CMPT 102 Introduction to Scientific Computer Programming

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Lecture-related

- Classroom AQ 5016
- Lecture-times Mon-Wed-Fri 12:30pm – 1:20pm
- Binay's Office-hours: MWF 11:00am – 12:00noon
- TA's Office-hours (TBA)

Grading Scheme

- Grading
  - Assignments (Programming) 20%
  - Quizzes (in-class) 30%
  - Final exam 50%
    - Must pass the final exam to pass the course.
- Consultations/discussions
  - Can help each other to understand materials
  - Not allowed to share code or work
  - May quote others but must include clear citation

A little bit about me

- Research area is designing algorithms
  - Geometric algorithms
  - Operations research
- Don’t want to pretend to know everything
- Questions are very much encouraged
- I want you to enjoy the course

About you

- Please fill in the survey.

About MATLAB

- Matlab: You'll like it!
- Matlab is very widely used in science
  - Much less frustrating than C++ or Java
- Lots of 'toolkits' expand it to many areas
  - Medicine, business, simulation, physics, chemistry, biology, computer vision, databases, symbolic math (e.g. symbolic integration), control, optimization, and on and on.
- Interactive language
  - The world's most sophisticated programmable calculator
- Sophisticated graphing tools
- Learn some programming and computer science
  - Emphasis on learning a useful tool
  - I predict it to be useful in your future works, irrespective of the application areas.

Textbook

- Title: MATLAB for Engineers
  - by Holly Moore
  - Pearson Prentice Hall, Third Edition
- Don’t let “Engineers” bother you
- I will alter the problem contents to suite your understanding.

Resources for the course are taken from .....

- Textbook
- Resources for the instructors provided by Pearson, the publisher of the textbook
- Lecture slides of Prof. Funt of SFU

Goal

… is to develop practical problem-solving skills using a computer.

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The vehicle is the MATLAB environment where one can easily

- Develop programs at a high level.
- Display ideas and results graphically.

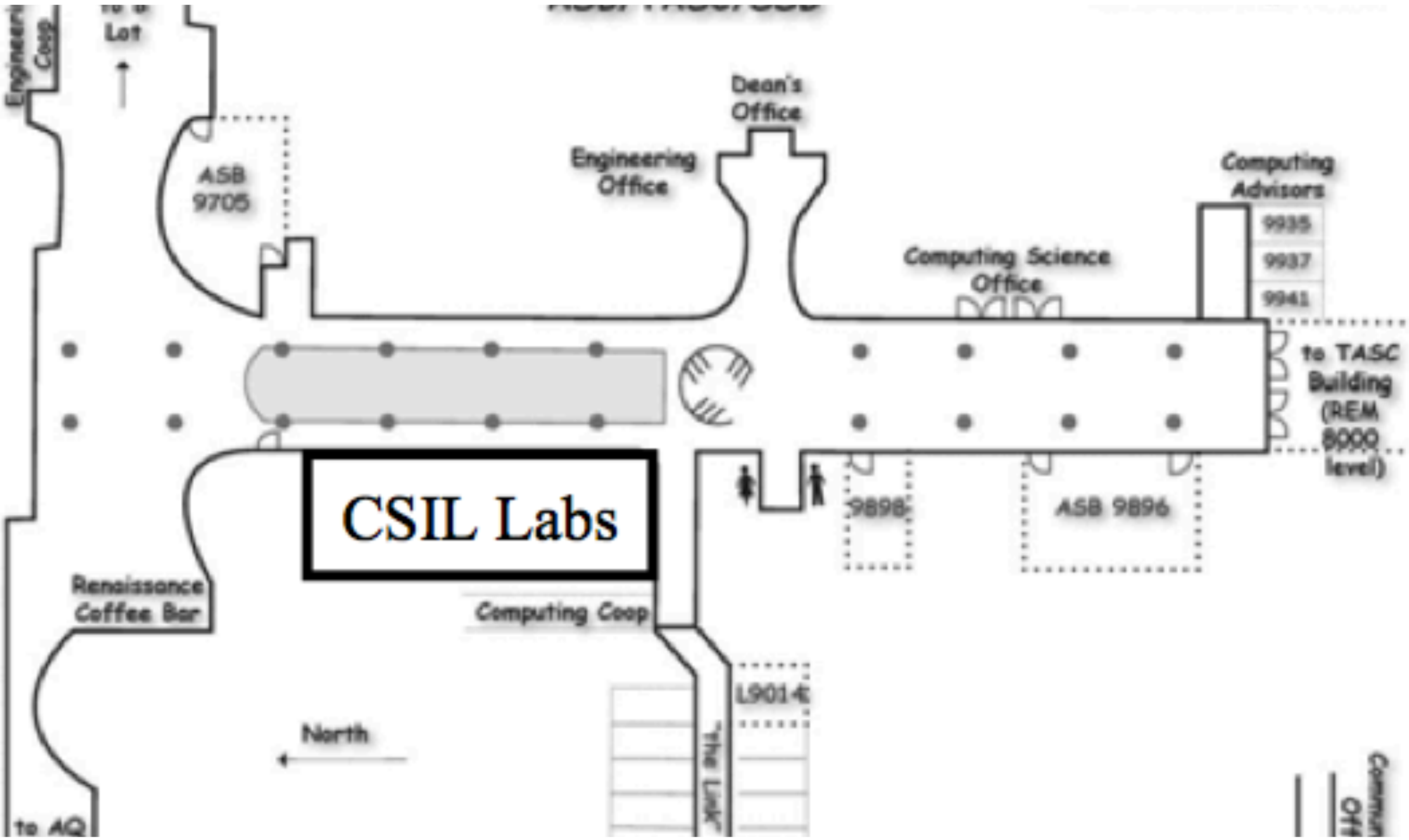
How is MATLAB used in industry?

