How Aspects are Added to Objects

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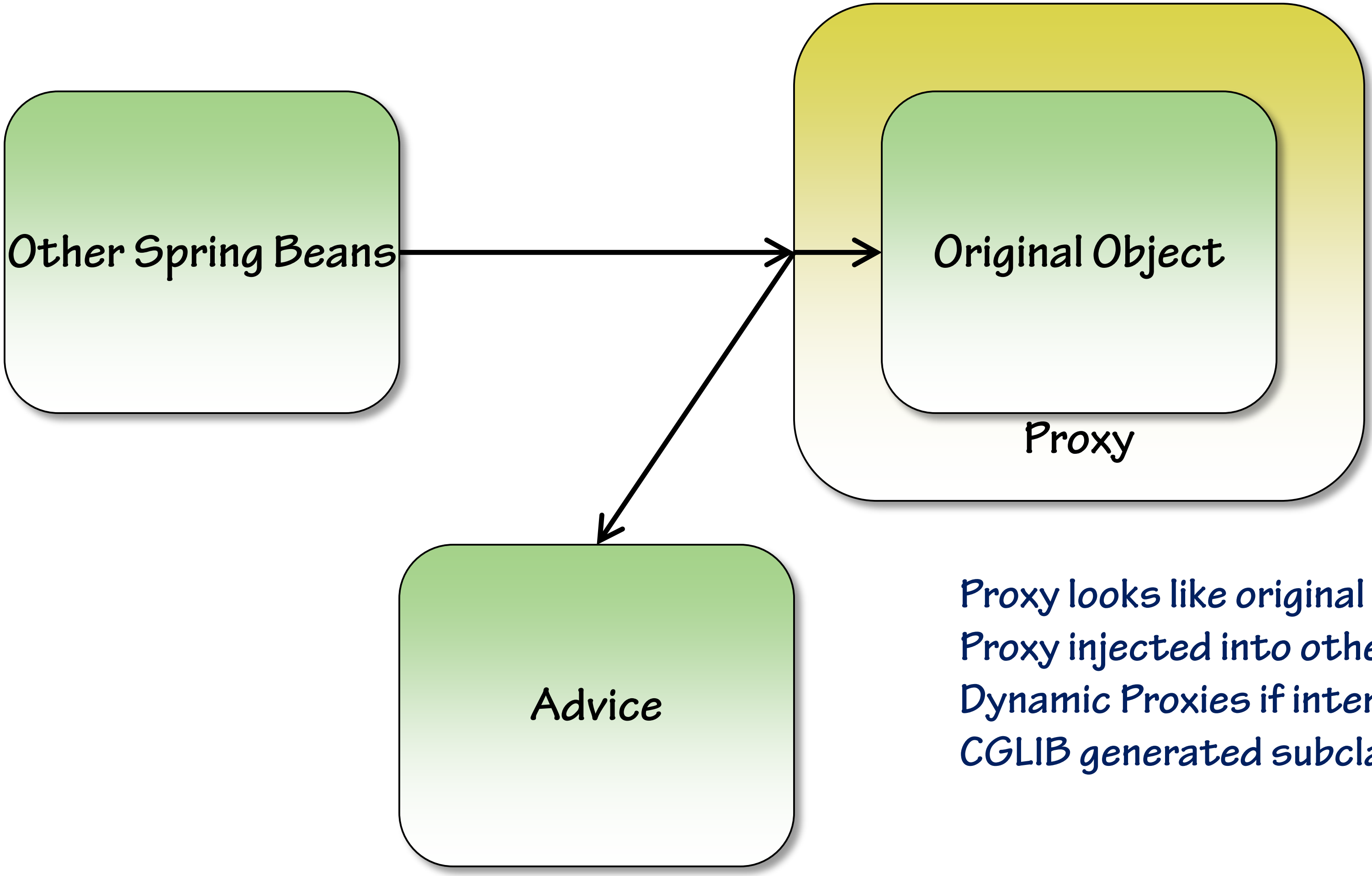
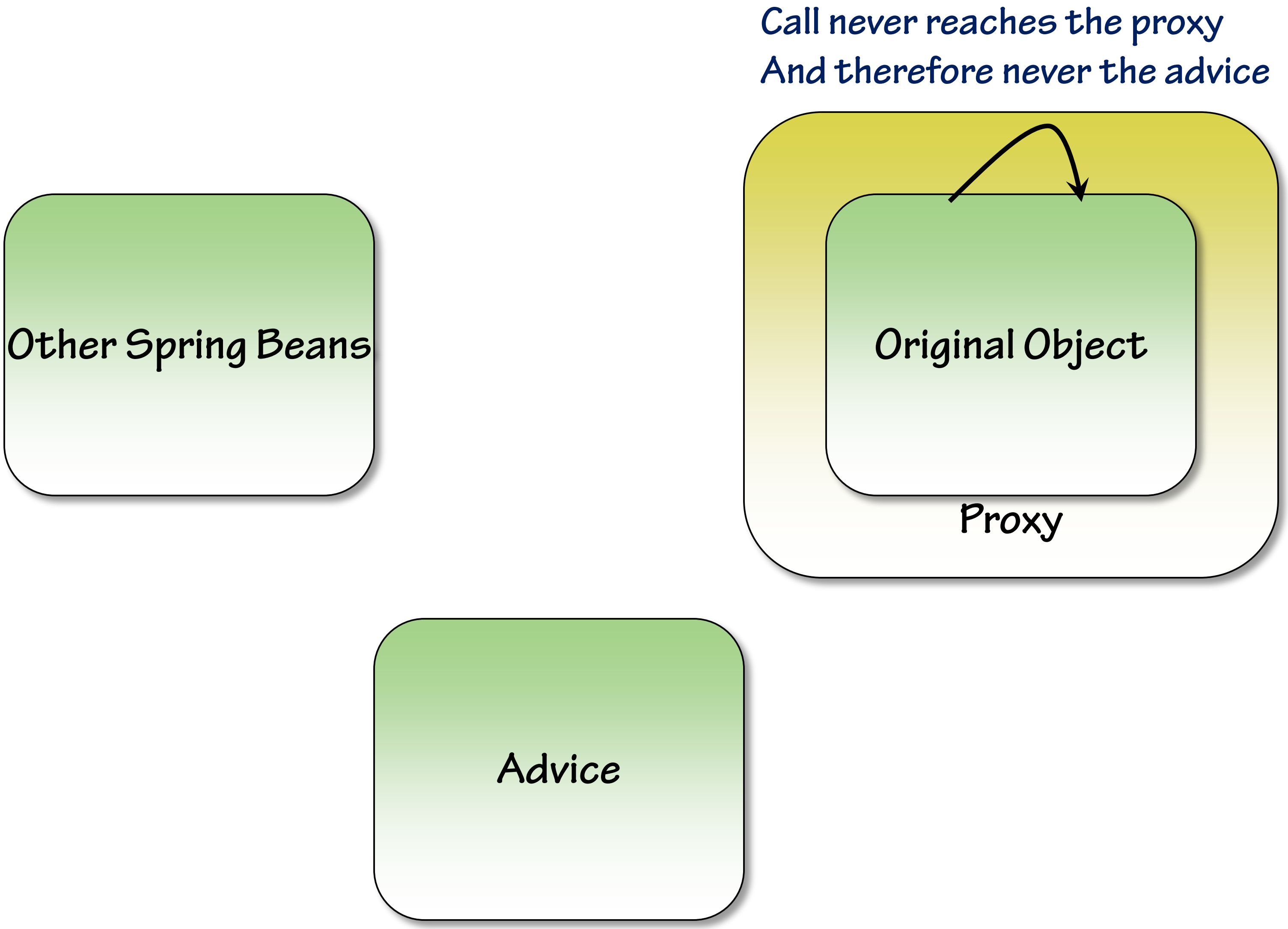


