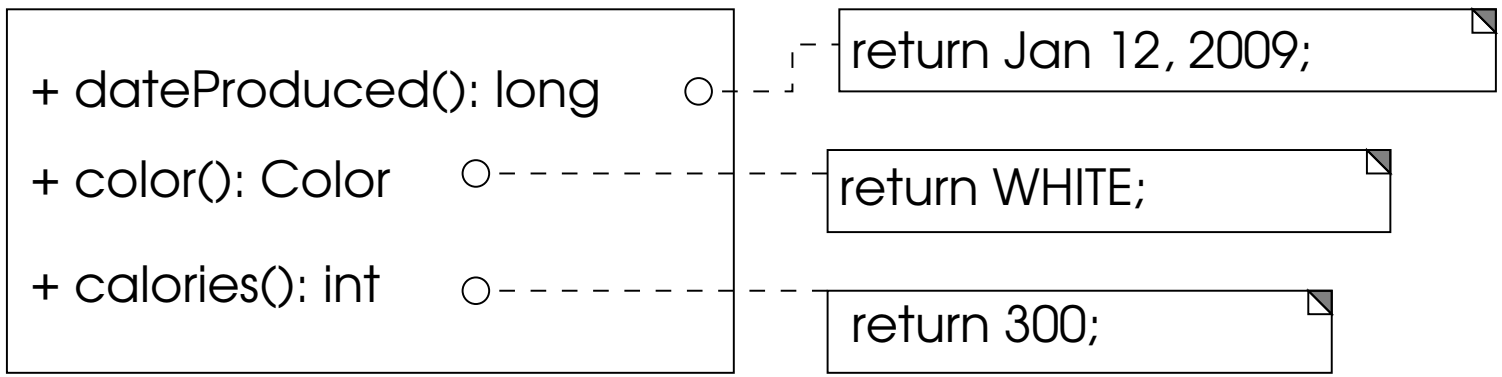
CS 335 — Software Development

Introduction/Review of Object-Oriented Concepts

Jan 27, 2012

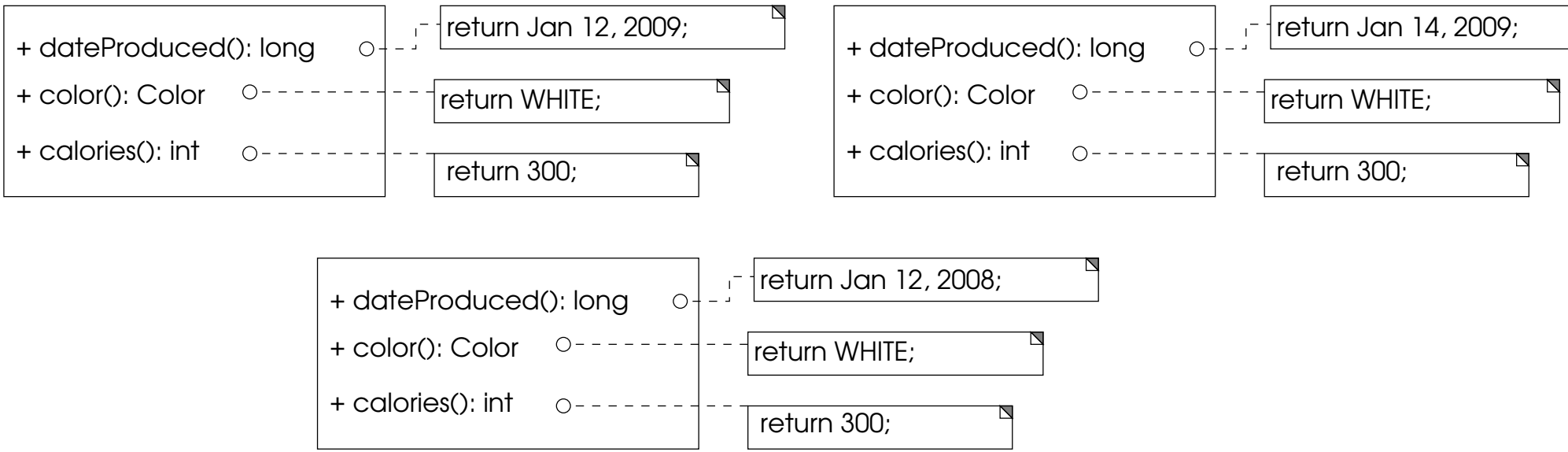
Objects


+ dateProduced(): long
+ color(): Color
+ calories(): int
return Jan 12, 2009;
return WHITE;
return 300;

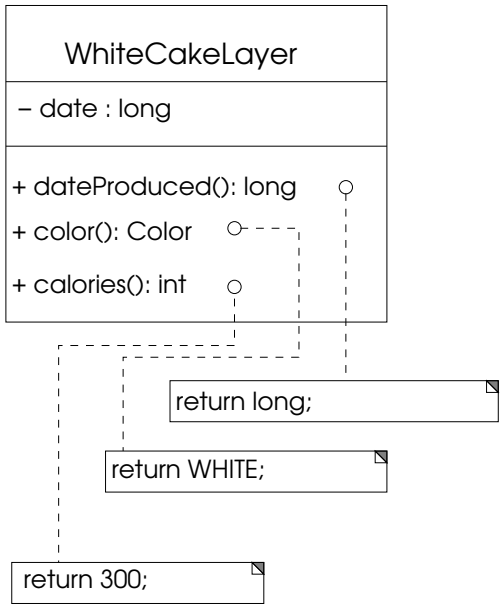
Objects don't need classes

```
typedef int Color;

unsigned long int _dateProduced() { return 862547416; }

Color _color() { return 0; }

int _calories() { return 300; }