- Quickly becoming a requirement for many job positions
  - Electrical Engineering: signal processing
  - Biomedical Engineering: medical imaging
  - Fluid dynamics in aerospace industry, three dimensional visualization
  - Discrete optimization: scheduling

Computing Science Instructional Lab (CSIL)

- The CSIL lab is available at all times starting from the second week of classes. (ASB 9838)
- Instructor/TA will be available in the lab to answer your questions.
  - Instructor: MW 11-12
  - TA: TBA

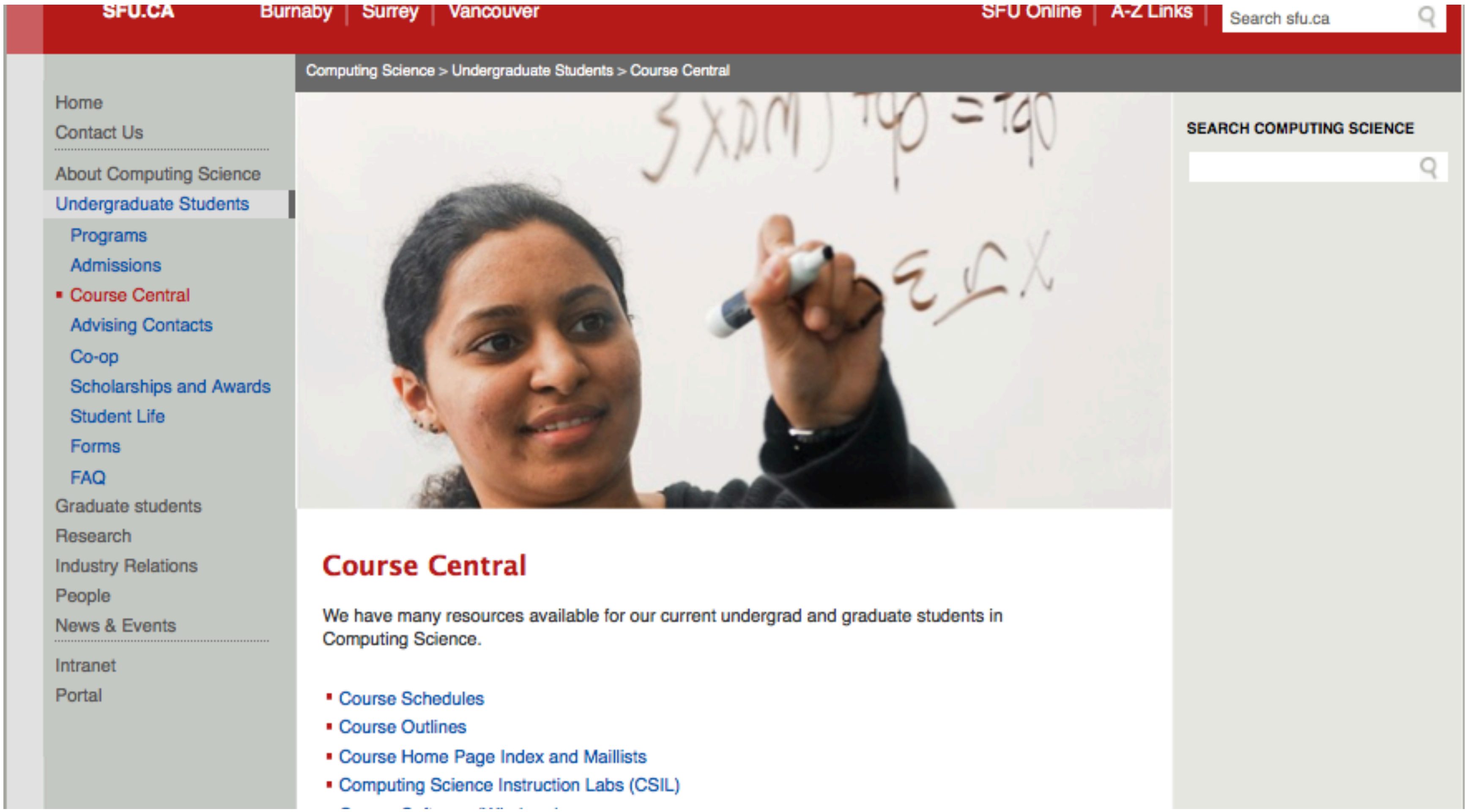
Finding CSIL lab



Access to CSIL

- You need an access card to enter the lab.
  - As a student in a CS course, you are eligible to have an access card.
  - If you have registered for the course, your access card can be picked up from the card office at traffic and security (refundable deposit fee + processing fee)
  - Before you can use the facility you need to sign and return an ethics form.

http://www.cs.sfu.ca/undergraduate/course-central.html



Getting started in CSIL

- Before you try programming in CSIL, read the general information provided in the web.
- Your CSIL computer Id and password are the same as Id and the password you use for your e-mail account.
- If your login Id does not work, see if the Id adsfu\Id works.

Information on CSIL

- Course Central
  - web pages under www.cs.sfu.ca/~binay/2012/102
  - course outlines, webpages
  - submission server instructions, etc.
- CSIL
  - Computing Science Instructional Lab
    - Information under course central
    - http://www.cs.sfu.ca/undergraduate/course-central.html

MATLAB at SFU and at home

- MATLAB is available on Windows and Linux in CSIL
- Also available over the Internet
  - Runs on CMPT servers
- Cannot install it free on your own machine
  - Can run demo version for a month or so
