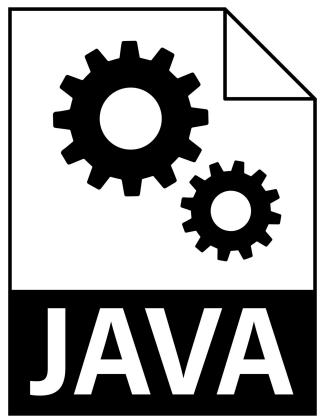
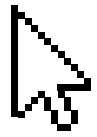


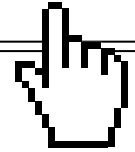


# CISC 3115: Introduction to Programming Using Java



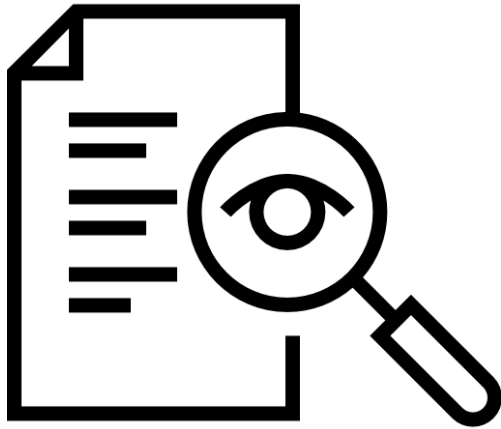
Winter 2025 Prep Workshop





# Itinerary

- 01 Review of Java Fundamentals
  - The Structure of a Java Program
  - Basic Syntax Rules
- 02 What is Object-Oriented Programming (OOP)?
- 03 Classes and Objects
- 04 Inheritance, Abstract Classes, and Interfaces
- 05 Overview and Next Steps



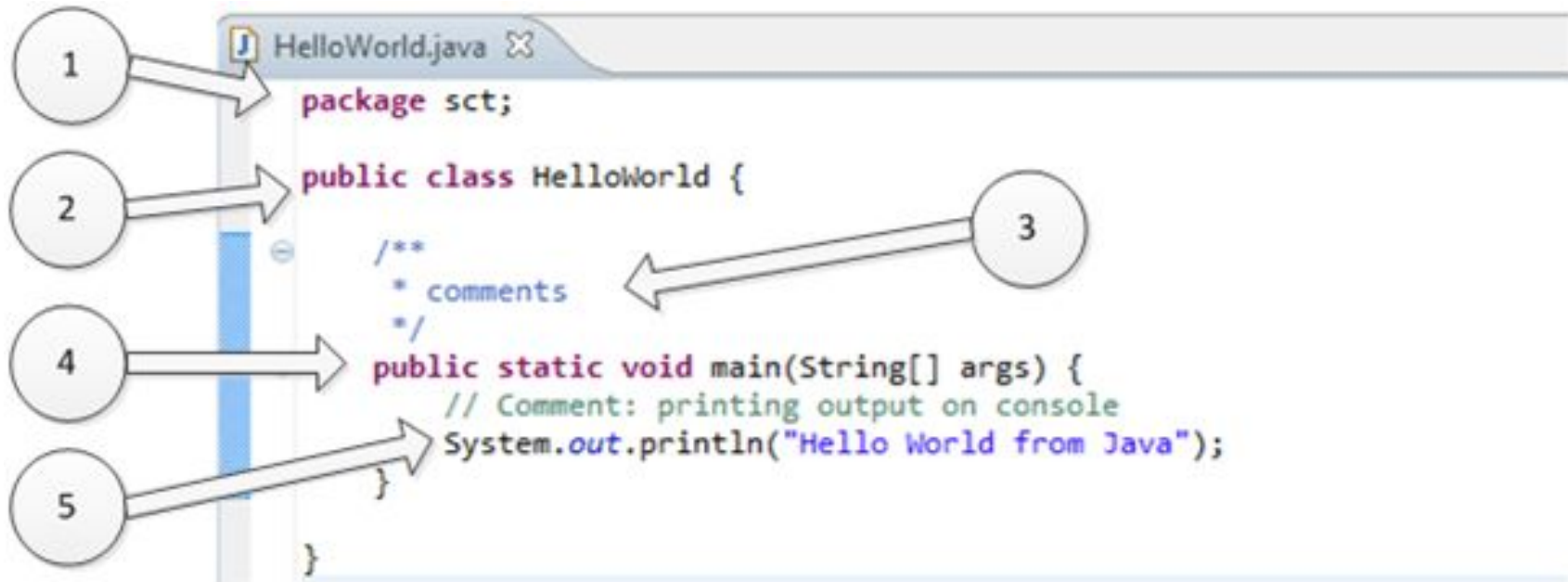
# 01

## Review of Java Fundamentals



# The Structure of A Java Program

- As you already know, the structure of a basic Java program is as follows:





# The Structure of A Java Program

- First, is the **package declaration statement**:
  - It **defines a namespace in which classes are stored**.
  - It is used to **organize the classes based on functionality**.
  - If you omit the package statement, the class names are put into the default package, which has no name.
  - Package statement **cannot appear anywhere in the program**.
  - It **must be the first line of your program** or you can omit it.



# The Structure of A Java Program

- Second, is the **class declaration**:
  - This line has various aspects of java programming:
    - **public**: This is **access modifier keyword which tells compiler access to class.**
    - Various values of access modifiers can be public, protected, private or default (no value).
    - **class**: This keyword is **used to declare a class.**
    - The name of class (HelloWorld) followed by this keyword.



# The Structure of A Java Program

- Third, is **the comment section**:
  - There are three types of Java comments:
    - **Single-Line Comments**: Start with `//` and extend to the end of the line.
    - **Multi-Line Comments**: Start with `/*` and end with `*/`.
      - They can span multiple lines.
    - **Documentation Comments**: Start with `/**` and end with `*/`.
      - These are used to create formal documentation using Javadoc.

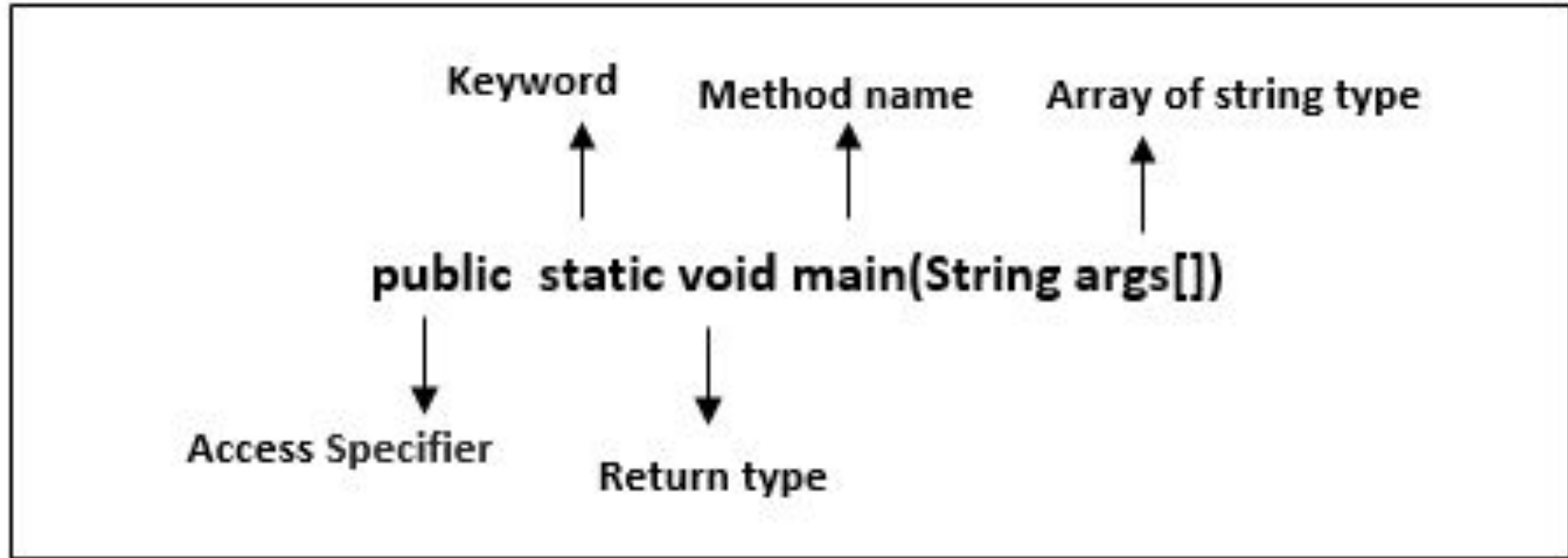


# The Structure of A Java Program

- Fourth, is **the main method declaration**:
  - It is **essential for all executable Java programs**, because the execution of all Java programs starts from the main() method (regardless of other methods).
  - In other words, it is an entry point of the class.
  - It must be inside the class.
  - It is made up of six distinct parts: **the access modifier, the static keyword, the return type, the name/signature, the method parameters, and the method body**



# The Structure of A Java Program





# The Structure of A Java Program

- **public:** is an access specifier
  - We should use a public keyword before the main() method so that JVM can identify the execution point of the program.
  - If we use private, protected, and default before the main() method, it will not be visible to JVM
- **static:** You can make a method static by using the keyword static
  - We should call the main() method without creating an object.
  - Static methods are the method which invokes without creating the objects, so we do not need any object to call the main() method.



# The Structure of A Java Program

- **void:** this is the return type
  - In Java, every method has the return type.
  - The void keyword acknowledges the compiler that main() method does not return any value.
