Patrones de diseño con typescript en el mundo real

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QALovers

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Apasionado de la informática y la tecnología desde pequeño, ha tenido la suerte de poder dedicarse profesionalmente a ello desde hace 11 años. Tras trabajar con diversos lenguajes y tecnologías dentro del ecosistema Microsoft, en los últimos años se ha especializado en tecnologías Frontend, consiguiendo ser un referente en los últimos proyectos en los que ha colaborado.

Actualmente es Frontend Technical Lead en Plain Concepts Madrid, intentando siempre aprender y mejorar junto a sus compañeros, aplicando buenas prácticas, desarrollando código limpio y apoyándose en las últimas tecnologías.

Si no encontráis ningún commit suyo en GitHub seguramente esté viajando, jugando al Super Mario, escuchando algún temazo de música electrónica, leyendo algún comic de Batman o automatizando su casa con el último juguete domótico de Xiaomi.

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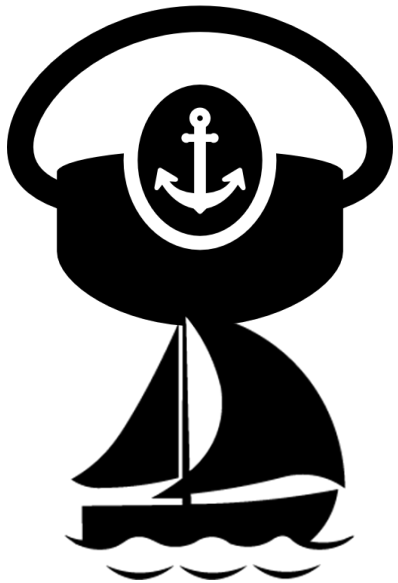
¿Qué es un patrón?

A)

B)



C)

QALovers

¿Qué es un patrón?

Wikipedia:

*Los patrones de diseño son unas **técnicas para resolver problemas comunes en el desarrollo de software** y otros ámbitos referentes al diseño de interacción o interfaces.*

*Un patrón de diseño resulta ser una **solución a un problema de diseño**. Para que una solución sea considerada un patrón debe poseer ciertas características. Una de ellas es que **debe haber comprobado su efectividad** resolviendo problemas similares en ocasiones anteriores. Otra es que **debe ser reutilizable**, lo que significa que es aplicable a diferentes problemas de diseño en distintas circunstancias.*

Factory method teoría

```ts
interface Product {
  // Contract members
}
```

```ts
abstract class Creator {
  public abstract factoryMethod(): Product;
}
```

implements

extends

```ts
class ConcreteProduct1 implements Product {
  // Contract members implemented
}
```

creates

```ts
class ConcreteCreator extends Creator {
  factoryMethod(): Product {
    return new ConcreteProduct1();
  }
}
```

Factory method realidad

```ts
interface Logger {
  log(message: string): void;
}
```

implements

```ts
class AppInsightsLogger implements Logger {
  log(message: string): void {
    (<any>window).appInsights.trackTrace({ message });
  }
}
```

creates

```ts
abstract class AbstractLoggerCreator {
  protected abstract createLogger(): Logger;

  public getLogger(): Logger {
    return this.createLogger();
  }
}
```

extends

extends

```ts
class AppInsightsLoggerCreator
  extends AbstractLoggerCreator {

  protected createLogger(): Logger {
    return new AppInsightsLogger();
  }
}
```

```ts
class ConsoleLoggerCreator
  extends AbstractLoggerCreator {

  protected createLogger(): Logger {
    return console;
  }
}
```

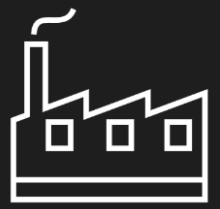
creates

creates

```ts
class LoggerCreator {
    public static getLogger(environment): Logger {
        const dictionary = {
            ['DEV']: () => new ConsoleLoggerCreator(),
            ['PROD']: () => new AppInsightsLoggerCreator()
        };
        return dictionary[environment]().getLogger();
    }
}
```

Usage:

```ts
export class Client {
    constructor(private appConfig: { environment: string }) { }

    main() {
        LoggerCreator.getLogger(this.appConfig.environment).log('a message to log');
    }
}
```



Factory method (with params) teoría

```ts
interface Product {
  // Contract members
}
```

implements

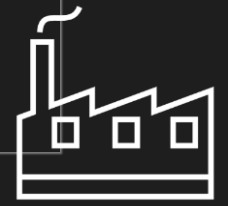
```ts
class ConcreteProduct1 implements Product {
  // Contract members implemented
}

class ConcreteProduct2 implements Product {
  // Contract members implemented
}

class ConcreteProduct3 implements Product {
  // Contract members implemented
}
```

creates

```ts
interface Creator {
  factoryMethod(param: 1 | 2 | 3): Product;
}
```

implements

```ts
class ConcreteCreator implements Creator {
  factoryMethod(param: 1 | 2 | 3): Product {
    const dictionary = {
      1: ConcreteProduct1,
      2: ConcreteProduct2,
      3: ConcreteProduct3
    }
    const ConcreteProduct = dictionary[param];
    return new ConcreteProduct();
  }
}
```



