COMP 202

Introduction to Computing 1

WELCOME

Focus of the Course

- Introduction to programming using Java
- Aimed at students with LITTLE or NO background in programming and knowledge of Computer Science

Course Outline

- Week 1-2: Introduction
- Weeks 2-3: Java in 2 weeks
  - Variables and assignments
  - if-then-else and loops
  - the class concept
- Week 4: Data and Expression and classes in detail
- Weeks 5-6: Control structures
- Week 7-8: Object-oriented programming
- Week 9: Arrays
- Week 10-13: Advanced Topics

Week 1

- Administrative
- What is programming?
- How does a computer work?
- Our first programs

Instructor Coordinates

- Clark Verbrugge
  - `clump@cs.mcgill.ca`
- McConnell Eng. Building, Room 230
  - `www.sable.mcgill.ca/~clump`
- Office Hours:
  - Wednesday 10:00 am -11:00 am
  - Friday 10:00 am – 11:00am
- Course website:
  - `www.cs.mcgill.ca/~cs202`

Structure

- Placement Quiz
- 3 hours lecture per week
- 9 tutorials
- Lab TA-Office hours
  - 7 hours per week
  - Times will be announced next week
  - TA's will patrol and be in a nearby room

Tutorials: TBA

- Tutorial 1 is next week
    - Several sessions
    - Date, place TBA
- Tutorial 1:
  - SOCS accounts, basics of Unix
  - WebCT
  - DrJava
- Tutorial 2 and 3:
  - basics of programming
- Tutorials 4, 6, 7, 8:
  - advanced programming
- Tutorials 5 and 9:
  - preparation for midterm, exam

What you have to do

- 5 Assignments
  - Part 1
    - Not graded
    - Simple questions and small exercises to reinforce what was learned in class and help study
    - TAs will help during lab hours to solve the problems
  - Part 2
    - Graded
    - Programming tasks
- Midterm + Final
- Labs: Optional, but highly recommended

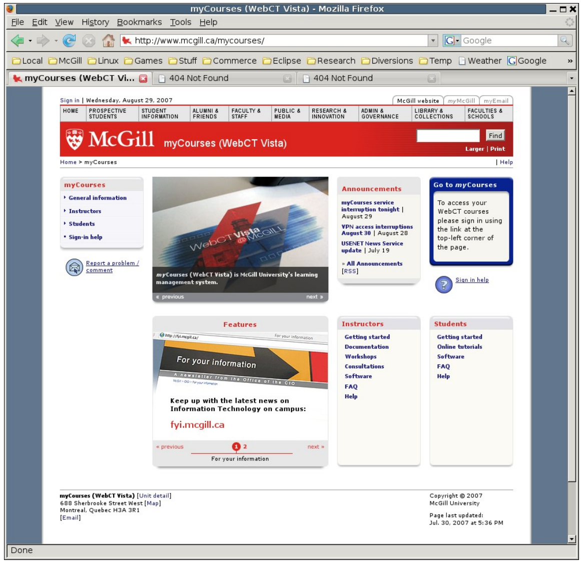
Grading Scheme

- Assignments: 30%
  - Assignments 1 through 4 have the same weight (5%)
  - Assignments 5: 10%
  - Late penalty
- Midterm: 20%
  - Date to be set soon
- Final: 50%

Communication

- WebCT Vista
  - Lecture notes
  - Assignments
  - Frequently asked questions
  - Discussions
  - Announcements
  - …
- Notes, assigs also on website:
  - `www.cs.mcgill.ca/~cs202`

www.mcgill.ca/webct



Sign in | Wednesday, August 29, 2007

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USENET News Service update | July 19

» All Announcements [RSS]

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To access your WebCT courses please sign in using the link at the top-left corner of the page.

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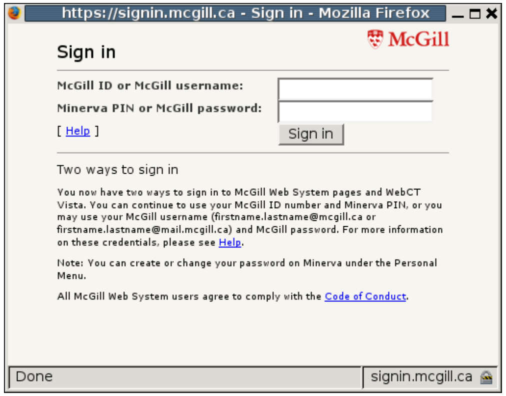
Login Screen



