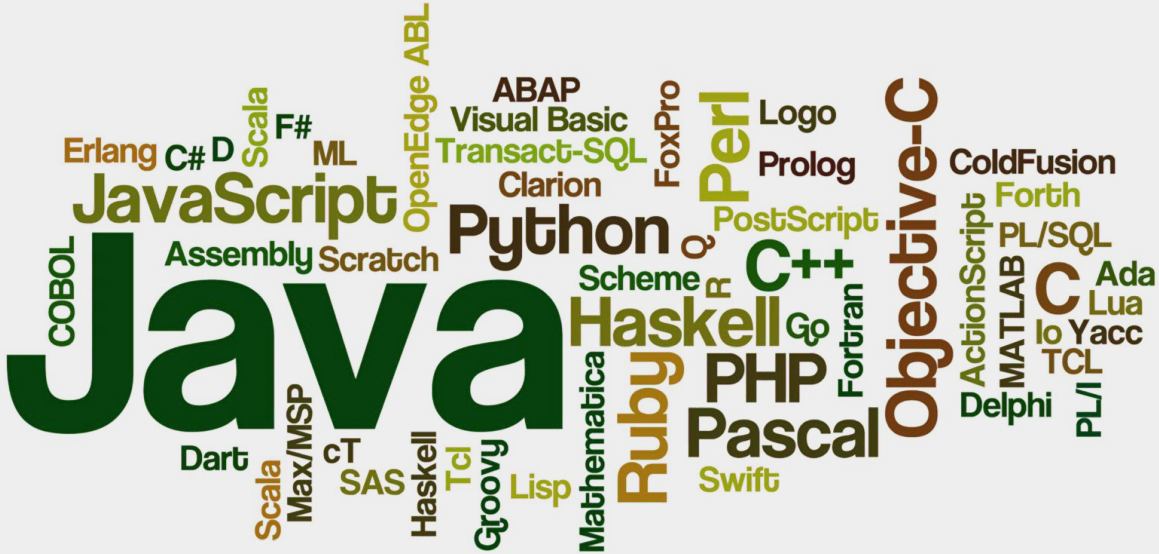



# AN INTRODUCTION TO BACKEND FOR BEGINNERS

## MODULO 2 – JAVA SE

Objectives:

- Java basics
- Object Oriented Programming
- Learn how to modelling a complex object structure

