Core Java

A general-purpose programming language that is class-based, object-oriented, and designed to have as few implementation dependencies as possible.

Cognixia™

Outline

1. Introduction
2. Basic Programming
3. Classes & objects
4. Packages
5. Dates
6. Flow Control
7. Enums
8. Strings
9. Regular Expressions
10. Arrays
11. Inheritance & Composition
12. Interfaces

Prerequisites

1. JDK Version 8
   - Select the **executable version** for your OS
   - Once downloaded, if on Windows, make sure **java is on your path**: How to set up Path
2. Eclipse Download
   - Select option for **"Eclipse IDE for Enterprise Java Developers"**
   - Create a folder in root directory called **"Java_Workspace"** and set your workspace to this folder when asked
   - Once opened, click **Help -> Eclipse Marketplace -> Search for "Spring Tools 4" -> Install**

Introduction to Java

What is Java?

- Java is a **programming language** and a platform
- **Platform** – any hardware r software environment in which a program runs
- Used in 9 billion devices around the world
- Used in 4 types of Applications:
  - Standalone Application
  - Web Application
  - Enterprise Application
  - Mobile Application

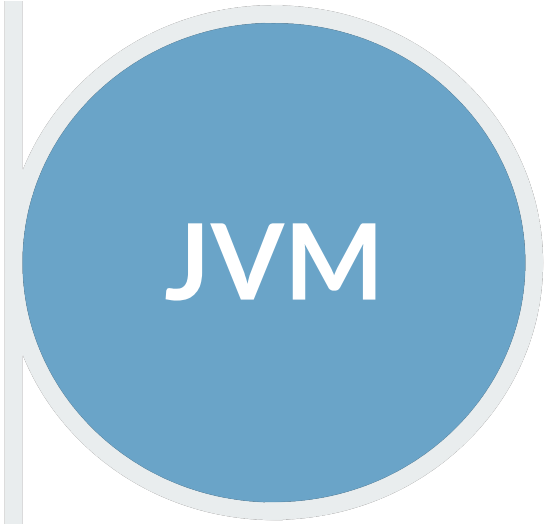
Why Java?

According to Sun, the **Java** language is simple because:

- ➔ **Simple syntax**, based in C++ (easier to learn it after C++)
- ➔ Removed confusing and/or rarely-used features (explicit pointer, operator overloading etc.)
- ➔ No need to remove unreferenced objects, there is **Automatic Garbage Collection**
- ➔ **Object-oriented**
- ➔ **Architecture neutral**

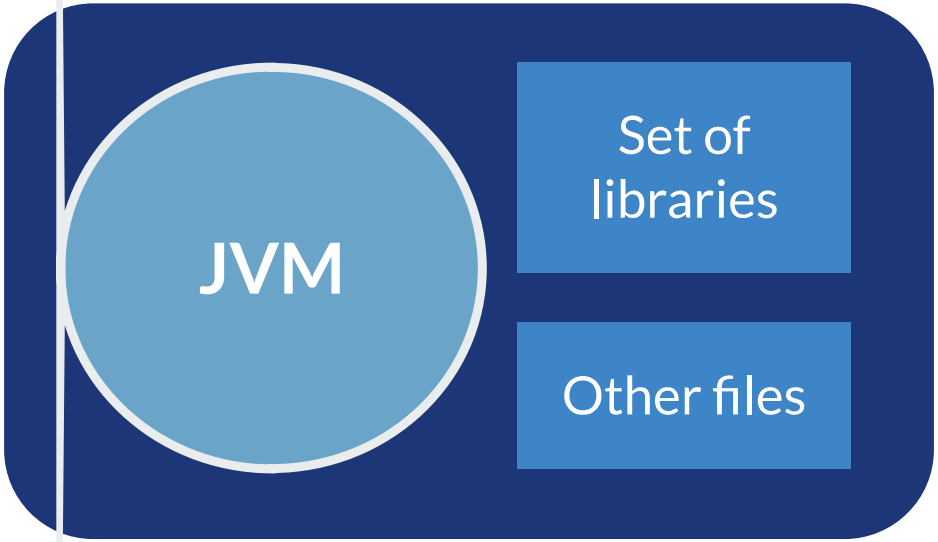
Java Virtual Machine (JVM)

- Abstract machine
- **Provides runtime environment** for java bytecode to be executed
- Main tasks:
  - *Loads code*
  - *Verifies code*
  - *Executes code*
  - *Provides runtime environment*



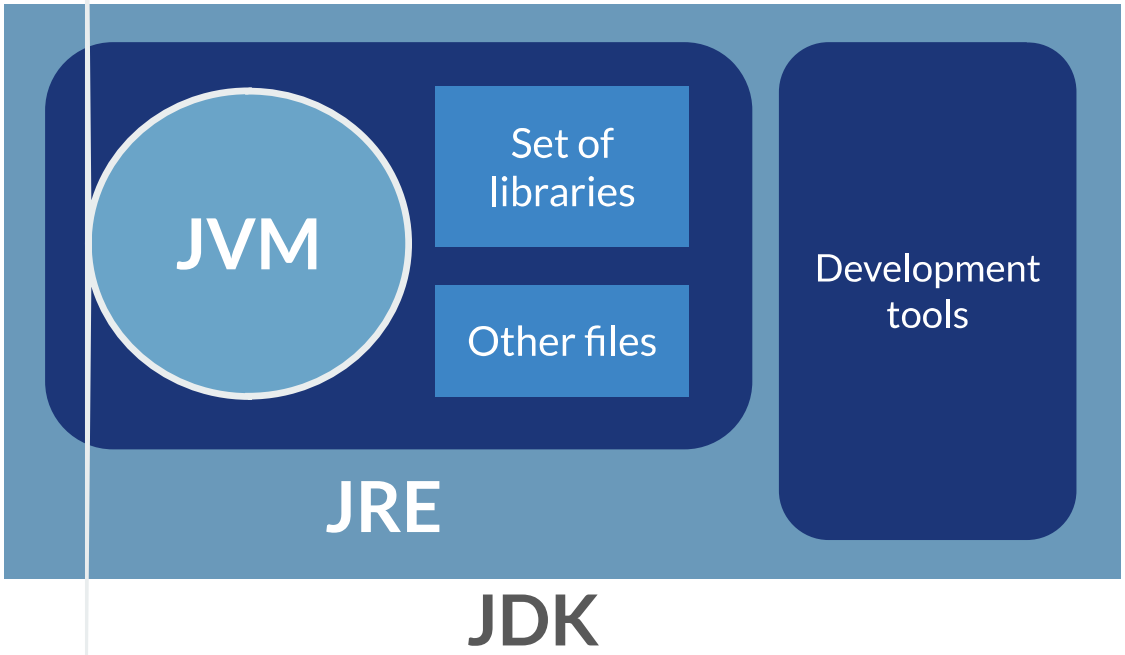
Java Runtime Environment (JRE)

- ➔ Provides runtime environment
- ➔ **Implementation of JVM**
- ➔ Physically exists
- ➔ **Contains libraries + other files that JVM uses at runtime**