- **main():** It is a default signature which is predefined in the JVM.
  - It is called by JVM to execute a program line by line and end the execution after completion of this method.
- **String [] args:** The main() method also accepts some data from the user.
  - It accepts a group of strings, which is called a string array.
  - It is used to hold the command line arguments in the form of string values.



# The Structure of A Java Program

- Lastly, there is a **print statement** inside of the body of the main method.
- This particular print statement is made up of four parts:
  - **System:** the name of Java utility class.
  - **out:** an object which belongs to System class.
  - **println:** A utility method name which is used to send any String to the console.
  - **“Hello World from Java”:** a String literal set as argument to println method.



# Basic Syntax Rules

- About Java programs, it is very important to keep in mind the following points:
- **Case Sensitivity** - Java is case sensitive, which means identifier Hello and hello would have different meaning in Java.
- **Class Names** - For all class names the first letter should be in Upper Case. If several words are used to form a name of the class, each inner word's first letter should be in Uppercase.
  - Example: class MyJavaClass

# Basic Syntax Rules

- **Method Names** - All method names should start with a Lowercase letter. If several words are used to form the name of the method, then each inner word's first letter should be in Uppercase.
  - Example: `public void myMethodName()`
- **Program File Name** - Name of the program file should exactly match the class name (Remember Java is case sensitive) and append `'.java'` to the end of the name (if the file name and the class name do not match, your program will not compile).
  - Example: If `'MyJavaProgram'` is the class name, the file should be saved as `'MyJavaProgram.java'`



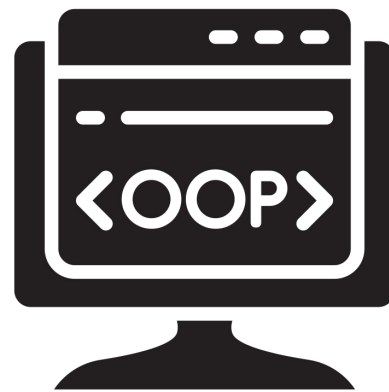
# Basic Syntax Rules

- All Java components require names. Names used for classes, variables, and methods are called **identifiers**.
- In Java, there are several points to remember about identifiers. They are as follows:
  - **All identifiers should begin with a letter (A to Z or a to z), currency character (\$), or an underscore (\_).**
  - **After the first character, identifiers can have any combination of characters.**
  - **A keyword cannot be used as an identifier.**
  - **Most importantly, identifiers are case sensitive.**
  - Examples of legal identifiers: age, \$salary, \_value, \_\_1\_value.
  - Examples of illegal identifiers: 123abc, -salary.



