Software Design Pattern

Final Homework Presentation

Serum Storage in stark industries

–using flyweight design pattern

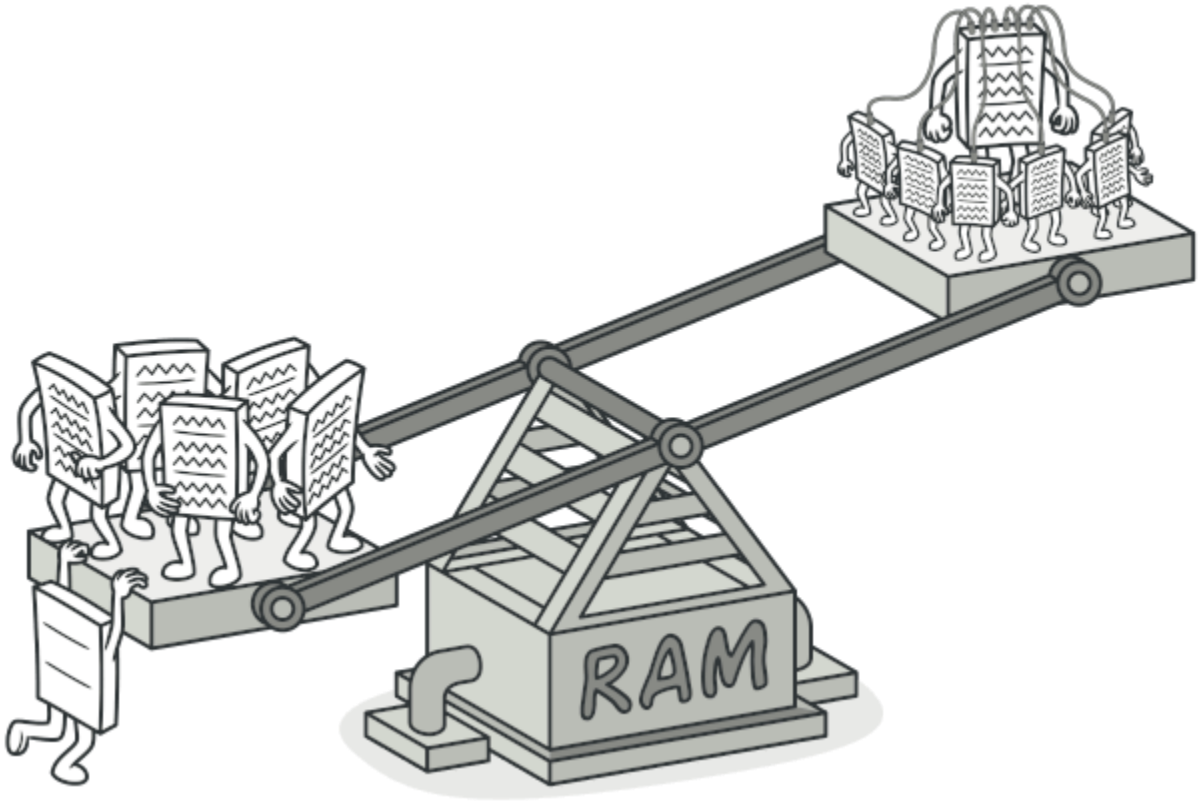
Teacher： 冯立波

Student : MD MAHFUZUR RAHMAN 罗尼

Student ID: 20183290375

Intent

Flyweight is a structural design pattern that lets you fit more objects into the available amount of RAM by sharing common parts of state between multiple objects instead of keeping all of the data in each object.



Explanation

- **Real world example:**

In stark industries lab has some super soldier and super human and some power serum. Many of the serum are the same so there is no need to create new object for each of them. Instead one object instance can represent multiple shelf items so memory footprint remains small.

- **In Plain words**

It is used to minimize memory usage or computational expenses by sharing as much as possible with similar objects.

