

What are  
we going to learn?

李宏毅

Hung-yi Lee

# System

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

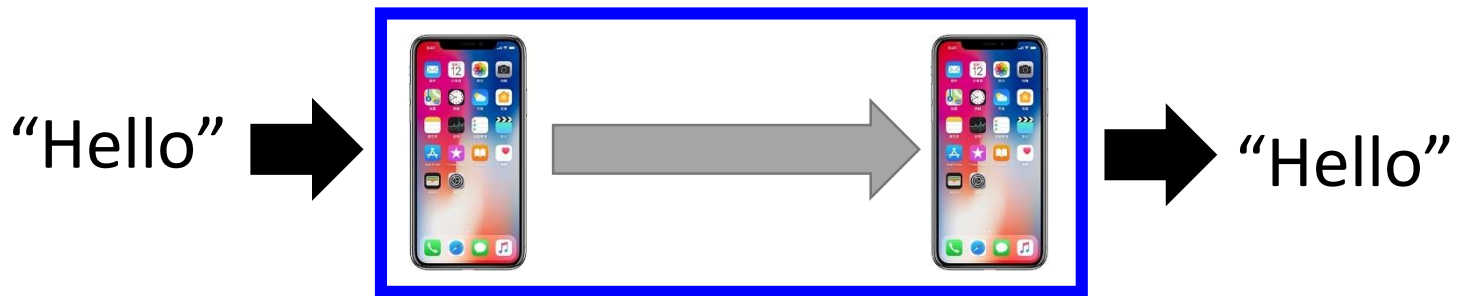
## Speech Recognition System



## Dialogue System (e.g. Siri, Alexa)

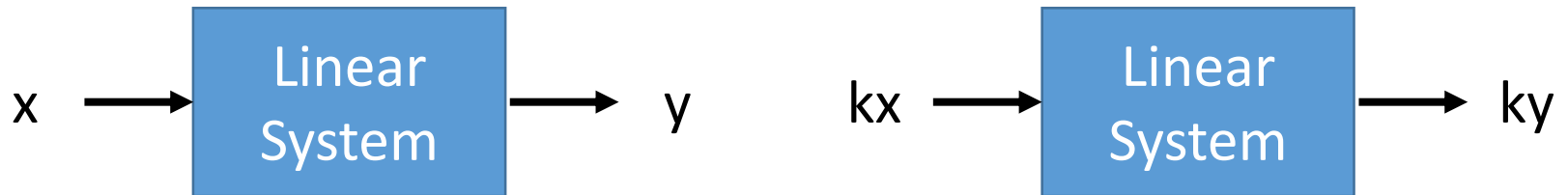


## Communication System

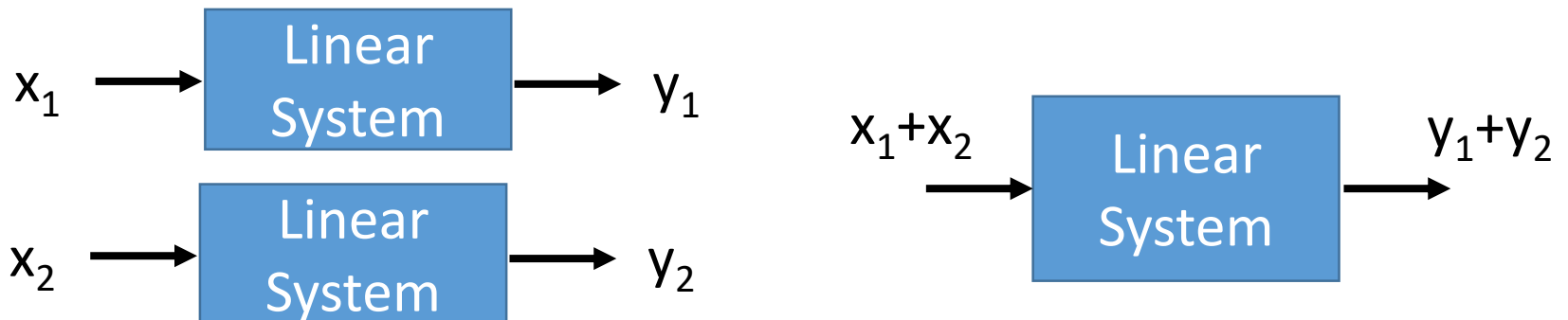


# Linear System

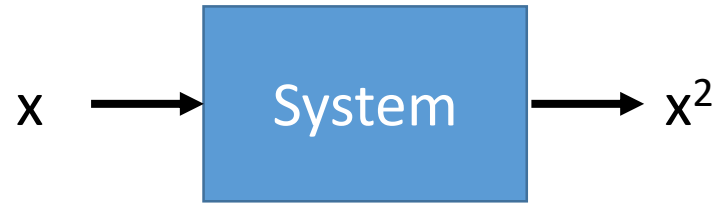
- Linear system have two properties
  - 1. Persevering Multiplication



- 2. Persevering Addition

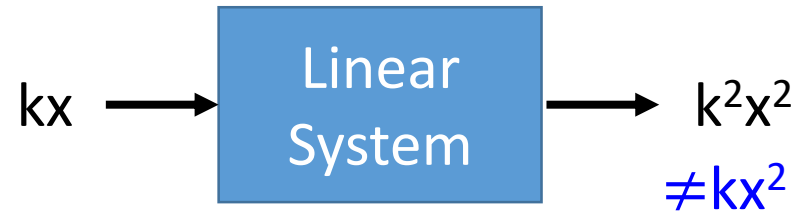
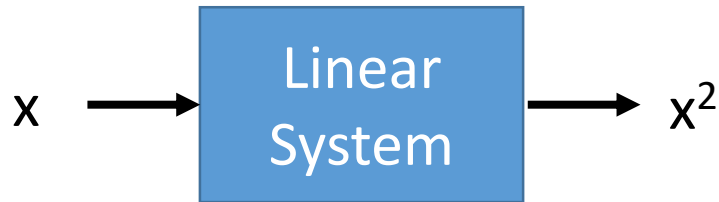


