CS544

LESSON 2
SPRING BOOT AND AOP

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Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
November 28 **Lesson 1** Introduction Spring framework Dependency injection	November 29 **Lesson 2** Spring Boot AOP	November 30 **Lesson 3** JDBC JPA	December 1 **Lesson 4** JPA mapping 1	December 2 **Lesson 5** JPA mapping 2	December 3 **Lesson 6** JPA queries	December 4
December 5 **Lesson 7** Transactions	December 6 **Lesson 8** MongoDB	December 7 **Midterm Review**	December 8 **Midterm exam**	December 9 **Lesson 9** REST webservices	December 10 **Lesson 10** SOAP webservices	December 11
December 12 **Lesson 11** Messaging	December 13 **Lesson 12** Scheduling Events Configuration	December 14 **Lesson 13** Monitoring	December 15 **Lesson 14** Testing your application	December 16 **Final review**	December 17 **Final exam**	December 18
December 19 **Project**	December 20 **Project**	December 21 **Project**	December 22 **Presentations**			

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SPRING BOOT

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Spring boot

- Framework that makes it easy to configure and run spring applications
- Simple maven configuration
- Default/auto spring configuration
- Containerless deployment

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Spring boot POM file

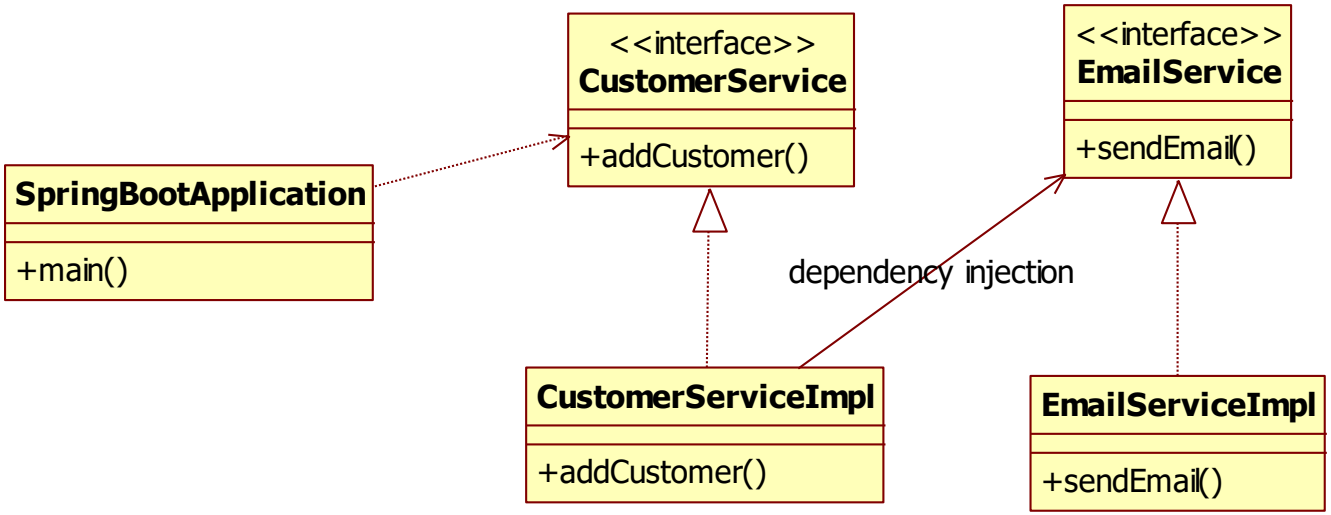
```xml
<parent>
  <groupId>org.springframework.boot</groupId>
  <artifactId>spring-boot-starter-parent</artifactId>
  <version>2.0.0.M6</version>
  <relativePath/> <!-- lookup parent from repository -->
</parent>


<dependencies>
  <dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter</artifactId>
  </dependency>

  <dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-test</artifactId>
    <scope>test</scope>
  </dependency>
</dependencies>

<build>
  <plugins>
    <plugin>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-maven-plugin</artifactId>
    </plugin>
  </plugins>
</build>
```

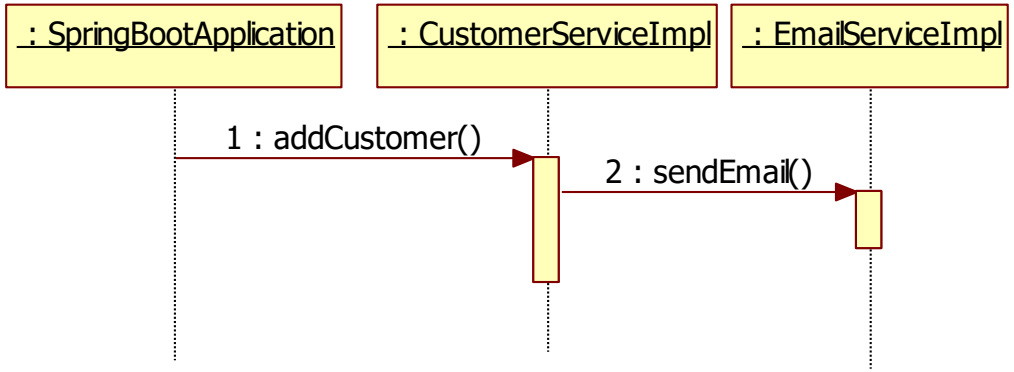
Inherit Spring Boot default dependencies and versions

Starter POM

Contains goals for packaging the application

Example application





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Using annotations

```java
public interface EmailService {
  void sendEmail();
}
```

```java
@Service
public class EmailServiceImpl implements EmailService{
  public void sendEmail() {
    System.out.println("Sending email");
  }
}
```

```java
public interface CustomerService {
  void addCustomer();
}
```

```java
@Service
public class CustomerServiceImpl implements CustomerService{
  @Autowired
  private EmailService emailService;

  public void addCustomer() {
    emailService.sendEmail();
  }
}
```

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Spring Boot option 1

Same as
@Configuration,
@ComponentScan
@EnableAutoConfiguration

```
@SpringBootApplication
public class SpringBootApplication {

  public static void main(String[] args) {
    ApplicationContext context = new
         AnnotationConfigApplicationContext(SpringBootApplication.class);
    CustomerService customerService =
    context.getBean("customerServiceImpl",CustomerService.class);
    customerService.addCustomer();
  }
}
```

Create an ApplicationContext based on the current configuration class

Spring Boot option 2

```java
@SpringBootApplication
public class SpringBootApplication {

  public static void main(String[] args) {
    ApplicationContext context = new
         AnnotationConfigApplicationContext(AppConfig.class);
    CustomerService customerService =
    context.getBean("customerServiceImpl",CustomerService.class);
    customerService.addCustomer();
  }
}
```

Create an ApplicationContext based on an external configuration class

```java
@Configuration
@ComponentScan("customers")
public class AppConfig {
}
```

Spring Boot option 3

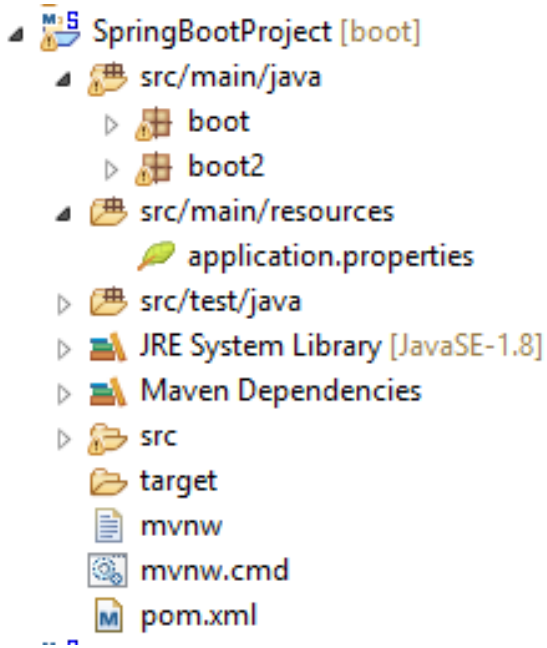
```
@SpringBootApplication
public class SpringBootProjectApplication implements CommandLineRunner {
  @Autowired
  private CustomerService customerService;

  public static void main(String[] args) {
    SpringApplication.run(SpringBootProjectApplication.class, args);
  }

  @Override
  public void run(String... args) throws Exception {
    customerService.addCustomer();
  }
}
```

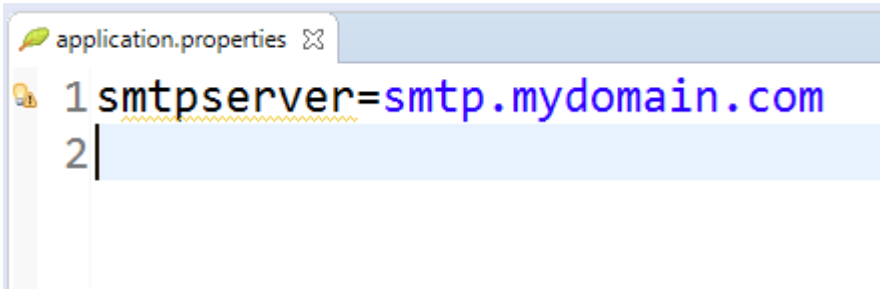
Implement the CommandLineRunner

Implement the run() method

Spring Boot configuration

- Spring Boot uses **application.properties** as the default configuration file





application.properties

```java
public interface EmailService {
  void sendEmail();
}
```

```java
@Service
public class EmailServiceImpl implements EmailService{
  @Value(" ${smtpserver}")
  String smtpServer;

  public void sendEmail() {
    System.out.println("Sending email using smtp server "+smtpServer);
  }
}
```

Inject the value from the properties file

application.properties

```
1 smtpserver=smtp.mydomain.com
2
```

Spring creates the context

```
@SpringBootApplication
public class SpringBootProjectApplication implements CommandLineRunner {
  @Autowired
  private EmailService emailService;

  public static void main(String[] args) {
    SpringApplication.run(SpringBootProjectApplication.class, args);
  }

  @Override
  public void run(String... args) throws Exception {
    emailService.sendEmail();
  }
}
```

Spring automatically reads application.properties

You create the context yourself

```
@SpringBootApplication
@PropertySource("classpath:application.properties")
public class SpringBootProjectApplication  {

  public static void main(String[] args) {
    ApplicationContext context = new
      AnnotationConfigApplicationContext(SpringBootProjectApplication.class);
    EmailService emailService = context.getBean("emailServiceImpl",
                                EmailService.class);
    emailService.sendEmail();
 }
}
```

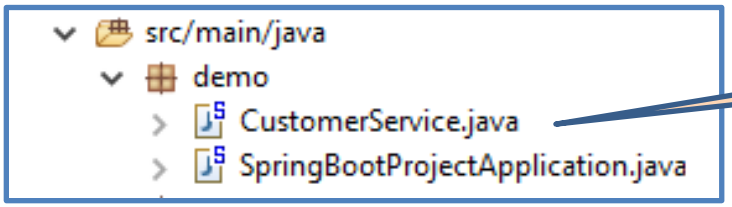
You need to define the application.properties file yourself

You create the context yourself

Spring component scanning

Spring will automatically scan all classes in the package ‘demo’ and all sub-packages of ‘demo’

```
package demo;

@SpringBootApplication
public class SpringBootProjectApplication implements CommandLineRunner {
  @Autowired
  private CustomerService customerService;

  public static void main(String[] args) {
    SpringApplication.run(SpringBootProjectApplication.class, args);
  }

  @Override
  public void run(String... args) throws Exception {
    customerService.addCustomer();
  }
}
```



CustomerService is in the package ‘demo’

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@ComponentScan

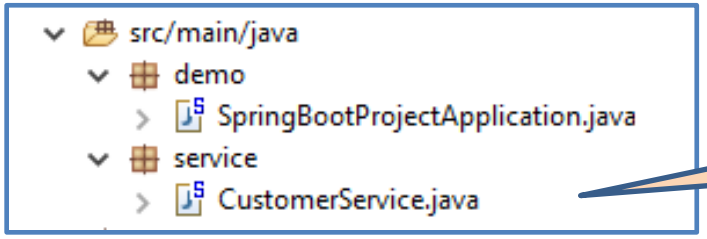
```
package demo;

@SpringBootApplication
@ComponentScan(basePackages = {"service"})
public class SpringBootProjectApplication implements CommandLineRunner {
  @Autowired
  private CustomerService customerService;

  public static void main(String[] args) {
    SpringApplication.run(SpringBootProjectApplication.class, args);
  }

  @Override
  public void run(String... args) throws Exception {
    customerService.addCustomer();
  }
}
```

Specify all packages that Spring will scan



CustomerService is not in the package ‘demo’ or subpackage of ‘demo’

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@ComponentScan with filters

Also scan the classes that follow this reggex pattern

```
@ComponentScan(basePackages = "com.concretepage",
includeFilters = @Filter(type = FilterType.REGEX, pattern="com.concretepage.*.*Util"),
excludeFilters = @Filter(type = FilterType.ASSIGNABLE_TYPE, classes = IUserService.class))
```

Do not scan the IUserService class

- The available FilterType values are:
  - FilterType.ANNOTATION: Include or exclude those classes with a stereotype annotation
  - FilterType.ASPECTJ: Include or exclude classes using an AspectJ type pattern expression
  - FilterType.ASSIGNABLE_TYPE: Include or exclude classes that extend or implement this class or interface
  - FilterType.REGEX: Include or exclude classes using a regular expression
  - FilterType.CUSTOM: Include or exclude classes using a custom implementation of theorg.springframework.core.type.TypeFilter interface

Set the logging level in application.properties

```
logging.level.root=ERROR
logging.level.org.springframework=ERROR
```

DI example

```
@Service
public class GreetingService {
  @Autowired
  private Greeting greeting;

  public String getTheGreeting() {
    return greeting.getGreeting();
  }
}
```

Spring does not know which class to inject

```
@Component
public class GreetingOne implements Greeting{

  public String getGreeting() {
    return "Hello World";
  }
}
```

```
public interface Greeting {
  String getGreeting();
}
```

```
@Component
public class GreetingTwo implements Greeting{

  public String getGreeting() {
    return "Hi World";
  }
}
```

DI example

```java
@SpringBootApplication
public class DemoProjectApplication implements CommandLineRunner {

  @Autowired
  private GreetingService greetingService;

  public static void main(String[] args) {
    SpringApplication.run(DemoProjectApplication.class, args);
  }

  @Override
  public void run(String... args) throws Exception {
    System.out.println(greetingService.getTheGreeting());
  }
}
```

```
***************************
APPLICATION FAILED TO START
***************************

Description:

Field greeting in demo.GreetingService required a single bean, but 2 were found:
        - greetingOne: defined in file [C:\springtraining\workspace\DemoProject\target\classes\demo\GreetingOne.class]
        - greetingTwo: defined in file [C:\springtraining\workspace\DemoProject\target\classes\demo\GreetingTwo.class]
```

Solution 1: use qualifier

```
@Service
public class GreetingService {
  @Autowired
  @Qualifier(value="greetingOne")
  private Greeting greeting;

  public String getTheGreeting() {
    return greeting.getGreeting();
  }
}
```

Solution 2: use profiles

```java
@Service
public class GreetingService {
  @Autowired
  private Greeting greeting;

  public String getTheGreeting() {
    return greeting.getGreeting();
  }
}
```

Set the active profile in application.properties

```
1 spring.profiles.active=One
2
```

```java
@Component
@Profile("One")
public class GreetingOne implements Greeting{
  public String getGreeting() {
    return "Hello World";
  }
}
```

Define a profile

```java
@Component
@Profile("Two")
public class GreetingTwo implements Greeting{
  public String getGreeting() {
    return "Hi World";
  }
}
```

Define a profile

Main point

- Spring boot makes writing enterprise applications simpler by using convention over configuration.