- **Wikipedia says**

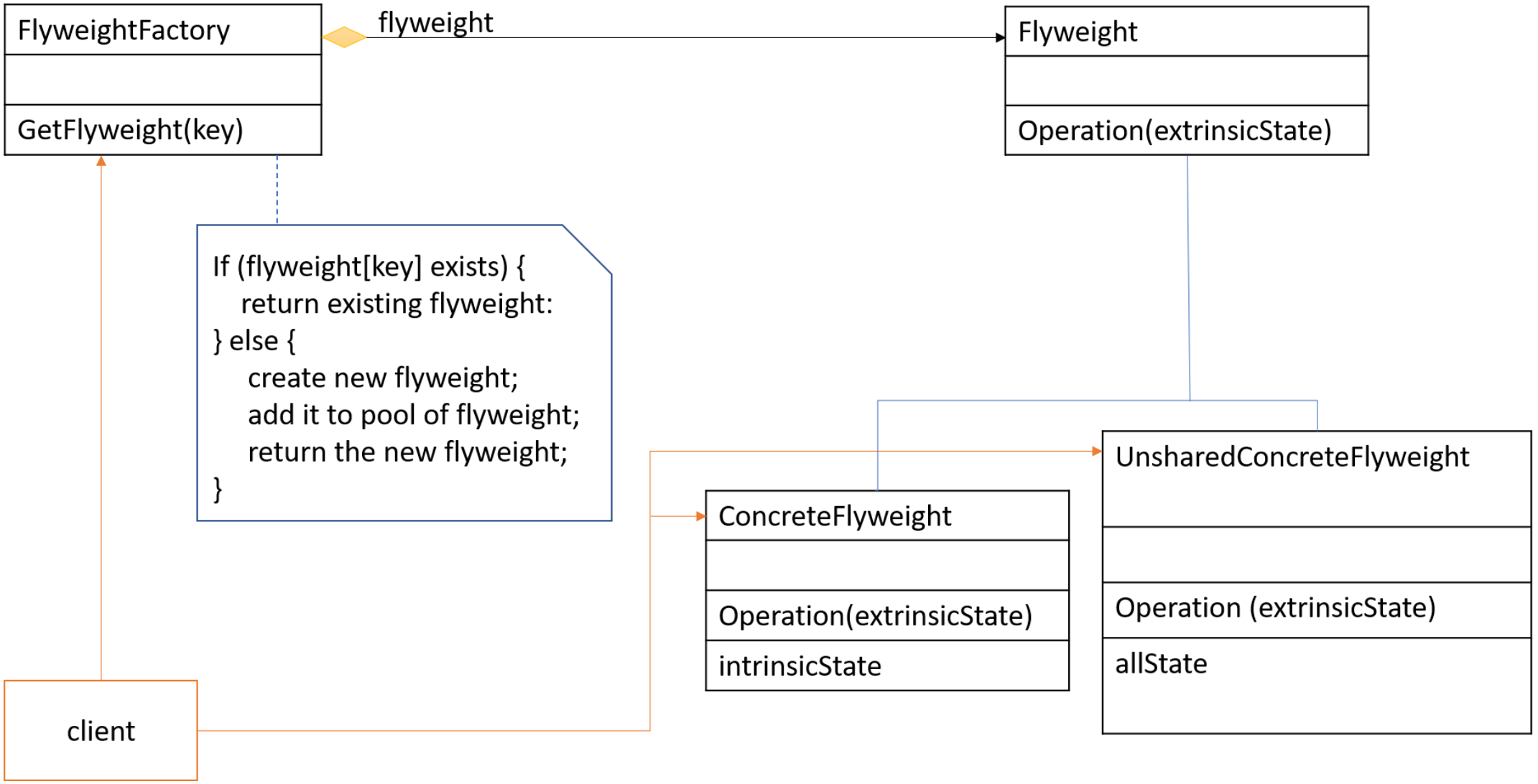
In computer programming, flyweight is a software design pattern. A flyweight is an object that minimizes memory use by sharing as much data as possible with other similar objects; it is a way to use objects in large numbers when a simple repeated representation would use an unacceptable amount of memory.

Advantage of Flyweight Design Pattern

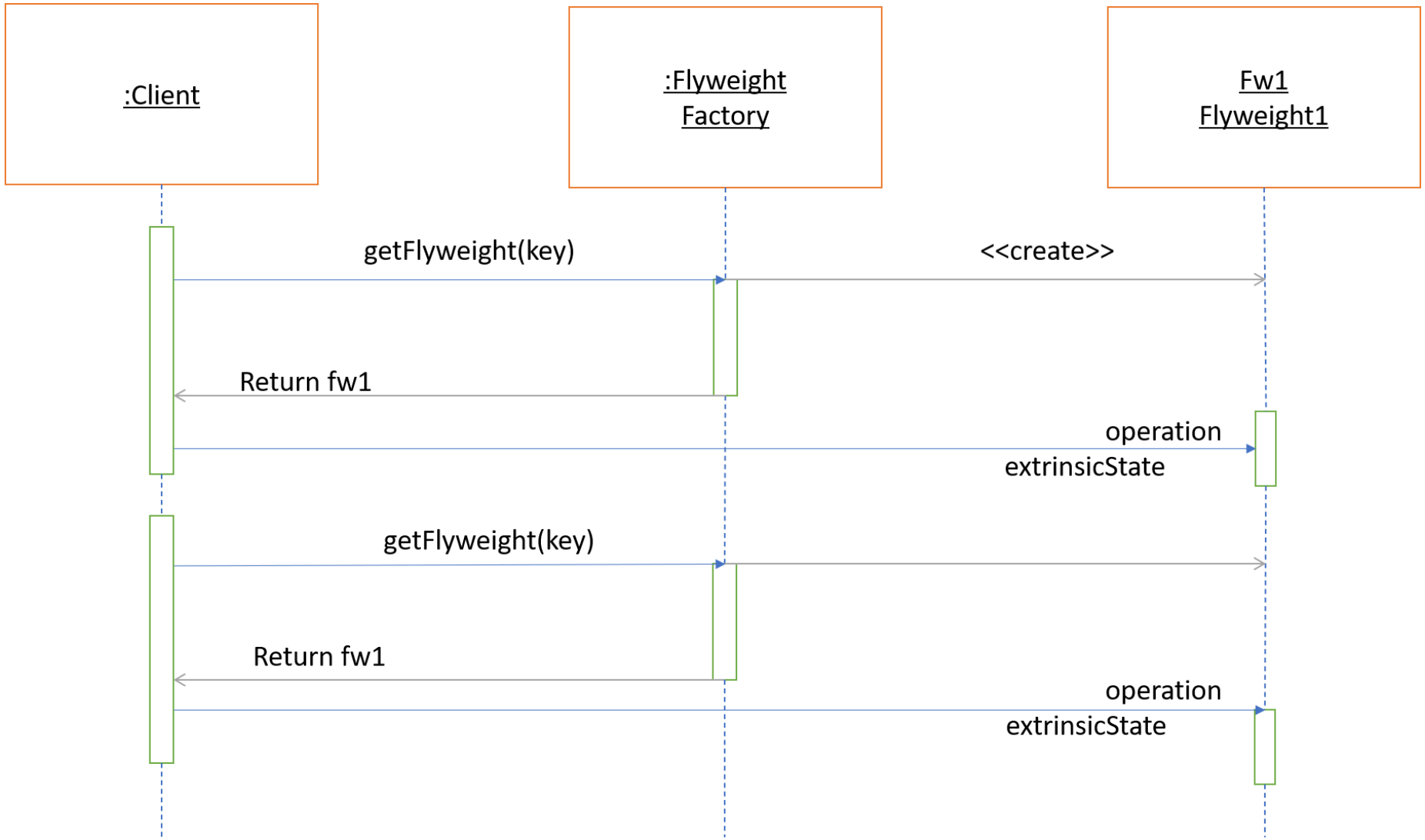
- It reduces the number of objects
- It reduces the amount of memory and storage device required if the objects are persisted.

