Object Oriented Concepts

Reference: Liang, Y., 2015. Intro To Java Programming. 10th ed. Pearson Education Limited.

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Information Hiding in real life

- Information Hiding is one of the most important principles of OOP inspired from real life which says that all information should not be accessible to all persons. Private information should only be accessible to its owner.

- ***Definition:***

Showing only those details to the outside world which are necessary for the outside world and hiding all other details from the outside world.

- **Examples:**

✔ An email server may have account information of millions of people but it will share only our account information with us if we request it to send anyone else accounts information our request will be refused.

✔ Ali's name and other personal information is stored in his brain we can't access this information directly. For getting this information we need to ask Ali about it and will be up to Ali how much details he would like to share with us.

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Information Hiding in OOP:

- In OOP it is,

"Hiding the object details(state and behavior) from the users"

- *In OOP information hiding is done through following principles:*
  - *All information related to object is stored within the object*
  - *It is hidden from the outside world*
  - *It can only be manipulated by the object itself.*
- We can achieve information hiding using Encapsulation and Abstraction.

Advantages of Information Hiding:

- Following are two major advantages of information hiding
  - It simplifies our OOM.
  - It does affect the OOM if we change the implementation of function.

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Interface

- It is a set of function of an object that he wants to expose to other objects.
- Different objects may need different functions of an object so interface of an object may be different for different objects.
- Interfaces are necessary for object communication. Each object provides interfaces (operations) to other objects through these interfaces other objects communicate with this object.
- Example- interface of a car
  - Steer wheels
  - Accelerate
  - Change Gear
  - Apply brakes
  - Turn Lights ON/OFF

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Implementation

- It is actual implementation of the behavior of the object in any object oriented language.
- It has two parts,
  - Internal data structures to hold an object state that will be hidden from us it will store values for an object data members.
  - Functionality in the form of member functions to provide required behavior.
- Example:
  - Address Book in a Phone

Contacts details saved in the SIM of a phone.

- Physical structure of SIM card as Data Structure.
- And Read/Write operations provided by the phone as Functionality

Separation of Interface and Implementatio

- We show interface of an object to outside world and hide the actual implementation from outside world. The benefit of using this approach is that our object interface to outside world becomes independent from inside implementation of that interface.
- This is achieved through the concept of information hiding

Real life example of Separation of interface and implementation.

  - Driver has a standard interface to drive a car and using that interface he drive can drive any car regardless of its model or type whatever engine type it has or whatever type of fuel it is using.

The Unified Modeling Language (UML)

- The Unified Modeling Language (UML) The UML is a graphical “language” for modeling computer programs. “Modeling” means to create a simplified representation of something, as a blueprint models a house. The UML provides a way to visualize the higher-level organization of programs without getting mired down in the details of actual code.
- The UML began as three separate modeling languages, one created by Grady Booch at Rational Software, one by James Rumbaugh at General Electric, and one by Ivar Jacobson at Ericson. Eventually Rumbaugh and Jacobson joined Booch at Rational, where they became known as the three amigos. During the late 1990s they unified (hence the name) their modeling languages into the Unified Modeling Language. The result was adopted by the Object Management Group (OMG), a consortium of companies devoted to industry standards.

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Why do we need the UML?

- One reason is that in a large computer program it's often hard to understand, simply by looking at the code, how the parts of the program relate to each other. As we've seen, object-oriented programming is a vast improvement over procedural programs. Nevertheless, figuring out what a program is supposed to do requires, at best, considerable study of the program listings.
- The trouble with code is that it's very detailed. It would be nice if there were a way to see a bigger picture, one that depicts the major parts of the program and how they work together. The UML answers this need.

Why we need UML?

- The most important part of the UML is a set of different kinds of diagrams. Class diagrams show the relationships among classes, object diagrams show how specific objects relate, sequence diagrams show the communication among objects over time, use case diagrams show how a program's users interact with the program, and so on. These diagrams provide a variety of ways to look at a program and its operation.
- The UML plays many roles besides helping us to understand how a program works. It can help in the initial design of a program. In fact, the UML is useful throughout all phases of software development, from initial specification to documentation, testing, and maintenance.
- The UML is not a software development process. Many such processes exist for specifying the stages of the development process. The UML is simply a way to look at the software being developed. Although it can be applied to any kind of programming language, the UML is especially attuned to OOP.