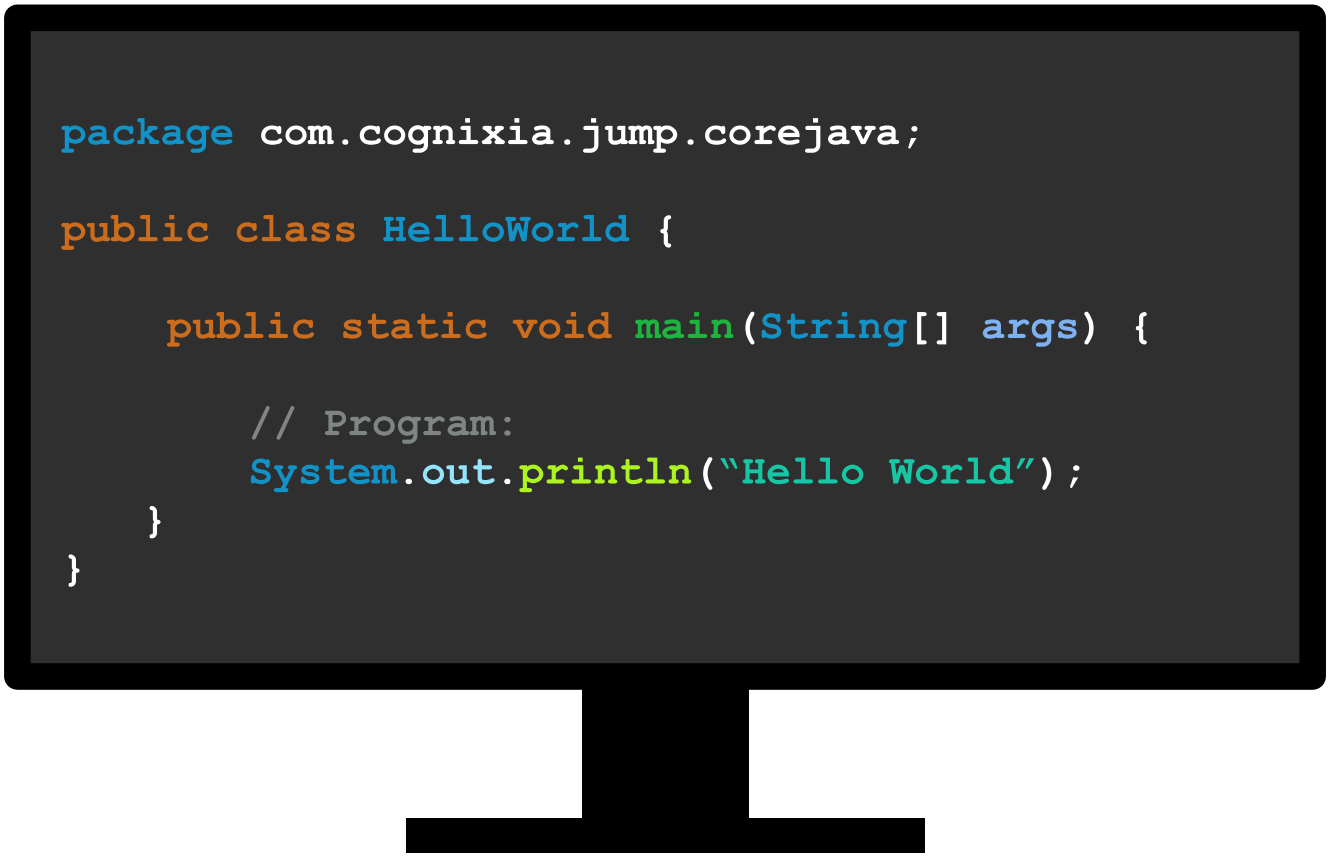


Java Development Kit (JDK)

- ➔ Physically exists
- ➔ **Contains JRE + development tools**



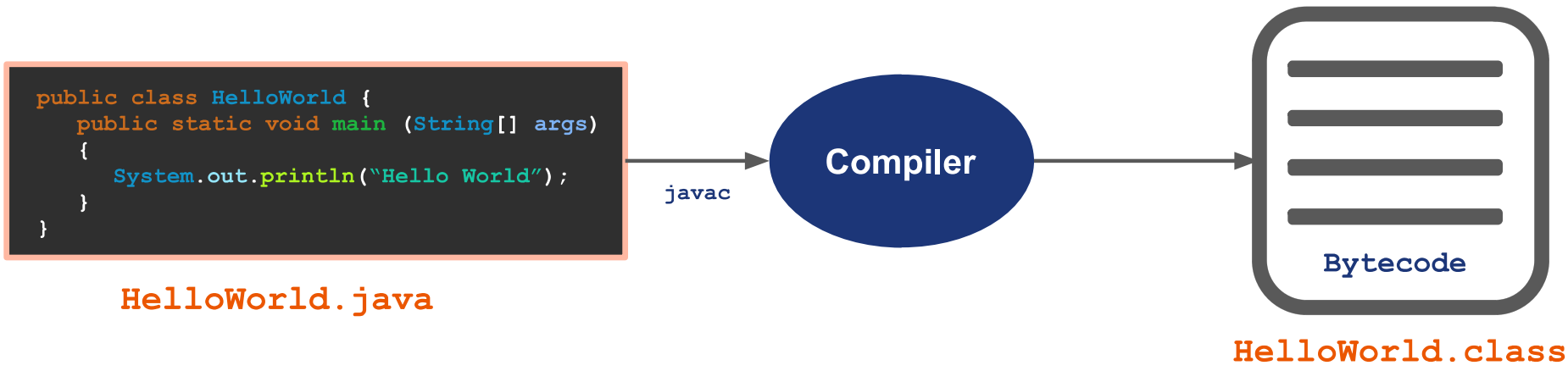
Hello World: First Program



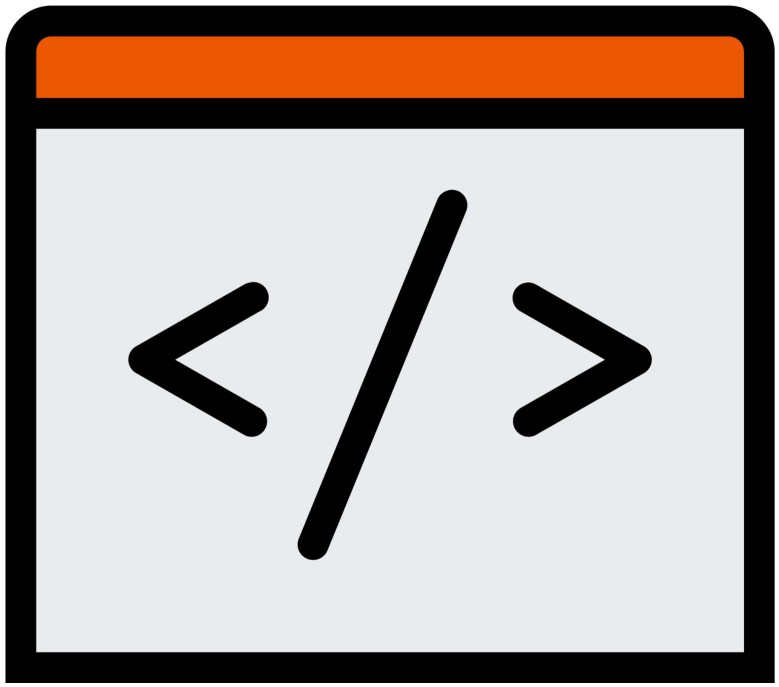
```java
package com.cognixia.jump.corejava;

public class HelloWorld {

    public static void main(String[] args) {

        // Program:
        System.out.println("Hello World");
    }
}
```

What Happens at Compile Time?

At **compile time**, the java file is compiled by the Java Compiler (does not interact with the OS) and converts the java code into bytecode.



Basic Programming

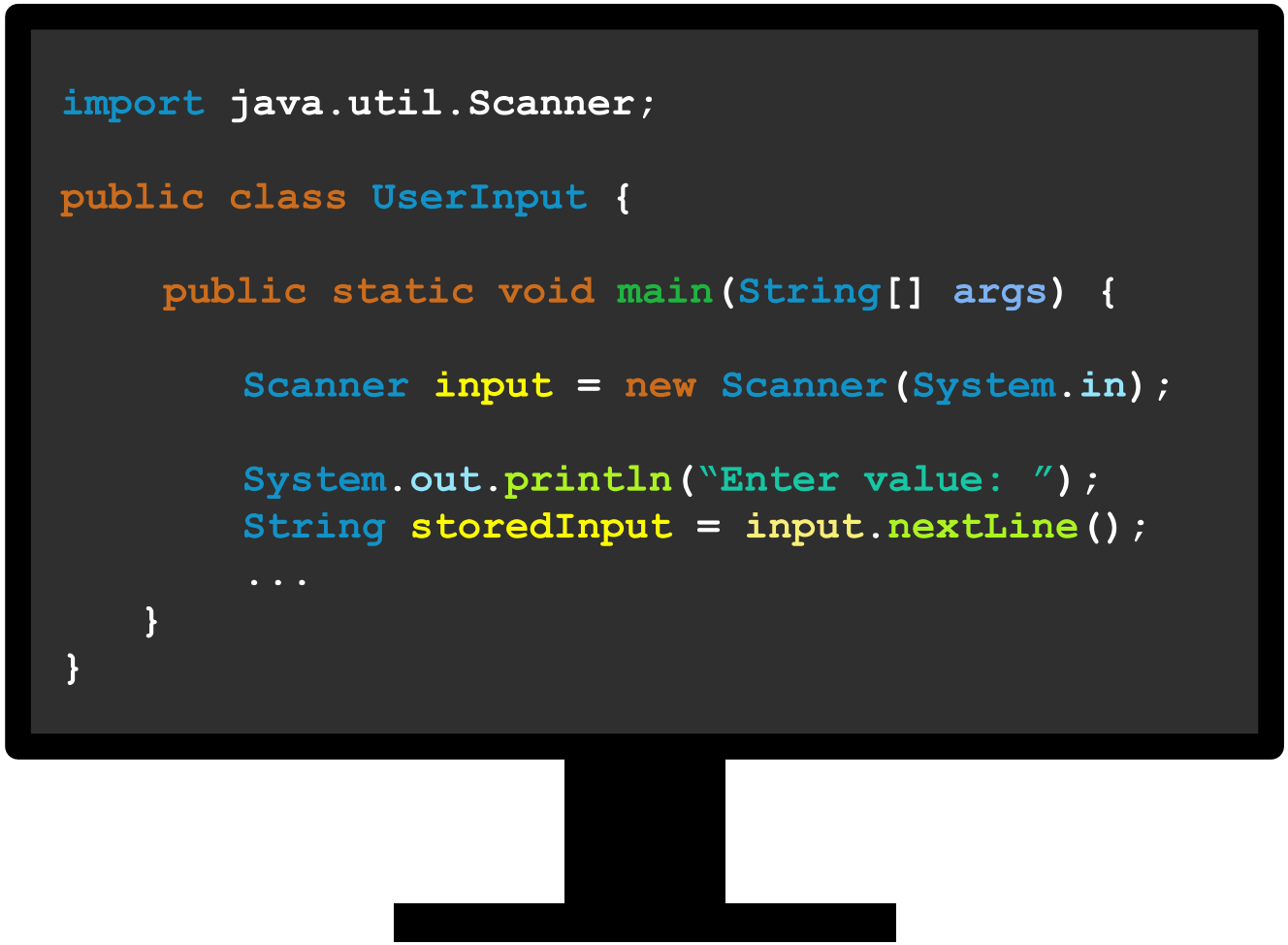


Variable Types

Primitives - most basic data type in Java, hold pure, simple values of a kind

Name	byte	short	int	long	float	double	char	boolean
Value	number	number	number	number	float number	float number	character	true or false
Size	1 byte	2 byte	4 byte	8 byte	4 byte	8 byte	2 byte	1 byte

