

Short Review of Simple Typecasting

Conversions 1

Recall that C++ provides for explicit conversions among built-in types by use of pre-defined typecast operators:

```
int I    = 12;
double D = 42.3;
int J    = int(D);
int K    = D;
double E = double(I);
```

Although the use of explicit casts above does not alter the values that are ultimately assigned to J and E, the use of explicit casts is still good practice since it renders the implicit conversions supplied by C++ more visible.

By making the conversions explicit, the programmer acknowledges that he/she is aware they will occur — and presumably that they are acceptable in the given context.

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A Simple Date Class

Conversions 2

Consider a simple class for representing dates:

```
class Date {
private:
    int Month, Day, Year;
public:
    Date();
    Date(int M, int D, int Y);
    Date(int yyyyymmdd); // conversion constructor
    void ShowDate(ostream& Out); // display function
};
```

Converts an int value into a Date object.

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Simple Date Class Implementation

Conversions 3

```
Date::Date() {
    Month = 3;
    Day   = 10;
    Year  = 1987;
}

Date::Date(int M, int D, int Y) {
    Month = M;
    Day   = D;
    Year  = Y;
}

void Date::ShowDate(ostream& Out) {
    Out << setfill('0')
        << setw(2) << Month << '/'
        << setw(2) << Day   << '/'
        << setw(2) << Year;
}
```

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Converting Built-in to User-defined

Conversions 4

The conversion of a built-in type to a user-defined type can be accomplished by the use of an appropriate constructor for the targeted user-defined type:

```
Date::Date(int yyyyymmdd) {
    Year = yyyyymmdd / 10000;
    Month = (yyyyymmdd - Year * 10000) / 100;
    Day   = yyyyymmdd - Year * 10000 - Month * 100;
}
```

The Date implementation should be improved by adding error-handling in case the parameter values simply could not represent a valid date.

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Using the Conversion Constructor Conversions 5

This makes the conversion as simple as an explicit cast of one built-in type to another built-in type.

```
void main() {
    Date a;
    cout << "Date a is:" << endl;
    a.ShowDate(cout);
    cout << endl;
    a = Date(20020101);
    cout << "Date a is now: " << endl;
    a.ShowDate(cout);
    cout << endl << endl;
}
```

Conversion of int value into a Date object.
Looks just like a standard explicit cast.
We could also write:
a = 20020101;
or even the old C-style:
a = (Date) 20020101;

Date a is:
07/04/2001
Date a is now:
01/01/2002

Output →

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Conversion Operators Conversions 6

A conversion operator function is simply an operator that takes a value of one type and produces a value of another type. The syntax is identical to that for the built-in typecasts:

```
Date::operator int() {
    // conversion code
}
```

Date member operator, so this takes an operand of type Date...

... operator name is simply the type of the entity produced at the end of the conversion.

Note that the type used for the operator name MUST be declared within the scope of the operator declaration.

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Converting User-defined to Built-in Conversions 7

The conversion of a user-defined type to a built-in type can be accomplished by the use of an appropriate conversion operator as a member of the user-defined type:

```
class Date {
private:
    int Month, Day, Year;
public:
    Date();
    Date(int M, int D, int Y);
    Date(int yyyyymmdd);
    operator int();
    void ShowDate(ostream& Out);
};
```

```
Date::operator int() {
    int yyyyymmdd;
    yyyyymmdd = Year * 10000
                + Month * 100 + Day;
    return yyyyymmdd;
}
```

Converts a Date object into an int.

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Using the Conversion Operator Conversions 8

As before, this also makes the conversion as simple as an explicit cast of one built-in type to another built-in type:

```
void main() {
    Date a(4, 1, 1999);
    int b;
    b = int(a);
    cout << "a's date is: ";
    a.ShowDate(cout);
    cout << endl
         << "This date, as an int, is: "
         << b << endl;
}
```

Conversion of Date object into an int value.
Looks just like a standard explicit cast.

a's date is: 04/01/1999
This date, as an int, is: 19990401

Output →

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Converting Between User-defined Types Conversions 9

The conversion of a user-defined type to a user-defined type is also accomplished by the use of a member conversion operator.