# 02

## What is Object-Oriented Programming (OOP)?







# What is Object-Oriented Programming (OOP)?

- Procedural programming (like C, COBOL, BASIC, etc.) which is about writing procedures or methods that perform operations on the data, while **object-oriented programming (OOP)** is a **fundamental programming paradigm based on the concept of “objects”**
- These objects can **contain data in the form of fields (often known as attributes or properties) and code in the form of procedures (often known as methods).**
- The core concept of the object-oriented approach is **to break complex problems into smaller objects.**



# What is Object-Oriented Programming (OOP)?

- Object-oriented programming has several advantages over procedural programming:
  - **OOP is faster and easier to execute**
  - **OOP provides a clear structure for the programs**
  - **OOP helps to keep the Java code DRY "Don't Repeat Yourself", and makes the code easier to maintain, modify and debug**
  - **OOP makes it possible to create full reusable applications with less code and shorter development time**
- Tip: You should extract out the codes that are common for the application, and place them at a single place and reuse them instead of repeating it



# 03

## Classes and Objects





# Classes and Objects

- You should be partially familiar with the concept of a Java Class from your previous class, but what exactly is a class?
- **A class is defined as a collection of objects.**
- You can also think of a class as **a blueprint from which you can create an individual object.**
- For example, Student is a class while a particular student named Tom is an object.
- To create a class, **we use the keyword class.**



# Classes and Objects

- Properties of Java Classes:
  - It is not a real-world entity. It is just a **template or blueprint or prototype from which objects are created.**
  - It does not occupy memory.
  - It is a group of variables of different data types and a group of methods.
  - It can contain:
    - **Data member(s)**
    - **Method(s)**
    - **Constructor(s)**
    - **Nested Class(s)**
    - **Interface(s)**



# Classes and Objects

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    - **Nested Class(s)**
    - **Interface(s)**

# Classes and Objects

- Most classes you write will have the keyword `public` before them though it is not required.
- Let's create a class called **Person**.
- Classes are almost always named with capitalized names though this is a matter of style, not a rule of the language.
- Here is the basic skeleton of a Person class:

```
public class Person
{
    // define class here - also called the "body" of the class
}
```

# Classes and Objects

- You can create instances of the Person class with the keyword **new** as in **new Person()** and you can declare variables that can **hold a reference to a Person object with Person variableName.**
- Or put it altogether to declare some variables and initialize each one with a reference to a new Person as shown here:

```
Person ada = new Person();  
Person charles = new Person();
```

- So what makes up the body of the class?
- Remember that **objects have both attributes and behaviors.**
- These correspond to **instance variables and methods** in the class definition.

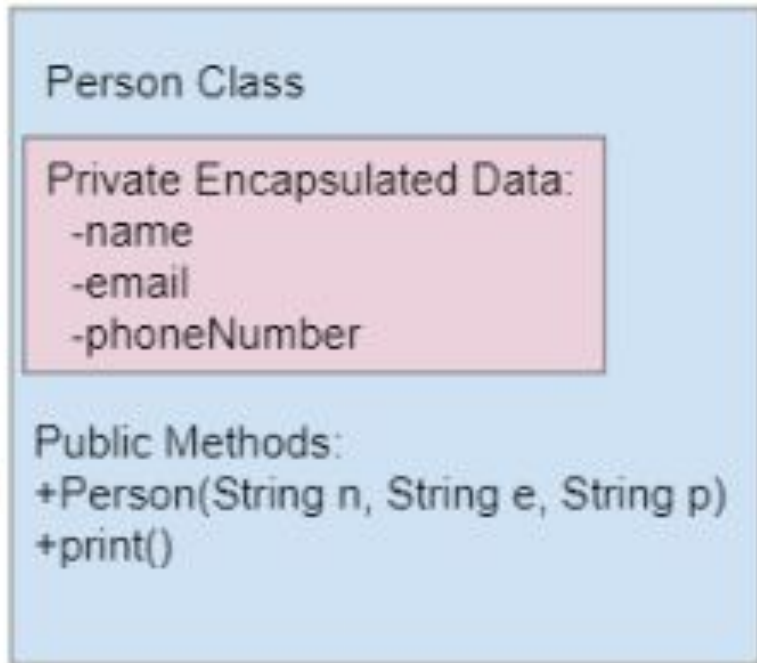




# Classes and Objects

- The first things we define in a class are usually the **instance variables**.
  - They are called that because **each instance of the class (each object) has its own set of variables that aren't shared with other instances**.
- The next thing we define in a class is usually its **constructors**.
  - A constructor's job is to **initialize the instance variables when the object is created**. Usually that will mean they need to take arguments.
- Lastly, the **methods** of the class **define the behaviors of the objects of that class** and share access to the object's instance variables and when a method is called on an object it uses the instance variables for that object.

