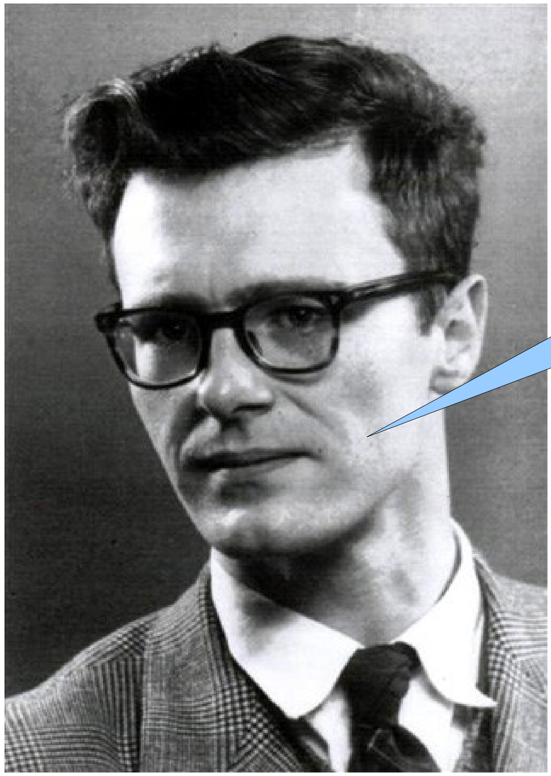
CSC148H
Introduction to Computer Science
(Summer 2009)

Instructor: Robert Danek
(rdanek@cdf.toronto.edu)

Lectures: BA1220 R4-6

What Computer Science Is Not

"Computer Science is no more about computers than astronomy is about telescopes."



Edsger W. Dijkstra

What Computer Science Is Not

PROGRAMMING != COMPUTER SCIENCE

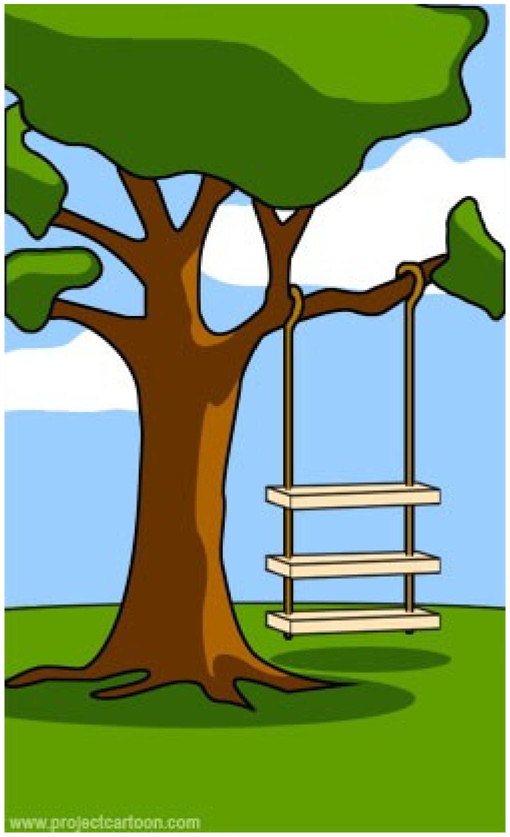
What is Computer Science?

- The study of problems, problem-solving, and the solutions that come out of the problem solving process

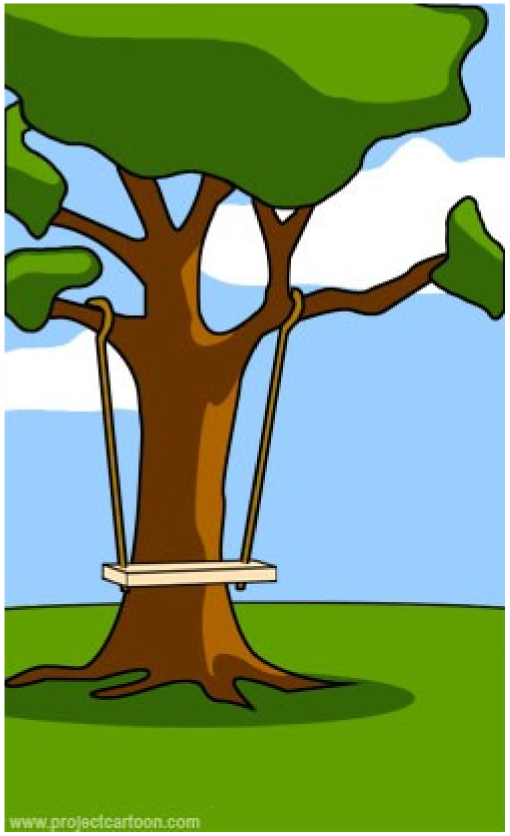
Steps to solving a CS problem

- **Specification**
  - Clear, precise descriptions
- Design
  - structure your solution carefully
  - employ abstraction
- Analysis
  - reason about an algorithm's efficiency and correctness
- Implementation
  - implement solution in some language
  - recursion vs. iteration?
  - which data structures to use?
- Verification
  - Unit testing

