CS 525 - ASD
Advanced Software Development

MS.CS Program

Department of Computer Science

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OF MANAGEMENT

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Lesson 10 Framework design

L1: ASD Introduction
L2: Strategy, Template method
L3: Observer pattern
L4: Composite pattern, iterator pattern
L5: Command pattern
L6: State pattern
L7: Chain Of Responsibility pattern

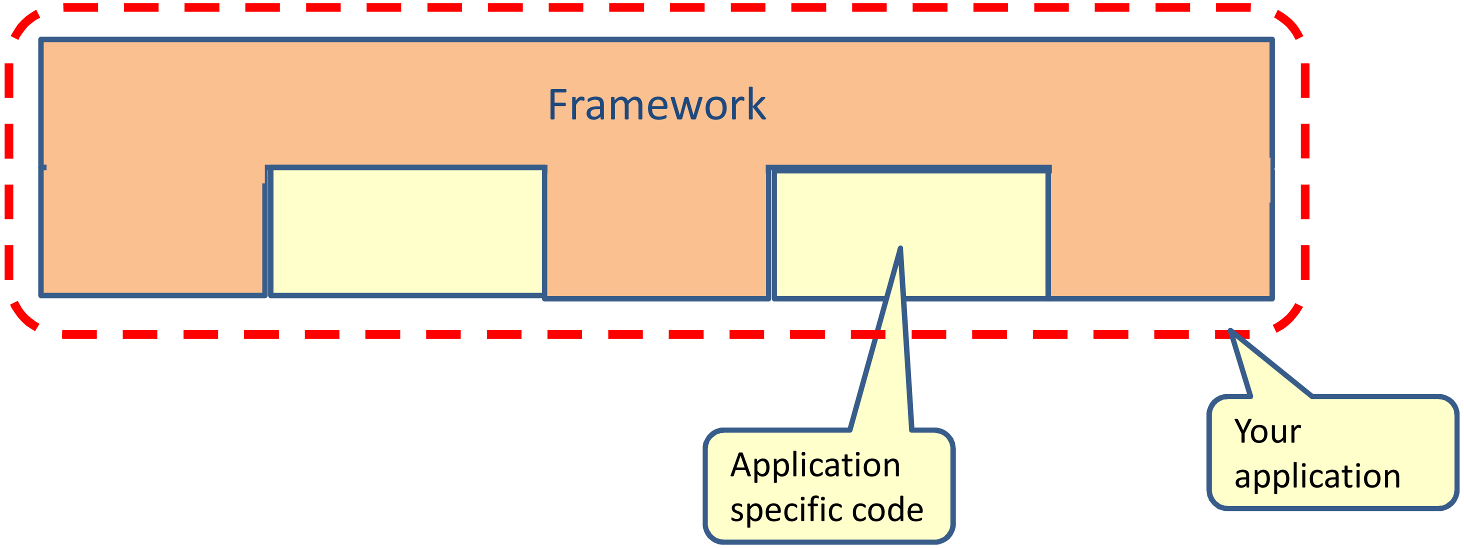
Midterm

L8: Proxy, Adapter, Mediator
L9: Factory, Builder, Decorator, Singleton
L10: Framework design
L11: Framework implementation
L12: Framework example: Spring framework
L13: Framework example: Spring framework

