National University
of computer and emerging sciences

Foundation for Advancement
of Science and Technology

Numerical Computing (NC-2008)

Course Instructor

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Lecture # 01

Orientation

About Course , Marking Division (Proposed) , Class Protocols

Let's Begin

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Course Details

Textbook(s)	**Title**	Numerical Analysis , 9th Edition
	Author	Burden and Faires
	Publisher	BOOKS/COLE (Cengage Learning)
Ref. Book(s)	**Title**	Numerical Methods in Engineering with Python 3
	Author	Jaan Kiusalaas
	Title	Applied Numerical Methods with Matlab for Engineers and Scientist, 3rd Edition
	Author	Steven C,Chapra

MARKING DIVISION

Particulars	% Marks
Sessional I (Theory + Lab)	15
Sessional II (Theory + Lab)	15
Assignment (Theory + Lab + Project)	14
Quiz/Lab Task	06
Final (Theory + Lab)	50
Total	**100**

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Protocols

- Be in Classroom on time
- Student who arrive more than 5 minutes late will be marked LATE & after 15 minutes as ABSENT
- Keep remember to turn off your Cell phone before entering the class
- Avoid conversation during lecture
- Submit your Assignment on time. **No submission after the deadline**
- Always bring your **Work Book/Note Book** and **Calculator** with you in the class

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Academic Calendar for Spring 2024 Semester

BS/BBA Program

S. No.	Week	Description	Date
1.	0	New Faculty Training	Jan 08 – 12 (Mon – Fri)
2.	0	The registration process of the course (s) start and its last date	Jan 17 – 19 (Wed - Fri)
3.	1	Commencement of the Classes	Jan 22 (Mon)
4.	2	Add & Drop of Courses	Feb 03 (Sat)
5.	2	Last Date for Applying Semester's freeze	Feb 03 (Sat)
6.	6	Sessional-I Examinations	Feb 26 – 29 (Mon - Thu)
7.		Procom Days	Mar 08 – Mar 09 (Fri – Sat)
8.	12	Sessional-II Examinations	Apr 08 – 11 (Mon - Thu)
9.	14	Developers Day	April 25 (Thu)
10.	16	Last Day of Classes	May 10 (Fri)
11.	17	Last Date of Withdrawal of Courses	May 17 (Fri)
12.	18-19	Final Examinations	May 20 – 31 (Mon - Fri)
13.	21	Final Result Announcement	June 08 (Sat)

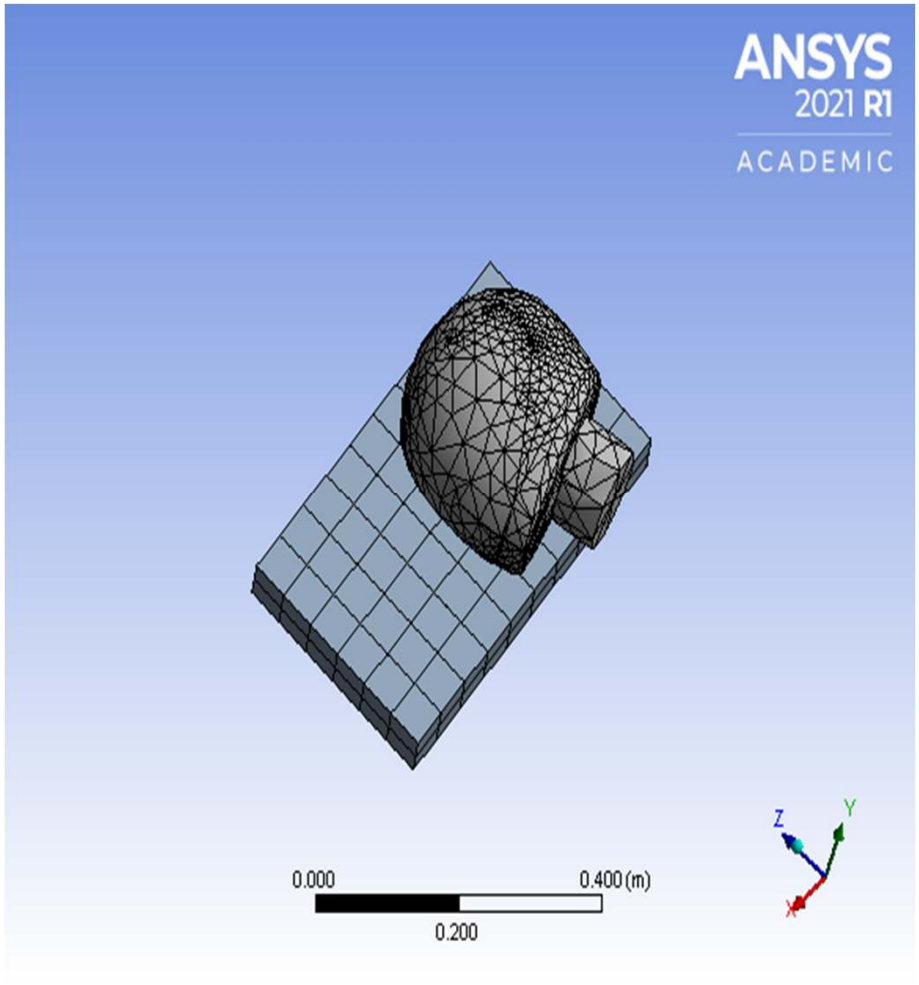
Note:

- Campus may decide to open on Saturday due to Procom Day, Developers Day, and Public holidays.

Why Numerical Methods??

To accurately *approximate* the solutions of problems that cannot be solved exactly (by analytical method).

Application of Numerical Computing in your domain??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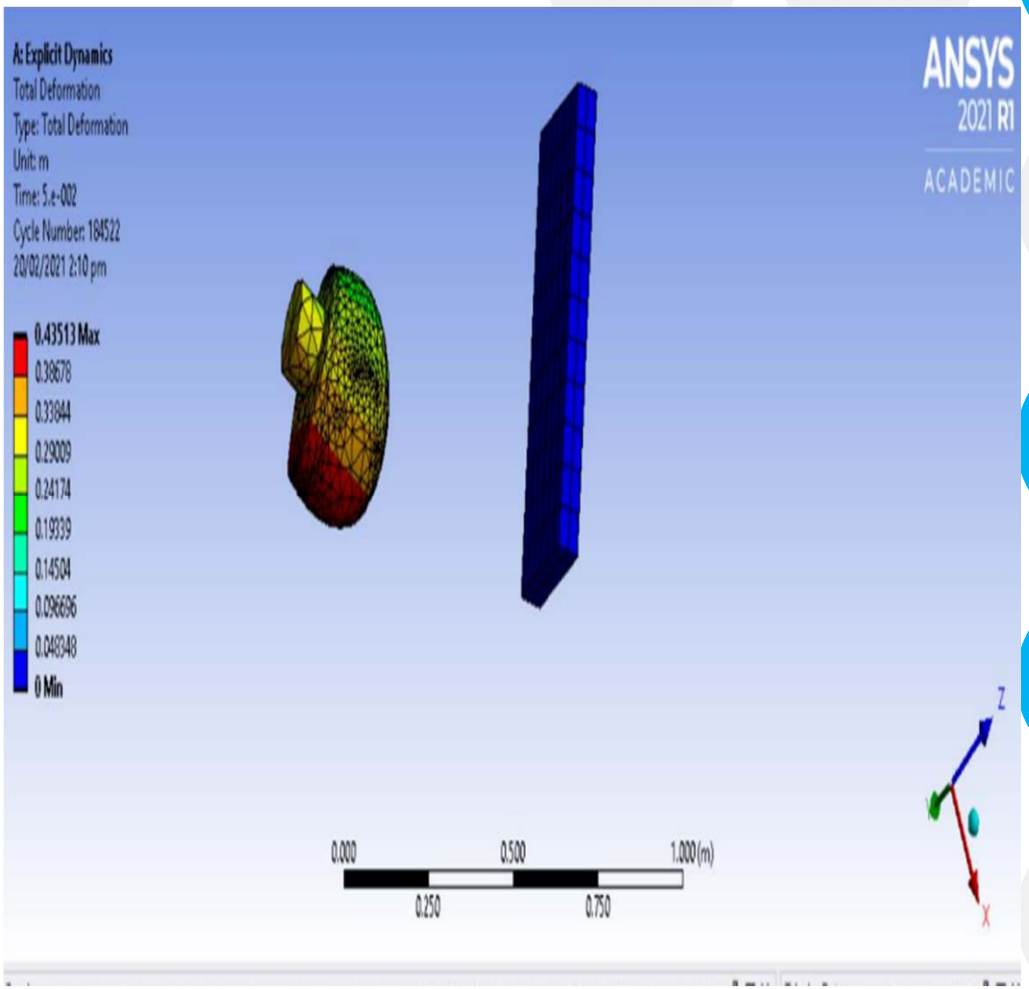
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Some of the Applications:

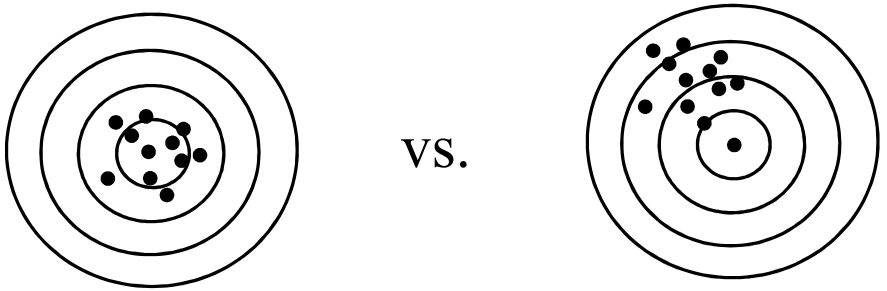
- ✓ Image Processing
- ✓ Computer Vision
- ✓ Computer Graphics (rendering, animation),
- ✓ Climate Modeling,
- ✓ Weather Predictions,
- ✓ “Virtual” crash-testing of cars etc.
- ✓ medical imaging (CT = Computed Tomography),
- ✓ CAD (Computer-Aided Design)
- ✓ And many more

Some Challenges/Issues in NC:

- ✓ Accuracy
- ✓ Precision
- ✓ Errors (True & Approximate)
- ✓ Significant Figures etc.

Accuracy:

- **Accuracy:**
  "How closely a computed value agrees with the true value"
- **Bias/Inaccuracy :**
  "A systematic deviation from the truth"



Accurate Biased/Inaccurate

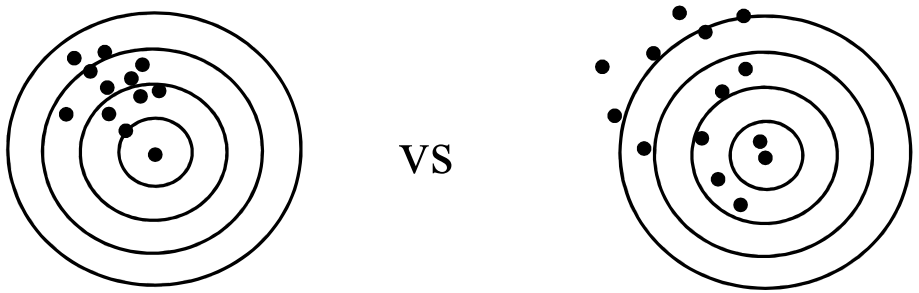
Precision:

- **Precision :**

  "How closely individual computed values agree with each other"

