# Lecture 1-2

## Java (OOP) Basics

```
public class Car {

    String color; // Attributes
    String brand; // Attributes

    public Car(String color, String brand) { // Constructor
        this.color = color;
        this.brand = brand;
    }
    void drive() {
            System.out.println("This " + brand + " is driving.");
    }
    }



// Calling the function
Car myCar = new Car("Blue", "BMW");
myOtherCar.drive();

// OUTPUT
This BMW is driving.
```

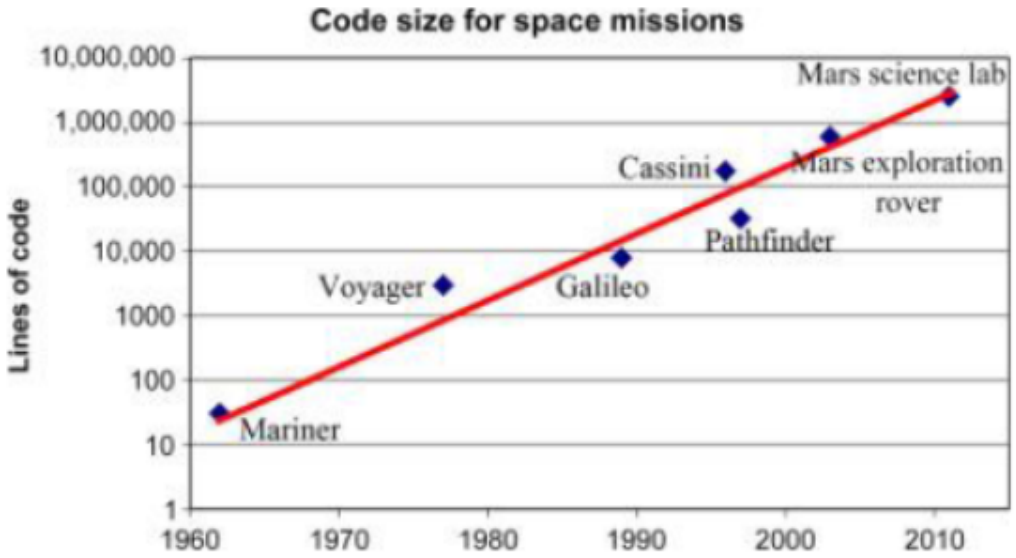
Steps:

- Class → Car.
    - Class → It is a BluePrint or Template for creating Objects.
        - It defines a set of properties (attributes) and methods (behaviors) thatthe objects created from the class will have.

        - The class doesn'trepresent an actual entity but rather a definition or a concept.
    - Color and Brand → attributes of the class Car.
- Constructor (Special Method)
    - It is special method that runs automatically when you create an object new.
    - Here it has 2 parametres Color and Brand.
    - We use the ‘this’ keyword under the Constructor.
        - `this.color` → means "the color attribute of this object".
        - Without `this`, Java would confuse between the parameter `color` and the attribute `color`.
- Method → drive()
    - The action or the Fucntion the car can do.

## Complexity

- No two software parts are alike
- Complexity grow non-linearly with size.
    - It is impossible to enumerate all the states of progeram.
    - Except perhaps “toy” programs.




## Changeability

- Change originates with
  - New application,users,machines,standards,laws.
  - Hardware problems
- Software is viewed as easiest to change.

## World Wide Web

- This is type of Web for
  - Hyperlinked Documetns
  - Phisycal machines
  - integration between machines
- WWW's Architecture
  - Architecture of Web is seperate from the code.
  - There is no single peices fo code but rather mutiple lines of code to implement the various architecture.

Software Design Patterns

- A software design pattern is a general, reusable solution to a commonly occurring problem during software development. [Repeatable/Reusable Solutions]
    - They are not blueprints of templates, but rather GUIDELINES FOR TRACKLING PARTICULAR ISSUES.

## Architecture vs patterns

Architecture is like a blueprint for a building. Patterns are like the designs for the furniture and fixtures within the rooms.

Level of Abstraction:

- Architecture is the big-picture view of the entire system's structure.
- Patterns are smaller-scale solutions that solve particular design problems within a system.

Scope of Impact:

- Architecture impacts the overall structure and communication of the system's components.
- Patterns impact specific parts of the system, like how an object communicates with another or how data flows within a specific module.

## Purpose

- Architecture is about defining the structure and foundation of a system, addressing global concerns like performance, scalability, and reliability.
- Patterns are about finding solutions to recurring problems within that structure, improving flexibility and maintainability.