Exercise

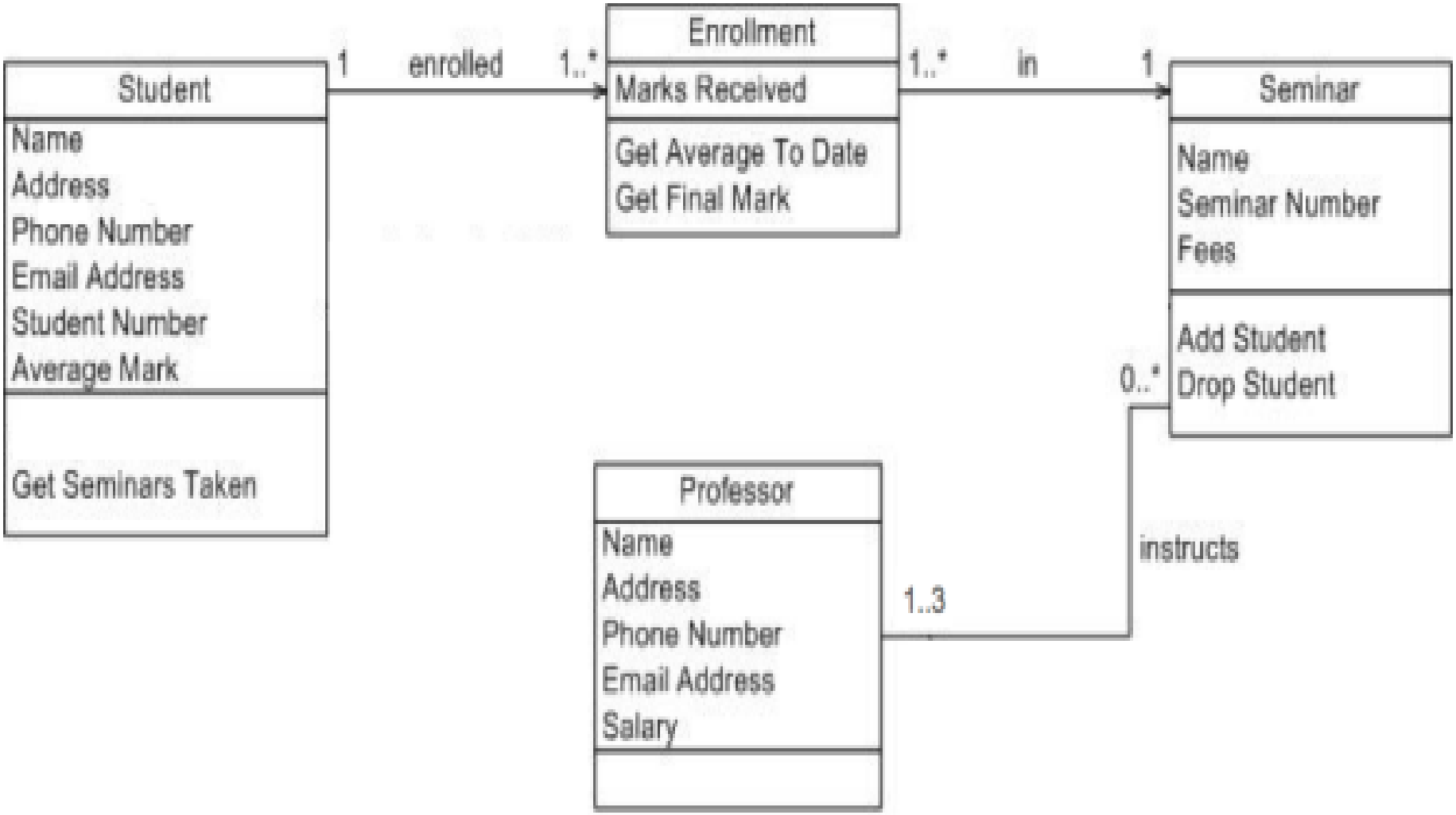
According to your understanding make UML of

Professor

Student

Enrollment

Seminar


Student
Name
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Enrollment
Marks Received
Get Average To Date
Get Final Mark
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in
1
Seminar
Name
Seminar Number
Fees
Add Student
Drop Student
0..*
instructs
1..3
Professor
Name
Address
Phone Number
Email Address
Salary

