Lecture Set 1: Introduction

Today's topics:

1. Course information
2. Tools needed for this course
3. Computer terminology basics

CMSC 131

- Name: "Object-Oriented Programming I"
- Instructor: Jan Plane
- Class meetings
  - Lecture sections
    - 4 lecture sections
    - 2 instructors
  - Lab sections
    - 8 lab sections
    - 10 teaching assistants

Coordination of Sections

- Five sections total of CMSC 131
  - two lectures taught by me
  - other two lectures taught by *Fawzi Emad*
  - *Ten TAs in total for the 4 sections*
- All sections will be closely coordinated:
  - Same lecture material on same day
  - Same projects
  - Same labs
  - Coordinated exams
- Lab/Discussion/Recitation Sections
  - exercises – laptops
  - quizzes
  - new material occasionally

What Is This Course?

- A *fast-paced* introduction to techniques for writing computer programs!
  - Skill Development in Programming
  - Conceptual Understanding of Programming
  - Not really “computer science”
- There will be quite a bit of work but assumes you are starting at level 0.
- Keys to success
  - Attend all classes and lab sections
  - Start assignments early – and continue until you truly understand
  - Get help early if you are having trouble – 2 instructors & 10 TAs
  - Study every day
    - it doesn’t work to cram for these exams
    - ask questions as soon as you realize you are confused
  - *Check announcements on course web-page every day*

Textbooks & Course Web-Page

- www.cs.umd.edu/class/spring2008/cmsc131/
- Check daily!
- Review:
  - Announcements
  - Syllabus
  - Contact
  - Schedule
  - Lecture slides - outlines

Study Questions

- Available on web-page
  - Login: study
  - Password: daily
- Look at them on evenings before class; they will help you keep up

Course Software

- Eclipse
  - An IDE (integrated development environment)
  - You will use it for writing Java™ programs
  - Access to Eclipse (it's free!)
    - You can install it on your own machine: http://www.cs.umd.edu/eclipse
    - Also accessible in some Workstations at Maryland (WAM) labs around campus: http://www.wam.umd.edu/
- CVS (Concurrent Versions System)
  - A version-management system
  - You will use it for submitting your projects
  - We will talk more about this later

Tools for Writing Programs

- The old days
  - Text editor: used to create files of source code
  - Compiler: generate executables from source
  - Debugger: trace programs to locate errors
- Today: IDE = "integrated development environment"
  - Text editor / compiler / debugger rolled in one
  - Examples: Eclipse, Visual Studio, etc.

Basics of Eclipse

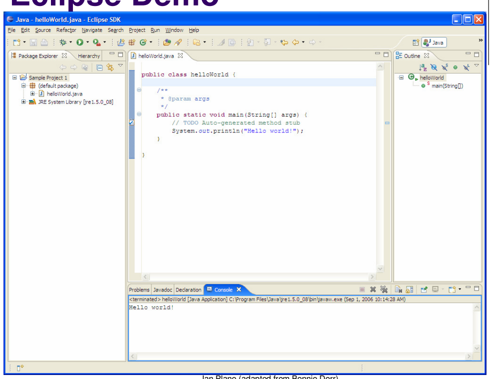
- www.cs.umd.edu/eclipse/EclipseTutorial/
- Eclipse is used to:
  - Create
  - Edit
  - Compile
  - Run
  - Debug

  programs (for this class, Java programs).

Basics of Eclipse-speak

- *Project*: collection of related source files
  To create a program in Eclipse:
  - Create a new project
  - Create files in the project
- *Perspective*: framework for viewing and/or manipulating programs
- Important perspectives in this class:
  - *Java*: for creating, running programs
  - *Debug:* for tracing, removing errors in programs
  - *CVS repository*: for interacting with assignment-submission system

Eclipse Demo

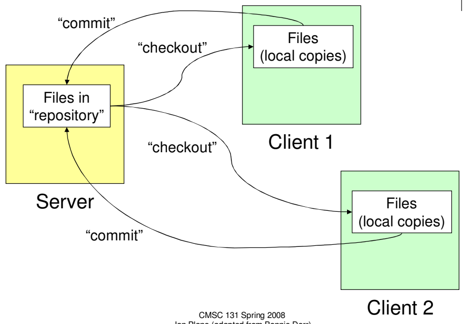


Class Projects with CVS

- You will use Eclipse for Java programming in this course
- How will you:
  - obtain (check-out) files that are supplied to you
  - save (commit) the files for later work
  - turn in (submit) when you are finished

  class projects?
- *CVS (= Concurrent Versions System)*
  - Tool for project-file management
  - Maintains versions, etc.
  - Allows different sites to work on same project

CVS Worldview



CVS in More Detail

- CVS server maintains current versions of files in project (= "repository")
- To access files from another machine ("client"), repository files must be "checked out"
- Changes to files on client may be "committed" to server, with changed files becoming new version
- (Once a repository is checked out by a client, subsequent versions may be accessed via "update")

What's Needed for CVS?