# Classes and Objects



p1 object

-----  
name = "Sana"  
email = "sana@gmail.com"  
phoneNumber="123-456-7890"

p2 object

-----  
name = "Jean"  
email = "jean@gmail.com"  
phoneNumber="404- 899-9955"



# Classes and Objects

- As we've said, instance variables hold the data for an object. They record what an object needs to know to play its role in the program.
- They are also sometimes called **attributes, fields, or properties**. (Think of private as like your diary, only you should have direct access to it)
- Similarly, in Java **a private instance variable can only be accessed by code in the class that declares the variable.**
- Note: **Instance variables are declared right after the class declaration.**
- They usually start with private then the type of the variable and then a name for the variable. Private means only the code in this class has access to it.

# Classes and Objects

- The Person class declares **3 private instance variables**:

```
// instance variables
private String name;
private String email;
private String phoneNumber;
```

- Once we have created a class like Person, we can create many instances (objects) of the class.
- Each object will have their own copies of the same instance variables but with possibly different values in them



# Classes and Objects

- In the source code for a class, **constructors are usually written after the instance variables and before any methods.**
- The signature of a constructor is similar to the signature of a method **except there is no return type, not even void, and instead of a method name, the name of the constructor is the same as the name of the class.**
- The constructors you write will **almost always be marked public.**
- Like methods, constructors also **have a parameter list specified in parenthesis that declare the variables that will be used to hold the arguments passed when the constructor is called.**



# Classes and Objects

- The easiest way to write a constructor is to not write one.
- If you do not write a constructor your class **will automatically get what is called the default no-argument constructor.**
- **This constructor will initialize all your instance variables to the default value for their type: 0 for int and double, false for boolean, and null for all reference types.**
- If those default values are sufficient to put your object into a valid state you may not need to write a constructor at all.



# Classes and Objects

- Usually, however, if you are writing a class that has instance variables, you need to initialize your instance values to some other values.
- In that case you probably need to write a constructor that takes arguments and uses them to initialize your instance variables.
- For example, look at the constructor from the Person class:

```
public Person(String initName, String initEmail, String initPhone)
{
    name = initName;
    email = initEmail;
    phoneNumber = initPhone;
}
```



# Classes and Objects

- This constructor ensures that all three of the instance variables (name, email, and phoneNumber) in Person are initialized to the values provided by whatever code called the constructor.
- For example, in the constructor call **new Person("Pat", "pat@gmail.com", "123-456-7890")**, the argument **"Pat"** is **passed into the parameter variable initName**, which the constructor then assigns to the instance variable name.
- One important note: **if you do write a constructor, Java will not generate the default constructor for you.**
- This is a good thing because it lets you **make sure that instances of your class are always properly initialized.** With this constructor in place, for instance, there's no way to construct a Person object without providing the three required String values.





# Classes and Objects

- Now to **methods** which **define what we can actually do with an object.**
- The most important methods in a class are the **public methods** since they can be accessed from outside the class.
- You may also write private methods that are not accessible outside of the class and therefore can only be used by other methods inside the same class.
- As you've probably figured out, the public and private keywords determine the external access and visibility of classes, instance variables, constructors, and methods.

# Classes and Objects

- The Person class has a void print method that takes no parameters and prints out all the data stored for a person object.
- As we've discussed, the method can access and use the instance variables defined in the class: name, email, and phoneNumber but will get the values specific to the object we called print on.

```
public void print()
{
    System.out.println("Name: " + name);
    System.out.println("Email: " + email);
    System.out.println("Phone Number: " + phoneNumber);
}
```



```
2 public class Person {
3     //instance variables
4     private String name;
5     private String email;
6     private String phoneNumber;
7
8     //constructor
9     public Person (String n, String e, String pN) {
10        name = n;
11        email = e;
12        phoneNumber = pN;
13    }
14
15    //method
16    public void print() {
17        System.out.println("Name: " + name);
18        System.out.println("Email: " + email);
19        System.out.println("Phone number: " + phoneNumber);
20    }
21 }
```

