descendants of a module don't gain its future ancestors, but descendants of a class, do

```
module Mod1
end

module Mod2
end

class Class1
end
class Class2 < Class1
end

p Class2.ancestors - Object.ancestors # [Class2, Class1]
Class1.include Mod1
p Class2.ancestors - Object.ancestors # [Class2, Class1, Mod1]
Mod1.include Mod2
p Mod1.ancestors - Object.ancestors # [Mod1, Mod2]
p Class2.ancestors - Object.ancestors # [Class2, Class1, Mod1]
```

note that descendants of a class do gain its future ancestors

so 2 issues:

1. It would seem natural that in dynamic language, dynamically added ancestors should propagate to descendants
2. Why is there a difference in ancestor propagation between modules and classes

Related issues:
Related to Ruby master - Bug #16973: Rails Active Support unit test fails sin...

Associated revisions
Revision 3556a834 - 02/27/2020 07:03 PM - jeremyevans (Jeremy Evans)
Make Module#include affect the iclasses of the module

When calling Module#include, if the receiver is a module, walk the subclasses list and include the argument module in each iclass.

This does not affect Module#prepend, as fixing that is significantly more involved.

Fixes [Bug #9573]

Revision 41582d58 - 06/18/2020 03:18 PM - jeremyevans (Jeremy Evans)
Make Module#prepend affect the iclasses of the module
3556a834a2847e52162d1d3302d4c64390df1694 added support for Module#include to affect the classes of the module. It didn't add support for Module#prepend because there were bugs in the object model and GC at the time that prevented it. Those problems have been addressed in ad729a1d11c6c57efd2e92803b4e937db0f75252 and 98286e9850936e27e8ae5e4f20858cc9c13d2dfe, and now adding support for it is straightforward and does not break any tests or specs.

Fixes [Bug #9573]

History

#1 - 02/27/2014 06:23 AM - nobu (Nobuyoshi Nakada)
- Description updated

First Last wrote:

so 2 issues:

1. It would seem natural that in dynamic language, dynamically added ancestors should propagate to descendants

It's a longstanding issue, a descendant knows its ancestors, but an ancestor doesn't know its descendants.

1. Why is there a difference in ancestor propagation between modules and classes

It is not between modules and classes, but caused by the order of inheritance and including.

#2 - 02/27/2014 06:43 AM - rits (First Last)
Nobuyoshi Nakada wrote:

First Last wrote:

so 2 issues:

1. It would seem natural that in dynamic language, dynamically added ancestors should propagate to descendants

It's a longstanding issue, a descendant knows its ancestors, but an ancestor doesn't know its descendants.

Is it the case that ancestors are cached in each descendant? So that it does not actually walk the ancestor tree each time. If so, is there any way to invalidate this cache for a given class or all, and have it reevaluate the ancestors?

1. Why is there a difference in ancestor propagation between modules and classes

It is not between modules and classes, but caused by the order of inheritance and including.

Please clarify. Mod1 is included in Class1 after Class2 extends Class1 and yet Class2 somehow learns of its new grandparent, Mod1. How does that happen if ancestors (Class1) do not know their descendants (Class2). So there is a difference, an ancestor added to a class, propagates to the descendant of this class, but an ancestor added to a module does not propagate to the descendant of this module.

#3 - 02/27/2014 08:30 AM - nobu (Nobuyoshi Nakada)
First Last wrote:

1. It would seem natural that in dynamic language, dynamically added ancestors should propagate to descendants

It's a longstanding issue, a descendant knows its ancestors, but an ancestor doesn't know its descendants.

Is it the case that ancestors are cached in each descendant? So that it does not actually walk the ancestor tree each time. If so, is there any way to invalidate this cache for a given class or all, and have it reevaluate the ancestors?

1. Why is there a difference in ancestor propagation between modules and classes

An included module is shared using an internal class (called as IClass), and IClasses are copied for each trees. Now subclasses/submodules are maintained in each classes/modules for method cache validation, so it may be possible.

1. Why is there a difference in ancestor propagation between modules and classes
It is not between modules and classes, but caused by the order of inheritance and including.