  Science of Consciousness: One gains full support of Nature when one operates from the level of the Unified Field, the source of all creation.

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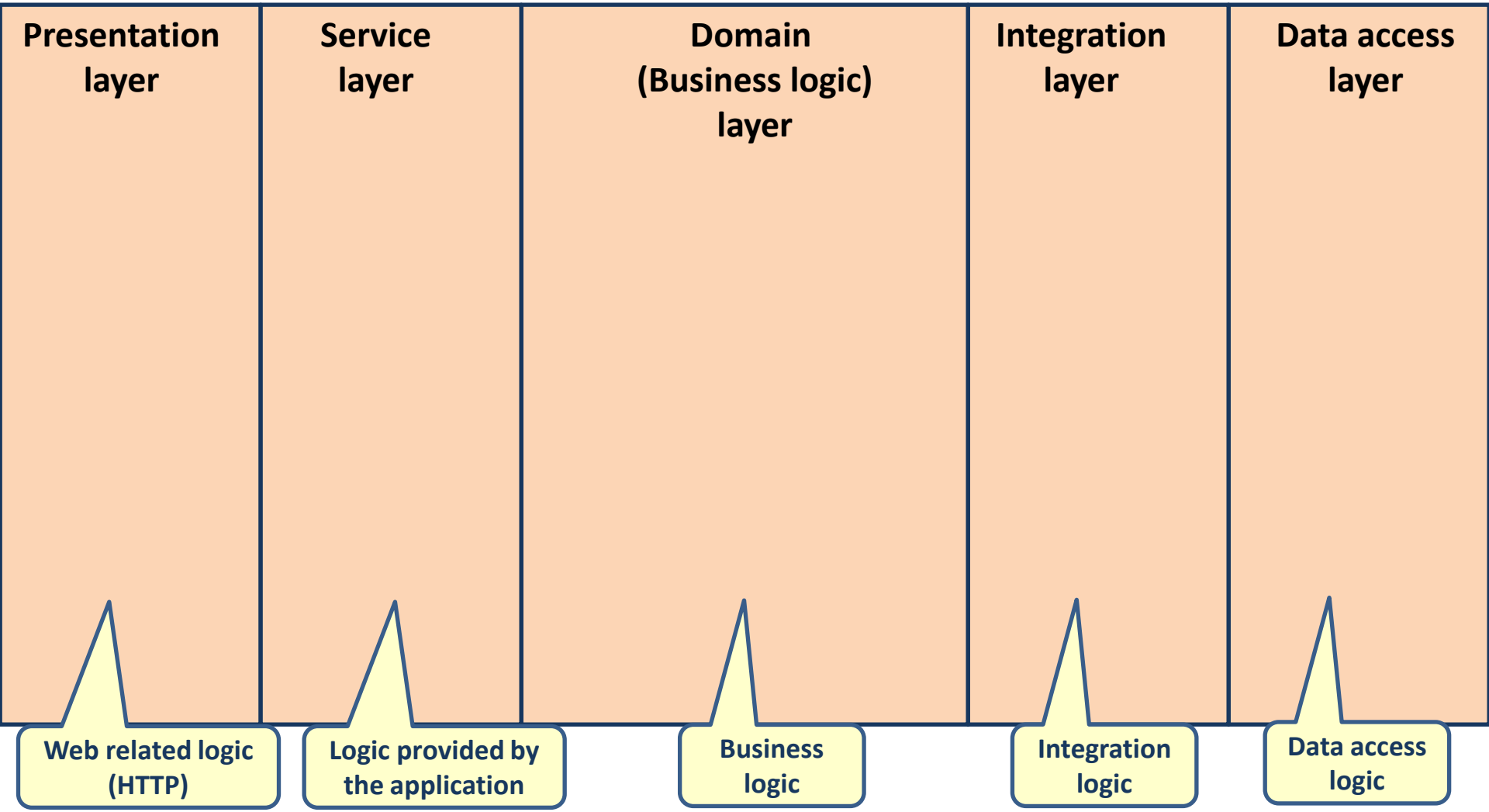
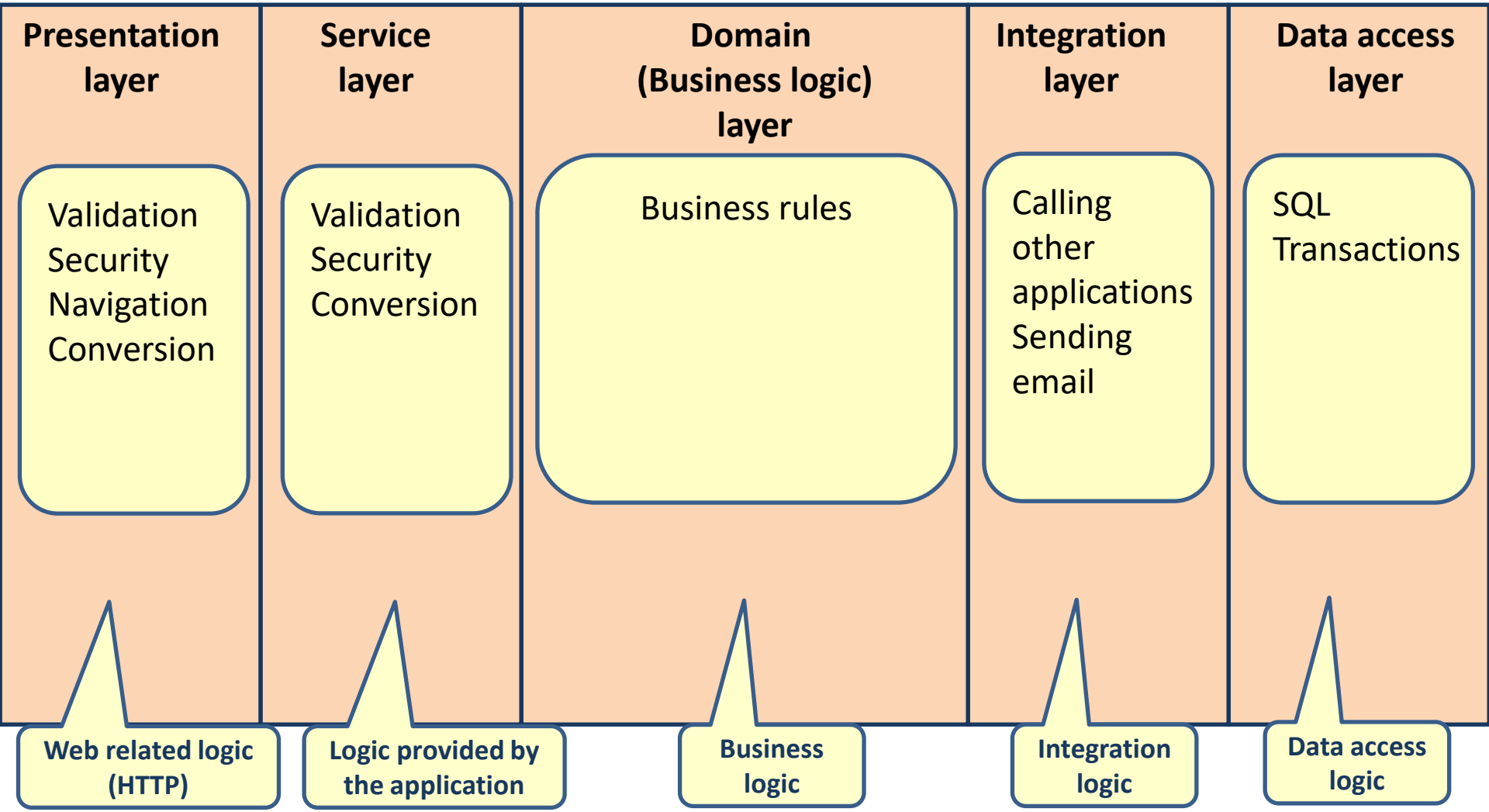
LAYERS OF AN ENTERPRISE APPLICATION

Application layers



Application layers



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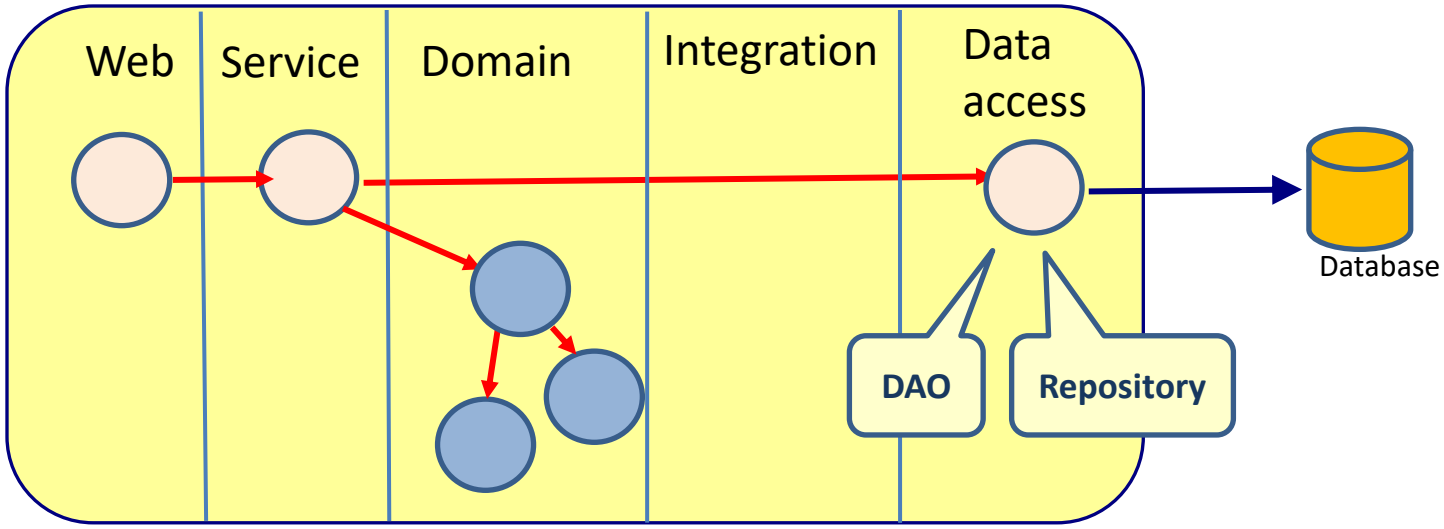
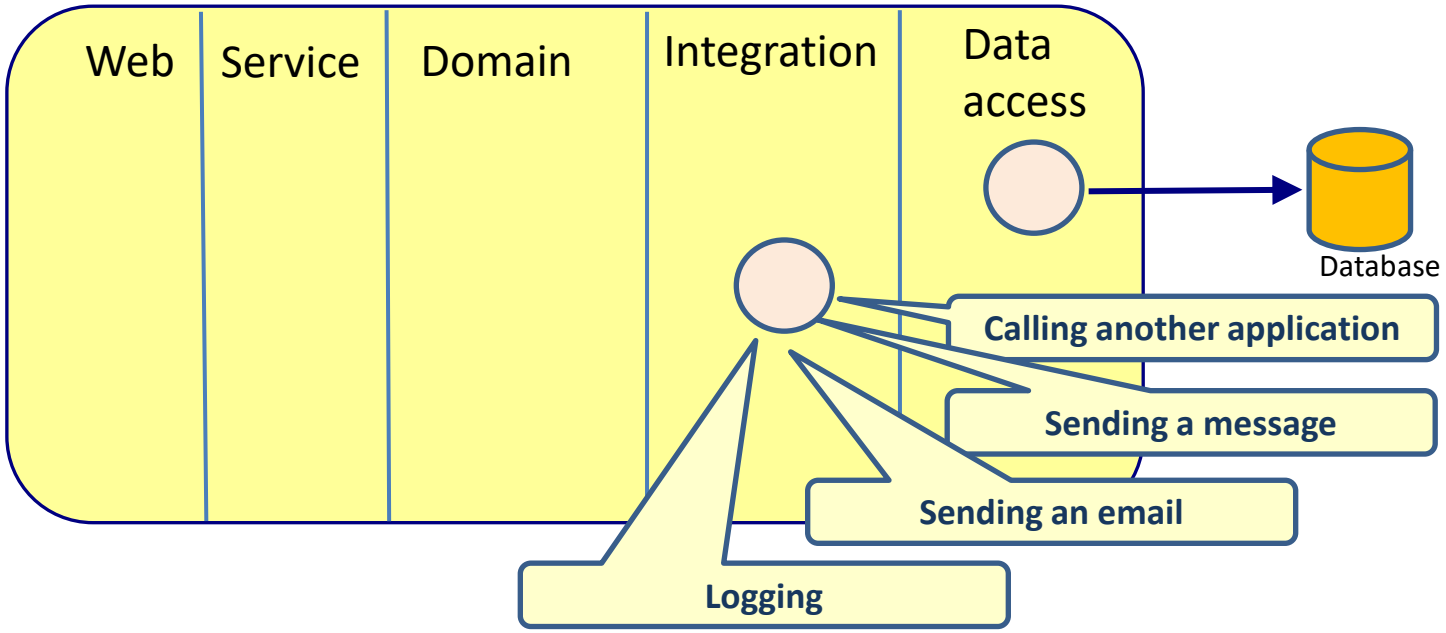
Data Access Object (DAO)/Repository

- Object that knows how to access the database
- Contains all database related logic
- Also called repository