# What is Java?

Object Oriented

Secured and Robust

Compiled and Interpreted

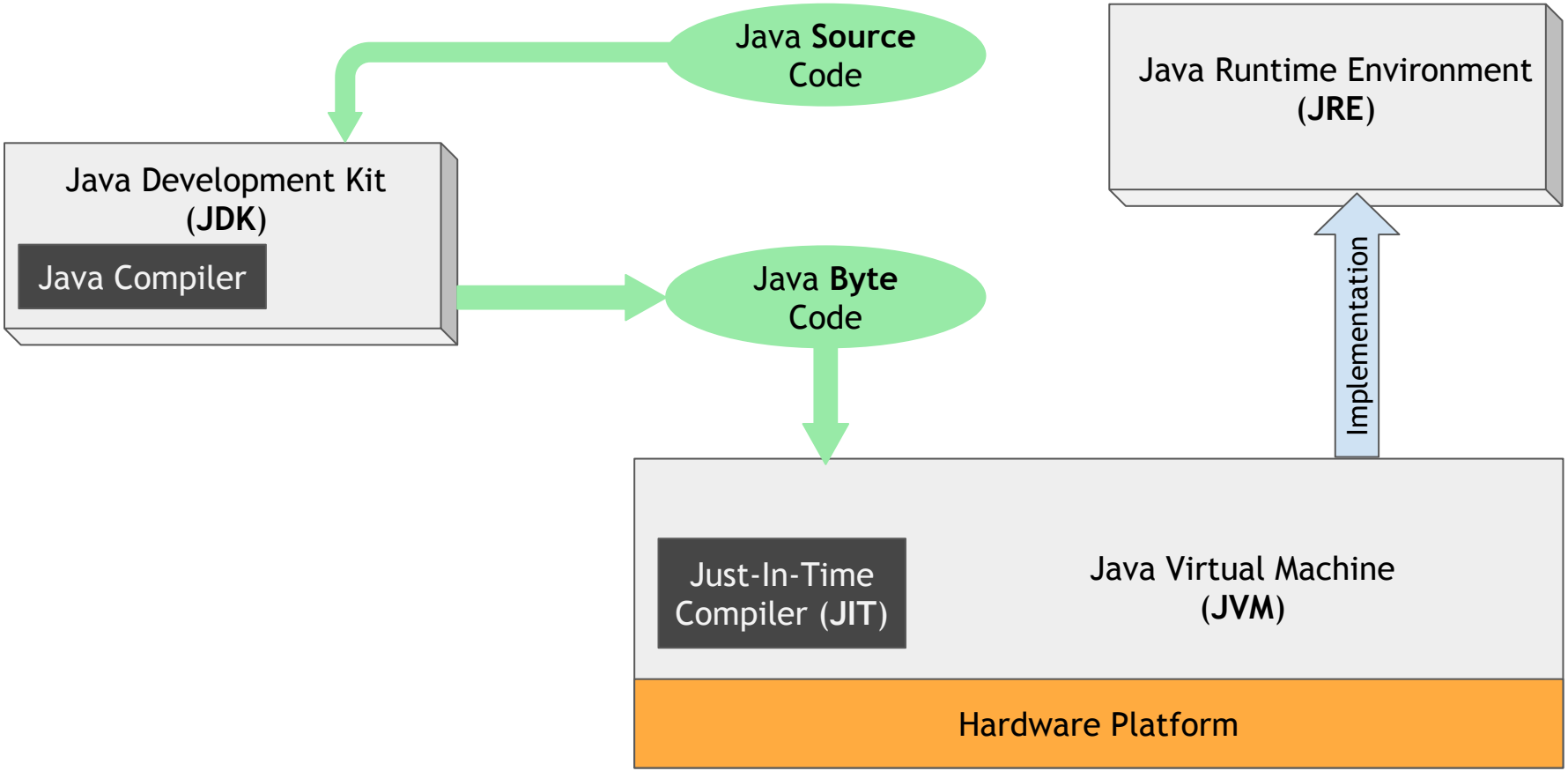
Platform Independent

Multi-threaded

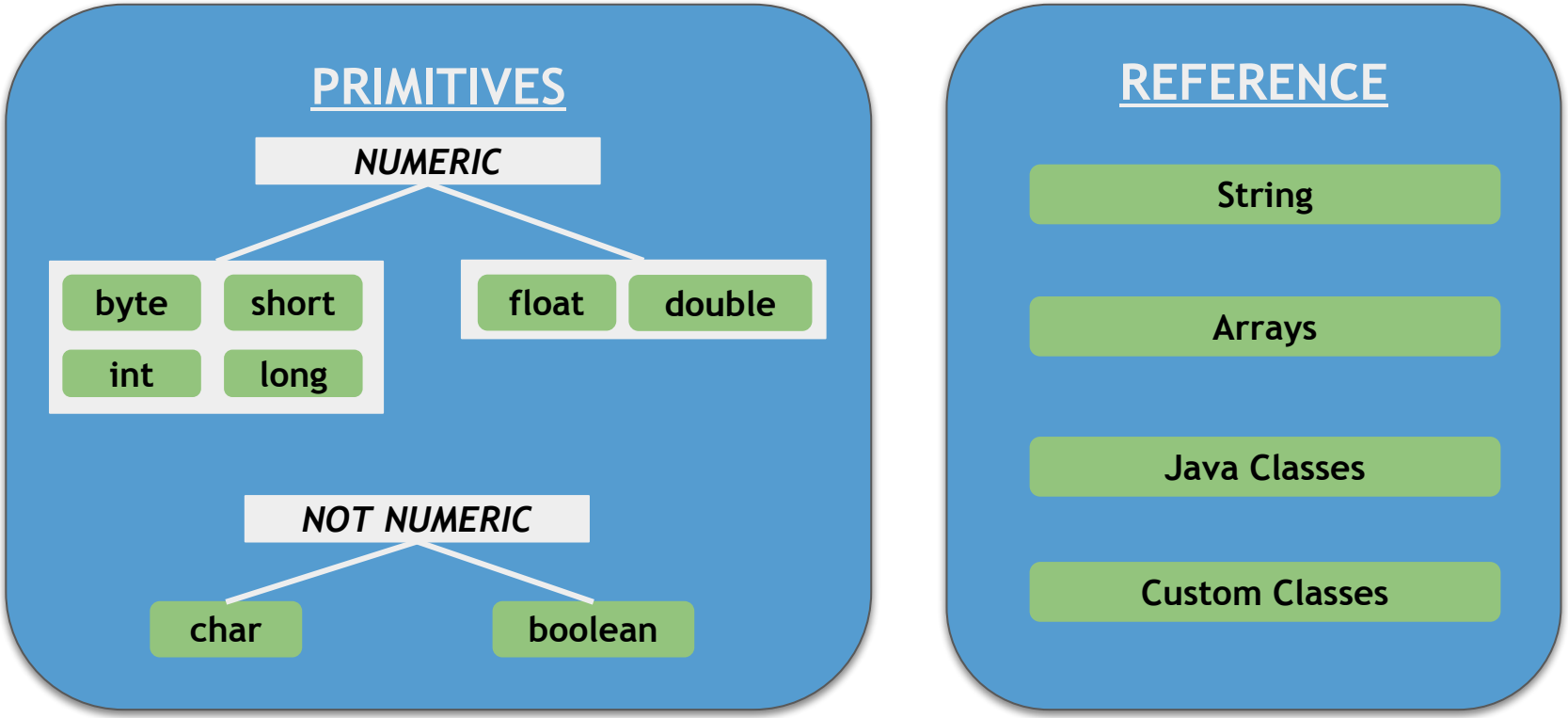
Portable

Programming Language

# JDK


Java Source Code
Java Development Kit (JDK)
Java Compiler
Java Byte Code
Java Runtime Environment (JRE)
Implementation
Just-In-Time Compiler (JIT)
Java Virtual Machine (JVM)
Hardware Platform