Sign in

McGill ID or McGill username:

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[Help]

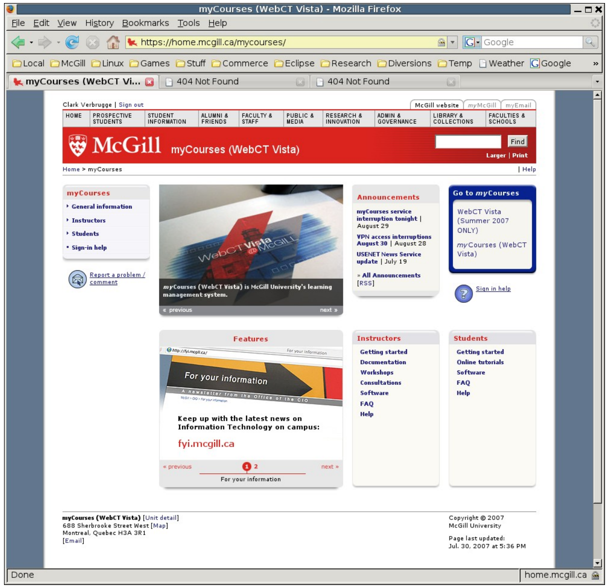
Two ways to sign in

You now have two ways to sign in to McGill Web System pages and WebCT Vista. You can continue to use your McGill ID number and Minerva PIN, or you may use your McGill username (firstname.lastname@mcgill.ca or firstname.lastname@mail.mcgill.ca) and McGill password. For more information on these credentials, please see Help.

Note: You can create or change your password on Minerva under the Personal Menu.

All McGill Web System users agree to comply with the Code of Conduct.

Selection Screen



Clark Verbrugge | Sign out

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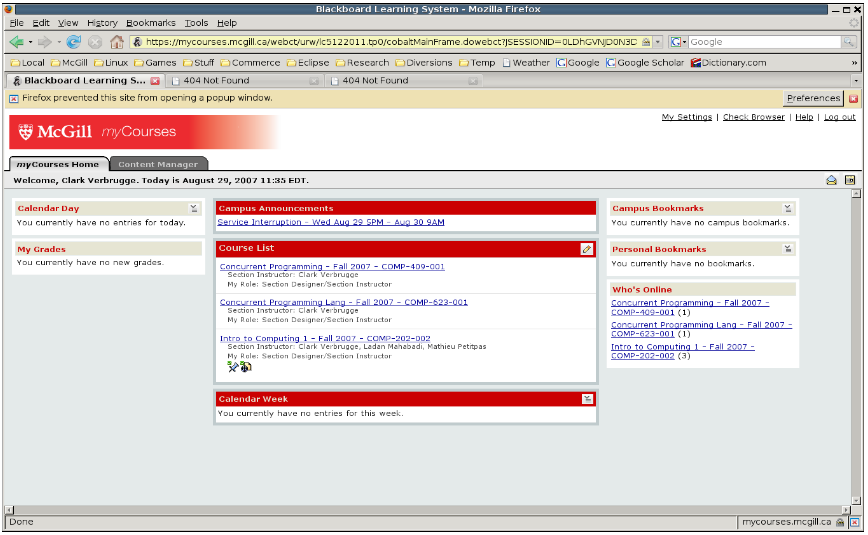
Course List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Firefox prevented this site from opening a popup window.

My Settings | Check Browser | Help | Log out

Welcome, Clark Verbrugge. Today is August 29, 2007 11:35 EDT.

Calendar Day
You currently have no entries for today.

My Grades
You currently have no new grades.

Campus Announcements
Service Interruption - Wed Aug 29 5PM - Aug 30 9AM

Course List

Concurrent Programming - Fall 2007 - COMP-409-001
Section Instructor: Clark Verbrugge
My Role: Section Designer/Section Instructor

Concurrent Programming Lang - Fall 2007 - COMP-623-001
Section Instructor: Clark Verbrugge
My Role: Section Designer/Section Instructor

Intro to Computing 1 - Fall 2007 - COMP-202-002
Section Instructor: Clark Verbrugge, Ladan Mahabadi, Mathieu Petitpas
My Role: Section Designer/Section Instructor