struct {
  unsigned  long int (*dateProduced) ();
  Color (*color)();
  int (*calories)();
}  aWhiteCake = { _dateProduced, _color, _calories };
```

Several similar objects



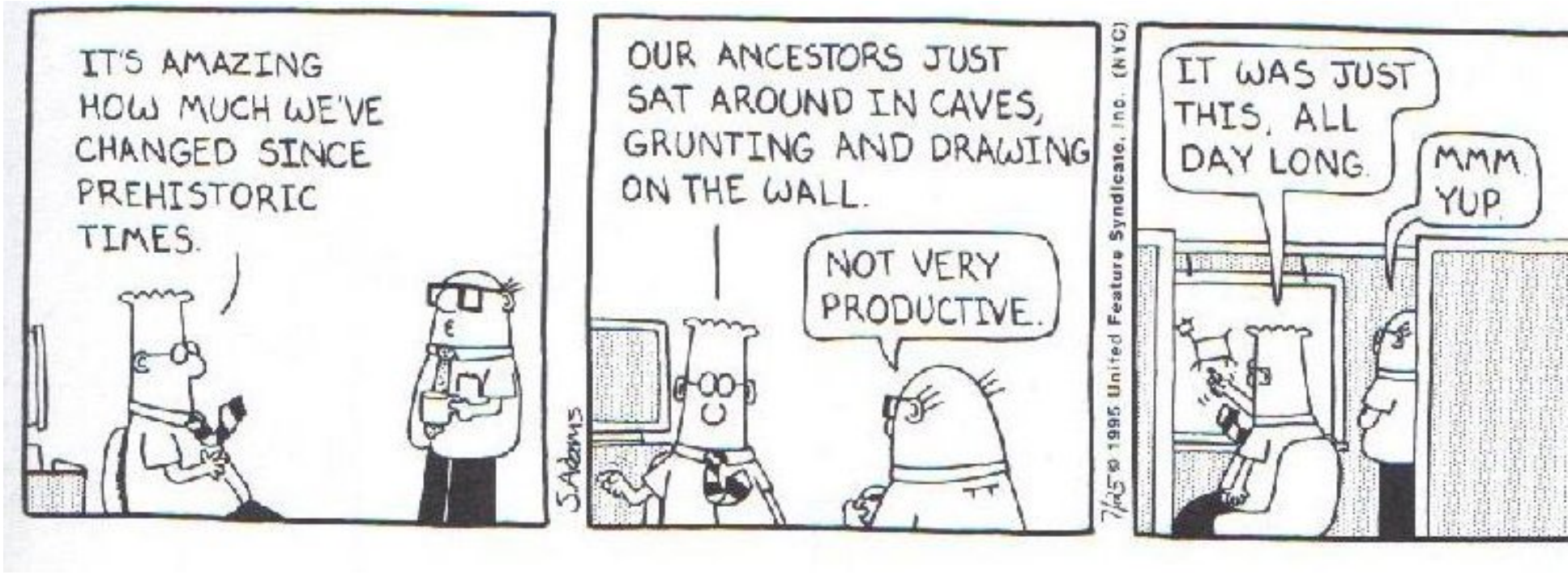
Classes




```
class WhiteCakeLayer {
    private long date;
    public WhiteCakeLayer() {
        date = System.currentTimeMillis();
    }
    public long dateProduced() { return date; }
    public Color color() { return Color.WHITE; }
    public int calories() { return 300; }
}
```