Exercise

According to your understanding make uml of

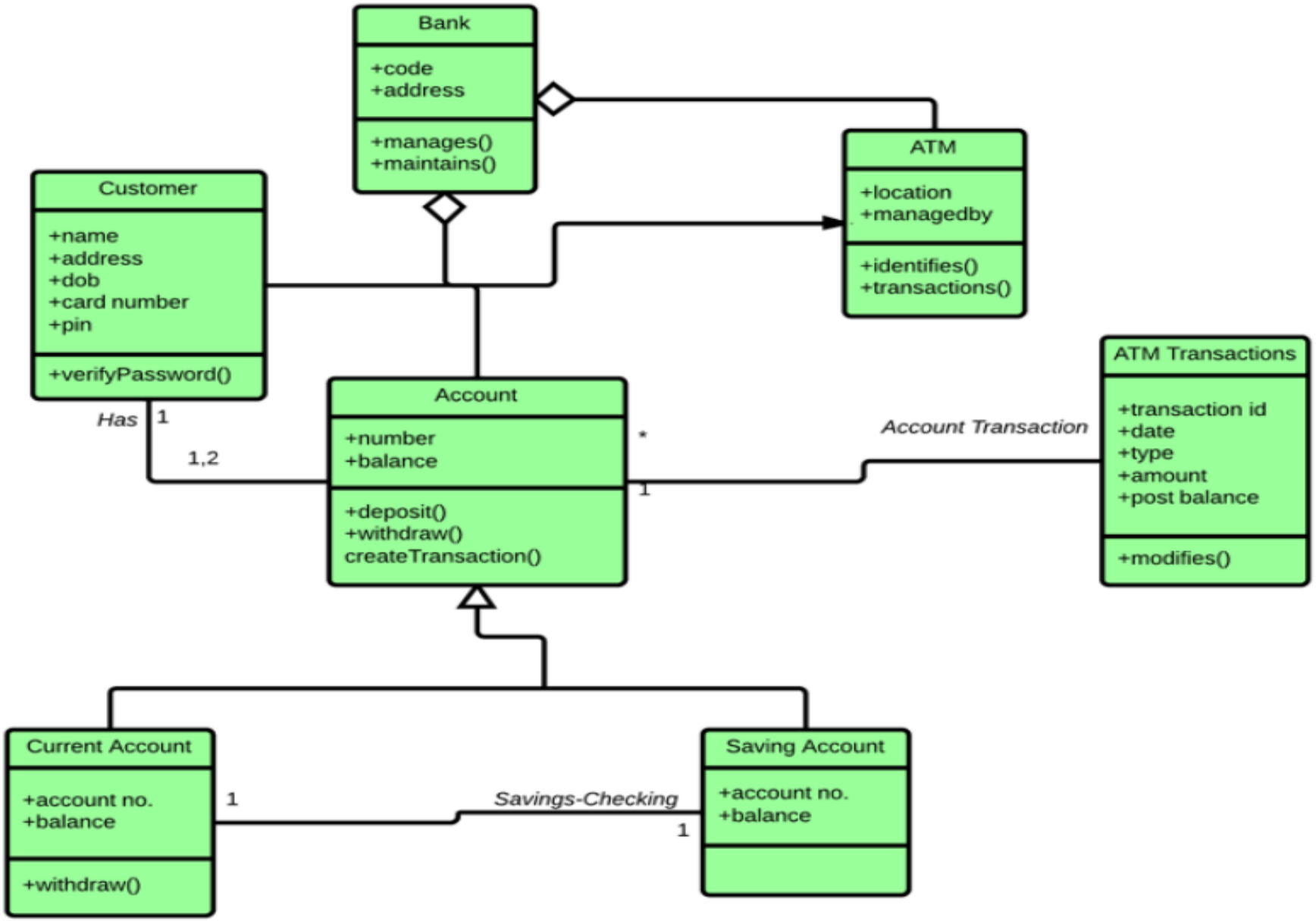
bank

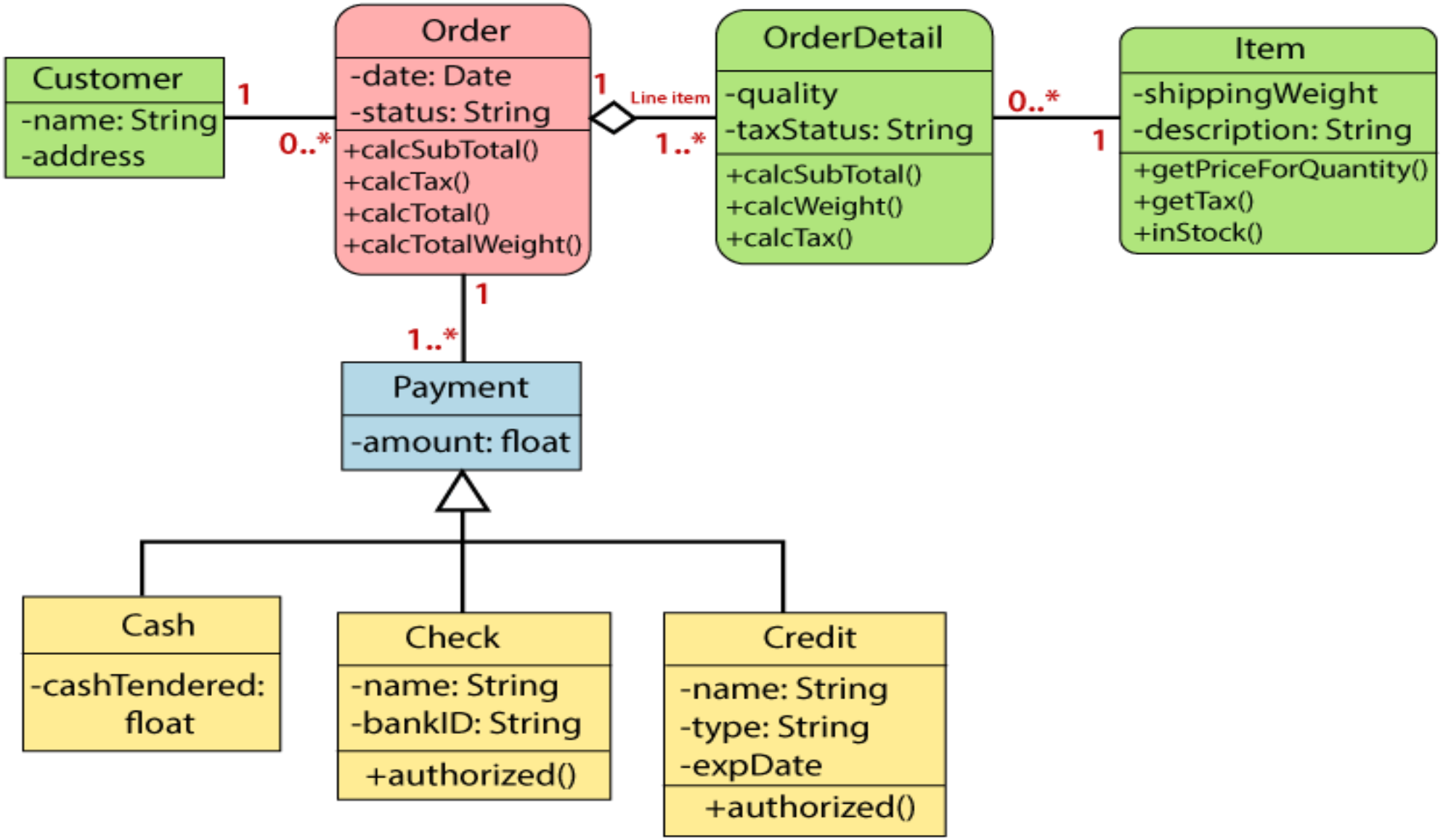
Customer

Account --- Saving , Current

ATM

ATM Transaction


Bank
+code
+address
+manages()
+maintains()
ATM
+location
+managedby
+identifies()
+transactions()
Customer
+name
+address
+dob
+card number
+pin
+verifyPassword()
Has
1
1,2
Account
+number
+balance
+deposit()
+withdraw()
createTransaction()
*
1
Account Transaction
ATM Transactions
+transaction id
+date
+type
+amount
+post balance
+modifies()
Current Account
+account no.
+balance
+withdraw()
1
Savings-Checking
1
Saving Account
+account no.
+balance