Read From the Console



Final Keyword

Final - a constant in Java

Final can apply to:

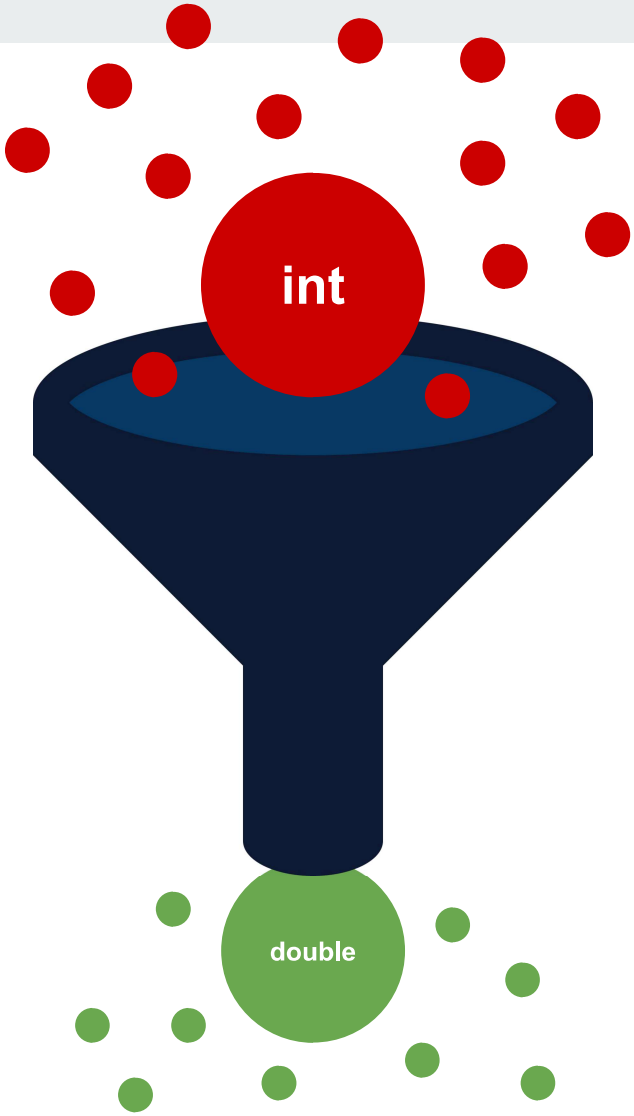
- **Variables**
  - Value cannot be changed.
- **Methods**
  - Method cannot be overridde
- **Classes**
  - Class cannot be inherited

Casting Variables

Casting variables is explicitly convert one type to another.

Primitives and **Objects** can be converted between one another using casting.

```
// converts from double to int
double dubs = 5.0;
int num = (int) dubs;
```



Order of Precedence (High to Low)

Order of Precedence - order in which operators in an expression are evaluated

Oracle Documentation:

https://docs.oracle.com/cd/E19253-01/817-6223/chp-typeopexpr-12/index.html

	Important to note
1	`!, +, - (unary)`
2	`*, /, %`
3	`+, -`
4	`<, <=, >=, >`
5	`==, !=`
6	`&&`
7	`||`
8	`= (assignment)`

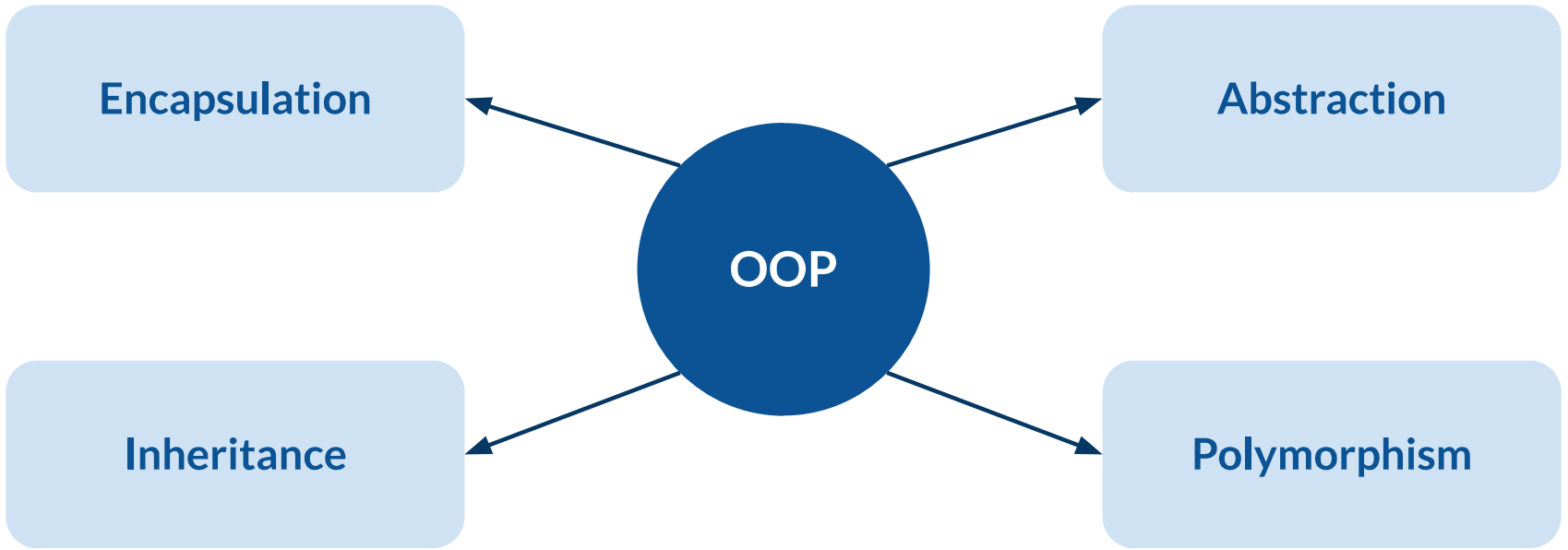
Primitive v Autoboxed

- Java is NOT a pure OOP language
  - has primitives
- Objects are required in many applications for Java
- Wrapper Classes - objects that wrap around the primitive type
- Can use Collections - Collections cannot store primitives on their own

```
double dubs = 5.0;
int num = (int) dubs;

// passes int to boxed type
Integer boxed = num;
```

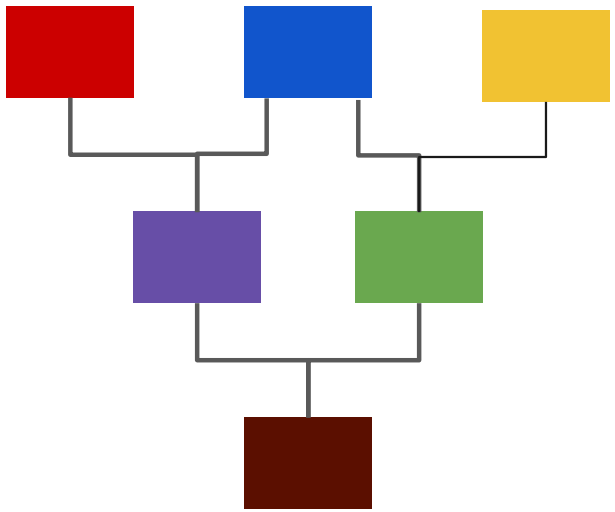

JAVA AEROBICS

Object Oriented Programming (OOP)

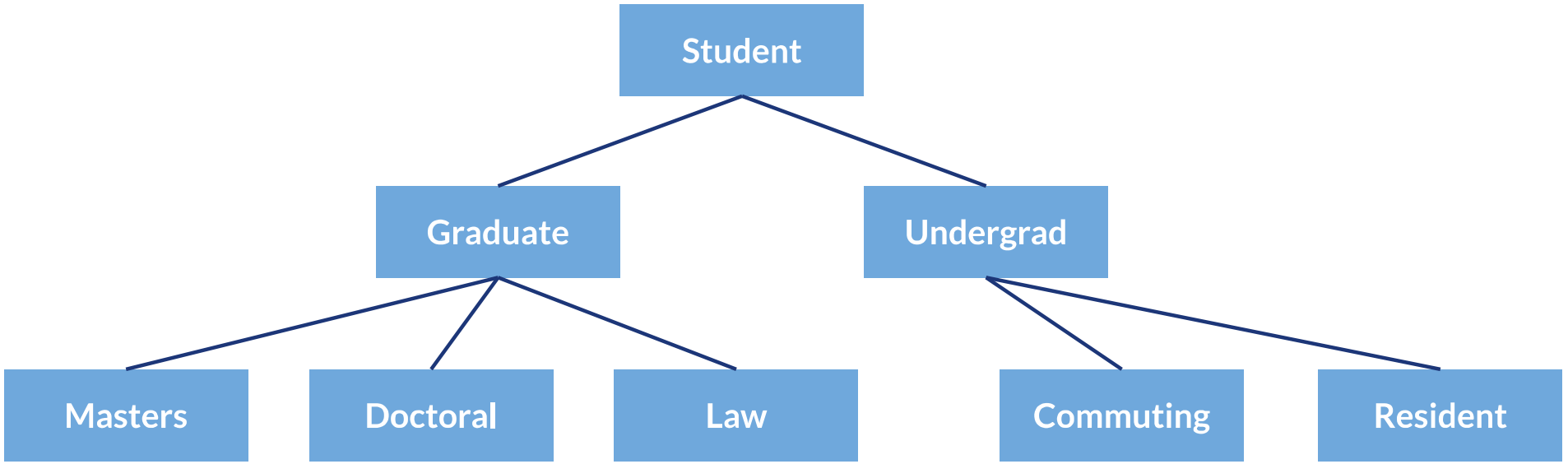


OOP - Inheritance

- ➔ ***Inheritance*** is a mechanism in OOP to design two or more entities that are different but share many common features
- ➔ Features common to all classes are defined in the ***superclass***
- ➔ The classes that inherit common features from the superclass are called ***subclasses***
- ➔ We also call the superclass an ***ancestor*** and the subclass a ***descendant***

