COMS W3101 Programming Language: C++ (Fall 2015)

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Lecture-3

- Constructor and destructor review
- Data and Member functions review
- Data encapsulation
  - public, private and protected members
- friend functions and friend classes
- Inheritance

A simple "account" example

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

Class methods

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
}
```

Constructor and Destructor

Constructor and destructor … contd.

Constructor

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

Destructor

- Called when an object is cleaned up (goes out of scope)
- 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
```

Back to "account" example

```
class account
{
  private:
     int user_SSN;            // data
     int accountNumber;       // data
  public:
     account( );                          // Constructor-1
     account(int m, int n);  // Constructor-2
   ~account( );                           // Destructor
     void withdrawMoney (int amount);  // method
     void depositMoney (int amount);    // method:
     void computeInterest( );              // method
};
```

Constructor and destructor

Constructor code

Constructor-1

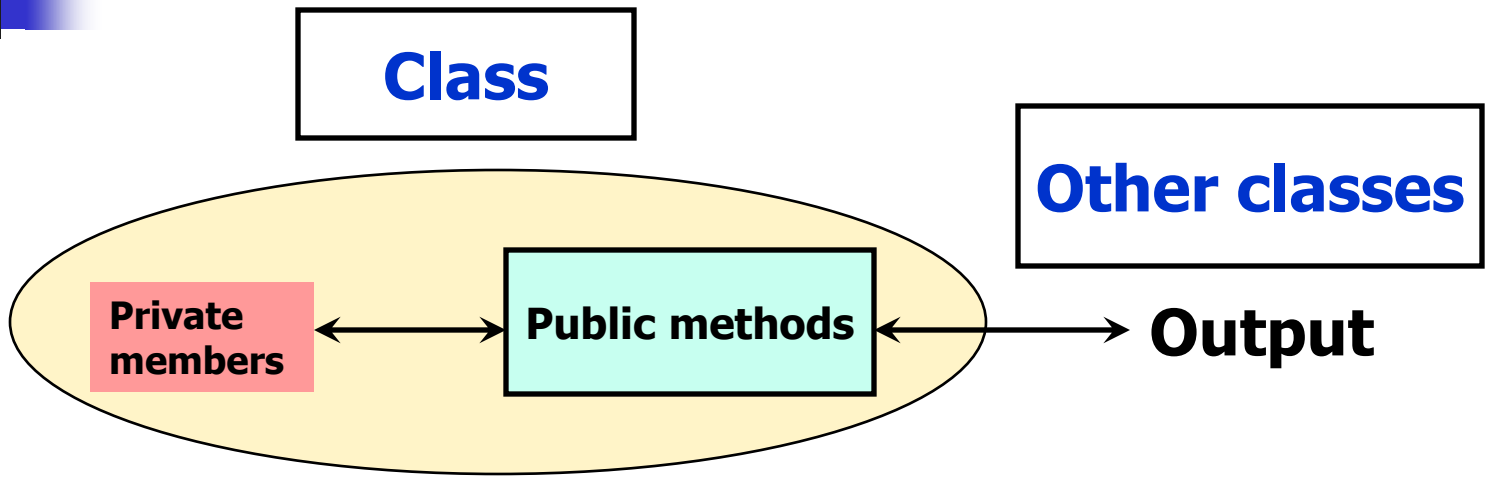
```
account::account( )
{ user_ssn = -1; accountNumber = -1; }
// OR
account::account( ) : user_ssn (-1),
                      accountNumber(-1) { }
// Constructor-2
account::account (int ssn, int acctNum)
{
        user_ssn = ssn;
        accountNumber = acctNum;
}
```

Destructor code

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

Data encapsulation

Data encapsulation … contd.



- Private members are hidden from other classes, fns.
- Public Methods act on data to provide output.
- External classes, functions have access to public methods
- User should not be affected by
  - Implementation details of public methods.
  - Changes in implementation of methods.

Data encapsulation

- Provide access restrictions to member data and functions
  - From other classes and functions.
- Implemented y using access modifiers
  - **public**, **private** and **protected**
- Other classes, functions need to know what methods are implemented
  - Not how they are implemented

Account example … contd.

- class has both "data" 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

- 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 the class, other classes, functions and friends
  - 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
}
```

friend functions and friend classes

friend functions

- 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

- 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
{
  …
   friend class bank
}
```

```
class bank
{
        …
}
```

Members of bank have access to private members of account

Examples

- Valid usage in an external function
  - account acct(123456, 5672);
  - checkingAccount ca;
  - acct.deposit (700);
  - acct.withdraw (300);
  - ca.deposit (1000);
  - ca.showAllChecksCleared( )
- Invalid usage in derived class
  - ca.user_SSN = 1234; // Can't access user_SSN
  - ca.accountNumber = 567;

Inheritance

Inheritance – base class & derived class

- Base class

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

- 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
    double computeInterest( );         // defined in both classes
};
```

Inheritance – base class and derived classes

- Base Class

```
class account
{
private:
    int user_SSN;
    int accountNumber;
    int balance;
public:
    account ( ) { }
    account (int ssn, acctNum);
    ~account( ) { }
    void deposit (int amount)
    void withdraw (int amount);
    double computeInterest( );
};
```

- Derived (or child) class-1

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

- Derived (or child) class-2

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

Inheritance – continued.

- 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

- Valid usage in an external function
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