Customer
-name: String
-address
1
0..*
Order
-date: Date
-status: String
+calcSubTotal()
+calcTax()
+calcTotal()
+calcTotalWeight()
1
Line item
1..*
OrderDetail
-quality
-taxStatus: String
+calcSubTotal()
+calcWeight()
+calcTax()
0..*
1
Item
-shippingWeight
-description: String
+getPriceForQuantity()
+getTax()
+inStock()
1
1..*
Payment
-amount: float
Cash
-cashTendered: float
Check
-name: String
-bankID: String
+authorized()
Credit
-name: String
-type: String
-expDate
+authorized()

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Introduction to Java

- Java is a programming language (Technology) based on OOP.
- It was first developed by James Gosling at Sun Microsystems, which is now a part of Oracle Corporation.
- It was released in 1995 as a part of Sun Microsystems' Java platform.
- The language has developed much of its syntax from C and C++.

Why Java?

Java is a powerful and versatile programming language for developing software running on mobile devices, desktop computers, and servers.

- Internet programming language.
- *write it once and run it anywhere.*
- General purpose programming language.

Characteristics of Java

- ✔ Java Is Simple
- ✔ Java Is Object-Oriented
- ✔ Java Is Distributed
- ✔ Java Is Robust
- ✔ Java Is Secure
- ✔ Java Is Architecture-Neutral
- ✔ Java Is Portable
- ✔ Java's Performance
- ✔ Java Is Multithreaded
- ✔ Java Is Dynamic

Java Editions

- **Java Standard Edition**

(Java SE) to develop client-side standalone applications or applets.

- **Java Enterprise Edition**

(Java EE) to develop server-side applications, such as Java servlets, JavaServer Pages (JSP), and JavaServer Faces (JSF).

- **Java Micro Edition**

(Java ME) to develop applications for mobile devices, such as cell phones.

Programming in Java

- For executing any java program, you need to

  - ✔Download the JDK and install it.
  - ✔ set path of the jdk/bin directory.
  - ✔ create the java program
  - ✔ compile and run the java program

https://www.oracle.com/java/technologies/downloads/#jdk17-windows

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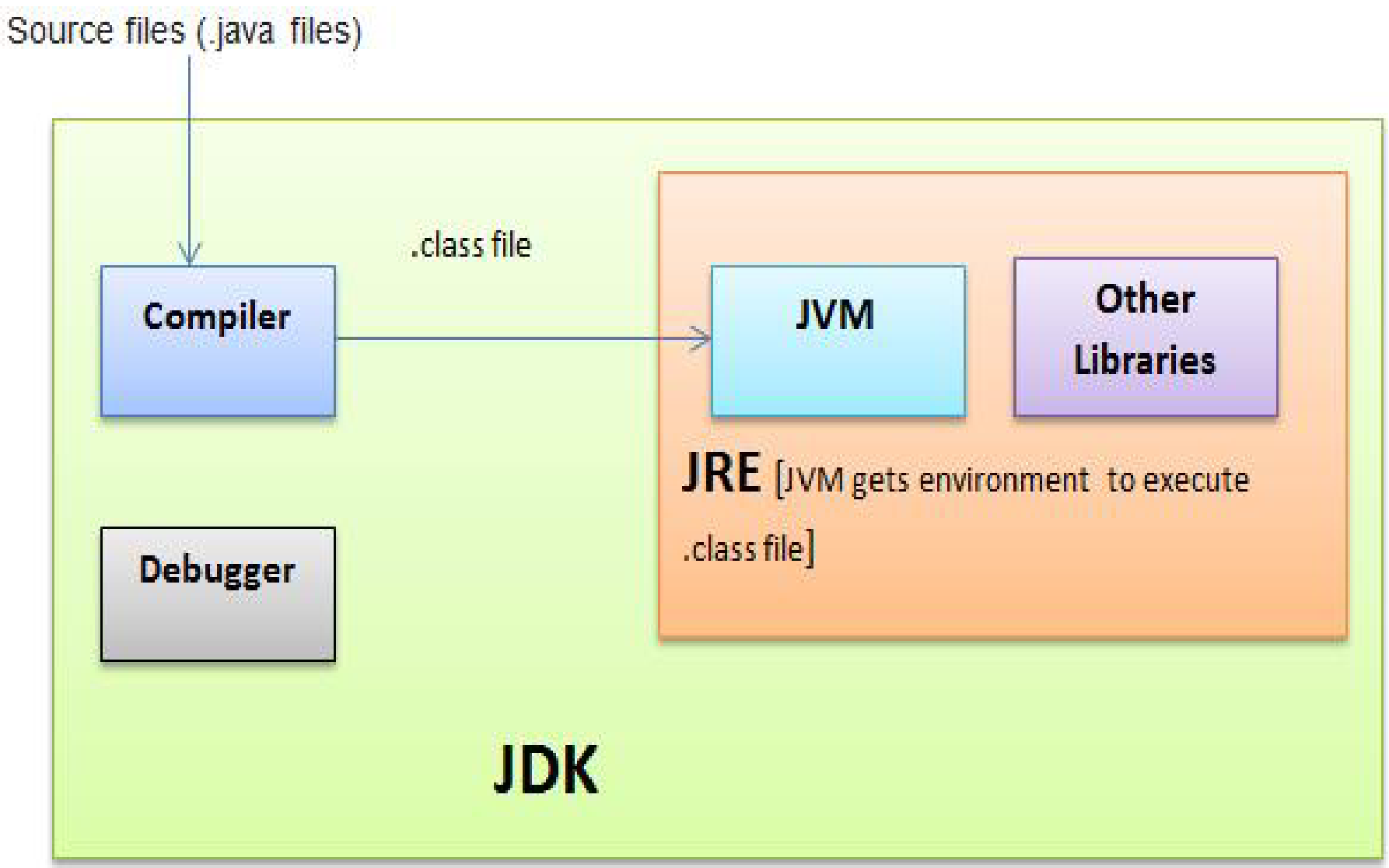
JDK, JRE & JVM

