Programming in Java

Introduction to Object-Orientation

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What We Will Learn

• Problems with Classical Data Abstraction

• Interface and Implementation

• Basic Concepts of Object-Orientation:
  – Objects
  – Classes
  – Messages
Abstraction
What’s the problem?

• Consider the University Registration System

• The Problem:
  – Representing a simple registration form

• Where C is chosen as the programming language
A Simple Registration Form

Registration Form

Name
SSN
Birth Date

...
Representing Form Data

```java
char name[100];

long ssn;

struct Date {
    int day;
    int month;
    int year;
} bdate;
```

Registration Form

- Name
- SSN
- Birth Date
- ...

Programming in Java 6
Discussion

• What’s wrong with our method of storing dates?

```java
struct Date {
    int day;
    int month;
    int year;
} bdate;
```
Problems with Date

• Problem 1 – Inconsistent Data

```java
birthdate.day = 31;
bdate.month = 8;
bdate.year = 1379;
```

Our data type is **insecure**
Problems with Date

• Problem 2 – Changing the Representation

```plaintext
typedef long Date;
```

Number of days since a fixed origin

```plaintext
bdate.day = 31;
bdate.month = 6;
bdate.year = 1379;
```

Our data type is **inflexible**
In Practice

• The real problem is with clients of Date
• Who are the clients of your code?

Yourself!
Co-workers in your team
Customers of your libraries
All developers in the world!
What to do?

• You cannot make sure the client writes error-free code

• You do not have access to all client when changing your code

• So we have to

   **improve our programming method**
A New Idea!
Interface and Implementation

Interface provides some operations…

…that act on the implementation

- switch on
- switch off
Secure and Flexible

- Client cannot harm himself
- Client cannot corrupt the light system
- You can easily change the wiring or bulb technologies
How we gained it?

By separating interface from implementation

- Client does not access to the implementation

- And does not need to have!
A Date Object

Field

- year: 1379
- month: 6
- day: 31

Implementation

Interface

- setDate
- advance
- dayOfWeek

Method
Multiple Objects

- We can have many date objects
- Storing various values in their fields

```
D1

D2

ddate

year 1379
month 4
day 12

setDate
advance
dayOfWeek

bdate

year 1379
month 6
day 31

setDate
advance
dayOfWeek
```
Multiple Similar Objects

• But they have some similarities:
  
  – Each have three integer fields:
    – Year, Month, and Day
  
  – And three methods (same for all objects):
    – SetDate, Advance, and DayOfWeek

• Since all of them are ‘Dates’

• Date is the class of all date objects
Classes

• A class defines the common characteristics of a group of similar objects

• Common Characteristics:
  – Fields they have (and their types)
  – Methods they have
  – How the methods operate
  – And more ...
More Examples

• Televisions
  – The interface is the remote control
  – The implementation is hidden in the box

• Mobile Phones
• Microwave Ovens
• And more...
Alan Kay’s Paradigm

• The principle of recursive design:

  Making the part have the same power as the whole

• Each object is a recursion of the entire possibilities of the computer
Alan Kay’s Principles

1. Everything is an object
2. Objects communicate by sending and receiving messages
3. Objects have their own memory
4. Every object is an instance of a class
5. The class holds the shared behavior for its instances
What Grady Booch Says

- An object has
  - state
  - behavior
  - identity
Inheritance
Class Hierarchies

Employee
- Name
- Address
- Salary
- Manager

Manager
- Dept
- Staff
- Grade
- ...

Project manager
- Project
- Date Appointed
- ...

Programmer
- Project
- Prog languages