**Short Review of Simple Typecasting**

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

```cpp
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.

**A Simple Date Class**

Consider a simple class for representing dates:

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

**Simple Date Class Implementation**

```cpp
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;
}
```

**Converting Built-in to User-defined**

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:

```cpp
Date::Date(int yyyymmdd) {
  Year = yyyymmdd / 10000;
  Month = (yyyymmdd - Year * 10000) / 100;
  Day = yyyymmdd - 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.
Using the Conversion Constructor

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

```cpp
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;
}
```

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

Conversion Operators

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

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

Converting User-defined to Built-in

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:

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

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

Converts a Date object into an int.

Using the Conversion Operator

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

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

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

Converting Between User-defined Types

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…

Add an IntDate Class

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

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

class IntDate {
private:
  int yyyymmdd;
public:
  IntDate(int ymd = 0); // conversion operator
  operator Date(); // conversion operator
  void ShowDate(ostream& Out);
};

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.
```

Update the Date Class Declaration

… and update the Date class for conversions also:

```cpp
// 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 operator
  void ShowDate(ostream& Out);
};

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

Assumes IntDate has an appropriate constructor.
```

Using the Conversions

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.

```cpp
#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.
Implementations

Each implementation file will include the appropriate class declarations:

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

```cpp
// IntDate.cpp
...
#include "IntDate.h"
#include "Date.h"
...
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);
}
```

Using the Conversions

```cpp
//... 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;
```

```
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
```

A Final Example

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

```cpp
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:

```cpp
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?