Structure

- **Sample class diagram**



- **Sample Sequence diagram**



Participants

1. **Flyweight**

- Declares an interface through flyweights can receive and action extrinsic state.

Participants

2. Concrete Flyweight

- Implements the Flyweight interface and adds storage for intrinsic state, if any. A ConcreteFlyweight object must be sharable. Any state it stores must be intrinsic; that is, it must be independent of the ConcreteFlyweight object's context.

Participants

3. Unshared Concrete Flyweight

- **N**ot all Flyweight subclasses need to be shared. The Flyweight interface enables sharing; it doesn't enforce it. It's common for UnsharedConcreteFlyweight objects to have ConcreteFlyweight objects as children at some level in the flyweight object structure (as the Row and Column classes have).

Participants

4. Flyweight Factory

- creates and manages flyweight objects.
- ensures that flyweights are shared properly. When a client requests a flyweight, the FlyweightFactory object supplies an existing instance or creates one, if none exists.

Participants

5. Client

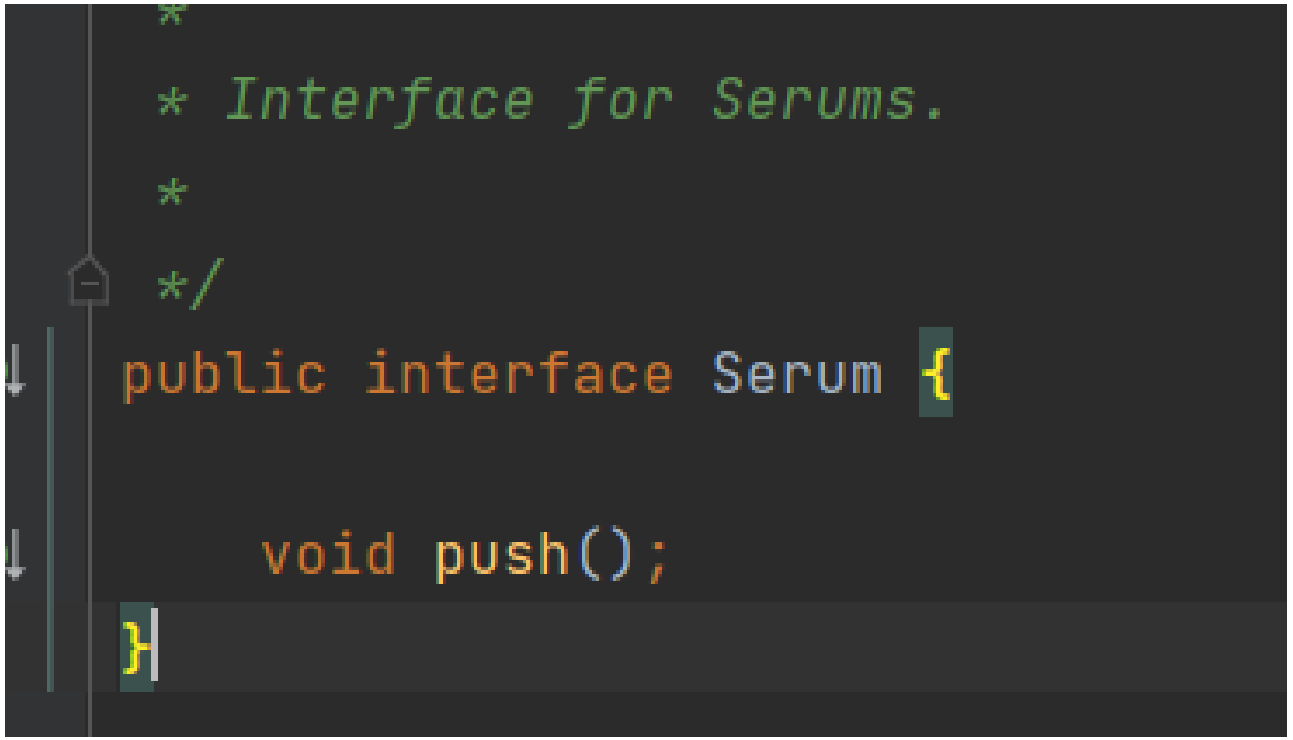
- maintains a reference to flyweights
- computes or stores the extrinsic state of flyweight