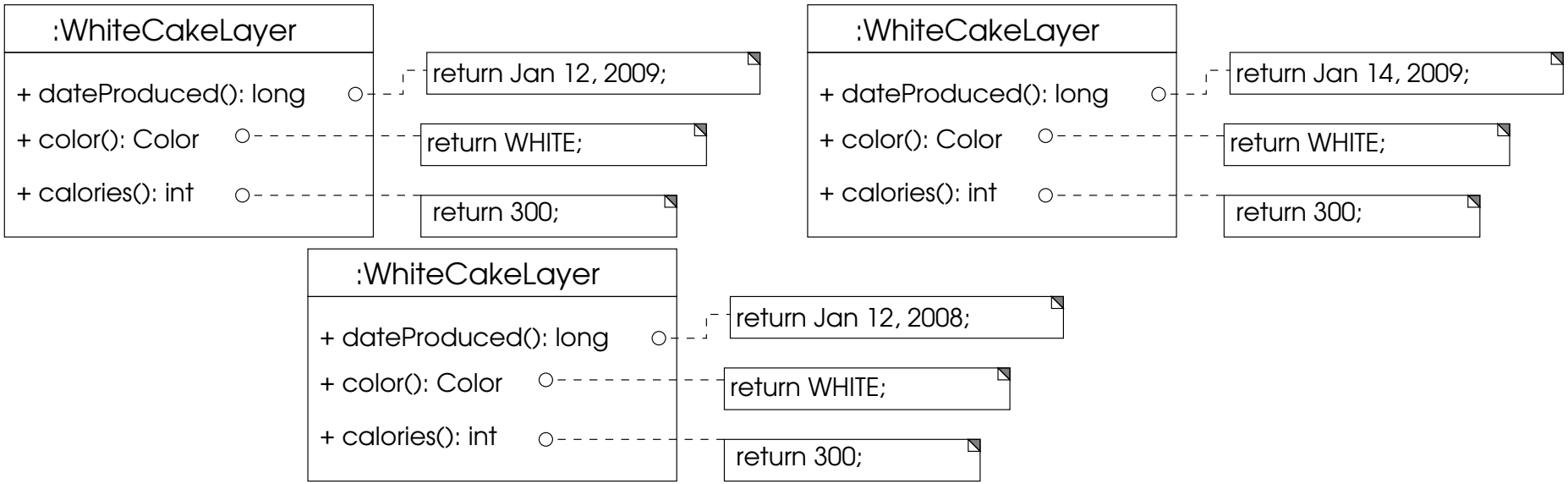
"An object's implementation is defined by its **class**. The class specifies the object's internal data and representation and defines the operations the object can perform." DP, pg 14

UML



Scott Adams. ©1995, Universal Features Syndicate

What has changed?



