ESO 208A

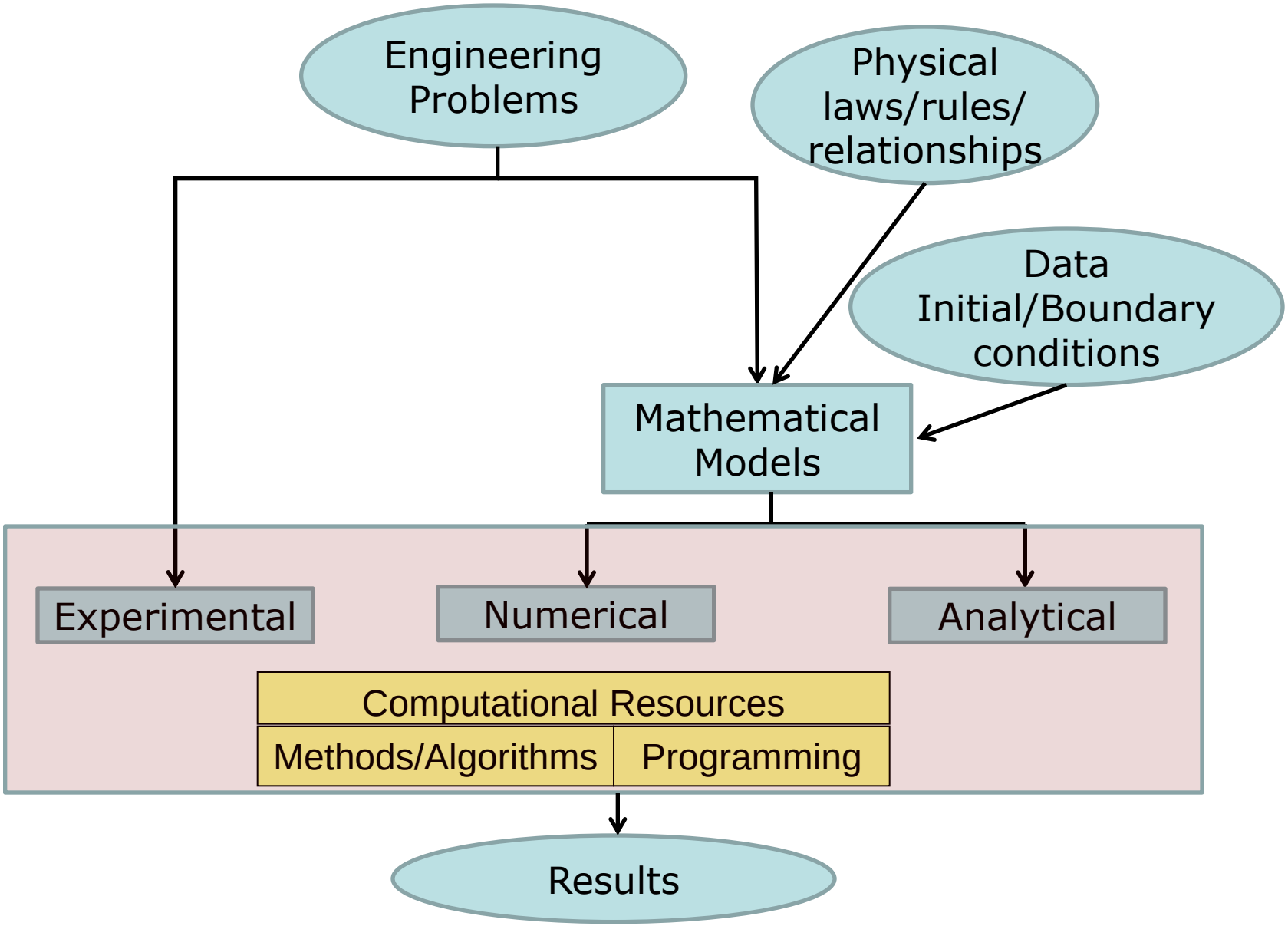
Computational Method in Engineering

Lecture 01

Objectives of the course

- Introduce you to computational methods and algorithms for the solution of engineering problems.
- Familiarize you to the algorithms behind the software packages so that you don’t use them as black boxes.
- Expose you the analysis of these algorithms so that, if needed, you can modify an existing algorithm or develop your own algorithm for the problem at hand.