# Classes and Objects

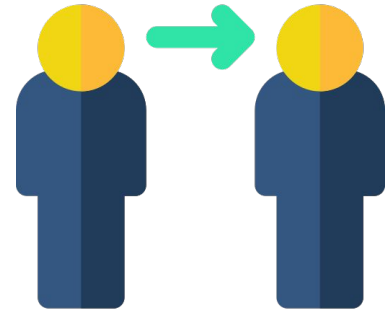
- Now we can write a main method:  
**public static void main (String [] args) {**  
To create an object and test out constructor and method
- First, **we need an object that is an instance of the class such as we get by calling its constructor.**
- Then **we use the dot (.) operator to call its public methods**, for example **p1.print()** means **call the print method on the object p1.**

```
// call the constructor to create a new person  
Person p1 = new Person("Sana", "sana@gmail.com", "123-456-7890");  
// call p1's print method  
p1.print();
```



04

# Inheritance, Abstract Classes, and Interfaces





# Inheritance

- One of the really useful features of Object-Oriented programming is **inheritance**. You may have heard of someone coming into an inheritance, which often means they were left something from a relative that died. Or, you might hear someone say that they have inherited certain traits from their parents.
- In Java, it is possible to inherit attributes and methods from one class to another.
- We group the "inheritance concept" into two categories:
  - **subclass** (child) - the class that inherits from another class
  - **superclass** (parent) - the class being inherited from
- Inheritance in Java is a mechanism in which **one object acquires all the properties and behaviors of a parent object.**



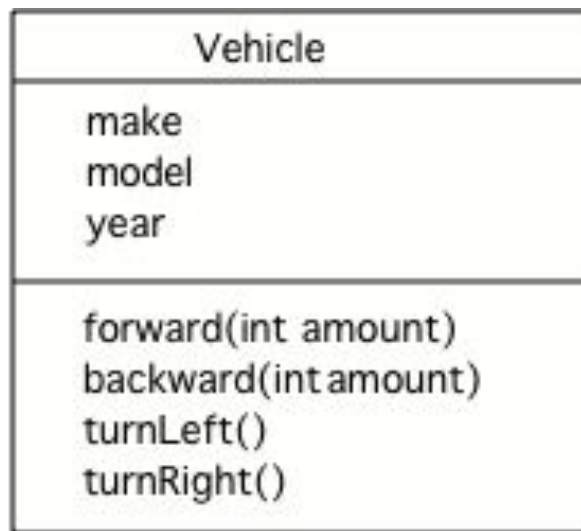
# Inheritance

- The idea behind inheritance in Java is that you can **create new classes that are built upon existing classes**.
- When you inherit from an existing class, you can **reuse methods and fields of the parent class**. Moreover, **you can add new methods and fields in your current class also**.
- To inherit from a class, **use the extends keyword**.
- When one class inherits from another, we can say that it is the same kind of thing as the parent class (the class it inherits from).
- For example, a car is a kind of vehicle, a motorcycle is another kind of vehicle.
- All vehicles have a make, model, and year that they were created, can go forward, backward, turn left, and turn right.
- The following **UML (Unified Modeling Language) class diagram** shows the classes and the relationships between the classes

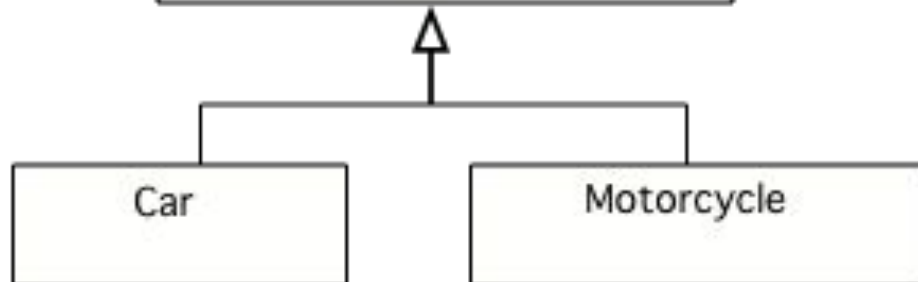


# Inheritance

Parent Class



Children Classes







# Inheritance

- As aforementioned, a parent class is specified using the extends keyword
- **Use the Java keyword extends after the class name and then followed by the parent class name** to specify the parent class as shown below:

```
public class Car extends Vehicle
public class Motorcycle extends Vehicle
```