  - Can purchase student version for $100 (approx)

Using MATLAB over Net

- Use Remote Desktop from Windows
- Use rdesktop from Linux
- On Windows
  - Connect to leto.csil.sfu.ca
  - Use your SFU computer account and password
    - Write your login name (adsfu\login_name)
  - In the remote desktop window
  - Start -> All Programs -> Matlab -> MATLAB R2010b

Using MATLAB over Net for MAC Users

- Google “mac remote desktop”
- Download (it is free)

Course Overview

- The text book covers both introductory programming skills and techniques specific to MATLAB for vector and matrix manipulation.
- First discuss an informal treatment of algorithms and how to view problem solving as a step by step processes.
- Discuss MATLAB environment

Concepts to be covered

- **Expressions**: arithmetic, logical and boolean expressions. Constructing complex expressions from simpler ones.
- **Variables:** Use of variables in expressions and changing their values with assignment.
- **Vectors and Matrices:** vectors as a data-type, vector creations, vector operations, and expressions with vectors. Extend same concepts to matrices.

Concepts to be covered (contd.)

- **Visualization:** Displaying data, Input/Output, 2D and 3D plotting.
- **Functions:** Functional abstraction, input parameters, return values, returning multiple values.
- **Conditionals:** Introduce ***if*** statements, control-flow diagrams for ***if, if … else, if … elseif*** conditional blocks.

Concepts to be covered (contd.)

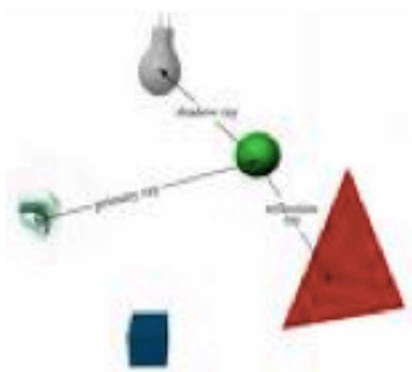
- **Iteration:** Bounded definite loops using ***for***, variable loop bounds, etc.
- **Other kinds data structures:** multidimensional arrays, character arrays, cell arrays and structure arrays.
- **Composition:** Whole program construction, composition of various program elements (conditionals, loops, functions, etc.)

