# Research Interviews

*Computational Science*
*CDS –CP*

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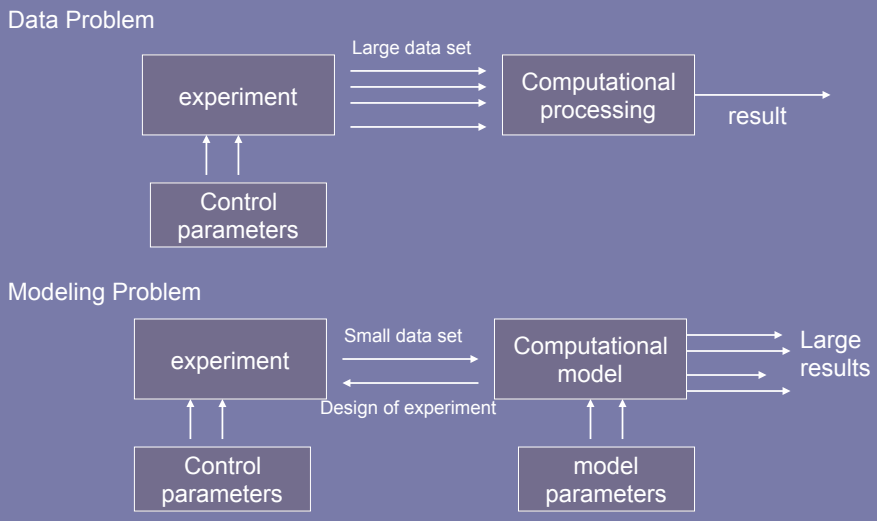
## Agenda

- What is computational Science?
- The interview process
- Clarifications

# Computation and Engineering




# CP today

- Complex experiments at the frontiers of knowledge
- All engineering and chemical, biological, material sciences
- Cyber-physical systems
- Examples: tsunami warnings, large hadron collider, gravitational wave observations, drug discovery, medical imaging and diagnosis/ prognosis

# Example Courses

- Numerical Linear Algebra
- Numerical Methods
- Numerical Solutions of Differential Equations
- Modeling and Simulation
- High Performance Computing
- Data Structures and Programming
- Data Assimilation to Dynamical Systems
- Finite Elements: Theory and Algorithms
- Constructive Approximation Theory

# Numerics Example 1

$$\begin{pmatrix} 1 & 1000 \\ 0 & 1 \end{pmatrix}$$

Eigenvalues: 1, 1

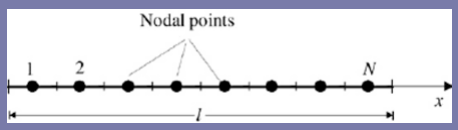
$$\begin{pmatrix} 1 & 1000 \\ 0.001 & 1 \end{pmatrix}$$

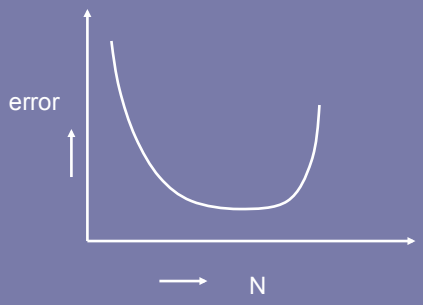
Eigenvalues: 0, 2

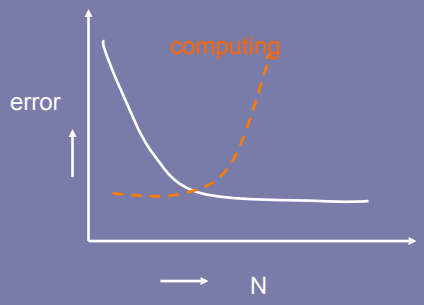
Increase in computational power due to computational methods/algorithms has also scaled like Moore's law on average !! Just that it is not as smooth and predictable.

# Numerics Example 2

Peril of naïve discretization




# Interviews - schedule

- Date and Session (9 AM or 2 PM)
- Written component (~ 5 Qs in 30 min)
- Oral interviews (~ 20 min)

*Keep a water bottle and some biscuits with you ☺*

# Written component

Written component (Duration: 30 minutes): Total Points 5X2=10

- (a) Two mandatory questions, one from Polynomials, functions, plotting, etc and another is a programming question
- (b) Answer any three out of five questions : Linear Algebra/Matrices, Probability and Statistics, and Differential Equations.

# Lab choices

**Preference Sheet for Ph.D./M.Tech(Res) Research Admissions – Computational Science (CD-CP)**

Carefully review the brochure and Research Lab descriptions before filling in this Preference Sheet. Choose the lab(s) whose research areas most closely match your own interests. You may choose up to three labs. Ph.D. students, if admitted, will be placed in the lab(s) chosen here, and this selection is binding.

1. Name: _____
2. Application No: _____
3. Program: *(Tick one)* [ ] M.Tech. (Research) [ ] Direct Ph.D. [ ] Ph.D.
4. External Research Program Candidate? *(Tick one)* [ ] No [ ] Yes

Rank up to three Research Labs below by their order of preference (using numbers 1,2,3).

[ ] Stable, Accurate, Fast, Robust Algorithms & Numerics Lab
[ ] Biomolecular Computation Laboratory
[ ] Structural Biology & Bio-Computing Lab
[ ] Computational Mathematics Group
[ ] Computational & Statistical Physics Lab
[ ] Computational Electromagnetics Lab

# Oral Interview

- Basic Area Subjects: Programming fundamentals; Linear Algebra; Numerical Methods; Ordinary Differential Equations; Probability & Statistics. Final year undergraduate level preparation is required.
- Advanced Topics: Matrix Algebra, Numerical and Functional Analysis, Numerical Solution of Differential and Differential-Algebraic Equations, Finite Element Methods, Signal Processing, Computational Biology and Structural Bioinformatics, Graph Algorithms, Structural Biology and Bioinformatics.

Don't hesitate to think aloud in an oral interview !!

# Anything else???