Поведенческие паттерны в Java: Iterator и Observer

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План презентации

Iterator

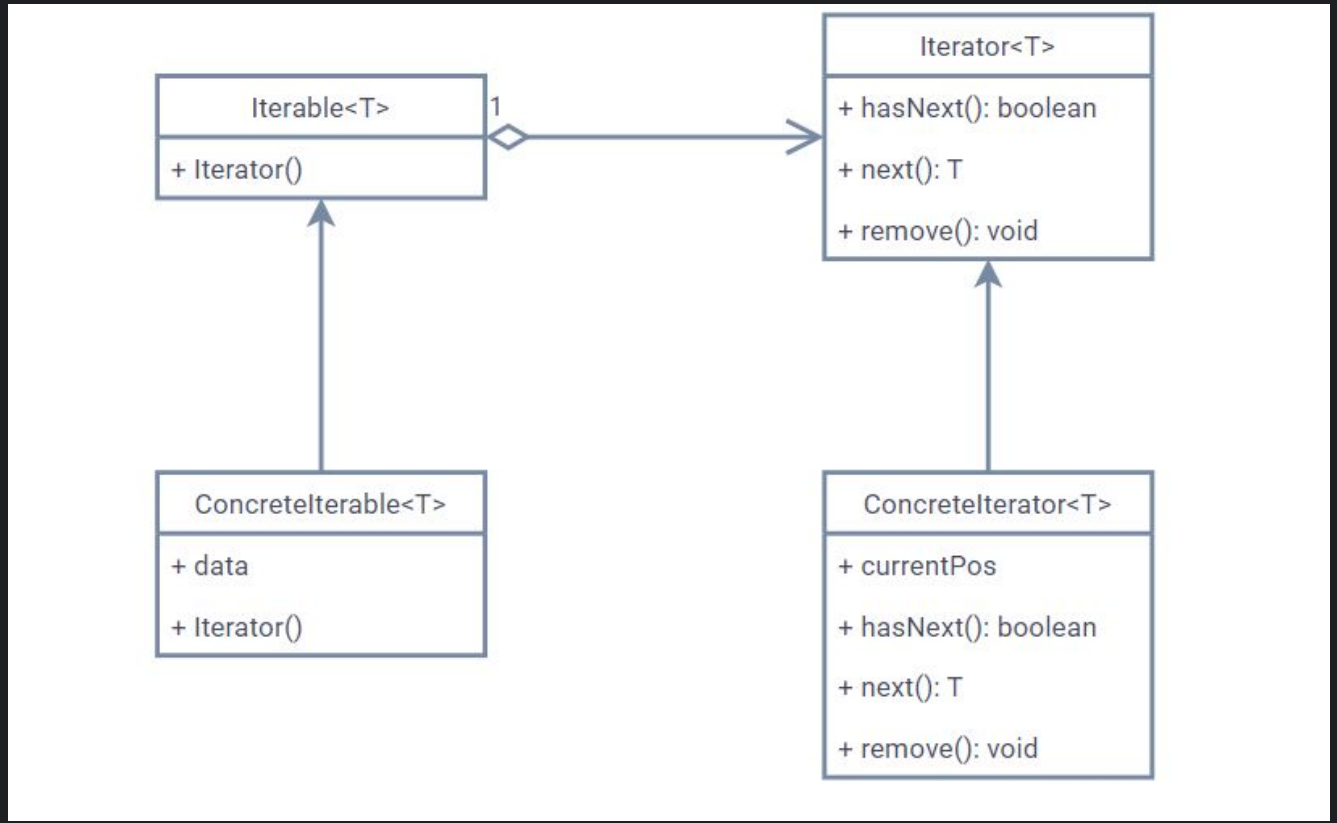
1. Описание и структура
2. Интерфейсы Iterator и Observable
3. Диаграмма последовательности и способы реализации
4. Пример использования паттерна


РАЗГОВОРЫ
С ИТЕРАТОРАМИ

Iterator

- Основные принципы:
    - Разделение ответственности
    - Инкапсуляция внутренней структуры
    - Работа с коллекциями в унифицированном интерфейсе