Software Design Patterns for Web Apps (MVC)

User Interface
View (Presentation Layer)

Business Logic
Controller (Control Layer)

Data Storage
Model (Data Layer)

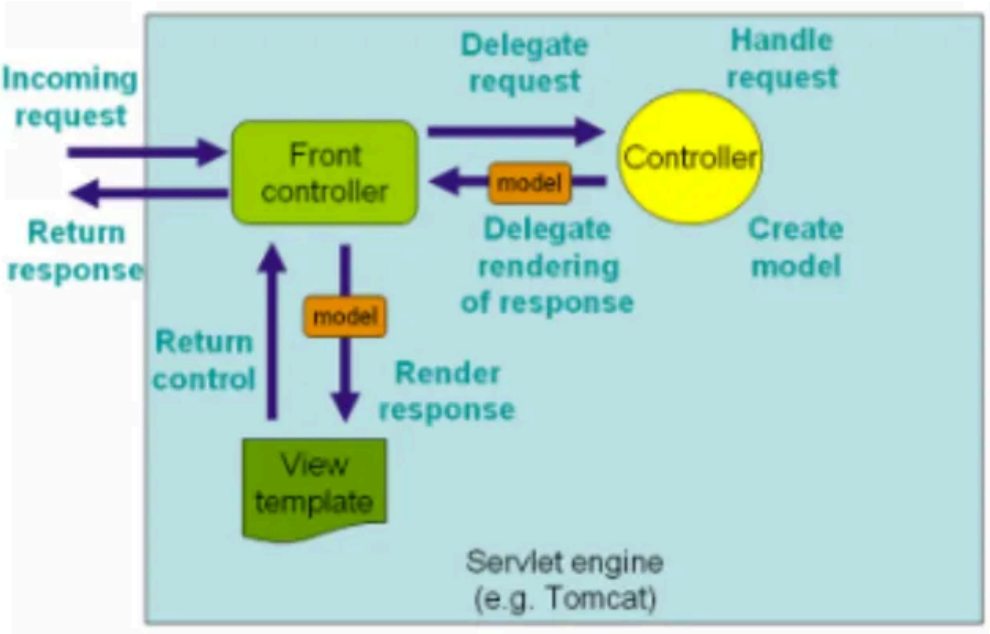
- View → manages the graphical and textual output to display that is allocated to its application.
- Controllers → It interprets inputs from the user, commanding the model and the view to change as appropriate.
- Model → It manages the behavior and teh data of the application domain.
  - responds to requests for information about its state.
  - Responds to instruction to change state.
- How MVC Fits into the Software Development Life Cycle26
  - Requirements Gathering → Identify the entities (models) and user interactions (views and controllers).
  - Design → Architect the separation of concerns. (improving modularity)
  - Implementation → Write separate modules for models, views, and controllers.
  - Testing → Easier to test each layer independently. (improving testability)
  - Maintenance → MVC allows for modifying views or controllers without affectingthe whole system.

## The Spring Framework Overview

- Comprehensive Platform for Building Java-based application.
- Spring provides dependency injection and a host of modules (AOP,security, data access, etc.).
- It simplifies the use of design patterns, including MVC, in real-world applications.

Spring MVC (Model/View/Controller)

- It is a specific implementation of the MVC pattern in Java.
  - MODEL→ Java Objects (POJOs) that hold data.
  - VIEW → JSPs Thymeleaf, etc for UI rendering
  - Controller → Annotated with `@controller` and `@RequestMapping` to handle web requests.




- Why Spring Boot?
  - As a framework built on top of spring, designed to make it easier to create stand-alone, production-ready applications.
  - It automates the setup process and allows for rapid prototying.

        - Setup process → Embedding Servers, Starter Dependencies, Auto-Configuration, Convention over Configuration.
    - Support a fasr development cycle enabling teams to move more quickly from design to implementation and testing.

## Gradle: Building and Managaing Dependencies

- Gradle as a powerful build automation tool that manages project dependencies (libraries) and automates taskslike compiling, testing, and packaging.
- Thinking about software development life cycle, Gradle helpsmanage the build and deployment phases by providing a consist entenvironment.

## Integrating MVC, Spring Boot and Gradle

- Spring MVC: Focus on the design and implementation stages,ensuring code modularity.
- Spring Boot: Accelerates the development, testing, and deploymentphases by simplifying configuration and setup.
- Gradle: Automates tasks across the build, test, and deploymentstages.

## Spring Boot

- Spring Boot is an open-source framework designed to simplify the development of Java applications.
- It is built on top of the Spring Framework and makes it easier to create production-ready applications with minimal configuration.
- Spring Boot automates configuration, dependency management, and embedded servers (like Tomcat).

## Beans

- A **Bean** is an **object managed by the Spring IoC container**.
- They are the **core building blocks** of a Spring application.
- Beans are automatically **created**, **assembled**, and **injected** by Spring.

## 💡 Common Annotations

- `@Component` → general bean
- `@Service` → service layer bean
- `@Repository` → database layer bean
- `@Controller` → web controller bean

> 📖 IoC (Inversion of Control): You don't manually create objects — Spring does it for you.

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# Dependency Injection (DI)

**Definition:**

A design pattern where an object's dependencies are provided **from outside**, not created by the object itself.