Commonality among classes

```
class WhiteCakeLayer {
   private long date;
   public WhiteCakeLayer() {
        date =
          System.currentTimeMillis();
   }
   public long dateProduced() {
        return date; }
   public Color color() {
        return Color.WHITE; }
   public int calories() {
        return 300;  }
}

class YellowCakeLayer {
   public Color color() {
        return Color.YELLOW; }
   public int calories() {
        return 400; }
}
```

```
class ChocolateCakeLayer {
   public Color color() {
      return Color.BLACK; }
   public int calories() {
      return 500; }
}

class VelvetCakeLayer {
   public Color color() {
      return Color.RED; }
   public int calories() {
      return 450; }
}
```

Types

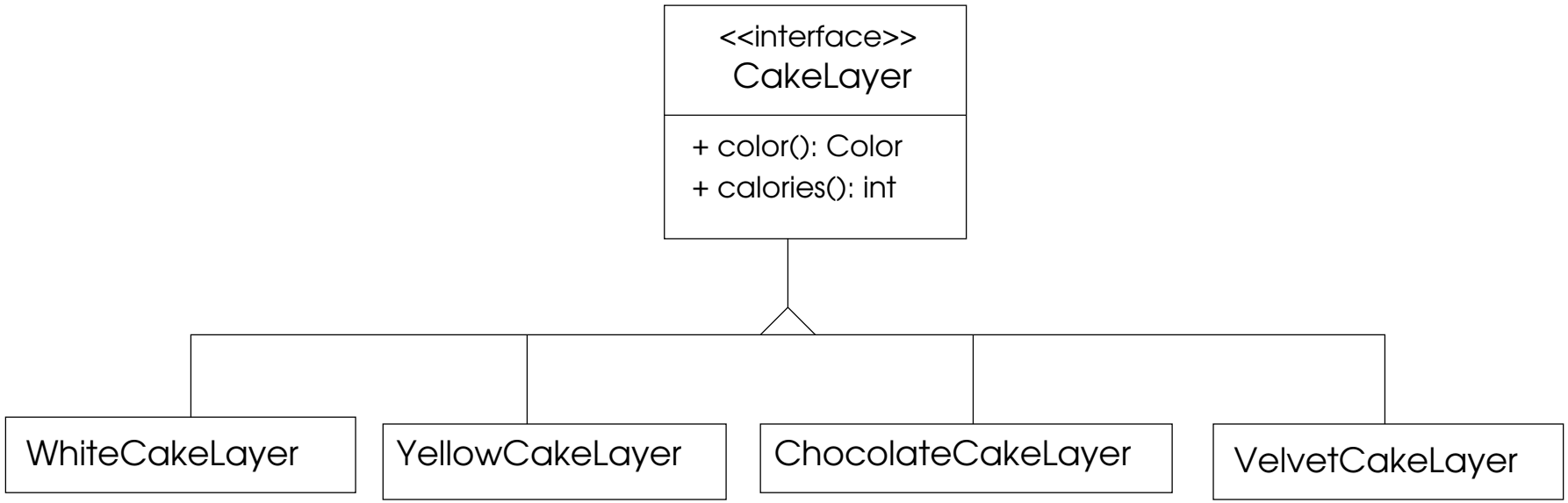
"The set of all signatures defined by an object's operations is called the **interface** to the object. An object's interface characterizes the complete set of requests that can be sent to the object. Any request that matches a signature in the object's interface may be sent to the object. A **type** is a name used to denote a particular interface."

DP, pg 13

"It's important to understand the difference between a object's *class* and its *type*. An object's class defines how the object is implemented. The class defines the object's internal state and the implementation of its operations. In contrast, an object's type only refers to its interface—the set of request to which it can respond. An object can have many types, and objects of different classes can have the same type."