# Linear System

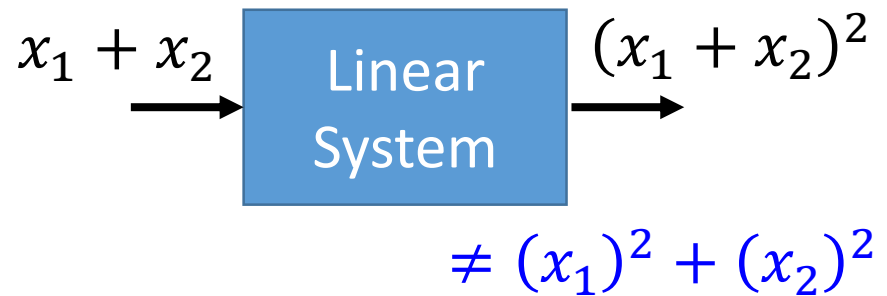
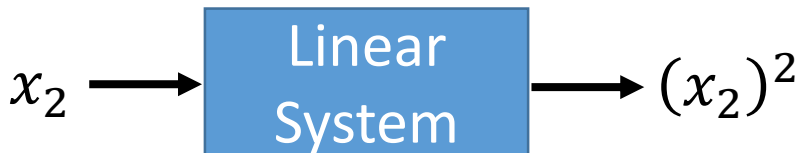
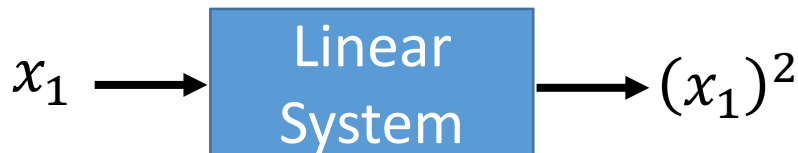


- Linear system have two properties

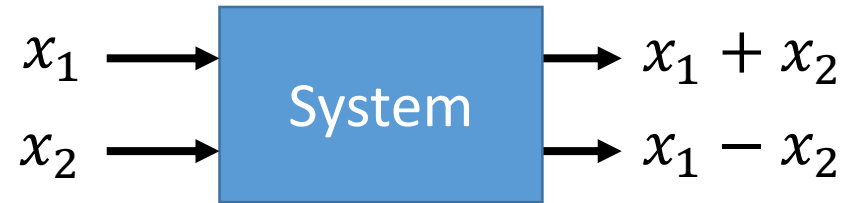
- 1. Persevering Multiplication



- 2. Persevering Addition

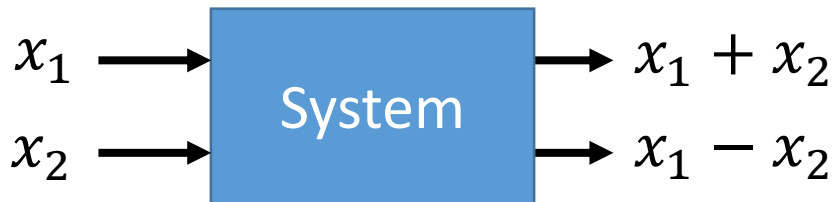


# Linear System

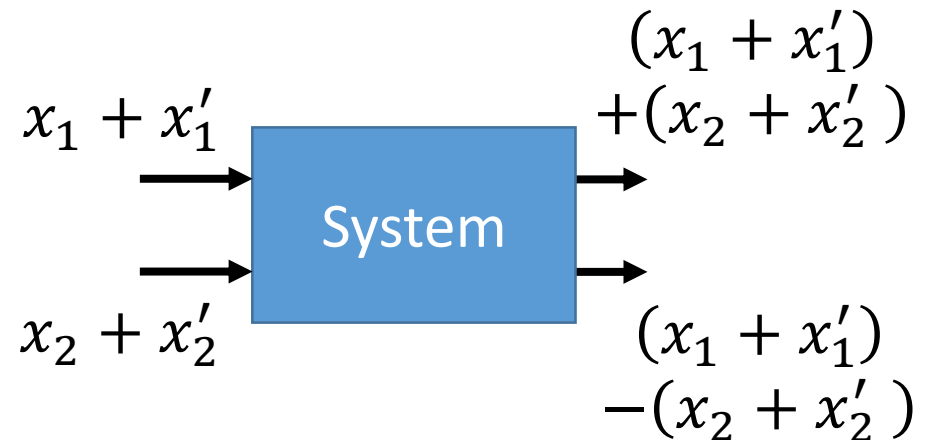
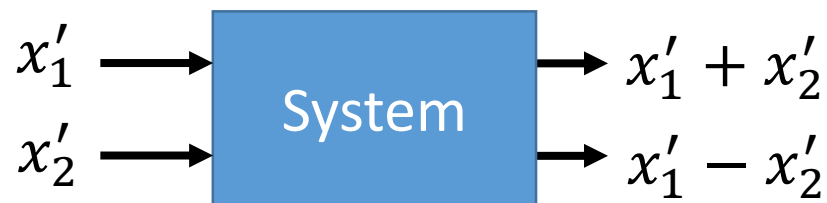
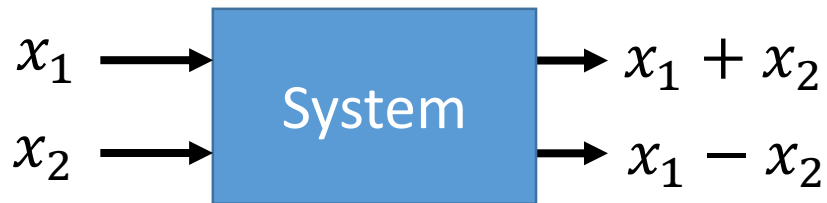