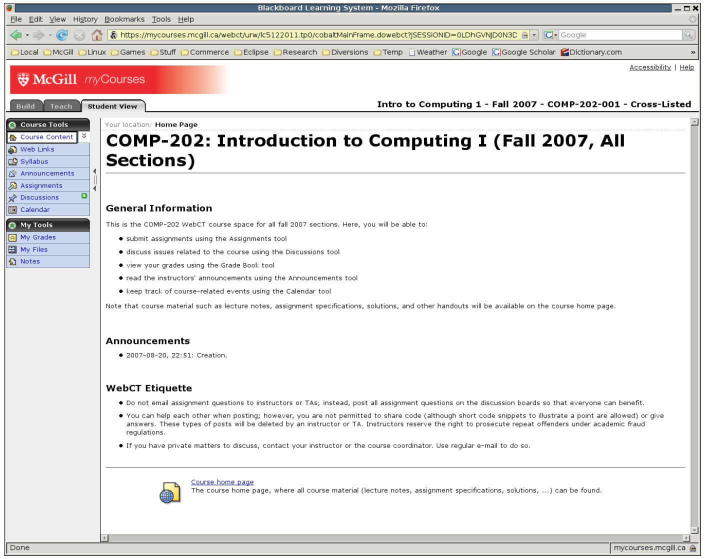
Calendar Week
You currently have no entries for this week.

Campus Bookmarks
You currently have no campus bookmarks.

Personal Bookmarks
You currently have no bookmarks.

Who's Online
Concurrent Programming - Fall 2007 - COMP-409-001 (1)
Concurrent Programming Lang - Fall 2007 - COMP-623-001 (1)
Intro to Computing 1 - Fall 2007 - COMP-202-002 (3)

The Course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Intro to Computing 1 - Fall 2007 - COMP-202-001 - Cross-Listed

Your location: **Home Page**

COMP-202: Introduction to Computing I (Fall 2007, All Sections)

General Information

This is the COMP-202 WebCT course space for all fall 2007 sections. Here, you will be able to:

- submit assignments using the Assignments tool
- discuss issues related to the course using the Discussions tool
- view your grades using the Grade Book tool
- read the instructors' announcements using the Announcements tool
- keep track of course-related events using the Calendar tool

Note that course material such as lecture notes, assignment specifications, solutions, and other handouts will be available on the course home page.

Announcements

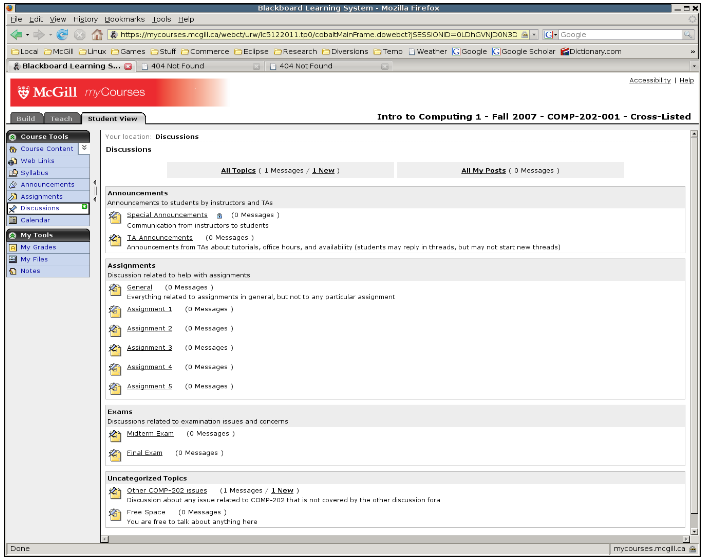
- 2007-08-20, 22:51: Creation.

WebCT Etiquette

- Do not email assignment questions to instructors or TAs; instead, post all assignment questions on the discussion boards so that everyone can benefit.
- You can help each other when posting; however, you are not permitted to share code (although short code snippets to illustrate a point are allowed) or give answers. These types of posts will be deleted by an instructor or TA. Instructors reserve the right to prosecute repeat offenders under academic fraud regulations.
- If you have private matters to discuss, contact your instructor or the course coordinator. Use regular e-mail to do so.

Course home page
The course home page, where all course material (lecture notes, assignment specifications, solutions, ...) can be found.