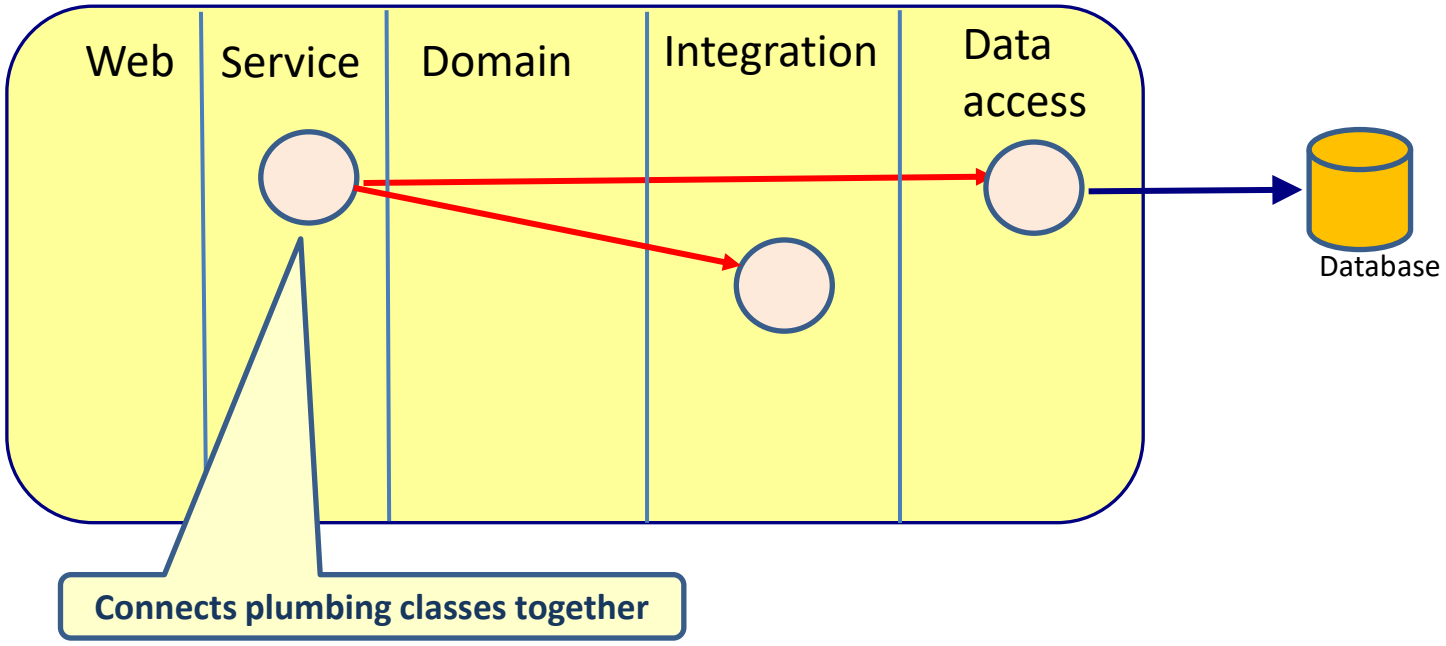
Technical plumbing classes

- Single responsibility



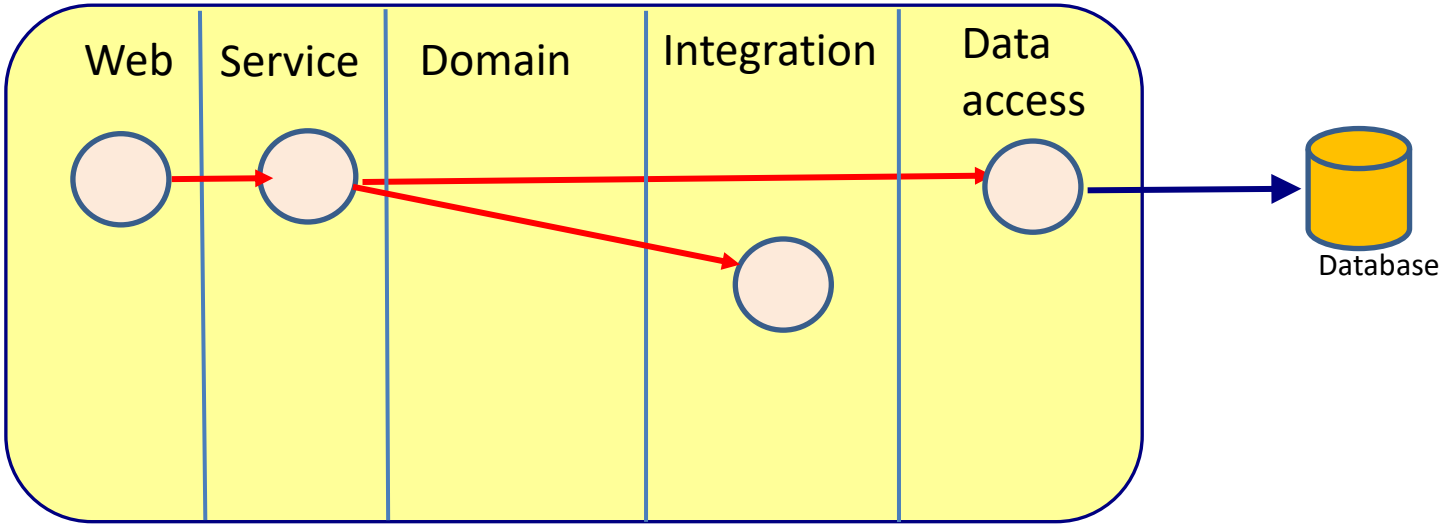
Service classes

- Reception
- Façade



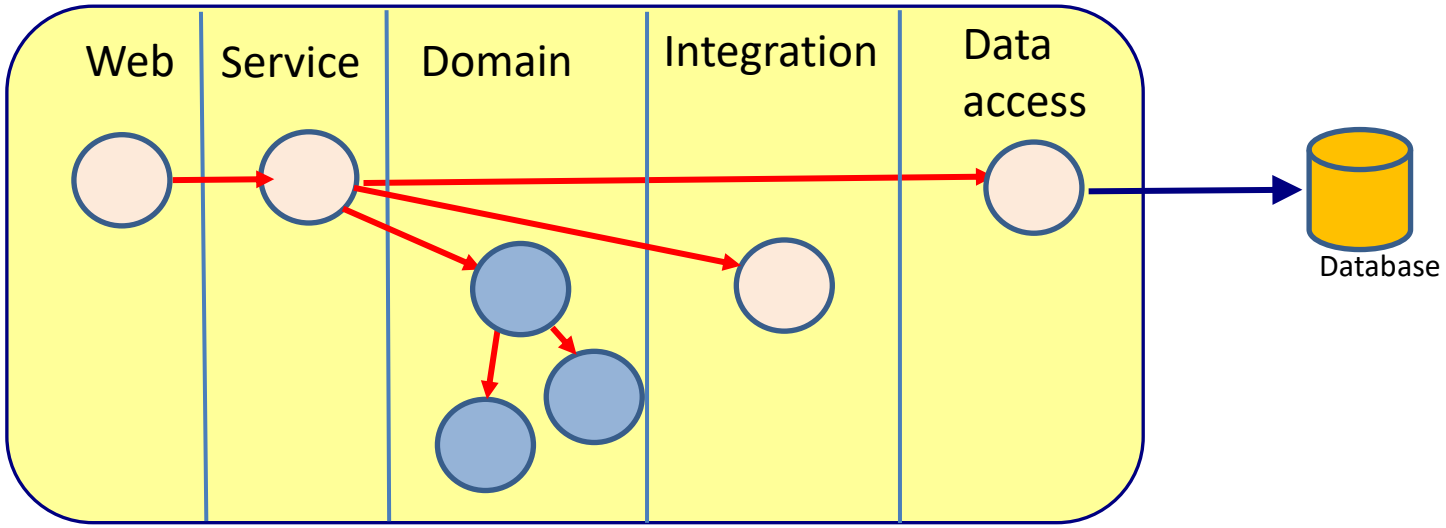
Controller classes

- HTTP controller
  - Receives the HTTP request

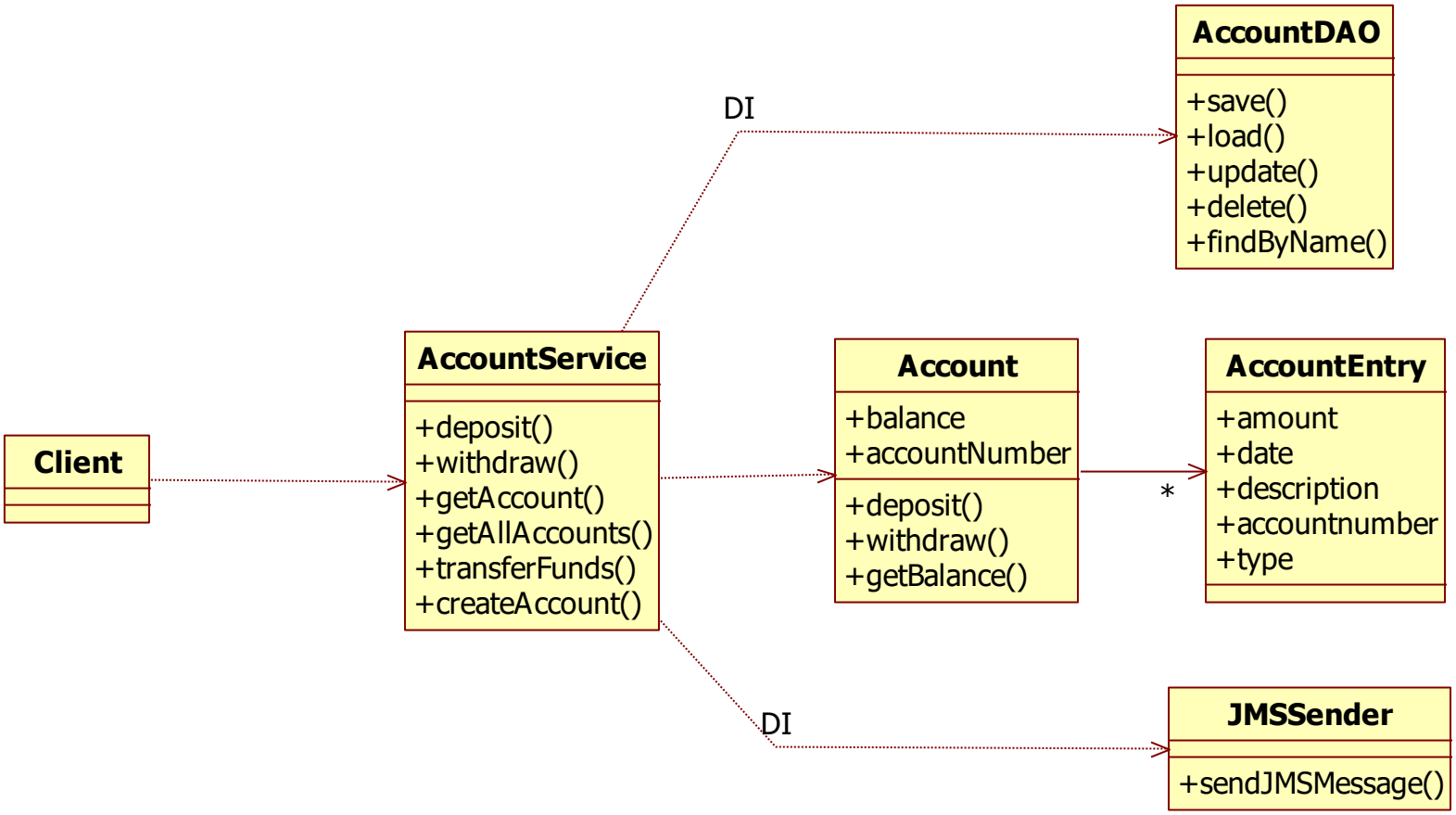


Domain classes

- Implement the business logic
  - Contains no technical code



Service Object



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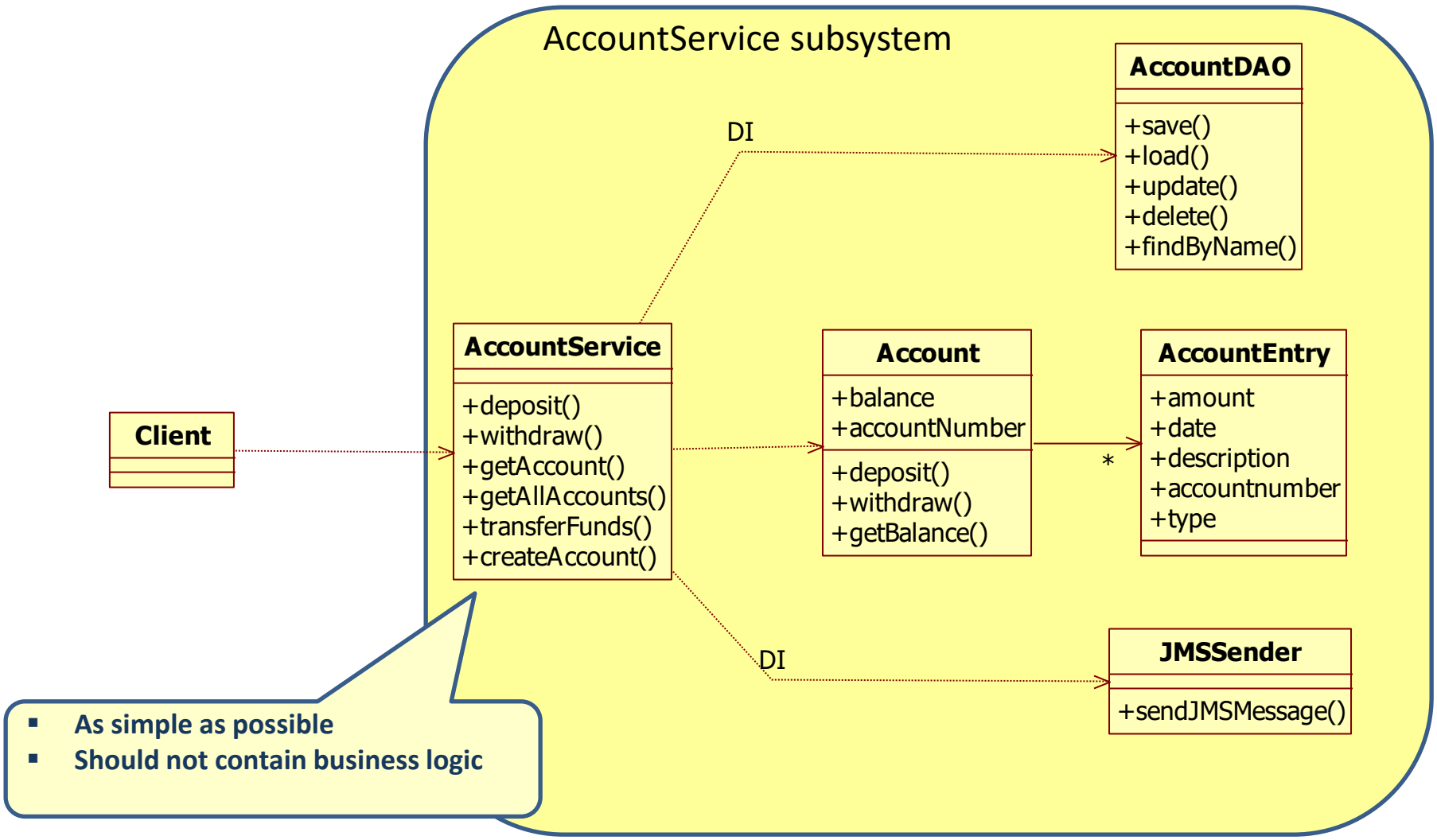
