

# PRELIMINARIES

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- **What is scientific computing?**

- Design and analysis of algorithms for numerically solving mathematical problems in science and engineering.
- Traditionally called Numerical Analysis.

- **Why Scientific Computing?**

- Simulation of natural phenomena
- Virtual prototyping of engineering design.

## ■ Well- Posed problems

Problem is well posed if solution

- Exists
- is unique
- depends continuously on problem data

otherwise, problem is ill –posed.

Even if problem is well posed, solution may still be sensitive to input data.

# GENERAL STRATEGY FOR SCIENTIFIC COMPUTING

- Replace difficult problem by easier one having same or closely related solution.
- Solution obtained may only approximate that of original problem.

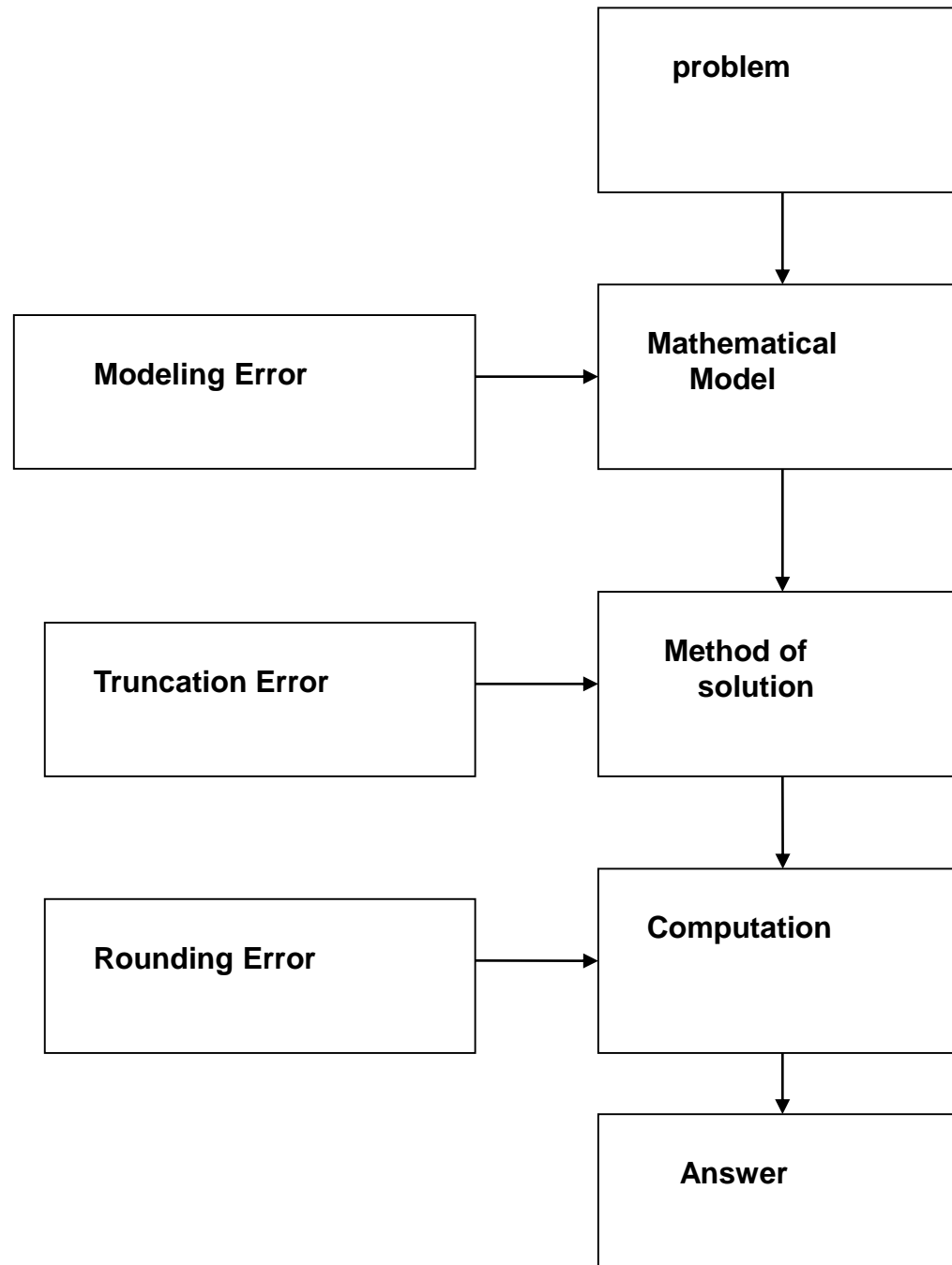
# SOURCE OF APPROXIMATION

## Before Computation

- Modelling
- Empirical measurement
- Previous computation

## During Computation

- Truncation and discretization
- Rounding
  - Accuracy of final result reflects all these.
  - Uncertainty in input may be amplified by problem.
  - Perturbations during computation may be amplified by algorithm.



# ERRORS

- Absolute and Relative Error
  - **Absolute error**: approximate – true value
  - **Relative error**: Absolute error / true value



# Truncation error and rounding error

- **Truncation errors:** The notion of truncation error usually refers to errors introduced when a more complicated mathematical expression is “replaced” with a more elementary formula.
- **Rounding error:** A computer’s representation of real numbers is limited to the fixed precision of the mantissa. True values are sometimes not stored exactly by a computer’s representation. This is called rounding or round-off error.
- **Computational error** is sum of truncation error and rounding error, but one of these usually dominates.