Get Started Now!!

from:

www.cs.cornell.edu/courses/cs100m/2007fa

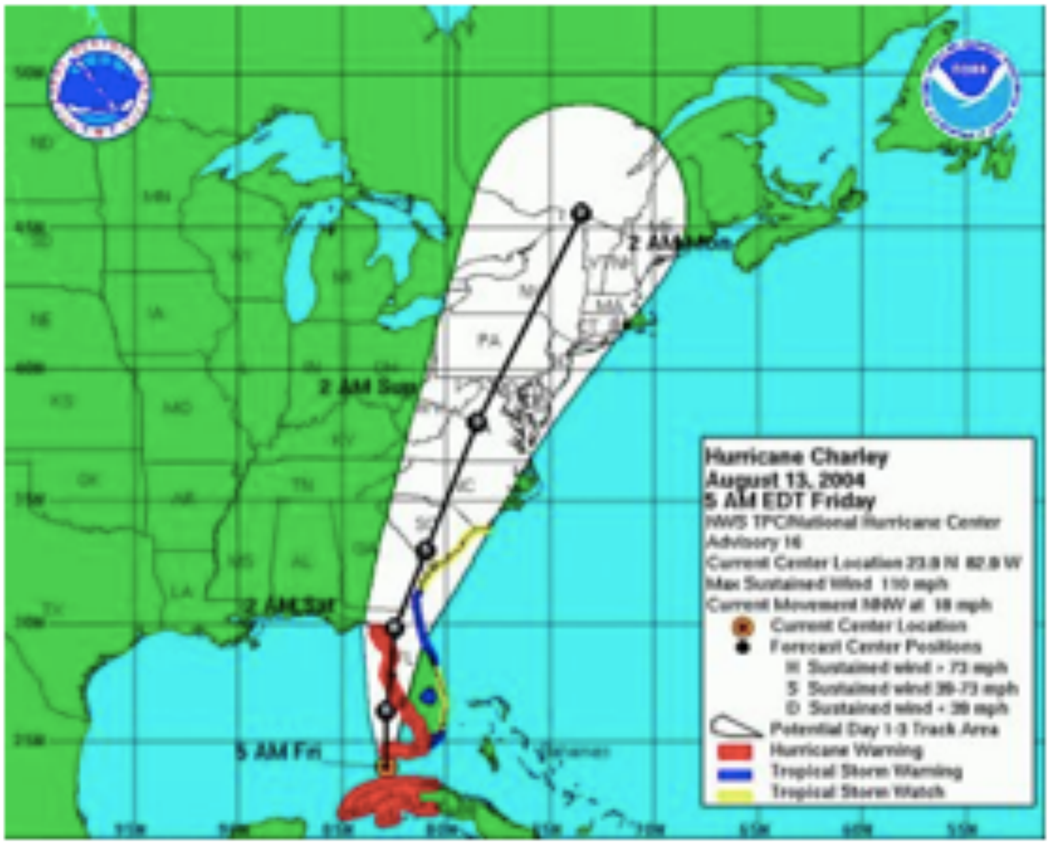
Geometry



Ray tracing

100 million triangles