## 🏎️ Example

Without DI:

```
Car car = new Car();
car.engine = new Engine(); // tight coupling
```

With DI:

```
@Autowired
Engine engine; // Spring provides the Engine automatically
```

## Why DI is Useful

- **Changeability:** swap parts (e.g., ElectricEngine) without editing main code.
- **Testability:** easily replace real dependencies with mocks.
- **Maintainability:** fewer side effects when requirements change.
- **Readability:** clear which dependencies a class needs.

### Analogy

You're a construction manager. Instead of hiring every worker (Electrician, Plumber), you let an **agency (Spring)** supply them automatically when needed.

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## Spring Boot and Automatic Dependency Injection

- `@Component` → marks a class to be managed by Spring.
- `@Autowired` → injects required beans automatically.
- Spring scans your project packages and **wires dependencies together**.

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## Example: Payment System

```
public interface PaymentService {
    void processPayment();
}

@Component
public class CreditCardPaymentService implements PaymentService {
    public void processPayment() {
        System.out.println("Processing credit card payment");
    }
}

@Component
public class PayPalPaymentService implements PaymentService {
    public void processPayment() {
        System.out.println("Processing PayPal payment");
    }
}

@Component
public class OrderService {
    private final PaymentService paymentService;
```

```
    @Autowired
    public OrderService(PaymentService paymentService) {
        this.paymentService = paymentService;
    }

    public void createOrder() {
        paymentService.processPayment();
        System.out.println("Order created");
    }
}
```

**Explanation:**

- `@Component` tells Spring to manage these classes.
- `@Autowired` in the constructor tells Spring to **inject** one of the available `PaymentService` beans automatically.
- This makes the code modular and flexible.

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# 5. Spring MVC – Model View Controller

**Spring MVC** follows the **Model-View-Controller** design pattern.

## Structure

- **Model:** stores data and business logic
- **View:** presents data (HTML/JSP pages)
- **Controller:** handles user input and updates model/view

## Controller Example

```
@Controller
public class MainController {
  @RequestMapping("/greet")
  public String greetWorld(Model model) {
```

```
    model.addAttribute("name", "Lab");
    return "greeting";
  }
}
```

**How it works**

1. User visits `/greet`
2. Controller method is called
3. Data is stored in the `model` (`"name" = "Lab"`)
4. Returns `"greeting"` → Spring looks for `greeting.jsp`
5. JSP renders:

```
<h2>Hello, ${name}!</h2>
```

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# 6. MVC Component Placement Rules

- **Convention over Configuration** – follow structure, less setup needed.
- **@ComponentScan** – automatically detects and manages classes.
- **Organized folders** → easier maintenance.

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# 7. Controller Request Mapping

| Type | Annotation | Example |
|---|---|---|
| GET | `@GetMapping("/path")` | Handles GET requests |
| POST | `@PostMapping("/path")` | Handles form submissions |
| General | `@RequestMapping("/path")` | Default is GET |

You can also add **conditions**, like:

```
@GetMapping(path = "/greet", params = "age")
```

→ Only works if `age` parameter exists.

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# 8. Handling User Input

## (a) Request Parameters

Appear after `?` in URL, e.g.

`/greet?name=Jose&age=22`

```
@RequestMapping("/greet")
public String ex1(@RequestParam String name, @RequestParam int age, Mod
el model) {
  model.addAttribute("name", name);
  model.addAttribute("age", age);
  return "greeting";
}
```

---

## (b) Path Variables

Part of the URL path, e.g.

`/greet/22/Jose`

```
@RequestMapping("/greet/{age}/{name}")
public String ex1(@PathVariable String name, @PathVariable int age, Model m
odel) {
  model.addAttribute("name", name);
  model.addAttribute("age", age);
  return "greeting";
}
```

---

### (c) Objects from URL (Using `@ModelAttribute`)

```
@RequestMapping("/myPet/{name}/{species}")
public String exD(@ModelAttribute Pet pet) {
  // automatically sets pet.name and pet.species
}
```

Spring automatically creates an object and fills its fields with data from the URL or form.

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### (d) Collections of Parameters

You can collect multiple same-named parameters:

`/greet?name=Vic&name=Dan&name=Jack`

```
@RequestMapping("/greet")
public String ex2(@RequestParam Collection<String> name) { ... }
```

Or rename the variable:

```
@RequestMapping("/greet")
public String ex2(@RequestParam("name") Collection<String> lecturers) { ... }
```

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## Typical MVC Flow

1. User requests URL `/greet`
2. Controller method runs and adds data to model
3. Returns view name `"greeting"`
4. View Resolver loads `greeting.jsp`
5. JSP uses `${name}` to show “Hello Lab”

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# Summary & Outlook

| Concept | Description |
| --- | --- |
| **Spring Boot** | Simplifies app setup, adds auto configuration |
| **Bean** | Managed object by Spring container |
| **Dependency Injection** | Spring automatically provides dependencies |
| **Controller** | Handles user requests |
| **Model** | Holds app data |
| **View (JSP/HTML)** | Displays output |
| **@RequestParam** | Gets data from query parameters |
| **@PathVariable** | Gets data from URL path |
| **@ModelAttribute** | Automatically binds object fields |