

# CSC 221: Computer Programming I

Spring 2008

## Computer basics and history

- hardware vs. software
- generations of computer technology
- evolution of programming
- why Java?
- exploring object concepts using Alice
  - class, object, field, method

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## hardware vs. software

### basic terminology:

- hardware – the physical components of the computer
  - e.g., processor (Pentium 4, Celeron, Athlon, PowerPC, Alpha)
  - memory (RAM, cache, hard drive, floppy drive, flash stick)
  - input/output devices (keyboard, mouse, monitor, speaker)
- software – programs that run on the hardware
  - e.g., operating system (Vista, Windows XP, Mac OS X, Linux)
  - applications (Word, Excel, PowerPoint, RealPlayer, IE, Mozilla Firefox)
  - development tools (JDK, BlueJ, .NET, CodeWarrior)

*The easiest way to tell the difference between hardware and software is to kick it. If it hurts your toe, it's hardware.*

Carl Farrell

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## History of computing technology

### DYK?

- When were "modern" computers invented?
- When were computers accessible/affordable to individuals?
- When was the Internet born?
- When was the Web invented?
- How did Bill Gates get so rich?

the history of computers can be divided into generations, with each generation defined by a technological breakthrough

- 0. gears and relays
  - 1. vacuum tubes
  - 2. transistors
  - 3. integrated circuits
  - 4. very large scale integration
  - 5. parallel processing & networking

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## Generation 0: Mechanical Computers (1642-1945)

### 1642 – Pascal built a mechanical calculating machine

- mechanical gears, hand-crank, dials and knobs
- other similar machines followed

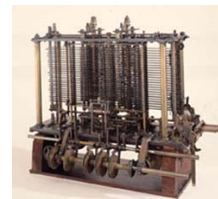


### 1805 – first programmable device, Jacquard loom

- wove tapestries with elaborate, programmable patterns
- pattern represented by metal punch-cards, fed into loom
- could mass-produce tapestries, reprogram with new cards

### mid 1800's – Babbage designed "analytical engine"

- expanded upon mechanical calculators, but programmable via punch-cards
- described general layout of modern computers
- never functional, beyond technology of the day



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## Generation 0 (cont.)

### 1890 – Hollerith invented tabulating machine

- used for 1890 U.S. Census
- stored data on punch-cards, could sort and tabulate using electrical pins
- finished census in 6 weeks (vs. 7 years)
- Hollerith's company would become IBM



### 1930's – several engineers independently built "computers" using electromagnetic relays

- physical switch, open/close via electrical current
- Zuse (Nazi Germany) – destroyed in WWII
- Atanasoff (Iowa State) – built with grad student
- Stibitz (Bell Labs) – followed design of Babbage

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## Generation 1: Vacuum Tubes (1945-1954)

### mid 1940's – vacuum tubes replaced relays

- glass tube w/ partial vacuum to speed electron flow
- faster than relays since no moving parts
- invented by de Forest in 1906



### 1940's – hybrid computers using vacuum tubes and relays were built

#### COLOSSUS (1943)

- built by British govt. (Alan Turing)
- used to decode Nazi communications

#### ENIAC (1946)

- built by Eckert & Mauchly at UPenn
- 18,000 vacuum tubes, 1,500 relays
- weighed 30 tons, consumed 140 kwatts

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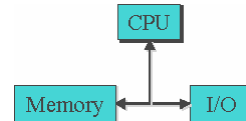
## Generation 1 (cont.)

### COLOSSUS and ENIAC were not general purpose computers

- could enter input using dials & knobs, paper tape
- but to perform a different computation, needed to reconfigure

### von Neumann popularized the idea of a "stored program" computer

- store both data and programs in Memory
- Central Processing Unit (CPU) executes by loading program instructions from memory and executing them in sequence
- interact with the user via Input/Output devices



virtually all modern machines follow this *von Neumann Architecture*

### programming was still difficult and tedious

- each machine had its own *machine language*, 0's & 1's corresponding to the settings of physical components
- in 1950's, *assembly languages* replaced 0's & 1's with mnemonic names

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## Generation 2: Transistors (1954-1963)

### mid 1950's – transistors began to replace tubes

- piece of silicon whose conductivity can be turned on and off using an electric current
- smaller, faster, more reliable, cheaper to mass produce
- invented by Bardeen, Brattain, & Shockley in 1948 (won 1956 Nobel Prize in physics)



### computers became commercial as cost dropped

high-level languages were designed to make programming more natural

- FORTRAN (1957, Backus at IBM)
- LISP (1959, McCarthy at MIT)
- BASIC (1959, Kemeny at Dartmouth)
- COBOL (1960, Murray-Hopper at DOD)

the computer industry grew as businesses could buy Eckert-Mauchly (1951), DEC (1957) IBM became market force in 1960's

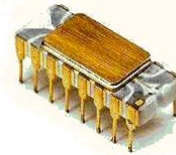
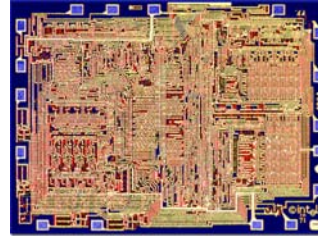
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## Generation 3: Integrated Circuits (1963-1973)