Please clarify. Mod1 is included in Class1 after Class2 extends Class1 and yet Class2 somehow learns of its new grandparent, Mod1. How does that happen if ancestors (Class1) do not know their descendants (Class2). So there is a difference, an ancestor added to a class, propagates to the descendant of this class, but an ancestor added to a module does not propagate to the descendant of this module.

Class1 only knows Mod1, and its ancestor tree is copied into Class2. And ditto for including a module.

#4 - 02/27/2014 10:12 AM - rits (First Last)
Nobuyoshi Nakada wrote:

First Last wrote:

Please clarify. Mod1 is included in Class1 after Class2 extends Class1 and yet Class2 somehow learns of its new grandparent, Mod1. How does that happen if ancestors (Class1) do not know their descendants (Class2). So there is a difference, an ancestor added to a class, propagates to the descendant of this class, but an ancestor added to a module does not propagate to the descendant of this module.

Class1 only knows Mod1, and its ancestor tree is copied into Class2. And ditto for including a module.

I am inferring that the ancestor tree is copied into Class2 when it extends Class1, yes? But at this time Mod1 has not yet been included, so how does Class2 learn of Mod1?

and why is the situation different with modules?

Do you see what I am pointing out, an ancestor added to a class, propagates to the past descendant of this class (Class2 extends Class1 before Mod1 is included in Class1), but an ancestor added to a module does not propagate to the past descendant of this module.

#5 - 02/28/2014 12:11 AM - rits (First Last)
First Last wrote:

Nobuyoshi Nakada wrote:

Class1 only knows Mod1, and its ancestor tree is copied into Class2.
And ditto for including a module.

I am inferring that the ancestor tree is copied into Class2 when it extends Class1, yes? But at this time Mod1 has not yet been included, so how does Class2 learn of Mod1?

and why is the situation different with modules?

Do you see what I am pointing out, an ancestor added to a class, propagates to the past descendant of this class (Class2 extends Class1 before Mod1 is included in Class1), but an ancestor added to a module does not propagate to the past descendant of this module.

Can someone please explain this phenomenon.

#6 - 03/05/2014 04:07 PM - rits (First Last)
First Last wrote:

First Last wrote:

Nobuyoshi Nakada wrote:

Class1 only knows Mod1, and its ancestor tree is copied into Class2.
And ditto for including a module.

I am inferring that the ancestor tree is copied into Class2 when it extends Class1, yes? But at this time Mod1 has not yet been included, so how does Class2 learn of Mod1?

and why is the situation different with modules?

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Can someone please explain this phenomenon.

#7 - 03/13/2014 07:45 PM - rits (First Last)
First Last wrote:

First Last wrote:

First Last wrote:

Nobuyoshi Nakada wrote:

Class1 only knows Mod1, and its ancestor tree is copied into Class2.
And ditto for including a module.

I am inferring that the ancestor tree is copied into Class2 when it extends Class1, yes?
But at this time Mod1 has not yet been included, so how does Class2 learn of Mod1?

and why is the situation different with modules?

Do you see what I am pointing out, an ancestor added to a class, propagates to the past descendant of this class (Class2 extends Class1 before Mod1 is included in Class1), but an ancestor added to a module does not propagate to the past descendant of this module.

Can someone please explain this phenomenon.

What is the objection to explaining how this works?

#8 - 03/13/2014 08:34 PM - jeremyevans0 (Jeremy Evans)
First Last wrote:

What is the objection to explaining how this works?

nobu explained how it works. However, as he is not a native English speaker, let me attempt to clarify.

In ruby, there exist pseudo-copies of modules called iclasses. These copies share the same variable(class variable/instance variable/constant) tables and the same method tables, but have a different super pointer in their C struct. iclasses are made when you attempt to include a module in another module or class.

When you do:

```ruby
module M0; end
module M1
  include M0
end
```

This creates a module M1 that includes an iclass of M0 (notated below as i0M0) in its inheritance list. For a module, the inheritance list is the the super pointer in struct RClass).