- Server machine
  For CMSC 131, CS linuxlab machines
- User authentication
  For CMSC 131, student linuxlab accounts

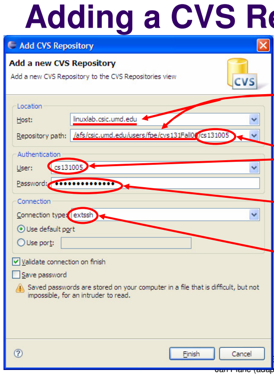
How CMSC Project Submission Works

- Repository created for each student linuxlab account
- You check out repository to start work on project
- When you “save” changes in Eclipse, “commit” automatically invoked by plug-ins
- You “submit” when finished using Eclipse (UMD plug-in handles relevant CVS commands)

To Checkout a Project

1. Set repository location
   - Change to “CVS Repository Exploring” perspective in Eclipse (“Window -> Open Perspective” …)
   - Right-click in “CVS Repositories” panel and select “New -> Repository Location…”

Adding a CVS Repository



Common to everyone

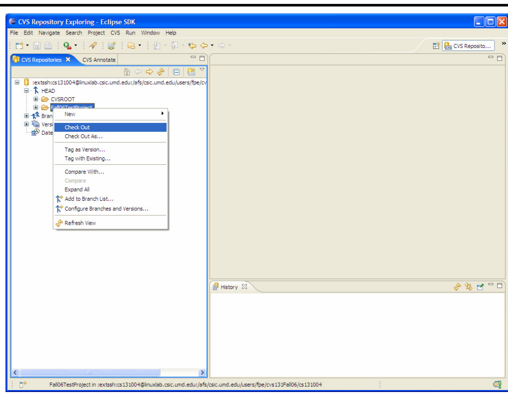
Your linuxlab username

Your linuxlab password

Don’t forget to set this!

To Checkout a Project (cont.)

1. Open repository name, then “Head”
2. Right-click on project name to save



Working on Project

- When you switch back to “Java” perspective, your project is now there!
- When you save in “Java” perspective, changes are automatically committed to CVS repository.

Submitting the Project

- Edit the file
- Make sure it runs correctly
- Submit the project for grading
- Go to submit.cs.umd.edu to see test results
  - Public tests
  - Private tests
  - Release tests
    - give limited feedback (first two failed tests give more)
    - costs you "tokens" – usually 3 to start with
    - spent tokens regenerate in 24 hours

Study Questions

- Login: study
- Password: daily

Computer Organization

- Hardware: physical parts of computer
  - Monitor, mouse, keyboard
  - Chips, boards
  - Cables, cards
  - etc.
- Software: non-physical ("logical") parts of computer
  - Programs = instructions for computer to perform

Hardware Overview

- **CPU** = central processing unit
  - Executes the "instructions" in programs
- **Main memory** = random-access memory = "RAM"
  - Stores data that CPU accesses, including instructions
  - FAST, but temporary; wiped out when computer is shut off!
- **Secondary memory**: Hard disks, CDs, DVDs, flash memory, etc.
  - Stores data that can be loaded into main memory
  - SLOWER, but permanent
- **I/O devices**
  - How you communicate with your machine
  - Keyboard, monitor, mouse, speakers, etc.
- **Networking equipment**
  - How others communicate with your machine
  - Networking "cards", cables, etc.

Main Memory

- Computer data consists of off and on pieces (often written as 0's and 1's)
- bit: A single cell in main memory that can hold either a 0 or 1
- *byte*: A sequence of 8 bits
- word: Smallest unit of addressable memory (often a sequence of 4 bytes)
- Main memory: table of bytes indexed by "addresses"

Address	Byte value
1	1 0 0 1 1 1 0 1
2	0 0 0 1 1 0 0 1
3	1 1 1 1 1 1 0 1
4	1 1 0 0 0 1 0 0

How Many Different Values in a…

- Bit?

  2
- Two bits?

  $4 = 2 \times 2$
- Byte?

  $256 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^8$
- Word?

  $4{,}294{,}967{,}296 = 2^{32}$

Other Standard Terminology

- 1 KB = 1 “kilobyte” = 2^{10} bytes = 1,024 bytes
- 1 MB = 1 “megabyte” = 2^{10} KB = 1,024 KB
- 1 GB = 1 “gigabyte” = 2^{10} MB = 1,024 MB

How Are Characters, Etc., Represented?