Структура


Iterable<T>
+ Iterator()
1
Iterator<T>
+ hasNext(): boolean
+ next(): T
+ remove(): void
ConcreteIterable<T>
+ data
+ Iterator()
ConcreteIterator<T>
+ currentPos
+ hasNext(): boolean
+ next(): T
+ remove(): void

Интерфейсы Iterator и Iterable

```
public interface Iterator<E> {

   E next();
   boolean hasNext();
   void remove();
}
```

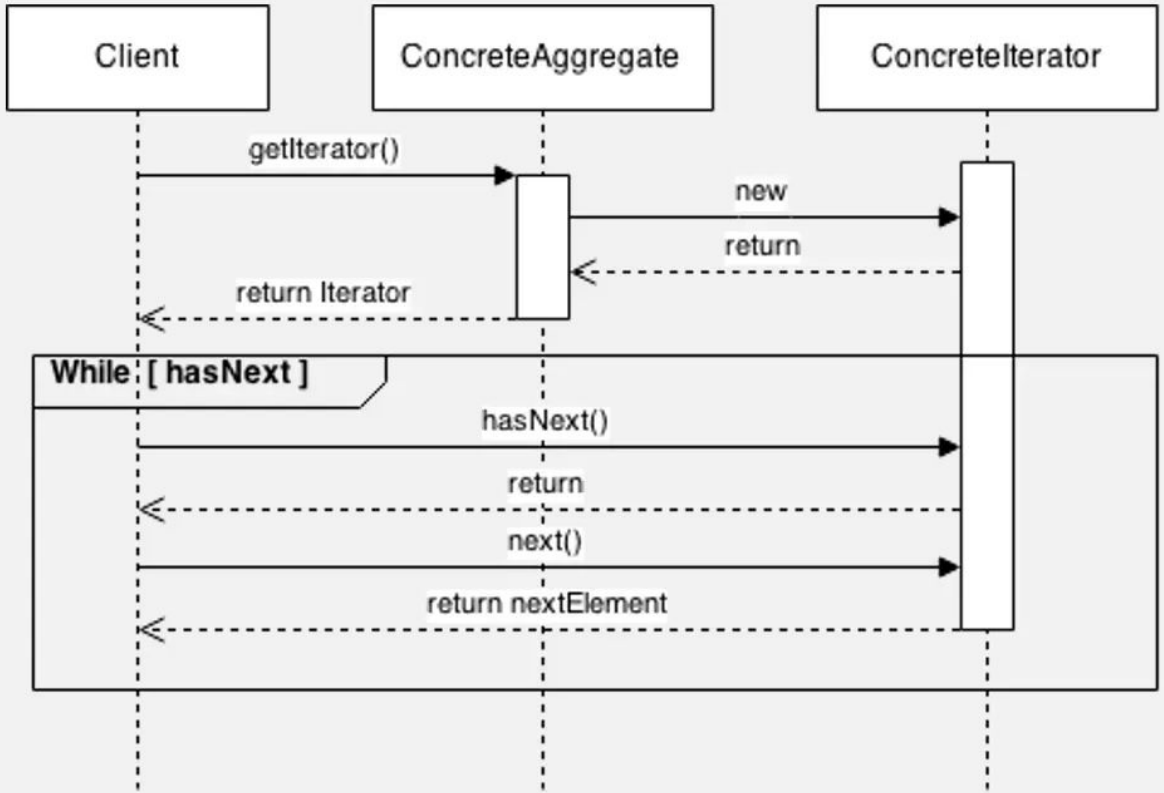
```
public interface Iterable<T> {
   Iterator<T> iterator();

   default void forEach(Consumer<? super T> action)
{...}
   default Spliterator<T> spliterator() {...}
}
```

Способы реализации

Если нужно создать свою коллекцию и итератор, нужно реализовать интерфейсы `Iterable` и `Iterator`

```
import java.util.Iterator;

class CustomCollection implements Iterable<Integer> {
    private int[] data;

    public CustomCollection(int[] data) {
        this.data = data;
    }

    @Override
    public Iterator<Integer> iterator() {
        return new CustomIterator();
    }

    private class CustomIterator implements Iterator<Integer> {
        private int index = 0;

        @Override
        public boolean hasNext() {
            return index < data.length;
        }

        @Override
        public Integer next() {
            return data[index++];
        }
    }
}
```