Factory method (with params) realidad

```
@Component({ selector: 'fm-text-component', templateUrl: './text.component.html' })
export class FactoryMethodTextComponent implements IComponent {
    @Input() data: Array<any>;
}

@Component({ selector: 'fm-textarea-component', templateUrl: './textarea.component.html' })
export class FactoryMethodTextAreaComponent implements IComponent {
    @Input() data: Array<any>;
}

@Component({ selector: 'fm-select-component', templateUrl: './select.component.html' })
export class FactoryMethodSelectComponent implements IComponent {
    @Input() data: Array<any>;
}
```

implements

```
export interface IComponent {
    data: Array<any>
}
```

creates

```
export class ComponentFactory {
    static getComponentByMode(mode: ComponentModes) {
        const dictionary = {
            [ComponentModes.Text]: FactoryMethodTextComponent,
            [ComponentModes.TextArea]: FactoryMethodTextAreaComponent,
            [ComponentModes.Select]: FactoryMethodSelectComponent
        };
        return dictionary[mode];
    }
}
```

gets

```
@Component({ selector: 'fm-creator-component', template: '' })
export class FactoryMethodCreatorComponent implements OnInit {
    @Input() mode: ComponentModes;
    @Input() data: Array<any>;

    constructor(
        private componentFactoryResolver: ComponentFactoryResolver,
        public viewContainerRef: ViewContainerRef
    ) { }

    ngOnInit() {
        const componentToInstance = ComponentFactory.getComponentByMode(this.mode);
        const componentFactory =
            this.componentFactoryResolver.resolveComponentFactory(componentToInstance);

        this.viewContainerRef.clear();

        const componentInstance =
            this.viewContainerRef.createComponent(componentFactory).instance;
        componentInstance.data = this.data;
    }
}
```

Usage:

```
<fm-creator-component [mode]="textMode" [data]="genericData"></fm-creator-component>
<fm-creator-component [mode]="textAreaMode" [data]="genericData"></fm-creator-component>
<fm-creator-component [mode]="selectMode" [data]="genericData"></fm-creator-component>

@Component({
    selector: 'factory-method-with-params',
    templateUrl: './real-world.component.html'
})
export class FactoryMethodRealWorldComponent {
    textMode = ComponentModes.Text;
    textAreaMode = ComponentModes.TextArea;
    selectMode = ComponentModes.Select;
    genericData = ['first item', 'second item'];
}
```

Singleton teoría

```
class Singleton {
  private static instance: Singleton;
  private constructor() { }
  static build(): Singleton {
    Singleton.instance = Singleton.instance || new Singleton();
    return Singleton.instance;
  }
}
```

creates

```
const instance = Singleton.build();
```

Singleton realidad

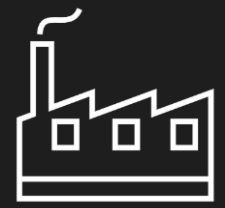
Usage:

```
export class Client {
    initializeApp(): void {
        ReportTemplatesAgentFactory.use(
            'https://my-base-url', 'my-app-id');
    }

    async generateReports(): Promise<void> {
        const reportTemplates =
            await ReportTemplatesAgentFactory
                .build().getReporTemplates();
        // Apply datasource over the report templates.
    }
}
```

```
class ReportTemplatesAgentFactory {
    private static instance: ReportTemplatesAgent;
    private static config: { baseUrl: string, applicationId: string };

    static use(baseUrl: string, applicationId: string) {
        this.config = { baseUrl, applicationId };
    }

    static build(): ReportTemplatesAgent {
        if (!this.config) {
            throw new Error('You should configure the factory before using it.')
        }
        this.instance = this.instance || new ReportTemplatesAgent(
            this.config.baseUrl,
            this.config.applicationId
        );
        return this.instance;
    }
}
```

creates

```
class ReportTemplatesAgent {
    constructor(
        private baseUrl: string,
        private applicationId: string
    ) { }

    getReporTemplates(): Promise<Array<ReportTemplate>> {
        return fetch(
            new Request('https://my-reports-api.com/get-all-report-templates')
        ).then(response => response.json());
    }
}
```



Adapter teoría

```
interface Target {
    requiredMethod(): void;
}
```

inherits

inherits

```
class Adapter implements Target {
    constructor(private adapteeObject: Adaptee) { }

    requiredMethod(): void {
        this.adapteeObject.oldMethod();
    }
}
```

```
class CompatibleObject implements Target {
    requiredMethod(): void { }
}
```

adapts

```
class Adaptee {
    oldMethod(): void { }
}
```

Usage:

```
export class Client {
    static main(): void {
        const a_compatible_object = new CompatibleObject();
        const a_non_compatible_object = new Adaptee();
        const adapter = new Adapter(a_non_compatible_object);

        a_compatible_object.requiredMethod();
        adapter.requiredMethod();
    }
}
```

