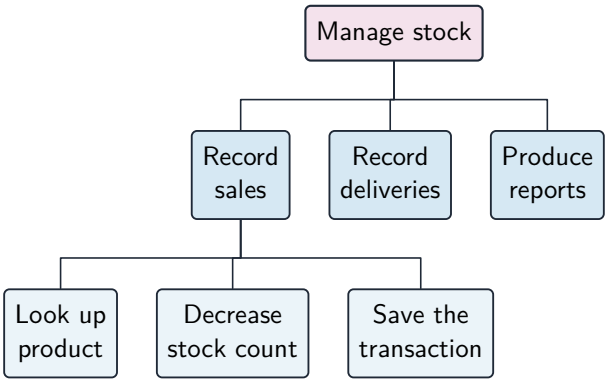
Class Creation

AP Computer Science A

Abstraction and Program Design

Abstraction 抽象 means hiding detail behind a simple interface –you use a `String` without knowing how it stores characters. Good design breaks a problem into classes, each responsible for one idea. This topic is about writing **your own** classes.



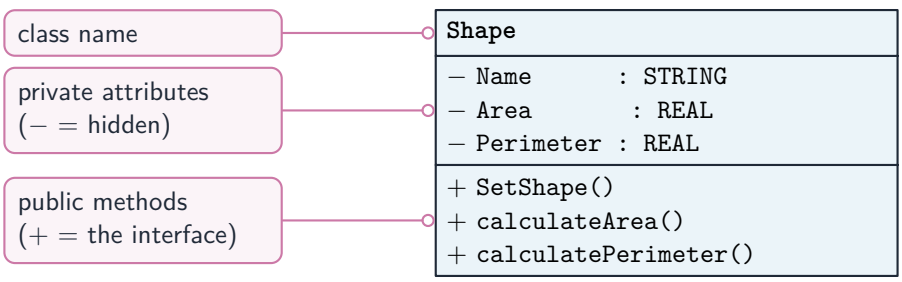
Decomposing a program into modules and sub-modules

The Impact of Program Design

Design choices affect whether code is correct, readable, and reusable. **Encapsulation** 封装–keeping data private and exposing it only through methods –protects an object's state from misuse and lets you change the inside without breaking users of the class. Thoughtful naming, single-purpose methods, and testing reduce bugs.

The Anatomy of a Class

A class has three parts: **instance variables** 实例变量 (fields –the object's data), **constructors** (build objects), and **methods** (behavior). Fields are usually `private`; methods are usually `public`:



A class diagram: private attributes and public methods

```java
public class Student {
    private String name;      // instance variable
    private int score;

    public Student(String n, int s) {   // constructor
        name = n;
        score = s;
    }
    public int getScore() { return score; }   // accessor
}
```

Constructors

A **constructor** 构造函数 has the **same name as the class** and no return type. It runs when you write `new`, and its job is to initialize the fields. A class can have several constructors with different parameter lists (**overloading** 重载); a **no-argument** constructor sets defaults.