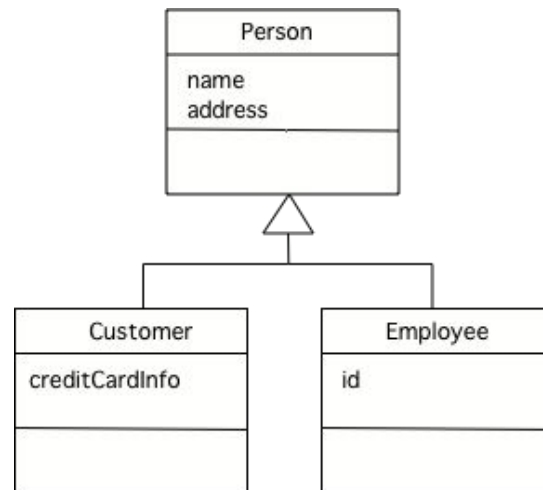
- Note: While a person has two parents, **a Java class can only inherit from one parent class.**
- If you leave off the extends keyword when you declare a class then the class will inherit from the Object class.



# Inheritance

- Inheritance is useful for **generalization** in which case you may notice that several classes share the same data and/or behavior and which you can contain in a parent class.
- It is also useful for **specialization** which is when you want most of the behavior of a parent class, but want to do at least one thing differently and/or add more data.

- For example, **Customers and Employees are both people** so it makes sense use the **general Person class**.
- However, **an employee is a person but also has a unique id**.
- **A customer is a person, but also has a credit card**.
- This is an example of **specialization**.





# Inheritance

- In Java, the **super** keyword is used to refer to the parent class of a subclass.
- Whenever you create the instance of subclass, **an instance of parent class is created implicitly which is referred by super reference variable.**
- super is used to call a superclass constructor, to call a superclass method, and to access a superclass field
- When calling a superclass constructor, the super() statement must be the first statement in the constructor of the subclass.



```
2 public class Customer extends Person {
3     //instance variables
4     private String ccInfo;
5
6
7     //constructor
8     public Customer (String n, String e, String pN, String cc) {
9         super(n, e, pN); //calls constructor of superclass Person
10        ccInfo = cc;
11    }
12
13    //method
14    public void printCC () {
15        System.out.println("Credit card #: " + ccInfo);
16    }
17 }
```



```
2 public class Main {
3     //main method
4     public static void main (String[] args) {
5         //create new Person obj
6         Person p1 = new Person ("Sana", "sana@gmail.com", "123-456-7890");
7         p1.print();
8         System.out.println("-----");
9         Person p2 = new Person ("Lee", "lee@gmail.com", "123-456-7890");
10        p2.print();
11        System.out.println("-----");
12        Customer c1 = new Customer("Tom", "tom@aol.com", "345-678-1230", "1123 3456 2345 6789");
13        c1.print(); //inherited from superclass Person
14        c1.printCC(); //written in subclass Customer
15    }
16 }
```



# Abstraction

- Data **abstraction** is the process of hiding certain details and showing only essential information to the user (i.e. showing only the required features, and hiding how those features are implemented behind the scene)
- Abstraction can be achieved with either **abstract classes** or **interfaces**
- The abstract keyword is a non-access modifier, used for classes and methods:
  - **Abstract class:** is a **restricted class that cannot be used to create objects (to access it, it must be inherited from another class)**.
  - **Abstract method:** can **only be used in an abstract class, and it does not have a body**. The body is provided by the subclass (inherited from).