Final

Framework

- A framework is a reusable semi complete application for a specific domain



Framework examples

Web frameworks

- SpringMVC
- Angular
- React
- Vue
- …

ORM frameworks

- Hibernate
- Open JPA
- EclipseLink
- …

Testing frameworks

- JUnit
- TestNG
- Mockito
- RestAssured
- Cucumber
- …

Logging frameworks

- Log4J 2
- LogBack
- SLF4J
- …

Spring related frameworks

- Spring
- Spring boot
- Spring security
- …

Game engine/frameworks

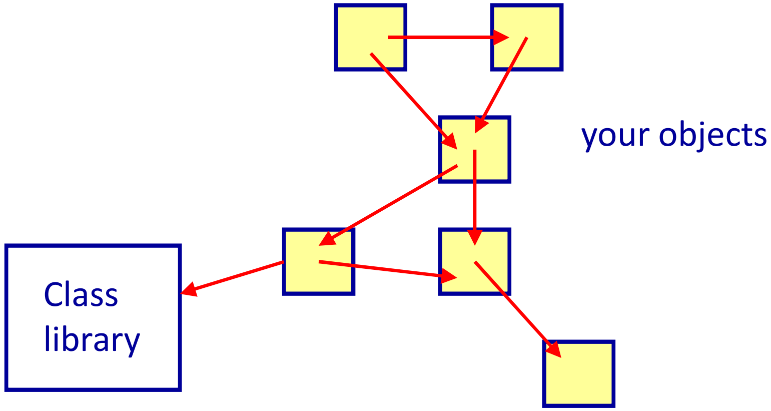
- Unreal Engine
- Unity
- Godot
- …

Why frameworks

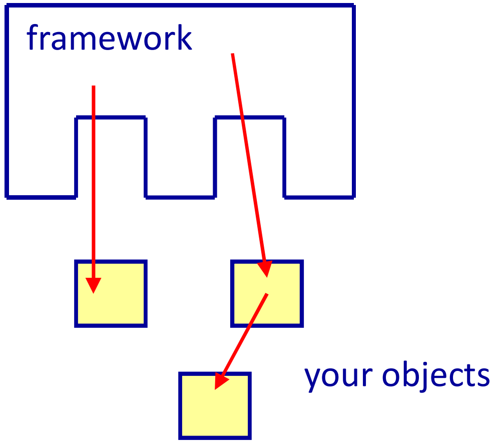
- They embody expertise
  - Developer can focus on the problem domain
- Reuse
- Reliability
  - Reusing a stable framework increases reliability.
- Standardization

Framework vs. Library

- Inversion of Control (IoC)
  - Hollywood principle: Don’t call us, we’ll call you
  - The framework has control over your code

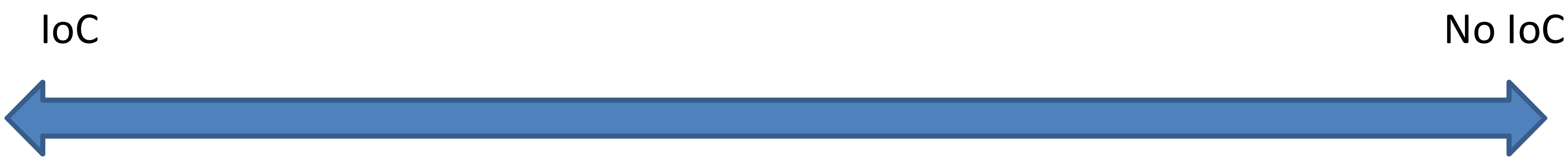


Your code calls the class library



IoC: The framework calls your code

Inversion of Control (IoC)



IoC

No IoC

- JUnit
- SpringMVC
- JavaFX

- Spring

- Java collection framework
- Hibernate
- JDBC

- Framework
- Library
- Platform
- Engine

Example of unit testing

```
import static org.junit.Assert.*;
import org.junit.*

public class CounterTest {
    private Counter counter;
```

Initialization

```
     @Before
     public void setUp() throws Exception {
       counter = new Counter();
     }
```

Test method

```
     @Test
     public void testIncrement(){
        assertEquals("Counter.increment does not work correctly",1,counter.increment());
        assertEquals("Counter.increment does not work correctly",2,counter.increment());
     }
```

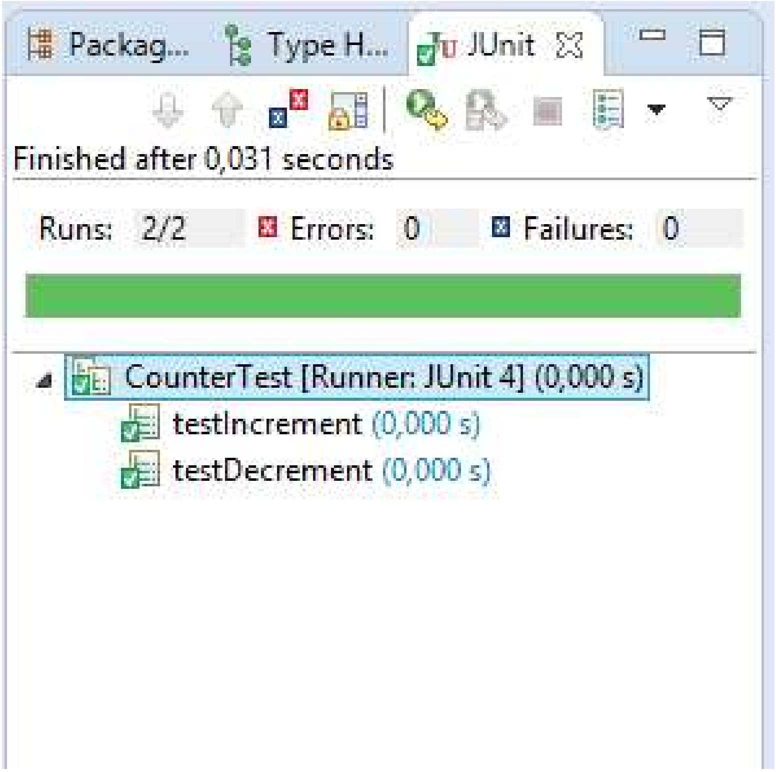
Test method

```
     @Test
     public void testDecrement(){
        assertEquals("Counter.decrement does not work correctly",-1,counter.decrement());
        assertEquals("Counter.decrement does not work correctly",-2,counter.decrement());
     }
}
```

```
public class Counter {
    private int counterValue=0;

    public int increment(){
       return ++counterValue;
    }
    public int decrement(){
       return --counterValue;
    }
    public int getCounterValue() {
       return counterValue;
    }
 }
```

