

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...

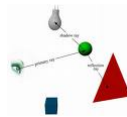
...is to develop a practical **intuition** about computer problem-solving and its role in science and engineering.

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

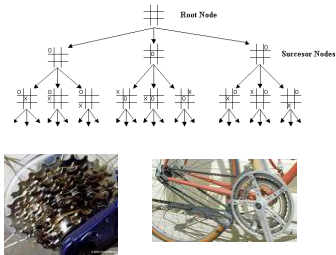


Ray Tracing



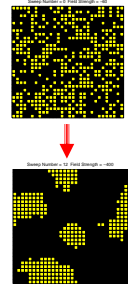
100 million triangles

A Sense of Complexity



Billions of Choices

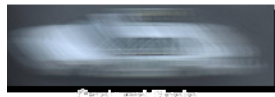
A Sense of Probability and Statistics Via Simulation



A Sense of Approximation, Error, and Noise

$$1/3 = .3333$$

$$\text{Pi} = 22/7$$



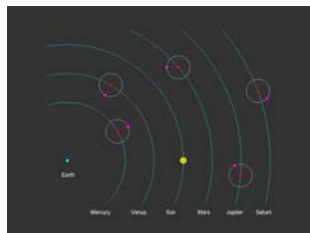
The Course Goal...

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

What Goes on In Science?

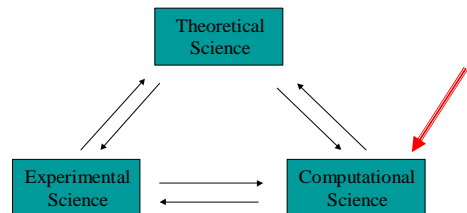


Data is Gathered



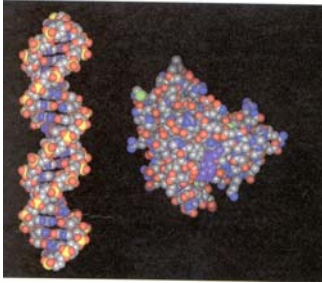
Models Are Built

Enter the Computer



Looking For Patterns

DNA



A Protein



Build one of these for Proteins...

Periodic Table of the Elements

1	2											10	11						
1	H																	He	
2	Li	Be											B	C	N	O	F	Ne	
3	Na	Mg											Al	Si	P	S	Cl	Ar	
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Cu	Ni	Cd	Zn	Ga	Ge	As	Se	Br	Kr	
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
6	Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
7	Fr	Ra	†Ac	Rf	Ha	104	105	106	107	108	109	110	111	112	113	114	115	116	117

* Lanthanide Series
† Actinide Series

A Challenge

The data is there.

("Tycho has cataloged the stars.")

Now make sense of it!

(Where are the "genomic Keplers"?)

The Course Goal...

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What Goes On in Engineering?

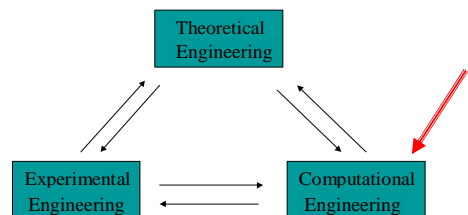


Design



Experimentation

Enter the Computer



The Course Goal...

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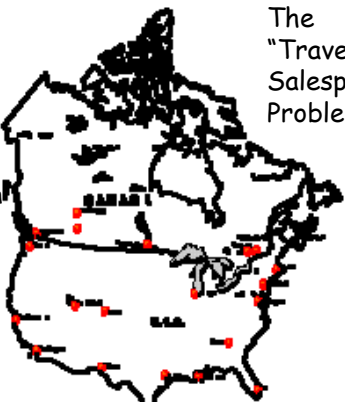
What Do We Mean By "Computer Problem-Solving"?

The key idea:

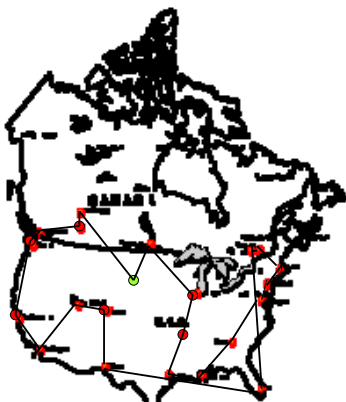
Algorithm. A step-by-step procedure that takes you from a prescribed set of **inputs** to a prescribed set of **outputs**.

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

The "Traveling Salesperson" Problem

A map of the United States with several red dots representing cities. A dashed line indicates a path that visits each city exactly once and returns to the starting point. The path is shown as a series of connected segments between the dots.

Algorithm: always go to the nearest unvisited city

A map of the United States with several red dots representing cities. A solid line indicates a path that visits each city exactly once and returns to the starting point. The path is shown as a series of connected segments between the dots.

The Course Goal...

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

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.