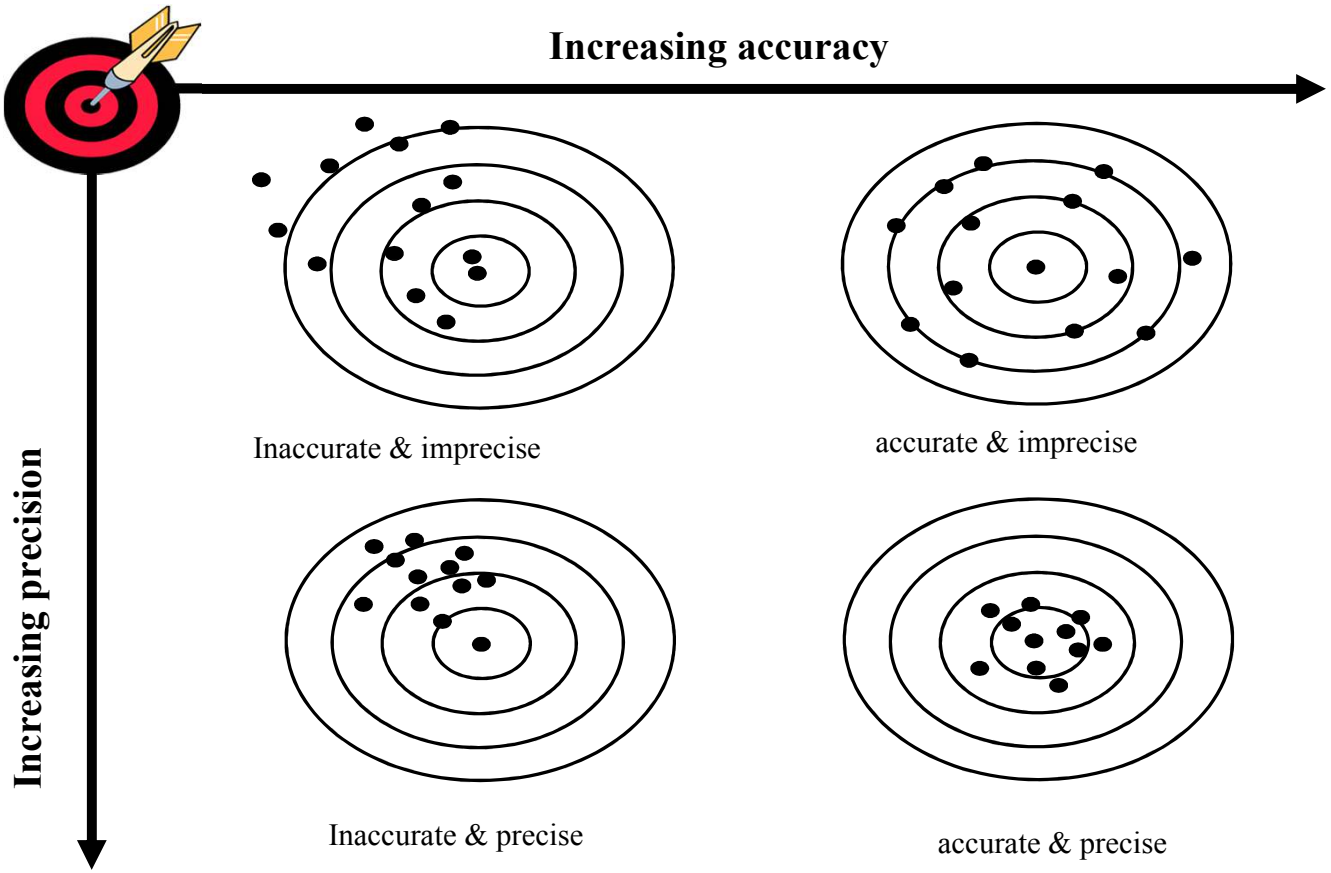
- **Uncertainty/Imprecision :**

  "magnitude of scatter"



Precise

Uncertain/Imprecise


Increasing accuracy
Increasing precision
Inaccurate & imprecise
accurate & imprecise
Inaccurate & precise
accurate & precise

Measurement of Errors :

- When the current solution is compared with the ***true/exact solution***, the error involved is called **true error**

- When the current solution is compared with the solution obtained in the ***previous iteration***, the error involved is called **approximate error**

True Errors :

"It is used to measure the lack of accuracy of an estimate"

- True (absolute) error = $\mathbf{E_t}$ = True value – Approximation

- True Relative error = $\dfrac{E_t}{True\ value}$

- True Percent Relative Error = $\dfrac{True\ value - approximation}{True\ value} \times 100\%$

Approximate Errors :

"Used to measure the lack of precision of an estimate"

- **Approximate (Absolute) Error**

  E_a = Current approximation - Previous approximation

- **Approximate Relative Error** = E_a / Current approx.

- **Approx. Percent Relative Error** $= \frac{\text{Current approx.} - \text{Previous approx}}{\text{Current approx}} \times 100\%$

Practice Problem:

The following sequence of estimates was obtained when a numerical method was applied to solve the equation:

$$x^4 - 5x - 7 = 0$$

1.8254 1.9633 2.0121 2.0283 2.0335 2.0351 2.0356 2.0358

Calculate the **four errors (True & Relative errors, Approximate & Relative errors)** for these estimates, given that one of the roots of the equation is 2.0359.