# Data Types


PRIMITIVES
NUMERIC
byte
short
int
long
float
double
NOT NUMERIC
char
boolean
REFERENCE
String
Arrays
Java Classes
Custom Classes

# Class and Objects

A Class is a blueprint

An object is an instance created from a blueprint

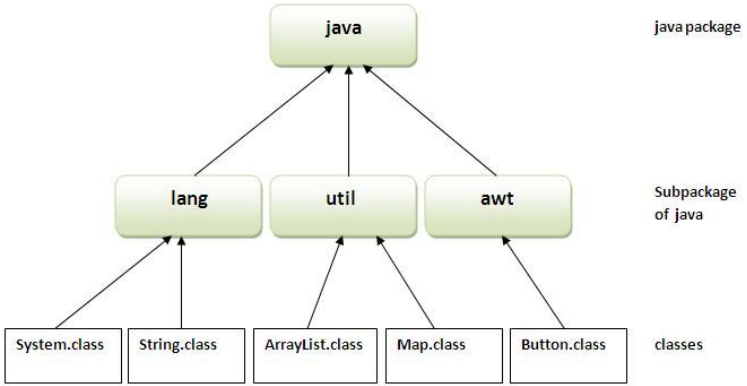
Objects belonging to same type has same attributes but different attributes values

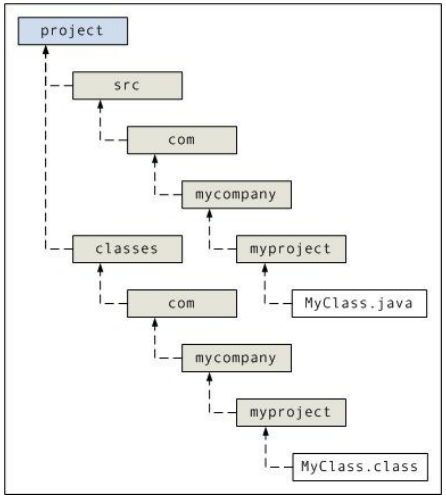
# Packages

A package is a container for classes.

A package is a **grouping** of related types(classes and interfaces) providing **access protection** and **namespace** management **avoiding name collisions**.

Packages are divided into two types they are **built-in packages** and **user defined** packages



# Class Structure

Access modifier

class keyword

Class Name

Imports

package

Instance variables

Constructor. If not exist default applied

Return type. Can be void

```
package slidecode;

import java.lang.String;

public class Cat {

    private String colour;
    private int age;

    public Cat(String colour, int age) {
        this.colour=colour;
        this.age=age;
    }

    protected String talk() {
            int local = 1;
            return "meow!";
    }

    public static String talk2() {  return "zzzzz!";  }
}
```

Local scope

Arguments. Can be void.

Instance method

Class Method

# Enum

```
enum Color {
   RED(1), BLUE(2), GREEN(3);
   private int value;
   Color(int value) {
      this.value = value;
   }
   public int getValue() { return value;}
}
Color color = Color.RED;
color.name()     // RED
color.ordinal()      // 0
color.toString()     // RED
color.values()  // [RED, BLUE, GREEN]
color == COLOR.RED  //true
```

Enum in java is type safe

Enum constants are implicitly static and final

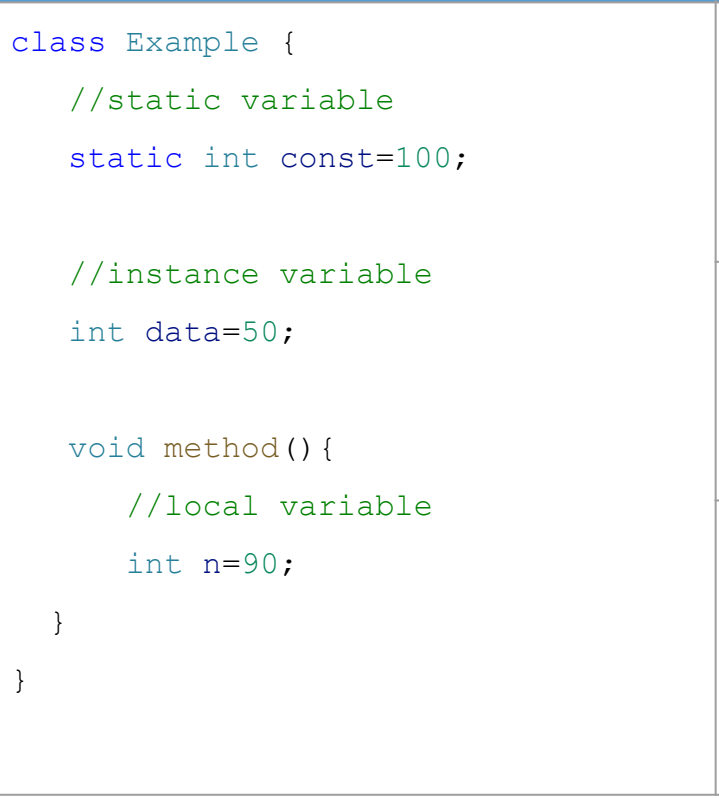
Enum can implement an interface

Can be threatened as static classes encapsulating fields.

