



Module 26

Partha Pratim
Das

Objectives &
Outline

Casting
Upcast &
Downcast

Static and
Dynamic
Binding

Summary

Module 26: Programming in C++

Dynamic Binding (Polymorphism): Part 1

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Module Objectives

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Casting
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Summary

- Understand Casting in a class hierarchy
- Understand Static and Dynamic Binding



Module Outline

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Casting
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Summary

- Casting
 - Upcast & Downcast
- Static and Dynamic Binding



Casting: Basic Rules

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- Casting is performed when a value (variable) of one type is used in place of some other type

```
int i = 3;  
double d = 2.5;
```

```
double result = d / i; // i is cast to double and used
```

- Casting can be implicit or explicit

```
int i = 3;  
double d = 2.5;
```

```
double *p = &d;
```

```
d = i;      // implicit
```

```
i = d;      // implicit -- // warning C4244: '=' : conversion from 'double' to 'int',  
           // possible loss of data
```

```
i = (int)d; // explicit
```

```
i = p;      // error C2440: '=' : cannot convert from 'double *' to 'int'  
i = (int)p; // explicit
```



Casting: Basic Rules

- (Implicit) Casting between unrelated classes is not permitted

```
class A { int i; };  
class B { double d; };
```

```
A a;  
B b;
```

```
A *p = &a;  
B *q = &b;
```

```
a = b;      // error C2679: binary '=' : no operator found  
            // which takes a right-hand operand of type 'main::B'
```

```
a = (A)b;   // error C2440: 'type cast' : cannot convert from 'main::B' to 'main::A'
```

```
b = a;      // error C2679: binary '=' : no operator found  
            // which takes a right-hand operand of type 'main::A'
```

```
b = (B)a;   // error C2440: 'type cast' : cannot convert from 'main::A' to 'main::B'
```

```
p = q;      // error C2440: '=' : cannot convert from 'main::B *' to 'main::A *'
```

```
q = p;      // error C2440: '=' : cannot convert from 'main::A *' to 'main::B *'
```

```
p = (A*)&b;  // Forced -- Okay  
q = (B*)&a;  // Forced -- Okay
```

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Casting: Basic Rules

- Forced Casting between unrelated classes is dangerous

```
class A { public: int i; };  
class B { public: double d; };
```

```
A a;  
B b;
```

```
a.i = 5;  
b.d = 7.2;
```

```
A *p = &a;  
B *q = &b;
```

```
cout << p->i << endl; // prints 5  
cout << q->d << endl; // prints 7.2
```

```
p = (A*)&b;  
q = (B*)&a;
```

```
cout << p->i << endl; // prints -858993459 ----- GARBAGE  
cout << q->d << endl; // prints -9.25596e+061 ----- GARBAGE
```

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Casting on a Hierarchy

- Casting on a hierarchy is permitted in a limited sense

```
class A {};  
class B : public A {};
```

```
A *pa = 0;  
B *pb = 0;  
void *pv = 0;
```

```
pa = pb; // okay ----- // UPCAST
```

```
pb = pa; // error C2440: '=' : cannot convert from 'A *' to 'B *' // DOWNCAST
```

```
pv = pa; // okay ----- // Lose the type
```

```
pv = pb; // okay ----- // Lose the type
```

```
pa = pv; // error C2440: '=' : cannot convert from 'void *' to 'A *'
```

```
pb = pv; // error C2440: '=' : cannot convert from 'void *' to 'B *'
```

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Casting on a Hierarchy

- Up-Casting is safe

```
class A { public: int dataA_; };  
class B : public A { public: int dataB_; };
```

```
A a;  
B b;
```

```
a.dataA_ = 2;  
b.dataA_ = 3;  
b.dataB_ = 5;
```

```
A *pa = &a;  
B *pb = &b;
```

```
cout << pa->dataA_ << endl; // prints 2  
cout << pb->dataA_ << " " << pb->dataB_ << endl; // prints 3 5
```

```
pa = &b;
```

```
cout << pa->dataA_ << endl; // prints 3  
// cout << pa->dataB_ << endl; // error C2039: 'dataB_' : is not a member of 'A'
```




Static and Dynamic Binding

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```
#include <iostream>
using namespace std;

class B {
public:
    void f() { cout << "B::f()" << endl; }
    virtual void g() { cout << "B::g()" << endl; }
};

class D: public B {
public:
    void f() { cout << "D::f()" << endl; }
    virtual void g() { cout << "D::g()" << endl; }
};

int main() {
    B b;
    D d;

    B *pb = &b;
    B *pd = &d; // UPCAST

    B &rb = b;
    B &rd = d; // UPCAST

    b.f(); // B::f()
    b.g(); // B::g()
    d.f(); // D::f()
    d.g(); // D::g()
}
```

```
pb->f(); // B::f() -- Static Binding
pb->g(); // B::g() -- Dynamic Binding
pd->f(); // B::f() -- Static Binding
pd->g(); // D::g() -- Dynamic Binding

rb.f(); // B::f() -- Static Binding
rb.g(); // B::g() -- Dynamic Binding
rd.f(); // B::f() -- Static Binding
rd.g(); // D::g() -- Dynamic Binding

return 0;
}
```



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Summary

- Introduced casting and discussed the notions of upcast and downcast
- Introduced Static and Dynamic Binding



Instructor and TAs

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Summary

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