- Two properties

- 1. Persevering Multiplication



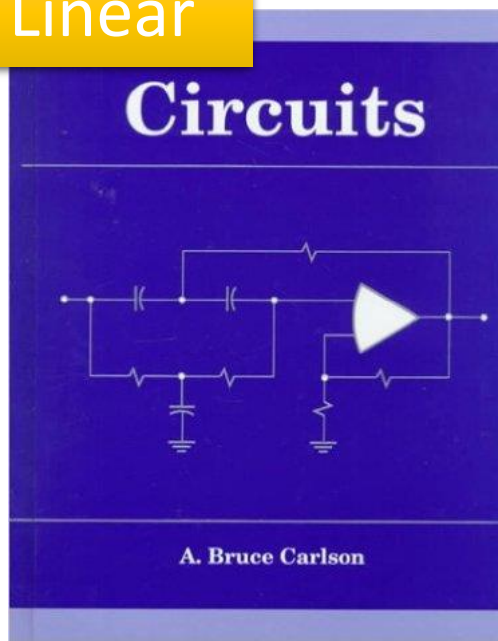
- 2. Persevering Addition



# Applications

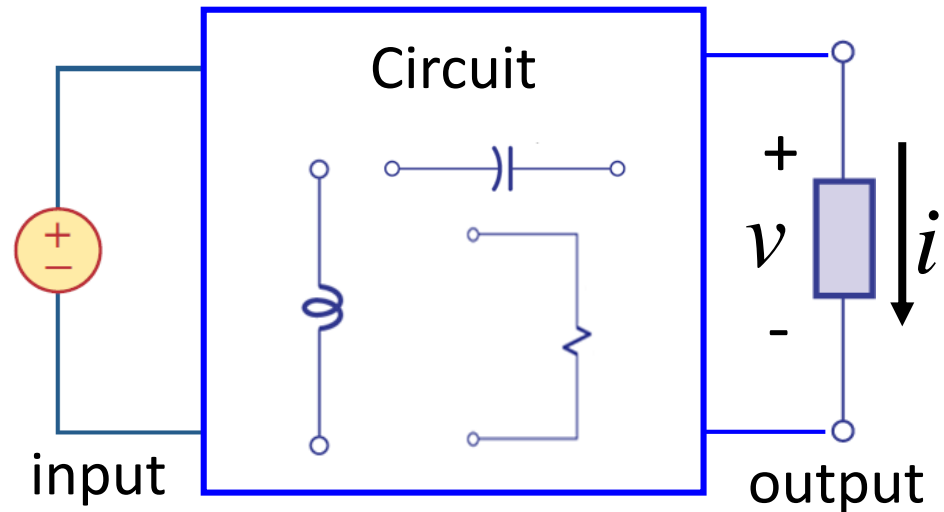
Most system are (assumed to) be linear

Linear



(大一必修)

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

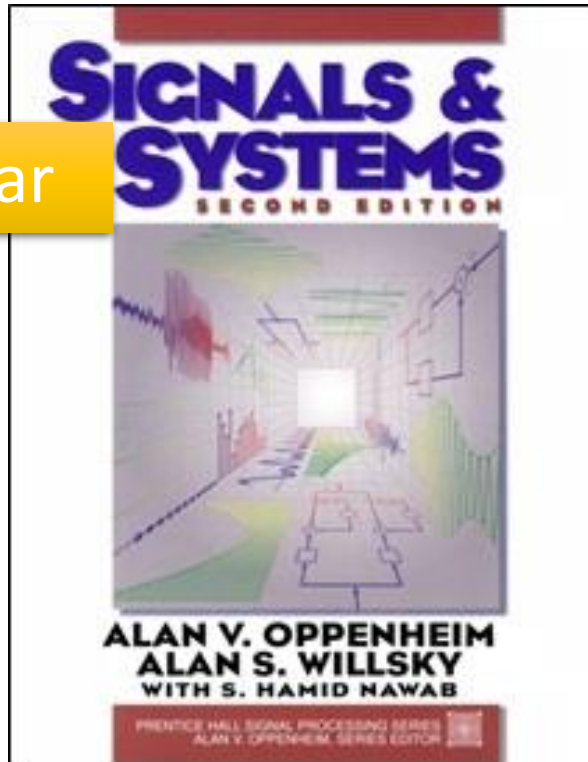


Linear System

# Applications

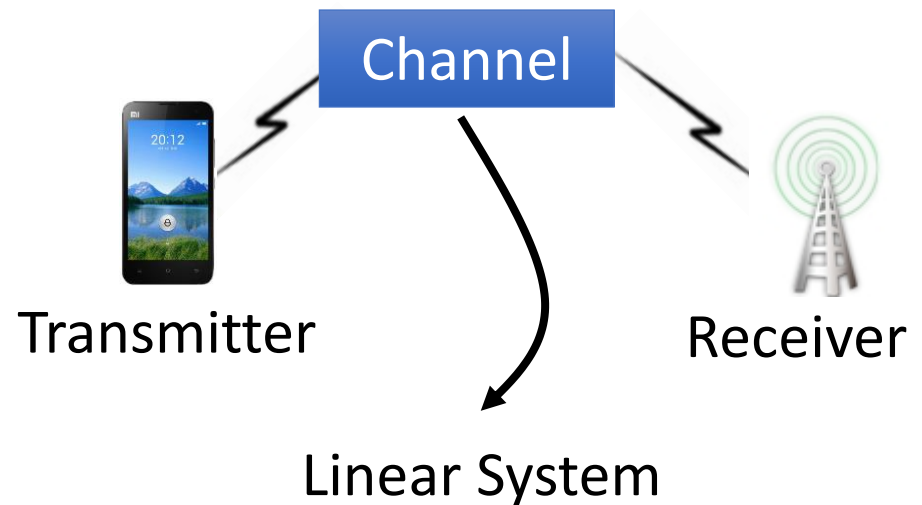
Most system are (assumed to) be linear

Linear

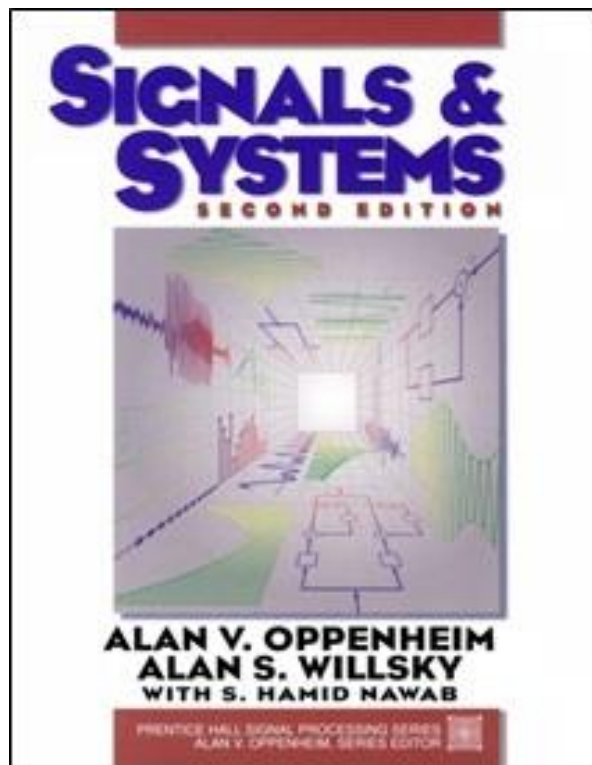


(大二必修)