Via *encoding schemes*

Example: ASCII (American Standard Code for Information Interchange)

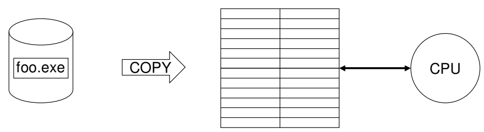
- Standard for encoding character values as bytes
- In ASCII:
  - ‘A’ 01000001
  - ‘a’ 01100001
  - ‘,’ 00101100
  - etc.

There are other character encoding schemes also: Shift-JIS, Unicode, etc.

Software Overview

1. **Operating system**: manages computer's resources; typically runs as soon as computer is turned on. Typical responsibilities:
   - *Process management*
     Determines when, how programs will run on CPU time
   - *Memory management*
     Controls access to main
   - *I/O, window system, network control*
     Performs low-level drawing, communication operations
   - *Security*
     Manages user IDs, passwords, file protections, etc.
2. **Applications**: programs users interact directly with; usually are explicitly run. Examples:
   - Word processors
   - Games
   - Spreadsheets
   - Music software,
   - Etc

How Programs Are Executed



Program “foo” initially stored in secondary storage

Program copied into main memory

CPU executes program instruction-by-instruction

Programming Languages

- Used to write programs that run on computers
- Generations of programming languages
  - 1st (1GL): machine code
  - 2nd (2GL): assembly code
  - 3rd (3GL): procedural languages
  - 4th (4GL): application-specific languages
  - 5th (5GL): constraint languages

1st Generation: Machine Code

- Recall: computer data is 0’s and 1’s.
- In machine code, so are programs!
  - Program: sequence of instructions
  - Machine code: instructions consist of 0’s and 1’s
- Next slide: example machine code instruction from MIPS (= “Microprocessor without interlocked pipeline stages”) architecture
  - Popular in mid-, late 90s
  - Instructions are 4 bytes long

Example MIPS Instruction

- “Add data in addresses 1, 2, store result in address 6”:
  00000000001000100011000000100000
- ???
000000	00001	00010	00110	00000	100000
opcode	1st address	2nd address	destination address	shift amount	function specifier

Programming in 1GLs

Courtesy of Microsoft Encarta Encyclopedia Online. Copyright (c) Microsoft Encarta Online

2nd Generation: Assembly

- Problem with 1GLs: Who can remember those opcodes, addresses, etc. as 0’s, 1’s?
- Solution (1950s): *assembly language*
  - Use *mnemonics* = descriptive character strings for opcodes
  - Let programmers give descriptive names to addresses
- MIPS example revisited:

  ```
  add $1, $2, $6
  ```

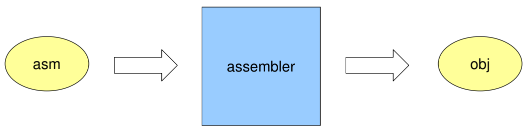
  instead of

  00000000001000100011000000100000

  for “add contents of addresses 1, 2, store result in 6”

Assemblers

- Computers still only work on machine code (1GL)
- Assembly language is not machine code
- *Assemblers* are programs that convert assembly language to machine code (= “object code”)

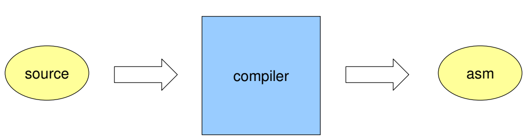


3rd Generation: Procedural Languages

- Problems with 2GLs
  - *Platform dependency*
    - Different kinds (*architectures*) of computers use different instruction formats
      E.g. x86, Pentium, 68K, MIPS, SPARC, etc.
    - 1GL / 2GL programs written for one kind of machine will not work on another
  - *Low level*: programs difficult to understand
- Solution (60s -- now): *procedural languages*
  - Higher-level, “universal” constructs
  - Examples: Cobol, Fortran, Algol, Pascal, C, C++, Java, C#

Compilers

- Computers can only execute machine code
- *Compilers* are programs for translating 3GL programs (“source code”) into assembler / machine code



Interpreters

- Another way to execute 3GL programs
  - Interpreters take source code as input
  - Interpreters execute source directly
  - Much slower than compiled programs
- *Debuggers* are based on interpreters
  - Debuggers support step-by-step execution of source code
  - Internal behavior of program can be closely inspected

Object Oriented Terminology

- Procedural Languages
  - have procedures that can be reused
- Object Oriented Languages
  - centered on the objects
- object
  - principal entities that are manipulated by the program (nouns)
- class
  - a “blueprint” that defines the structure for one or more objects
- method
  - java term for a “function”, a “procedure” or a “subroutine”
  - this is the code that does something (verbs)
- main method
  - a special method that defines where program execution begins
- *statements*
  - individual instructions