Department of Computer Science and Information Engineering
National Taiwan Normal University

Numerical Methods

Fall 2020

Mei-Chen Yeh

2020/09/18

Basic information

- Instructor

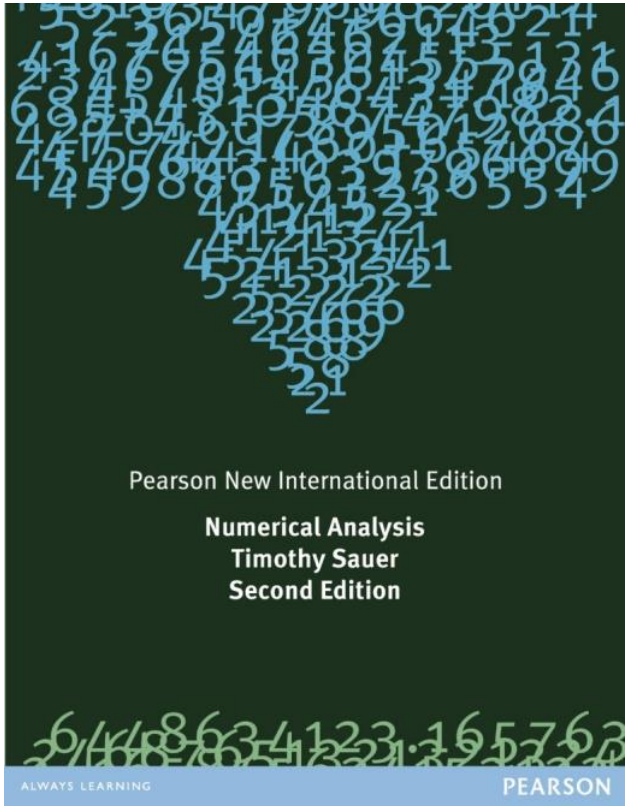
  Mei-Chen Yeh 葉梅珍 (myeh@csie.ntnu.edu.tw)

  Office hours: by appointment, CSIE **504**
- Meeting time and location

  Fri. 14:20-17:10 (w/ 10-mins breaks) at 理圖802
- Course materials on moodle
  - Announcements
  - Slides
  - Homework assignments

Basic information (cont'd)

- Reference book
  - T. Sauer. *Numerical Analysis: Pearson New International Edition*. Pearson, 2013.
- TA
  - 鐘子淳



Schedule

Week	Date	Topic
1	09/18	Introduction Solving equations Solving systems of equations **10/02 10/09 no class**
2	09/25 09/26	
3	**10/02**	
4	**10/09**	
5	10/16	
6	10/23	
7	10/30	
8	**11/06**	**Midterm**
9	11/13	Interpolation Least squares QR factorization Nonlinear least squares **11/20 01/01 no class**
10	**11/20**	
11	11/27	
12	12/04	
13	12/11	
14	12/18	
15	12/25	
16	**01/01**	
17	**01/08**	**Final exam**
18	01/15	Discussion (optional)

What will you learn/review in this course?

- Algorithms (computational methods) for solving mathematical problems
- Linear Algebra

Grading

- Participation + homework 50%
  - 出席且於課堂(5pm)完成作業 100
  - 出席且於當日完成作業 90
  - 出席且於三天內完成作業 80
  - 出席但未於三天內完成作業 40
  - 未出席但於三天內完成作業 40
  - 未出席且未於三天內完成作業 0
- Midterm 25%
- Final exam 25%

Firm! 不調分
勿討價還價

Policy (1)

Taking any unfair advantages over other class members is **not allowed**.

No Cheating!

考試**不作弊**

作業(練習)可討論但**不抄襲**

Policy (2)

Taking any unfair advantages over other class members is **not allowed**.

Cellphone?

No phubbing, or please slide outside

Policy (3)

Taking any unfair advantages over other class members is **not allowed**.

國立臺灣師範大學資訊中心電腦教室使用規範

三、嚴禁事項

1. 不得攜帶食物、飲料(非瓶裝礦泉水)入內。
2. 不得在教室安裝與教學無關之軟體。
3. 不得在教室瀏覽色情圖片、影片或網站。
4. 不得在教室內玩電腦遊戲。
5. 不得使用 P2P、PPS...等類型軟體。
6. 不得擅自拔除電源線、網路線、滑鼠等配備。
7. 不得未經向服務臺報備，攜行動裝置私接電源。

Policy (4)

Taking any unfair advantages over other class members is **not allowed**.

Sleeping?

Fine, but no snoring, or please go back to the dorm

Policy (5)

Taking any unfair advantages over other class members is **not allowed**.

No pirated copies of hard copy books

請尊重智慧財產權

Questions?

Today

- HW#0: Evaluating a polynomial

What is an efficient way to compute

$$P(x) = 2x^4 + 3x^3 - 3x^2 + 5x - 1$$

$$P\left(\frac{1}{2}\right) = ?$$

How many operations in total?

Method 1

$$P(x) = 2x^4 + 3x^3 - 3x^2 + 5x - 1$$

$$P\left(\frac{1}{2}\right) = 2*\frac{1}{2}*\frac{1}{2}*\frac{1}{2}*\frac{1}{2} + 3*\frac{1}{2}*\frac{1}{2}*\frac{1}{2} - 3*\frac{1}{2}*\frac{1}{2} + 5*\frac{1}{2} - 1$$

- Number of multiplications? **10**
- Number of additions? **4**

Method 2

$$P(x) = 2x^4 + 3x^3 - 3x^2 + 5x - 1$$

$$\frac{1}{2} * \frac{1}{2} = \left(\frac{1}{2}\right)^2 \quad \left(\frac{1}{2}\right)^2 * \frac{1}{2} = \left(\frac{1}{2}\right)^3 \quad \left(\frac{1}{2}\right)^3 * \frac{1}{2} = \left(\frac{1}{2}\right)^4$$

$$P\left(\frac{1}{2}\right) = 2 * \left(\frac{1}{2}\right)^4 + 3 * \left(\frac{1}{2}\right)^3 - 3 * \left(\frac{1}{2}\right)^2 + 5 * \frac{1}{2} - 1$$

- Number of multiplications? **7**
- Number of additions? **4**

14
↓
11

fewer *operations?*

Nested multiplication (Horner's method)

$$P(x) = 2x^4 + 3x^3 - 3x^2 + 5x - 1$$

$$= -1 + 5x - 3x^2 + 3x^3 + 2x^4$$

$$= -1 + x\left(5 - 3x + 3x^2 + 2x^3\right)$$

$$= -1 + x\left(5 + x\left(-3 + 3x + 2x^2\right)\right)$$

$$= -1 + x\left(5 + x\left(-3 + x\left(3 + 2x\right)\right)\right)$$

- Number of multiplications? **4**
- Number of additions? **4**

11→8

程式練習

And, please upload your program on moodle.

- 請使用Horner's method計算多項式的值
- 請用你的程式計算

$$P(x) = 1 + x + \cdots + x^{50}$$

$$P(1.0001) = ? \quad P(0.5) = ?$$

1 2

Next week

- Solving nonlinear equations in one variable