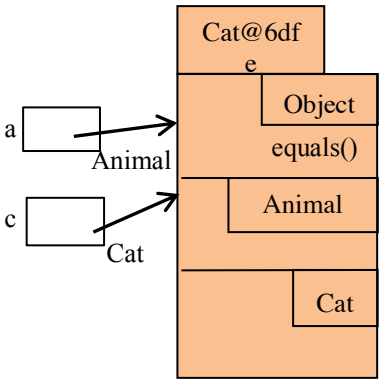
Casting problem: compile-time or runtime?

The object of class `Cat` to the right shows that `Cat` extends class `Animal`. It is used later in the discussion.



Suppose we have the following cast:

```
(String) a
```

From the type of variable `a`, which is `Animal` (look to the right) and the fact that class `String` extends `Object` and cannot be extended, it is clear that no `Animal` object has a partition named `String`. If the program were compiled and the program run, every evaluation of this expression would throw a `ClassCastException`. Therefore, this is expression is deemed a compile-time error, a syntax error, and the expression will not be compiled.

We state the rule more generally

Compile-time casting rule. Consider a cast-expression

(*name*) *expression*

where *name* is the name of some class[1] and the type of *expression* is some class-type `C`.

1. If it can be determined solely from the declaration of `C` (and its subclasses and superclasses) that no object that has a `C` partition also has a *name* partition, then this expression is syntactically incorrect, and it will not be compiled.
2. If at least one object that has a `C` partition also has a *name* partition, then the expression is OK and will be compiled.

When casting at runtime may throw a ClassCastException

Now consider this code, where variable `a` is as described in the diagram in the upper right.

```
a= new Cat();
…

… (Cat) a …
```

The type of variable `a` is `Animal`, and it is known some object with an `Animal` partition also has a `Cat` partition. Therefore the compile-time casting rule allows this to be compiled. It is syntactically OK.

Here is a case to be analyzed carefully, for jumping to what seems an obvious conclusion leads to an error. Consider the expression

```
(Cat)(new Animal())
```

What do *you* think — is it syntactically OK? Will it be compiled?

The type of the *expression* `new Animal()` is `Animal`. As said above, objects exist that have both `Animal` and `Cat` partitions. Therefore, the *expression* is syntactically OK and can be compiled!

Here is the important point: *The compile-time casting rule does not look at the particular value of the expression but only at its type*. You and I know that evaluation of this expression will throw a `ClassCastException`, but according to the compile-time casting rule, it is allowed. The compiler does not look at the object itself, but only its type.

[1] For simplicity, we mention only classes. But in all generality, interfaces should be included. For example, *name* can be an interface and `C` can be an interface.