- **JVM:** Java Virtual Machine is an abstract machine. It is an interpreter. It is a specification that provides runtime environment in which java bytecode can be executed.

- **JRE:** Java Runtime Environment. It basically implements the JVM where Java programs run on. It physically exists. It contains set of libraries + other files that *JVM* uses at runtime.

- **JDK:** It's the full featured Software Development Kit for Java, including *JRE*, and the compilers and tools (like Java Debugger) to create and compile programs.

JDK, JRE & JVM


Source files (.java files)
.class file
Compiler
JVM
Other Libraries
JRE [JVM gets environment to execute .class file]
Debugger
JDK

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.java VS .class

Java file:

The actual java source file which is written by java programmer.

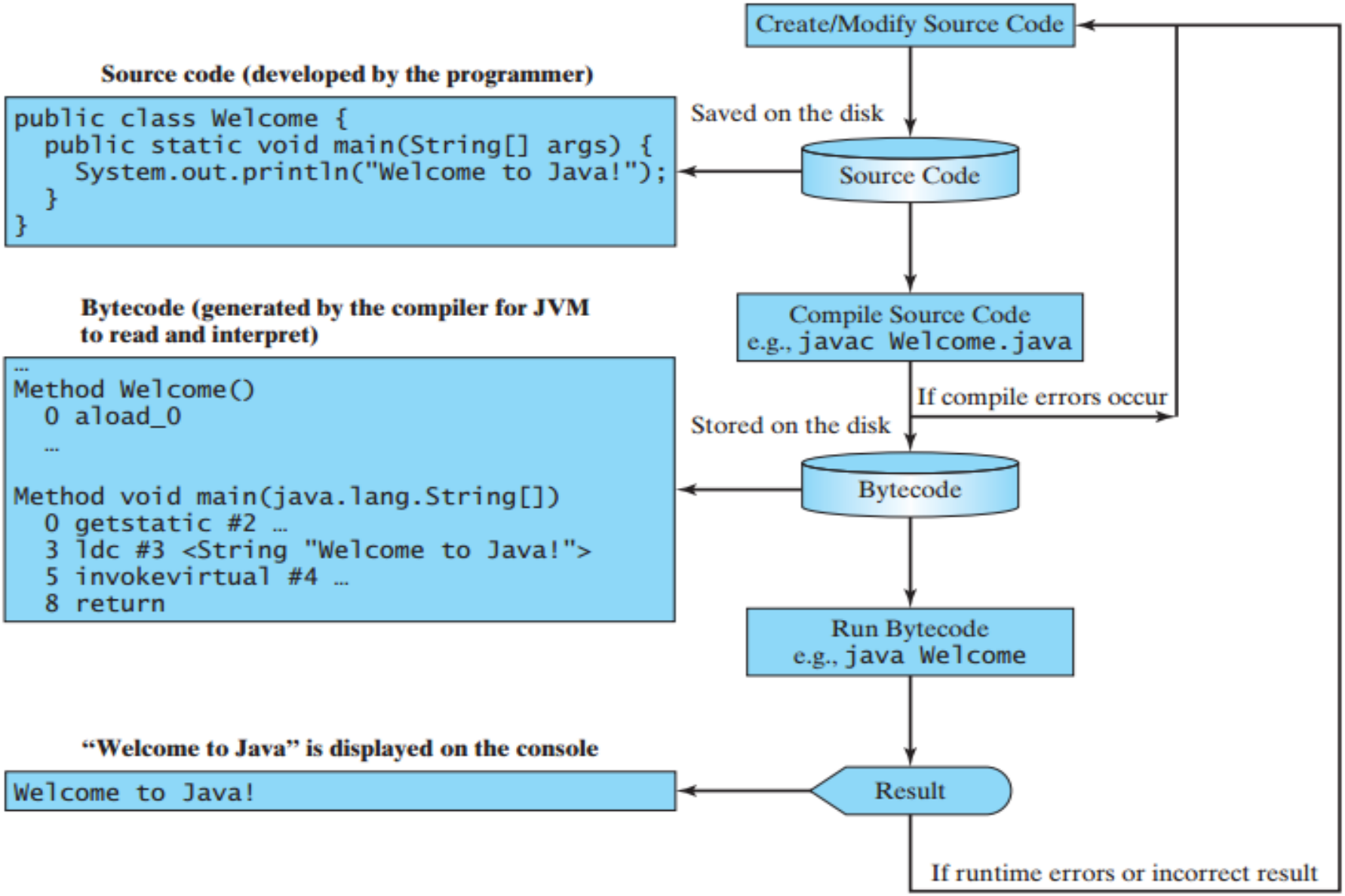
- Human readable
- Before compilation.