Pseudocode

In this example stark industries lab has some super soldier and super human and some power serum. Many of the serum are the same so there is no need to create new object for each of them. Instead one object instance can represent multiple shelf items so memory footprint remains small.

Pseudocode

- Let’s create Serum Interface



Pseudocode

- Now let’s create enumeration for serums types

```
/**
 *
 * Enumeration for serums types.
 *
 */
public enum SerumType {

    HEALING, INVISIBILITY, STRENGTH, HOLY_WATER, POISON, SUPERHUMAN, HULK, DEADPOOL, JACKIECHAN, WOLVERINE, FLASH, MAGNETO,
    MINECRAFT, REGENERATOR, WEAKNESS, CAP, MINDREADER
}
```

Pseudocode

- Now let’s create different types of serum class

```
public class BecomeHulkSerum implements Serum {

    @Override
    public void push() {
        System.out.println("You will be Hulk and get his power. (Serum=" + System.identityHashCode( x: this) + ")");
    }
}
```

```
public class BeDeadpoolSerum implements Serum {

    @Override
    public void push() {
        System.out.println("You will have Deadpool power and will have chance to join Avengers. (Serum=" + System.identityHashCode( x: this) + ")
    }
}
```

Pseudocode

- Then the actual Flyweight object which is the factory for creating serums

```java
import java.util.EnumMap;
import java.util.Map;

/**
 *
 * Serum is the Flyweight in this example. It minimizes memory use by sharing obj
 * instances. It holds a map of potion instances and new potions are created only
 * type already exists.
 *
 */
public class SerumFactory {

    private final Map<SerumType, Serum> Serums;

    public SerumFactory() { Serums = new EnumMap<>(SerumType.class); }

    Serum createPotion(SerumType type) {
        Serum serum = Serums.get(type);
        if (serum == null) {
            switch (type) {
                case HEALING:
                    serum = new HealingSerum();
                    Serums.put(type, serum);
                    break;
                case HOLY_WATER:
                    serum = new HolyWaterSerum();
                    Serums.put(type, serum);
                    break;
                case INVISIBILITY:
                    serum = new InvisibilitySerum();
                    Serums.put(type, serum);
```

```java
                    break;
                case MINECRAFT:
                    serum = new SerumOfMinecraft();
                    Serums.put(type, serum);
                    break;
                case WOLVERINE:
                    serum = new BeWolverineSerum();
                    Serums.put(type, serum);
                    break;
                case JACKIECHAN:
                    serum = new BeJackieChanSerum();
                    Serums.put(type, serum);
                    break;
                case REGENERATOR:
                    serum = new SerumOfRegenerator();
                    Serums.put(type, serum);
                    break;
                case MINDREADER:
                    serum = new MindReaderSerum();
                    Serums.put(type, serum);
                    break;
                default:
                    break;
            }
        }
        return serum;
    }
}
```

Pseudocode

- Now create stark industries lab to uses Serum Factory to provide the serums

```java
import java.util.ArrayList;
import java.util.Collections;
import java.util.List;

/**
 *
 * Stark industry holds serum on its shelves. It uses SerumFactory to provide the serums.
 *
 */
public class StarkIndustriesLab {

    private List<Serum> lab01;
    private List<Serum> lab02;

    /**
     * Constructor
     */
    public StarkIndustriesLab() {
        lab01 = new ArrayList<>();
        lab02 = new ArrayList<>();
        fillShelves();
    }

    private void fillShelves() {

        SerumFactory factory = new SerumFactory();

        lab01.add(factory.createPotion(SerumType.INVISIBILITY));
        lab01.add(factory.createPotion(SerumType.INVISIBILITY));
        lab01.add(factory.createPotion(SerumType.STRENGTH));
        lab01.add(factory.createPotion(SerumType.HEALING));
```

```java
    /**
     * Get a read-only list of all the items on the bottom shelf
     *
     * @return The bottom shelf serums
     */
    public final List<Serum> getLab02() { return Collections.unmodifiableList(this.lab02); }

    /**
     * Enumerate serums
     */
    public void enumerate() {

        System.out.println("Bellow the serum you will find in stark lab 1\n" +
                "if you have any problem then please contract with Ronnie\n");

        for (Serum p : lab01) {
            p.push();
        }

        System.out.println("\nBellow the serum you will find in stark lab 2\n" +
                "if you have any problem then please contract with Ronnie\n");

        for (Serum p : lab02) {
            p.push();
        }
    }
}
```

