Java Concepts for Selenium Automation (Detailed Guide)

1. Variables & Data Types

What?

Variables store data. Data types define the type of data.

Why in Automation?

Used to store test data, counters, configurations, URLs.

Example in Framework

```java
String baseUrl = "https://myapp.com";
int retryCount = 3;
```

Used in BaseTest or Config classes.

---

2. Operators

Used for logical, comparison, or arithmetic operations.

Real Use

```java
if(attempts <= maxRetries) {
    retryTest();
}
```

Used in RetryAnalyzer.

---

3. Control Statements (if, switch, loops)

Why?

Control flow for validations, retries, waits.

Example

```
for(int i=0; i<elements.size(); i++){
    elements.get(i).click();
}
```

Used in clicking multiple elements.

---

4. Methods

Reusable block of code.

Example

```
public void click(WebElement element){
    element.click();
}
```

Used in utility/helper classes.

---

5. Method Overloading (Compile Time Polymorphism)

Multiple methods with same name, different parameters.

Example

```
public void click(String locator);
public void click(By locator);
```

Used in custom wrapper classes.

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6. Method Overriding (Runtime Polymorphism)

Child class provides different implementation.

Example

```
@Override
public void click(){
    System.out.println("Click via Selenium");
}
```

Used in POM inheritance.

---

7. Classes and Objects

Why?

Everything in framework revolves around classes: Page Classes, Utility Classes, DriverFactory.

Example

```
LoginPage login = new LoginPage();
```

---

8. Constructors

Used for initializing driver, objects, test data.

Example

```
public LoginPage(WebDriver driver){
    this.driver = driver;
}
```

Used in POM.

---

9. this & super Keywords

this

Refers to current class object.

super

Refers to parent class.

Real Example

```
super(driver); // In BasePage patterns
```

---

10. Static & Non-static

Static belongs to class, non-static belongs to object.

Example

```
public static WebDriver driver;
```

Used in DriverManager.

---

11. Access Modifiers (public, private, protected)

Real Use

Private locators:

```
private By username = By.id("username");
```

---

12. Encapsulation

Bind data + method.

Example

```
public class ConfigReader{
    private String url;
    public String getUrl(){ return url; }
}
```

Used for Config classes.

---

13. Inheritance

Used to share common methods.

Example

```
public class BasePage{} // parent
public class LoginPage extends BasePage{}
```

---

14. Abstraction (Interfaces & Abstract Classes)

Real Use

WebActions interface → implemented by SeleniumActions.

Example

```
public interface Clickable { void click(); }
```

---

15. Interfaces in Automation

Used for framework flexibility.

Example

`WebDriver` is an interface.

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16. Collections Framework

Why?

Handle lists of elements.

Example

```
List<WebElement> items = driver.findElements(...);
```

---

17. List, Set, Map

Usage

- **List** → dropdown items
- **Set** → window handles
- **Map** → store test data

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18. Exception Handling (try-catch, throws)

Real Use

```
try{
    element.click();
}catch(Exception e){
    takeScreenshot();
}
```

Used for resilient automation.

---

19. Custom Exceptions

Example

```
throw new FrameworkException("Element not found");
```

---

20. File Handling

Used for reading Excel, JSON, Properties.

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21. Properties File Reading

```
Properties prop = new Properties();
prop.load(new FileInputStream("config.properties"));
```

---

22. Java OOPs in POM Framework

- Encapsulation → Page classes
- Inheritance → Base classes
- Polymorphism → Action methods
- Abstraction → Interfaces for drivers

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23. Java Streams & Lambda (Modern Automation)

Example

```
elements.stream().filter(e -> e.isDisplayed()).forEach(WebElement::click);
```

Used in filtering lists of elements.

---

24. Generics

Used in reusable utilities.

Example

```
public <T> T getValue(String key){...}
```

---

25. Enums

Used for environment values, log levels.

```
enum Environment { DEV, QA, PROD }
```

---

26. Wrapper Classes

Used when converting strings to numbers.

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27. Final Keyword

Used for constants.

```
final int TIMEOUT = 10;
```

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28. Multithreading (Used in Parallel Execution)

TestNG parallel execution uses threading.

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29. Synchronization (wait/notify)

Used internally by WebDriver.

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30. String Manipulation

Used in dynamic XPath creation.

```
String dynamicXpath = "//div[text()='" + value + "']";
```

---

31. Java I/O & NIO

Used for reading/writing files, screenshots.

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32. Date & Time API

Used for timestamping screenshots.

```
LocalDateTime.now().toString()
```

---

33. Singleton Pattern (DriverManager)

Ensures one driver instance.

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34. Factory Pattern

Used to create drivers based on browser.

---

35. Builder Pattern

Used for complex payloads.

---

36. Immutable Classes

Used for stable configs.

---

37. Annotations (TestNG / JUnit)

```
@BeforeTest
public void setup(){...}
```

---

38. Serialization & Deserialization

Used in API automation.

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39. Reflection API

Used indirectly by TestNG.

---

40. Java Memory Management

Helps optimize test runs.

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41. Garbage Collection

Driver quit helps GC.

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42. Regex

Used to extract OTP, dynamic text.

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43. Assertions

Used to validate results.

---

44. Java Optional

Avoid null pointer.

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45. Streams with Selenium

Filter visible elements.

46. Parallel Streams

Used for heavy data processing.

---

47. Nested Classes

Used for grouping constants.

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48. Packages

Organize framework.

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49. Maven Basics

Build tool for Selenium.

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50. Logging (Log4j / SLF4j)

Used for debugging.

Hope so now your know where Java Concepts are used in Test Automation !!

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