Iterator pattern – Diagram of sequence



Пример использования паттерна

```java
import java.util.Iterator;

class CustomCollection implements Iterable<Integer> {
    private int[] data;

    public CustomCollection(int[] data) {
        this.data = data;
    }

    @Override
    public Iterator<Integer> iterator() {
        return new CustomIterator();
    }

    private class CustomIterator implements Iterator<Integer> {
        private int index = 0;

        @Override
        public boolean hasNext() {
            return index < data.length;
        }

        @Override
        public Integer next() {
            return data[index++];
        }
    }
}
```

```java
public class Main {
    public static void main(String[] args) {
        int[] numbers = {1, 2, 3, 4, 5};
        var collection = new CustomCollection(numbers);

        // Явное использование итератора
        Iterator<Integer> iter = collection.iterator();
        while (iter.hasNext()) {
            System.out.println(iter.next());
        }

        // Цикл foreach
        for (int number : collection) {
            System.out.println(number);
        }
    }
}
```

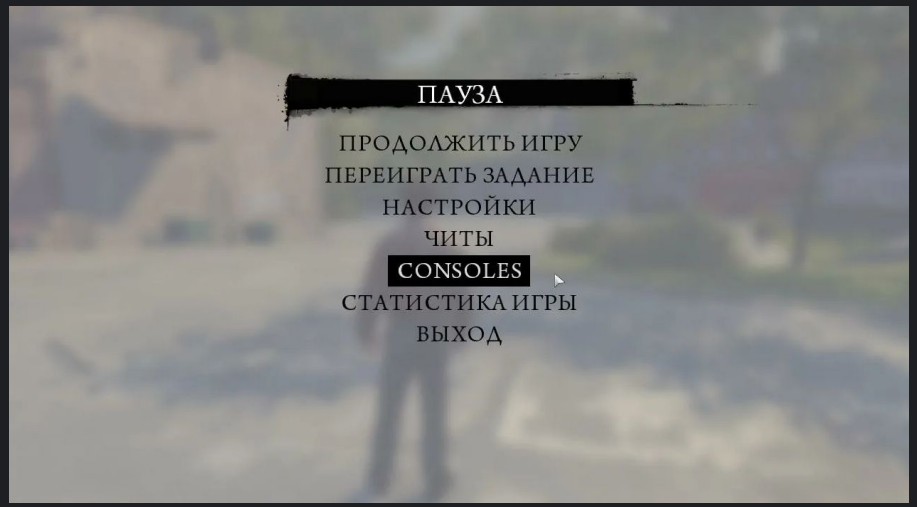
```
1
2
3
4
5
1
2
3
4
5

Process finished with exit code 0
```

Преимущества и недостатки

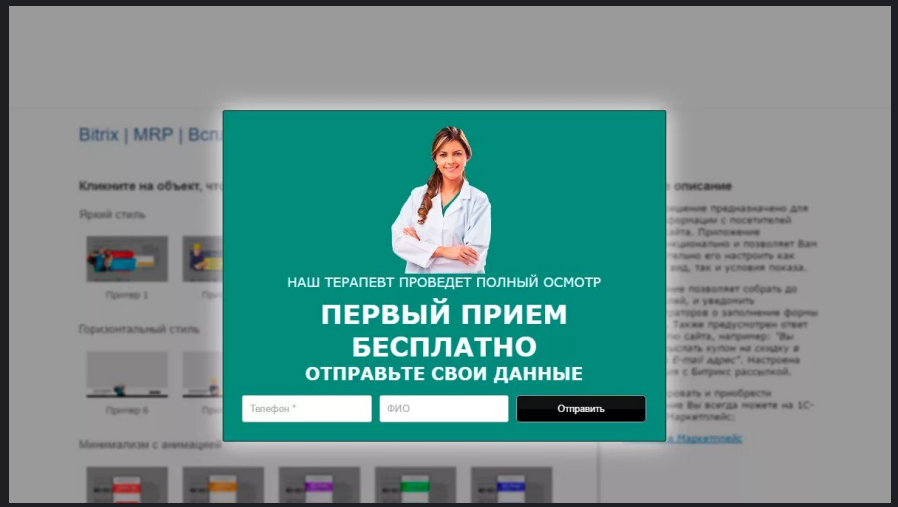
Observer

Состояния программы

Игра на паузе



Предложение регистрации



Исходники примеров:

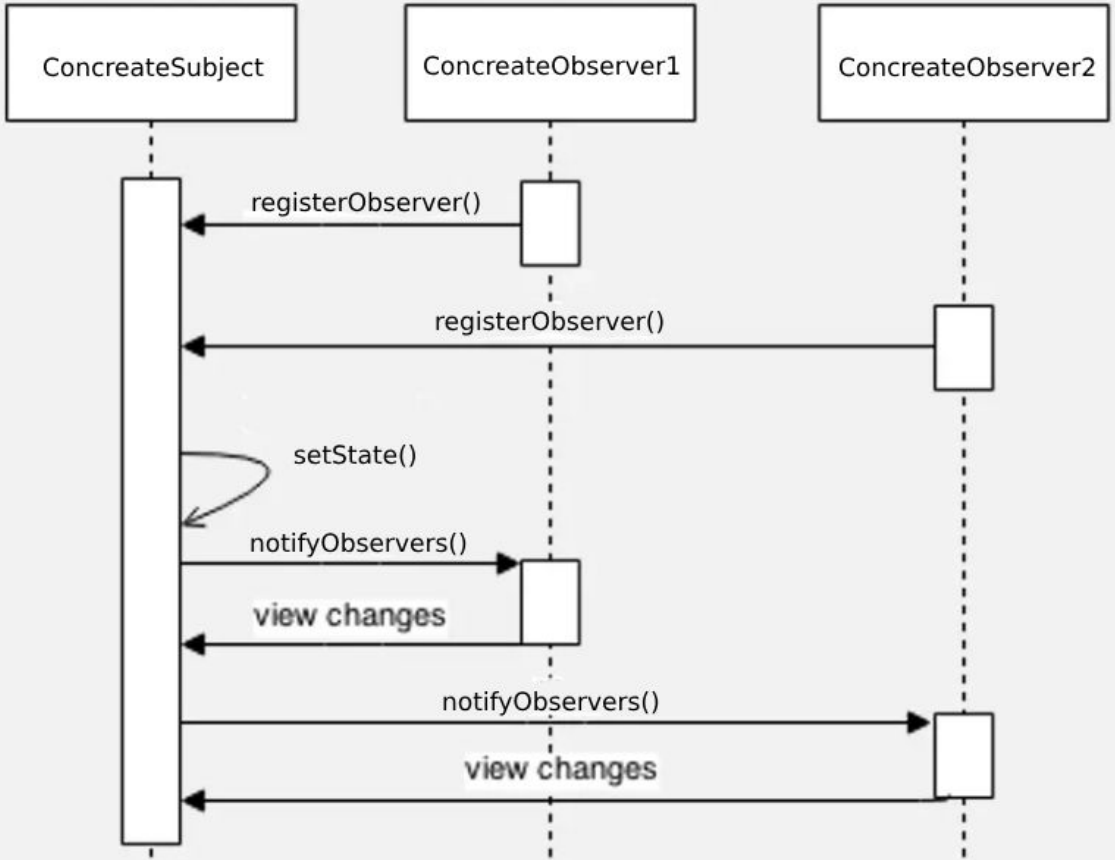
https://github.com/azya0/java2025 Директория “Presentation“

```java
interface Subject {
    void registerObserver(Observer observer);
    void removeObserver(Observer observer);
    void notifyObservers();

    int getState();
    void setState(int state);
}

interface Observer {
    void subscribe(Subject subscriber);
    void update(int state);

    Subject getSubject();
}
```

```java
class ConcreteSubject implements Subject {
    private List<Observer> observers;
    private int state;

    public ConcreteSubject() {
        observers = new ArrayList<>();
    }

    public Observer createObserver() {
        var result = new ConcreteObserver(this);
        registerObserver(result);
        return result;
    }

    @Override
    public void registerObserver(Observer observer) {
        observers.add(observer);
    }

    @Override
    public void removeObserver(Observer observer) {
        observers.remove(observer);
    }

    @Override
    public void notifyObservers() {
        for (Observer observer : observers) {
            observer.update(state);
        }
    }

    @Override
    public void setState(int state) {
        this.state = state;
        notifyObservers();
    }

    @Override
    public int getState() {
        return this.state;
    }
}
```