Pseudocode

- It will be use like this

```
SerumFactory factory = new SerumFactory();
factory.createSerum(SerumType.HULK).push(); // You will be Hulk and get his power. (Serum=883049899)
factory.createSerum(SerumType.WOLVERINE).push(); // You will get Logan power. (Serum=317574433)
factory.createSerum(SerumType.DEADPOOL).push(); // You will have Deadpool power and will have chance to join Avengers. (Serum=2093176
factory.createSerum(SerumType.HULK).push(); // You will be Hulk and get his power. (Serum=883049899)
factory.createSerum(SerumType.WOLVERINE).push(); // You will get Logan power. (Serum=317574433)
factory.createSerum(SerumType.DEADPOOL).push(); // You will have Deadpool power and will have chance to join Avengers. (Serum=2093176
```

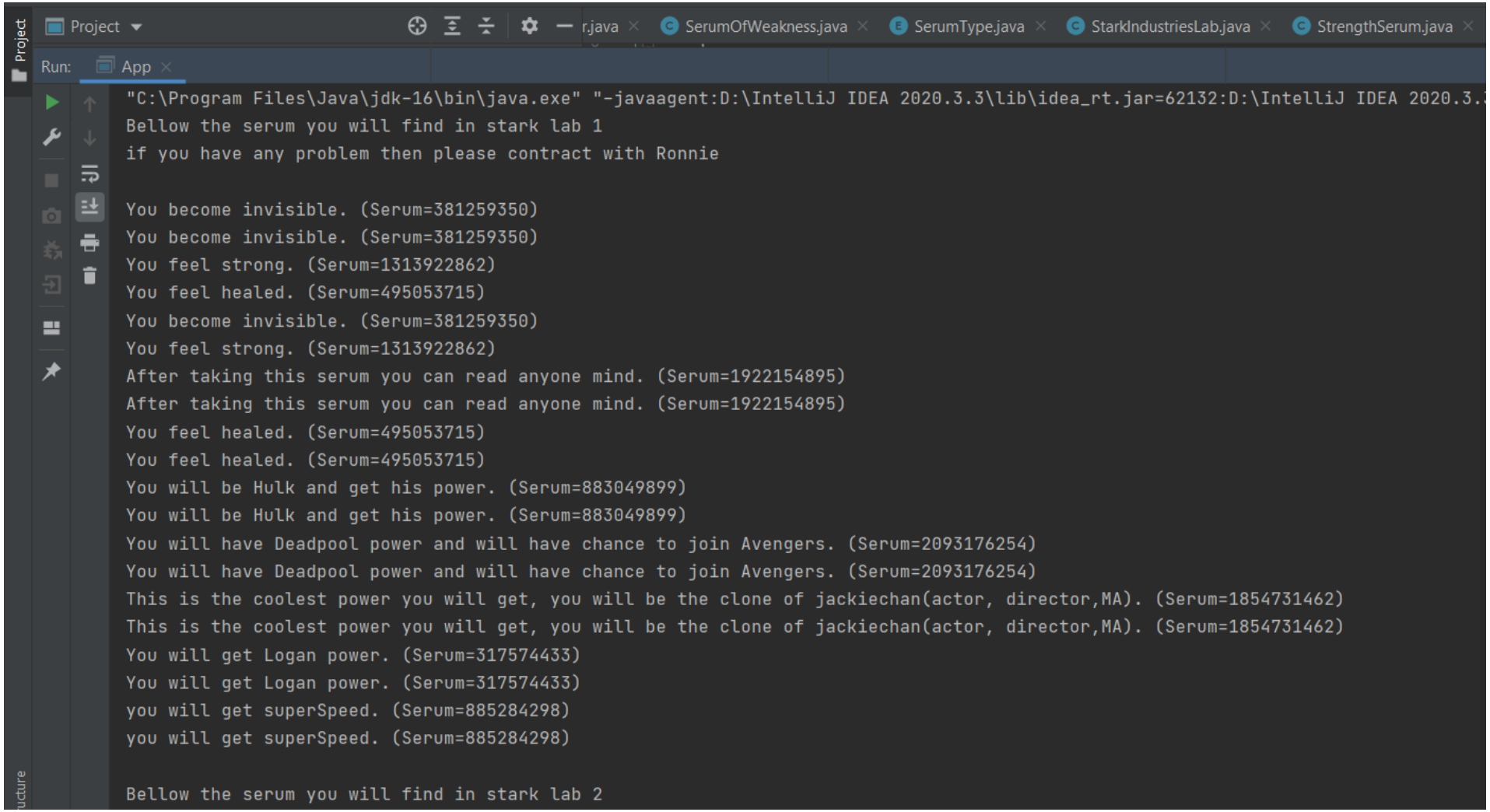
Pseudocode

- Now create a App class and run the program

```java
/**
 *
 * Flyweight pattern is useful when the program needs a huge amount of objects. It provides means to
 * decrease resource usage by sharing object instances.
 * <p>
 * In this example {@link StarkIndustriesLab} has great amount of potions on its shelves. To fill the
 * shelves {@link StarkIndustriesLab} uses {@link SerumFactory} (which represents the Flyweight in this
 * example). Internally {@link SerumFactory} holds a map of the serums and lazily creates new ones
 * when requested.
 * <p>
 * To enable safe sharing, between clients and threads, Flyweight objects must be immutable.
 * Flyweight objects are by definition value objects.
 *
 */
public class App {

    /**
     * Program entry point
     *
     * @param args command line args
     */
    public static void main(String[] args) {
        StarkIndustriesLab starkIndustriesLab = new StarkIndustriesLab();
        starkIndustriesLab.enumerate();
    }
}
```

Result


Project
r.java
SerumOfWeakness.java
SerumType.java
StarkIndustriesLab.java
StrengthSerum.java
Run:
App
"C:\Program Files\Java\jdk-16\bin\java.exe" "-javaagent:D:\IntelliJ IDEA 2020.3.3\lib\idea_rt.jar=62132:D:\IntelliJ IDEA 2020.3.
Bellow the serum you will find in stark lab 1
if you have any problem then please contract with Ronnie
You become invisible. (Serum=381259350)