Class file:

A Java class file is a file containing Java bytecode that can be executed on the Java Virtual Machine (JVM).

- After compilation.
- Intended for machine to execute.

Code Compilation



First Java Program

```
class simple{
public static void main(String
args[])
{
System.out.println("Hello java");
}
}
```

Executing Java Program

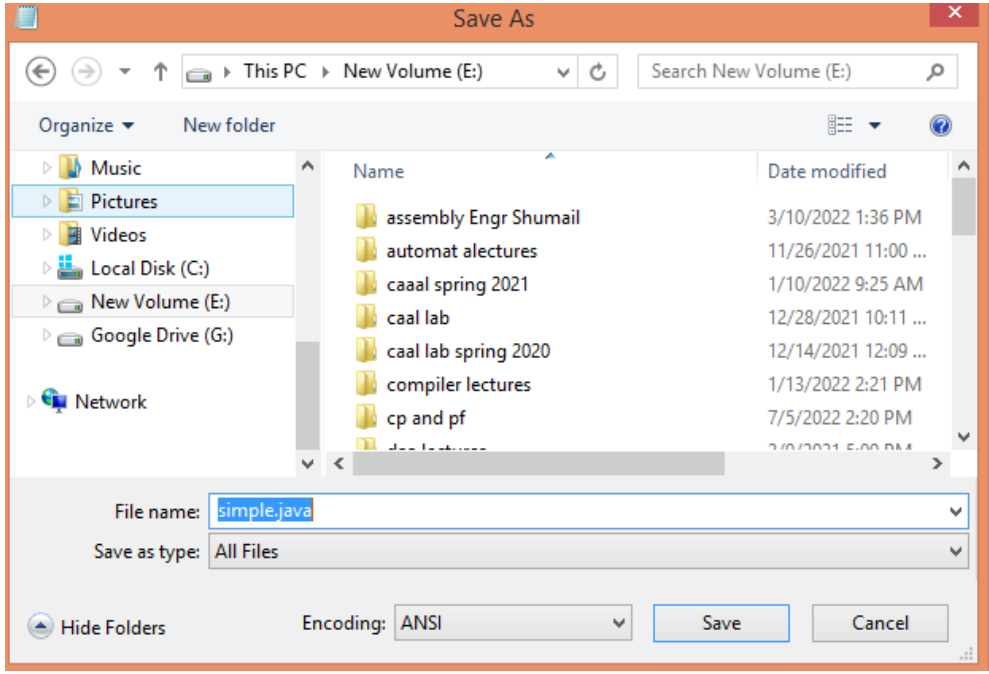
- Save the file with name Simple and .java extension in E drive.
- Compile the program

