An application for private inheritance? Lightning Talk for MUC++

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2 {};

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- models HAS-A instead of IS-A

However HAS-A is usually better modelled by using a member variable because this causes less coupling (*favor composition over inheritance*).

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There are also other use cases, see the C++FAQ or cppreference.com.

The problem

Suppose a dynamic library with the following C API:

```
1 typedef struct
  {
2
      /* pointer to a resource, e.g., a C string */
3
      char const * foo;
4
5
      /* more variables that need resources ... */
6
7
8 } Widget;
9
int createWidget(Widget const ** widget);
12 void freeWidget(Widget const * widget);
```

We want to implement this API using C++...

The C-ish approach

Tedious but effective

```
int createWidget(Widget const ** widget)
      Widget * newWidget =
 4
         (Widget *) std::malloc(sizeof(Widget));
 5
      if (!newWidget)
 6
 7
       return OUT_OF_MEMORY;
 8
      3
9
      *widget = {}: // zero initialize
10
      std::string foo = frobnicate(/* ... */);
      if (foo.emptv())
13
      Ł
14
       freeWidget(newWidget):
15
       return FROBNICATE FAILED:
16
      3
      newWidget->foo = strdup(foo.c_str());
18
19
      /* ... */
20
      *widget = newWidget:
      return SUCCESS:
23 }
```

```
1 void freeWidget(Widget const * widget)
2 {
3 std::free(widget->foo);
4
5 /* ... */
6
7 std::free(widget);
8 }
```

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- easy to understand
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- manual ressource management
- raw owning pointers
- error prone
- hard to get right
- tedious

Idea:

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1 class ResourcedWidget : public Widget
2 {
3 public:
4 explicit ResourcedWidget()
5 : Widget() // Default initialization!
6 {
7
7
```

Idea:

- introduce class ResourcedWidget
- derive from C struct Widget
- default initialize the base C struct
- for every resource in Widget
 - add managing member
 (std::string, std::unique_ptr,
 std::vector, ...) to
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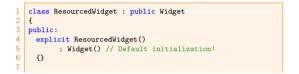
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```
class ResourcedWidget : public Widget
    Ł
   public:
     explicit ResourcedWidget()
           : Widget() // Default initialization!
     ብ
     void setFoo(std::string const & value)
       m foo = value:
       foo = m foo.c str():
14
     // more setters...
16
   private:
     std::string m_foo;
18 };
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Using the power of C++

```
1 int createWidget(Widget const ** widget)
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3 try
4 {
5 auto newWidget = std::make_unique<ResourcedWidget>();
6
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       if (foo.empty())
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       newWidget->setFoo(foo);
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      catch (std::bad_alloc const &)
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     catch (std::bad_alloc const &)
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       return OUT OF MEMORY:
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   }
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1 void freeWidget(Widget const * widget)
2 {
3 delete static_cast<ResourcedWidget const *>(widget);
4 }

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Potential for resource leaks:

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• static_cast can be forgotten during deletion

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- automated resource management
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- feels like a C++ class

Disadvantages:

Potential for resource leaks:

- static_cast can be forgotten during deletion
- implementers can still access Widget members and use them wrongly (e.g. assign raw owning pointers)

Making Widget members inaccessible

1	class	ResourcedWidget	:	private	Widget	11	private!	

2 {

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1 class ResourcedWidget : private Widget // private!
2 {
3 // as before...
4
```

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1 class ResourcedWidget : private Widget // private!
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3     // as before...
4 
5     public:
6     Widget const * toWidget() const
7     {
8         return static_cast<Widget const *>(this);
9     }
10
```

```
class ResourcedWidget : private Widget // private!
3
     // as before...
4
5
   public:
     Widget const * toWidget() const
6
7
8
       return static_cast<Widget const *>(this);
9
     3
10
     static void deleteWidget(Widget const * widget)
13
       delete static_cast<ResourcedWidget const *>(widget);
14
15
   };
```

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12 catch /* as before */
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1 void freeWidget(Widget const * widget)
2 {
3 ResourcedWidget::deleteWidget(widget);
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- Widget members not public anymore in ResourcedWidget context
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Disadvantages:

- still possible to delete a ResourcedWidget via a pointer to Widget (but easier to remember the function than the static_cast)
- increased complexity, two additional functions necessary
- uses private inheritance for an IS-A relationship

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Please share your opinion and ideas (brandl.matthaeus@gmail.com)

There is a working example on Coliru