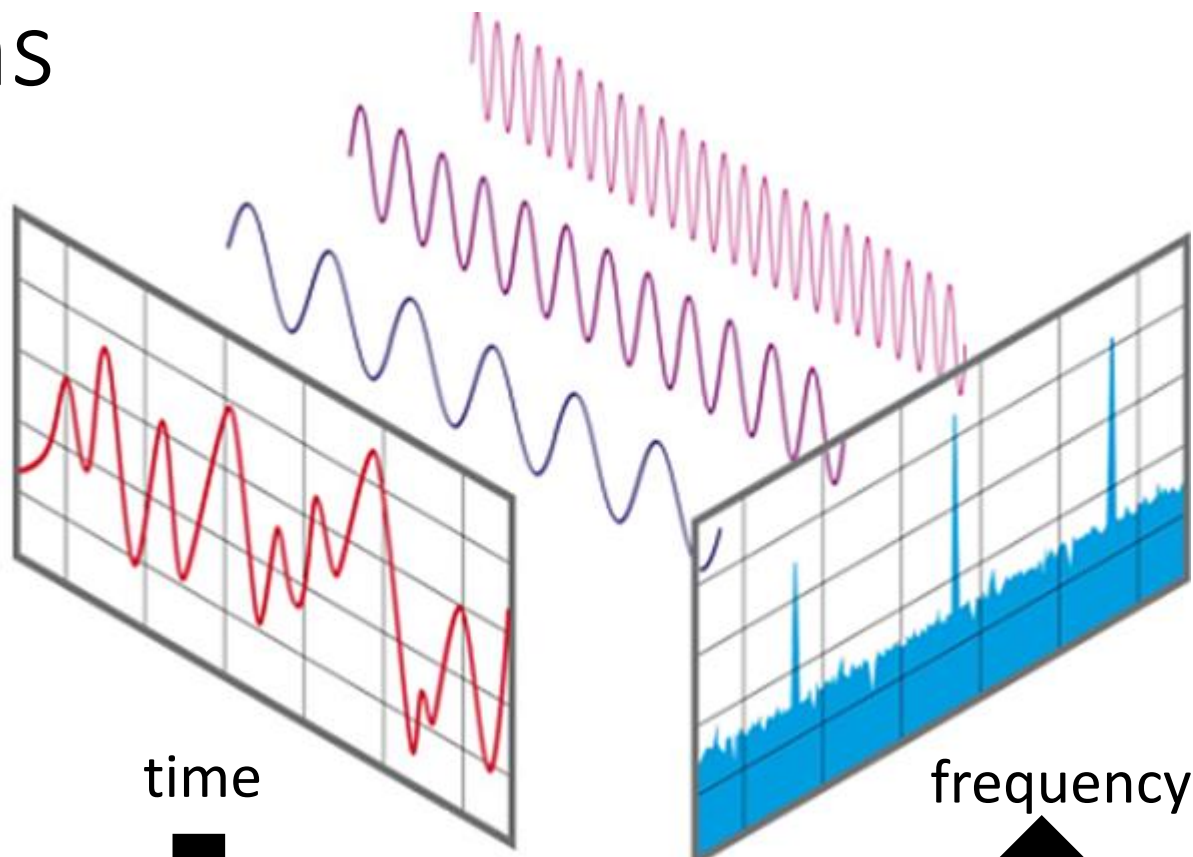
## Communication System



# Applications



(大二必修)



time

frequency

Fourier  
Transform

Linear System (Transform)