Scope of the course



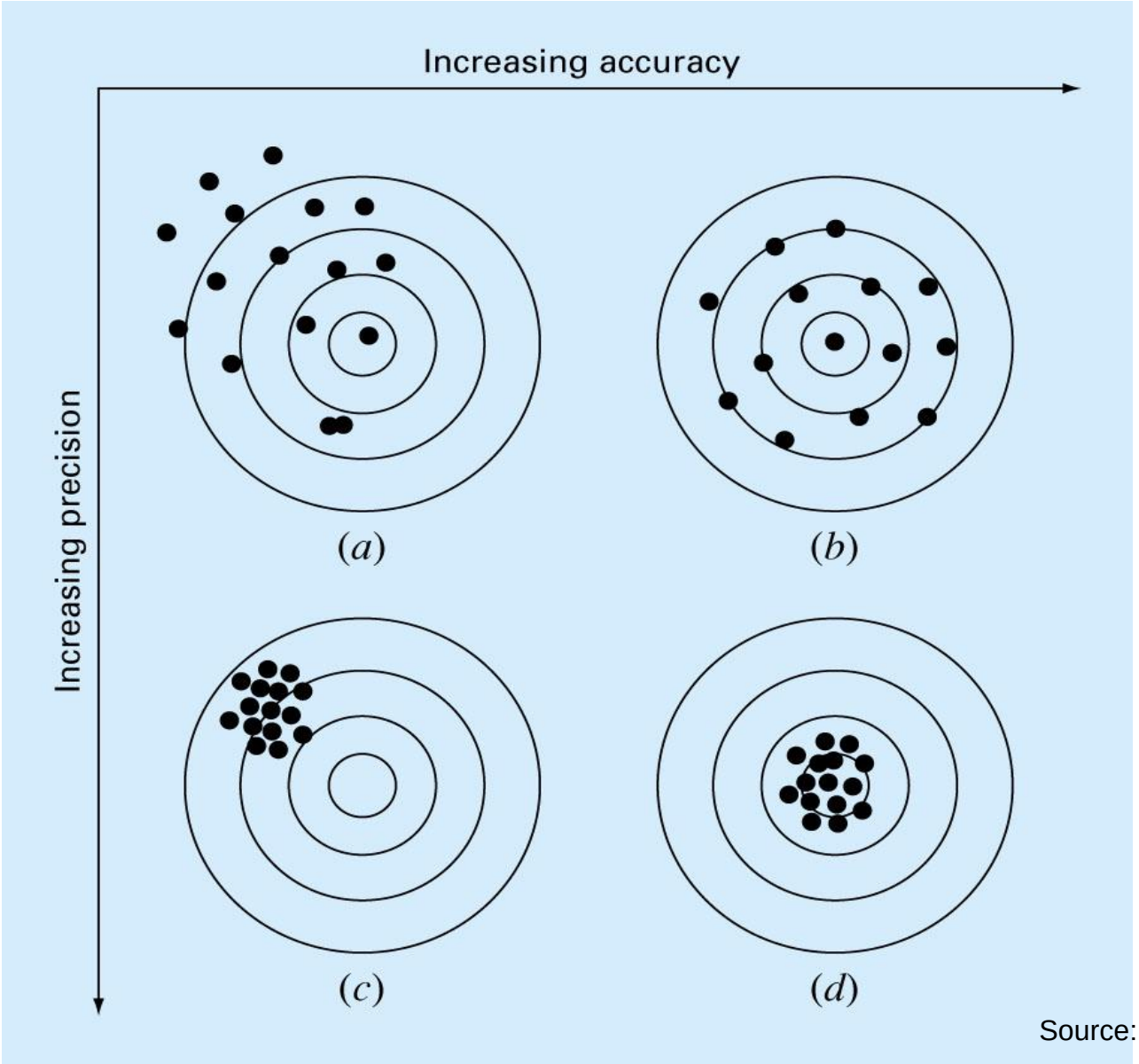
Recap

- What are computational methods? How they are used for solving engineering problems?
- The choice of computational method depends on the problem and intended use of the results.
- Example: Object falling from a building
  - Formulation of mathematical model
  - Choice of methods, convergence, convergence rate, errors [model, data, round-off and truncation], propagation of errors, stability & condition number.
- Number representation in computers
  - Binary and decimal representation

Errors and Error Analysis

- Accuracy - How closely a measured/computed value agrees with the true value
  - Inaccuracy (or *bias*) A systematic deviation from the actual value
- Precision (or *reproducibility*)- How closely individual computed/measured values agree with each other
  - Imprecision (or *uncertainty*). Magnitude of scatter