### integrated circuit (IC)

- as transistor size decreased, could package many transistors with circuitry on silicon chip
- mass production further reduced prices

1971 – Intel marketed first *microprocessor*, the 4004, a chip with all the circuitry for a calculator



### 1960's saw the rise of Operating Systems

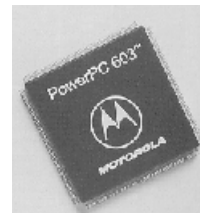
- an *operating system* is a collection of programs that manage peripheral devices and other resources
- allowed for *time-sharing*, where users share a computer by swapping jobs in and out
- as computers became affordable to small businesses, specialized programming languages were developed
  - Pascal (1971, Wirth), C (1972, Ritchie)

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## Generation 4: VLSI (1973-1985)

### Very Large Scale Integration (VLSI)

- by mid 1970's, could fit hundreds of thousands of transistors w/ circuitry on a chip
- could mass produce powerful microprocessors and other useful IC's
- computers finally affordable to individuals



### late 1970's saw rise of personal computing

- Gates & Allen founded Microsoft in 1975
  - Gates wrote BASIC compiler for personal computer
  - would grow into software giant, Gates richest in world
  - <http://evan.quuxuum.org/bgnw.html>
- Wozniak and Jobs founded Apple in 1977
  - went from garage to \$120 million in sales by 1980
- IBM introduced PC in 1980
  - Apple countered with Macintosh in 1984
- Stroustrup developed C++ in 1985
  - object-oriented extension of C language

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## Evolution of programming: assembly language

mid 1950's: assembly languages  
replaced numeric codes with  
mnemonic names

- an *assembler* is a program that translates assembly code into machine code
  - input*: assembly language program
  - output*: machine language program
- still low-level & machine-specific, but easier to program

```
gcc2_compiled.:
    .global _Q_qtod
    .section      ".rodata"
    .align 8
.LLC0: .asciz  "Hello world!"
    .section      ".text"
    .align 4
    .global main
    .type        main,#function
    .proc        04
main:  !#PROLOGUE# 0
    save %sp,-112,%sp
    !#PROLOGUE# 1
    sethi %hi(cout),%o1
    or %o1,%lo(cout),%o0
    sethi %hi(.LLC0),%o2
    or %o2,%lo(.LLC0),%o1
    call __ls__7ostreamPcc,0
    nop
    mov %o0,%l0
    mov %l0,%o0
    sethi %hi(endl__FR7ostream),%o2
    or %o2,%lo(endl__FR7ostream),%o1
    call
__ls__7ostreamPFR7ostream_R7ostream,0
    nop
    mov 0,%i0
    b .LL230
    nop
.LL230: ret
    restore
.LLfel: .size    main,.LLfel-main
    .ident  "GCC: (GNU) 2.7.2" 13
```

## Evolution of programming: high-level language

late 1950's – present:  
high-level languages allow the  
programmer to think at a  
higher-level of abstraction

- a *compiler* is a program that translates high-level code into machine code

*input*: C++ language program  
*output*: machine language program

similar to assembler, but more complex

- an interpreter is a program that reads and executes each language statement in sequence

Java programs are first compiled into a virtual machine language (Java byte code)  
then the byte code is executed by an interpreter (Java Virtual Machine)

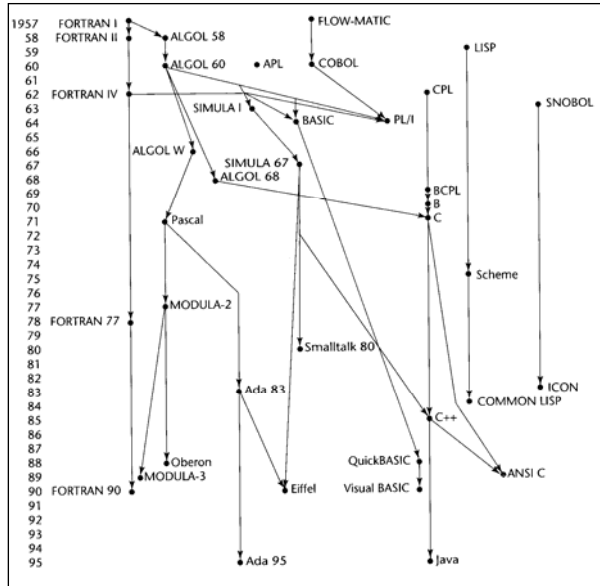
```
/**
 * This class can print "Hello world!"
 * @author Dave Reed
 * @version 8/20/07
 */

class Greeter {
    public Greeter() { }

    public void SayHello() {
        System.out.println("Hello world!");
    }
}
```

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## Why Java?