Running the test

```
package count;

public class Counter {
    private int counterValue=0;

    public int increment(){
       return ++counterValue;
    }
    public int decrement(){
       return --counterValue;
    }
    public int getCounterValue() {
       return counterValue;
    }
 }
```



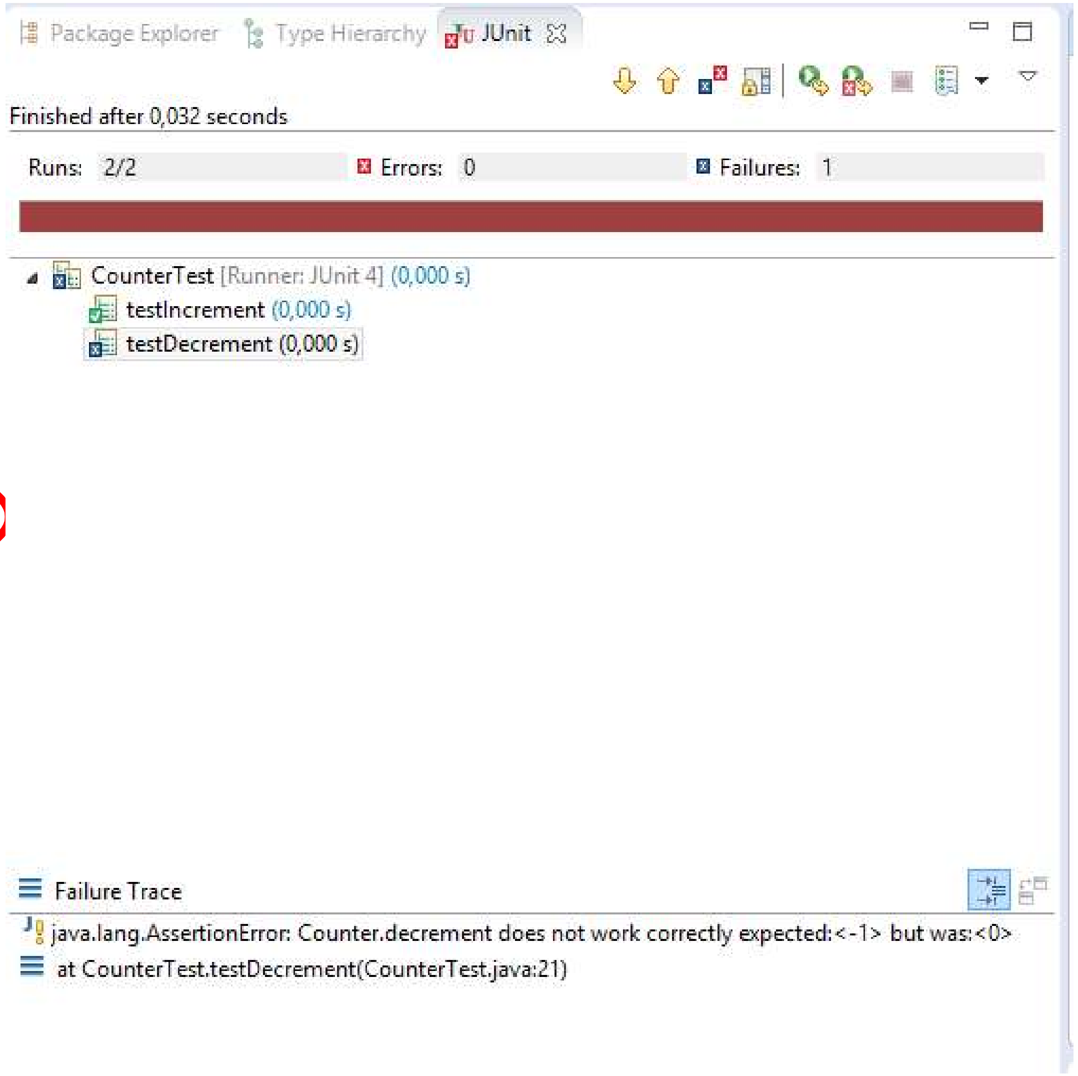
Finished after 0,031 seconds

Runs: 2/2 Errors: 0 Failures: 0

```
CounterTest [Runner: JUnit 4] (0,000 s)
    testIncrement (0,000 s)
    testDecrement (0,000 s)
```

