

# Lecture-2

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- Concepts of class/object
- Data encapsulation
- Constructor and destructor
- Inheritance
- public, private and protected members
- friend functions
- friend classes



# C++ — Philosophically different from C

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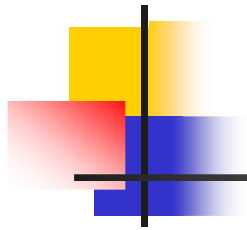
- High level features of C++
  - Uses concepts of “object oriented programming” (OOP)
  - Everything that works in C works in C++
    - C syntax, operators, structures, control statements, etc. work in C++
    - Reverse is NOT true
- Object Oriented Programming
  - Concept of class/object, methods, inheritance, encapsulation, abstraction, polymorphism
  - Key concepts in this
    - Separation of data and methods



# Data types, IO, control statements

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- C data types, IO and control statements work in C++
- C++ defines additional IO.
- Popular among that
  - cout
  - cin
- Advantage of cout and cin over printf, scanf
  - No need fo %d, %s, %c, etc

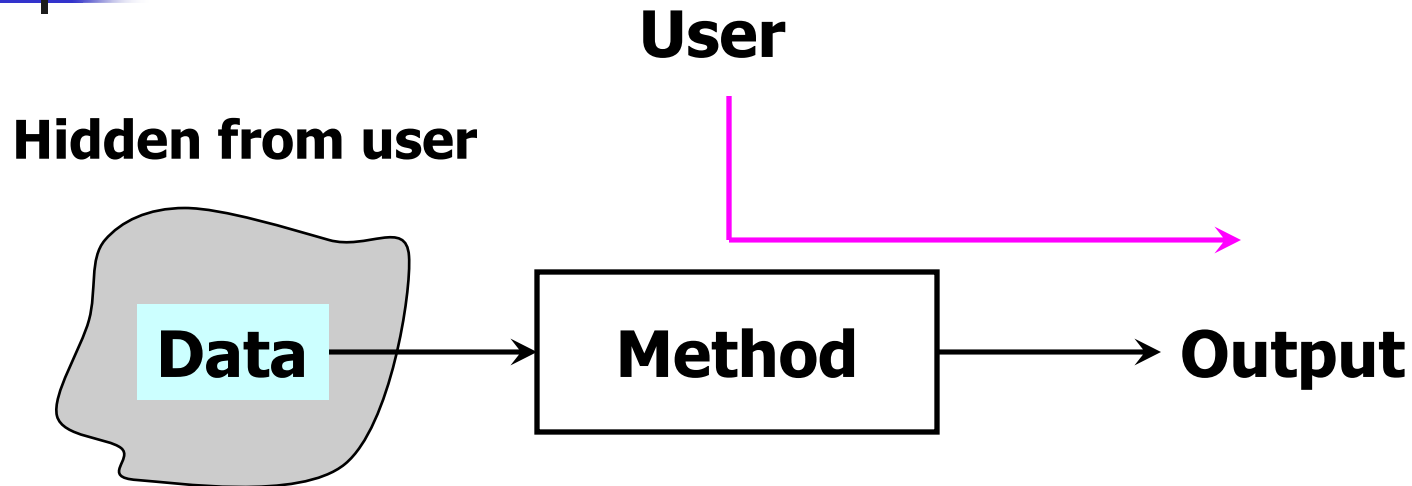


# Data encapsulation

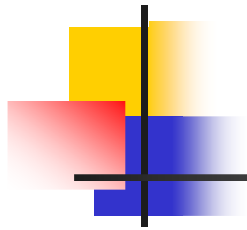
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- Hide the data from end user
- Need to know **what** methods are implemented
- **Not how** they are implemented
- E.g. To compute interest in a bank an user
  - Needs to know what function to call
  - NOT how the function is implemented

# Data encapsulation ... contd.



- Methods act on data to provide output.
- User needs to see only method, not data.
- User should not be affected by
  - Implementation details of methods.
  - Changes in implementation of methods.



# A simple "account" example

```
class account
{
    private:
        int user_SSN;           // attribute (data)
        int accountNumber;      // attribute (data)
    public:
        void withdrawMoney (int amount); // method
        void depositMoney (int amount);  // method:
        void computeInterest( );         // method
};
account x; // x is an object of class "account"
```



# Account example ... contd.

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- **class** has both “**attributes**” and “**methods**”.
- Attributes and methods are “**members**” of a class
- An instance of a class is an **object**.
- A class should typically correspond to some meaningful entity.
- A class uses methods to interact with other classes/functions.
- **private** members accessible only to the class (and friends)
- **public** members are accessible to every class and functions



# Back to data encapsulation

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- How can data be hidden?
  - Only class should have access to data
  - Class methods use data
- Define every class member to be one of
  - **public** - accessible to every class, function
  - **private** - accessible only to class and **friends**
  - **protected** - accessible only to class, friends and children





# Data encapsulation in account example

- In an object of account
  - user\_ssn and accountNumber are declared **private**
    - Accessible only to account objects (and **friends**)
  - Methods are **public**
    - Anyone can access them.