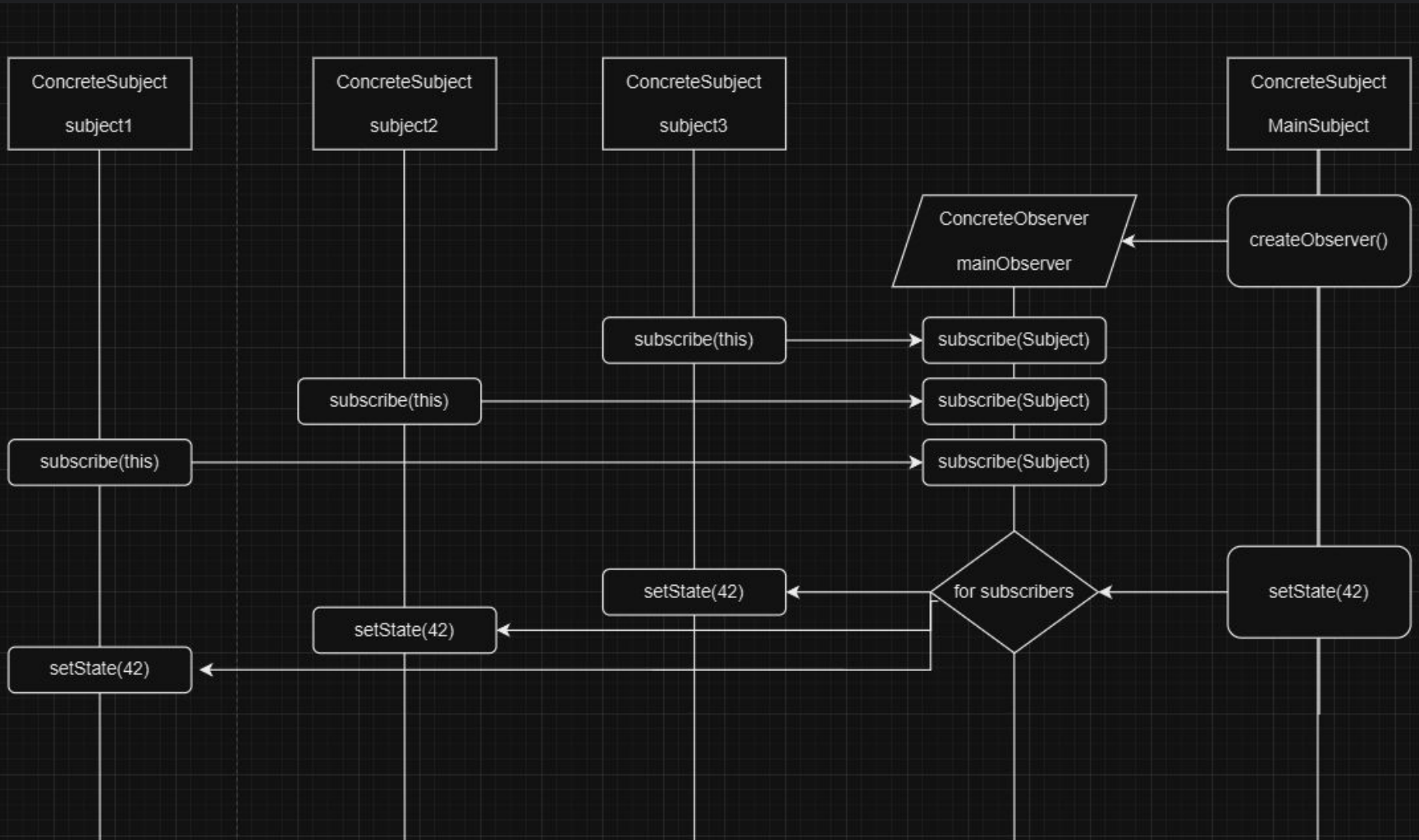
```java
class ConcreteObserver implements Observer {
    private Subject subject;
    private List<Subject> subscribers;


    public ConcreteObserver(Subject subject) {
        this.subject = subject;
        this.subject.registerObserver(this);
        this.subscribers = new ArrayList<>();
    }

    @Override
    public void update(int state) {
        for (Subject subject : subscribers) {
            if (subject.getState() != state) {
                subject.setState(state);
            }
        }
    }

    @Override
    public Subject getSubject() {
        return this.subject;
    }

    @Override
    public void subscribe(Subject subscriber) {
        subscribers.add(subscriber);
    }
}
```

