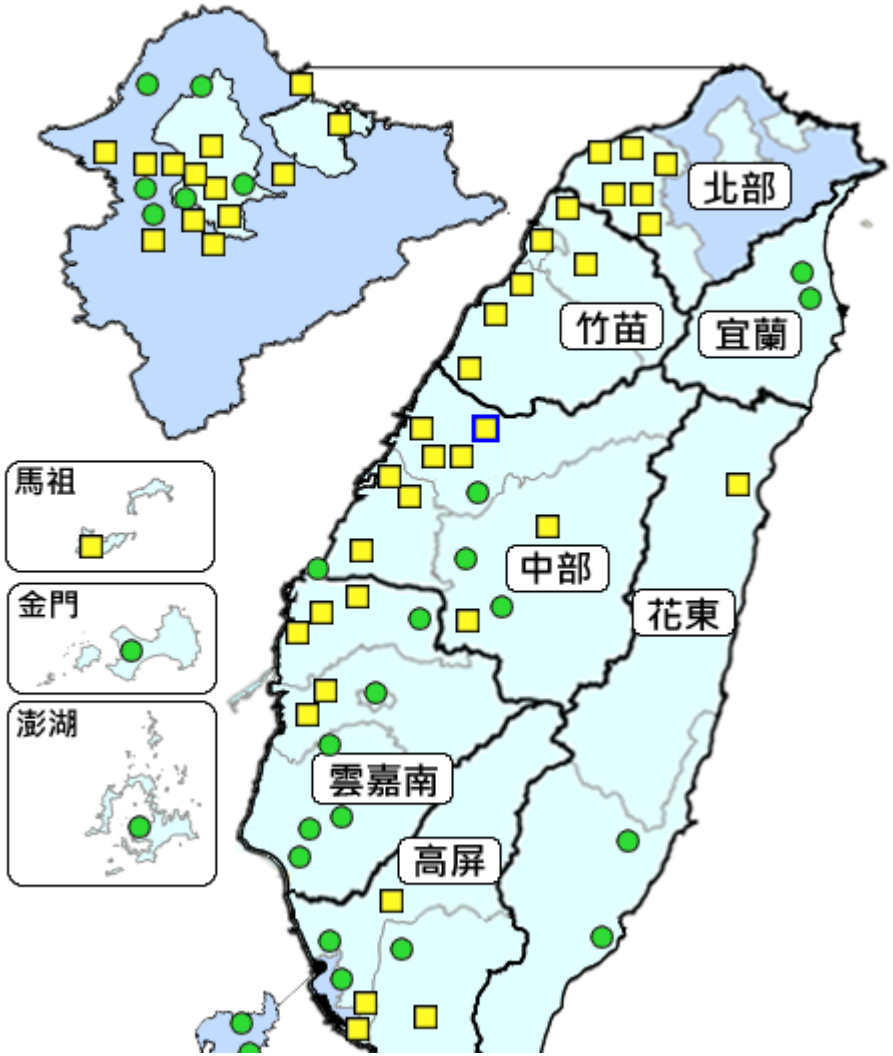
Applications



(大二必修)



Applications



預測豐原站在下一個小時會觀測到的 PM2.5

地區： 中部 > 豐原 查詢

發布時間： 2017-09-29 08:00:00

豐原 (一般站)

AQI			64
空氣品質指標			普通
	O_3 (ppb) 臭氧	8小時 移動平均	17
		小時 濃度	14
◎	$PM_{2.5}$ ($\mu g/m^3$) 細懸浮微粒	移動 平均	21
		小時 濃度	27
	PM_{10} ($\mu g/m^3$) 懸浮微粒	移動 平均	35
		小時 濃度	44