Running the test

```java
package count;

public class Counter {
    private int counterValue=0;

    public int increment(){
       return ++counterValue;
    }
    public int decrement(){
       return counterValue;
    }
    public int getCounterValue() {
       return counterValue;
    }
 }
```



Finished after 0,032 seconds

Runs: 2/2 ☒ Errors: 0 ☒ Failures: 1

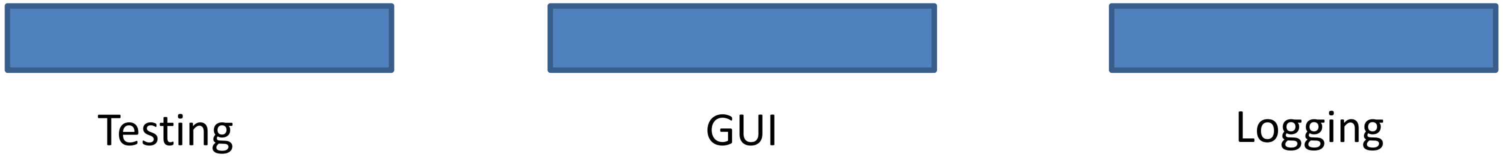
- CounterTest [Runner: JUnit 4] (0,000 s)
  - testIncrement (0,000 s)
  - testDecrement (0,000 s)

Failure Trace

```
java.lang.AssertionError: Counter.decrement does not work correctly expected:<-1> but was:<0>
at CounterTest.testDecrement(CounterTest.java:21)
```

Framework classification

- Technical frameworks (horizontal frameworks)

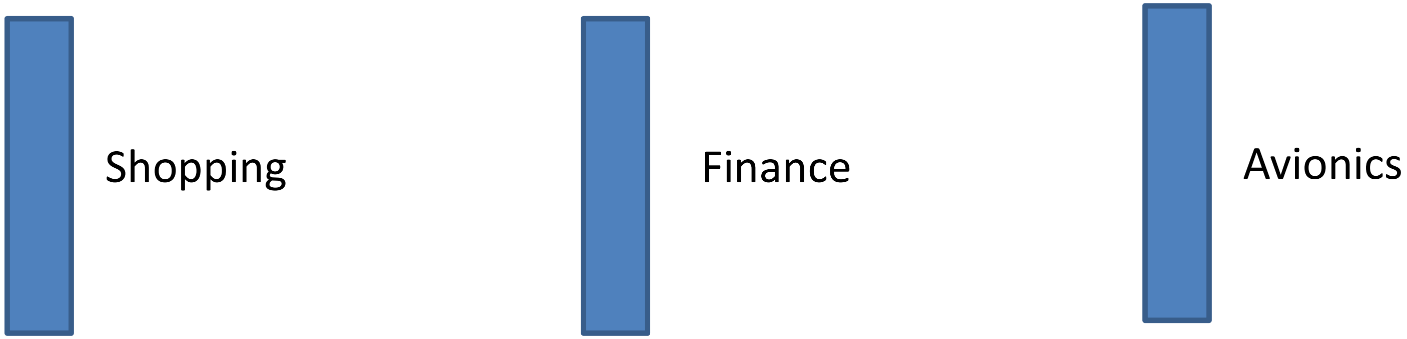


Testing

GUI

Logging

- Business domain frameworks (vertical frameworks)



