

CS2110: Casting about

Consider the object of class S on the right. Class S was declared as a subclass of class C. Variables ob, c, and s were declared like this:

```
Object ob;
C c;
S s= new S(...);
```

A cast of a pointer to an object to another class has the form

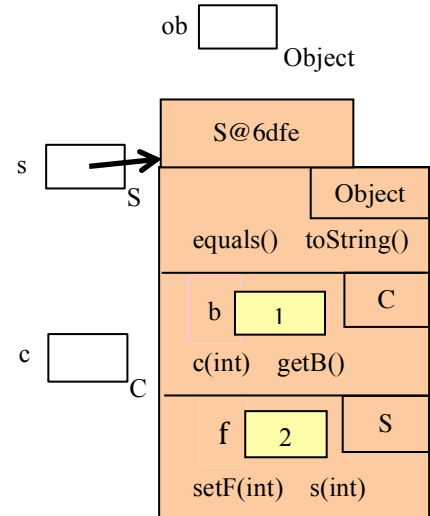
```
( <class-name> ) <pointer-to-object>
```

The first statement below casts pointer s to Object and stores it in ob. The second statement casts pointer ob to C and stores it in variable c.

```
ob= (Object) s;
c= (C) ob;
```

These casts do *not* change the object or the pointer. They simply provide a different view of the object. They do not take any time —except to make sure that the cast can be done.

The pointer in ob views the object as if it were of class Object. The pointer in c views the object as if it were of class C. Read the dictionary entry for the *compile-time reference-rule* for information about the effects of the different views of an object.



Rules governing casts

Here are rules governing class casts.

1. A pointer to an object can be cast to any class for which it has a partition, and to none other.
2. Upward casts (from a subclass to some superclass) will be inserted automatically when necessary. Downward casts must be given explicitly.

Here are examples, given the three variables shown above.

- The pointer in s can be cast to S, C, and Object and to nothing else.
- One can write a sequence of casts like this: (S) (C) (Object) s. They are performed right to left.
- ob= s; is equivalent to ob= (Object) s; . The upward cast is inserted automatically.
- The cast (JFrame) s is syntactically incorrect because it is known at compile-time that no partition of an S object has name JFrame.
- The cast (S) ob is OK if ob contains a pointer to an S object but is not ok if it contains a pointer to an object of class Object. In the latter case, at runtime, a ClassCastException will be thrown.

Please note that we were careful to say that the “pointer to the object” is cast, not the object. However, we generally are not so precise and simply write that the object is cast.

Reasons for having casts

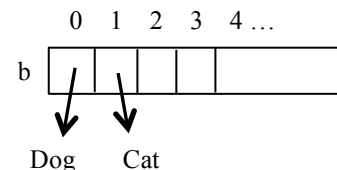
Consider a class Animal with subclasses Dog, Cat, and Cow. We draw an Animal array b to the right. Element b[0] is a Dog and b[1] is a Cat.

Each element b[i] of the array has type Animal. Suppose the assignment

```
b[2]= new Cow(...);
```

is executed. An upward cast is automatically inserted because the type of b[2] is Animal, so the assignment is equivalent to the following one:

```
b[2]= (Animal) (new Cow(...));
```



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The following example illustrates a cast upward to store an argument value in a parameter. It happens frequently. Suppose class `Animal` has fields for the birthdate of an animal. In class `Animal`, we might have this static method:

```
/** Return the age in years of Animal an. */  
public static int age(Animal an) { ... }
```

In the second statement below, Argument `d` is automatically cast to class `Animal` because the pointer has to be stored in parameter `an`, which has type `Animal`.

```
Dog d= new Dog(...);  
int age= Animal.age(d);
```

Testing whether a downward cast is will work: operator `instanceof`

As you will see from studying the *compile-time reference-rule*, the call `ob.c(int)` is syntactically incorrect and will not compile. In order to use method `c`, `ob` has to be cast down to class `C`:

```
((C ob).c(5);    //Cast ob to C and then call method c.
```

But this will throw an exception if `ob` cannot be cast to `C`, which will happen if `ob` points to an object of class `Object`, which has no `C` partition.

Use the `instanceof` operator to tell whether the cast is OK:

```
if (ob instanceof C) {  
    C v= (C) ob;  
    v.c(5);  
    ...  
}
```

The `instanceof` operator has the syntax:

```
<pointer-to-object> instanceof <class-name>
```

Its evaluation yields true if and only if the object has a partition named `<class-name>` and false otherwise.

Be frugal with the use of `instanceof`

Operator `instanceof` should not have to be used often. If it is being used a lot, then probably good use is not being made of the OO features of Java, and a restructuring of the program is in order.

One case in which the `instanceof` operator has to be used when overriding function equals (which is declared in class `Object`). Turn to the dictionary entry for `equals(...)` for an explanation.