When you do:

```ruby
class A
  include M1
end
```

What happens is iclasses of M1 and i0M0 are made (notated below as i0M1, i1M0). So method lookup for an instance of A will be:

A -> i0M1 -> i0M0 -> Object

Here's how the super pointers for the struct RClass should look:

M0: NULL
i0M0: NULL
M1: i0M0
i1M0: Object
When you do:

```ruby
module M2; end
M1.include M2
```

This creates an iclass of M2 (i0M2) and updates the super pointer in M1, as shown:

```
M1: i0M2
i0M2: i0M0
i0M0: NULL
```

However, it has no effect on any of the iclasses of M1 already created.

Ruby doesn't have multiple inheritance. Ruby method lookup uses a linked list, not a tree. This is the reason for iclasses, and why including module B in module A after A has been included in class C does not include B in C.

Note that I am not an expert on ruby internals, so if there are errors in the above description, hopefully a more knowledgeable person can correct me.

#9 - 03/13/2014 09:29 PM - rits (First Last)

Jeremy Evans wrote:

Ruby doesn't have multiple inheritance. Ruby method lookup uses a linked list, not a tree. This is the reason for iclasses, and why including module B in module A after A has been included in class C does not include B in C.

Conceptually Ruby does have multiple inheritance, an object is_a?(all included modules).

Is MRI's iclass snapshotting an implementation detail? Can it theoretically be done differently (e.g. tree that you mentioned)

#10 - 06/05/2014 06:16 AM - hsbt (Hiroshi SHIBATA)

ref. https://github.com/ruby/ruby/pull/549

#11 - 01/04/2020 05:43 AM - ioquatix (Samuel Williams)
- Backport deleted (1.9.3: UNKNOWN, 2.0.0: UNKNOWN, 2.1: UNKNOWN)

Is there a clean way to fix this issue?

#12 - 01/04/2020 07:21 AM - ioquatix (Samuel Williams)

From jeremyevans0 (Jeremy Evans):

Previously it wasn't possible because there wasn't a way to go from the module to all iclasses generated from it.
I think module_subclasses in struct rb_subclass_entry may now contain the necessary pointers, but I'm not sure.
Actually, looks like the subclasses entry may contain it (module_subclasses is used by iclasses, not modules). This appears to be a linked list of iclasses for the module.

#13 - 01/07/2020 04:44 PM - jeremyevans0 (Jeremy Evans)
- File include-future-ancestors-9573.patch added

Attached is a patch that implements support for this for Module#include, but not Module#prepend. It passes make check. I'm not sure if we want to support this for Module#include but not Module#prepend, as it would make them inconsistent.

Module#include support isn't too difficult to implement. Conceptually, the patch is similar to the pull request nobu was working on (https://github.com/ruby/ruby/pull/549). nobu's approach using rb_class_foreach_subclass is definitely simpler, but I'm not sure what the issues were with it that caused the pull request to be closed (I didn't see nobu's pull request until after working on my patch).

It is probably possible to support this for Module#prepend, but I believe it would at least require creating an origin module for all modules that are included/prepended to other modules/classes. I think that's a necessary condition, but not a sufficient one, as doing that by itself doesn't allow Module#prepend to work similarly.

#14 - 01/08/2020 08:23 PM - jeremyevans0 (Jeremy Evans)
- File prepend-future-ancestors-9573.patch added

Attached is a work-in-progress patch that includes similar support for Module#prepend. It does work in terms of Module#prepend affecting
classes/modules that have already included the receiver, but it causes failures in the tests that would need to be fixed. Example:

class Object
def foo; [] end
end
module A
def foo; [:A] + super end
end
module B
def foo; [:B] + super end
end
module C
def foo; [:C] + super end
end
module D
def foo; [:D] + super end
end
module E
  include C
  prepend D
  def foo; [:E] + super end
end
module Enumerable
def foo; [:Enumerable] + super end
end

Enumerable.include A
Enumerable.prepend B
Enumerable.include E

p []).foo
p({},).foo

Output:


This does require creating origin iclasses for all modules that are included or prepended to other modules. It changes the origin pointer handling for iclasses such that the iclass origin pointer points not to the module origin but to the iclass origin. Due to the way module inclusion works, the iclass origin is not created at the point the iclass is created, so we need to keep a record of the created iclass, and when we come across the module origin and create the iclass origin, we set the origin for the iclass to the iclass origin.