Shopping

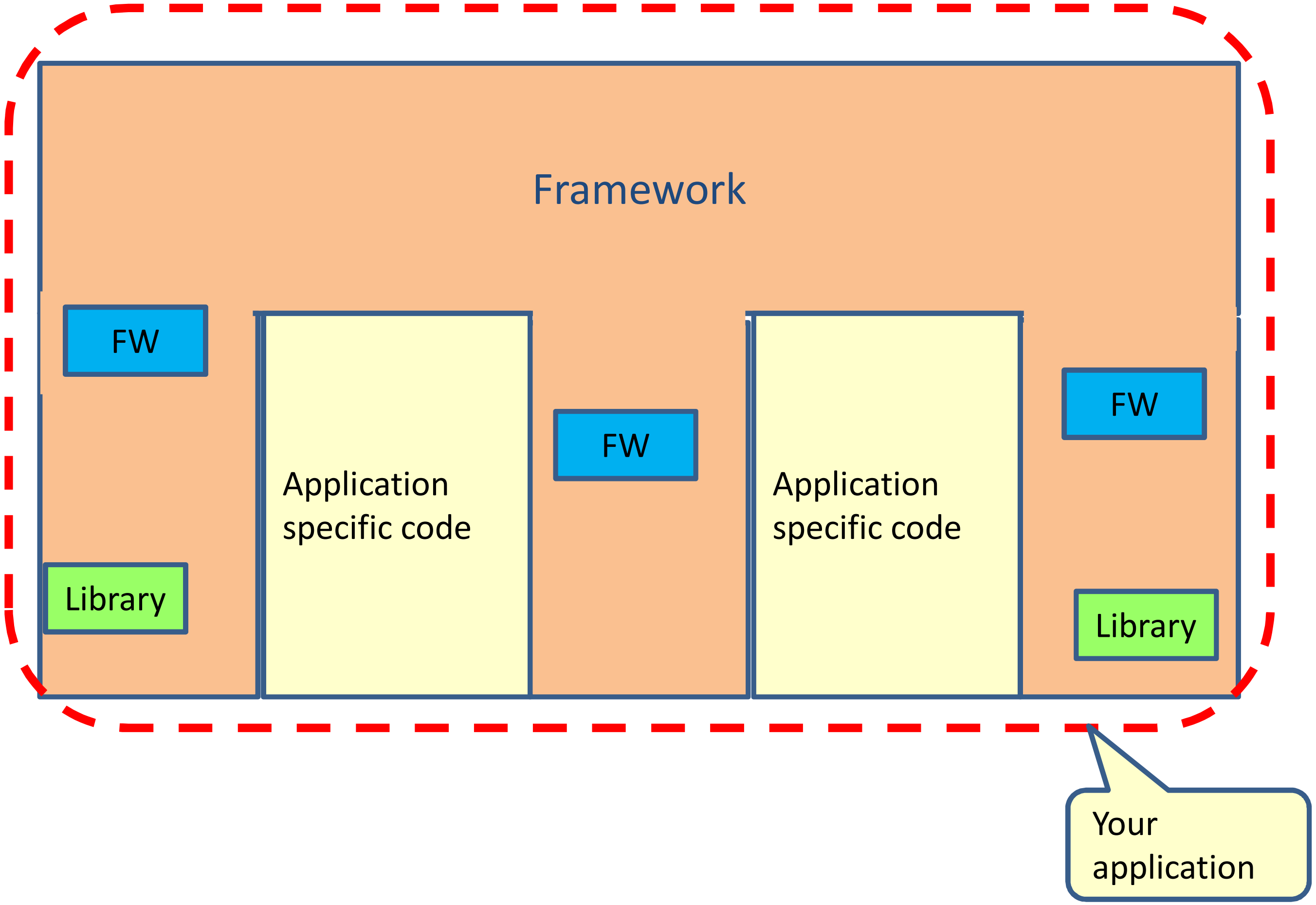
Finance

Avionics

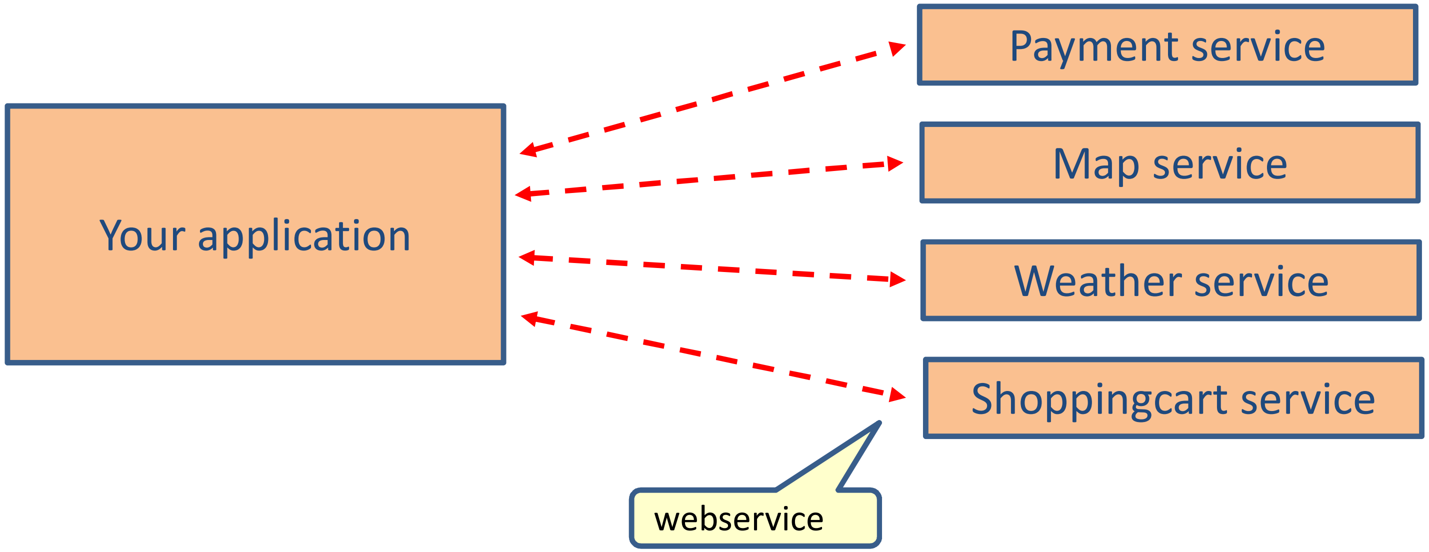
Characteristics of reuse

- To make something generic is 3 to 10 times more expensive that to make something specific
- High risk
- Is everyone aware that this framework exist?
- A framework is a product
  - That need documentation and tests
  - That need maintenance (project, budget)