Adapter realidad

```
<i [tooltip]="text" (events)="handleTooltipEvents($event)" class="material-icons">info</i>
@Component({
    selector: 'fa-tooltip',
    templateUrl: './tooltip-adapter.component.html'
})
export class TooltipAdapterComponent {
    @Input() text: string;
    @Output() shown: EventEmitter<void> = new EventEmitter<void>();

    handleTooltipEvents(event: { type: string, position: DOMRect }) {
        if (event.type === 'shown') {
            this.shown.emit();
        }
    }
}
```

calls

Usage:

```
<span>One text</span>
<fa-tooltip text="one tooltip" (shown)="tooltipWasShown()"></fa-tooltip>
<span>Another text</span>
<fa-tooltip text="another tooltip" (shown)="tooltipWasShown()"></fa-tooltip>
```

Facade teoría

```ts
export class Client {
    callOperations(): void {
        const facade = new Facade();
        facade.operation1();
        facade.operation2();
    }
}
```

calls

```ts
class Facade {
    private part1: Part1 = new Part1();
    private part2: Part2 = new Part2();
    private part3: Part3 = new Part3();

    operation1(): void {
        this.part1.method1();
        this.part2.method2();
    }

    operation2(): void {
        this.part1.method1();
        this.part3.method3();
    }
}
```

calls

```ts
class Part1 {
    method1(): void {
        console.log("method 1 (Part 1)");
    }
}
```

calls

```ts
class Part2 {
    method2(): void {
        console.log("method 2 (Part 2)");
    }
}
```

calls

```ts
class Part3 {
    method3(): void {
        console.log("method 3 (Part 3)");
    }
}
```

Facade realidad

```ts
export class Client {
    private agent = new ReportsAgentFacade();

    async showAvailableReports(): Promise<void> {
        const reports = await this.agent.loadReports();
        // Show the available reports in a dropdown
    }

    async printReport(reportId: number): Promise<void> {
        const report = await this.agent.getReport(reportId);
        document.body.innerHTML = report.template;
    }
}
```

calls

```ts
export class ReportsAgentFacade {
    private reportsService = new ReportsService();
    private assetsService = new AssetsService();
    private appModeService = new AppModeService();

    async loadReports(): Promise<IReport[]> {
        let reports: IReport[] = [];
        if (this.appModeService.isOffline()) {
            reports = await this.assetsService.getJsonFromFile('reports');
            localStorage.setItem('reports', JSON.stringify(reports));
        } else {
            reports = await this.reportsService.getAll();
        }
        return reports;
    }

    async getReport(reportId: number): Promise<IReport> {
        let reports: IReport[] = [];
        if (this.appModeService.isOffline()) {
            reports = JSON.parse(localStorage.getItem('reports'));
        } else {
            reports = await this.reportsService.getAll();
        }
        return reports.find(r => r.id === reportId);
    }
}
```

calls

```ts
export class ReportsService {
    async getAll(): Promise<IReport[]> {
        const reports = await fetch(
            new Request('http://my-reports-rest-api/reports'))
            .then(response => response.json());

        return reports.map((report, index) =>
            ({
                id: index,
                template: 'a-html-report-template',
                name: report.name
            }));
```

calls

```ts
export class AssetsService {
    getJsonFromFile(fileName: string): Promise<any> {
        return fetch(new Request(`./my-assets-path/${fileName}.json`))
            .then(response => response.json());
    }
}
```

calls

```ts
export class AppModeService {
    isOffline(): boolean {
        return !!window.navigator.userAgent.match(/Electron/);
    }
}
```

Flyweight teoría

```
interface Flyweight {
    operation(extrinsicState);
}
```

implements

```
class ConcreteFlyweight implements Flyweight {
    operation(extrinsicState) { }
}
```

creates and stores

```
class FlyweightFactory {
    private flyweights: { [key: string]: Flyweight };

    GetFlyWeight(intrinsicState): Flyweight {
        const key = this.getKey(intrinsicState);
        if (!this.flyweights[key]) {
            const newFlyweight = new ConcreteFlyweight();
            this.flyweights[key] = newFlyweight;
            return newFlyweight;
        } else {
            return this.flyweights[key];
        }
    }

    private getKey(intrinsicState): string {
        return `${intrinsicState.model}-${intrinsicState.color}`;
    }
}
```

Usage:

```
class Client {
    run() {
        const factory = new FlyweightFactory();
        const car1 = factory.GetFlyWeight({ model: 'BMW', color: 'red' });
        const car2 = factory.GetFlyWeight({ model: 'BMW', color: 'red' });
        const car3 = factory.GetFlyWeight({ model: 'Toyota', color: 'white' });
        car1.operation({ km: 1000 });
        car2.operation({ km: 200 });
        car3.operation({ km: 3500 });
    }
}
```

