Practice of Programming using Java

Lecture 1
June 15, 2006
6-8pm LT
Objectives

- Improve/Learn Programming
  - Basics of programming
  - Organizing and using data structures and control structures
- Introduce Object Oriented Programming
- Learn Java as a programming language
- Introduction to good programming practices
Schedule

- Saturdays: 2 to 5 pm
- Tuesdays: 6 to 8 pm
- Thursdays: 6 to 8 pm
- Fridays: 6 to 8 pm
- Last lecture: July 5\textsuperscript{th}.
- Exam: July 9\textsuperscript{th} 9 to 12 AM
- Any changes will be emailed to you.
- See course webpage: [http://www.cse.iitb.ac.in/~rkj/summercourse](http://www.cse.iitb.ac.in/~rkj/summercourse)
- TAs will be available as per allocation.
Note your TAs

- rahuvar@cse mostly in H6/276 or OSL
- aniketd@cse H6/12 but mostly in OSL(maths1)
- padmaja@cse mostly in CH Kresit
- dhananjays@cse mostly in H13 B/222 or OSL
- chawley@iitb H5/113, but mostly in met 3rd floor (302 Met) polymer lab
- saurabhg@ee H4/106 mostly in GG bldg, 5th floor- design lab
- manishg@cse H12/C508. but mostly in OSL(maths1)

- Use email to contact them, and use 7730 or email to contact me.
- Assignment submissions will be through the website.
- The course schedule is fast paced. Regular practice and programming will be required to get the best (grade:-) out of the course.
Today’s Topics: Basic Ideas

- Program
- Data
- Control
- Interfaces
- Objects
- Classes
A Program

- Pickup 100 Rs.
- Go to market
- Select a vegetable vendor
  - Choose a vegetable, assess its quality, ask for its price, if satisfied select a quantity and buy it.
  - Repeat till you are satisfied/have money
- Repeat the above with another vendor to complete your vegetable collection.
A Program

- Control Logic
- Data

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At runtime:
- Initialization
- Dynamic changes to data as per the control logic
- Termination condition
A quick look at some Control Abstractions (we shall visit this again)

- **Basic Control Abstractions**
  - Functions, function calls, recursion
  - Assignment statement
  - Sequential execution
  - If then else, case statements
  - While, repeat, case and for statements
  - Threads

- Control abstractions cover data flows and value changes \( \rightarrow \) i.e. dynamics
A quick look at some Data Abstractions (we shall visit them again)

- Data Abstractions
  - symbols and lists
  - Types: int, bool, char, float..
  - Structures
  - Unions, enumerated types
  - Arrays, Vectors

- Data abstractions are entity abstractions

- operations supported on data abstractions are mostly general: read, write
The above control and data abstraction are low level abstraction as compared to...

High level abstractions need to be composites of these
- Besides function composition, structures:
- it makes sense to combine data and control together to form an interesting composite abstraction called **object**
Object Abstraction
Examples of Richer Abstractions used inside your PC.

- **File at OS level**
  - **Data**: stream of bytes
  - **Operations supported**: open, close, read, write, rewind, seek

- **Process at OS level**
  - **Data/internal objects**: control and data segments, page tables, open files, priority..
  - **Control**: create, terminate, suspend, resume, trace

- **Stack Data structure**
  - **Data**: elements arranged in the form of stack
  - **Control**: create, delete, push, pop, top
More Examples of Richer Abstractions which you may have used directly or indirectly

- **Table in a spreadsheet/GUI**
  - Data: rows, columns, content
  - Operations (control): create, delete, add/del row/column, insert element

- **Name server**
  - Data: name-location bindings arranged in a hierarchy
  - Operations: add new binding, delete existing binding, create/delete namespaces
Compare These with Some Examples of Abstraction in Real life

- Fan
  - Data/internal objects: motor, capacitor ..
  - Operations: switch on, off, set speed

- Tape
  - Data/internal objects: internal circuits, cassette holder
  - Operations: switch on/of, open/close cassette holder, play, rewind, forward, record, pause, continue
  - It’s a composite object: player/recorder + cassette holder
They have something in common:

→ Explaining Object Abstractions

- It is convenient to think of abstractions in terms of the data that they possess along with the operations which they allow on them
  - Data: Internal data elements, internal objects
  - Operations: Expose for External Use

- User only worries about how to use an abstraction but now how it is implemented
The important steps in formulating object abstractions

- Thinking data and high level control on the data as one unit of abstraction
- Separating internal data from exposable operations on them (i.e. separation of Interfaces from Implementation)
- Hiding data from external environment (through Encapsulation)
Interfaces and Implementation

- Interactions with an object from an external entity happens through the object’s interface(s). An interface is a collection of object’s controls.
- Implementation is responsible to provide the required behavior.
- An implementation can be changed so long as it sticks to what is promised as part of interface.
Two Basic Principles of Object Orientation

- Abstraction
  - Hiding complexities of lower layer
  - We discussed about data and control abstractions
  - Object abstraction: data + observable behavior together as a unit

- Encapsulation
  - Only the observable behavior is exposed, the rest (data and internal objects) is hidden from external environment
Exercise Session 1

Define one of the following objects in terms of their observable behavior as Java interfaces.

- Stack of books
- List of items
- Push button

(expected code size: at most half a page)
Exercise Session 2

• Figure out the object abstractions of the below objects. Express their interfaces and internal components in Java.

  • Washing Machine
  • Bike
  • MP3 CD Player
  • Phone unit on your desk

(at least one example per student. Pick from above list, or pick some other real life object abstraction.).
(expected code size: 1 page)
A Class and its instance

- **Class**
  - Defines the structure
    - Data
    - Behavioral abstraction

- **Instance**
  - The actual object that is to be used
  - Has values which get updated
  - You can invoke member functions on it
  - Many instances of same class can be created
Exercise Session 3

- Write class specifications for one of the below objects, implement the class fully and test it through a main() function.

  - Tossable Coin
    - Achieve the randomness
  - Coffee Vending Machine
    - Implement a few rules

Alternatively, you can implement any other interesting (but simple) object if you wish to.

(expected code size: 1 page)