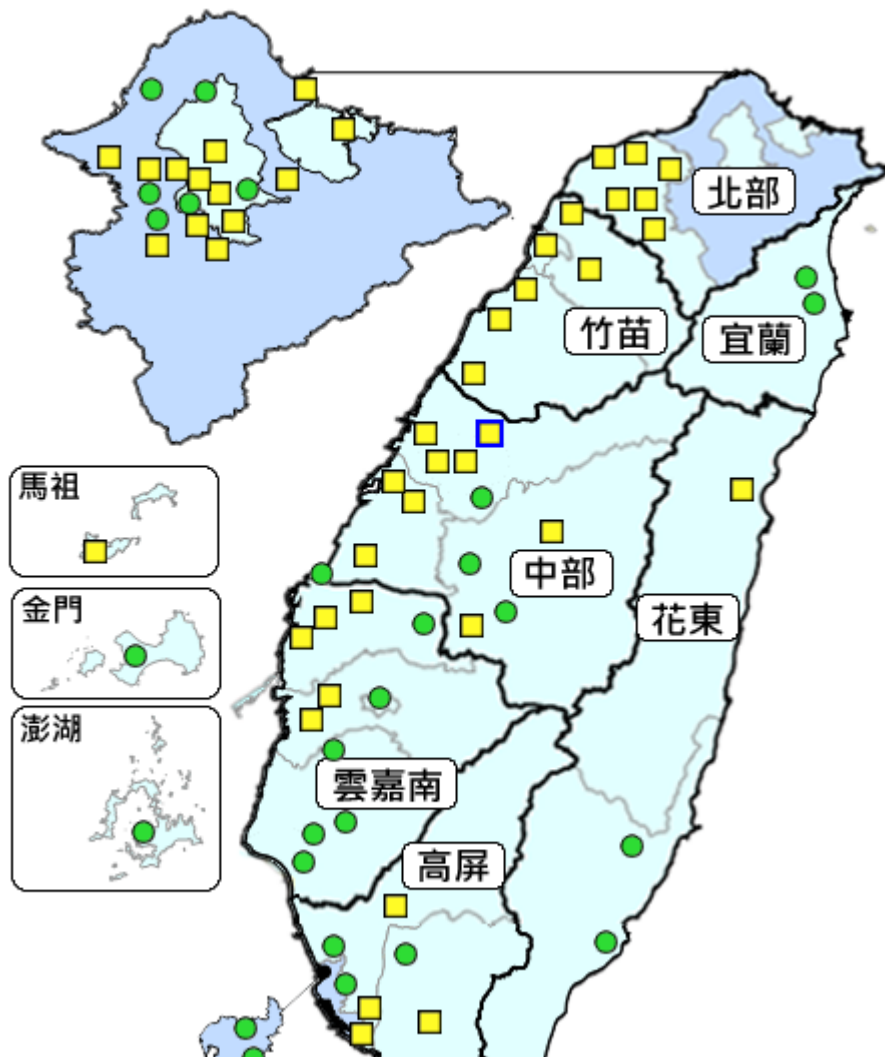


# Applications

預測豐原站在下一個小時  
會觀測到的 PM2.5

地區：  >

發布時間：2017-09-29 08:00:00



## 豐原 (一般站)

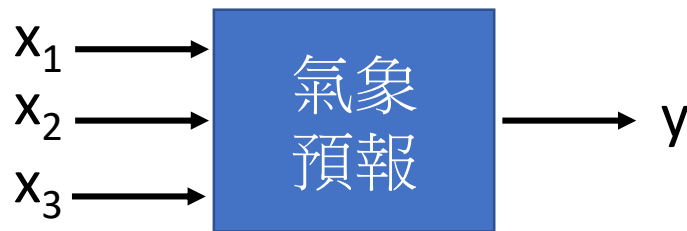
**AQI** **64**  
空氣品質指標 **普通**

O <sub>3</sub> (ppb) 臭氧	8小時 移動平均	17
	小時 濃度	14
◎ PM <sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ) 細懸浮微粒	移動 平均	21
	小時 濃度	27
PM <sub>10</sub> ( $\mu\text{g}/\text{m}^3$ ) 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  $w_1$ ,  $w_2$  and  $w_3$  come from?

全部 地圖 圖片 新聞 影片 更多 ▾ 搜尋工具

# Applications

P336 of Textbook

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/](http://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 - ...

### 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 - ...

### 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 ...

### 學術單位

文學院 - 工學院 - 理學院 - 生物資源暨農學院 - ...

### 圖書館

館藏資源 - 電子資源 - 資料庫 - 開放時間 - 學生 - ...

### 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 - ...

## 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](http://www.facebook.com) ▾ Places ▾ Taipei, Taiwan ▾ Landmark ▾

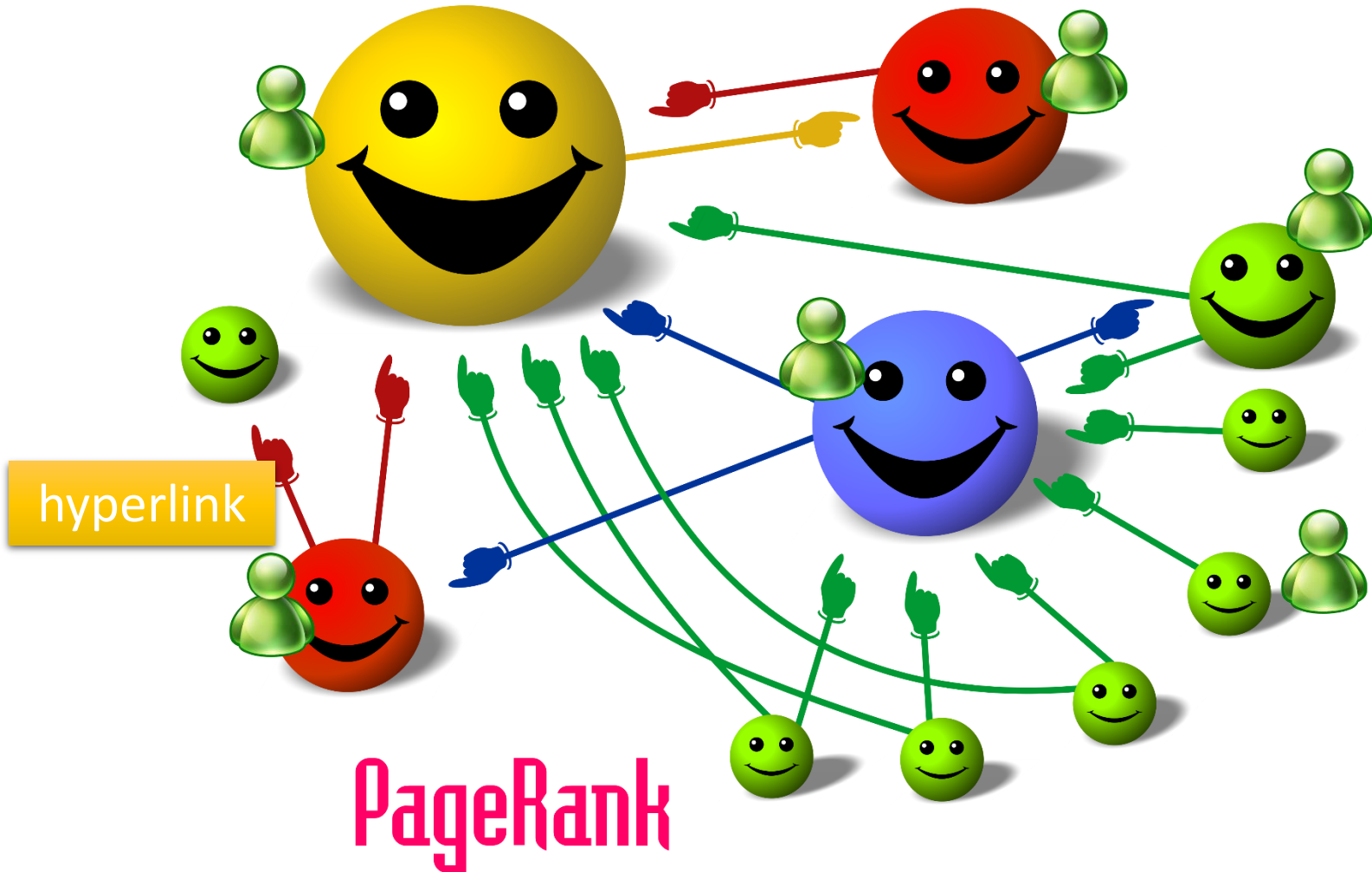
★★★★ 評分：1.8 - 11,822 票

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.