Flyweight realidad

```
<h3>Original implementation:</h3>
<fly-original-info infoText="first info"></fly-original-info>
<fly-original-info infoText="second info"></fly-original-info>
```

has 1..n

```
<button (click)="showDialog()">Show info</button>
<fly-dialog #dialog></fly-dialog>
```

```
@Component({
    selector: 'fly-dialog',
    templateUrl: 'dialog.component.html',
    styleUrls: ['./dialog.component.css']
})
export class FlyweightDialogComponent {
    text = '';
    visible = false;
    show(text: string) { this.text = text; this.visible = true; }
    close() { this.visible = false; }
}
```

Extracting intrinsic (the dialog) and extrinsic (the info text) properties:

```
<h3>Flyweight implementation:</h3>
<fly-refactored-info infoText="first info" (showDialog)=showFlyweightDialog($event)></fly-refactored-info>
<fly-refactored-info infoText="second info" (showDialog)=showFlyweightDialog($event)></fly-refactored-info>
<fly-dialog #dialog></fly-dialog>
```

```
@Component({
    selector: 'flyweight',
    templateUrl: './real-world.component.html'
})
export class FlyweightRealWorldComponent {
    @ViewChild('dialog', { static: false }) dialog: FlyweightDialogComponent;
    showFlyweightDialog(extrinsicInfoText: string) {
        this.dialog.show(extrinsicInfoText);
    }
}
```

has

```
@Component({
    selector: 'fly-dialog',
    templateUrl: 'dialog.component.html',
    styleUrls: ['./dialog.component.css']
})
export class FlyweightDialogComponent {
    text = '';
    visible = false;
    show(text: string) { this.text = text; this.visible =
    close() { this.visible = false; }
}
```

Strategy teoría

```ts
interface Strategy {
    strategicMethod(): void;
}
```

implements

implements

```ts
class ConcreteStrategyB implements Strategy {
    public strategicMethod(): void {
        console.log('Strategy B');
    }
}
```

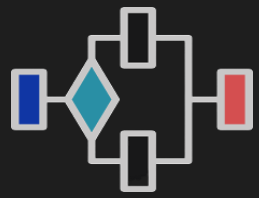
```ts
class ConcreteStrategyA implements Strategy {
    public strategicMethod(): void {
console.log('Strategy A');
    }
}
```

executes

```ts
class Context {
    private strategy: Strategy;

    constructor(strategy: Strategy) {
        this.strategy = strategy;
    }

    setStrategy(strategy: Strategy) {
        this.strategy = strategy;
    }

    performStrategicMethod(): void {
        this.strategy.strategicMethod();
    }
}
```

Usage:

```ts
export class Client {
    run(): void {
        const context = new Context(new ConcreteStrategyA());
        context.performStrategicMethod();

        context.setStrategy(new ConcreteStrategyB());
        context.performStrategicMethod();
    }
}
```



Strategy realidad

implements

executes

```
export interface FieldFormatter<T> {
    format(field: Field<T>): string;
}
```

```
export class StringFormatter implements FieldFormatter<string> {

    format(field: Field<string>): string {
        return field.value;
    }
}
```

```
export class BooleanFormatter implements FieldFormatter<boolean> {

    format(field: Field<boolean>): string {
        return field.value ? 'True' : 'False';
    }
}
```

```
@Injectable()
export class FieldFormatterService {
    private formattersDictionary: { [key: number]: FieldFormatter<any> };

    constructor() {
        this.formattersDictionary =
            FieldTypeFormatsFactory.buildFormattersDictionary();
    }

    format(field: Field<any>): string {
        const typeFormatter = this.formattersDictionary[field.type];
        return typeFormatter !== undefined && typeFormatter.format(field);
    }
}
```

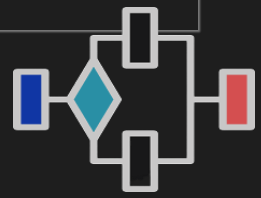
gets

```
export class FieldTypeFormatsFactory {

    static buildFormattersDictionary(
    ): { [key: number]: FieldFormatter<any> } {
        return {
            [FieldTypes.String]: new StringFormatter(),
            [FieldTypes.Boolean]: new BooleanFormatter()
        };
    }
}
```

```
<ul>
    <li *ngFor="let fieldFormatted of fieldsFormatted">{{fieldFormatted}}</li>
</ul>
```

```
@Component({
    selector: 'strategy',
    templateUrl: './real-world.component.html'
})
export class StrategyRealWorldComponent implements OnInit {
    fieldsFormatted: Array<string>;

    constructor(private fieldFormatter: FieldFormatterService) { }

    ngOnInit() {
        const fields: Array<Field<any>> = [
            { type: FieldTypes.Boolean, value: true },
            { type: FieldTypes.String, value: 'a field value' }
        ]
        this.fieldsFormatted = fields.map(f => this.fieldFormatter.format(f));
    }
}
```