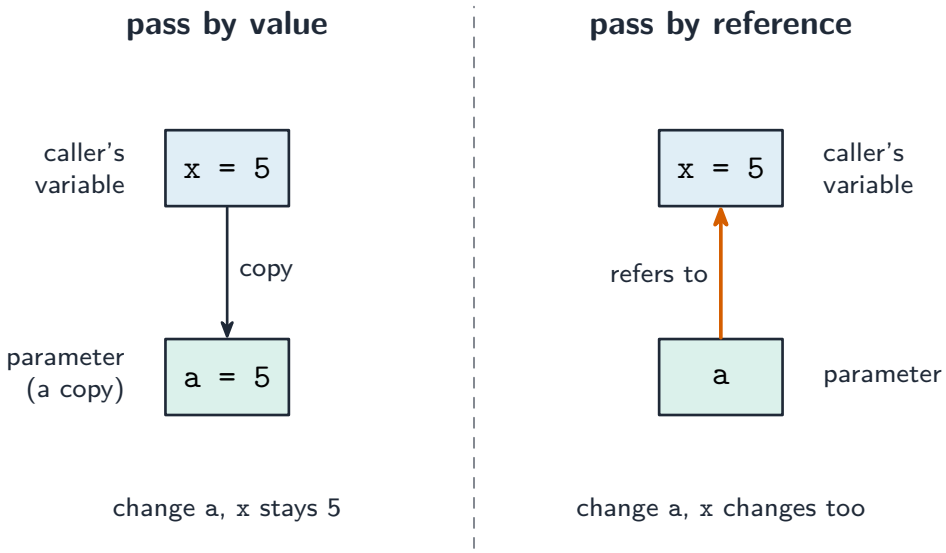
Methods: How to Write Them

A method has a signature, a return type, and a body. An **accessor (getter)** 访问器 returns information without changing the object; a **mutator (setter)** 修改器 changes a field. A method returning a value must have a `return` of the right type on every path; a `void` method returns nothing.

```java
public void setScore(int s) { score = s; }   // mutator
public String toString() { return name + ": " + score; }
```

Passing and Returning References of an Object

When you pass an object to a method, Java copies the **reference**, so the method acts on the **same** object –changes to its fields are visible to the caller. (Primitives are copied by value, so changes to them are not.) A method can also **return** a reference to an object. Because a `String` is immutable, passing one is safe; passing a mutable object lets a method change it.



Pass by value gives a copy; pass by reference lets the method change the original

Exam skill: know that mutating an object's fields inside a method affects the original, but **reassigning** the parameter (`param = new...`) does not affect the caller.

Worked example. Suppose `s` is a `Student` with score `50`, and we call `tweak(s)`:

```
public static void tweak(Student a) {
    a.setScore(100);          // (1) mutates the shared object
    a = new Student("Z", 0);  // (2) repoints the local copy only
    a.setScore(5);            // (3) changes only the new local object
}
```

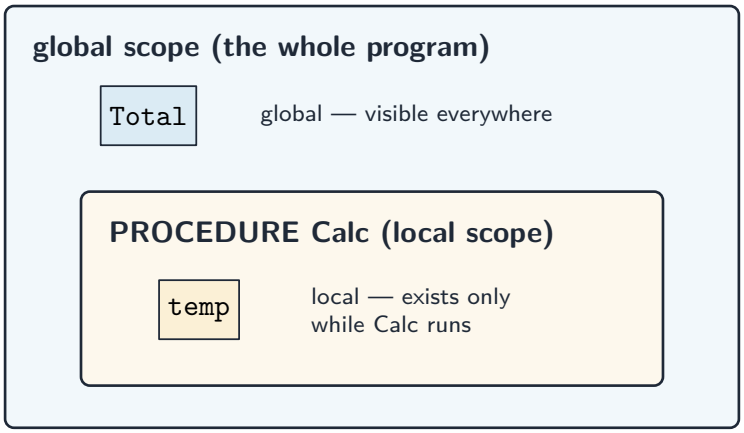
Line (1) changes the object `s` points to, so the caller now sees `100`. Line (2) makes the method's own copy of the reference point at a fresh object –the caller's `s` is untouched –and line (3) affects only that new object. After the call, `s.getScore()` is `100`: the mutation stuck, the reassignment did not.

Class Variables and Class Methods

A **static (class) variable** 类变量, marked `static`, is shared by **all** objects of the class –one copy total (e.g. a counter of how many objects exist). A **static method** belongs to the class and cannot use instance fields directly. Access them by class name: `Student.getCount()`.

Scope and Access

Scope 作用域 is where a name is visible. A **local variable** declared in a method exists only inside it; a **parameter** exists only in its method; an **instance variable** is visible throughout the object. Access modifiers control visibility across classes: `private` (this class only) versus `public` (anywhere). Local variables **shadow** fields of the same name –a source of bugs.



A global variable is visible everywhere; a local variable only inside its block

The this Keyword

`this` is a reference to the **current object**. Use it to tell a field apart from a parameter with the same name, or to call another method of the same object:

```
public Student(String name, int score) {
    this.name = name;      // this.name is the field; name is the parameter
    this.score = score;
}
```

Exam skill: when a constructor or setter's parameter has the same name as a field, you **must** write `this.field = param` –without `this`, the assignment does nothing useful.

Exam tips

- Design with methods and classes: encapsulate data as `private` fields and expose behaviour through public methods.
- Know the difference between an **object** and its **class**, and that objects are passed by **reference** (a method can change the object's state).
- Traverse arrays and `ArrayList`s safely —size is `length` vs `.size()`, and removing during a loop shifts indices.
- Write and trace a **recursive** method: find the base case first, then check the recursive call moves toward it.
- Use inheritance and polymorphism (override, `super`) so the right method runs at run time.