Object Oriented Programming
“...customers are allowed to have different types of bank accounts, deposit money, withdraw money and transfer money between accounts”
Procedural Approach

```c
struct Account {
    float balance;
    int accountNumber;
};

void deposit (Account a, float amount);
void withdraw(Account a, float amount);
```
Procedural Approach cont’d

- Focus is on procedures
- All data is shared: no protection
- More difficult to modify
- Hard to manage complexity
Procedural vs. Object Oriented

- **Procedural**
  - Withdraw, deposit, transfer

- **Object Oriented**
  - Customer, money, account
Mapping the world to software

Objects in the problem domain are mapped to objects in software
Object Oriented

Data and operations are grouped together

Account

Withdraw
Deposit
Transfer

Interface:
Set of available operations
Procedural Approach

```c
struct Account {
    float balance;
    int accountNumber;
};

void deposit (Account a, float amount);
void withdraw(Account a, float amount);
```
Object Oriented Approach

class Account {
    public:
        void withdraw (float amount);
        void deposit  (float amount);
    private:
        float balance;
        int accountNumber;
};
Object Oriented Approach

class Account {
    public:
        void withdraw (float amount);
        void deposit  (float amount);
    private:
        float balance;
        int accountNumber;
};
Object Oriented Approach

class Account {
  public:
    void withdraw (float amount);
    void deposit  (float amount);

  private:
    float balance;
    int accountNumber;
};
Advantages

- Protection
- Consistency
- Allows change
Objects and Classes

Classes reflect concepts, objects reflect instances that embody those concepts.
Objects and Classes cont’d

- A class captures the common properties of the objects instantiated from it.
- A class characterizes the common behavior of all the objects that are its instances.
Objects and Classes cont’d

Class BankAccount
Balance

Operations
Deposit
Withdraw

Balance 500

Balance 10,000
Objects as instances of Classes

- The world conceptually consists of objects
- Many objects can be said to be of the same type or class
  - My bank account, your bank account, Bill Gates’ bank account ...
- We call the object type a class
Instantiation

An Object is instantiated from a Class

BankAccount myAccount;
myAccount = new BankAccount;
Objects and Classes

Class
- Visible in source code
- The code is not duplicated

Object
- Own copy of data
- Active in running program
- Occupies memory
- Has the set of operations given in the class
Classification

Animal

Mammal
  - Rodent
    - Mouse
  - Primate
    - Squirrel
  - Cats
    - Rabbit

Reptile
Classification

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• Younger than 24 years old and in school: **Student Checking**
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• Make the most out of every dollar: **Tailored Money Sweep**
Classification

Account

Checking Account

Value First

Select Access

Savings Account

First Interest
Inheritance

A class which is a subtype of a more general class is said to be inherited from it.

The sub-class inherits the base class’ data members and member functions
Inheritance cont’d

- A sub-class has all data members of its base-class plus its own
- A sub-class has all member functions of its base class (with changes) plus its own
- Inheritance is meant to implement sub-typing (don’t abuse it)
Abstraction

- Management of complexity
- Hierarchical classification:
  - is-a relationship: inheritance
  - has-a relationship: containment
Polymorphism

- One interface
- Multiple implementations
- Inheritance
- Method overloading
What is a good class?

- A class abstracts objects
- A class should be non-trivial in the context of the program (has data structures and operations different from other classes)
Summary

What is Object Oriented Programming?

Object-oriented programming is a method of implementation in which programs are organized as cooperative collections of objects, each of which represents an instance of some class, and whose classes are all members of one or more hierarchy of classes united via inheritance relationships.