Welcome to COSC 1302

Introduction to Computer Science
(Syllabus)
Chapter 1

The Big Picture
1.1 Computing Systems

**Hardware**  The physical elements of a computing system (printer, circuit boards, wires, keyboard…)

**Software**  The programs that provide the instructions for a computer to execute
Layers of a Computing System
Abstraction

*Abstraction* = mental model that removes complex details
Internal View
(lots of details)
Abstract View
(few details)
Abstraction is a key concept.

*It will reappear throughout this class (and the rest of your life!)* Make sure you *grok* it!

[Link to Grok - Wikipedia]
QUIZ

Explain the abstractions we normally apply when using the following systems:

- DVD player
- Registering for classes on DuckTrax
- Walking

In each case, explain what is the internal view and what is the abstract view.
1.2 History of computing
Early History of Computing

**Abacus**  (about 1600 BC, or even 2700-2300 BC) = early device to record numeric values and perform addition and subtraction manually.

**Blaise Pascal**  1642
The *Pascaline* = mechanical device to *add and subtract* automatically.

**Gottfried Leibniz**  1672
The *Steppe Reckoner* = mechanical device to *add, subtract, divide & multiply*. Leibniz anticipated many of the hardware and software concepts developed later by Babbage & Lovelace. He invented *binary* notation!

**Joseph Jacquard**  1801
The *Jacquard Loom*. He invented *punched cards*!
Early History of Computing

Charles Babbage
- 1822: Difference Engine
- 1837-71: Analytical Engine

Ada Lovelace, the "Enchantress of numbers"
- 1843: Invented the loop (to calculate Bernoulli numbers).
- She’s considered the first programmer!

William Gibson & Bruce Sterling: The Difference Engine
Doron Swade: The Difference Engine, Cogwheel Brain
Early History of Computing

Herman Hollerith

- **Tabulating machine** used for 1890 U.S. Census.
- This is the official birthday of the data processing industry.
- The term **Super Computing** was first used by the New York World newspaper in 1931 to refer to a large custom-built tabulator that IBM made for Columbia University.

What to do for next class? (a.k.a. Individual work)

- Read pages 2-11 of our text and write in your notebook three facts not mentioned in class.
- Answer end-of-chapter Exercises 1-7, and 9 in the notebook.
- Answer end-of-chapter Thought Question 1 in the notebook:

  Identify 5 abstractions in our school environment. For each, indicate some of the details hidden by the abstraction, and how the abstraction helps manage complexity.
QUIZ

1. True or False? Computer software is the collection of programs that provide the instructions that a computer carries out.

2. True or False? An abstraction is a mental model that removes or hides complex details.

3. True or False? The abacus was the world's first electronic digital computer.

4. True or False? Ada Augusta, Countess of Lovelace, is credited with being the first programmer.
QUIZ

• What is **hardware**?

• What is **software**?

  ● What is an **abstraction** and why do we need abstractions in CS?
    
    ● What is the internal/physical view?
    
    ● What is the external/abstract view?
Match each inventor with his/her invention(s):

Pascal
Leibniz
Jacquard
Babbage
Lovelace

...’s Loom
Programming Loop
Punched Cards
Difference Engine
Stepped Reckoner (+-*/)
Binary Code
Mechanical + and –
Analytical Engine
Alan Turing and WWII computers

Bletchley Park
- German Enigma machine and British **Bombe** computers
- German Lorentz machine and British **Colossus** computers (Mark I, Mark II) – first electronic, digital, programmable computers

Alan Turing
- 1936: Turing Machine, Artificial Intelligence Testing (the Turing test)

"On Computable Numbers, with an Application to the Entscheidungsproblem" (decision problem)

Neil Stephenson: **Cryptonomicon**
Colossus Mark I
Computers after WWII
Late 40s and 50s

John von Neumann
1945: Stored-program computer, a.k.a. the von Neumann architecture

ENIAC, EDVAC, UNIVAC I

Univac I was delivered to the US Bureau of the Census

At the end of WWII, these early computers launched a new era in mathematics, physics, engineering and economics!
A (very) brief history of the hardware
First Generation Hardware (1951-1959)

**Vacuum Tubes**
Large, not very reliable, generate a lot of heat

**Magnetic Drum**
Memory device that rotated under a read/write head

**Card Readers → Magnetic Tape Drives**
Sequential auxiliary storage devices
Second Generation Hardware (1959-1965)

**Transistor**
Replaced vacuum tube, fast, small, durable, cheap

**Magnetic Cores**
Replaced magnetic drums, information available instantly

**Magnetic Disks**
Replaced magnetic tape, data can be accessed directly
Third Generation Hardware (1965-1971)

**Integrated Circuits (ICs)**
Replaced circuit boards, smaller cheaper, faster, more reliable

**Transistors**
Now used for memory construction

**Terminal**
An input/output device with a keyboard and screen
Fourth Generation Hardware (1971-2001)

Large- and Very Large Scale Integration (LSI, VLSI)
Great advances in chip technology