DP, pg 16

Subtyping


<<interface>>
CakeLayer
+ color(): Color
+ calories(): int
WhiteCakeLayer
YellowCakeLayer
ChocolateCakeLayer
VelvetCakeLayer

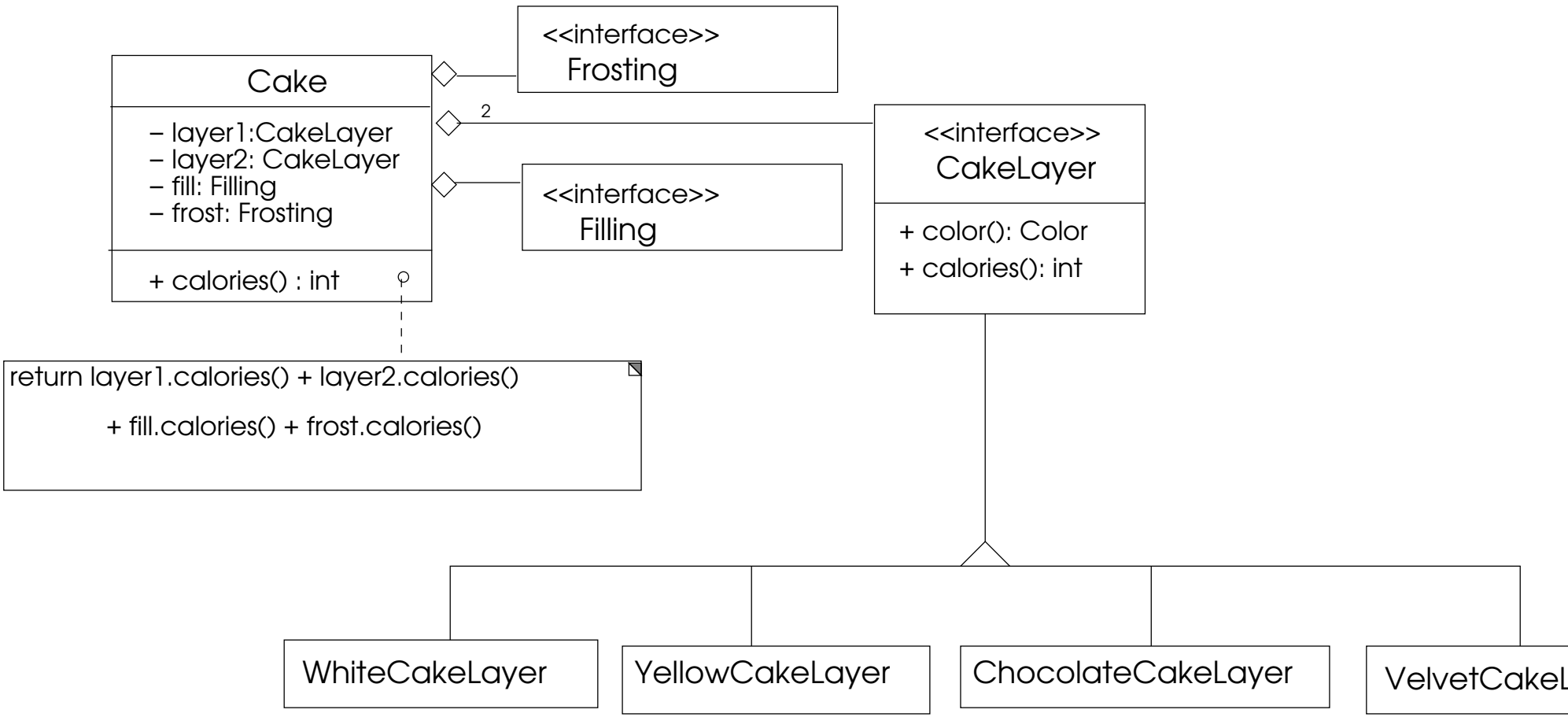
Liskov substitution principle

> *If for each object o_1 of type S, there is an object o_2 of type T such that for all programs P defined in terms of T, the behavior of P is unchanged when o_1 is substituted for o_2, then S is a subtype of T.*

