

04834580 Software Engineering (Honor Track) 2024-25

# Design Principles

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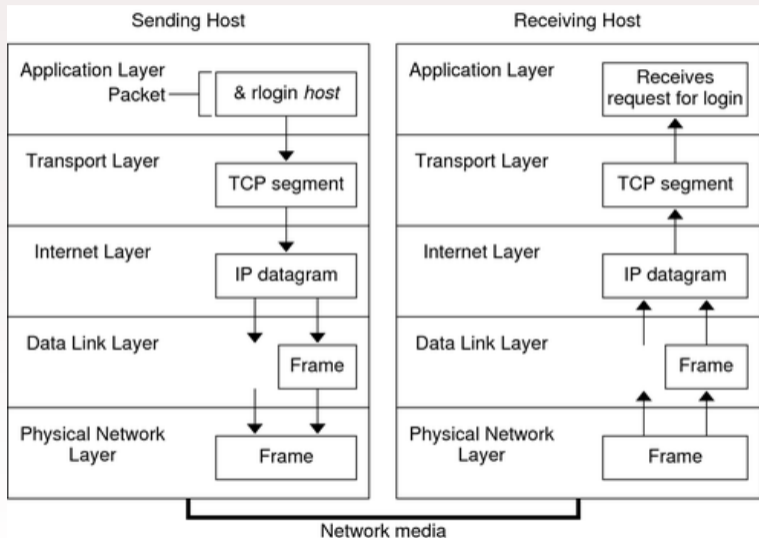
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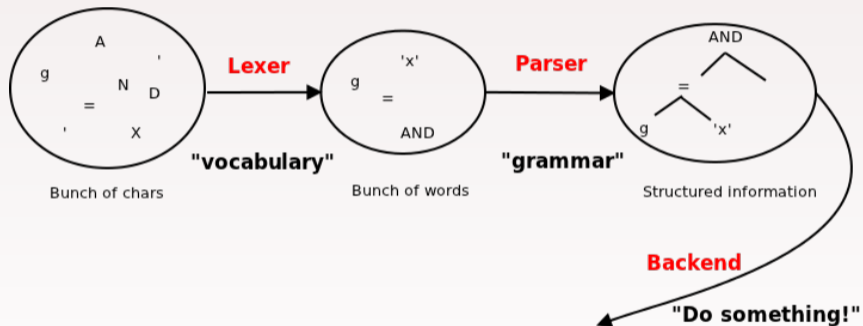


Edsger W. Dijkstra in “On the role of scientific thought” [1]:

*Let me try to explain to you, what to my taste is characteristic for all intelligent thinking. It is, that one is willing to study in depth an aspect of one's subject matter in isolation for the sake of its own consistency, all the time knowing that one is occupying oneself only with one of the aspects. We know that a program must be correct and we can study it from that viewpoint only; we also know that it should be efficient and we can study its efficiency on another day, so to speak. In another mood we may ask ourselves whether, and if so: why, the program is desirable. But nothing is gained — on the contrary! — by tackling these various aspects simultaneously. It is what I sometimes have called “the separation of concerns”, which, even if not perfectly possible, is yet the only available technique for effective ordering of one's thoughts, that I know of. This is what I mean by “focusing one's attention upon some aspect”: it does not mean ignoring the other aspects, it is just doing justice to the fact that from this aspect's point of view, the other is irrelevant. It is being one- and multiple-track minded simultaneously.*







Robert C. Martin, the originator of the term [2, 3], expresses the principle as

*A class should have only one reason to change.*

Illustrating Example:

*As an example, consider a module that compiles and prints a report. Imagine such a module can be changed for two reasons. First, the content of the report could change. Second, the format of the report could change. These two things change for different causes. The single responsibility principle says that these two aspects of the problem are really two separate responsibilities, and should, therefore, be in separate classes or modules. It would be a bad design to couple two things that change for different reasons at different times.*

Formulated by Bertrand Meyer [4]:

*Software entities (classes, modules, functions, etc.) should be open for extension, but closed for modification.*

```
class Drawing {
    public void drawShape(String shape) {
        if ("circle".equals(shape)) {
            System.out.println("Drawing a circle");
        } else if ("rectangle".equals(shape)) {
            System.out.println("Drawing a rectangle");
        }
        // Adding new shapes requires modifying this method:
        // else if ("triangle".equals(shape)) {
        //     System.out.println("Drawing a triangle");
        // }
    }
}
```



```
interface Shape {
    void draw();
}

// Implement different shapes
class Circle implements Shape {
    @Override
    public void draw() {
        System.out.println("Drawing a circle");
    }
}

class Rectangle implements Shape {
    @Override
    public void draw() {
        System.out.println("Drawing a rectangle");
    }
}

// Add a Drawing class that works with the Shape abstraction
class Drawing {
    public void drawShape(Shape shape) {
        shape.draw();
    }
}
```

```
class Rectangle {
    private double width;
    private double height;

    public Rectangle(double width, double height) {
        this.width = width;
        this.height = height;
    }
    ...

    public double calculateArea() {
        return width * height;
    }
}

class Square extends Rectangle {
    public Square(double side) {
        super(side, side);
    }
}
```

```
class Square {
    private double side;

    public Square(double side) {
        this.side = side;
    }

    public double calculateArea() {
        return side * side;
    }
}

class Rectangle extends Square {
    private double height;

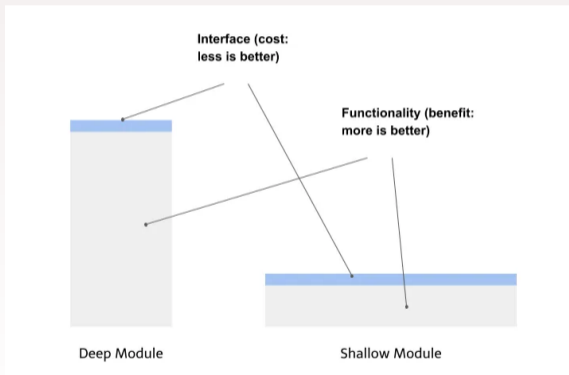
    public Rectangle(double width, double height) {
        super(width);
        this.height = height;
    }

    @Override
    public double calculateArea() {
        return getWidth() * height;
    }
}
```

Barbara Liskov and Jeannette Wing formulated this principle in “A behavioral notion of subtyping” [5]:

*Subtype Requirement: Let  $\phi(x)$  be a property provable about objects  $x$  of type  $T$ . Then  $\phi(y)$  should be true for objects  $y$  of type  $S$  where  $S$  is a subtype of  $T$ .*

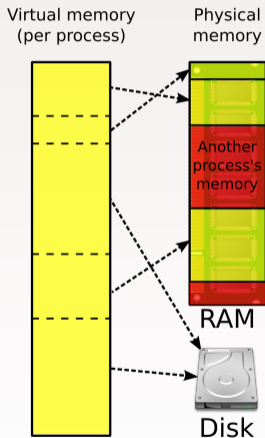
Deep modules provide a lot of functionality behind a simple interface, while shallow modules have a relatively complicated interface.



```
int open(const char* path, int flags, mode_t permissions)
int close(int fd)
ssize_t read(int fd, void* buffer, size_t count)
ssize_t write(int fd, const void* buffer, size_t count)
off_t lseek(int fd, off_t offset, int referencePosition)
```

## Abstracts:

- ▶ On-disk representation, disk block allocation
- ▶ Directory management, path lookup
- ▶ Permission management
- ▶ Disk scheduling
- ▶ Block caching



## Linus Torvalds in TED interview [6]:

*sometimes you can see a problem in a different way and rewrite it so that a special case goes away and becomes the normal case, and that's good code*

```
void remove(list *l, list_item *target)
{
    list_item *cur = l->head, *prev = NULL;
    while (cur != target) {
        prev = cur;
        cur = cur->next;
    }
    if (prev)
        prev->next = cur->next;
    else
        l->head = cur->next;
}
```

```
void remove(list *l, list_item *target)
{
    list_item **p = &l->head;
    while (*p != target)
        p = &(*p)->next;
    *p = target->next;
}
```

Ron Jeffries, a co-founder of extreme programming (XP):

*Always implement things when you actually need them, never when you just foresee that you will need them.*



- ▶ DRY (Don't Repeat Yourself)
- ▶ KISS (Keep it simple, stupid!)

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On the role of scientific thought.  
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- [4] Bertrand Meyer.  
*Object-oriented software construction*, volume 2.  
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- [5] Barbara H Liskov and Jeannette M Wing.  
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