You become invisible. (Serum=381259350)
You feel strong. (Serum=1313922862)
You feel healed. (Serum=495053715)
You become invisible. (Serum=381259350)
You feel strong. (Serum=1313922862)
After taking this serum you can read anyone mind. (Serum=1922154895)
After taking this serum you can read anyone mind. (Serum=1922154895)
You feel healed. (Serum=495053715)
You feel healed. (Serum=495053715)
You will be Hulk and get his power. (Serum=883049899)
You will be Hulk and get his power. (Serum=883049899)
You will have Deadpool power and will have chance to join Avengers. (Serum=2093176254)
You will have Deadpool power and will have chance to join Avengers. (Serum=2093176254)
This is the coolest power you will get, you will be the clone of jackiechan(actor, director,MA). (Serum=1854731462)
This is the coolest power you will get, you will be the clone of jackiechan(actor, director,MA). (Serum=1854731462)
You will get Logan power. (Serum=317574433)
You will get Logan power. (Serum=317574433)
you will get superSpeed. (Serum=885284298)
you will get superSpeed. (Serum=885284298)
Bellow the serum you will find in stark lab 2

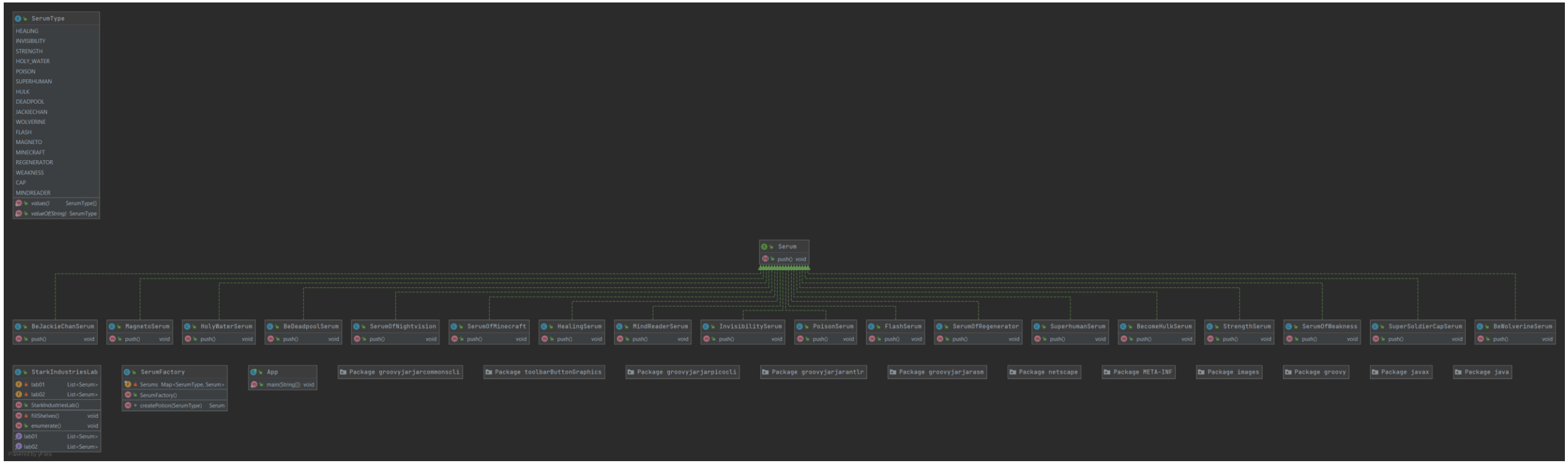
Result

```
Bellow the serum you will find in stark lab 2
if you have any problem then please contract with Ronnie

This is poisonous. (Serum=1389133897)
This is poisonous. (Serum=1389133897)
This is poisonous. (Serum=1389133897)
You feel blessed. (Serum=1534030866)
You feel blessed. (Serum=1534030866)
Once you drink this you won't be weak anymore. (Serum=664223387)
You will become super human(like superman). (Serum=824909230)
You can control metal. (Serum=122883338)
You can control metal. (Serum=122883338)
You can read anyone mind. (Serum=666641942)
You will be able to regenerate anything from a small piece. (Serum=960604060)
You will be able to regenerate anything from a small piece. (Serum=960604060)
You will be able to regenerate anything from a small piece. (Serum=960604060)
Once you drink this you won't be weak anymore. (Serum=664223387)
using this you will be powerful like (captain america). (Serum=1349393271)

Process finished with exit code 0
```

