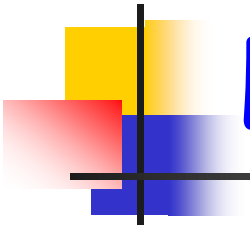


Lecture-6

- C++ static members
- this keyword
- Templates
- Standard template library
  - vector
  - list
- Operator overloading
- Inline functions
- Casting in C++
- Namespaces

this keyword

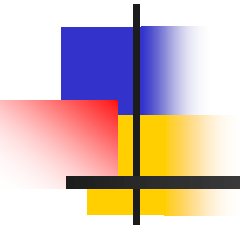
- this refers to the addrss of the current object
- E.g.

```
class Account
{
   private:
      int balance;
   public setBalance (int amount)
    {
       this->balance = amount;
    }
};
```

C++ static members

- static members in C++
  - Shared by all the objects of a class
  - Specific to a class, NOT object of a class
  - Access them using className::static_member
  - E.g., myClass::staticVar, or myClass::f1
  - NOT myClassObj.staticVar or myClassObj.f1( )

```
class myClass
{
  public:
        static int staticVar;
        static void f1( );
};
```



Templates

Templates – motivation

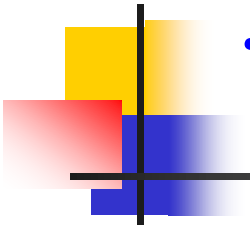
- Consider a function to sort integers

```
int findMaxInt (int num1, int num2)
{
        if (num1 > num2) return num1;
        return num2;
}
```

- Consider a function to sort floats

```
float findMaxFloat (float num1, float num2)
{
        if (num1 > num2) return num1;
        return num2;
}
```

- Same code, but two functions are needed
  - One for each data type



Templates motivation … cont.

- Problem here
  - One max. function is needed for each data type.
  - But the code finding max itself is the same.
- Templates are used to solve this issue.
- Templates
  - Define functions with generic types
  - Define generic classes.
  - Same code can be used with any data type.
  - No need for code repetition.

Template functions

- Define functions with generic types

  template <class anyType>

  function definition

- Example

```
template <class anyType>
    anyType GetMax (anyType a, anyType b)
    {
        if (a > b) return a;
        return b;
    }
```

Template classes

- Define any class
- Use template definition to define any generic data type.
- Rest of the code remains the same.

```
template <class anyType>
class someClass
{
    anyType a;
    someClass (…) // constructor
    ~someClass( ) // destructor
//    member data & methods // can use anyType
};
```

Template class example

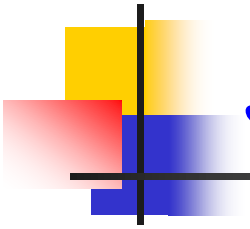
```
template <class anyType>
class myClass
{
   private:
     anyType value1, value2;

    public:
       myClass (anyType i, anyType j) : value1(i), value2(j)
   {  }
       ~myClass() { }
       anyType findMaxValue ()
       {
            if (value1 > value2) return (value1);
            return (value2);
       }
};
```

Template class example … contd.

```
main()
{
   myClass <int> intObject (2, 3);
   int maxInt = intObject.findMaxValue();
   cout << "maxInt: " << maxInt << endl;

   myClass <float> floatObject (4.3, 3.2);
   float maxFloat = floatObject.findMaxValue();
   cout << "maxFloat: " << maxFloat << endl;
}
```

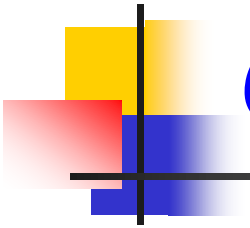


Standard template library

- Defines many useful classes.
- Popular among them
  - vector, list, map, iterators, etc.
  - Each of these is a template class.
  - Has many useful functions.
- References:

http://www.cplusplus.com/reference/stl/

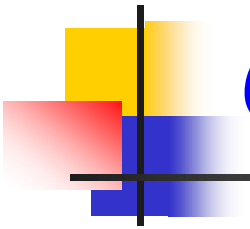
They list all the functions, coding examples and many nice features for strings, vectors, lists and iterators.



Operator overloading

- On two objects of the same class, can we perform typical operations like
  - Assignment (=), increment (++), decrement(--)
  - Write to a stream (<<)
  - Reading to a stream (>>)
- Can be defined for user defined classes.

  ⇒ Operator overloading
- Most of the common operators can be overloaded.
- Operators – can be member/non-member functions

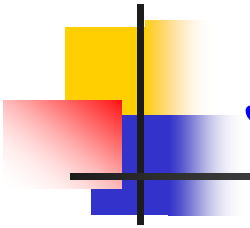


Operator overloading … cont.