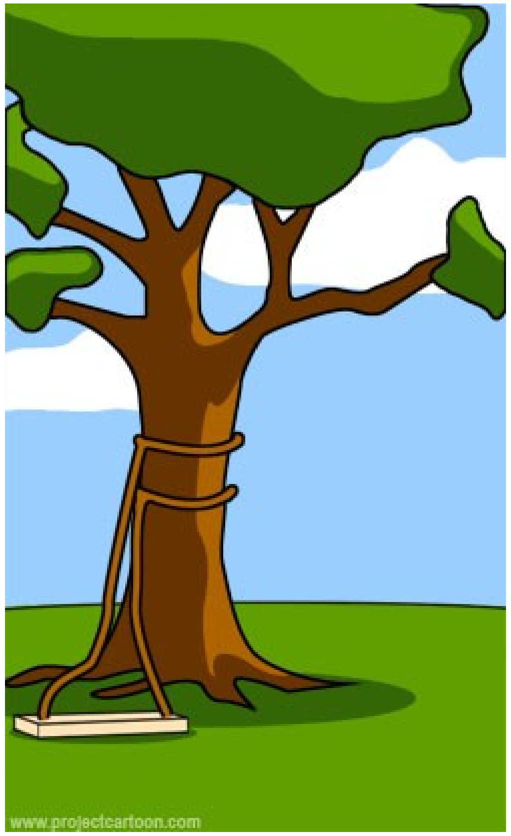
How the customer explained it



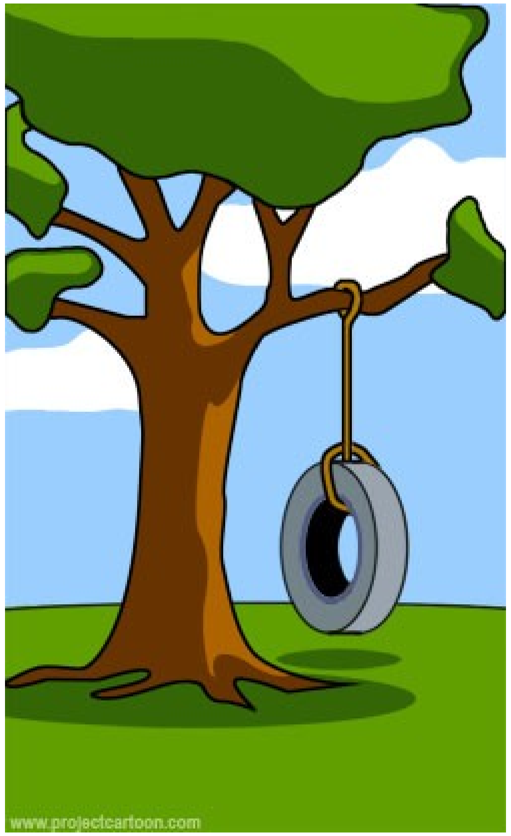
How the project leader understood it



How the programmer wrote it



What the customer really needed



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  - recursion vs. iteration?
  - Clean, modular, easy to understand code
- Verification
  - Unit testing
  - Write clear docs for tests

Abstraction

- **Abstraction** is an integral part of problem solving
  - Ignore certain details to make the problem easier to solve.
  - The details still need to be dealt with
  - Simplifies the process of problem solving

Abstract Data Types (ADTs)

- Fundamental computer science concept
- ***Abstract***: no mention of the implementation
- ***Data Type***:

  1) the data being stored, and
  2) the operations that can be performed on the data

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The Value of Testing

“Beware of bugs in the above code; I have only proved it correct, not tried it.”

Donald Knuth

ADT examples from CSC108/A08H

- List
  - Data: a sequence of objects, in order
  - Operations: append, index into, find, ...
- Dictionary
  - Data: a collection of key-value pairs
  - Operations: insert pair, lookup value with key, ...
- Both ideas are abstract, since
  - no mention of how data is stored in memory
  - how operations are performed

Stack ADT (2.3)

- A sequence of objects.
- Objects are removed in the ***opposite*** order they are inserted.
- Last-In-First-Out (LIFO)
- Like a stack of plates
- The object last inserted is at the **top**.

- Operations:
  - **push(o)** Add a new item to the top of the stack
  - **pop()** Remove and return top item
  - **peek()** Return top item
  - **isEmpty()** test if stack is empty
  - **size()** return # of items in stack

Uses For A Stack

- Keep track of pages visited in a browser tab
- Keep track of function calls in a running program
- Check for balanced parentheses

Python Stack Class

- How will we store the data?
- What effect does this decision have on speed?
- Lets explore in Wing.

Queue ADT (2.4)

- A sequence of objects.
- Objects are removed in the ***same*** order they are inserted.
- First-In-First-Out (FIFO)
- Like a store line up

- Operations:
  - **enqueue(o)** Add ***o*** to the end of the queue
  - **dequeue()** Remove and return object at the front of the queue
  - **front()** Return object at the front of queue
  - **isEmpty()** test if queue is empty
  - **size()** return # of items in queue

Uses for a Queue

- Queues are used in operating systems to keep track of processes waiting for a turn to use the CPU
- Graphical User Interfaces (GUIs)
  - Queues keep track of events waiting to be handled, like multiple button clicks

Implementation of a Queue

- Implementation of Queue using Python Lists

Priority Queue ADT

- A sequence of objects.
- Objects are removed in order of their priority
- Like a line up in a bank where the customer with largest bank account goes to the front

- Operations:
  - **insert(o)** Add ***o*** to the queue
  - **extractMin()** Remove and return object with minimum value
  - **min()** Return object with min. value
  - **isEmpty()** test if queue is empty
  - **size()** return # of items in queue

In Closing ...

- We covered the following :
  - Section 1.1-1.3 (What is Computer Science?)
  - Section 2.3 (Stacks), 2.4 (Queues)
  - Python Style Rules
- You may also want to read Section 1.4 if you need a review of Python
- Assignment 1 is now posted. It is due in two weeks.
- Next week: More Stacks and Queues, Exceptions, and OOA/OOD.