



Software Architecture

Software Architecture - SOLID Principles



- SOLID means :
 - **S**ingle responsibility principle
 - **O**pen–closed principle
 - **L**iskov substitution principle
 - **I**nterface segregation principle
 - **D**ependency inversion principle



- Single responsibility principle

Every module, class or function in a computer program should have responsibility over a single part of that program's functionality, and it should encapsulate that part.

Software Architecture - SOLID Principles



- Open-closed principle

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



- Liskov substitution principle

If S is a subtype of T, then objects of type T in a program may be replaced with objects of type S without altering any of the desirable properties of that program



- Interface segregation principle

Many client-specific interfaces are better than one general-purpose interface

Software Architecture - SOLID Principles



- Dependency inversion principle

Depend upon abstractions, not concretions

Software Architecture - Bad Example



```
export class CoffeeCup {  
  constructor(  
    private coffeeType: "arabica" | "robusta",  
    private cupCapacity: number  
  ) {}  
}
```

```
import { CoffeeCup } from "../CoffeeCup";  
const coffeeCup = new CoffeeCup("arabica", 20);
```



- ✗ Single Responsibility : coffee is not separate from the cup
- ✗ Open-closed principle : to create a cup of tea we would need to modify the code
- ✗ Dependency inversion principle : CoffeeCup does not have any dependency

Software Architecture - Bad Example



```
import fs from "fs";

export class FileLogger {
  constructor(private filePath: string) {}

  async log(msg: string) {
    const formatted = `${new Date().toISOString()} - ${msg}\n`;
    await fs.promises.appendFile(this.filePath, formatted);
  }
}
```

```
import { FileLogger } from "../FileLogger";

const logger = new FileLogger("app.log");
await logger.log('Message');
```

- ✗ Single Responsibility : file writing is not separate from logging
- ✗ Open-closed principle : to log in the terminal we would need to modify the code
- ✗ Dependency inversion principle : FileLogger does not have any dependency

Software Architecture - Bad Example



```
export class Coffee {  
  constructor(  
    private type: "arabica" | "robusta",  
  ) {}  
}
```

```
import { Coffee } from "../Coffee";  
  
export class Cup {  
  private coffee: Coffee;  
  constructor(  
    private capacity: number  
  ) {  
    this.coffee = new Coffee('arabica');  
  }  
}
```

```
import { Cup } from "../Cup";  
  
const coffeeCup = new Cup(10);
```



- ✓ Single Responsibility : 1 class for coffee, 1 class for cup
- ✗ Open-closed principle : to create a cup of tea we would need to modify the code
- ✗ Dependency inversion principle : Coffee is a hard-coded dependency, it can't be replaced programmatically

Software Architecture - Bad Example



```
import fs from "fs";

export class FileWriter {
  constructor(private filePath: string) {}

  async write(msg: string) {
    await fs.promises.appendFile(this.filePath, msg);
  }
}
```

```
import { FileWriter } from "../FileWriter";

export class Logger {
  private fileWriter: FileWriter;

  constructor(filePath: string) {
    this.fileWriter = new FileWriter(filePath);
  }

  async log(msg: string) {
    const formatted = `${new Date().toISOString()} - ${msg}\n`;
    await this.fileWriter.write(formatted);
  }
}
```

```
import { Logger } from "../Logger";

const logger = new Logger("app.log");
await logger.log('Message');
```

Software Architecture - Bad Example



- ✓ Single Responsibility : 1 class for file writing, 1 class for logging
- ✗ Open-closed principle : to log in the terminal we would need to modify the code
- ✗ Dependency inversion principle : Coffee is a hard-coded dependency, it can't be replaced programmatically

Software Architecture - Bad Example



```
export class Coffee {  
  constructor(  
    private type: "arabica" | "robusta",  
  ) {}  
}
```

```
import { Coffee } from "../Coffee";  
  
export class Cup {  
  constructor(  
    private capacity: number,  
    private coffee: Coffee  
  ) {}  
}
```

```
import { Coffee } from "../Coffee";  
import { Cup } from "../Cup";  
  
const coffee = new Coffee('arabica');  
const coffeeCup = new Cup(10, coffee);
```



- ✓ Single Responsibility : 1 class for coffee, 1 class for cup
- ✓ Open-closed principle : we could pass a specialization of Coffee to modify the code (but it could break the Liskov substitution principle)
- ✗ Dependency inversion principle : Coffee is a hard-coded dependency, it can't be replaced programmatically

Software Architecture - Bad Example



```
import fs from "fs";

export class FileWriter {
  constructor(private filePath: string) {}

  async write(msg: string) {
    await fs.promises.appendFile(this.filePath, msg);
  }
}
```

```
import { FileWriter } from "../FileWriter";

export class Logger {
  constructor(private fileWriter: FileWriter) {}

  async log(msg: string) {
    const formatted = `${new Date().toISOString()} - ${msg}\n`;
    await this.fileWriter.write(formatted);
  }
}
```

```
import { FileWriter } from "../FileWriter";
import { Logger } from "../Logger";

const writer = new FileWriter("app.log");
const logger = new Logger(writer);
await logger.log('Message');
```

Software Architecture - Bad Example



- ✓ Single Responsibility : 1 class for file writing, 1 class for logging
- ✓ Open-closed principle : we could pass a specialization of FileWriter to modify the code (but it could break the Liskov substitution principle)
- ✗ Dependency inversion principle : Coffee is a hard-coded dependency, it can't be replaced programmatically

Software Architecture - Good Example



```
export interface DrinkInterface {}
```

```
import { DrinkInterface } from "./DrinkInterface";
```

```
export class Coffee implements DrinkInterface {  
  constructor(private type: "arabica" | "robusta") {}  
}
```

```
import { DrinkInterface } from "./DrinkInterface";
```

```
export class Cup {  
  constructor(private capacity: number, private drink: DrinkInterface)  
}
```

```
import { Coffee } from "./Coffee";  
import { Cup } from "./Cup";  
  
const coffee = new Coffee("arabica");  
const coffeeCup = new Cup(10, coffee);
```



- ✓ Single Responsibility : 1 class for coffee, 1 class for cup
- ✓ Open-closed principle : we could pass an implementation of DrinkInterface to modify the code
- ✓ Dependency inversion principle : Cup depends on an abstraction, we could easily create a cup of Tea

Software Architecture - Good Example



```
export interface WriterInterface {  
  write(msg: string): Promise<void>;  
}
```

```
import fs from "fs";  
import { WriterInterface } from "../WriterInterface";  
  
export class FileWriter implements WriterInterface {  
  constructor(private filePath: string) {}  
  
  async write(msg: string) {  
    await fs.promises.appendFile(this.filePath, msg);  
  }  
}
```

```
import { WriterInterface } from "../WriterInterface";  
  
export class Logger {  
  constructor(private writer: WriterInterface) {}  
  
  async log(msg: string) {  
    const formatted = `${new Date().toISOString()} - ${msg}\n`;  
    await this.writer.write(formatted);  
  }  
}
```

```
import { FileWriter } from "../FileWriter";  
import { Logger } from "../Logger";  
  
const writer = new FileWriter("app.log");  
const logger = new Logger(writer);  
await logger.log('Message');
```

Software Architecture - Good Example



- ✓ Single Responsibility : 1 class for file writing, 1 class for logging
- ✓ Open-closed principle : we could pass an implementation of WriterInterface to modify the code
- ✓ Dependency inversion principle : Logger depends on an abstraction, we could easily create a logger that would log on a different