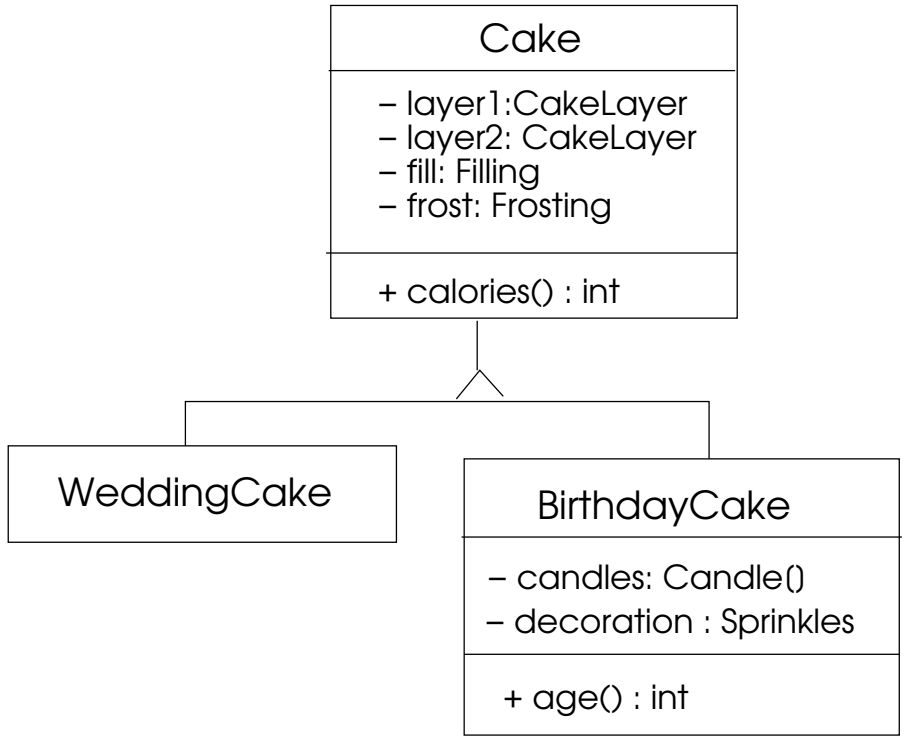
Barbara Liskov, "Data Abstraction and Hierarchy," *SIGPLAN Notices*, 23.5, May 1988.

> *If a value of type S can be substituted into any context where a value of type T is expected, then S is a subtype of T.*

Interchangeablility



Class extension



Class extension vs. interface implementation

"It's also important to understand the difference between class inheritance and interface inheritance (or subtyping). Class inheritance defines an object's implementation in terms of another object's implementation. In short, it's a mechanism for code and representation sharing. In contrast, interface inheritance (or subtyping) describes when an object can be used in place of another.

"It's easy to confuse these two concepts, because many languages don't make the distinction explicit."

DP, pg 17

Inheritance and reuse

"Because inheritance exposes a subclass to details of its parent's implementation, it's often said that "inheritance breaks encapsulation." The implementation of a subclass becomes so bound up with the implementation of its parent class that any change in the parent's implementation will force the subclass to change."

DP, pg 19

Two principles

Program to an interface, not an implementation.

DP, pg 18

Favor object composition over class inheritance.

DP, pg 20

Suggestions from *Effective Java*

- 13: Minimize the accessibility of classes and members.
- 14: In public classes, use accessor methods, not public fields.
- 15: Minimize mutability.
- 16: Favor composition over inheritance.
- 17: Design and document for inheritance or else prohibit it.
- 18: Prefer interfaces to abstract classes
- 19: Use interfaces only to define types.
- 20: Prefer class hierarchies to tagged classes
- 21: Use function objects to represent strategies
- 22: Favor static member classes over nonstatic.

Joshua Bloch, *Effective Java*, Addison-Wesley, 2008. Pg 67–108