Can be used inside switch like int and String

***You should use enum types to represent fixed set of constants***

# Scope

| Variable | Scope | Lifetime |
|---|---|---|
| **static** |  | Exists for **as long as the class** it belongs to is loaded in the ***JVM***. |
| **instance** | | Exists for **as long as the instance** of the class it belongs to. |
| **local** | | Exists **until the method** it is declared in **finishes executing.** |

```
class Example {
    //static variable
    static int const=100;

    //instance variable
    int data=50;

    void method(){
        //local variable
        int n=90;
    }
}
```

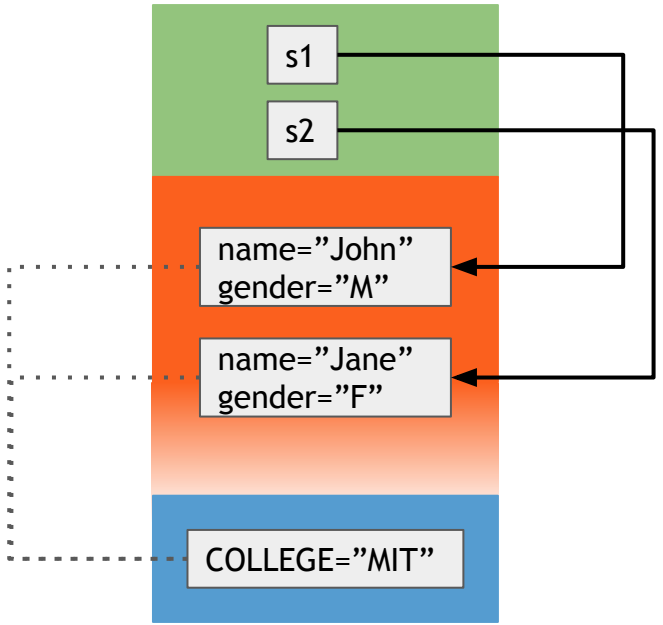
# Memory Organization

Stack: portion of memory containing local (block) variables, primitives, ...

Heap: portion of memory dynamic containing objects

Static Area: portion of memory containing global and static variables

```java
public class Student {

    String name;
    String gender;
    static String COLLEGE = "MIT";

    public Student(String name, String gender) {
        this.name=name;
        this.gender=gender;
    }

    public static void main(String[] args) {
        System.out.println(Student.COLLEGE); // MIT

        Student s1 = new Student( name: "John",  gender: "M");
        Student s2 = new Student( name: "Jane",  gender: "F");

        System.out.println(s1.name); // John
        System.out.println(s2.name); // Jane
        s1.COLLEGE = "BHO!";
        System.out.println(Student.COLLEGE); // BHO!
        System.out.println(s2.COLLEGE); // BHO!
    }
}
```

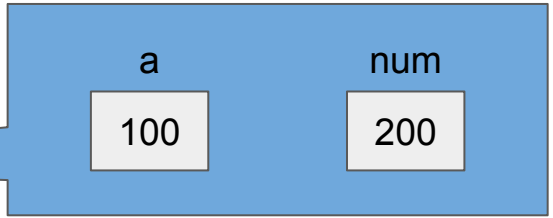


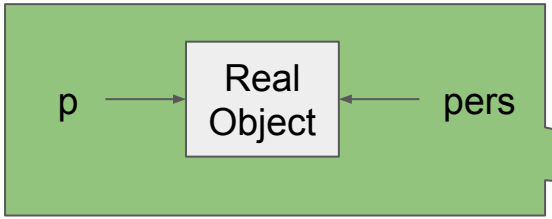
# Call by Value vs by Reference

**Pass by Value**: The method parameter values are copied to another variable and then the copied object is passed. All primitives types are passed by value.

**Pass by Reference**: An alias or reference to the actual parameter is passed to the method, that's why it's called pass by reference. PAY ATTENTION: also the reference to the object passed as parameter is passed by value.

```
void method(int num) {
    num = 200;
}

int a = 100;
method(a);

System.out.println("a"); // 100
```




```
void method(Person pers) {
    pers.setName = "new Name";
}

Person p = new Person();
p.setName("Pippo");
method(p);

System.out.println(p.getName()); // new Name
```