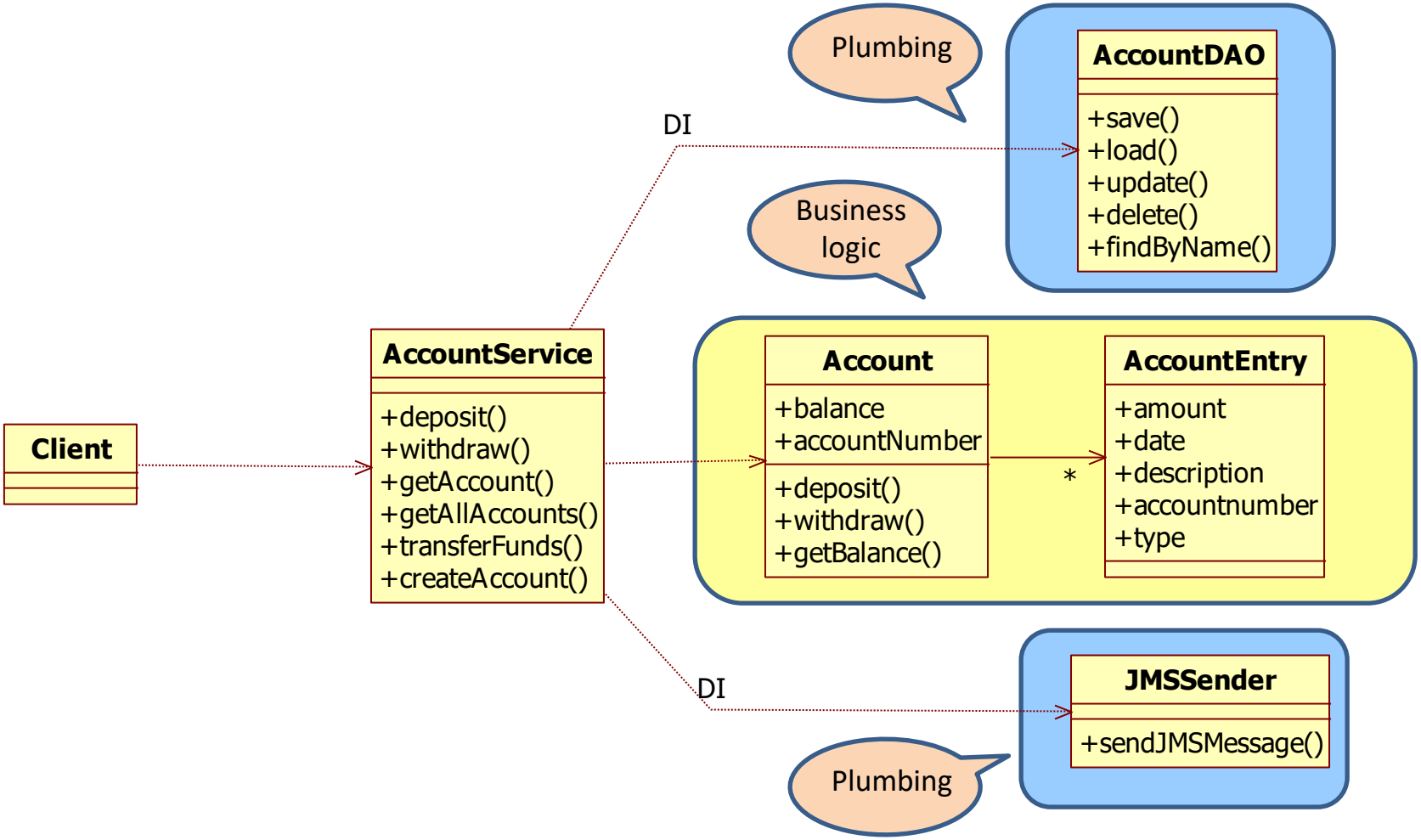
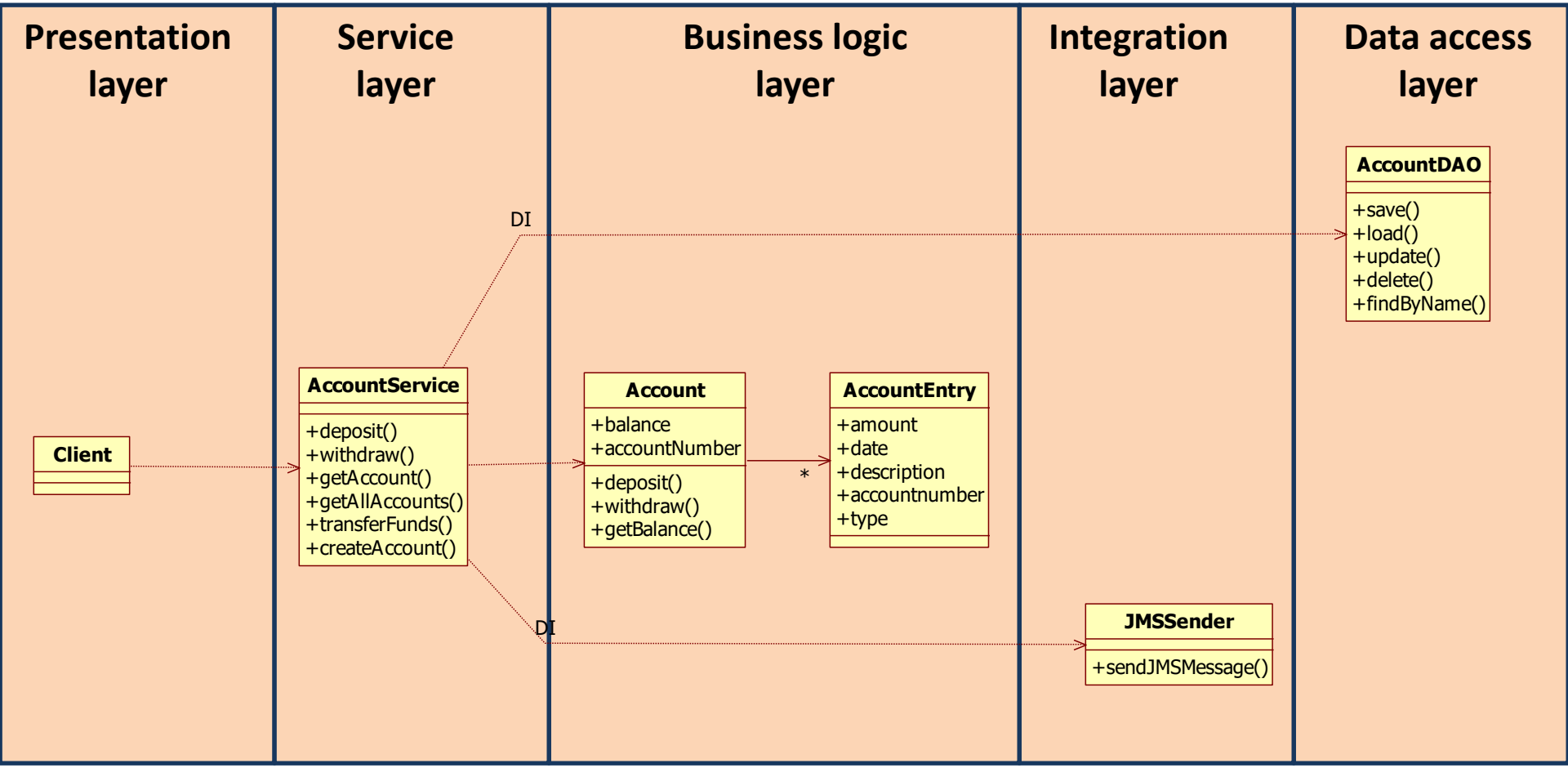
Entry of a complex subsystem



Separation of concern



Application layers



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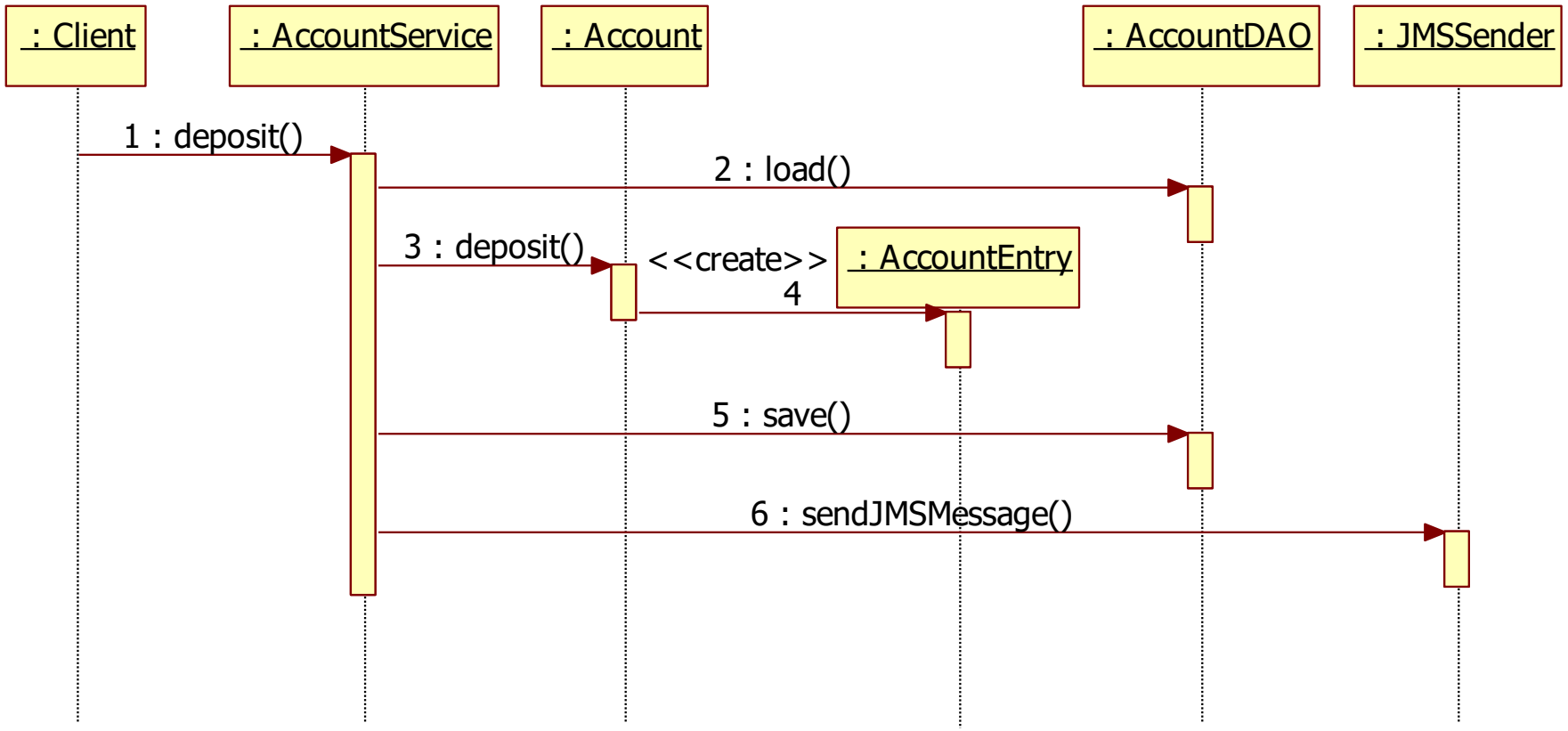
Service object



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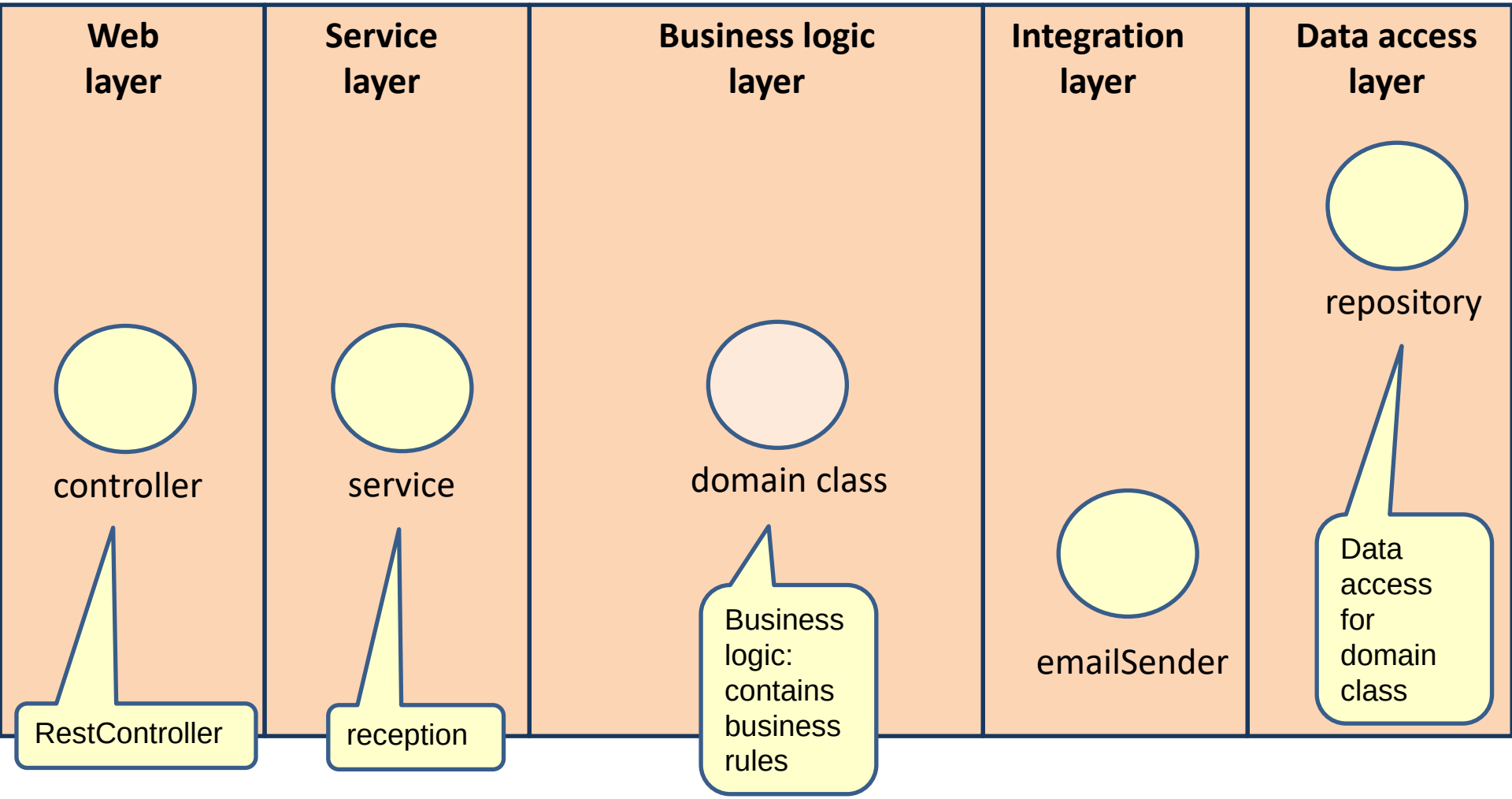
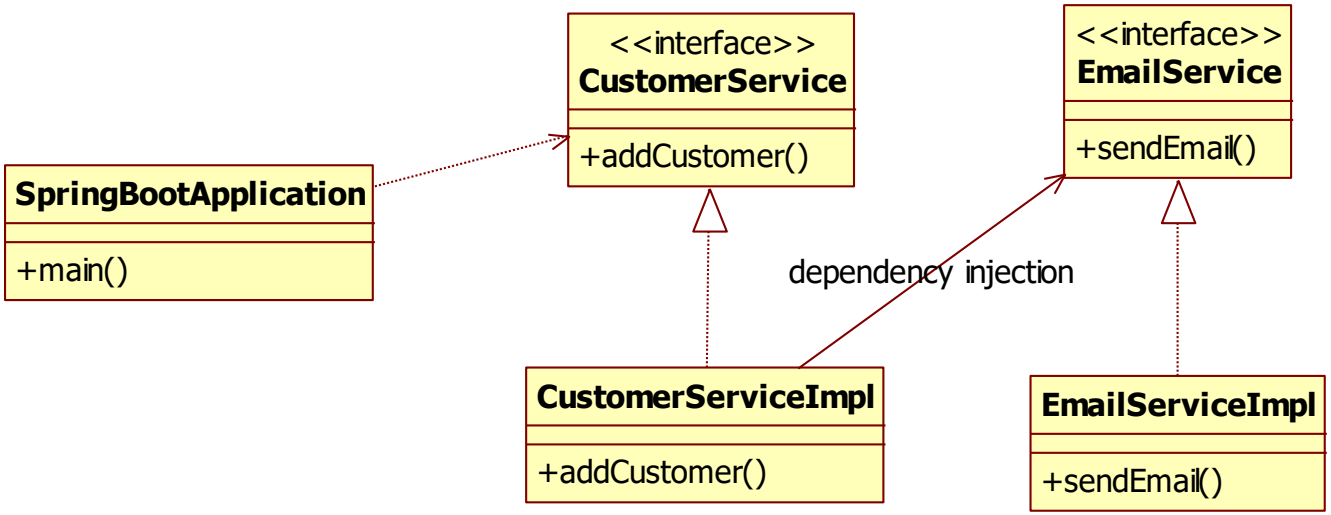
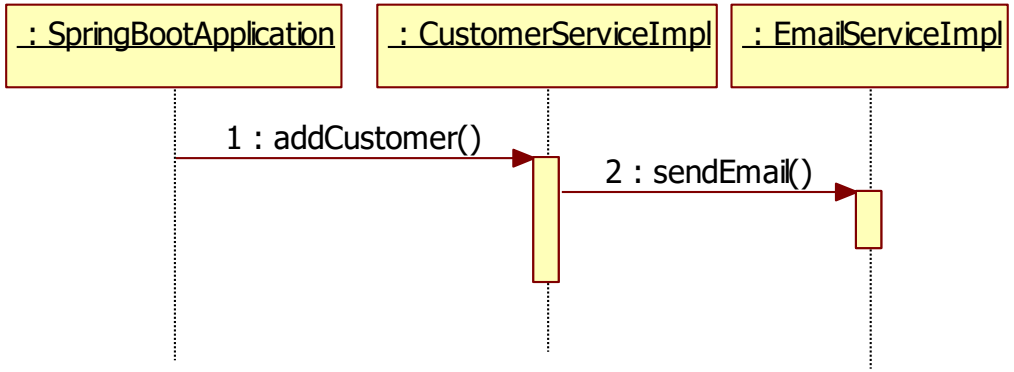
Layered architecture



