Introduction to Algorithms and Data Structures

CSC 1051 – Algorithms and Data Structures I

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Course website:
www.csc.villanova.edu/~map/1051/

Some slides in this presentation are adapted from the slides accompanying Java Software Solutions by Lewis & Loftus
What is this course about?

- Computer Science
- Problem solving
- Algorithmic thinking
- Data representation
- Software engineering
Our textbook

Java Software Solutions
Foundations of Program Design
Seventh Edition

John Lewis
William Loftus
Overview of today’s class

• Go over syllabus/course information
  – www.csc.villanova.edu/~map/1051
• Introduction to the course – reverse history of computing
• Try running a Java program
• Take the online survey
Reverse History of computing

Examine what we already know, travel backwards…

1. What we see now all around us – a connected world of computing

2. Focus on a single “traditional” computer

3. Dig deeper – data and processing
Networks

A network is two or more computers that are connected so that data and resources can be shared.

A Local-Area Network (LAN) covers a small distance and a small number of computers.

A Wide-Area Network (WAN) connects two or more LANs, often over long distances.
The Internet

- **History:** Started as a United States government project, sponsored by the Advanced Research Projects Agency (ARPA) in late 1970’s
  - 1980’s: *ARPANET*
    - the wide area network and Protocols for communication, including url’s developed
  - 1990’s: *World Wide Web*
    - html and web browsers

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IP and Internet Addresses

• Each computer on the Internet has a unique *IP address*, such as:

  204.192.116.2

• Most computers also have a unique Internet name, which also is referred to as an *Internet address*:

  hector.vt.edu
  kant.gestalt-llc.com

• The first part indicates a particular computer (*hector*)

• The rest is the *domain name*, indicating the organization (*vt.edu*)
Domain Names

- The last part of a domain name, called a *top-level domain* (TLD), supposedly indicates the type of organization:
  - edu: educational institution
  - com: commercial entity
  - org: non-profit organization
  - net: network-based organization

Sometimes the suffix indicates the country:
- uk: United Kingdom
- au: Australia
- ca: Canada
- se: Sweden

Additional TLDs have been added:
- biz
- info
- tv
- name
The World Wide Web

- The *World Wide Web* allows many different types of information to be accessed using a common interface

- A *browser* is a program which accesses network resources and presents them
  - Popular browsers: Internet Explorer, Safari, Firefox

- Resources presented include:
  - text, graphics, video, sound, audio, executable programs

- A Web document usually contains *links* to other Web documents, creating a *hypermedia* environment

- The term Web comes from the fact that information is not organized in a linear fashion
The World Wide Web

- Web documents are often defined using the *HyperText Markup Language* (HTML)

- Information on the Web is found using a *Uniform Resource Locator* (URL):
  
  http://www.cnn.com

  http://www.vt.edu/student_life/index.html

  ftp://java.sun.com/applets/animation.zip

- A URL specifies a protocol (http), a domain, and possibly specific documents
Reverse History of computing

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A Computer Specification

- Consider the following specification for a personal computer:
  - 3.07 GHz Intel Core i7 processor
  - 4 GB RAM
  - 750 GB Hard Disk
  - 16x Blu-ray / HD DVD-ROM & 16x DVD+R DVD Burner
  - 17” Flat Screen Video Display with 1280 x 1024 resolution
  - Network Card
Main memory is divided into many memory locations (or cells).

Each memory cell has a numeric address, which uniquely identifies it.
The Central Processing Unit

• A CPU is on a chip called a microprocessor

• It continuously follows the *fetch-decode-execute* cycle:

  - **fetch**: Retrieve an instruction from main memory
  - **decode**: Determine what the instruction is
  - **execute**: Carry out the instruction

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The Central Processing Unit

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  - **fetch**: Retrieve an instruction from main memory
  - **decode**: Determine what the instruction is
  - **execute**: Carry out the instruction
  - **system clock**: controls speed, measured in gigahertz (GHz)
The Central Processing Unit

- **Arithmetic / Logic Unit**: Performs calculations and makes decisions.
- **Control Unit**: Coordinates processing (system clock, decoding, etc).
- **Registers**: Small, very fast memory.
Automatic control of computation

• The concept of a machine that can follow a series of steps - a “program”

• Some early steps:
  – Jacquard loom (1801)
  – Babbage's Difference engine and Analytical engine (1822)
  – Holerith's census machine (1890)

• Stored program and the fetch/decode/execute cycle (John von Neumann, 1945)

• ENIAC - first fully electronic digital computer (Eckert and Mauchley, 1946)
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Binary Representation of Information

• Computers store all information digitally, in binary:
  – numbers
  – text
  – graphics and images
  – audio
  – video
  – program instructions
Mechanization of arithmetic

• Historic note – the creation of various special purpose calculators
  – Abacus (2400 BC)
  – Number systems (Babylonian, Greek, Roman, Arabic 1000 BC = 600 AD)
  – Stonehenge (1900-1600 BC)
  – Napier's bones (1600, a precursor of the slide rule)
  – Pascal's adder (1642)
  – Leibniz's calculator (1670s)
  – modern calculators
Mechanization of Arithmetic
+
Automatic Control of Computation
=
Modern Computer
Hardware and Software

• Hardware
  – the physical, tangible parts of a computer
  – keyboard, monitor, disks, wires, chips, etc.

• Software
  – programs and data
  – a *program* is a series of instructions

• A computer requires both hardware and software

• Each is essentially useless without the other
Software – What is it?
Communicating with a Computer

• Programming languages
  – Bridge the gap between human thought and
  – Computer binary circuitry

• Example Java program Lincoln.java
public class Lincoln
{
    public static void main (String[] args)
    {
        System.out.println ("A quote by Abraham Lincoln:");
        System.out.println ("Whatever you are, be a good one.");
    }
}
public class Lincoln {

    // Prints a presidential quote.
    public static void main (String[] args) {
        System.out.println ("A quote by Abraham Lincoln:");
        System.out.println ("Whatever you are, be a good one.");
    }
}

Output
A quote by Abraham Lincoln:
Whatever you are, be a good one.
Homework

• Read Chapter 1
  – **Always** do all self-review exercises when you review material

• Do Exercises EX 1.15-1.20

• Take the [online survey](#)