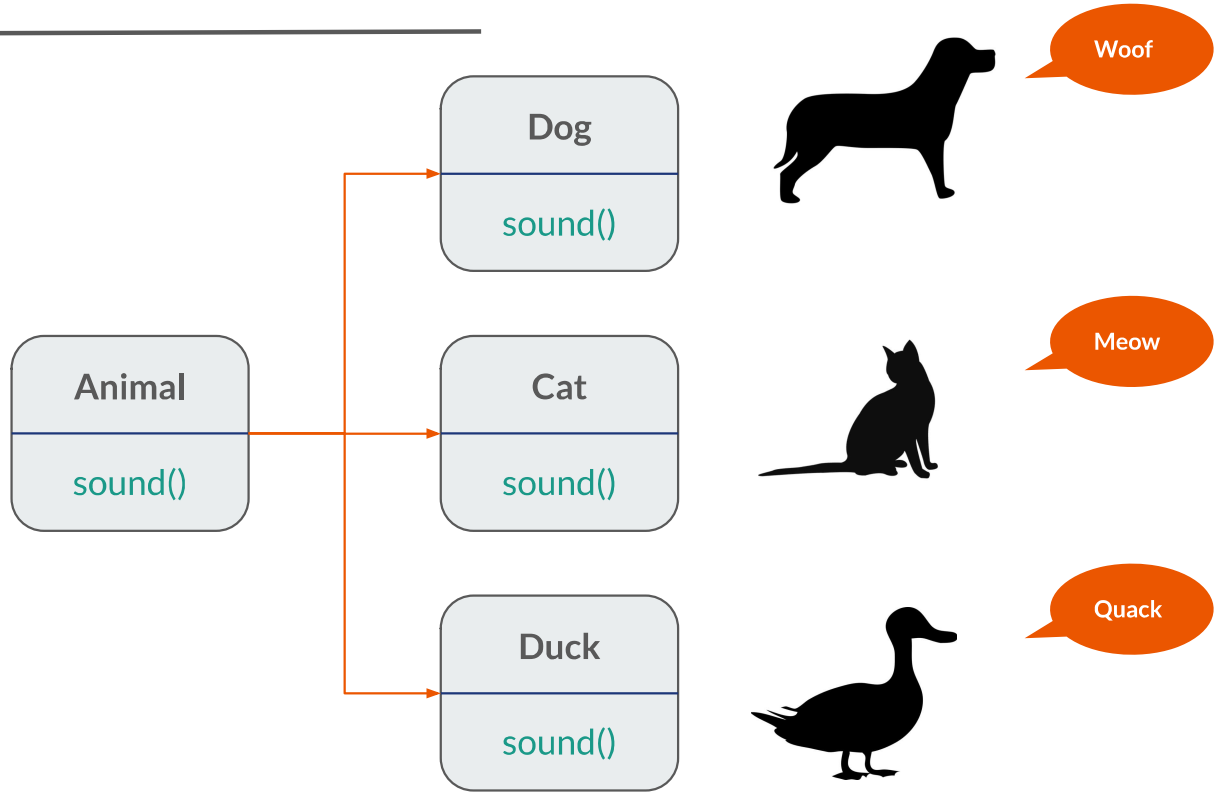


OOP - Inheritance



OOP - Polymorphism

- ***Polymorphism*** is a mechanism in OOP where one element of code can have many forms
  - Polymorphism can be implemented in such as **objects** and **classes**, and **class methods**



OOP - Abstraction and Encapsulation

Abstraction as a concept of OOP enforces "***data hiding***". That is, only relevant code is displayed, so that code is layered.

Encapsulation is a "***data grouping***". Think of this as a protective shield around code. An example would be grouping functions together in class.

WHITE BOARD EXERCISE

Creating a Class Diagram

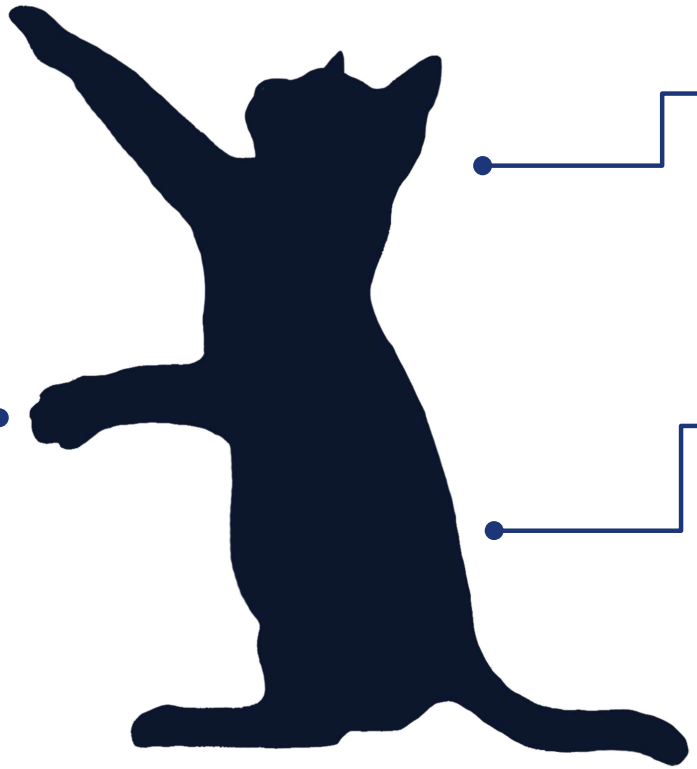
Create Class	Class Properties	Child Class	Polymorphism	Explain
Choose a topic and create a class for this, draw it up on the board	Create attributes and methods for this class.	Create a child class that can inherit from this original class. Come up with attributes and methods for this child class.	Create a method that will override one of the methods from the parent.	What is happening in this diagram? Is there encapsulation?