# Keywords

**1. Java Files (3)**
- class
- interface
- enum (1.5)

**2. Data Types (8+1)**
- byte
- short
- int
- long
- float
- double
- char
- boolean
- void

**3. Memory Location (2)**
- static
- new

**4. Control Statements (11)**

4.1 conditional
- if
- else
- switch
- case
- default

4.2 loop
- while
- do
- for

4.3 transfer
- break
- continue
- return

**5. Accessibility Modifiers (3)**
- private
- protected
- public

**6. Modifiers (8)**
- static
- final
- abstract
- native
- transient
- volatile
- synchronized
- strictfp

**7. Object Representation (3)**
- this
- super
- instanceOf

**8. Inheritance Relationship (2)**
- extends
- implements

**9. Package (2)**
- package
- import

**10. Exception Handling (5+1)**
- try
- catch
- finally
- throw
- throws
- assert (1.4)

**11. Unused Keywords (2)**
- const
- goto

*These are not keywords*

**Default Literals**

1. referenced literal
   - null
2. boolean literals
   - true
   - false

## Java is an **Object Oriented Programming** Language

Object

Object

Object

Object

Object

Object

Class

# OOP - Principles

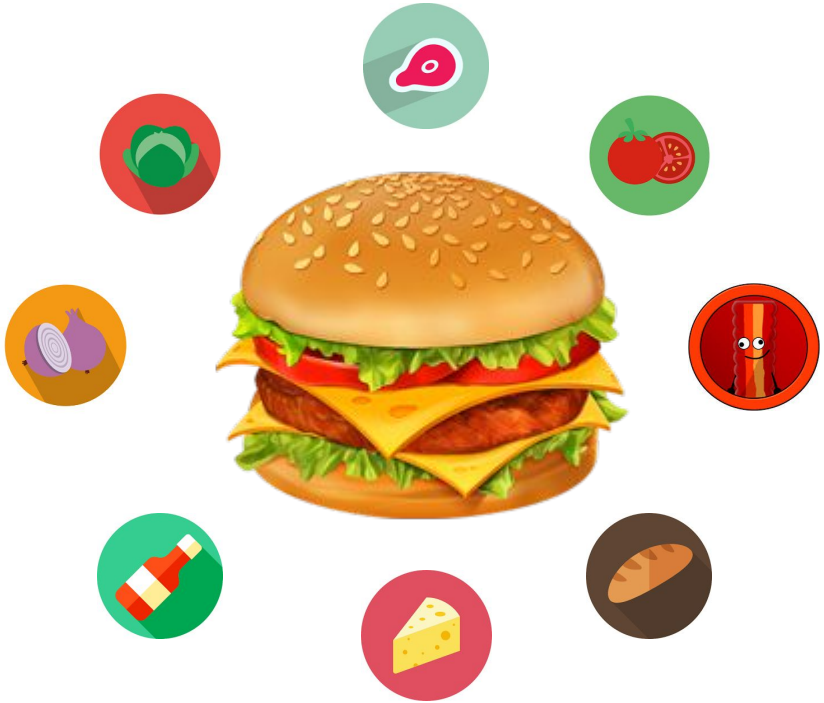
**Encapsulation**

**Abstraction**

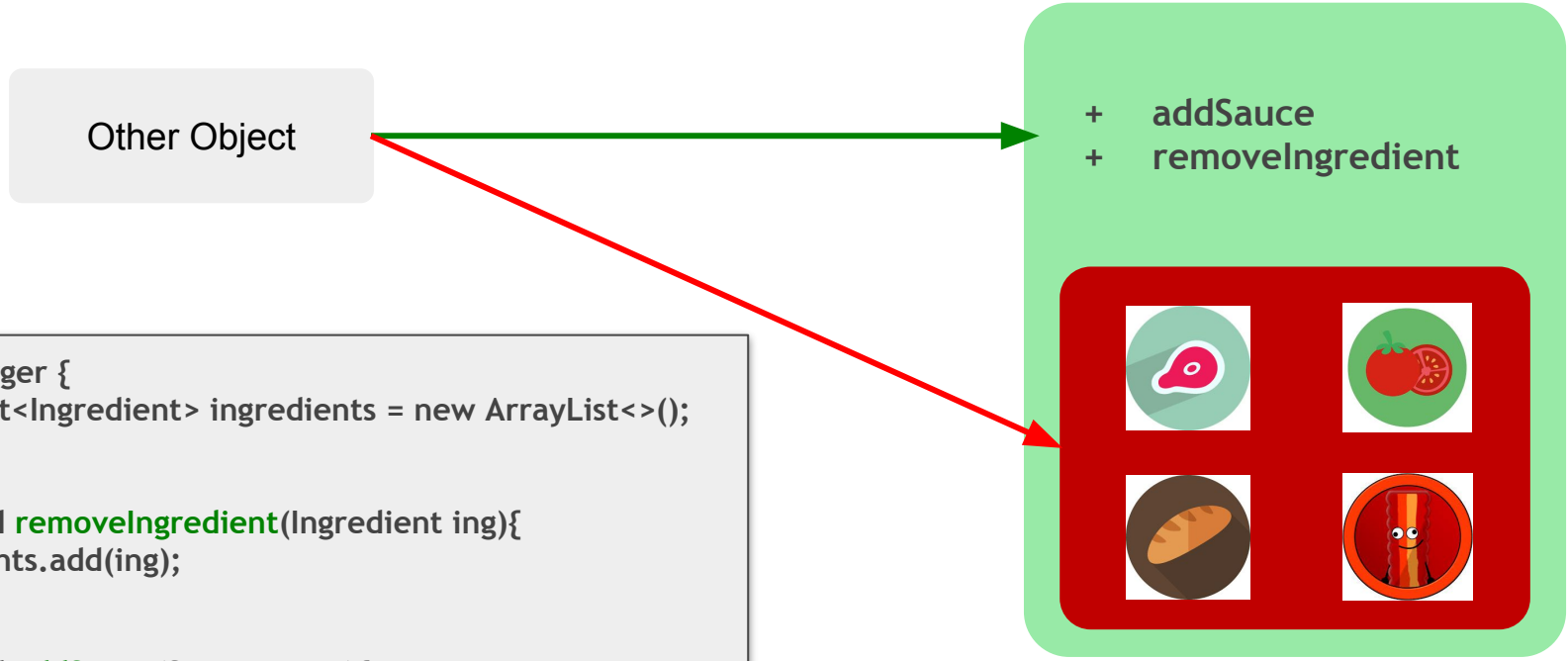
**Inheritance**

**Polymorphism**

# OOP - Encapsulation



# Deny access to state - Wrapping




```
class Hamburger {
    private List<Ingredient> ingredients = new ArrayList<>();
    ...

    public void removeIngredient(Ingredient ing){
      ingredients.add(ing);
    }

    public void addSauce(Sauce sauce){
      ingredients.add(sacue);
    }
}
```