Applications

y: A 年 B 月 C 日 N 時的 PM2.5

x_K: A 年 B 月 C 日 N – K 時的 PM2.5 觀測值

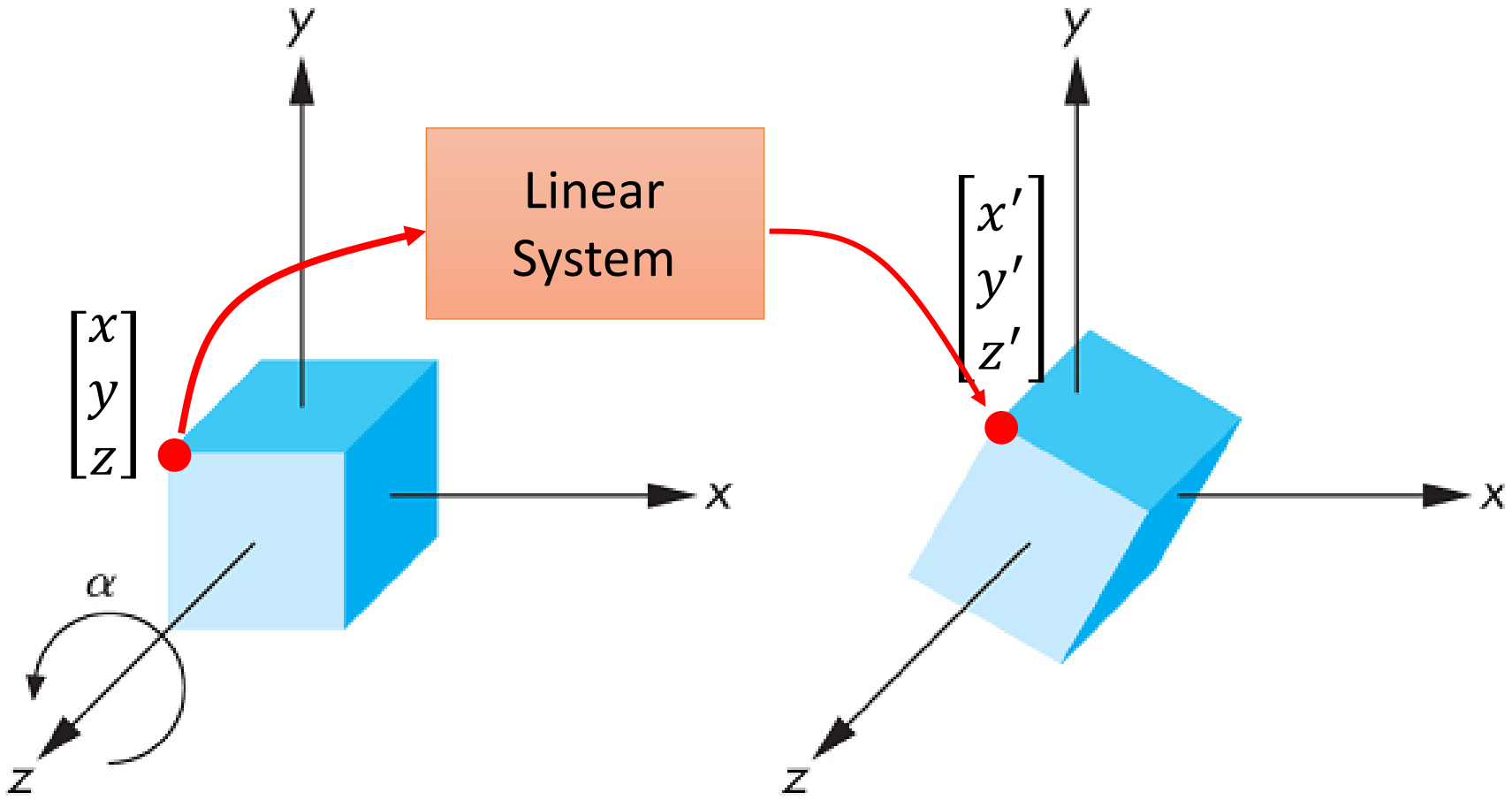
Linear system

$$y = w_1x_1 + w_2x_2 + w_3x_3$$

Where do w1, w2 and w3 come from?

Applications - Computer Graphics

Section 7.9 of Textbook



http://www.c-jump.com/bcc/common/Talk3/Math/Matrices/Matrices.html

Applications

P336 of Textbook

http://incomebully.com/does-pr-pagerank-still-matter/

Google 台灣大學

全部 地圖 圖片 新聞 影片 更多 搜尋工具

約有 5,160,000 項結果 (搜尋時間：1.01 秒)

國立臺灣大學
www.ntu.edu.tw/
包含學校簡介、系所介紹、校園資訊。成立於1928年，前身為臺北帝國大學。1945年更名為臺灣大學。
您已造訪這個網頁 3 次。上次造訪日期：2016/5/1

ntu.edu.tw 內容的搜尋結果

招生資訊
碩士班招生 - 學士班轉學考 - 碩士班甄試入學 - ...

學術單位
文學院 - 工學院 - 理學院 - 生物資源暨農學院 - ...

資訊網路與多媒體研究所
碩士班 - 本所成員 - 碩士班修業規定 - 課程介紹 - ...

圖書館
館藏資源 - 電子資源 - 資料庫 - 開放時間 - 學生 - ...

myNTU臺大人入口網
... 計中帳號登入！ SSO1.3. 登入 · ※ 預防帳號遭盜用，請定期修改 ...

國立臺灣大學學士班轉學考試
招生名額及科目 一般生(不招收陸生)陸生(限在臺就讀). 預定日程 一 ...

國立臺灣大學- 維基百科，自由的百科全书
https://zh.wikipedia.org/zh-tw/國立臺灣大學
國立臺灣大學，簡稱臺灣大學、臺大，乃臺灣最早的現代綜合大學，前身是於1928年創立的臺北帝國大學，籌設之初定位為只辦醫學和農學的實業大學，伊澤多喜男力排 ...

國立臺灣大學National Taiwan University - Facebook
www.facebook.com › Places › Taipei, Taiwan › Landmark
★★☆☆☆ 評分：1.8 - 11,822 票
國立臺灣大學National Taiwan University, Taipei, Taiwan. 37715 likes · 1580 talking about this · 175196 were here. 國立臺灣大學粉絲專頁.

Linear Algebra is Important