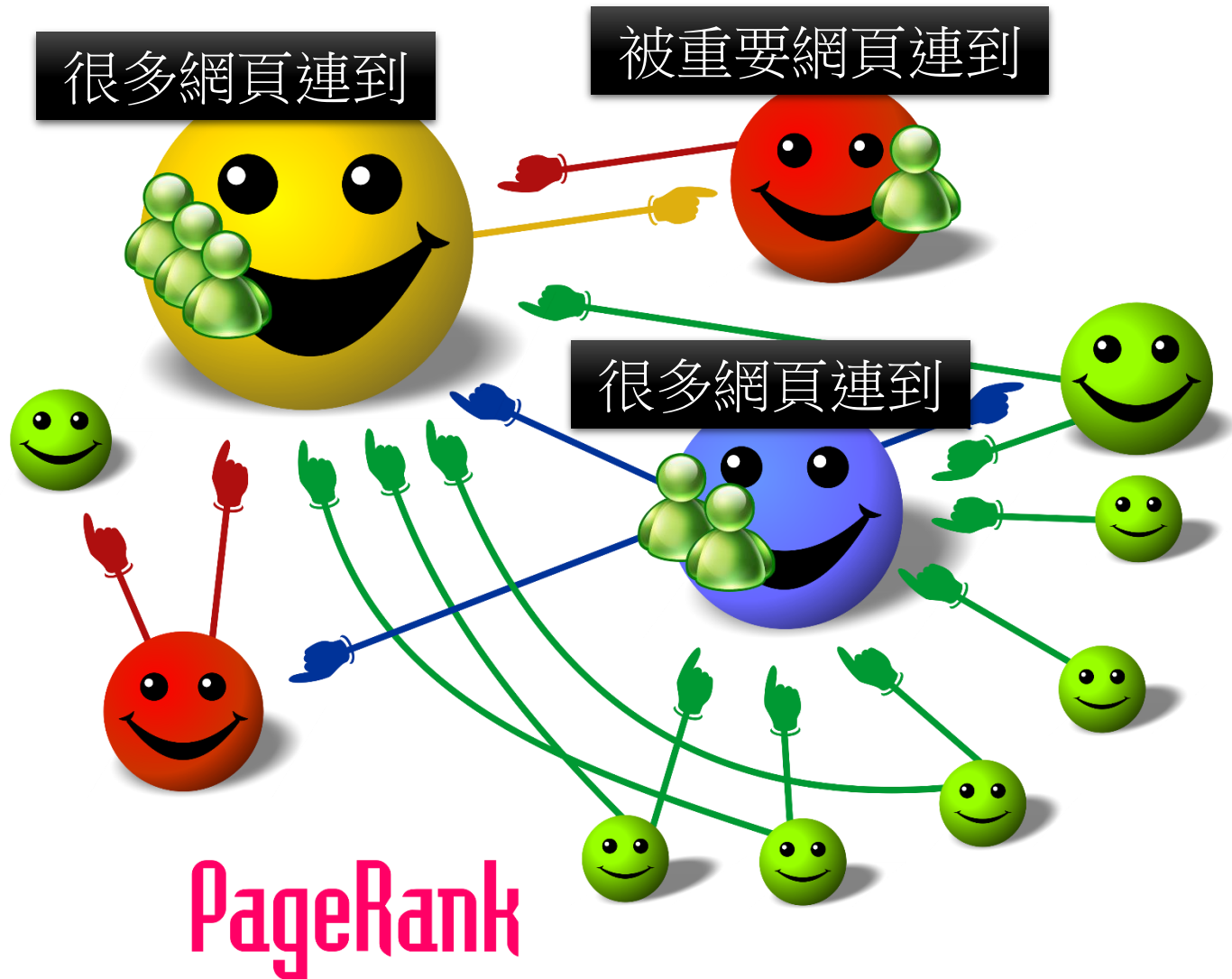


<http://incomebully.com/does-pr-pagerank-still-matter/>

# Applications - PageRank

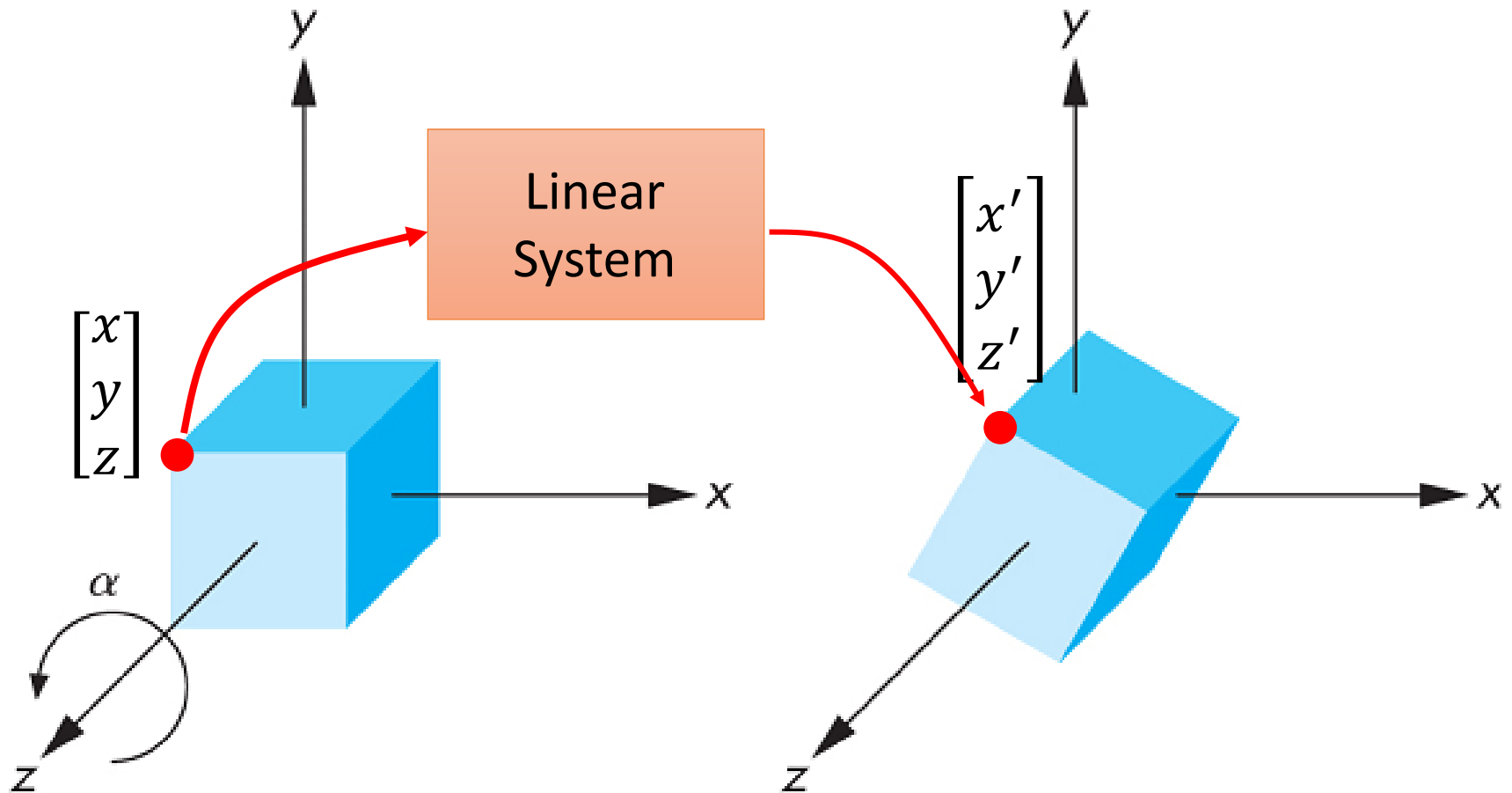


# Applications - PageRank



# Applications - Computer Graphics

