Lec 1. Course Overview

Intuition
Programming
Computer-based problem solving
Theory vs Practice
Other Perspectives

The Course Goals

1. To develop a practical intuition about computer problem-solving and its role in science and engineering.
2. To learn how to build graphical user interfaces (GUIs) using Matlab.

The Vehicle...

...is the Matlab Environment where you can easily
- Develop programs.
- Display results & ideas graphically.
- Interact with large data sets.
- Process images and sound.
- Develop graphical user interfaces

The Course Goal...

...is to develop a practical intuition about computer problem-solving and its role in science and engineering.

Let's discuss the key words

What do we mean by “Intuition”?

If intuition is a sense of direction, then computational intuition is a sense of computational direction.

A Sense of Geometry

Ray Tracing
100 million triangles
A Sense of Complexity

Search Trees

Design Space

Billions of Choices

A Sense of Probability and Statistics Via Simulation

Sweep Number = 12  Field Strength = −400

Sweep Number = 0  Field Strength = −60

A Sense of Approximation, Error, and Noise

1/3 = .3333  Pi = 22/7

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What Goes on In Science?

Data is Gathered

Models Are Built

Enter the Computer

Theoretical Science

Experimental Science  Computational Science
Looking For Patterns

DNA → A Protein

Build one of these for Proteins...

A Challenge

The data is there.
("Tycho has cataloged the stars.")
Now make sense of it!
(Where are the "genomic Keplers"!)

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What Goes On in Engineering?

Design  Experimentation

Enter the Computer

Theoretical Engineering
Experimental Engineering
Computational Engineering
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What Do We Mean By “Computer Problem-Solving”?

The key idea:

Algorithm. A step-by-step procedure that takes you from a prescribed set of inputs to a prescribed set of outputs.

The “Traveling Salesperson” Problem

Make a roundtrip visiting each city exactly once. Find the shortest possible path.

Algorithm: always go to the nearest unvisited city.

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What Do We Mean By “Practical”?

It means that you carry away useful computer skills.
Theory versus Practice

Prove that the program controlling this missile silo is correct.

A theoretical exercise with great practical importance.

A Note on the GUI Part

The Matlab GUIDE facility makes life easy.
A vehicle for learning about object-oriented programming.
An opportunity to refine your communication skills.
A platform for follow-up ugrad research in the spring.