approximation, error, and noise

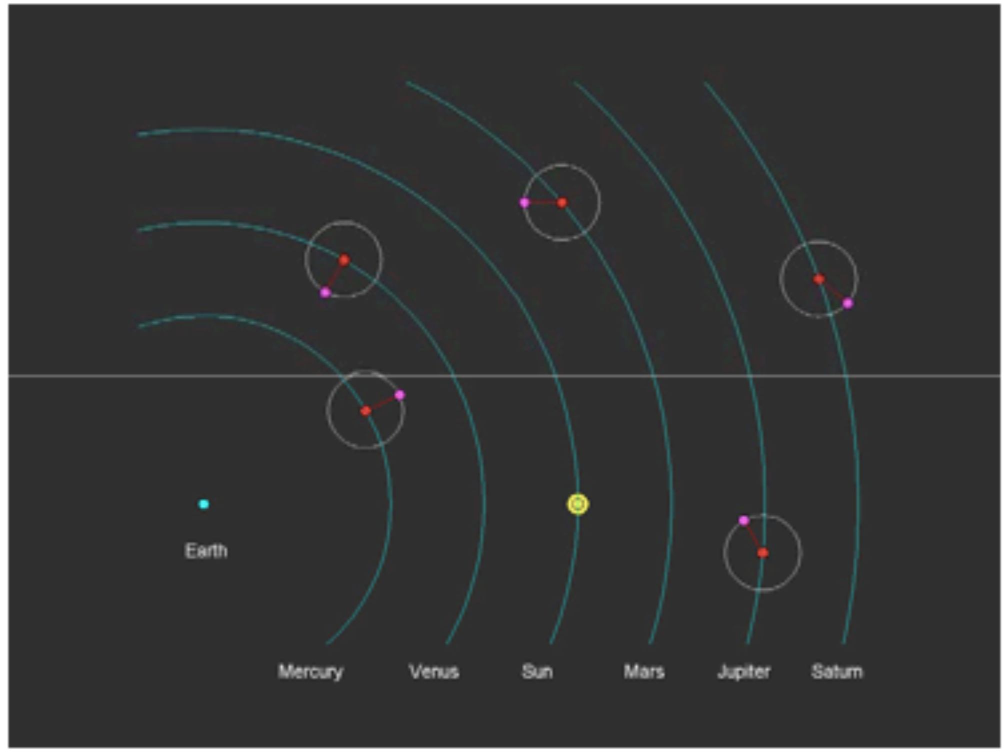


1/3=.3333

pi = 22/7

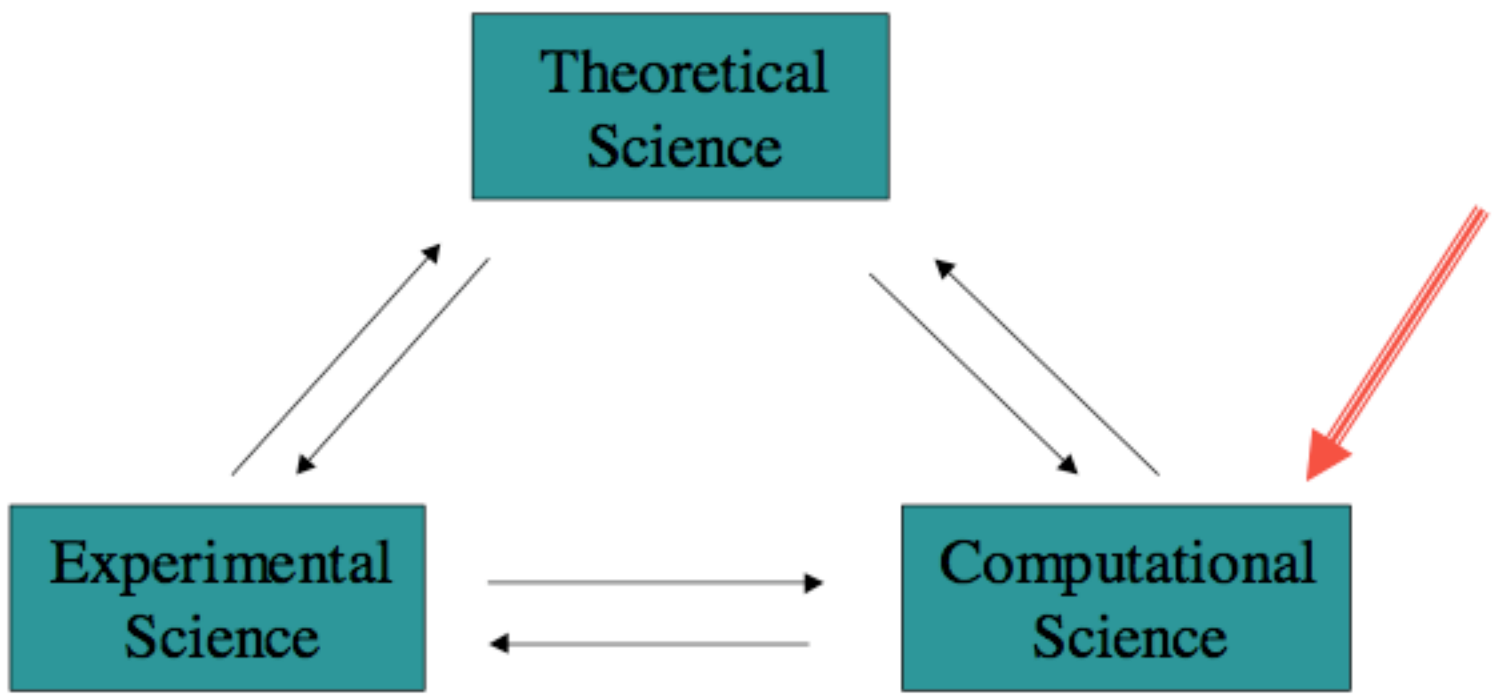
What Goes on In Science?