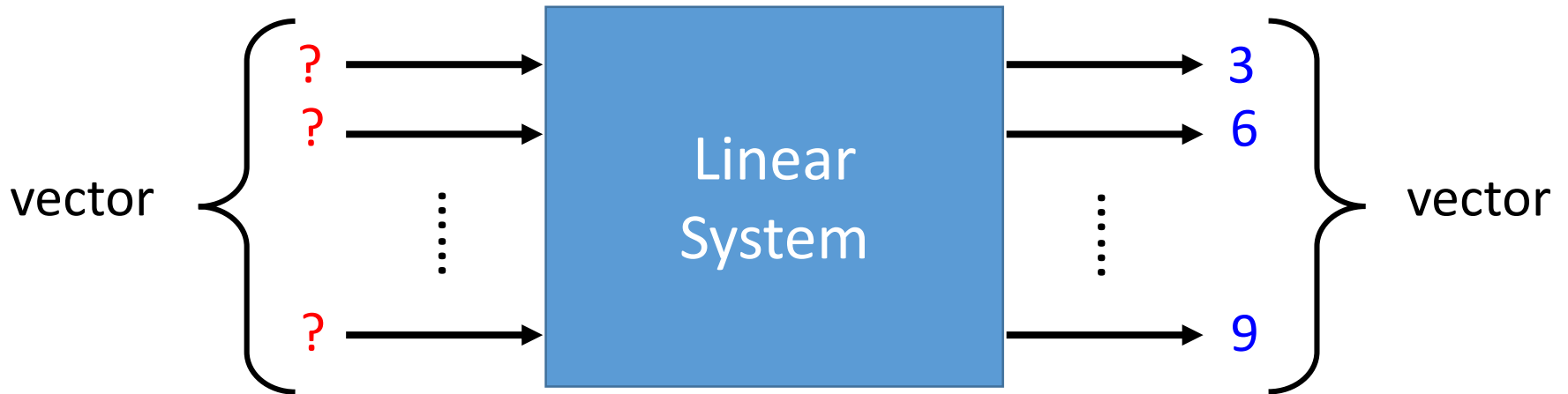
Section 7.9 of Textbook



# 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?

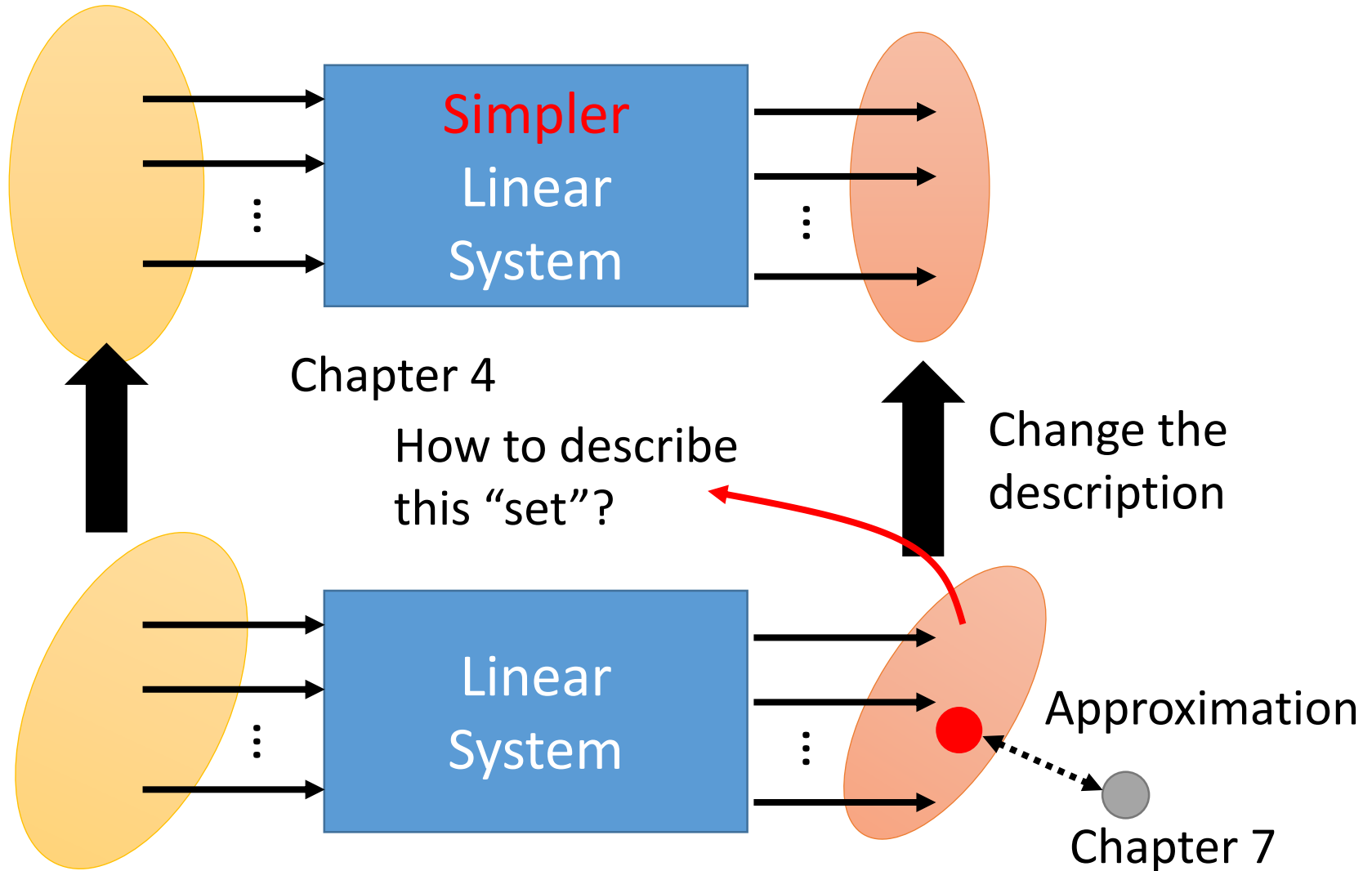
How to find  
the solution?

Determinants  
(行列式)

Beyond 3 X 3