Dependency injection





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Dependency injection: Setter injection

```java
@Service
public class CustomerServiceImpl implements CustomerService {

  private EmailService emailService;

  @Autowired
  public void setEmailService(EmailService emailService) {
    this.emailService = emailService;
  }


  public void addCustomer() {
    emailService.sendEmail();
  }
}
```

Setter injection

```java
@Service
public class EmailServiceImpl implements EmailService{
  public void sendEmail() {
    System.out.println("Sending email");
  }
}
```

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Dependency injection: Constructor injection

```java
@Service
public class CustomerServiceImpl implements CustomerService {

  private EmailService emailService;

  @Autowired
  public CustomerService(EmailService emailService) {
    this.emailService = emailService;
  }


  public void addCustomer() {
    emailService.sendEmail();
  }
}
```

Customer injection

```java
@Service
public class EmailServiceImpl implements EmailService{
  public void sendEmail() {
    System.out.println("Sending email");
  }
}
```

Dependency injection: Field injection

```java
@Service
public class CustomerServiceImpl implements CustomerService {
  @Autowired
  private EmailService emailService;

  public void addCustomer() {
    emailService.sendEmail();
  }
}
```

Field injection

```java
@Service
public class EmailServiceImpl implements EmailService{
  public void sendEmail() {
    System.out.println("Sending email");
  }
}
```

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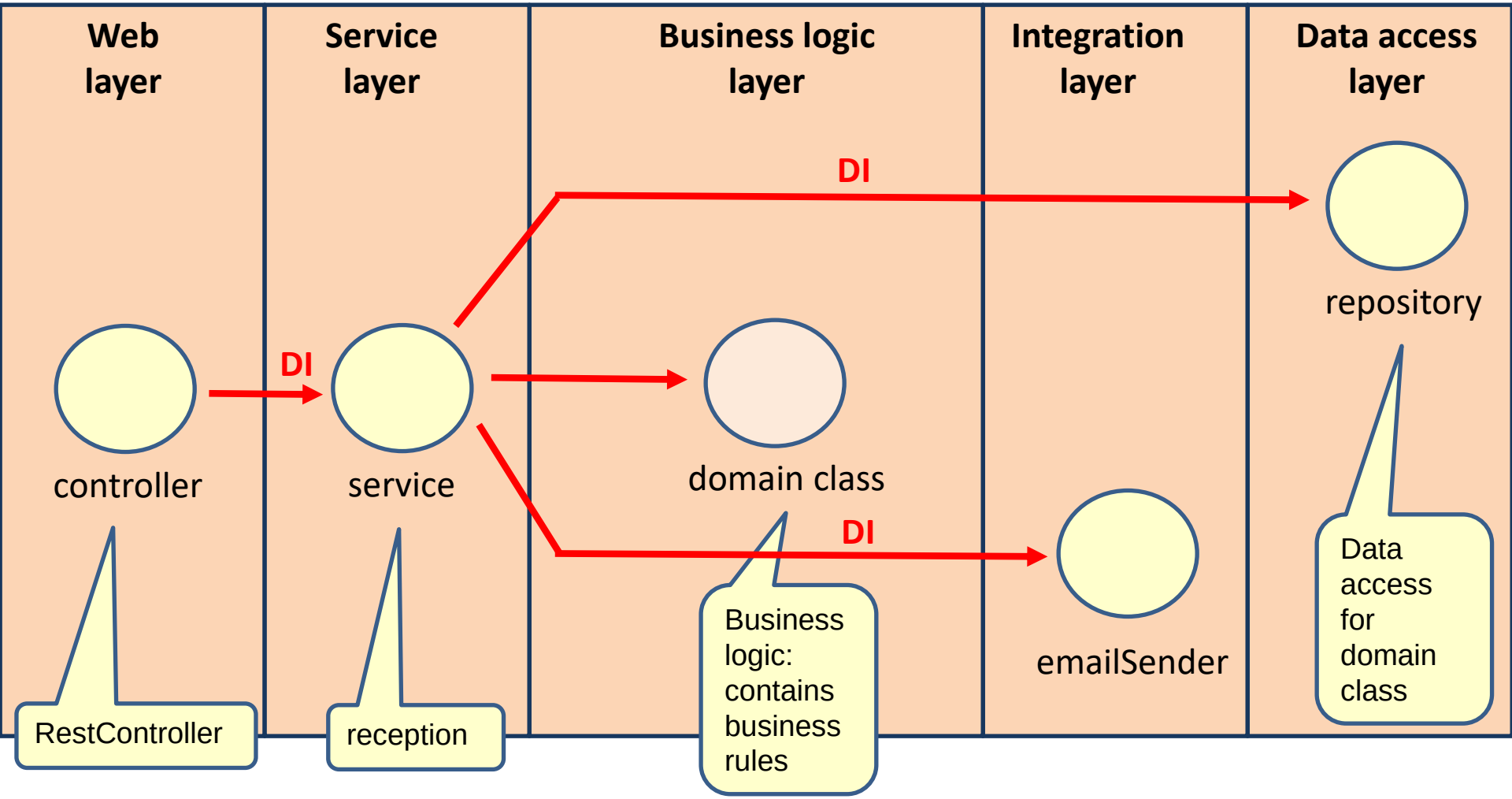
Layered architecture



Main point

- An enterprise back-end system is typically divided in different layers.

  Science of Consciousness: Life is found in layers.

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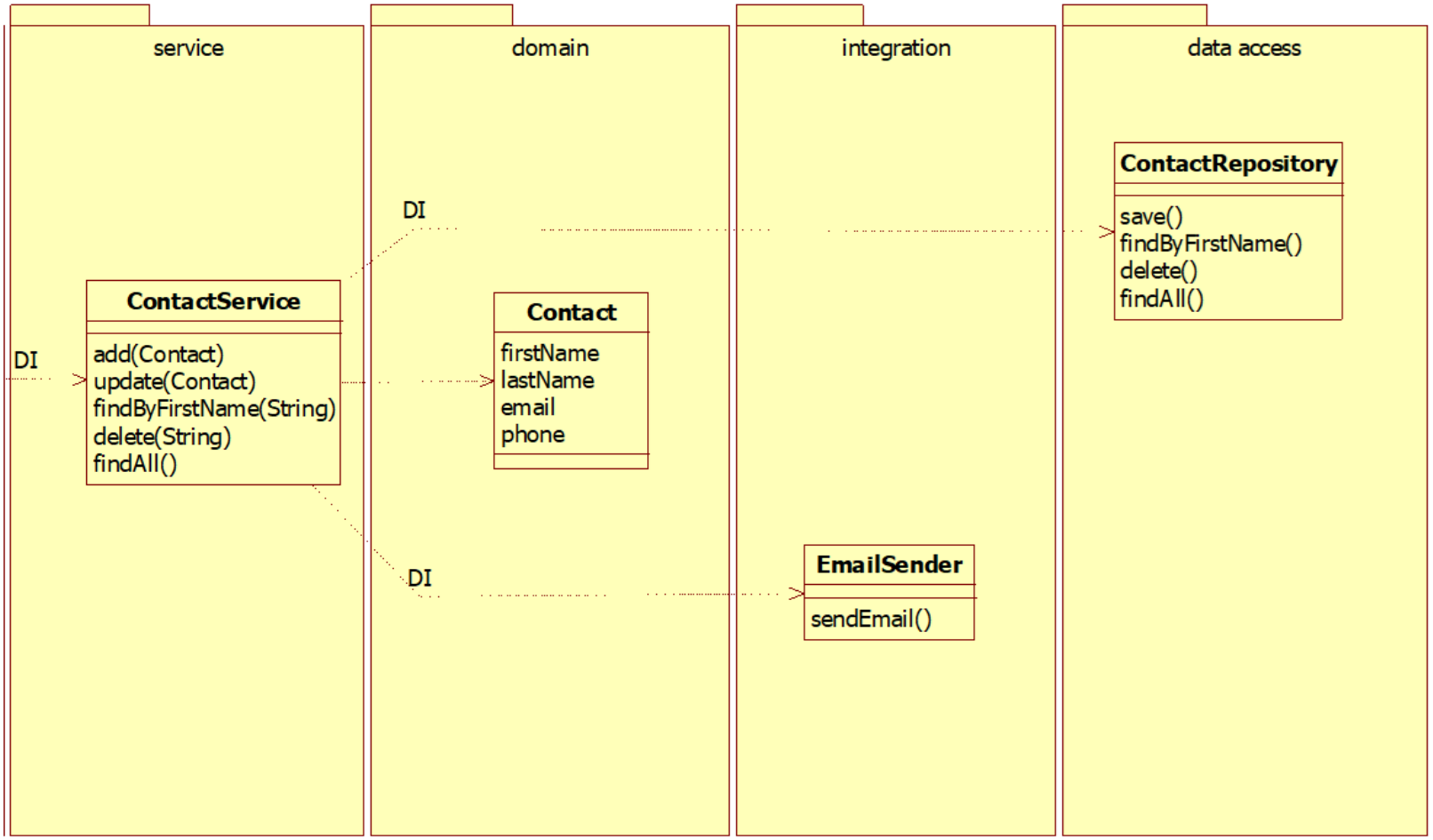
Spring Boot example



Repository

@Repository

```
@Repository
public class ContactRepository {
   private Map<String, Contact> contacts = new HashMap<String, Contact>();

   public void save(Contact contact){
      contacts.put(contact.getFirstName(),contact);
   }

   public Contact findByFirstName(String firstName){
      return contacts.get(firstName);
   }

   public void delete(String firstName){
      contacts.remove(firstName);
   }

   public Collection<Contact> findAll(){
      return contacts.values();
   }
}
```

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EmailSender

@Component

```
@Component
public class EmailSender {
   public void sendEmail (String message, String emailAddress){
      System.out.println("Send email message '"+ message+"' to"+emailAddress);
   }
}
```

Service

@Service

@Autowired

```
@Service
public class ContactService {
   @Autowired
   ContactRepository contactRepository;
   @Autowired
   EmailSender emailSender;

   public void add(Contact contact){
      contactRepository.save(contact);
      emailSender.sendEmail(contact.getEmail(), "Welcome");
   }

   public void update(Contact contact){
      contactRepository.save(contact);
   }

   public Contact findByFirstName(String firstName){
      return contactRepository.findByFirstName(firstName);
   }

   public void delete(String firstName){
      Contact contact = contactRepository.findByFirstName(firstName);
      emailSender.sendEmail(contact.getEmail(), "Good By");
      contactRepository.delete(firstName);
   }

   public Collection<Contact> findAll(){
      return contactRepository.findAll();
   }
}
```

Application

```
@SpringBootApplication
public class SpringBootMVCApplication implements CommandLineRunner {
  @Autowired
  private ContactService contactService;

  public static void main(String[] args) {
    SpringApplication.run(SpringBootMVCApplication.class, args);
  }

  @Override
  public void run(String... args) throws Exception {
    contactService.add(new Contact("Frank","Brown","fbrown@gmail.com","4723459800"));
    System.out.println(contactService.findByFirstName("Frank"));
  }
}
```

ASPECT-ORIENTED PROGRAMMING

BASICS OF AOP

Crosscutting concern

- Check security for every service level method

```
public class CustomerService {

  public void getAllCustomers(){
    checkSecurity();
    ...
  }

  public void getCustomer(long customerNumber){
    checkSecurity();
    ...
  }

  public void addCustomer(long customerNumber, String firstName){
    checkSecurity();
    ...
  }

  public void removeCustomer(long customerNumber){
    checkSecurity();
    ...
  }
}
```

We have to call checkSecurity() for all methods of all service classes

Crosscutting concern

- Log every call to the database

```
public class AccountDAO {

  public void saveAccount(Account account){
     ...
     Logger.log("...");
  }

  public void updateAccount(Account account){
     ...
     Logger.log("...");
  }

  public void loadAccount(long accountNumber){
     ...
     Logger.log("...");
  }

  public void removeAccount(long accountNumber){
     ...
     Logger.log("...");
  }
}
```

We have to call Logger.log() for all methods of all DAO classes

Good programming practice principles

DRY: Don't Repeat Yourself

- Write functionality at one place, and only at one place
- Avoid code scattering