## ■ Example

```
void function1 ( ) // function, not defined in Account
{
    account x;
    x.user_ssn = 123; // Will NOT work
    x.computeInterest ( ); // Will work
}
```



# How do we initialize and cleanup objects?

```
class account
```

```
{
```

```
    private:
```

```
        int user_SSN;
```

```
        int accountNumber;
```

```
    public:
```

```
        account( ); // constructor - to initialize account object
```

```
        account(int ssn, int acctNum); // constructor
```

```
        ~account( ); // destructor - used to cleanup resources
```

```
        void withdrawMoney (int amount);
```

```
        void depositMoney (int amount);
```

```
};
```



## Constructor and destructor ... contd.

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### Constructor

- o A function with the same name as the class
- o Called when an object is created
- o A class can have more than one constructor

### Destructor

- o Called when an object is cleaned up (goes out of scope)
- o One class can have only one destructor

### Examples

```
account x; // constructor code is called  
account *y = new account; // constructor code is called  
delete (y); // destructor code is called
```



# Constructor and destructor

## Constructor code

```
account::account( )  
{ user_ssn = -1; accountNumber = -1; }  
  
account::account( ) : user_ssn (-1),  
                    accountNumber(-1) { }  
  
account::account (int ssn, int acctNum)  
{  
    user_ssn = ssn;  
    accountNumber = acctNum;  
}
```

## Destructor code

```
account::~~account( )  
{ // Any memory/resource cleanup, etc. }
```



# Class methods

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## Syntax:

```
<ret_type> class::functionName(args)
{
    // code
}
```

Method code can be present in class definition

- Outside the class definition
- In a separate file

## Example

```
void account::withdrawMoney (int amount)
{
    // code
}
```



# Inheritance

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- Let's take the account example again
- There are many types of accounts
  - Checking, saving, money market, IRA, etc.
- All accounts may have
  - Some common members.
    - Account number, user SSN, etc.
  - Some class specific members.
- Method implementation may be
  - Same in different classes
  - Different in different classes.



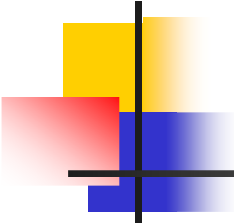
# Inheritance - base class & derived class

- Base class

```
class account
{
    int user_SSN;
    int accountNumber;
    void deposit (int amount);
    void withdraw (int amount);
};
```

- Derived class or child class

```
class checkingAccount : public account // checkingAccount is
{                                     // derived from account
    int lastCheckCleared;             // not present in account
    void showAllChecksCleared( ); // not present in account
};
```



# Inheritance - base class and derived classes

- Base Class

```
class account
{
private:
    int user_SSN;
    int accountNumber;
public:
    void deposit (int amount)
    void withdraw (int amount);
};
```

- Derived (or child) class-1

```
class checkingAccount : public account
{
    int lastCheckCleared;
    void showChecksCleared ( );
};
```

- Derived (or child) class-2

```
class IRA_account : public account
{
    void buyFund (int fund_ID);
    void sellFund (int fund_ID);
};
```

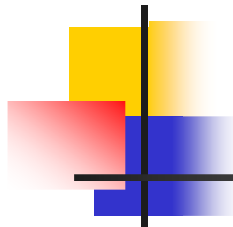




# Inheritance - continued.

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- Important points to note:
  - Derived classes have access to members of base classes in this example.
  - Derived classes can have their own members.
    - E.g. `lastCheckCleared`, `showAllChecksCleared( )`, `buyFund( )`, `sellFund( )`, etc.
    - Members of one derived class are not accessible to another



# Examples

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- Valid usage in an external function
  - `account acct(123456, abc);`
  - `checkingAccount ca;`
  - `acct.deposit (700);`
  - `acct.withdraw (300);`
  - `checkingAccount.deposit (1000);`
  - `checkingAccount.withdraw (600);`
- Invalid usage in an external function
  - `acct.user_SSN = 1234; // Can't access user_SSN`
  - `acct.accountNumber = 567;`



# friend functions

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- What if a function genuinely needs to have access to private data?
  - E.g. `showAccountInfo (Account acct )`
- Need to give access **ONLY** to that function, not others.
- Use **friend** function definition
- **friend** functions of a class have access to private members of the class.



# Example - friend function

---

```
class account
{
private:
    int user_SSN;
    int accountNumber;
public:
    void deposit (int amount)
    void withdraw (int amount);
friend showAccountInfo
    (class Account)
};
```

```
void showAccountInfo
    (Account acct)
{
    cout << user_SSN << endl;
    cout << accountNumber <<
        endl;
}
```

This is valid.  
Friend function can access  
private members.



# friend class

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- Concept of **friend** can be extended to a class from a function.
- A class gives access to its private members to its **friend** classes.

```
class account          class bank
{
    ...
    friend class bank  }
}
```

Members of bank have access to private members of account