Classes & Objects

Blueprint

Houses built according to the blueprint

Classes



Class
Cat

Methods
Meow
Play
Sleep

Attributes
Name
Favorite Toy

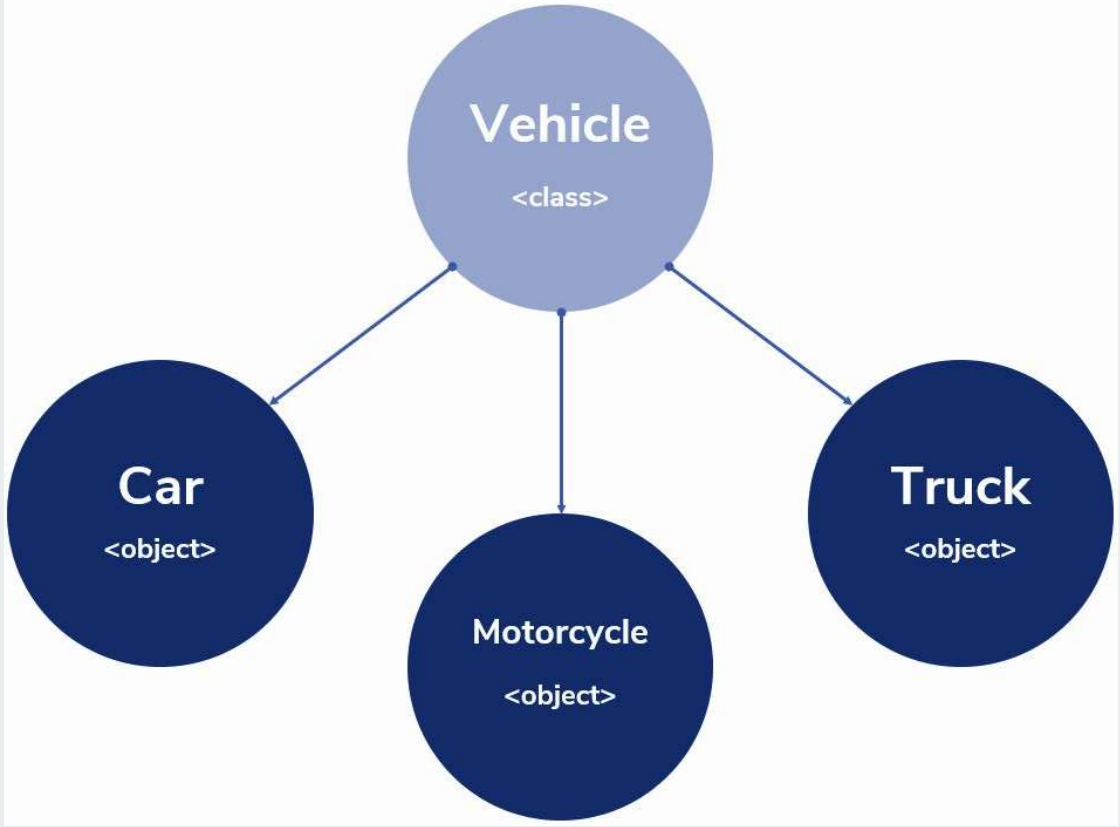
Classes and Objects

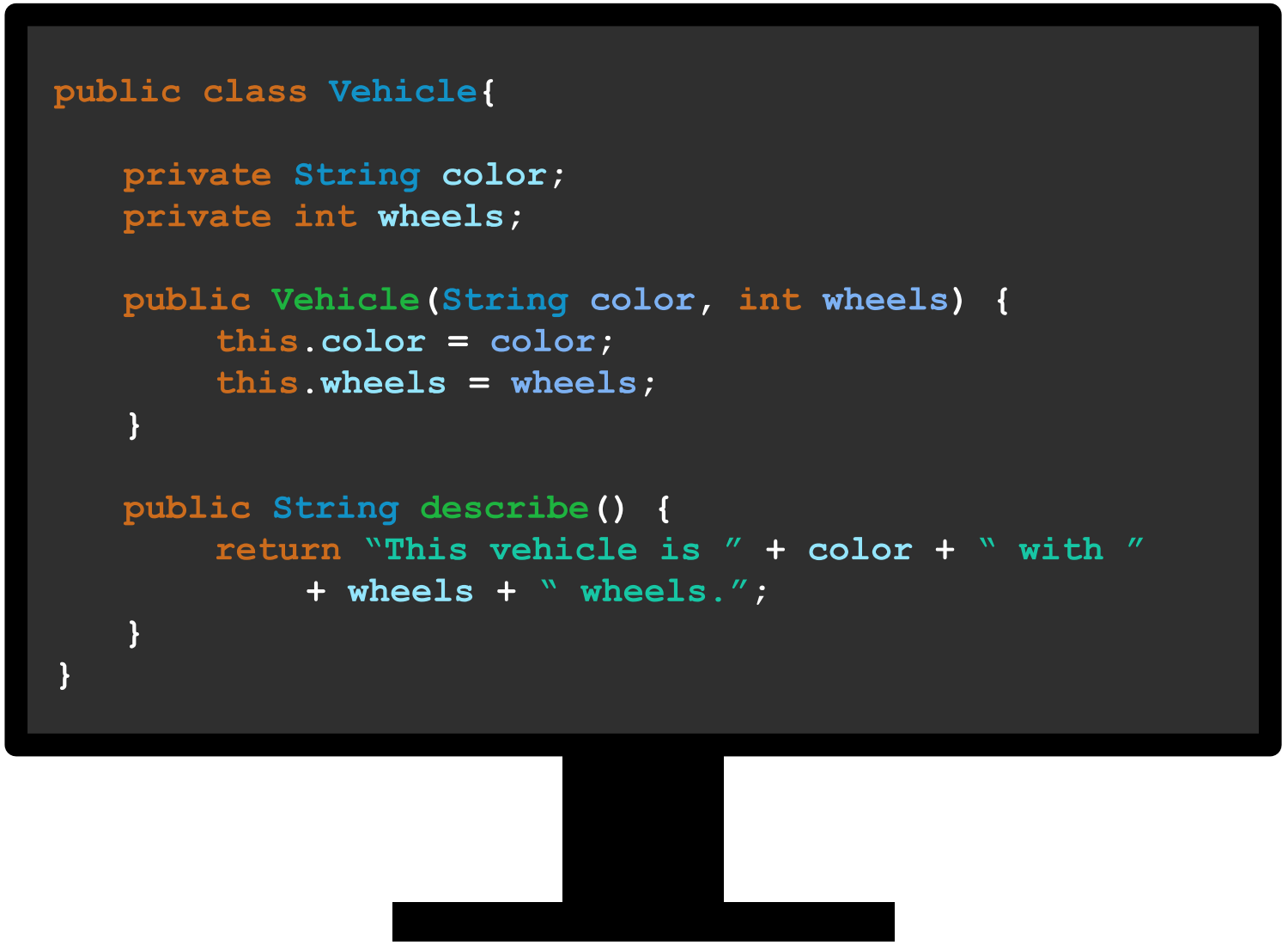
Object-oriented programs use **objects**.

An ***object*** is a thing, both tangible and intangible.

To create an object inside the computer program, we must provide a definition for objects—how they behave and what kinds of information they maintain —called a ***class***.

An object is called an ***instance*** of a class.


Vehicle
<class>
Car
<object>
Motorcycle
<object>
Truck
<object>


public class Vehicle{
private String color;
private int wheels;
public Vehicle(String color, int wheels) {
this.color = color;
this.wheels = wheels;
}
public String describe() {
return "This vehicle is " + color + " with "
+ wheels + " wheels.";
}
}

Messages and Methods

To instruct a class or an object to perform a task, we send a ***message*** to it.

You can send a message only to the classes and objects that understand the message you sent to them.

A class or an object must possess a matching ***method*** to be able to handle the received message.

Messages and Methods

A method defined for a class is called a ***class method***, and a method defined for an object is called an ***instance method***.

A value we pass to an object when sending a message is called an ***argument*** of the message.

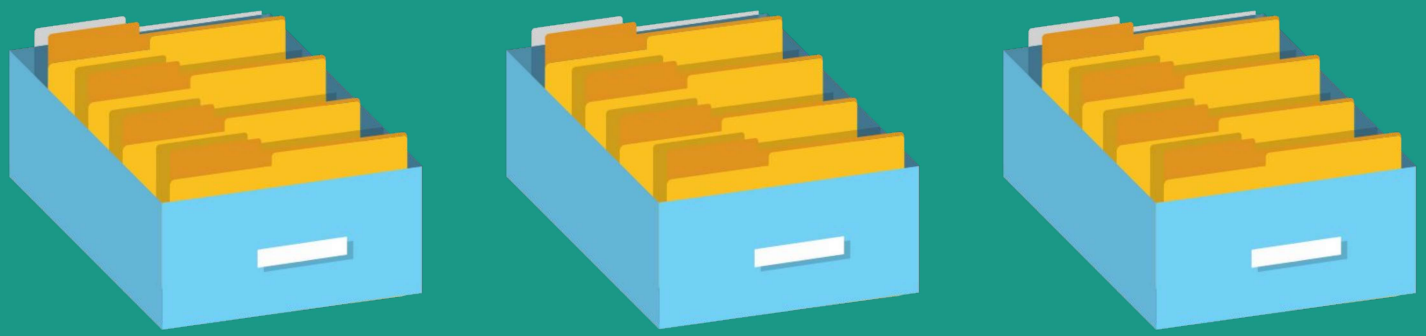
Access Modifiers

Modifier	Class	Package	Subclass	Global
Public	Allowed	Allowed	Allowed	Allowed
Protected	Allowed	Allowed	Allowed	Denied
Default	Allowed	Allowed	Denied	Denied
Private	Allowed	Denied	Denied	Denied

Class Example

```
public class Animal {

    // attributes here

    // create constructor

    // define methods

}
```

Packages and Imports



Packages and Imports

- **Packages** - Java mechanism to organize classes
  - Naming Conventions:
    - i.e. - com.cognixia.jump.corejava
    - OrganizationType.CompanyName.OrganizationTopic
- **Imports** - Java needs to know what libraries to reference

  to use certain Classes
  - I.e. - java.lang, java.util

Dates


SEP
Su Mo Tu We Th Fr Sa
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30

java.util.date

- Java comes with **Date** package, imported from **java.util**
- New Date object is created, given current date from system
- Date objects contain a toString( ) method, converts date to readable string

```
import java.util.Date;

public class PrintDate {

    public static void main(String[]
        args) {

        Date today = new Date();
        today.toString();
        // Sun Dec 15 16:58:01 EST 2019
    }
}
```