Discussions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Intro to Computing 1 - Fall 2007 - COMP-202-001 - Cross-Listed

Your location: **Discussions**

Discussions

All Topics (1 Messages / **1 New**) **All My Posts** (0 Messages)

Announcements
Announcements to students by instructors and TAs

Special Announcements (0 Messages)
Communication from instructors to students

TA Announcements (0 Messages)
Announcements from TAs about tutorials, office hours, and availability (students may reply in threads, but may not start new threads)

Assignments
Discussion related to help with assignments

General (0 Messages)
Everything related to assignments in general, but not to any particular assignment

Assignment 1 (0 Messages)

Assignment 2 (0 Messages)

Assignment 3 (0 Messages)

Assignment 4 (0 Messages)

Assignment 5 (0 Messages)

Exams
Discussions related to examination issues and concerns

Midterm Exam (0 Messages)

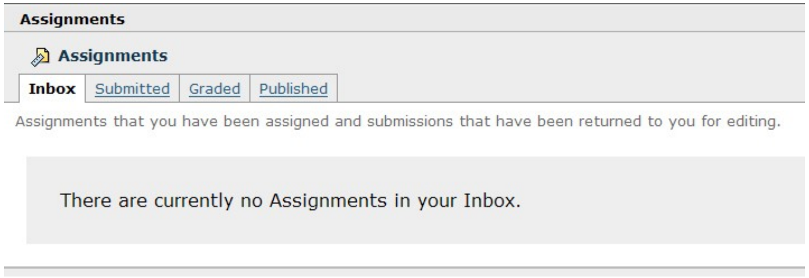
Final Exam (0 Messages)

Uncategorized Topics

Other COMP-202 issues (1 Messages / **1 New**)
Discussion about any issue related to COMP-202 that is not covered by the other discussion fora

Free Space (0 Messages)
You are free to talk about anything here

Assignments



Assignments

Assignments

Inbox | Submitted | Graded | Published

Assignments that you have been assigned and submissions that have been returned to you for editing.

There are currently no Assignments in your Inbox.

What is programming?

What do other sciences do?

- Life Science:
  - Example: study how a cell works
  - cell is something compex that already exists
  - researcher tries to figure out how this complex cell works
    - get background knowledge
    - learn laboratory skills
    - make hypothesis
    - run many experiments to see whether hypothesis works
- Engineer
  - Example: build a bridge
  - Create something new
    - Must follow many rules --> must work
    - Must know the math, materials, physics,…
  - What is more complex: a cell or a bridge?

What do Computer Scientists do?

- Example: build the web-portal for an online bookstore
- Create something new
  - Webpages
  - Functionality:
    - browse with keywords
    - Maintain your shopping card
    - Perform checkout
- What is more complex: a cell or a piece of software?

Let’s start small: Recipe for Scrambled Eggs

- Ingredients: two eggs, tablespoon of oil, salt
- Instructions:
  - Add oil to pan
  - Heat pan on stove
  - Crack eggs into pan
  - Add salt
  - Mix until light and flakey
- Output: scrambled eggs

What if we did not follow the order?

A recipe is a series of steps

Currency Exchange

1. Input:
   - *Amount*
   - *Source Currency*
   - *Desired Currency*

- Instructions
  - Look up in table current *exchange rate* for the selected currencies
  - Calculate *result* as *amount* * *exchange rate*
- Output: *result*

What is a program?

- A program solves a particular task
- A program is a list of instructions
- The list must be ordered correctly
- A program has inputs and outputs
- Each instruction tells the computer to do something (an action, a calculation, a comparison)

What is software?

- Software = Program ?
- Software typically consists of many subcomponents / modules / subprograms
- Each subprogram solves a particular task
- Software also includes the data to be used and manipulated
  - input / output data
  - internal data (e.g, table with exchange rates)

The bank machine: functionality

- Withdraw money from checking account
- Show balance on checking account
- Show balance on saving account
- Transfer money from checking account to saving account
- Transfer money from saving account to checking account
- Deposit money on checking account
- Deposit money on saving account
- Make bill payment from checking account
- …

The bank machine: Interaction

- Login (sub-program)
- Task menu (each being a sub-program)
  - Withdraw
  - Balance
  - Transfer
  - Deposit
  - Bill payment
- Once task is selected walk-through for specific task on hand
  - requires different input data, produces different output
- Allow many tasks in one session
- logout

The bank machine: login

- Input: pin
- If pin is correct
  - Result: go to task menu
- Else get new pin as input
- If pin is correct
  - Result: go to task menu
- Else get new pin as input
- If pin is correct
  - Result: go to task menu
- Else print warning, do not release card

Bank machine: money transfer

- Input ?
- Instructions?
- Output?