Observer pattern – Diagram of sequence



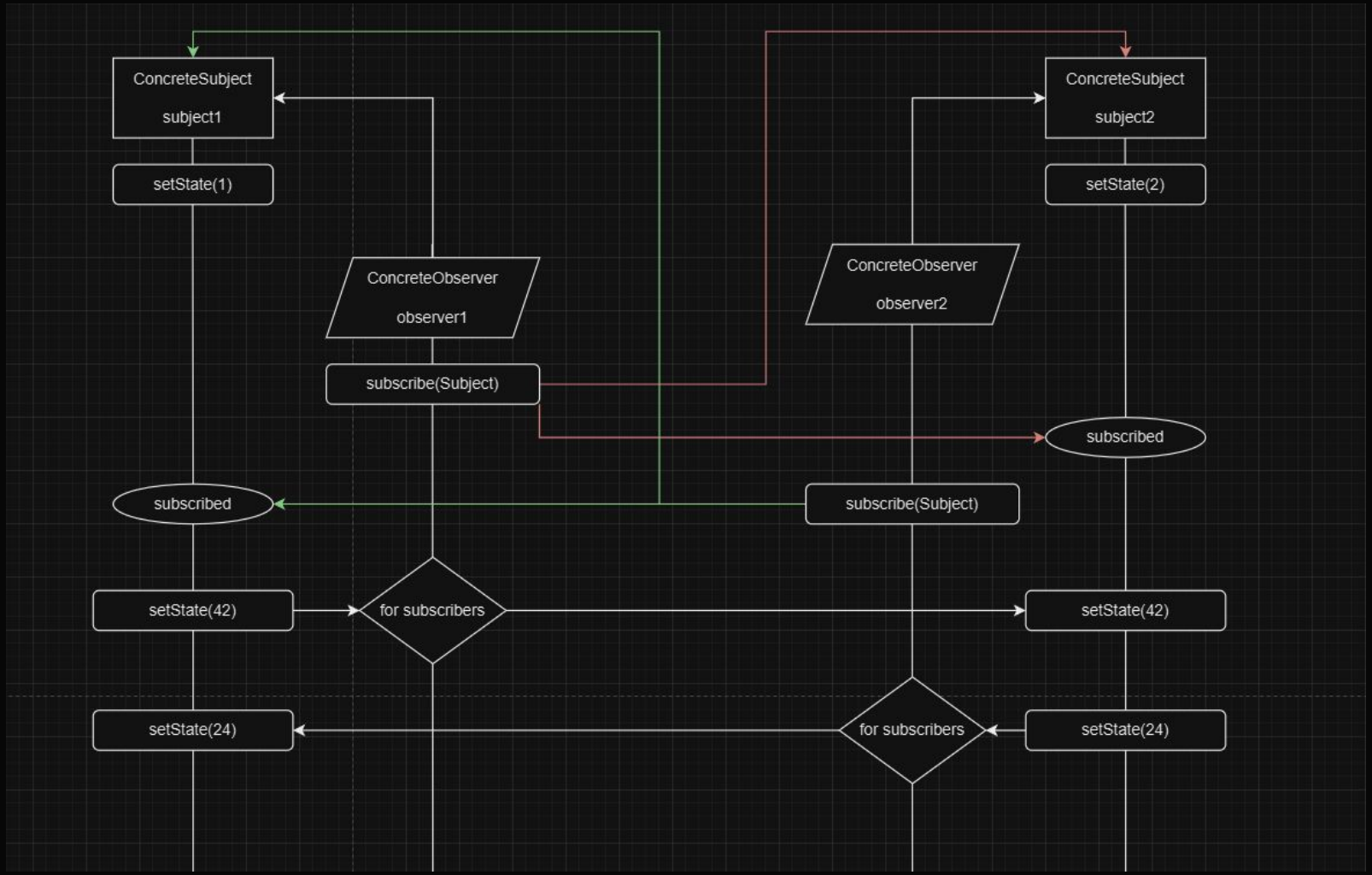
```java
public static void firstExample() {
    ConcreteSubject mainSubject = new ConcreteSubject();

    ConcreteSubject subject1 = new ConcreteSubject();
    ConcreteSubject subject2 = new ConcreteSubject();
    ConcreteSubject subject3 = new ConcreteSubject();

    subject1.setState(state:1);
    subject2.setState(state:2);
    subject3.setState(state:3);

    System.out.println("subject1 state: " + subject1.getState());
    System.out.println("subject2 state: " + subject2.getState());
    System.out.println("subject3 state: " + subject3.getState());

    Observer mainObserver = mainSubject.createObserver();

    mainObserver.subscribe(subject1);
    mainObserver.subscribe(subject2);
    mainObserver.subscribe(subject3);

    mainSubject.setState(state:42);

    System.out.println("subject1 state: " + subject1.getState());
    System.out.println("subject2 state: " + subject2.getState());
    System.out.println("subject3 state: " + subject3.getState());
}
```

```
subject1 state: 1
subject2 state: 2
subject3 state: 3
subject1 state: 42
subject2 state: 42
subject3 state: 42
```