Usage



Observer teoría

```ts
interface Observer {
    update(): void;
}
```

implements

```ts
class ConcreteObserver implements Observer {
    update(): void { }
}
```

notifies

registers

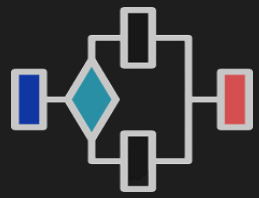
```ts
interface Subject {
    registerObserver(observer: Observer);
    unregisterObserver(observer: Observer);
    notifyObservers();
}
```

implements

```ts
class ConcreteSubject implements Subject {
    observers: Array<Observer>;

    registerObserver(observer: Observer) {
        this.observers.push(observer);
    }

    unregisterObserver(observer: Observer) {
        // TODO: find and remove observer from the collection.
    }

    notifyObservers() {
        this.observers.forEach(o => o.update());
    }
}
```

Usage:

```ts
class Client {
    run() {
        const subject = new ConcreteSubject();
        const observer1 = new ConcreteObserver();
        const observer2 = new ConcreteObserver();

        subject.registerObserver(observer1);
        subject.registerObserver(observer2);

        subject.notifyObservers();
    }
}
```



Observer realidad

```
<observer1></observer1>
<observer2></observer2>

@Component({
    selector: 'observer',
    templateUrl: './real-world.component.html'
})
export class ObserverRealWorldComponent { }
```

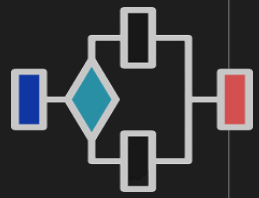
```
@Injectable()
export class ConnectorService {
    private currentState: Order;
    private observers = [];

    constructor(private store: Store) {
        this.currentState = this.store.state;
    }

    registerObserver(component) {
        this.observers.push(component);
        this.notifyObserver(component);
    }

    updateState(newState: Order) {
        if (this.isStateChanged(newState)) {
            this.currentState = newState;
            this.notifyObservers();
        }
    }

    private notifyObservers() {
        this.observers.forEach(o => this.notifyObserver(o));
    }
```

notifies

registers and updates

```
<ul>
    <li *ngFor="let productName of productNames">{{productName}}</li>
</ul>
<button (click)="addNewProduct()">Add new product</button>
```

```
@Component({
    selector: 'observer2',
    templateUrl: './observer2.component.html'
})
export class Observer2Component {
    public productNames: Array<string> = [];
    private model: Order;

    @Input() set order(orderFromState: Order) {
        this.model = orderFromState;
        this.buildFormattedOrderList();
    }
    get order() { return this.model; }

    constructor(private connector: ConnectorService) {
        this.connector.registerObserver(this);
    }

    private buildFormattedOrderList(): void {
        this.productNames = this.model.productList.map(p => p.name);
    }

    addNewProduct() {
        this.connector.updateState(
            addNewProductStateAction(this.model)
        );
    }
}
```



Page-Object teoría

```html
<ul>
    <li class="id">1</li>
    <li class="name">A product</li>
    <li><a href="#" class="view-detail">View Detail</a></li>
</ul>
<ul>
    <li class="id">2</li>
    <li class="name">Another product</li>
    <li><a href="#" class="view-detail">View Detail</a></li>
</ul>
```

reads and interacts

```typescript
class TestClient {
    private pageObject = new ProductListPageObject();

    is_a_valid_product_id(): boolean {
        const productId = this.pageObject.getProductId();
        return productId > 0;
    }

    is_a_valid_product_name(): boolean {
        const productName = this.pageObject.getProductName();
        return productName.length < 255;
    }

    is_a_product_detail_visible(): boolean {
        this.pageObject.openDetail()
        // ...
```

calls

```typescript
export class ProductListPageObject {
    getProductId(): number {
        const productId = this.getHTMLElementByClass('id')[0].textContent;
        return parseInt(productId);
    }

    getProductName(): string {
        const productName = this.getHTMLElementByClass('name')[0].textContent;
        return productName;
    }

    openDetail(): void {
        const viewDetailButton = this.getHTMLElementByClass('view-detail')[0];
        viewDetailButton.click();
    }

    private getHTMLElementByClass(className: string): Array<HTMLElement> {
        return [new HTMLElement()];
    }
}
```

Page-Object realidad

```
<label for="name"></label>
<input type="text" name="name" [value]="name" (input)="name = $event.target.value" />
<button (click)="sayHello()">Say Hello!</button>
<span id="greeting">{{greeting}}</span>
```

reads and interacts

```
describe('The page object pattern real world example', () => {
    let testable_component: TestablePageObjectRealWorldComponent;

    beforeEach(() => {
        TestBed.configureTestingModule({
            imports: [AppModule]
        }).compileComponents();
        testable_component = TestablePageObjectRealWorldComponent.build();
    });

    it('should initialize the name as empty', () => {
        expect(testable_component.is_name_empty()).toBeTruthy();
    });

    describe('when the user requests a greeting', () => {

        const one_valid_name = 'JsDay';

        beforeEach(() => {
            testable_component.set_name(one_valid_name);
            testable_component.request_greeting();
        });

        it('should show the greeting', () => {
            expect(testable_component.get_greeting()).toBe(`Hello ${one_valid_name}!`);
        });

    });

});
```