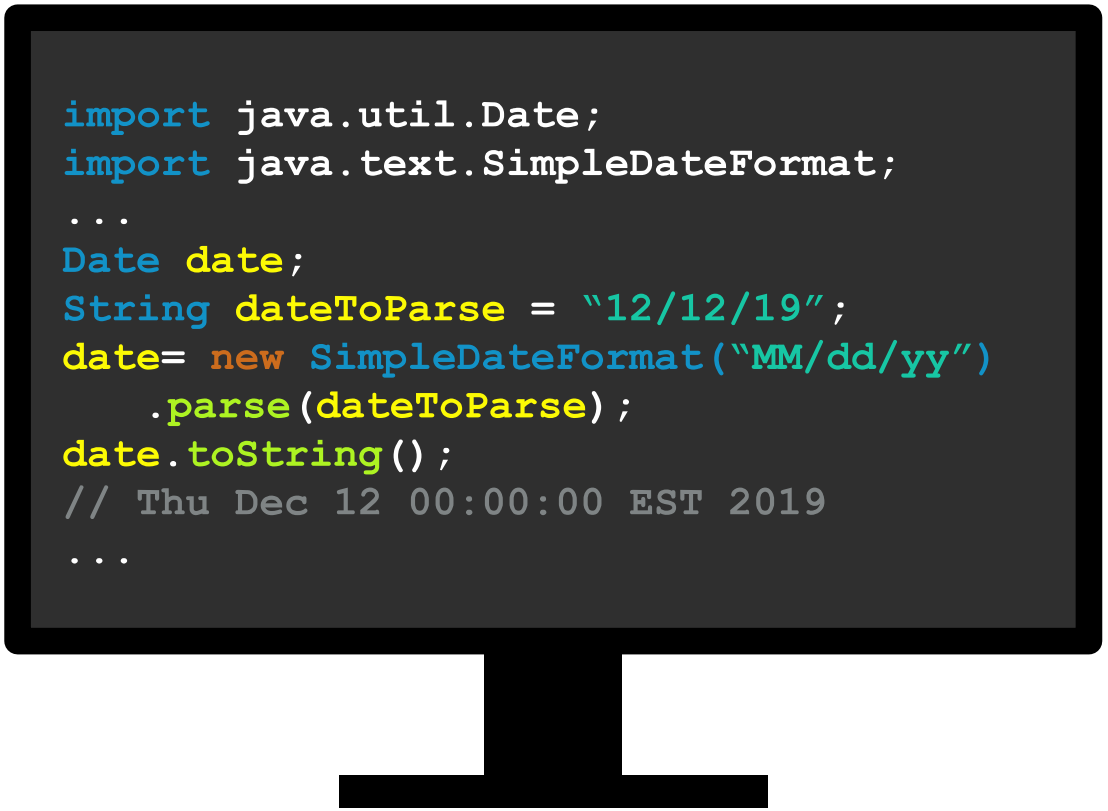
Formatting Dates

- ➔ **SimpleDateFormat** can be used to change how the date is presented
- ➔ By passing desired format (ex. Month/Day/Year) in the ***SDF*** constructor, ***Date*** object can be displayed with any desired format

```
import java.util.Date;
import java.text.SimpleDateFormat;

...
Date today = new Date();
SimpleDateFormat sdf;
sdf = new SimpleDateFormat("MM/dd/yy");
sdf.format(today);
// 12/15/19
...
```

String to Date

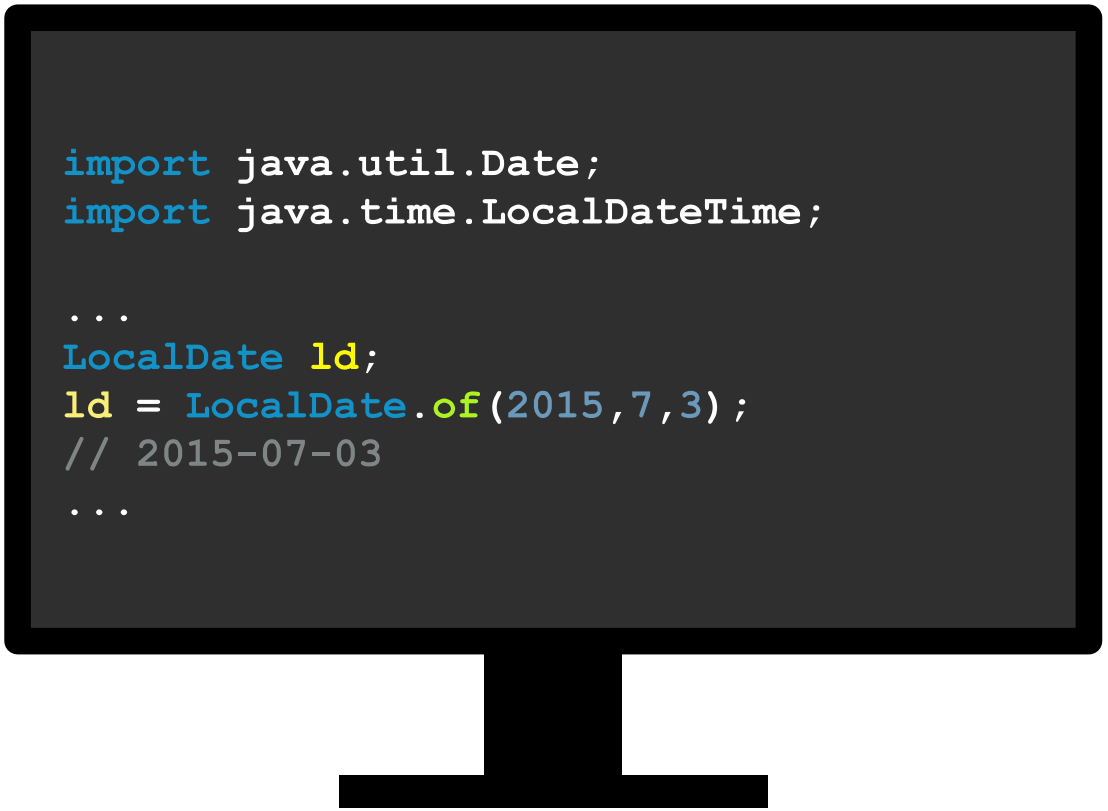
- ➔ **SimpleDateFormat** can also convert date string to Date object
- ➔ The string “12/12/19” is converted to date object
- ➔ SDF object is created to parse incoming string to useable date



```
import java.util.Date;
import java.text.SimpleDateFormat;
...
Date date;
String dateToParse = "12/12/19";
date= new SimpleDateFormat("MM/dd/yy")
    .parse(dateToParse);
date.toString();
// Thu Dec 12 00:00:00 EST 2019
...
```

LocalDate

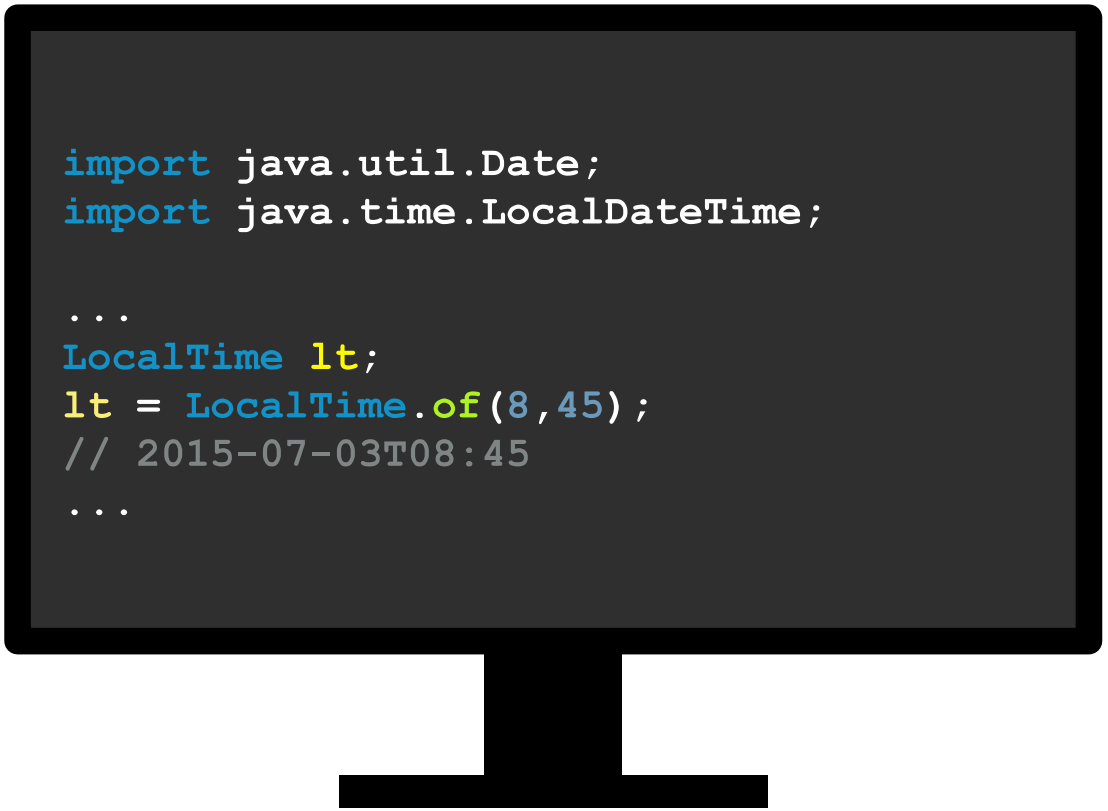
- **LocalDate** used to represent a date when time zones do not need to be considered
- By passing in ***year, month, and day;*** a new LocalDate object is created
- LocalDate gives access to useful methods associated with dates
  - Adding days, months, or years
  - Checking the day of the week
  - Checking if one date is before another



```
import java.util.Date;
import java.time.LocalDateTime;

...
LocalDate ld;
ld = LocalDate.of(2015,7,3);
// 2015-07-03
...
```

LocalTime

- **LocalTime** used to represent a time without a date
- By passing in an ***hour and minute***; a new LocalTime object is created
- LocalTime gives access to useful methods associated with times
  - Adding hours or minutes
  - Checking if a time is before another



```
import java.util.Date;
import java.time.LocalDateTime;

...
LocalTime lt;
lt = LocalTime.of(8,45);
// 2015-07-03T08:45
...
```