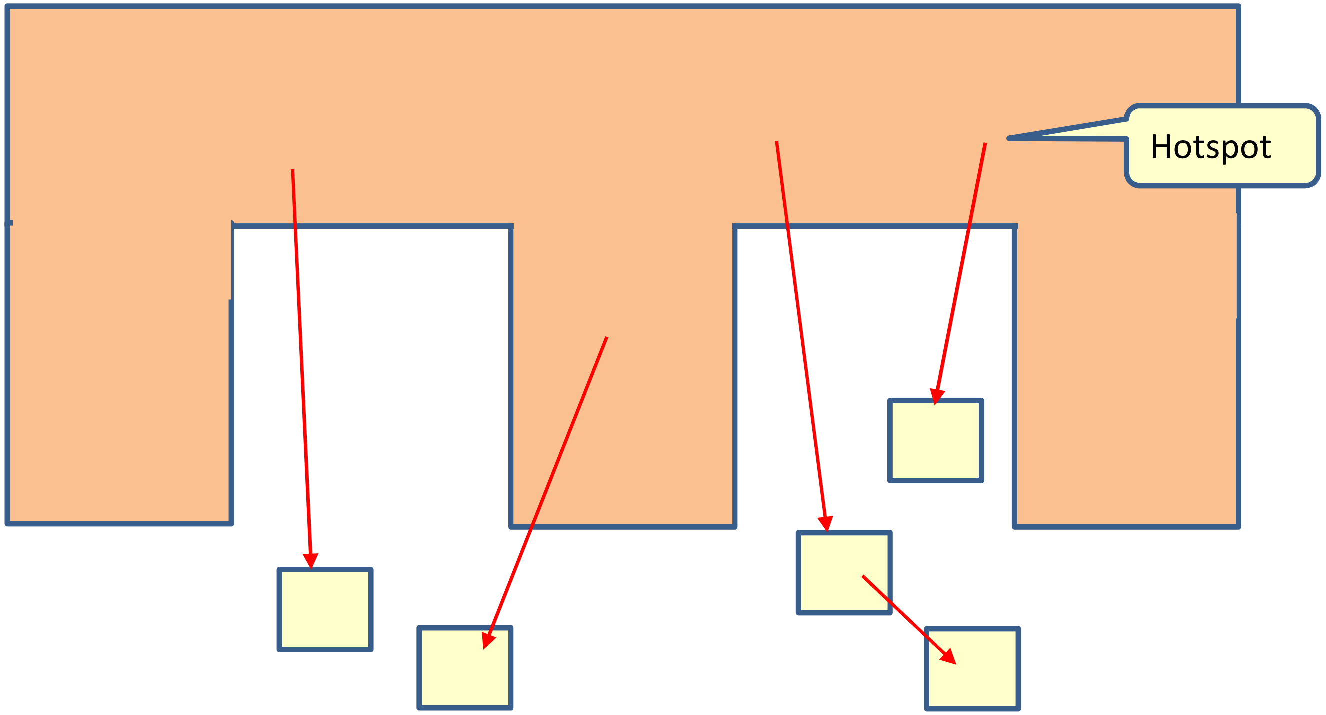
Frameworks + libraries



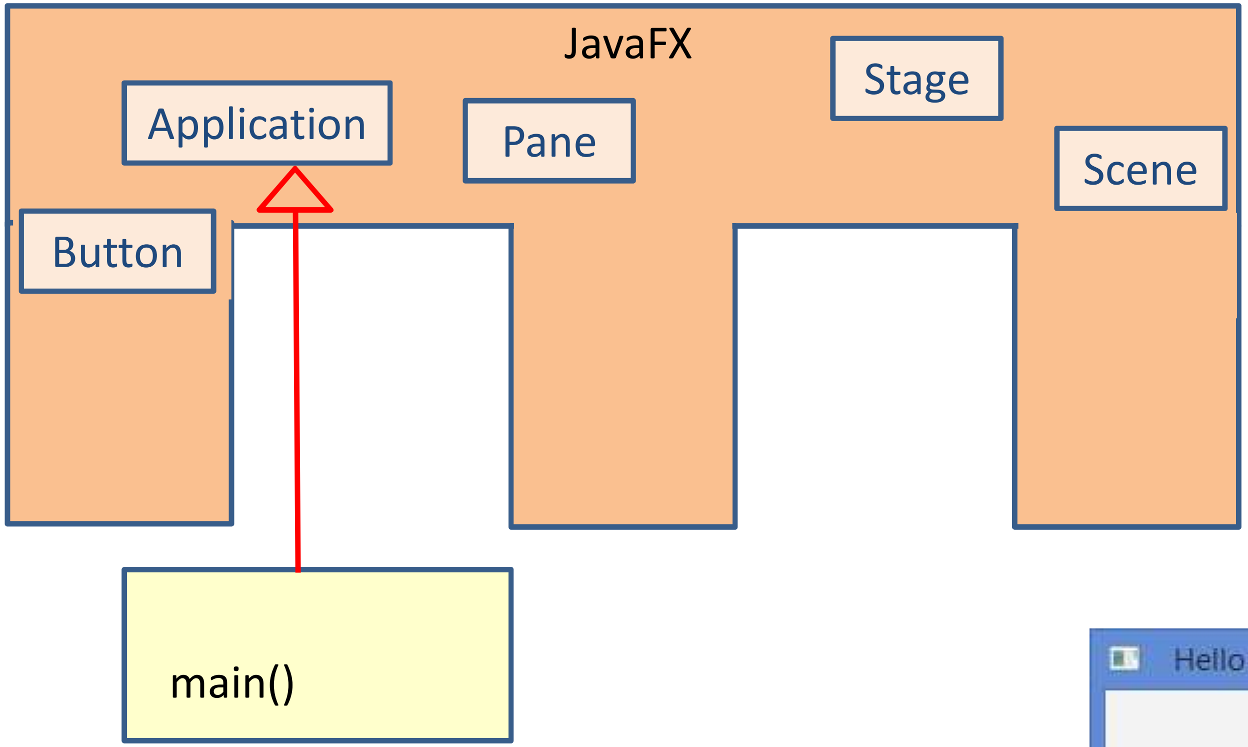
Supporting services

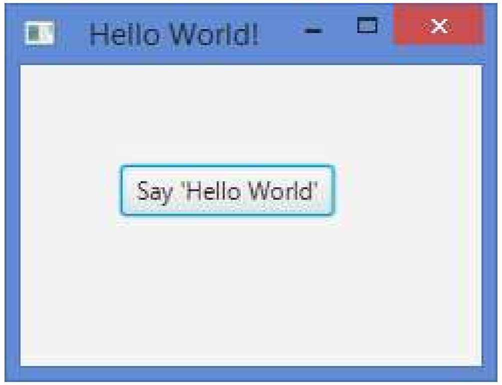


Hotspot (plugin point)



Using JavaFX framework





Using JavaFX framework

```
public class HelloWorld extends Application {

    @Override
    public void start(Stage primaryStage) {
        Button button = new Button();
        button.setText("Say 'Hello World'");
        button.relocate(50, 50);
        button.setOnAction(new EventHandler<ActionEvent>() {
            @Override
            public void handle(ActionEvent event) {
                System.out.println("Hello World!");
            }
        });
        Pane root = new Pane();
        root.getChildren().add(button);

        Scene scene = new Scene(root, 230, 150);
        primaryStage.setTitle("Hello World!");
        primaryStage.setScene(scene);
        primaryStage.show();
    }
    public static void main(String[] args) {
        launch(args);
    }
}
```