calls

```
export class TestablePageObjectRealWorldComponent {
    get instance(): PageObjectRealWorldComponent { return this.fixture.componentInstance; }

    private constructor(private fixture: ComponentFixture<PageObjectRealWorldComponent>) { }

    static build(): TestablePageObjectRealWorldComponent {
        const page_object_fixture = TestBed.createComponent(PageObjectRealWorldComponent);
        const testable_component = new TestablePageObjectRealWorldComponent(page_object_fixture);
        testable_component.fixture.detectChanges();
        return testable_component;
    }

    set_name(name: string): void {
        this.instance.name = name;
        this.fixture.detectChanges();
    }

    is_name_empty(): boolean {
        const name = this.fixture.nativeElement.querySelector('[name="name"]');
        return !name || name.value === '';
    }

    request_greeting(): void {
        const request_greeting_button = this.fixture.nativeElement.querySelector('button');
        request_greeting_button.click();
        this.fixture.detectChanges();
    }

    get_greeting(): string {
        const greeting = this.fixture.nativeElement.querySelector('#greeting');
        return !greeting ? '' : greeting.textContent;
    }
}
```

QALovers

Y aún hay más...

Builder teoría

```
class ProductBuilder {
  private product_attr_1: string;
  private product_attr_N: string;

  public addSomeConfig(param: string): ProductBuilder {
    this.product_attr_1 = param;
    return this;
  }

  public addAnotherConfig(param: string): ProductBuilder {
    this.product_attr_N = param;
    return this;
  }

  public build(): Product {
    const product = new Product();
    product.attr_1 = this.product_attr_1;
    product.attr_N = this.product_attr_N;
    return product;
  }
}
```

creates

```
class Client_and_director {
  public static main(args: String[]): void {
    const director = new ProductBuilder()
      .addSomeConfig('some param value')
      .addAnotherConfig('another param value');

    const product = director.build();
  }
}
```

returns

```
class Product {
  attr_1: string = "";
  attr_N: string = "";
}
```

Builder realidad

```
export default class Migrations {
  private migrations = [];

  last() {
    return this.migrations[this.migrations.length - 1];
  }

  add(migration: Migration) {
    this.migrations.push(migration);
    return this;
  }

  getGreaterThan(version: string) {
    const { migrations } = this;
    const migrationOfVersionIndex = migrations.indexOf(
      migrations.filter(m => m.version === version)[0]
    );
    return migrations.slice(migrationOfVersionIndex + 1, migrations.length);
  }

  build() {
    return new Migrator(new DataStorage(), this);
  }
}
```

creates

```
const migrations = new Migrations()
  .add(new Migration_v1())
  .add(new Migration_v2());

const migrator = migrations.build();

migrator.migrateToLastVersion();
```

returns

```
export default class Migrator {
  constructor(
    private storage: DataStorage,
    private migrations: Migrations
  ) { }

  migrateToLastVersion(): void {
    const current_storage_version = this.storage.get('db_pm:version');
    if (current_storage_version) {
      let current_storage_data = this.storage.get('db_pm:data');
      if (current_storage_data) {
        this.migrations.getGreaterThan(current_storage_version).forEach((migration) => {
          current_storage_data = migration.migrate(current_storage_data);
        });
        this.storage.set('db_pm:data', current_storage_data);
        this.storage.set('db_pm:version', this.migrations.last().version);
      }
    }
  }
}
```

Prototype teoría

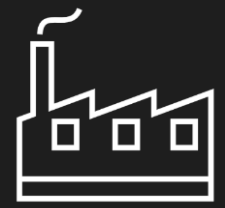
```typescript
class ClaseConcreta implements Cloneable<ClaseConcreta> {
  constructor(public attr_1: string) { }

  public clone() {
    // Member clonation
    return new ClaseConcreta(this.attr_1);
  }
}
```

implements

```typescript
interface Cloneable<T> {
  clone(): T;
}
```

Usage:

```typescript
class PrototipoClient {
  static main() {
    const p1 = new ClaseConcreta("Clone-I");
    const c1 = p1.clone();
    console.log(`Clonación: ${c1.attr_1}`);
  }
}
```



Prototype realidad

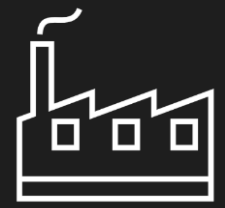
```ts
export function clone<T>(obj: T): T {
  if (obj === null || typeof obj !== 'object') {
    return obj;
  }
  const clonator = typeClonators.find(c => obj instanceof c.for);
  if (clonator) {
    return clonator.copy(obj) as T;
  }
  throw new Error('Unable to copy obj! Its type isn\'t supported.');
}
```

calls

calls

calls

```ts
const typeClonators = [
  {
    for: Date,
    copy(date) {
      const copy = new Date();
      copy.setTime(date.getTime());
      return copy;
    },
  },
  {
    for: Array,
    copy(array) {
      const copy = [];
      for (let i = 0, len = array.length; i < len; i++) {
        copy[i] = clone(array[i]);
      }
      return copy;
    }
  },
  {
    for: Object,
    copy(obj) {
      let copy = {};
      try {
        copy = obj.constructor ? new obj.constructor() : {};
      } catch (e) {
        copy = {};
      }
      Object.keys(obj).forEach((attr) => {
        /* eslint no-prototype-builtins: "off" */
        if (obj.hasOwnProperty(attr)) {
          copy[attr] = clone(obj[attr]);
        }
      });
      return copy;
    }
  }
];
```