Goal of this Course

- Translate a complex task into the software that executes this tasks
  - ***Structure*** the problem space into many small sub-tasks
  - Write programs for each subtask
  - ***Connect the programs*** to build software
- At the end of course, you will be able to write a program that simulates a bank machine (and many other things)
  - Of course, since we don’t have the machines themselves, no “real” money and “real” cards are involved

The Java Programming language

- A *programming language* specifies the words and symbols that we can use to write a program
- A programming language employs a set of rules that dictate how the words and symbols can be put together to form valid *program statements*
- Java was created by Sun Microsystems, Inc.
- It was introduced in 1995 and has become quite popular
- It is an object-oriented language

Our first Java Program

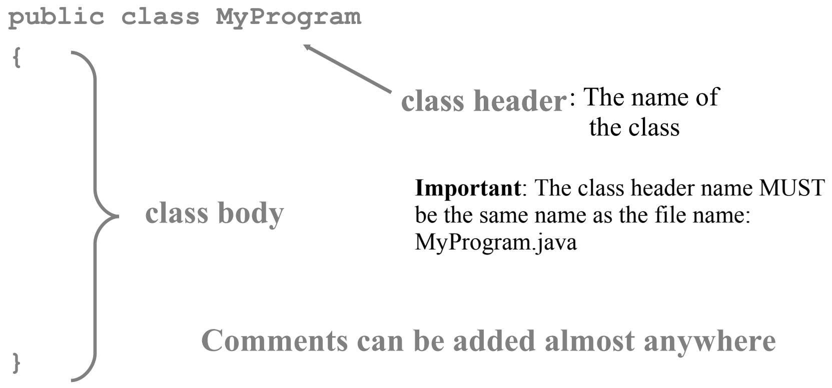
```
public class MyFirstProgram
{
  public static void main (String [] args)
  {
     // let’s say hello
    System.out.println(“hello world!”);
  }
}
```

Output: hello world

Program Structure (for now)

- Each program is a file
- Each program describes one *class*
- A *class* describes a real-life concept
  - Bank machine, Calculator, System.out, MyFirstProgram
- A *class* has data and methods (functions, operations)
- Example methods
  - *main method (*most classes have one main method*)*
  - *println*
  - In the example, we provide an implementation for *main* and we use *println* (somebody else has already programmed this method; we simply call it)
- A method contains statements
  - Statements are the instruction steps that are executed when the program runs
- Ignore *public, static, void, args* for now

Java Program Structure



```
public class MyProgram
{

}
```

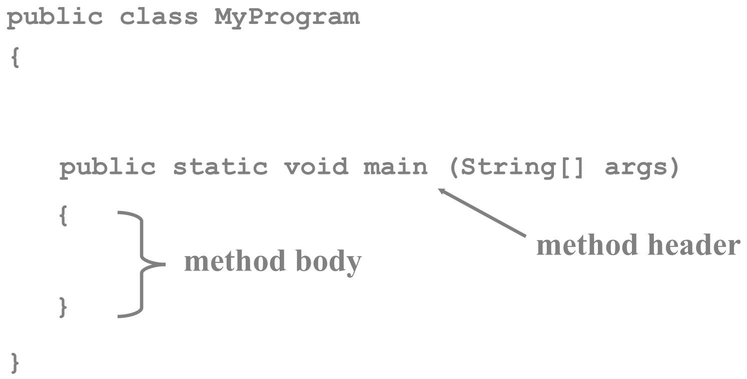
class header: The name of the class

class body

Important: The class header name MUST be the same name as the file name: MyProgram.java

Comments can be added almost anywhere

Java Program Structure



```
public class MyProgram
{

    public static void main (String[] args)
    {

    }

}
```