Data is Gathered



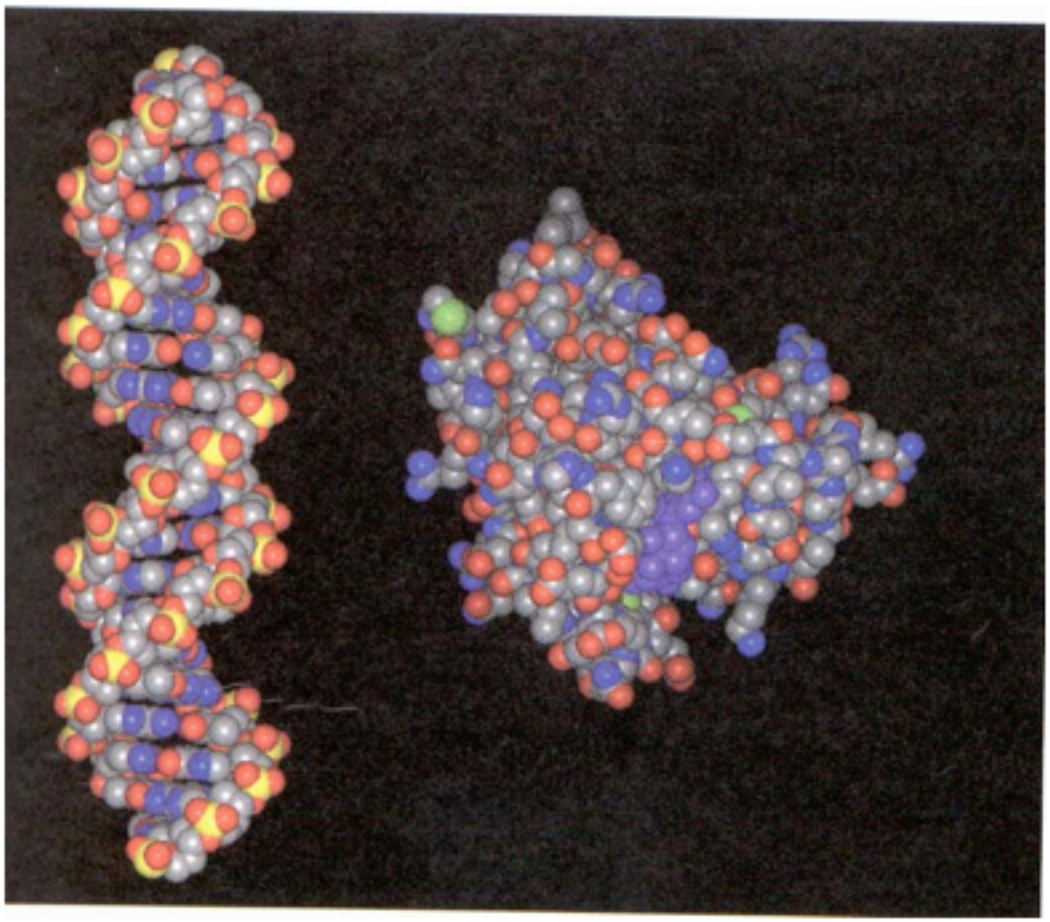
Models Are Built

Enter the computer



Looking for patterns

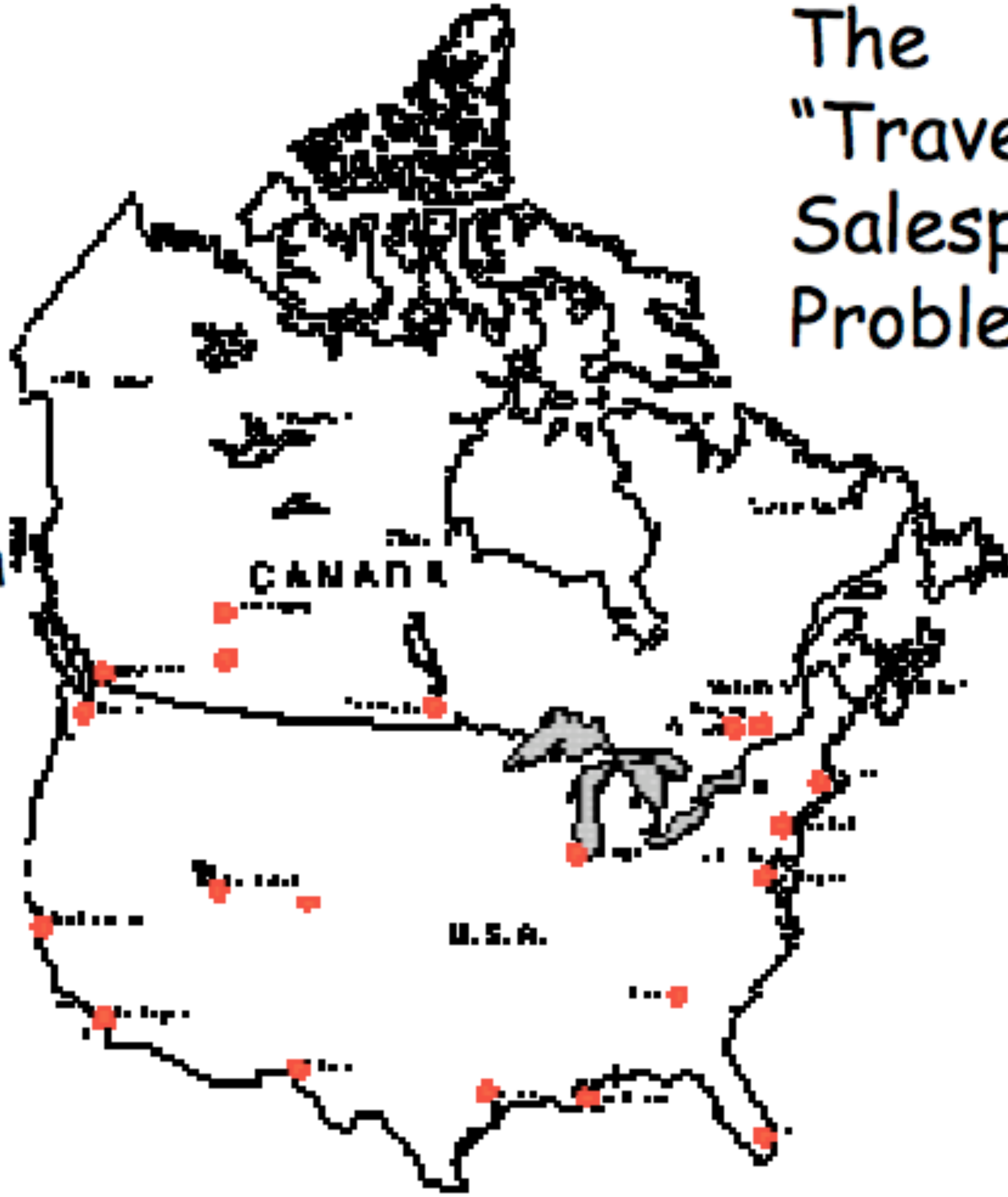
DNA



A Protein

The "Traveling Salesperson" Problem

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