# Visibility

| Class | Different class but same package | Different package but subclass | Unrelated class and different package |
|---|---|---|---|
| package p1;<br>class A { | | | |
| **private** int var1; | | | |
| int var2; | | | |
| **protected** int var3; | | | |
| **public** int var4; | | | |
| } | | | |

# OOP - Abstraction

**FOOD**

**BEVERAGE**

**MEAL**

# Abstract vs Interface

IS A — ABSTRACT Beverage

**Eatable** **Drinkable** CAN DO — INTERFACE

IS A — ABSTRACT Food

```
abstract class Food {

   abstract void abstractMethod();

   void concreteMethod(){
       // code here
   }
}

interface Eatable {
   void eat();
}

class Hamburger
       extends  Food
       implements Eatable {

   @Override
   void abstractMethod() {
       //code here
   }

   @Override
   public void eat() {
       //code here
   }
}
```

# Annotations

*"Annotation-based development lets us avoid **writing boilerplate** code under many circumstances by enabling tools to **generate** it **from annotations** in the source code. This leads to a **declarative programming style** where the programmer **says what should be done** and **tools emit the code** to do it."*

Oracle Definition

declaration →

```
public @interface Author {
    String name();
    int year();
}
```

usage →

```
@Author(name = "Brett Whiskers",
        year = 2008)
 class MyClass {}
```

Program metadata – decorations on ordinary Java code.

Like javadoc comments, but with syntax and strong types.

Meant to be both human- and machine-readable.

# OOP - Inheritance

PARENT

1°LEVEL CHILD

2°LEVEL CHILD

# Object class - super - this

```
class Hamburger {
   int meat;
   int tomato

   public Hamburger(){
      this(1,1);
   }
   public Hamburger(int meat, int tomato){
      this.meat = meat;
      this.tomato = tomato;
   }
}
class Cheeseburger extends Hamburger {
   int cheese;
   public MyCustomBurger(int cheese) {
       super(2,0);
       this.cheese = cheese;
   }
}
```

A class can inherit **only from a superclass**,
in the hierarchy tree the parent of all java classes is **OBJECT**.

**SUPER**: **explicit reference to superclass constructor, method or field**.
*In case of constructor if not explicitly called the default one or the one without parameters is called*

**THIS**: **explicit reference to instance constructor, method or field**.

# OOP - Polymorphism

Menu 1

Menu 2

Menu 3

JUST EAT!!!

# Overload and Override

**Overloading**: same method name with different argument and perhaps return type.

**Override**: same method name with identical signature in a child class.

```
public void eat(){
…
}

public void eat(Food f) {
…
}

public void eat(Food f, Beverage b)
{
…
}
```

```
public class Menu {
        public void eat(){
        …
        }
}
```

```
public class MegaMenu
extends Menu{
        @Override
        public void eat(){
        …
        }
}
```

```
public class SimpleMenu
extends Menu{
        @Override
        public void eat(){
        …
        }
}
```

# Final Keyword

```
class Bike {
        final int speedlimit = 90;//final variable

        void run() {
            speedlimit = 400;
        }

        final void runFinal() { // final method
        }
    }

    class Ducati extends Bike {
        @Override
        void runFinal() {
        }
    }

    final class Ducati999 extends Ducati {
    }

    class DucatiNew extends Ducati999 {
    }
```