Errors and Error Analysis

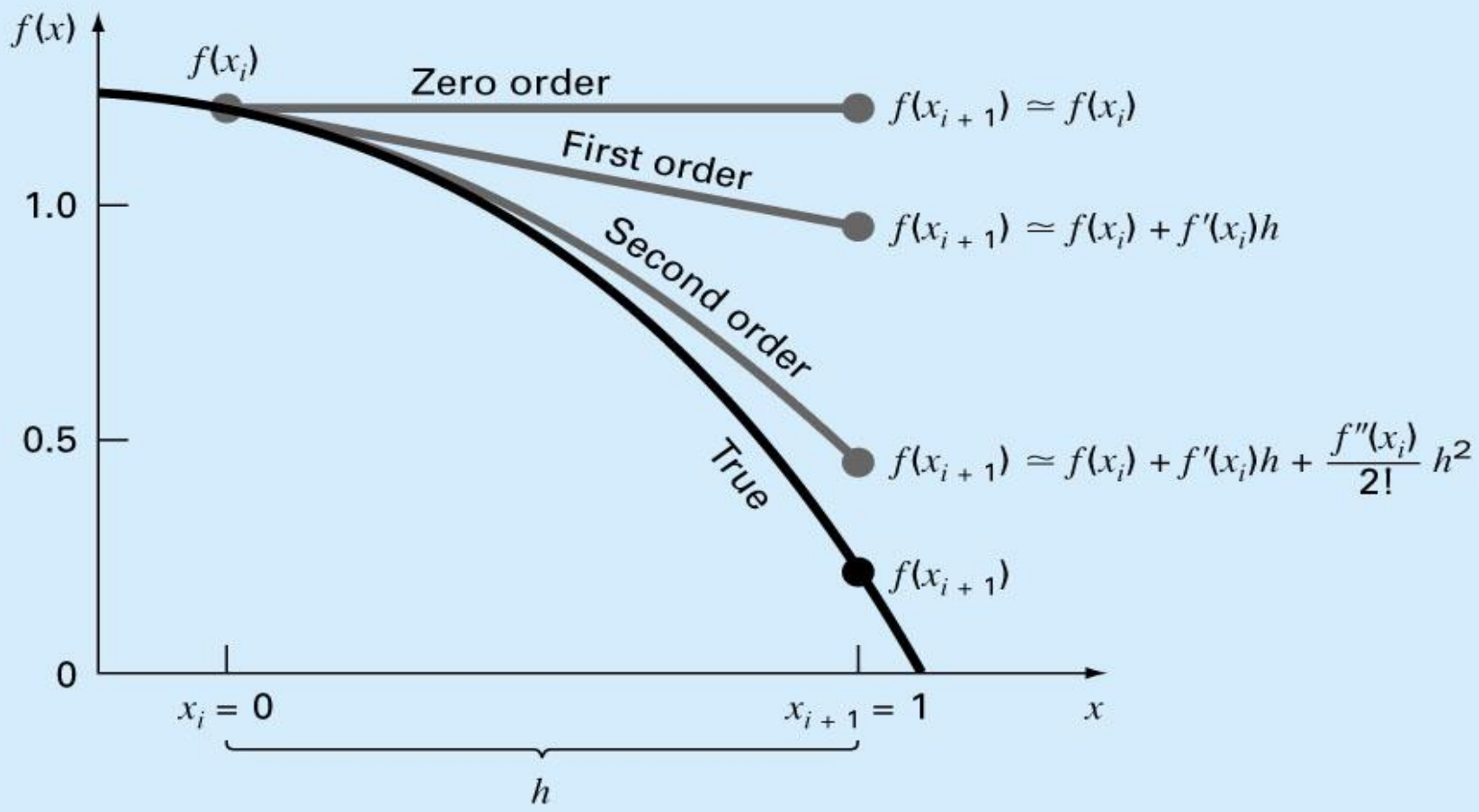


Source: Chapra and Canale

Significant digits

Number	Significant digits	Rule
228.18	5	All non-zero digits are significant
10.08	4	Zeros between non-zero digits are significant.
0034.5	3	Leading zeros are not significant.
34.500	5	In a decimal number trailing zeros are significant.
34500	3 or 4 or 5	In a non-decimal number trailing zeros may or may not be significant
3.450×10^4	4	No ambiguity in scientific notation

Truncation error



Source: Chapra and Canale

Integer Representation

Binary	Unsigned	Signed bit	Excess-p	2's complement
000	0	0	-3	0
001	1	1	-2	1
010	2	2	-1	2
011	3	3	0	3
100	4	-0	1	-4
101	5	-1	2	-3
110	6	-2	3	-2
111	7	-3	4	-1