SoC: Separation of Concern

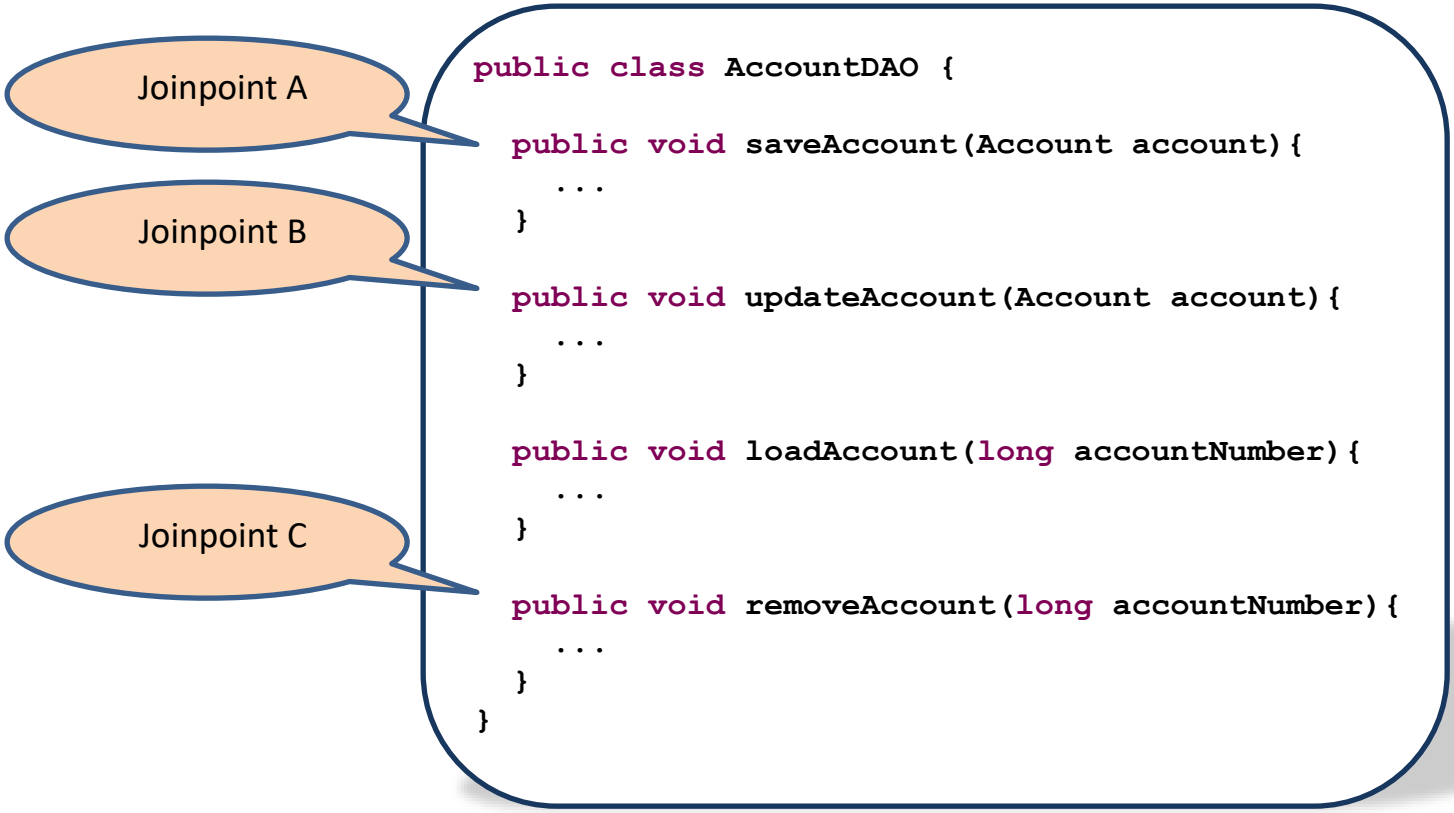
- Separate business logic from (technical) plumbing code
- Avoid code tangling

AOP concepts

- Joinpoint
- Pointcut
- Aspect
- Advice
- Weaving

AOP concept: Joinpoint

- A specific point in the code



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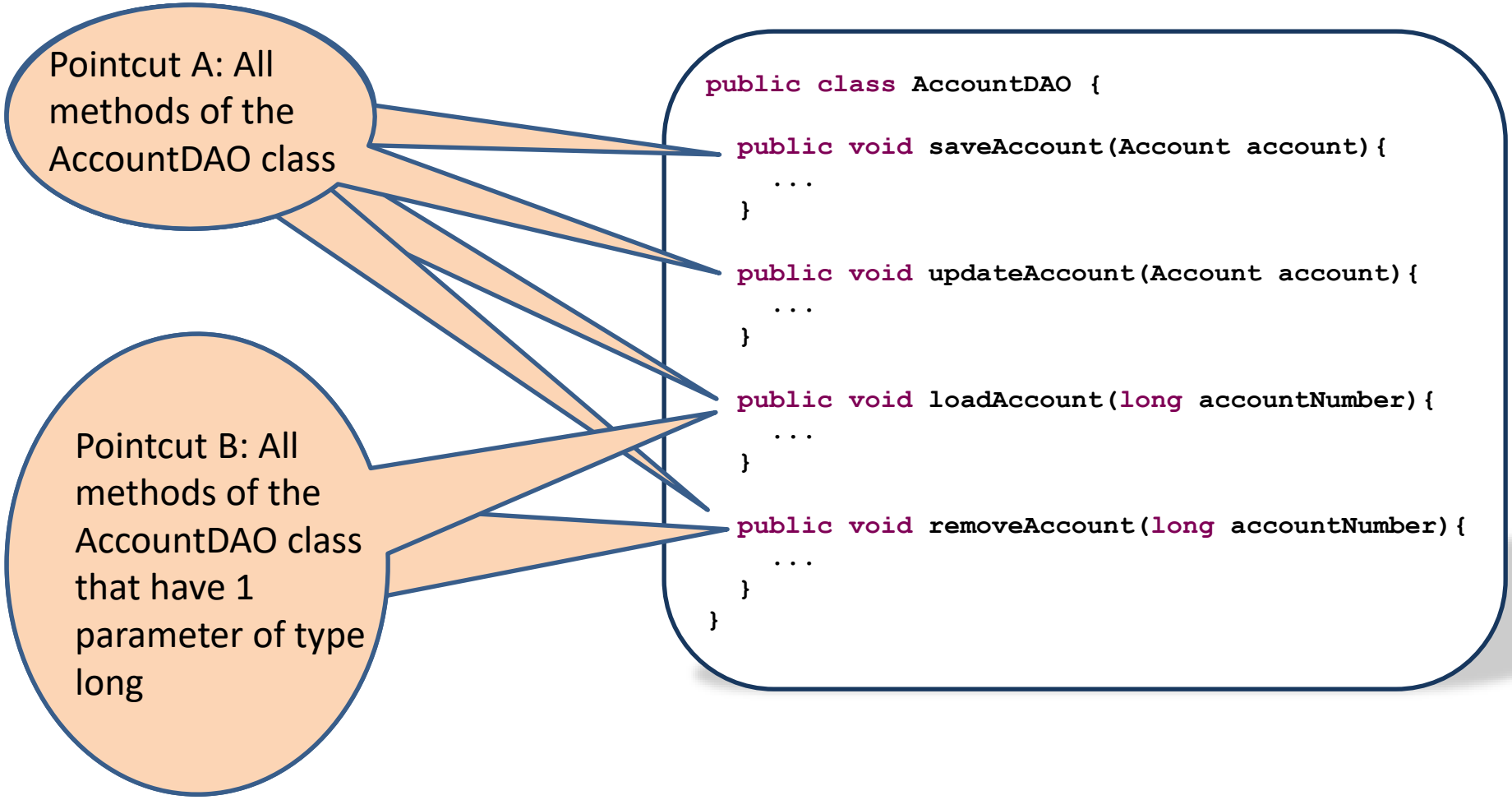
AOP concept: Pointcut

- A collection of 1 or more joinpoints



AOP concept: Advice

- The implementation of the crosscutting concern

```
public class LoggingAdvice {

  public void log(){
    ...
  }
}
```

```
public class EmailAdvice {

  public void sendEmailMessage(){
    ...
  }
}
```

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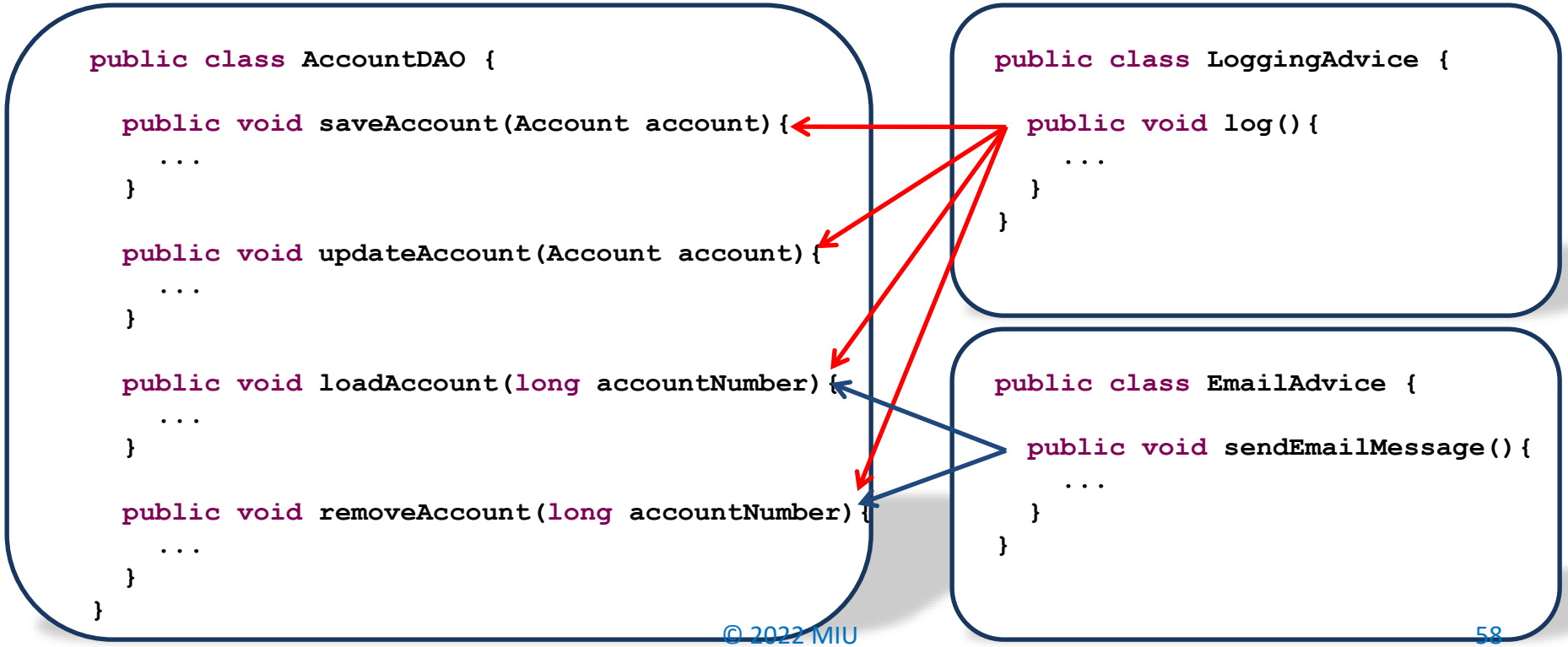
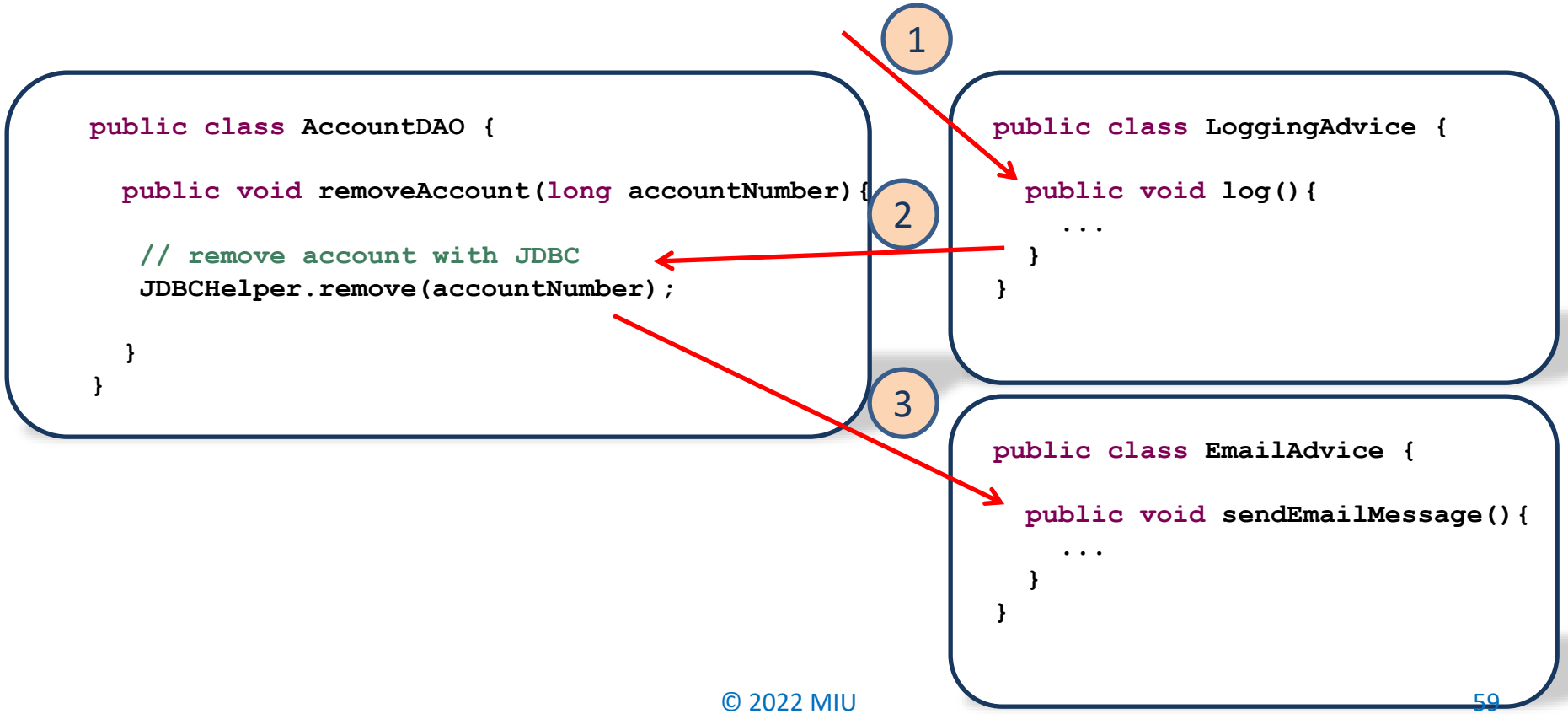
AOP concept: Aspect