Java is a general-purpose, object-oriented language

- derived from C++, which was an object-oriented extension of C
- Java was designed to be a simpler, more robust language
- added features to make software engineering easier; removed features that led to confusion

Java and C++ are the dominant languages in industry

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## If you want to know more...

check out the following (purely optional) links

[Inventors: The History of Computers](#)

[Computer Museum History Center](#)

[Transistorized! from PBS.org](#)

[Apple Computer Reading List](#)

[The History of Microsoft](#)

[Internet Pioneers: Tim Berners-Lee](#)

[Internet Pioneers: Marc Andreessen](#)

[Wikipedia entry on Programming Languages](#)

[Webopedia entry on Programming Languages](#)

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## Exploring objects with Alice

Alice is a simple environment for creating and viewing 3-D animations

- developed at Carnegie Mellon University for teaching introductory programming

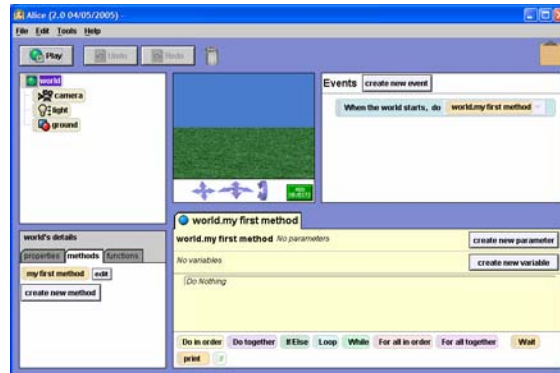
- great for making object-oriented concepts concrete

*class*: blueprint for a type of figure

*object*: a particular figure in the scene (i.e., an instance of a class)

*fields*: properties of an object

*methods*: actions that the object can perform

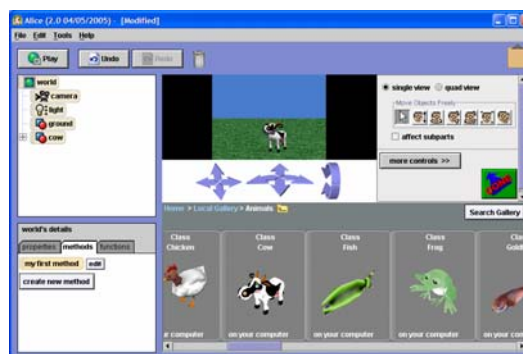
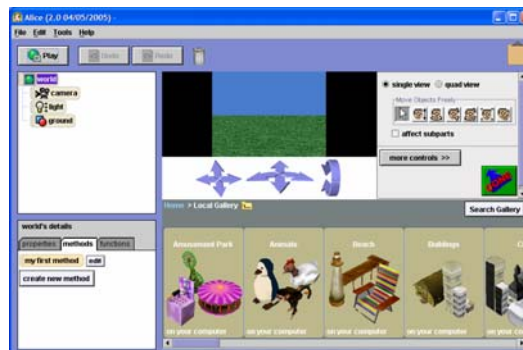


when you start up Alice, you get a blank scene (perhaps some default prompts the first time)

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## Alice

- click on the "Add Object" button to see a menu of figure types (i.e., classes) across the bottom
- you can click on any category, then select a figure type (i.e., class) and drag it onto the scene above
- you can resize/reorient this figure (i.e., object) using the buttons at the top-right
- you can add and position multiple figures (i.e., objects) in the scene, even multiple instances of the same type (i.e., objects of same class)
- click "Done" when the scene is set



## Alice

- each figure (i.e., **object**) is composed of many smaller figures (i.e., **objects**)
- you can inspect the composite structure of a figure (i.e., **object**) in the upper-left pane
- each figure (i.e., **object**) has properties (i.e., **fields**) and predefined actions (i.e., **methods**)
- you can inspect these in the lower-left pane
- to perform an action (i.e., **call a method**), drag its box into the lower-right pane and select values (i.e., **parameters**) when prompted
- then, click on the "Play" button



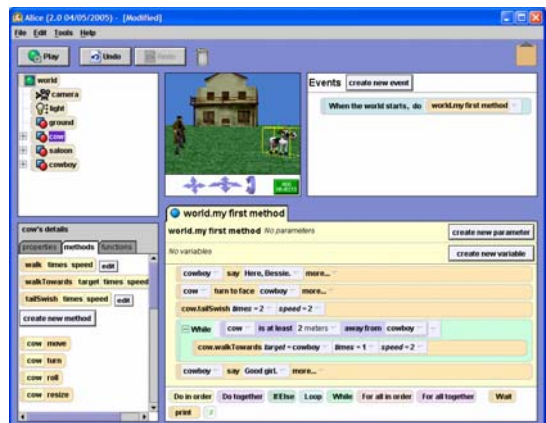
## Alice

- you can drag a sequence of actions (i.e., **method calls**) into the lower-right pane to produce complex animations
- at the bottom of the pane, are drag-and-drop "control statements"

*Do-together*: allows you to group actions (i.e., method calls) and perform them simultaneously

*Loop*: allows you to perform an action (i.e., method call) a specified number of times

*If/Else* and *While*: allow for conditional actions (i.e., method calls based on some condition) – must use functions from the lower-left pane for the condition



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