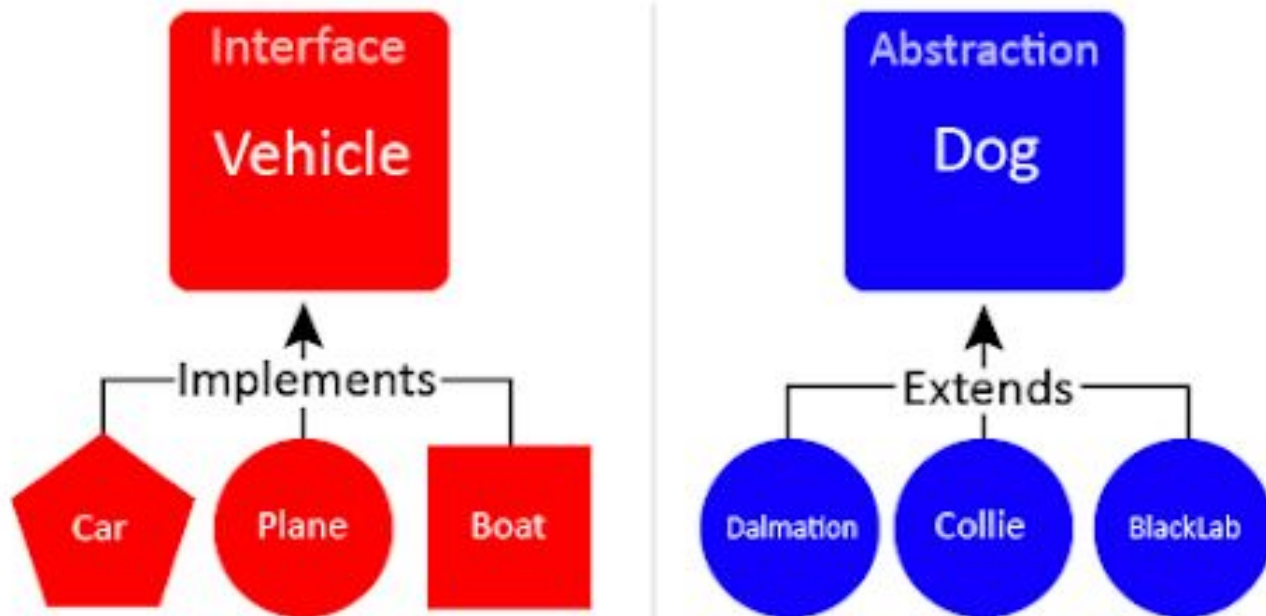
# Abstraction

- Another way to achieve abstraction in Java, is with interfaces.
- An **interface** is a completely "abstract class" that is used to group related methods with empty bodies
- To access the interface methods, the **interface must be "implemented"** (kinda like inherited) **by another class with the implements keyword (instead of extends).**
- The body of the interface method is provided by the "implement" class
- A class **can inherit from only one abstract class**, but it **can implement multiple interfaces.**
- This is because **an abstract class represents a type of object**, while **an interface represents a set of behaviors.**

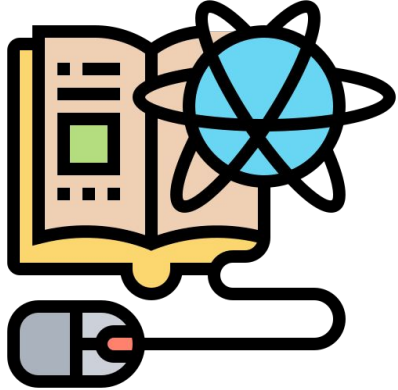


# Abstraction

## Interfaces vs. Abstract Classes







05

# Overview and Next Steps





# Overview

- At this point we have reviewed the basic Java syntax and main fundamentals
- In addition, you should have gained some familiarity with:
  - **The concept of Object-Oriented Programming vs Procedural Programming**
  - **The concept of Classes and Objects**
  - **Inheritance and Subclasses and Superclasses**
  - **The differences between an Abstract Class and an Interface**
- All of which will be covered in further depth in your upcoming 3115 course (along with more concepts as well)



# Next Steps

- You are highly encouraged to read the following text (one of the best intro books for Java AND available as a free PDF online):

**Allen Downey and Chris Mayfield, *Think Java: How to Think Like a Computer Scientist*, 2nd Edition, Version 7.1.0, Green Tea Press, 2020, Creative Commons License.**

- Furthermore, **tutors are available in the Learning Center – 1300 Boylan Hall** if you ever need any study assistance throughout the course
- Congratulations and best of luck on your CS journey! 🎉

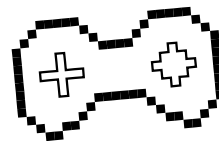


# Thank You!

Presented By:

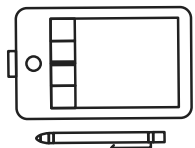
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