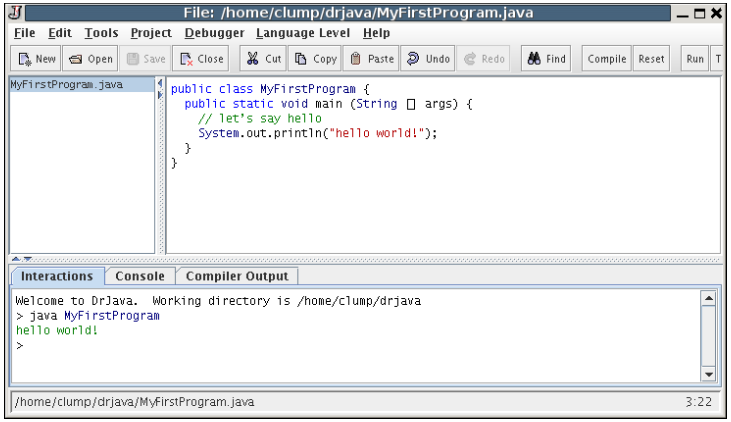
method header

method body

Syntax is important

- Natural Languages are ambiguous
- Programming languages may not!
- Examples of Java syntax rules
  - The class name is the same as the file name
  - Parenthesis
- Comments
  - Describe purpose and programming steps
  - Do not affect what the program does
  - Syntax:
    - // this is a comment
    - /* this is a comment */

DrJava



```
public class MyFirstProgram {
  public static void main (String [] args) {
    // let's say hello
    System.out.println("hello world!");
  }
}
```

```
Welcome to DrJava.  Working directory is /home/clump/drjava
> java MyFirstProgram
hello world!
>
```

Compiling and running a program in DrJava

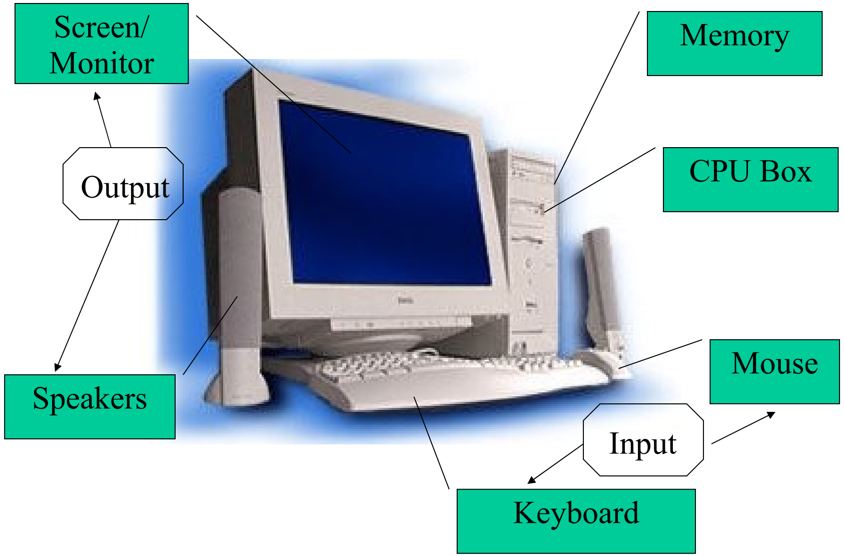
- Type in your program
- Save the program
  - Store all your files in one directory for now
  - Give the program the same name as the class
- Compile the program
  - this produces a .class file
  - Translates the program into something the computer can understand and execute
- Run the program
- Observe the result and adjust the program if necessary

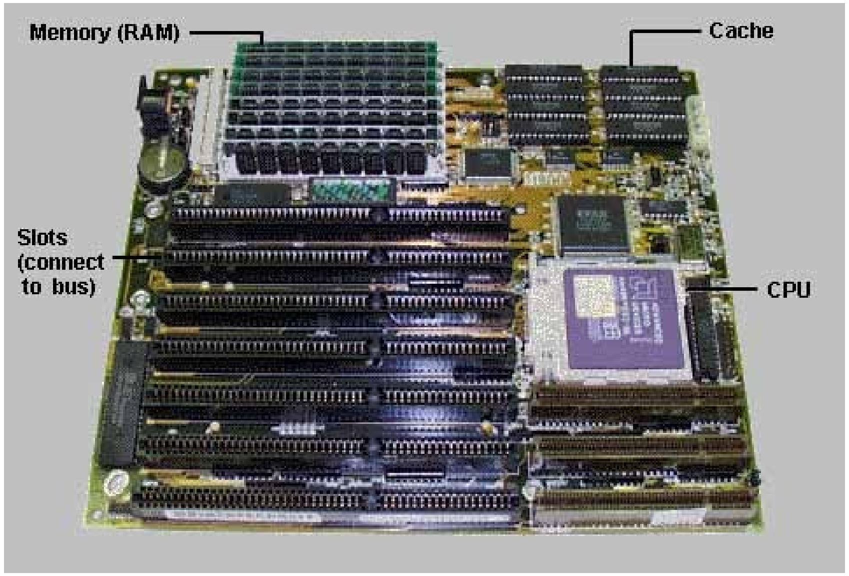
How a computer works

Hardware and Software

- Hardware
  - the physical, tangible parts of a computer
  - keyboard, monitor, wires, chips, mouse
- Software
- A computer requires both hardware and software
- Each is essentially useless without the other