Before doing more work in this area to attempt to fix the test failures, we should decide if we want this behavior and whether the necessary tradeoff of doubling the number of iclasses is worth it. Here are a few of the 43 test-all failures:

1) Failure:
Complex_Test#test_respond [/home/jeremy/tmp/ruby/test/ruby/test_complex.rb:934]:
Complex#clamp.
Expected (1+1i) to not respond to clamp.

2) Failure:
TestModule#test_override_optmethod_after_prepend [/home/jeremy/tmp/ruby/test/ruby/test_module.rb:1990]:
[ruby-core:72226] [Bug #11836].
(1/2) > expected but was <0>.

... 42) Error:
TestAlias#test_super_in_aliased_module_method:
NoMethodError: super: no superclass method `foo' for #<TestAlias::SuperInAliasedModuleMethod::Derived:0x000006e8b02d3d78>
Did you mean? for /home/jeremy/tmp/ruby/test/ruby/test_alias.rb:96:in `foo'
/home/jeremy/tmp/ruby/test/ruby/test_alias.rb:115:in `test_super_in_aliased_module_method'

43) Error:
TestRefinement#test_refine_module:
NoMethodError: super: no superclass method `bar' for #<TestRefinement::RefineModule::C:0x000006e8afad0018>
Did you mean? baz
/home/jeremy/tmp/ruby/test/ruby/test_refinement.rb:453:in `bar'
/home/jeremy/tmp/ruby/test/ruby/test_refinement.rb:469:in `call_bar'
/home/jeremy/tmp/ruby/test/ruby/test_refinement.rb:479:in `test_refine_module'

#15 - 02/27/2020 08:23 AM - matz (Yukihiro Matsumoto)
The patch for include looks OK to me. To ensure there are no unseen compatibility issues, I'd like to experiment with it during the 2.8 development cycle. I am not yet sure how prepend should work here. I need to think about it more deeply. Keep it as it is for prepend for the moment.

Matz.

#16 - 02/27/2020 07:03 PM - jeremyevans (Jeremy Evans)
- Status changed from Open to Closed
Make Module\include affect the iclasses of the module

When calling Module\include, if the receiver is a module, walk the subclasses list and include the argument module in each iclass.

This does not affect Module\prepend, as fixing that is significantly more involved.

Fixes [Bug #9573]

#17 - 02/27/2020 07:08 PM - jeremyevans0 (Jeremy Evans)
- Status changed from Closed to Open

#18 - 04/17/2020 03:38 AM - ioquatix (Samuel Williams)
jeremyevans0 (Jeremy Evans) thanks so much for fixing this at least in the \include case.

#19 - 06/03/2020 07:19 PM - jeremyevans0 (Jeremy Evans)
With my recent changes to fix the bugs in the object model related to prepend and refinements, adding support for Module\prepend is now straightforward and breaks no tests or specs. I've added a pull request for it: https://github.com/ruby/ruby/pull/3181

#20 - 06/18/2020 05:00 AM - matz (Yukihiro Matsumoto)
Updating prepend looks OK to me now. Let's try it.

Matz.

#21 - 06/18/2020 03:18 PM - jeremyevans (Jeremy Evans)
- Status changed from Open to Closed

Applied in changeset git|41582d5866ae34c57094f70f95c3d31f4a1fa4ff.

Make Module\prepend affect the iclasses of the module

3556a834a2847e52162d1d3302d4c64390df1694 added support for Module\include to affect the iclasses of the module. It didn't add support for Module\prepend because there were bugs in the object model and GC at the time that prevented it. Those problems have been addressed in ad729a1d11c6c57ef02e9280394ed937db0f75252 ad 98286e9850f9d6e27e8ae5e4f20858cc9c13d2dde, and now adding support for it is straightforward and does not break any tests or specs.

Fixes [Bug #9573]

#22 - 06/21/2020 06:57 AM - naruse (Yui NARUSE)
- Related to Bug #16973: Rails Active Support unit test fails since 41582d5866 added

Files

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<td>jeremyevans0 (Jeremy Evans)</td>
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<td>prepend-future-ancestors-9573.patch</td>
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