

Discuss C++ Template Downcast



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This is a discuss in C board in bbs.sjtu.edu.cn, about type down-cast in C++ template.

Original Discuss

<http://bbs.sjtu.edu.cn/bbstcon,board,C,reid,1330078933,file,M.1330078933.A.html>

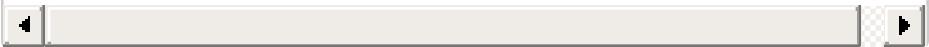
The problem

Today I read a book about we can do cast-down in template, so I write this to test:

```
1 template <bool _Test, class _Type =  
void>  
2 struct enable_if { };  
3  
4 template<class _Type>  
5 struct enable_if<true, _Type> {  
6     typedef _Type type;  
7 };
```

```
8
9 class A { };
10 class B : A { };
11
12 template <typename T>
13 struct traits { static int const val
ue = false; };
14
15 template <>
16 struct traits<A> { static int const
value = true; };
17
18 template <typename T>
19 void f(T, typename enable_if<traits<T
>::value>::type* = 0) { }
20
21 template <>
22 void f<A>(A, enable_if<traits<A>::va
lue>::type*) { }
23
24
25
26 template <typename T>
27 class BB {};
28
29 template <typename T>
30 class DD : public BB<T> {};
31
32 template <typename T> void ff(BB<T>)
{};
33
34 int main(int argc, char * argv[])
```

```
35  {
36      A a; B b;
37      DD<long> dd;
38      //f(b);
39      ff(dd);
40 }
```



It is strange when `f` it don't allow my specified `f<A>``.

But in `ff` it allowed `ff<BB<long>>``.

Tested under VC10 and GCC3.4

My answer to the problem

Let's think ourself as compiler to see what happened there.

Define mark `# : A#B` is the instantiated result when we put `B` into the parameter `T` of `A<T>`.

First we discuss `ff`

```
1 DD<long> dd;
```

After this sentence, the compiler saw the instantiation of `DD<long>`, so it instantiate `DD#long`, and also `BB#long`.

```
1 ff(dd);
```

This sentence required the compiler to calculate set of overloading functions.

Step 1 we need to infer `T` of `ff<T>` from argument `DD#long -> BB<T>`. Based on the inference rule:

Argument with type `:code:`class_template_name<T>`` can be used to infer `:code:`T``.

So compiler inferred `T` as `long`. Here if it is not `BB` but `CC` which is completely unrelated, we can also infer, as long as `CC` is a template like `CC<T>`.

Step 2 Template Specialization Resolution.
There is only one template here so we matched `ff<T>`.

Step 3 Template Instantiation

After inferred `long -> T` , compiler instantiated `ff#long` .

Set of available overloading functions :
`{ff#long}`

Then overloading resolution found the only match `ff#long`` , checked its real parameter `DD#long` can be down-cast to formal parameter `BB#long` .

Then we discuss f

```
1  f(b);
```

Calculate set of overloading functions.

Step 1 infer all template parameters for template `f` . According to inference rule:

Parameter with type `T` can be used to infer `T` .

So `B -> T` is inferred.

Step 2 Template Specialization Resolution.

Here B is not A so we can not apply specialization of $f<A>$, remaining $f<T>$ as the only alternative.

Step 3 Template Instantiation.

When we put B into $f<T>$ to instantiate as $f#B$, we need to instantiate $\text{traits}\#B`$.

There is no specialization for B so we use template $\text{traits}<T>$, $\text{traits}\#B::\text{value}=\text{false}$, so $\text{enable_if}\#\text{false}$ didn't contains a type , an error occurred.

The only template is mismatch, available overloading functions is empty set. So we got an error.