Value Change

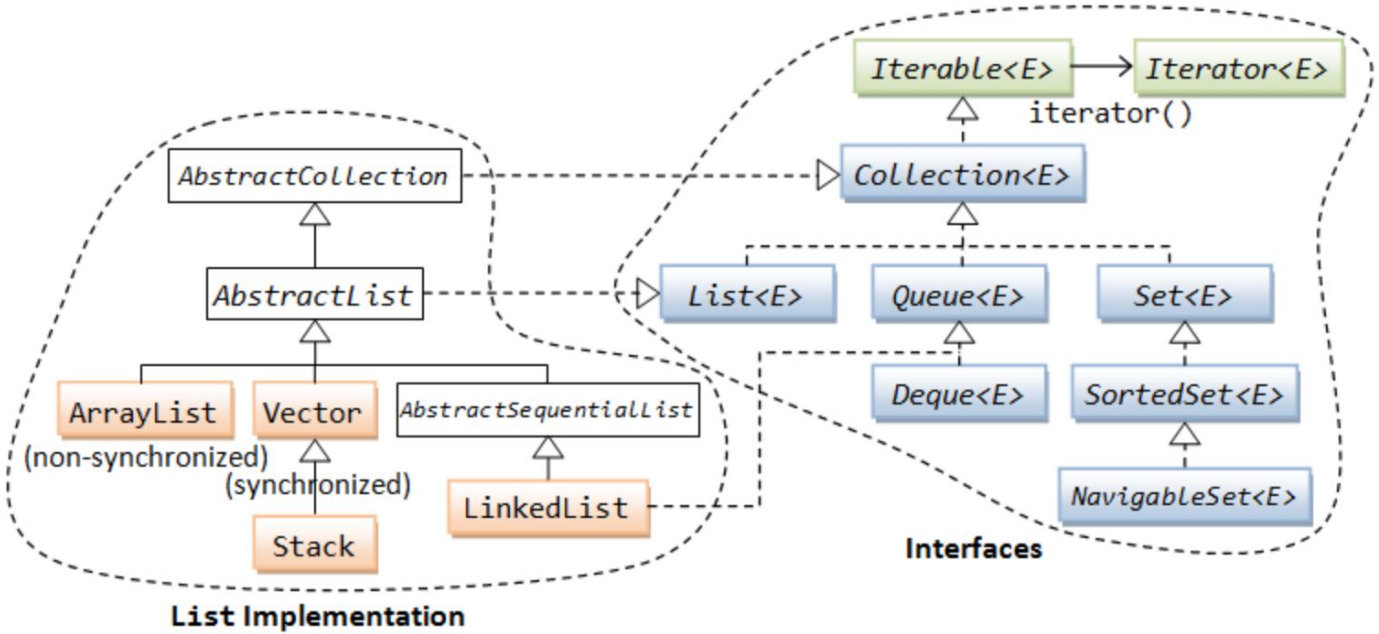
Method Overriding

Inheritance

# Collections

Java collections framework:

- a **hierarchy of interface types and classes for collecting objects**
- each interface type is implemented by one or more classes



# Hash - Equals contract

Equals and Hashcode must be ovverriden together

If not overridden the java.lang.Object method are invoked

```
public native int hashCode();
public boolean equals(Object var1) {
    return this == var1;
}
```

| First Value | Second Value | == | equals() |
|---|---|---|---|
| int i = 10 | int j = 10 | | |
| Integer i = new Integer(10) | Integer i = new Integer(10) | | |
| Person p1 = new Person(“John”) | Person p2 = new Person(“John”) | | |
| Integer i = new Integer(10) | int j = 0 | | |

# Sorting - Comparable - Comparator

```java
class Student implements Comparable<Student> {
    @Override
    public int compareTo(Student student) {
        return this.surname.compareTo(student.getSurname());
    }
}
```

Meant for **natural sorting** order

Returns:
- **Negative obj1 < obj2**
- **Zero obj1 == obj2**
- **Positive obj1 > obj2**

Frequently implemented in java class String, Date, Calendar, ecc

```java
List<Student> classroom= new ArrayList<>();
classroom.add(new Student("Rossi", 7.5d));
classroom.add(new Student("Bianchi", 5.5d));
Collections.sort(classroom); // Bianchi, Rossi
Collections.sort(classroom, new Comparator<Student>() {
    @Override
    public int compare(Student o1, Student o2) {
        return o1.getAverage().compareTo(o2.getAverage());
    }
});
```

Meant for **customized sorting** order

Same as comparable

To be implemented if necessary.
Implemented in a separate Class

# Generics - Casting

```
import java.util.Calendar;
import java.util.GregorianCalendar;

public class Test {

   public class Pair<K extends Number, V> {
       K key;
       V value;

       public void set(K k, V v) {
           key = k;
           value = v;
       }

       <T extends Calendar> void test(T arg) {
           if(arg instanceof GregorianCalendar) {
               //do something
           }
       }
   }

   Pair<Integer,String> pair1 = new Pair<>();
   pair1.set(1, "Test");

   Pair<Integer,Object> pair2= new Pair<>();
   pair2.set(2, new Object());

   Calendar c = new GregorianCalendar();
   pair1.test(c);

}
```

Introduced with Java 1.5 a generic Type is a formal Type that is not clearly defined at compilation time.

The advantages on using Generics are:

- Type-safety
- Type casting is not required
- Compile-Time Formal Checking

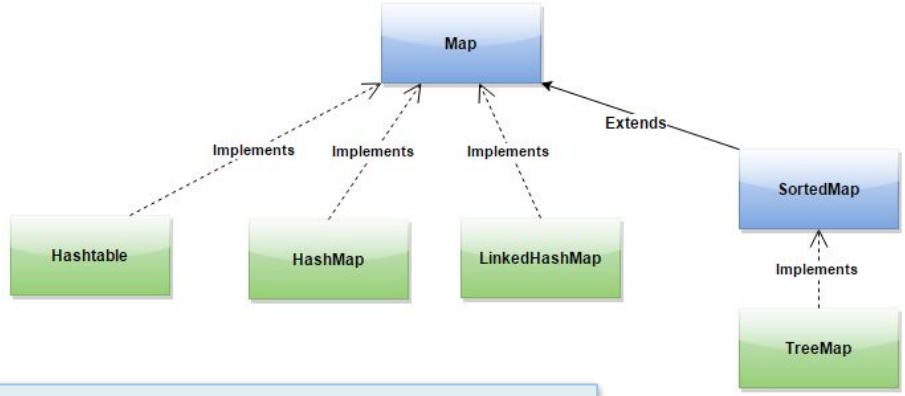
```
// Without generics
List list = new ArrayList();
list.add(new Integer(0));
Integer x = (Integer) list.get(0); // Explicit downcast
list.add("abc");
Integer y = (Integer) list.get(1); // Run -time exception

// With Generics
List<Integer> list = new ArrayList<> ();
list.add(new Integer(0));
Integer x = list.get(0);
list.add("abc"); // Compiler Error - Expected Integer
```