- Arity of operator
  - Number of parameters required.
- Unary operators – take one argument
  - *E.g.*, ++, --, !, ~, etc.
  - C unary operators remain unary in C++
- Binary operators – take two arguments.
  - *E.g.*, =, >, <, +, -, etc.
  - C binary operators remain binary.
- Typical overloaded operators
  - +, -, >, <, +=, ==, !=, <=, >=, <<, >>, [ ]

Operator functions rules

- Member function operators
  - Leftmost operand must be an object (or reference to an object) of the class.
  - If left operand is of a different type, operator function must NOT be a member function
- Built-in operators with built-in data types CANNOT be changed.
- Non-member operator function must be a **`friend`** if
  - **`private`** or **`protected`** members of that class are accessed directly



Syntax

- Member function

```
return_type classname :: operatorSymbol (args)
  {
    // code
  }
```

- Non-member function

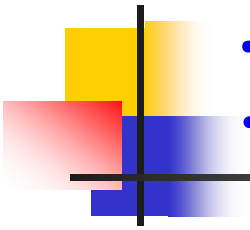
```
return_type operatorSymbol (args)
  {
    // code
  }
```

Example

```
class Integer
   {     private:
            int value;
         public:
            Integer (int val) : value (val) {  }
            void operator ++( ) { value++; }  // Member op
            friend Integer operator +       // Non-member op
                  (const Integer& i, const Integer& j);
   };

   Integer operator + (const Integer&i, const Integer& j)
   {
          return Integer (i.value + j.value);
   }

Examples:
   Integer a(10);  Integer b(20); a++; b++
   Integer c = b+a;
```



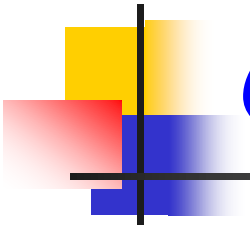
Inline functions

- Normal functions
  - Carry operational overhead
  - Function call, parameter passing, etc.
- Inline functions
  - No overhead related to function calls
  - Might be as simple as a memory access

```
class myClass
{
        public:
                int x;
                inline int getX ( ) { return x; }
};
```

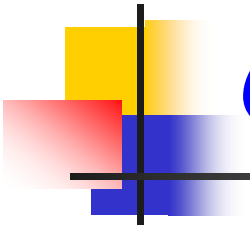
Inline functions … contd.

- Compiler decides if a function defined as "inline" can be "inline" or not.
- Too much of code for any function defined as inline
  - Compiler may treat as a regular (non-inline) function
- Note: Code for an inline function
  - Can be in the class itself, or
  - Can be in the same file as the class definition.
  - CANNOT be defined in any file outside the class definition



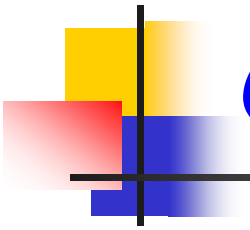
C++ type casting

- Casting: converting a variable/object of one type/cast to another.
- C type casting can create run time errors in C++.
- C++ needs to casting between "related" classes
- C++ provides additional casting methods
  - dynamic_cast
  - static_cast
  - reinterpret_cast
  - const_cast



C++ type casting … contd.

- E.g., Base b, *bp; Derived d, *dp
- dynamic_cast:
  - Casting from derived to base class, NOT from base to derived to base class.
    - bp = dynamic_cast <base*> (d); // Allowed
    - dp = dynamic_cast <derived *>(b); // NOT allowed
- static_cast:
  - Casting from base to derived and vice-versa.
    - bp = dynamic_cast <base*> (d); // Allowed
    - dp = dynamic_cast <derived *>(b); // allowed



Casting … contd.

- reinterpret_cast:
  - Binary copy of values from one pointer to another
  - Can cast any type to any other type, even for unrelated class objects.
    - `Class A {.. };  Class B {..}; // not related to A`

      `A *pa = new A;`

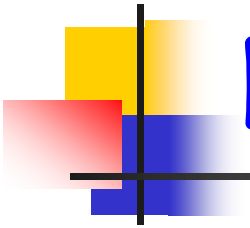
      `B *pb = reinterpret_cast<B*> pa;`

    Suggestion: Don't use it unless you know what you are doing.
- const_cast:
  - Set or remove the const'ness of an object
  - Const object can be passed as an non-const argument to a function.

const_cast - example

```
#include <iostream>
using namespace std;
void myPrint (char * str)
{
   cout << str << endl;
 }

int main ( )
{
   const char * c = "sample text";
   myPrint ( const_cast<char *> (c) );
   return 0;
}
```



Namespaces

- A way to give "scope" to different variables, as opposed to a global scope.
  - E.g., namespace myNameSpace
    { int a, b; }
  - a and b are visible ONLY in myNameSpace
  - Can be accessed using the keywork "using"
    - using namespace myNamespace
      a = 3; b = 4;
    - myNamespace::a = 3; myNamespace::b = 4;
    - using myNamespace::a
      cout << "value of a is: " << a << endl;