Theory ~~versus~~ Practice

Prove that the program controlling this missile silo is correct.

A theoretical exercise with great practical importance.

What do you mean by “computer problem-solving”?

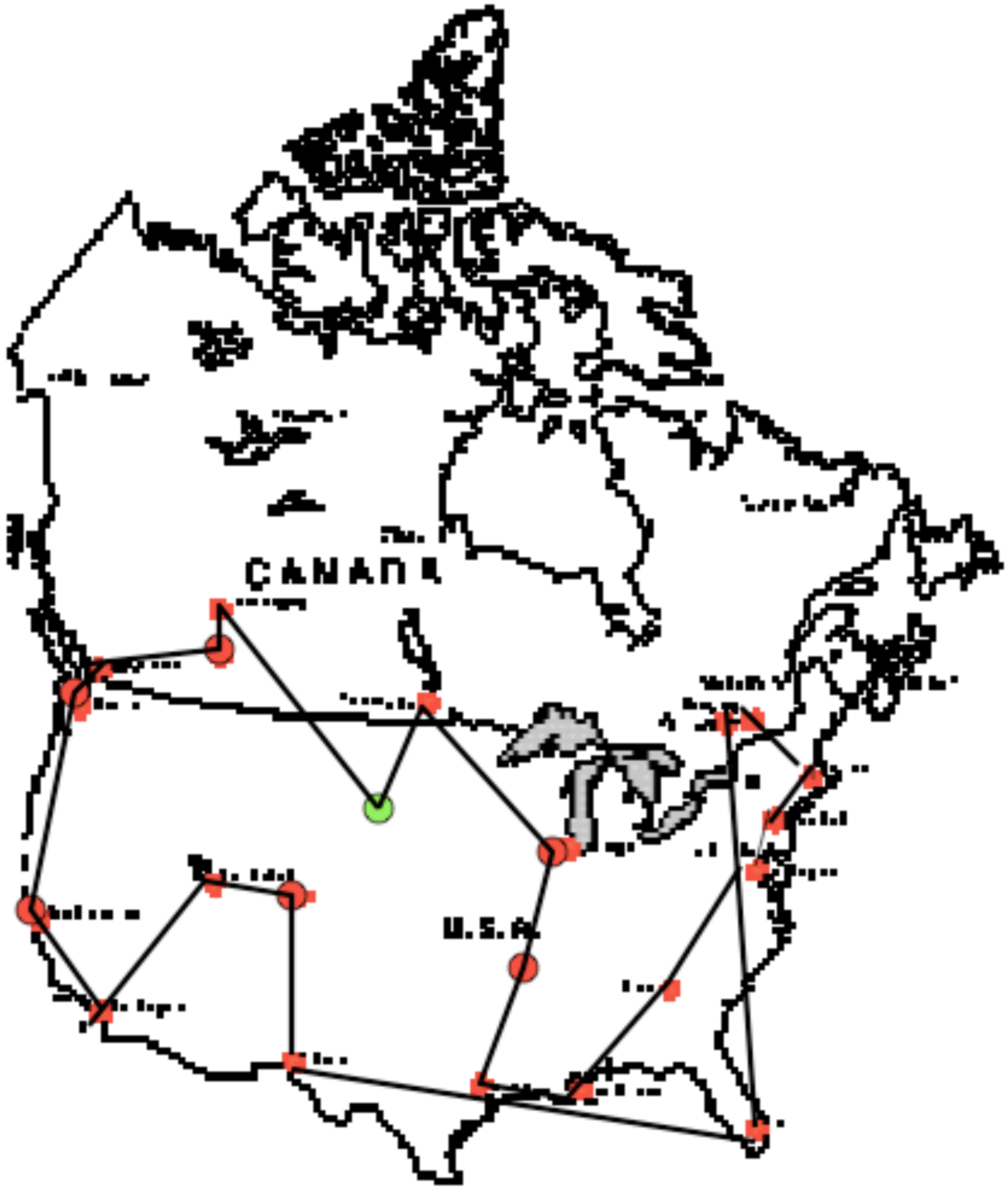
The key idea:

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

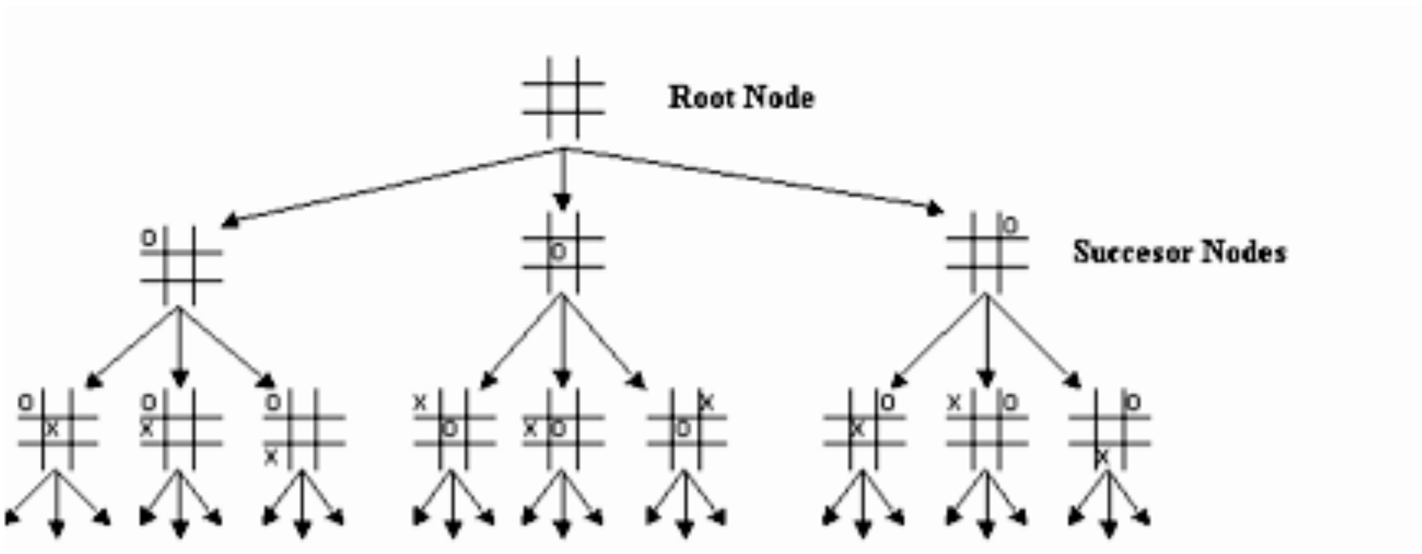
Problem solving steps

- State the problem
  - need to understand the problem completely before answers could be computed.
- Describe the input and output
  - be careful to include units to describe the input and output
- Develop an algorithm to solve the problem
  - make sure the model is right (right equations)
  - work through a simplified version of the problem by hand
- Solve the problem using a computer (MATLAB)
- Test the solution
  - Do the results make sense?
  - Do they match your sample calculations?

Algorithm: always go to the nearest unvisited city



A sense of complexity



Search trees for Tic-Tac-To