Class Diagram

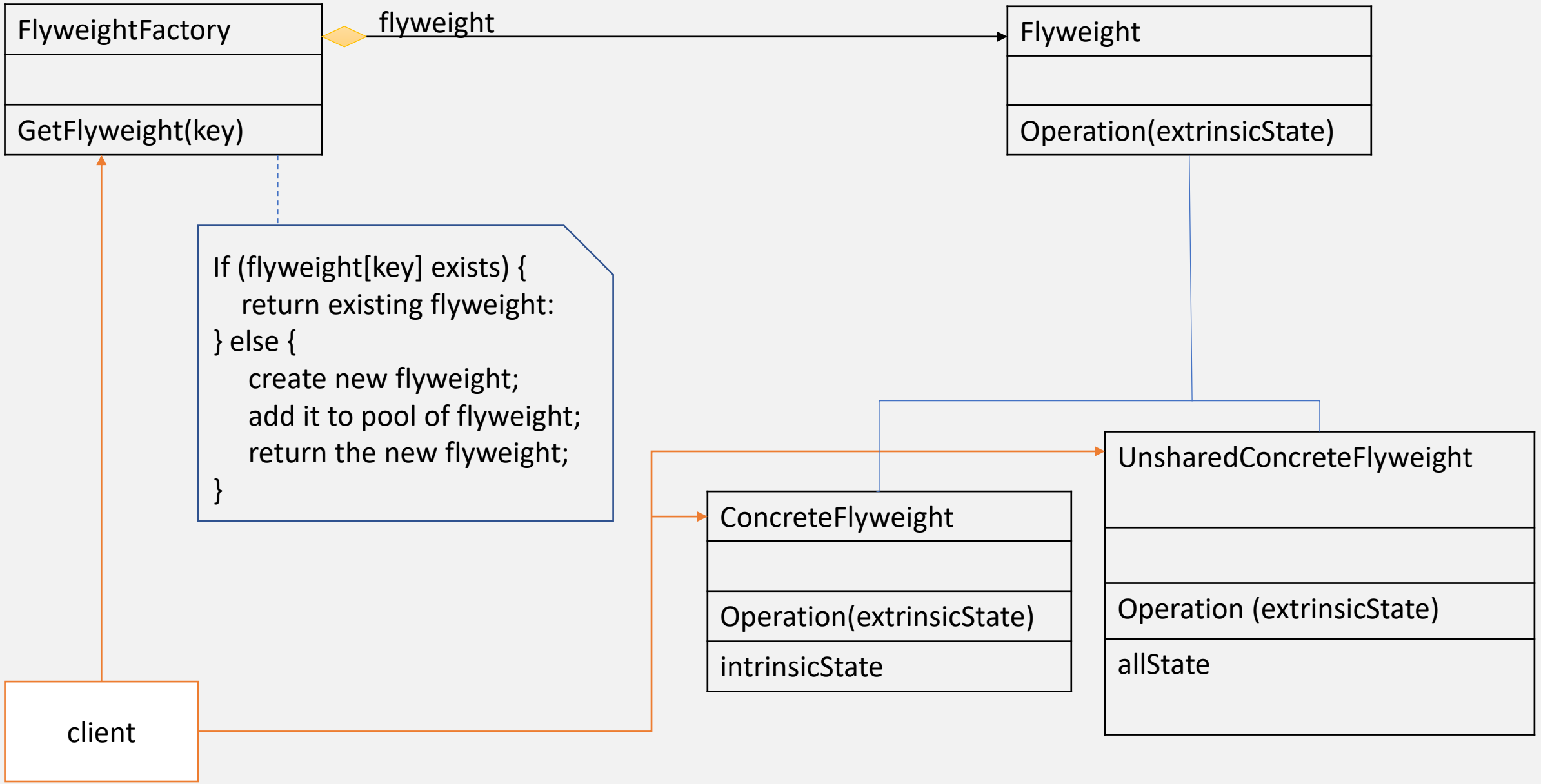


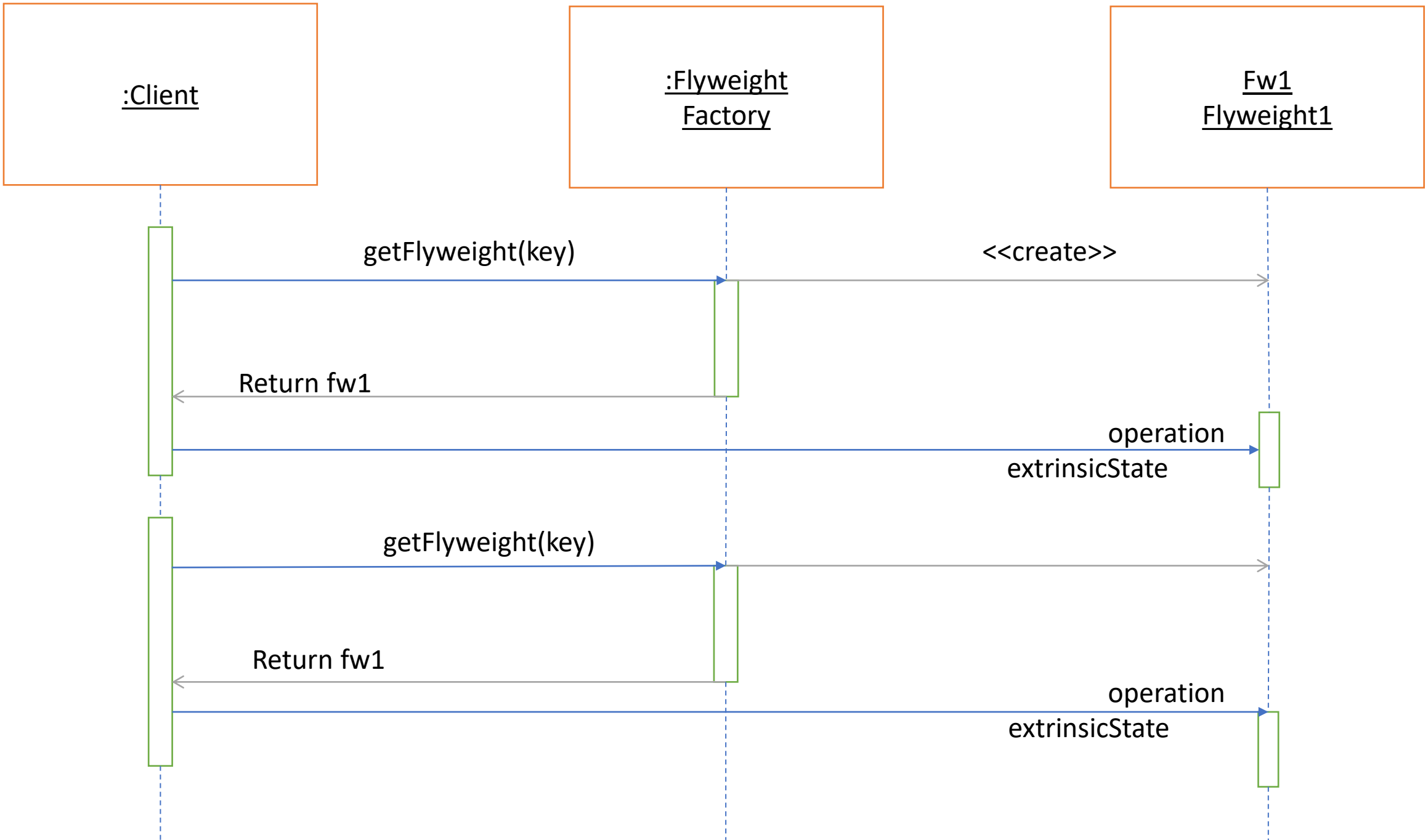
Applicability

The Flyweight pattern's effectiveness depends heavily on how and where it's used. Apply the Flyweight pattern when all of the following are true:

- An application uses a large number of objects.
- Storage costs are high because of the sheer quantity of objects.
- Most object state can be made extrinsic.
- Many groups of objects may be replaced by relatively few shared objects once extrinsic state is removed.
- The application doesn't depend on object identity. Since flyweight objects may be shared, identity tests will return true for conceptually distinct objects.

THANK YOU


FlyweightFactory
GetFlyweight(key)
flyweight
Flyweight
Operation(extrinsicState)
If (flyweight[key] exists) {
return existing flyweight:
} else {
create new flyweight;
add it to pool of flyweight;
return the new flyweight;
}
ConcreteFlyweight
Operation(extrinsicState)
intrinsicState
UnsharedConcreteFlyweight
Operation (extrinsicState)
allState
client


:Client
:Flyweight
Factory
Fw1
Flyweight1
getFlyweight(key)
<<create>>
Return fw1
operation
extrinsicState
getFlyweight(key)
Return fw1
operation
extrinsicState