- What crosscutting concern do I execute (=advice) at which locations in the code (=pointcut)
  - Aspect A: call the log() method of LoggingAdvice before every method call of AccountDAO
  - Aspect B: call the sendEmailMessage() method of EmailAdvice after every method call of AccountDAO that has one parameter of type long



AOP concept: Weaving

- Weave the advice code together with the target code at the corresponding pointcuts such that we get the correct execution



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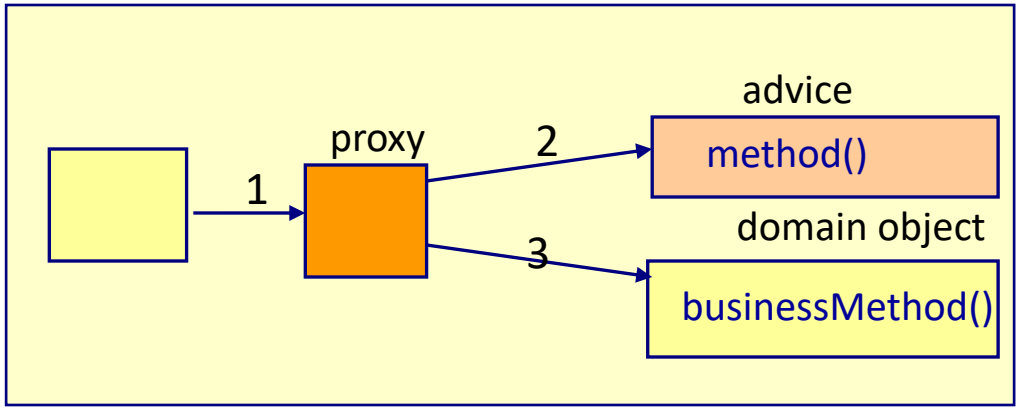
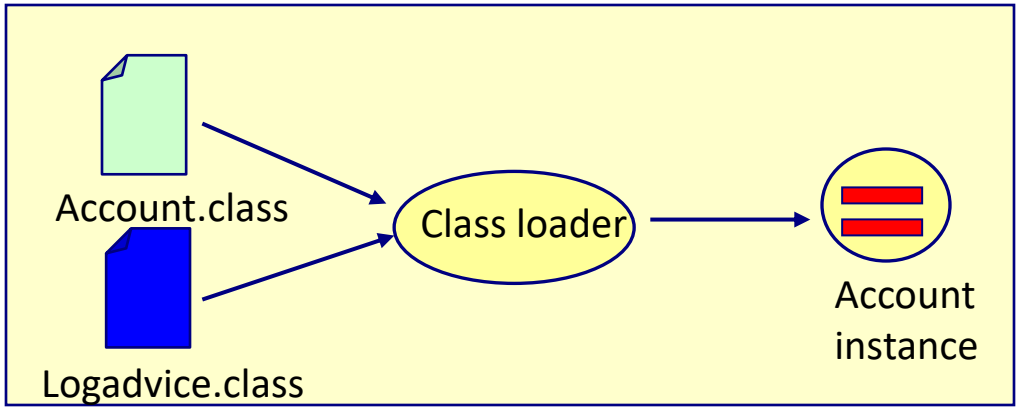
Weaving

Proxy-based weaving



Load time weaving

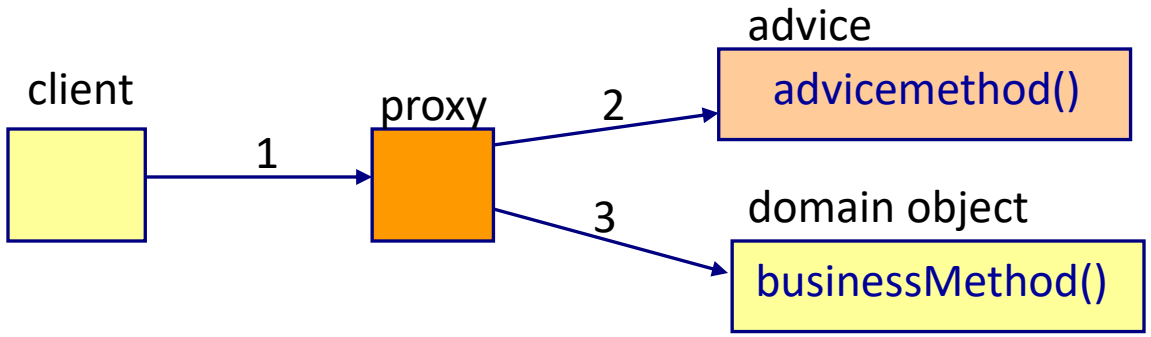


Advice types

- Before
- After returning
- After throwing
- After (finally)
- Around

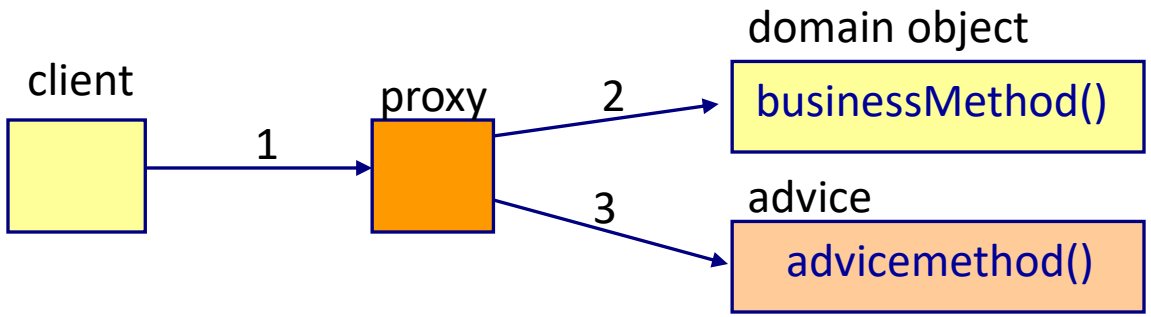
Before advice

- First call the advice method and then the business logic method



After returning advice

- First call the business logic method and when this business logic method returns normally without an exception, then call the advice method



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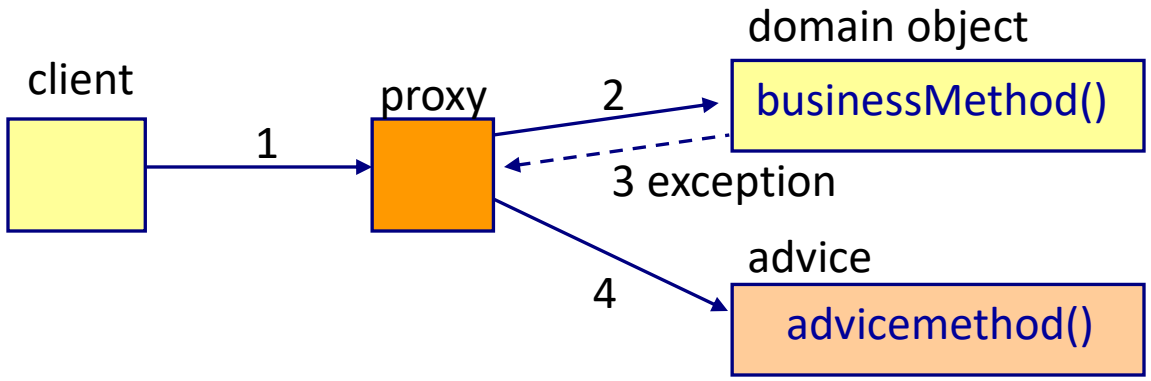
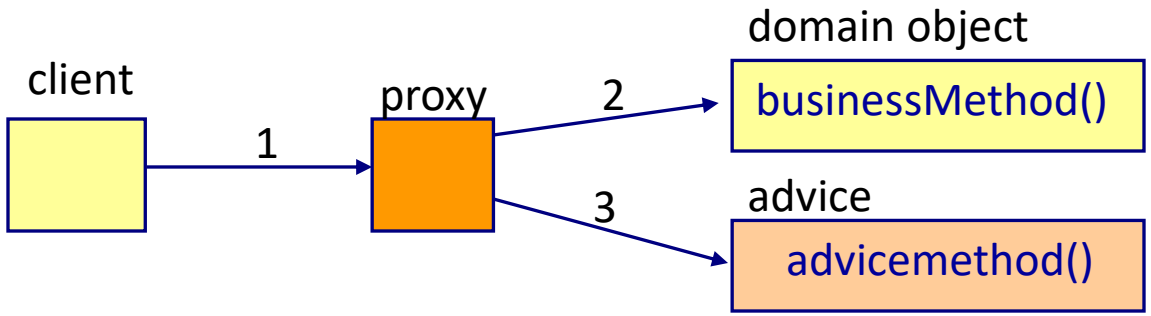
After throwing advice

- First call the business logic method and when this business logic method throws an exception, then call the advice method



After advice

- First call the business logic method and then call the advice method (independent of how the business logic method returned: normally or with exception)



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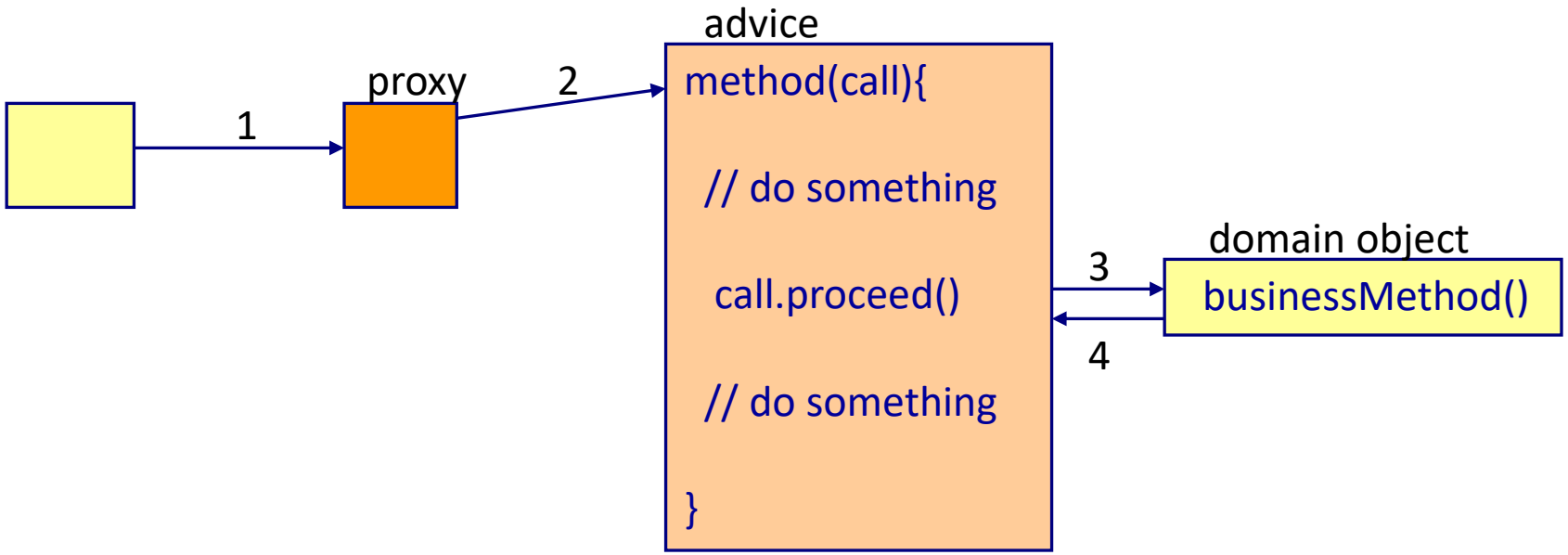
Around advice

- First call the advice method. The advice method calls the business logic method, and when the business logic method returns, we get back to the advice method



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AOP with Spring Boot

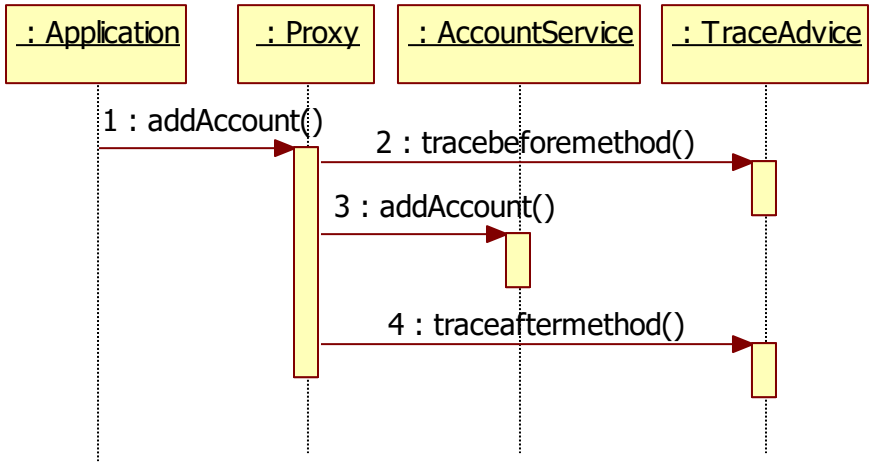
```
public class AccountService implements IAccountService{
  Collection<Account> accountList = new ArrayList();

  public void addAccount(String accountNumber, Customer customer){
    Account account = new Account(accountNumber, customer);
    accountList.add(account);
    System.out.println("in execution of method addAccount");
  }
}
```

@Configuration

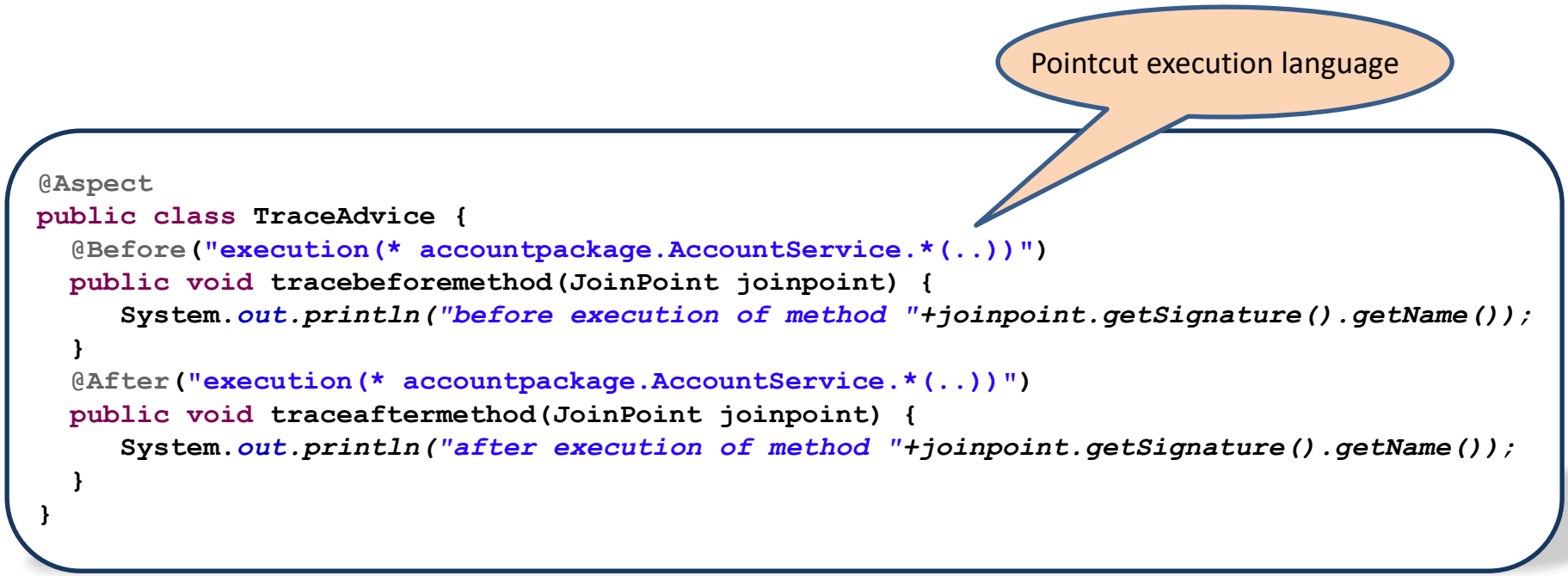
```
@Aspect
@Configuration
public class TraceAdvice {
  @Before("execution(* accountpackage.AccountService.*(..))")
  public void tracebeforemethod(JoinPoint joinpoint) {
     System.out.println("before execution of method "+joinpoint.getSignature().getName());
  }
  @After("execution(* accountpackage.AccountService.*(..))")
  public void traceaftermethod(JoinPoint joinpoint) {
     System.out.println("after execution of method "+joinpoint.getSignature().getName());
  }
}
```