In this case, it frequently makes sense to provide conversion operators “on both sides” to facilitate translation in both directions.

That, of course, poses a small problem since both type names must be declared prior to the declaration of the relevant operators...

... resolution is normally done by use of forward declarations...

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Add an IntDate Class Conversions 10

Let's implement a more space-efficient class for dates:

```

// IntDate.h
...
class Date; // forward declaration

class IntDate {
private:
    int yyyymmdd;

public:
    IntDate(int ymd = 0);
    operator Date(); // conversion op
    void ShowDate(ostream& Out);
};
    
```

Converts an IntDate object into a Date object.

IntDate::operator Date() {
 int M, D, Y;
 Y = yyyymmdd / 10000;
 M = (yyyymmdd - Y*10000) / 100;
 D = yyyymmdd - Y*10000 - M*100;
 return Date(M, D, Y);
 }

Assumes Date has an appropriate constructor.

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Update the Date Class Declaration Conversions 11

... and update the Date class for conversions also:

```

// Date.h
...
class IntDate; // forward declaration

class Date {
private:
    int Month, Day, Year;

public:
    Date(int M = 7, int D = 4, int Y = 2001);
    operator IntDate(); // conversion op
    void ShowDate(ostream& Out);
};
    
```

Converts a Date object into an IntDate object.

Date::operator IntDate() {
 int Temp;
 Temp = 10000 * Year + 100*Month + Day;
 return IntDate(Temp);
 }

Assumes IntDate has an appropriate constructor.

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Using the Conversions Conversions 12

This makes the conversions between the user-defined types as simple as an explicit cast of one built-in type to another built-in type.

```

#include "Date.h"
#include "IntDate.h"

void main() {
    Date a(4, 1, 1999), b;
    IntDate c(20011215), d;

    b = Date(c);
    d = IntDate(a);

    cout << "a's date is: ";
    a.ShowDate(cout);

    cout << endl << "as an IntDate object this date is: ";
    d.ShowDate(cout);

    // continues . . .
}
    
```

Conversions of IntDate object into a Date object and of a Date object into an IntDate object look just like standard explicit casts.

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Implementations Conversions 13

Each implementation file will include the appropriate class declarations:

```
// Date.cpp
...
#include "Date.h"
#include "IntDate.h"
...
Date::operator IntDate() {
    int Temp;
    Temp = 10000 * Year + 100*M
    Day;
    return IntDate(Temp);
}
```

```
// IntDate.cpp
...
#include "IntDate.h"
#include "Date.h"
...
IntDate::operator Date() {
    int M, D, Y;

    Y = yyyyymmdd / 10000;
    M = (yyyyymmdd - Y*10000) / 100;
    D = yyyyymmdd - Y*10000 - M*100;
    return Date(M, D, Y);
}
```

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Using the Conversions Conversions 14

```
// ... continued

cout << endl << "c's date is: ";
c.ShowDate(cout);

cout << endl << "as a Date object this date is: ";
b.ShowDate(cout);
cout << endl << endl;
}
```

Output →

```
a's date is: 04/01/1999
as an IntDate object this date is: 19990401
c's date is: 20011215
as a Date object this date is: 12/15/2001
```

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A Final Example Conversions 15

Recall the `Person/Employee` hierarchy defined earlier. The following assignment of a base object to a derived object would normally be illegal:

```
Employee Jill(. . .);
Staff   Jillian(. . .);
Jillian = Jill; // derived <-- base type assign.
```

However, with the implementation shown before, this statement is legal. Why?

Recall that the class `Staff` has the following constructor:

```
Staff::Staff(const Employee& E, double R = 0.0) : Employee(E) {
    HourlyRate = R;
}
```

QTP: why does the inclusion of this constructor make the assignment above legal?

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