Different view from high school

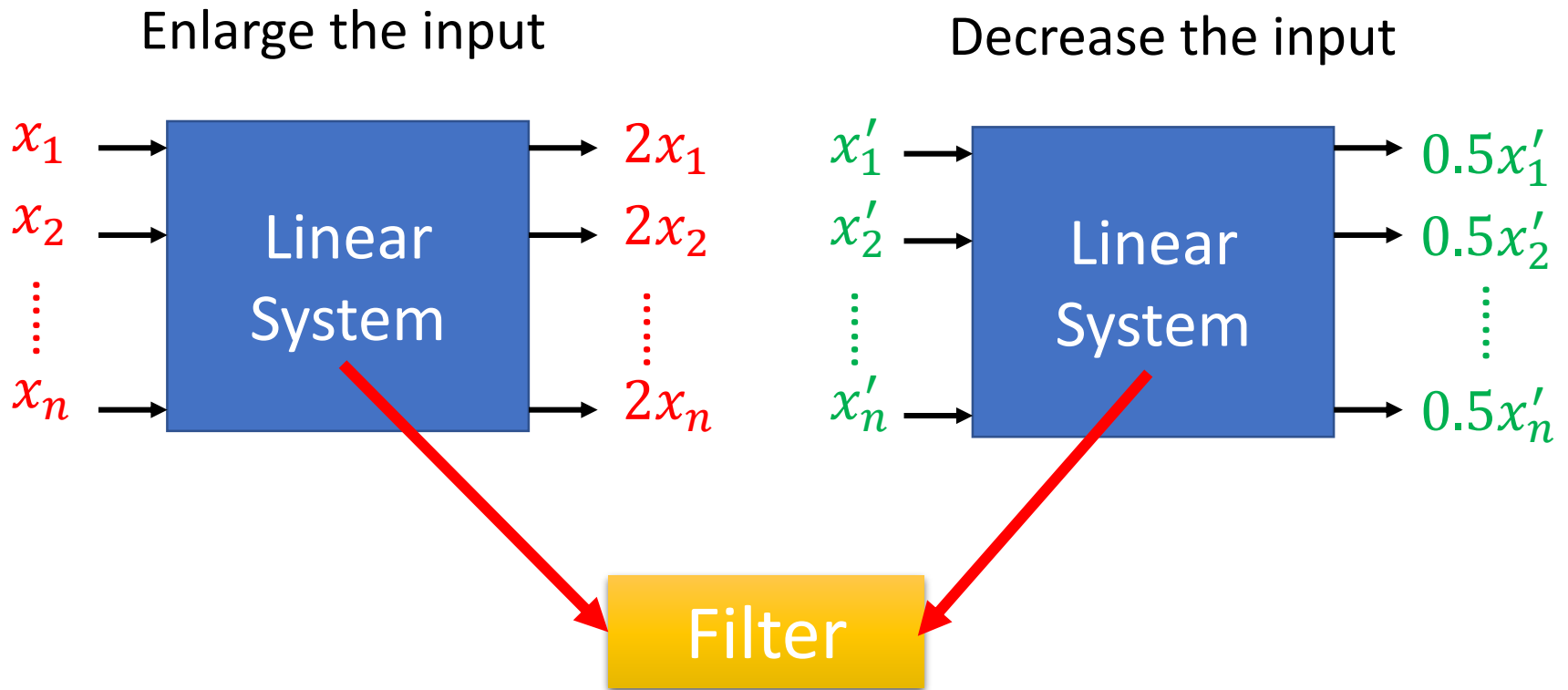
# What are we going to learn?





# What are we going to learn?

- Chapter 5: EigenXXX



# Linear Algebra is Important



在電機系  
如果沒有把線性代數學好  
就好像沒有學念能力

卻到了天空鬥技場兩百樓

李宏毅