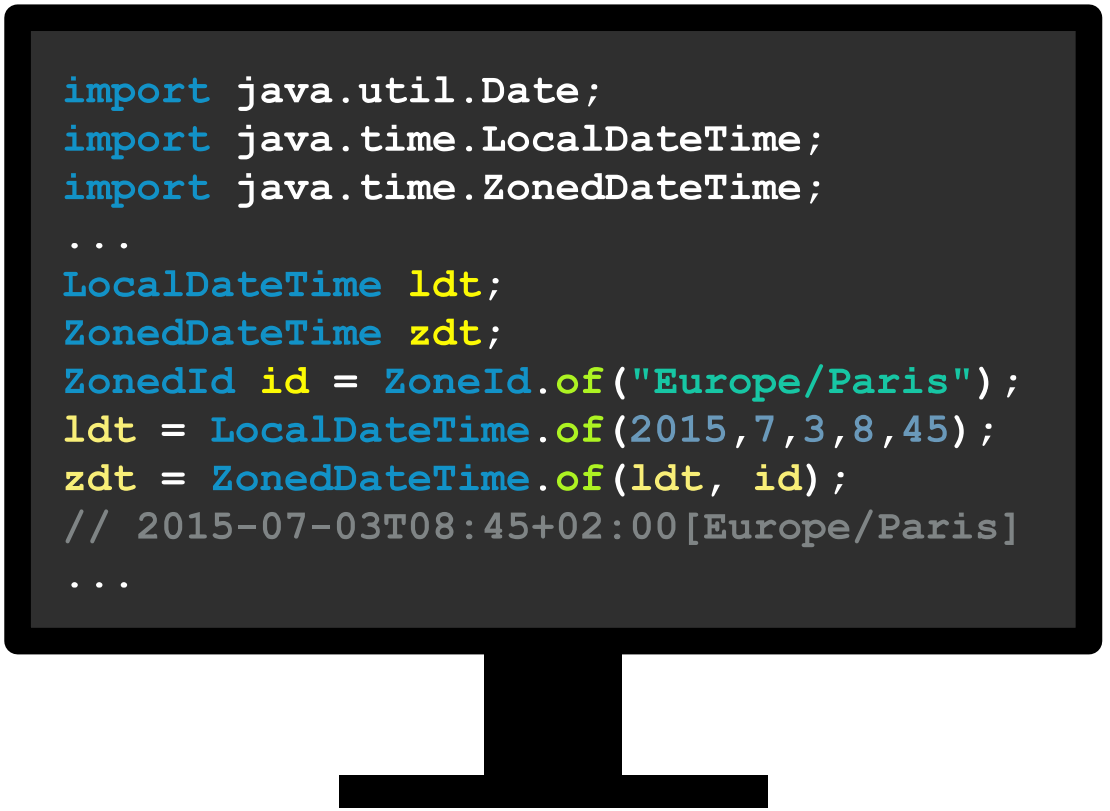
LocalDateTime

- **LocalDateTime** used to represent a combination of date and time
- By passing in ***year, month, day,hour, and minute***; a new LocalDateTime object is created

```
import java.util.Date;
import java.time.LocalDateTime;

...
LocalDateTime ldt;
ldt = LocalDateTime.of(2015,7,3,8,45);
// 2015-07-03T08:45
...
```

ZonedDateTime

- ➔ **ZonedDateTime** used to create an object representing a date in a given time zone
- ➔ **ZoneId** object created with the desired time zone
- ➔ ZonedDateTime created with the local date and time and the ZoneId.



```
import java.util.Date;
import java.time.LocalDateTime;
import java.time.ZonedDateTime;
...
LocalDateTime ldt;
ZonedDateTime zdt;
ZonedId id = ZoneId.of("Europe/Paris");
ldt = LocalDateTime.of(2015,7,3,8,45);
zdt = ZonedDateTime.of(ldt, id);
// 2015-07-03T08:45+02:00[Europe/Paris]
...
```

Convert the following Strings to Date objects:

04/23/2004

November 05 2014

1993/30/09

Assume the following Dates and Times on the left are in the EST time zone. Convert them to the given time zones on the right.

04/23/2004 7:30pm ➡ **Paris**

November 05 2014 9:23am ➡ **Gurugam**

1993/30/09 21:50 ➡ **Honolulu**

Flow Control

Conditionals: If/Else

- ➔ Conditionals are a core part of nearly every programming language.
- ➔ Java uses **if / else if/ else** syntax to control the flow of a program

```
if (condition1){
    // this code will execute if condition1 a strict true boolean
}
else if (condition2){
    // this code will execute if condition2 a strict true boolean
    // and condition1 is a strict false boolean
}
else {
    // this code will execute if neither condition1 or condition2
    // are strict true booleans
}
```

Conditionals: Nested If Statements

➔ Nesting if statements can test conditions that are reliant on the state of other conditions

```
if (condition1) {
    if (condition2) {
        // this code will execute if condition1 and condition2 are
        // strict true booleans
    } else {
        // this code will execute if condition1 is a strict true
        // boolean, and condition2 is a strict false boolean
    }
} else {
    // this code will execute if condition1 is a strict false boolean,
    // but has no relationship to condition2
}
```

Conditionals: Logical Operators

Logical operators can be used to check the conditions on primitive data types

```
<  → Less than
>  → Greater than
<= → Less than or equal to
>= → Greater than or equal to
== → Equal to (NOTE: This compared memory locations)
!= → Not equal to
!  → Not (reverses a boolean)
&& → And (True if Both booleans are true)
|| → Not (True if at least one boolean is true)
^  → XOR (True if one boolean is true and the other false)
```

Important note: Strings are objects, not primitives, these operators with not work as properly on Strings.

Conditionals: Switch

- ➔ Switch statements are a more compact syntax for conditionals.
- ➔ Switch statements can be used to direct the flow of a program based on the value of an int, char or (as of Java 7) an enum value

```
switch (condition){
     case condition1:
          // code
          break;
     case condition2:
          // code
          break;
}
```

- ➔ Note the break statements. Without them, the switch will execute all code following the matching condition

Conditionals: Switch

➔ A default case can be added to a switch expression which will be executed when no case is matched

```
switch (condition){
     case condition1:
          // code
          break;
     case condition2:
          // code
          Break;
    default:
         // This code will run if neither
         // condition1 or condition2 is met
         break;
}
```

Loops: While Loop

- ➔ **Loops** executes block of code a number of times until condition is met
- ➔ **While loop** repeat a code block until condition is a strict boolean false

```
int counter = 1;
while (counter < 10){
      System.out.println(counter);
      counter++;
}
```

- ➔ Above, the loop will print numbers from 1 to 10
- ➔ While loops have no internal means of keeping track of the number of loops
- ➔ Developer must be careful to ensure that infinite loops don't occur

Loops: While Loop

- The conditional in a while loop does not have to be a counter

```
boolean condition1 = true;
while (condition1){
      // code
      if (condition2) {
          condition1 = false;
      }
}
```

- Above, loop executes code block indefinitely because it is looping on a true boolean
- Once **condition2** is met, will swap the loop boolean **condition1** to false
- Last loop is executed

Loops: Do While

➔ The **do/while loop** similar to while loop, except it executes its code block at least once before checking the condition

```
boolean condition = false;
do {
    // code
} while (condition);
```

➔ Above, even though condition is immediately set to false, the loop will execute once

Loops: For Loop

- ➔ **For loops** are more complex loop that have terminating and increment conditions built in
- ➔ Consist of an ***initialization block***, a ***condition block,*** and an ***increment block***

```
for (int i = 0; i < 10; i++){
     System.out.println(i);
}
```

- ➔ Above, an int i is set to zero, it is incremented by one for each iteration of the loop, and once i is greater than ten, the loop terminates.
- ➔ Initialized variable is block-scoped to the for loop, i cannot be accessed outside the loop

Loops: For Loop

- Standard form of for loop is the most common, but there are a few variations possible

```
boolean condition = true;
for (int i = 1; condition; i *= 5){
     if (i % 3 == 0){
          condition = false;
     }
     System.out.println(i);
}
```

- Above, an int i is set to one, it is incremented by multiplying it by five each time through the loop, and the loop is broken through some outside condition
- Some specific use cases for unusual for loops like this, but most standard cases require a loop initialized to 1 that increments by one, and ends when a number is reached

Loops: Nested Loops

- Nesting loops can be used to generate two dimensional arrays or tables

```
for (int length = 1; length < 4; length++){
    for (int width = 1; width < 4; width++){
        area = length * width;
        System.out.println("area: " + area);
    }
    System.out.println("");
}
```

- Code above will print a grid that labels the area of rectangles of the given length and width
- Nesting loops is significantly more memory and processor intensive than a single for loop, so be careful with implementations that require them

Loops: Break and Continue

- **Loop-and-a-half** conditions implemented for more precise control of code execution within a loop
- **Break**
  - Will immediately end all repetitions of a loop and return to normal flow of a program
- **Continue**
  - Will end the current iteration of a loop, and move on to the next iteration
  - In ***for loop***, will still trigger the increment block
- **Return**
  - Within a method, return statement can be used to end a loop and return a value; similar to a break statement.
  - Will end any resources associated with a method, including any further iterations of loop