Proxy looks like original objects
Proxy injected into other Spring Beans
Dynamic Proxies if interfaces are used
CGLIB generated subclasses otherwise

Local Method Calls



Call never reaches the proxy
And therefore never the advice

Implications

```
public class TxExample {

  @Transactional
  public void transactionalMethod() {
  }

  public void callsTransactionalMethod() {
    transactionalMethod();
  }

}
```

@Transactional is implemented using Spring AOP

@Transactional will not be evaluated in this case

Demo: CGLIB vs. Dynamic Proxy

- Introduce an Interface
- Show that Dependency Injection does not work any more
- Fix problem by introducing proxyTargetClass=true

How Proxies are Implemented

- **CGLIB**
  - Subclass dynamically create subclass
  - Subclass implements the proxy

- **Dynamic Proxies**
  - Feature of the JDK
  - Allow dynamic method dispatch
  - For interfaces only

- **CGLIB is used**
  - …if no interface is implemented
  - …if proxy-target-class is set to true

What We Saw in the Demo

- Interface introduced
- Dynamic Proxies instead of CGLIB
- Proxy implements interface only
- Test asks for class
- Dependency injection not possible

- Fix: proxy-target-class forces CGLIB

- Add all methods to the interface
- …and use interface instead of class
- Proxy implements interface only
- …but that is enough

Limits of the Proxy-based AOP Model

- Work only on public methods
- No protected, private

- Works only on methods calls from outside

- Spring Dependency Injection makes it transparent

- What if no Dependency Injection is used?

Spring AOP: Just Another Module

- Spring is modular
- Each part of Spring can be used independently from the other parts
- This is also true for Spring AOP

Summary

- Spring AOP uses proxy based AOP

- Either CGLIB (subclasses)
- …or Dynamic Proxies (interfaces)

- Dependency Injection makes proxies transparent

- Beware: Call on the local object will not go through the proxy

- Can write code to create proxies