Composite teoría

```abstract class Component {
    operation(): any { }
}```

extends

extends

```class Leaf extends Component {
    operation(): any { }
}```

```class Composite extends Component {
    protected children: Component[] = [];

    add(component: Component) { }
    remove(component: Component) { }
    operation(): any { }
}```


```

Composite realidad

```ts
export class Customer implements Validatable {
    constructor(private name: string) { }

    validate(): Array<string> {
        const errors = [''];
        if (!this.name) {
            errors.push('name is mandatory');
        }
        return errors;
    }
}
```

implements

```ts
export interface Validatable {
    validate(): Array<string>;
}
```

implements

```ts
export class Product implements Validatable {
    constructor(private name: string) { }

    validate(): Array<string> {
        const errors = [''];
        if (!this.name) {
            errors.push('name is mandatory');
        }
        return errors;
    }
}
```

implements

has

```ts
export class Order implements Validatable {
    constructor(private productList: Array<Product>, private customer: Customer) { }

    validate(): Array<string> {
        let errors = [''];
        this.productList.forEach(p => errors = errors.concat(p.validate()));
        errors = errors.concat(this.customer.validate());
        return errors;
    }
}
```

has

Usage:

```ts
export class Client {
    validateEntity(): void {
        const productList = [new Product('one product'), new Product('another product')];
        const customer = new Customer('a customer');
        const errors = new Order(productList, customer).validate();
        console.log(errors);
    }
}
```

Mediator teoría

```
interface IComponent {
    operation(): any;
}
```

implements

implements

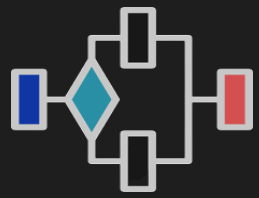
```
class Component1 implements IComponent {
    operation(): any { }
}
```

```
class Component2 implements IComponent {
    operation(): any { }
}
```

calls

calls

```
class Mediator {
    component1: IComponent;
    component2: IComponent;

    operation(): any {
        this.component1.operation();
        this.component2.operation();
    }
}
```



Mediator realidad

```
<observer1></observer1>
<observer2></observer2>

@Component({
    selector: 'observer',
    templateUrl: './real-world.component.html'
})
export class ObserverRealWorldComponent { }
```

updates

calls

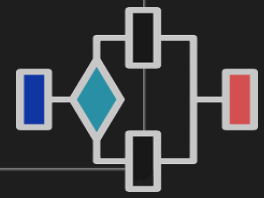
calls

updates

```
@Injectable()
export class ConnectorService {
    private currentState: Order;
    private observers = [];

    constructor(private store: Store) {
        this.currentState = this.store.state;
    }

    registerObserver(component) {
        this.observers.push(component);
        this.notifyObserver(component);
    }

    updateState(newState: Order) {
        if (this.isStateChanged(newState)) {
            this.currentState = newState;
            this.notifyObservers();
        }
    }

    private notifyObservers() {
        this.observers.forEach(o => this.notifyObserver(o));
    }
```

```
@Component({
    selector: 'observer1',
    templateUrl: './observer1.component.html'
})
export class Observer1Component {
    public productNames: Array<string> = [];
    private model: Order;

    @Input() set order(orderFromState: Order) {
        this.model = orderFromState;
        this.buildFormattedOrderList();
    }
    get order() { return this.model; }

    constructor(private connector: ConnectorService) {
        this.connector.registerObserver(this);
    }

    private buildFormattedOrderList(): void {
        this.productNames = this.model.productList.map(p => p.name);
    }

    addNewProduct() {
        this.connector.updateState(
            addNewProductStateAction(this.model)
        );
    }
}
```

```
@Component({
    selector: 'observer2',
    templateUrl: './observer2.component.html'
})
export class Observer2Component {
    public productNames: Array<string> = [];
    private model: Order;

    @Input() set order(orderFromState: Order) {
        this.model = orderFromState;
        this.buildFormattedOrderList();
    }
    get order() { return this.model; }

    constructor(private connector: ConnectorService) {
        this.connector.registerObserver(this);
    }

    private buildFormattedOrderList(): void {
        this.productNames = this.model.productList.map(p => p.name);
    }

    addNewProduct() {
        this.connector.updateState(
            addNewProductStateAction(this.model)
        );
    }
}
```