PCs, the Commercial Market, Workstations
Personal Computers and Workstations emerge
New companies emerge: Apple, Sun, Dell …

Laptops
Everyone has his/her own portable computer
Fifth Generation Hardware (2001-today)

Multi-core processors
IBM Power4, released in 2001, had 2 cores in the same chip.
QUIZ

Connect each generation of computer hardware with its defining technology:

1\textsuperscript{st} Gen. \hspace{1cm} ICs (SSI, MSI)
2\textsuperscript{nd} Gen. \hspace{1cm} Multi-core processors
3\textsuperscript{rd} Gen. \hspace{1cm} LSI, VLSI
4\textsuperscript{th} Gen. \hspace{1cm} Vacuum tubes
5\textsuperscript{th} Gen. \hspace{1cm} Transistors
Beyond the isolated computer

Parallel Computing
Computers rely on interconnected central processing and/or memory units that increase processing speed.

Computer Networks
- WAN technology started in 1969 with the ARPANET
- LAN technology started in 1973 with the Ethernet

WANs and LANs → Internet

Wide-Area Network

Local-Area Network
A (very) brief history of the software
First Generation Software (1951-1959)

**Machine Languages**
Computer programs written in binary (1s and 0s)

**Assembly Languages and Assemblers**
Programs written using mnemonics, which were translated into machine language

a.k.a. low-level languages (Ch.6)
Second Generation Software (1959-1965)

High-level Languages

English-like statements (print, for, while, if ... then ... else, etc.) made programming easier

• Examples: Fortran, COBOL, Lisp
Third Generation Software
(1965-1971)

**Systems Software**

**Operating system** (OS), which decides:

- Which programs to run and when
- What resources to allocate to each program
- What utility programs to call (e.g. loaders, linkers)

Programs are created to be used by nonprogrammers, e.g. SPSS.

New high-level languages for **structured programming**
Pascal, C, C++, ... 

Lots of New Applications for Users
• Spreadsheets
• Word processors
• Database management systems (DBMS)
Fifth Generation Software
(1990- present)

Object-Oriented Programming
Based on a hierarchy of data objects (e.g. Java, Python)

World Wide Web
• Allows easy global communication through the Internet
• Single-handedly invented by a physicist, along with the HTML and the first browser!!

Microsoft and the OFFICE SUITE
**Component-Oriented Programming**

- Aims to enhance code reusability (80% of software development is maintenance of old code!)
- The component model specifies how interfaces should be defined and the elements that should be included in an interface definition.

Examples of component models:
- Enterprise JavaBeans (EJB)
- Component Object Model (COM)
- .NET
- Common Object Request Broker Architecture (CORBA)
QUIZ

Connect each generation of computer software with its defining technology:

1\textsuperscript{st} Gen. \hspace{1cm} OOP
2\textsuperscript{nd} Gen. \hspace{1cm} Structured progr.
3\textsuperscript{rd} Gen. \hspace{1cm} Systems software (OS)
4\textsuperscript{th} Gen. \hspace{1cm} Component-oriented progr.
5\textsuperscript{th} Gen. \hspace{1cm} Machine and assembly progr.
6\textsuperscript{th} Gen. \hspace{1cm} High-level programs
SKIP:
• Computing as a Discipline
• Computing as a Tool
• Areas of Computer Science
Who am I?

Read Ada’s bio on pp.13-14
Ethical Issues

What is “The Tenth Strand”?

• Read pp.27-28 in our text.
• For more info, follow link on our webpage!
Chapter review questions

• Describe the layers of a computer system
• Describe the concept of abstraction and its relationship to computing
• Describe the history of computer hardware and software (only the material covered)
• Why is Ada Lovelace important to CS?
• Explain the “tenth strand”
Individual work
To do by next class, before starting to work on homework:

• Read the entire Chapter 1
  • Read Ada Lovelace’s bio
  • Read Ethical Issues: The Tenth Strand
• Give brief answers to the chapter review questions
• Answer end-of-chapter questions 1 – 38 in your notebook
Homework
Due next Wed, Sep.2:

• End-of-chapter ex. 50 – 59
• End-of-chapter thought question 3  
  (paragraph-length answer required)

The latest homework assigned is always available on the course webpage: www.agapie.net