ConcreteSubject
subject1
ConcreteSubject
subject2
ConcreteSubject
subject3
ConcreteSubject
MainSubject
ConcreteObserver
mainObserver
createObserver()
subscribe(this)
subscribe(Subject)
subscribe(this)
subscribe(Subject)
subscribe(this)
subscribe(Subject)
for subscribers
setState(42)
setState(42)
setState(42)
setState(42)

```java
public static void secondExample() {
    ConcreteSubject subject1 = new ConcreteSubject();
    subject1.setState(state:1);
    Observer Observer1 = new ConcreteObserver(subject1);

    ConcreteSubject subject2 = new ConcreteSubject();
    subject2.setState(state:2);
    Observer Observer2 = new ConcreteObserver(subject2);

    Observer1.subscribe(subject2);
    Observer2.subscribe(subject1);

    System.out.println("subject1 state: " + subject1.getState());
    System.out.println("subject2 state: " + subject2.getState());

    subject1.setState(state:42);

    System.out.println("subject1 state: " + subject1.getState());
    System.out.println("subject2 state: " + subject2.getState());

    subject2.setState(state:24);

    System.out.println("subject1 state: " + subject1.getState());
    System.out.println("subject2 state: " + subject2.getState());
}
```

```
subject1 state: 1
subject2 state: 2
subject1 state: 42
subject2 state: 42
subject1 state: 24
subject2 state: 24
```


ConcreteSubject
subject1
ConcreteSubject
subject2
setState(1)
setState(2)
ConcreteObserver
observer1
ConcreteObserver
observer2
subscribe(Subject)
subscribed
subscribed
subscribe(Subject)
setState(42)
for subscribers
setState(42)
setState(24)
for subscribers
setState(24)

Источники

- https://javarush.com/quests/lectures/questcollections.level07.lecture03
- https://docs.oracle.com/en/java/javase/17/docs/api/java.base/java/lang/Iterable.html
- https://javarush.com/groups/posts/1884-pattern-iterator