Memento teoría

```
class Memento {
    constructor(private state: string) { }

    getSavedState(): string {
        return this.state;
    }
}
```

remembers

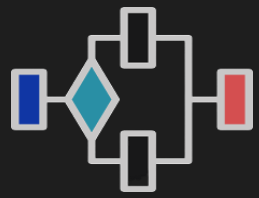
```
class Caretaker {
    private savedStates: Array<Memento> = [];
    addMemento(m: Memento): void { this.savedStates.push(m); }
    getMemento(index: number): Memento { return this.savedStates[index]; }
}
```

creates and restores

```
class Originator {
    private state: string;

    set(state: string): void {
        this.state = state;
    }

    saveToMemento(): Memento {
        return new Memento(this.state);
    }

    restoreFromMemento(m: Memento): void {
        this.state = m.getSavedState();
    }
}
```

Usage:

```
export class Client {
    run() {
        const caretaker = new Caretaker();

        const originator = new Originator();
        originator.set("State1");
        originator.set("State2");
        caretaker.addMemento(originator.saveToMemento());
        originator.set("State3");
        caretaker.addMemento(originator.saveToMemento());
        originator.set("State4");

        originator.restoreFromMemento(caretaker.getMemento(1));
    }
}
```



Memento realidad

```
<observer1></observer1>
<observer2></observer2>

@Component({
    selector: 'observer',
    templateUrl: './real-world.component.html'
})
export class ObserverRealWorldComponent { }
```

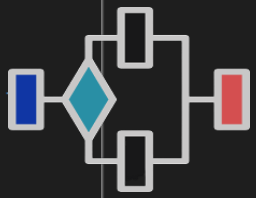
updates

```
@Component({
    selector: 'observer1',
    templateUrl: './observer1.component.html'
})
export class Observer1Component {
    public productNames: Array<string> = [];
    private model: Order;

    @Input() set order(orderFromState: Order) {
        this.model = orderFromState;
        this.buildFormattedOrderList();
    }
    get order() { return this.model; }

    constructor(private connector: ConnectorService) {
        this.connector.registerObserver(this);
    }

    private buildFormattedOrderList(): void {
        this.productNames = this.model.productList.map(p => p.name);
    }

    addNewProduct() {
        this.connector.updateState(
            addNewProductStateAction(this.model)
        );
    }
}
```

```
@Component({
    selector: 'observer2',
    templateUrl: './observer2.component.html'
})
export class Observer2Component {
    public productNames: Array<string> = [];
    private model: Order;

    @Input() set order(orderFromState: Order) {
        this.model = orderFromState;
        this.buildFormattedOrderList();
    }
    get order() { return this.model; }

    constructor(private connector: ConnectorService) {
        this.connector.registerObserver(this);
    }

    private buildFormattedOrderList(): void {
        this.productNames = this.model.productList.map(p => p.name);
    }

    addNewProduct() {
        this.connector.updateState(
            addNewProductStateAction(this.model)
        );
    }
}
```

updates

```
@Injectable()
export class ConnectorService {
    private currentState: Order;
    private observers = [];

    constructor(private store: Store) {
        this.currentState = this.store.state;
    }

    registerObserver(component) {
        this.observers.push(component);
        this.notifyObserver(component);
    }

    updateState(newState: Order) {
        if (this.isStateChanged(newState)) {
            this.currentState = newState;
            this.notifyObservers();
        }
    }

    private notifyObservers() {
        this.observers.forEach(o => this.notifyObserver(o));
    }

    private notifyObserver(observer) {
        observer.order = this.currentState;
    }

    private isStateChanged(newState: Order): boolean
        return this.currentState.id !== newState.id;
    }
}
```



Model View ViewModel teoría

Model View ViewModel realidad

```
@Component({
    selector: 'mvvm',
    templateUrl: './real-world.component.html'
})
export class MvvmRealWorldComponent {
    public productNames: Array<string> = [];
    private model: Order;

    @Input() set order(orderFromState: Order) {
        this.model = orderFromState;
        this.buildFormattedOrderList();
    }
    get order() { return this.model; }

    constructor(private connector: ConnectorService) {
        this.connector.registerObserver(this);
    }

    private buildFormattedOrderList(): void {
        this.productNames = this.model.productList.map(p => p.name);
    }

    addNewProduct() {
        this.connector.updateState(
            addNewProductStateAction(this.model)
        );
    }
}
```

shows

calls

```
<ul>
    <li *ngFor="let productName of productNames">{{productName}}</li>
</ul>
<button (click)="addNewProduct()">Add new product</button>
```

contains

```
export class Order implements Validatable {
    constructor(public id: string,
        public productList: Array<Product>,
        private customer: Customer) { }

    validate(): Array<string> {
        let errors = [''];
        this.productList.forEach(p => errors = errors.concat(p.validate()));
        errors = errors.concat(this.customer.validate());
        return errors;
    }
}
```

QALovers

¿Preguntas?

¡MUCHAS GRACIAS!