# Maps

**NOT** a Collection.

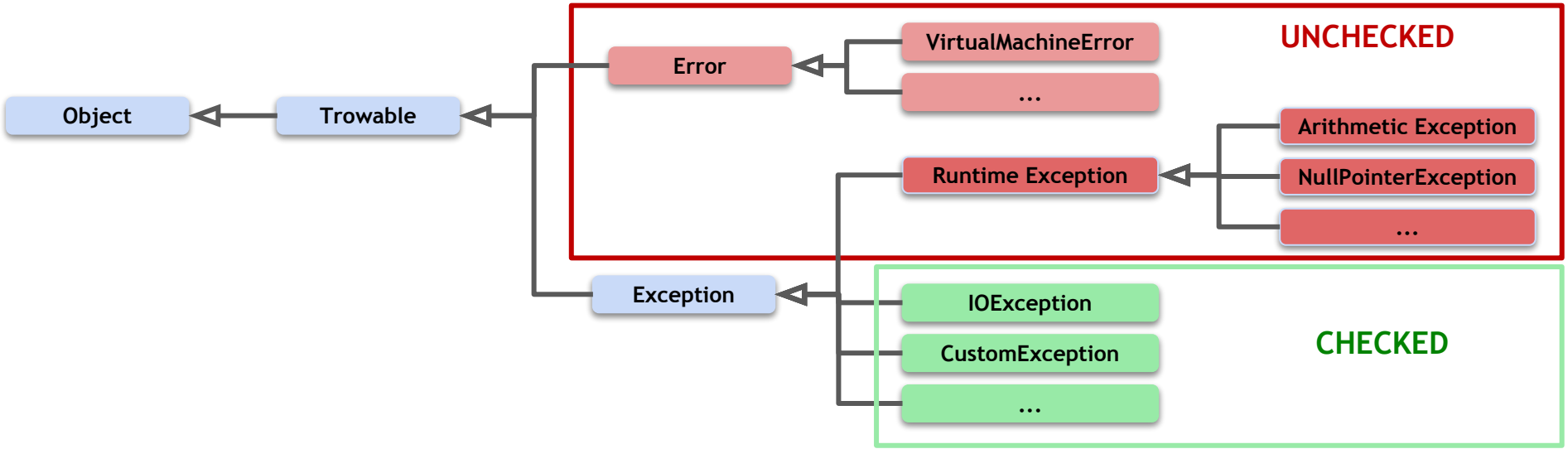
Map<K,V> is an **interface** representing a data structure that allows you to store and search an element associated to a Key.

The **key** must be **unique**. If a second element is stored with an existing key it will **replace** the first.




```
Map<String, Person> persons = new HashMap<>();
Person johnDoe = new Person("John","Doe");
Person janeDoe = new Person("Jane","Doe");
users.put("XXX", johnDoe);
users.put("XXX", janeDoe);
persons.get("XXX); // gets janeDoe

Set<String> keySet = persons.keySet(); // set of all the keys
Collection<Person> values = persons.values(); // collection of all values
Set<Map.Entry<String, Person>> entries = persons.entrySet()); // set of (K,V)
```

# Exceptions




UNCHECKED: Tipically represents serius errors or logic errors. Catching is optional. Handled by JVM.

CHECKED: Tipically represents operation errors. Catching or declaration required.

# Exceptions Handling

```
public static void main(String[] args){
  try {
       methodCallExample();
  } catch(CustomException e) {
       // do something
  }
}
void methodCallExample() throws CustomException  {
  try {
      //do something
      throw new CustomException("message");
  } catch(NullPointerException npe) {
     // do something
  } catch(RuntimeException e) {
     //do something
  } finally {
     // do something
  }
}
class CustomException extends Exception {
   public CustomException() {}
   public CustomException(String message) {
     super(e);
  }
}
```

TRY: Encloses all statements that may throw an exception

CATCH: Catches exception matching type. Only the catch that match is executed, the evaluation is made by order priority.

FINALLY: Optional block. Always executed after try - catch block.

THROW: used to throw an exception

THROWS: used at method signature level to declare methods could throw an exception

# Useful Links

Java:
JavaDocs
Collections 1 - Collections 2
Oracle Java SE tutorial

Java 8:
Java 8 in practice - Streams 1
Java 8 in practice - Streams 2
Java 8 in practice - Optional
Java 8 in practice - Virtual Extension Method

Github project course repository and Lessons documentation:
https://github.com/mcolombosperoni/an-introduction-to-backend-for-beginners