Stage

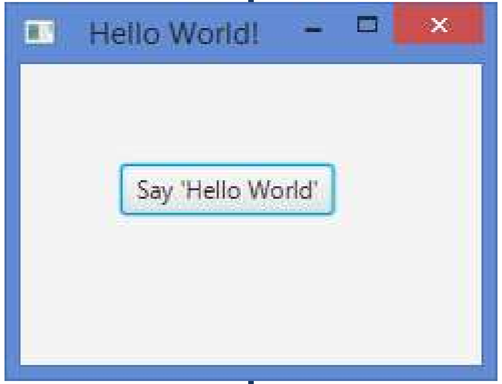
Extend Application

Eventhandler for the button

Pane

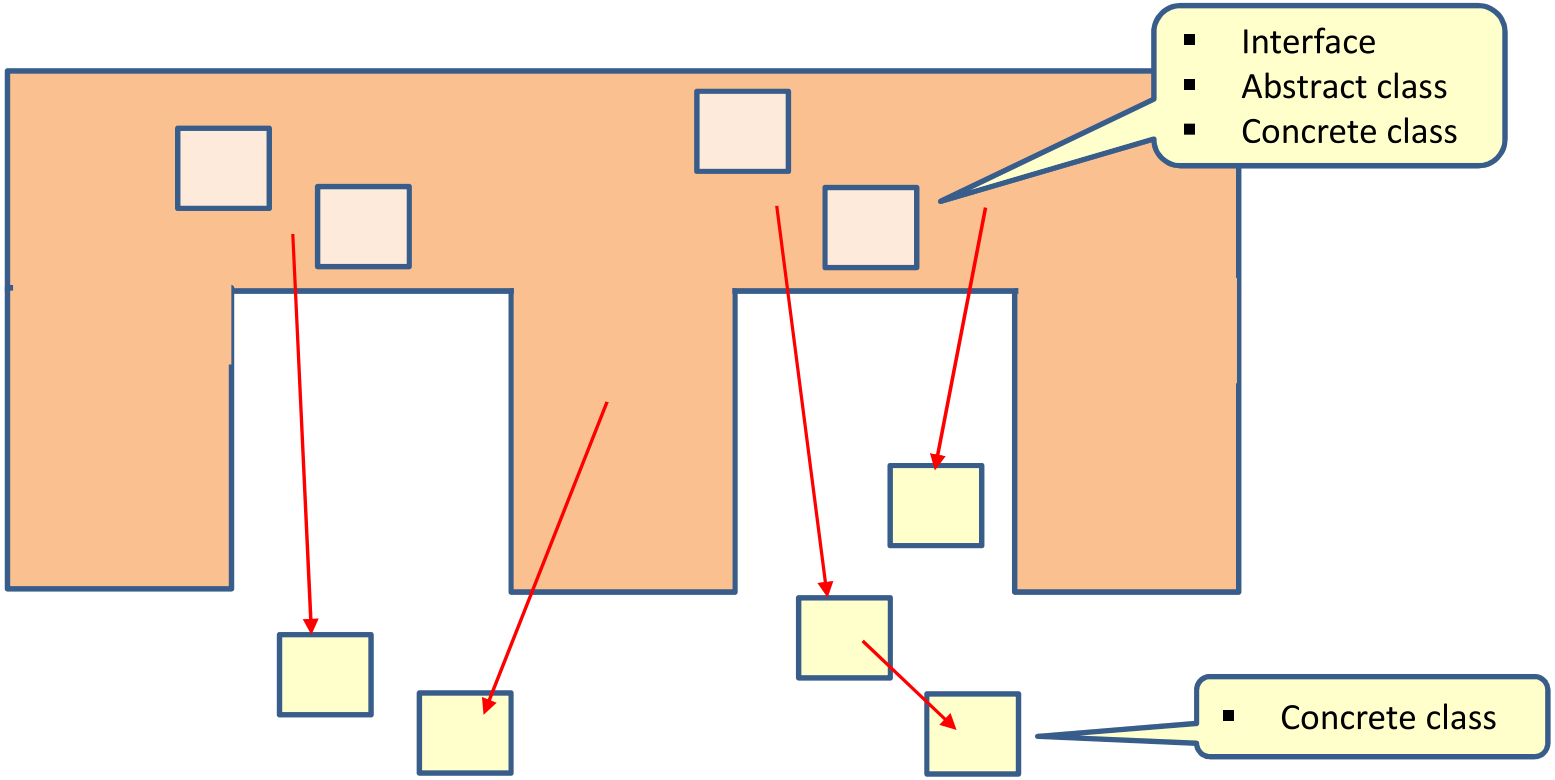
Scene

Launch the application



```
Hello World!
```

Framework implementation

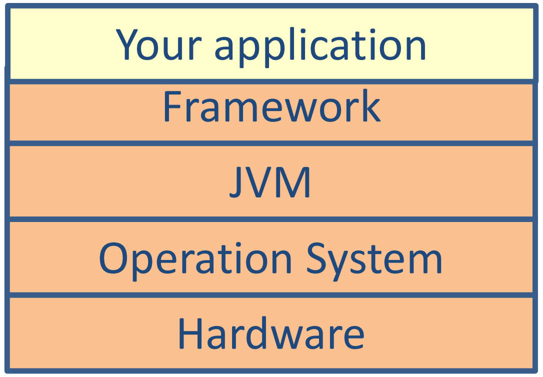


- Interface
- Abstract class
- Concrete class

- Concrete class

Disadvantage of frameworks

- Another layer of abstraction
  - You don’t know the internal details of the FW
    - The framework can contain errors
- Steep learning curve



Your application

Framework

JVM

Operation System

Hardware

Main point

- Application development is much easier and faster when you reuse a framework rather than writing the application from scratch.

- Life is much easier, simpler and enjoyable if you make use of the framework of Nature, the Unified Field of all the laws of nature. Established in being (coherence), perform action.