AOP with Spring Boot




```
@Aspect
@Configuration
public class TraceAdvice {
  @Before("execution(* accountpackage.AccountService.*(..))")
  public void tracebeforemethod(JoinPoint joinpoint) {
     System.out.println("before execution of method "+joinpoint.getSignature().getName());
  }
  @After("execution(* accountpackage.AccountService.*(..))")
  public void traceaftermethod(JoinPoint joinpoint) {
     System.out.println("after execution of method "+joinpoint.getSignature().getName());
  }
}
```

Pointcut execution language



Pointcut execution language

```
@Before("execution(public * *.*.*(..))")
```

Visibility:
- Possibilities:
  - private
  - public
  - Protected
- **Optional**
- **Cannot** be *

Return type:
- The return type of the corresponding method(s)
- Not optional
- Can be *

package.class.method(args):
- Name of the package can also be *
- Name of the class can also be *
- Name of the method can also be *
- Arguments can be ..
- Not optional
- Can also be *.*(..)
- Can also be *(..)

Pointcut execution language examples

```
@After("execution(public * *(..))")
```

All public methods

```
@After("execution(public void *(..))")
```

All public methods that return void

```
@After("execution(* order.*.*(..))")
```

All methods from all classes in the order package

```
@After("execution(* *.*.create*(..))")
```

All methods that start with create

```
@After("execution(* *.Customer.*(..))")
```

All methods from the Customer class

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Pointcut execution language examples

```
@After("execution(* order.Customer.*(..))")
```

All methods from the Customer class in the order package

```
@After("execution(* order.Customer.getPayment(..))")
```

The getPayment () method from the Customer class in the order package

```
@After("execution(* order.Customer.getPayment(int))")
```

The getPayment () method with a parameter of type int from the Customer class in the order package

```
@After("execution(* *.*.*(long,String))")
```

All methods from all classes that have 2 parameters, the first of type long, and the second of type String

Around example

```
@Around("execution(* *.*.*(..))")
public Object profile (ProceedingJoinPoint call) throws Throwable{
StopWatch clock = new StopWatch("");
clock.start(call.toShortString());

Object object= call.proceed();

clock.stop();
System.out.println(clock.prettyPrint());
return object;
}
```

Create and start a stopwatch

Call the business logic method

Stop the stopwatch and print result

```
StopWatch '': running time (millis) = 1
-----------------------------------------
ms     %     Task name
-----------------------------------------
00001  100%  execution(addAccount)
```

Getting the return value

- Works only for @AfterReturning

```
public class Customer {
  private String name;

  public String getName() {
    return name;
  }
  public void setName(String name) {
    this.name = name;
  }
}
```

getName() returns a String

```
@Aspect
public class TraceAdvice {
  @AfterReturning(pointcut="execution(* mypackage.Customer.getName(..))",returning="retValue")
  public void tracemethod(JoinPoint joinpoint, String retValue) {
    System.out.println("method ="+joinpoint.getSignature().getName());
    System.out.println("return value ="+retValue);
  }
}
```

The pointcut expression

Add 'returning' parameter

Add parameter to the advice method. The name of the parameter must be the same as the name of the returning parameter of the @AfterReturning annotation

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Getting the return value

```
public class Customer {
private int age;

  public int getAge() {
    return age;
  }
  public void setAge(int age) {
    this.age = age;
  }
}
```

getAge() returns an integer

Add 'returning' parameter

```
@Aspect
public class TraceAdvice {
  @AfterReturning(pointcut="execution(* mypackage.Customer.getAge(..))",returning="retValue")
  public void tracemethod(JoinPoint joinpoint, int retValue) {
    System.out.println("method ="+joinpoint.getSignature().getName());
    System.out.println("return value ="+retValue);
  }
}
```

retValue is an int

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Getting the exception

- Works only for @AfterThrowing

```
public class Customer {
  public void myMethod() throws MyException{
    throw new MyException("myexception");
  }
}
```

```
public class MyException extends Exception{
  private String message;

  public MyException(String message){
    this.message=message;
  }
  public String getMessage(){
    return message;
  }
}
```

Add 'throwing' parameter

```
@Aspect
public class TraceAdvice {
  @AfterThrowing(pointcut="execution(* mypackage.Customer.myMethod(..))",throwing="exception")
  public void tracemethod(JoinPoint joinpoint, MyException exception) {
     System.out.println("method ="+joinpoint.getSignature().getName());
     System.out.println("exception message ="+exception.getMessage());
  }
}
```

Add parameter to the advice method

Get parameters

```
public class Customer {
  private String name;

  public String getName() {
    return name;
  }
  public void setName(String name) {
    this.name = name;
  }
}
```

```
@Aspect
public class TraceAdvice {
  @After("execution(* mypackage.Customer.setName(..)) && args(name)")
  public void tracemethod(JoinPoint joinpoint, String name) {
     System.out.println("method ="+joinpoint.getSignature().getName());
     System.out.println("parameter name ="+name);
  }
}
```

Add 'args' parameter

Add parameter(s) to the advice method

Get parameters

```
public class Customer {
  private String name;
  private int age;

  public void setNameAndAge(String name, int age){
    this.name = name;
    this.age = age;
  }
}
```

2 parameters

```
@Aspect
public class TraceAdvice {
  @Before("execution(* mypackage.Customer.setNameAndAge(..)) && args(name,age)")
  public void tracemethod(JoinPoint joinpoint, String name, int age) {
     System.out.println("method ="+joinpoint.getSignature().getName());
     System.out.println("parameter name ="+name);
     System.out.println("parameter age ="+age);
  }
}
```

Add name and age to the args parameter

Add 2 parameters to the advice method

Get parameters from the Joinpoint

```
public class Customer {
  private String name;

  public String getName() {
    return name;
  }
  public void setName(String name) {
    this.name = name;
  }
}
```

Get the arguments from the joinpoint

Take the first argument

```
@Aspect
public class TraceAdvice {
 @After("execution(* mypackage.Customer.setName(..))")
  public void tracemethodA(JoinPoint joinpoint) {
  Object[] args = joinpoint.getArgs();
  String name = (String)args[0];
  System.out.println("method ="+joinpoint.getSignature().getName());
  System.out.println("parameter name ="+name);
  }
}
```

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Get multiple parameters from the Joinpoint

```
public class Customer {
  private String name;
  private int age;

  public void setNameAndAge(String name, int age){
    this.name = name;
    this.age = age;
   }
}
```

2 parameters

```
@Aspect
public class TraceAdvice {
  @Before("execution(* mypackage.Customer.setNameAndAge(..))")
  public void tracemethod(JoinPoint joinpoint ) {
     Object[] args = joinpoint.getArgs();
     String name = (String)args[0];
     int age = (Integer)args[1];
     System.out.println("method ="+joinpoint.getSignature().getName());
     System.out.println("parameter name ="+name);
     System.out.println("parameter age ="+age);
  }
}
```

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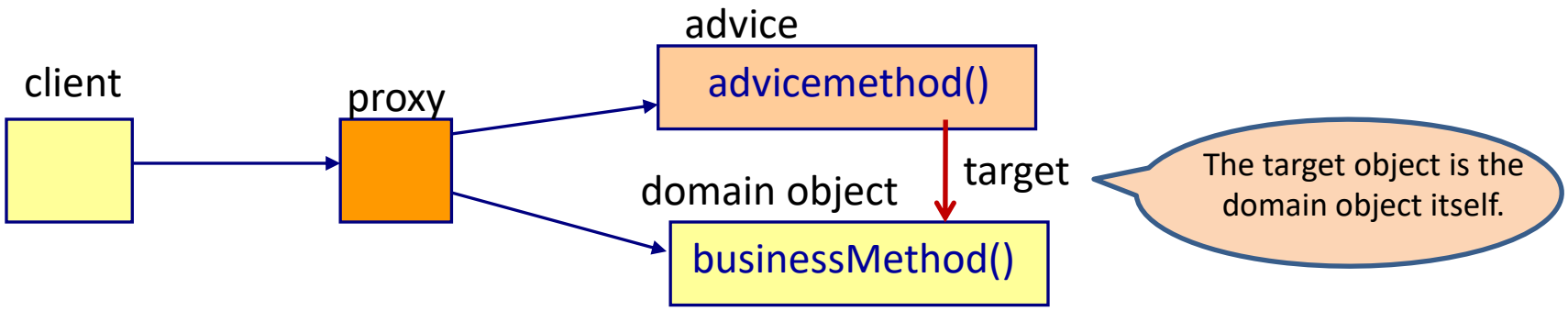
The target class



Get the target class

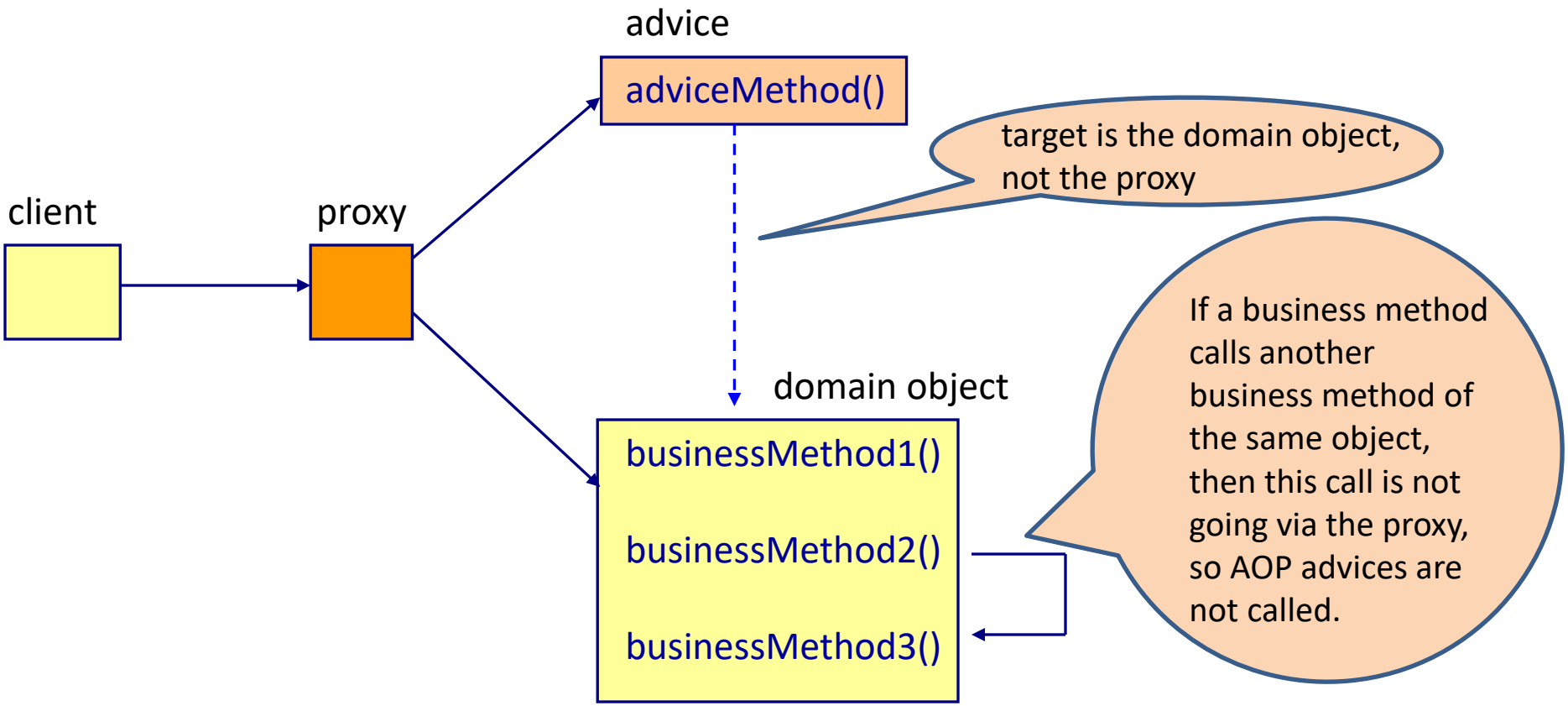
```
public class Customer {
   private String name;
   private int age;

   public int getAge() {
      return age;
   }
   public void setAge(int age) {
      this.age = age;
   }
   public String getName() {
      return name;
   }
   public void setName(String name) {
      this.name = name;
   }
}
```

Get the target object from the joinpoint

```
@Aspect
public class TraceAdvice {
 @After("execution(* mypackage.Customer.setName(..))")
   public void tracemethod(JoinPoint joinpoint) {
      Customer customer = (Customer)joinpoint.getTarget();
      System.out.println("method ="+joinpoint.getSignature().getName());
      System.out.println("customer age ="+customer.getAge());
   }
}
```

Disadvantage of a proxy



Advantages of AOP

- No code tangling
  - Clean separation of business logic and plumbing code
- No code scattering

Disadvantages of AOP

- You don’t have a clear overview of which code runs when
- A pointcut expression is a string that is parsed at runtime
  - No compile time checking of the pointcut expression
- You make mistakes easily
- Problems with proxy-based AOP

Be careful with AOP: always use unit testing and integration testing with AOP

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Main point

- Aspect Oriented Programming lets us program additional logic in one place, and then declaratively apply that logic to many places. *Science of Consciousness*: We create harmony (single implementation), in diversity (applied to many places).

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Connecting the parts of knowledge with the wholeness of knowledge

1. Layering is a powerful technique to separate different aspects of a system
2. The service class is the connection point between the different layers

3. **Transcendental consciousness** is the source of all intelligence of creation.
4. **Wholeness moving within itself:** In unity consciousness, one experiences that everything is just an expression of one'sown Self.

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