The Personal Computer





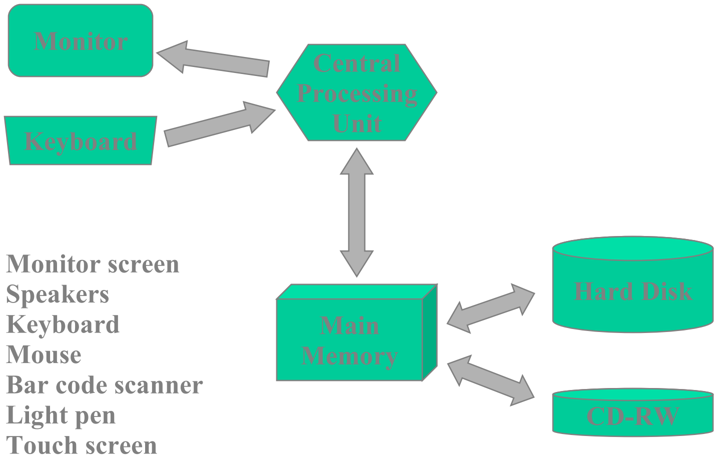
CPU (Central Processing Unit)

- Performs instructions
  - Arithmetic operations
  - Much more fine-grained than what we have seen so far
  - Controls the information / data in a computer

Memory

- Memory holds the data
- Main memory (most of it called RAM):
  - Data has to be in main memory so that CPU can access it
  - Volatile: lost when program exits; computer shuts off
- Disk / CD
  - Persistent
  - This is where you keep the data for long-term storage

Interaction



Monitor

Keyboard

Central Processing Unit

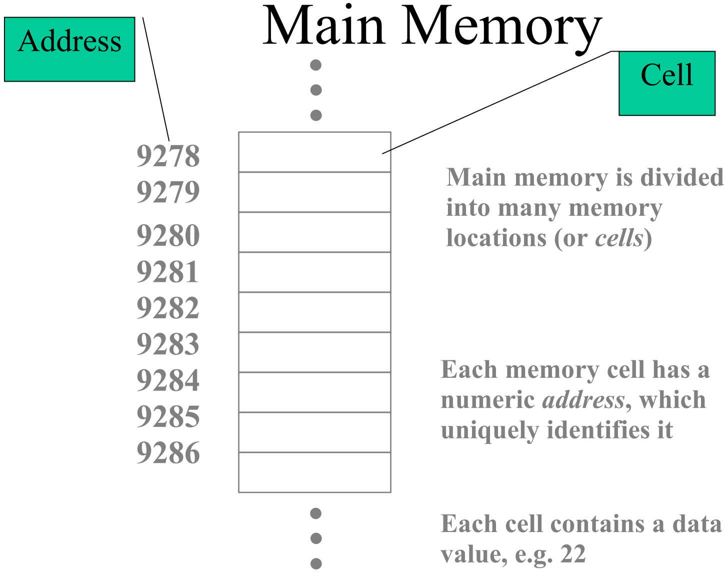
Main Memory

Hard Disk

CD-RW

Monitor screen
Speakers
Keyboard
Mouse
Bar code scanner
Light pen
Touch screen

Main Memory



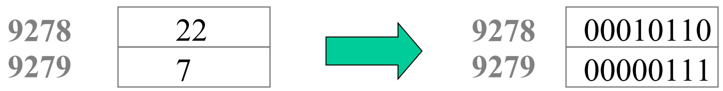
Main memory is divided into many memory locations (or *cells*)

Each memory cell has a numeric *address*, which uniquely identifies it

Each cell contains a data value, e.g. 22

Bits and Bytes

- Bit -- most basic unit of memory
  - 1 or 0, on or off
- 1 Byte = 8 bits
- In a computer, data values are stored as a sequence of bits