WHITE
BOARD
EXERCISE

```java
public class FizzBuzz {

    public static void main(String[] args) {
        System.out.println("1");
        System.out.println("2");
        System.out.println("Fizz");
        System.out.println("4");
        System.out.println("Buzz");
        System.out.println("Fizz");
        System.out.println("7");
        System.out.println("8");
        System.out.println("Fizz");
        System.out.println("Buzz");
        System.out.println("11");
        System.out.println("Fizz");
        System.out.println("13");
        System.out.println("14");
        System.out.println("FizzBuzz");
        System.out.println("16");
        System.out.println("17");
        System.out.println("Fizz");
        System.out.println("19");
        System.out.println("Buzz");
        System.out.println("Fizz");
        System.out.println("22");
        System.out.println("23");
        System.out.println("Fizz");
        System.out.println("Buzz");
        System.out.println("26");
        System.out.println("Fizz");
        System.out.println("28");
        System.out.println("29");
        System.out.println("FizzBuzz");
        System.out.println("31");
        System.out.println("32");
        System.out.println("Fizz");
```

Create a method that follows the following rules that :

The method should print out a list of length n, with each index i following these rules

If a number n is divisible by 3, print “Fizz”

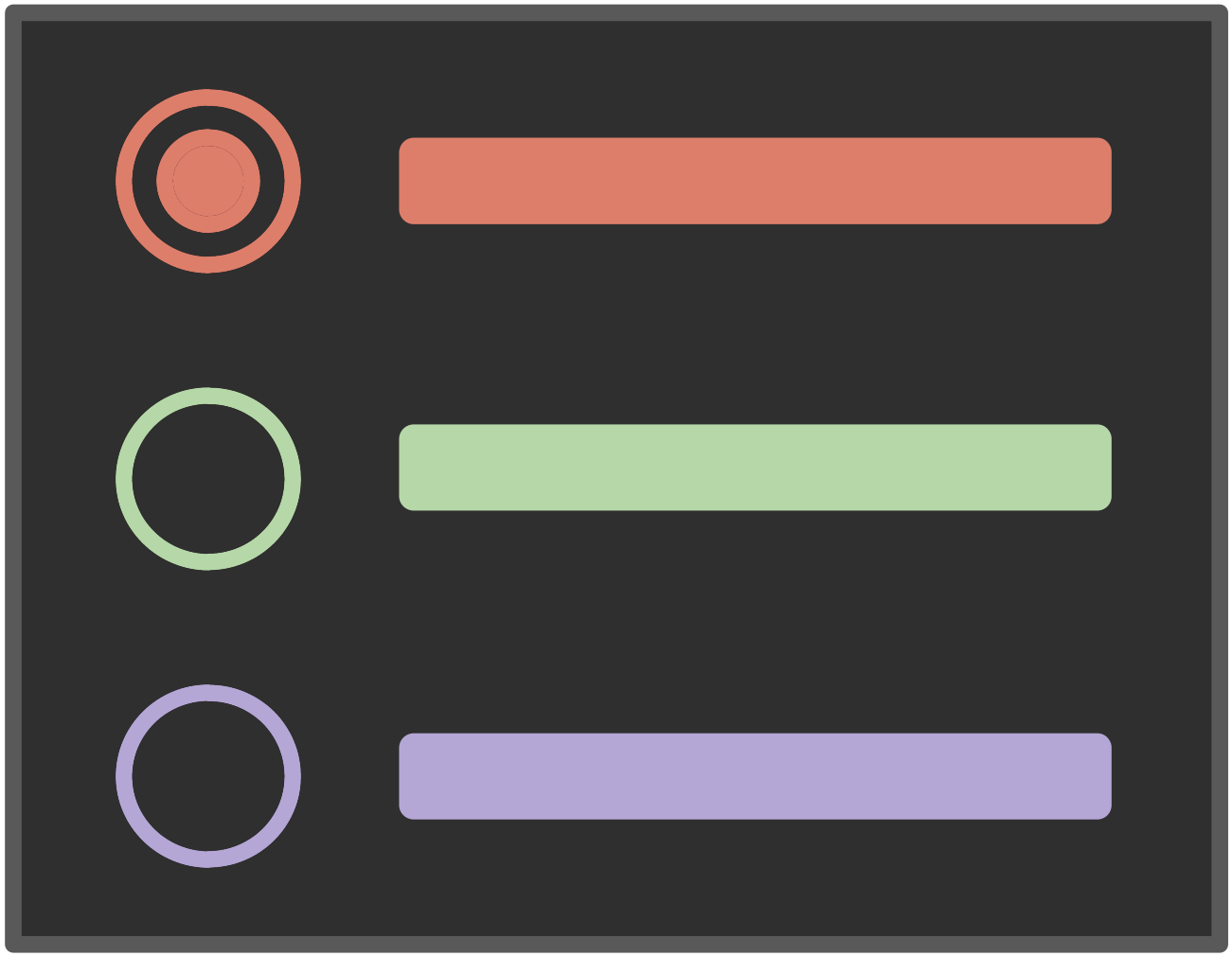
If a number n is divisible by 5, print “Buzz”

If a number n is divisible by 3 and 5, print “Fizzbuzz”

Bonus :

If a number is prime, do not print it.

Enums



Enums

- **Enumerated Constants** or **Enums** are a Java language supported way to create constant values
- More type safe than variables like String or int
- If used properly, enums help create reliable and robust programs

Enums

- Enums create public static final int variables.
- Without enums:

```
public static final int ICE_CREAM = 0;
public static final int CHOCOLATE = 1;
public static final int VANILLA = 2;
```

- With enums:

```
public static enum Cake {
    ICE_CREAM, CHOCOLATE, VANILLA
}
```

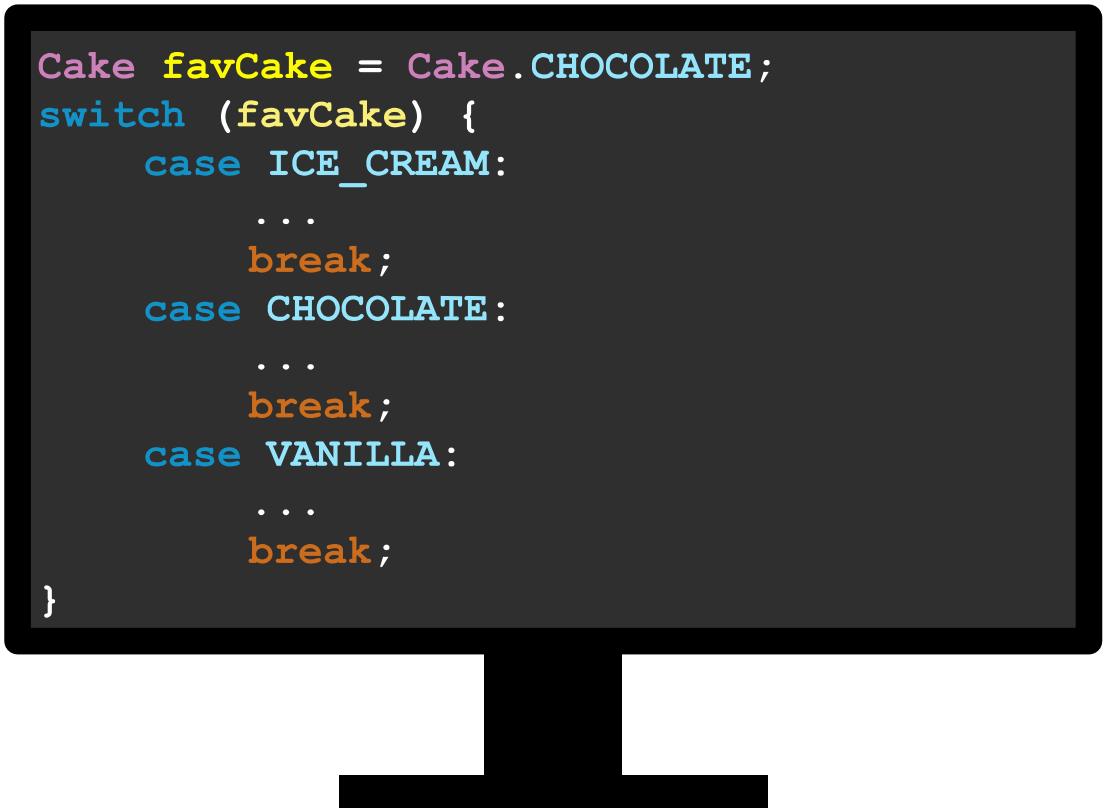
Enums

- ➔ Once an enum is created, its values can be accessed with dot notation
- ➔ A local variable can be instantiated of the enum's type, then initialized with a value from the enum :

```
public static enum Cake {
    ICE_CREAM, CHOCOLATE, VANILLA
}
...
Cake c1 = Cake.CHOCOLATE;
System.out.println(c1); // CHOCOLATE
```

Enums in Switches

- ➔ Enums can be used in switch cases.
- ➔ Enums allow for switch cases to use values no more complex than int or char



Enums with Constructors

- ➔ Each value in an enum instantiates a public final class
- ➔ The constructor defined in the enum is run for each value
- ➔ Arguments passed to the enumerated values can be used in the constructor to create new data members

```
public enum Cake {
     ICE_CREAM("Graham Cracker"),
     CHOCOLATE("Chocolate Custard"),
     VANILLA ("Fresh Strawberries");

     public final String filling;

     Cake (String filling){
          this.filling = filling;
     }
}
```