9278	22
9279	7

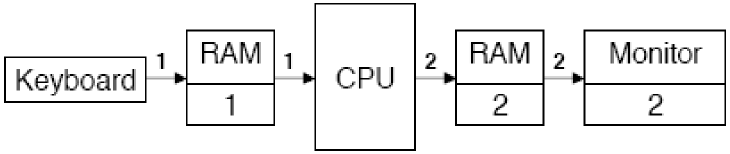
9278	00010110
9279	00000111

Program execution

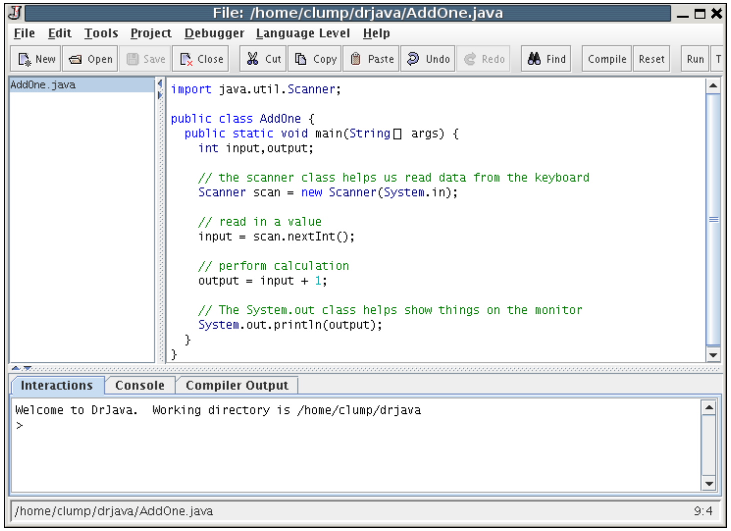
- A program tells the CPU how to manipulate and/or move information
- Programming is about processing information
  - Take some input, manipulate it in some way, and produce a particular output

Program / CPU / Memory

- Example:
  - Input read a number from keyboard
  - Add 1 to it
  - Output it on screen



In Java


File: /home/clump/drjava/AddOne.java
File Edit Tools Project Debugger Language Level Help
New Open Save Close Cut Copy Paste Undo Redo Find Compile Reset Run T
AddOne.java
Interactions Console Compiler Output

```java
import java.util.Scanner;

public class AddOne {
  public static void main(String[] args) {
    int input,output;

    // the scanner class helps us read data from the keyboard
    Scanner scan = new Scanner(System.in);

    // read in a value
    input = scan.nextInt();

    // perform calculation
    output = input + 1;

    // The System.out class helps show things on the monitor
    System.out.println(output);
  }
}
```

```
Welcome to DrJava.  Working directory is /home/clump/drjava
>
```

/home/clump/drjava/AddOne.java 9:4

Improving our understanding

- Compile the program
  - The CPU does not understand the Java language!
  - Java Language is translated into language that the CPU understands
- To build this “program” we'll need 3 classes:
  - Each class fulfills a task
  - System.out: allows us to print things on the monitor
  - Scanner: allows us to read input from keyboard
  - AddOne: that is the class that implements our task!

Variables

- A variable is a placeholder for a cell/location in main memory (or a consecutive block of cells)
- Each variable has a type
  - For now: integers (int)
- Each variable has a name
  - This is how we can refer to the data
  - Much easier than using an address
- Each variable has a value
  - The content of the cell (or set of cells)) the variable is referring to
  - An int has 4 Bytes, thus it uses 4 consecutive cells

input (int) 1

Variable Declaration

- Variable Declaration
  - Typically at begin of method
  - Must indicate type, name
    - int input;
  - Can indicate several variables in one statement
    - int input, output;
  - Can additionally indicate value
    - int input = 1;

Using a Variable

- Variable Assignment Statement
  - Throughout the program we can assign values to a variable
    - *input* = scan.nextInt();
    - *output* = input + 1;
- The assignment operator is the = sign
- The *expression* on the right is evaluated and the result is stored in the variable on the left
  - The old value of the left variable is overwritten
- Reading
  - We can read the value
    - output = *input* + 1;
    - System.out.println(*output*);

println so far

- *println* takes one input
  - A character string: *println("hello world")*
  - The value of a variable: *println(output);*
    - This value is automatically converted into a character string that can be printed

What we learned so far

- What is a program?
- How does a simple Java program look like?
- How is a simple Java program executed on a computer?
- Fundamentals:
  - A program has operations/statements/instructions
    - They are executed by the CPU
  - A program uses data
    - Data is stored in main memory
    - Data is accessed via the variable concept
  - Different tasks are implemented via different classes