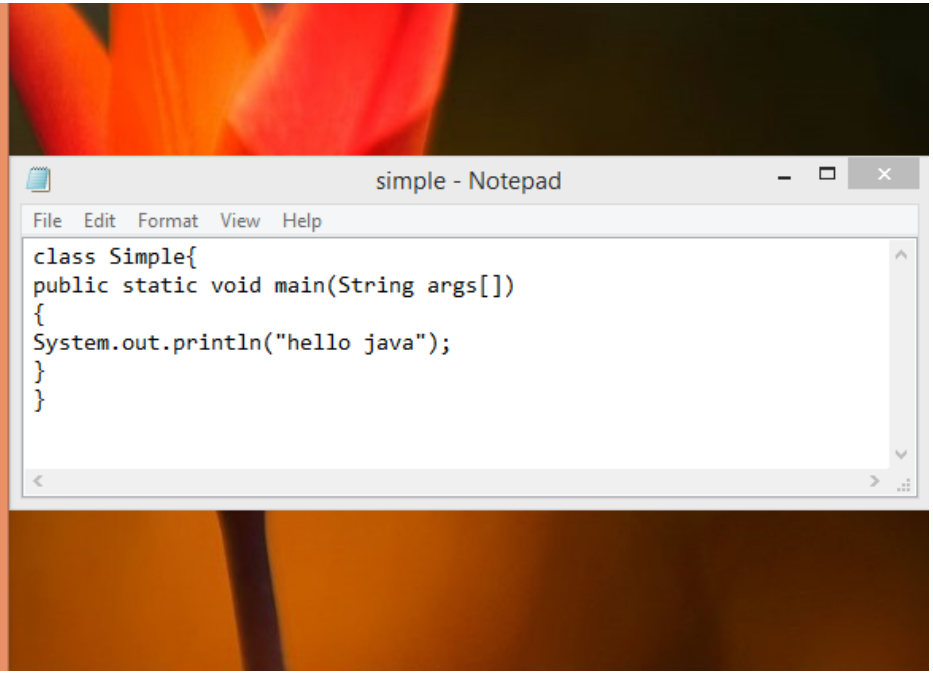
```
E:\>set path=C:\Program Files\Java\jdk-17.0.2\bin

E:\>javac Simple.java
```

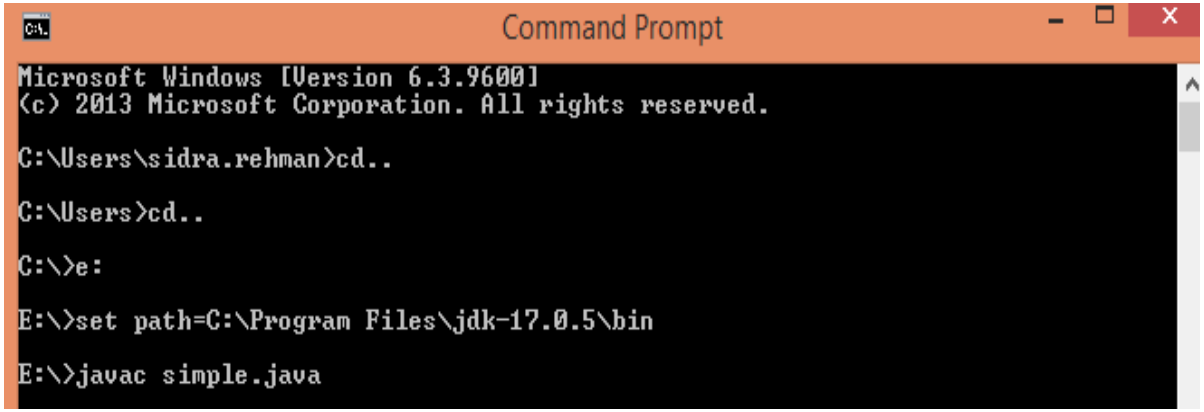
- Execute the program

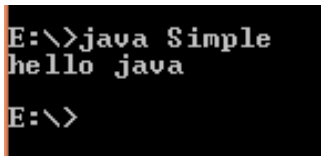
```
E:\>java Simple
```

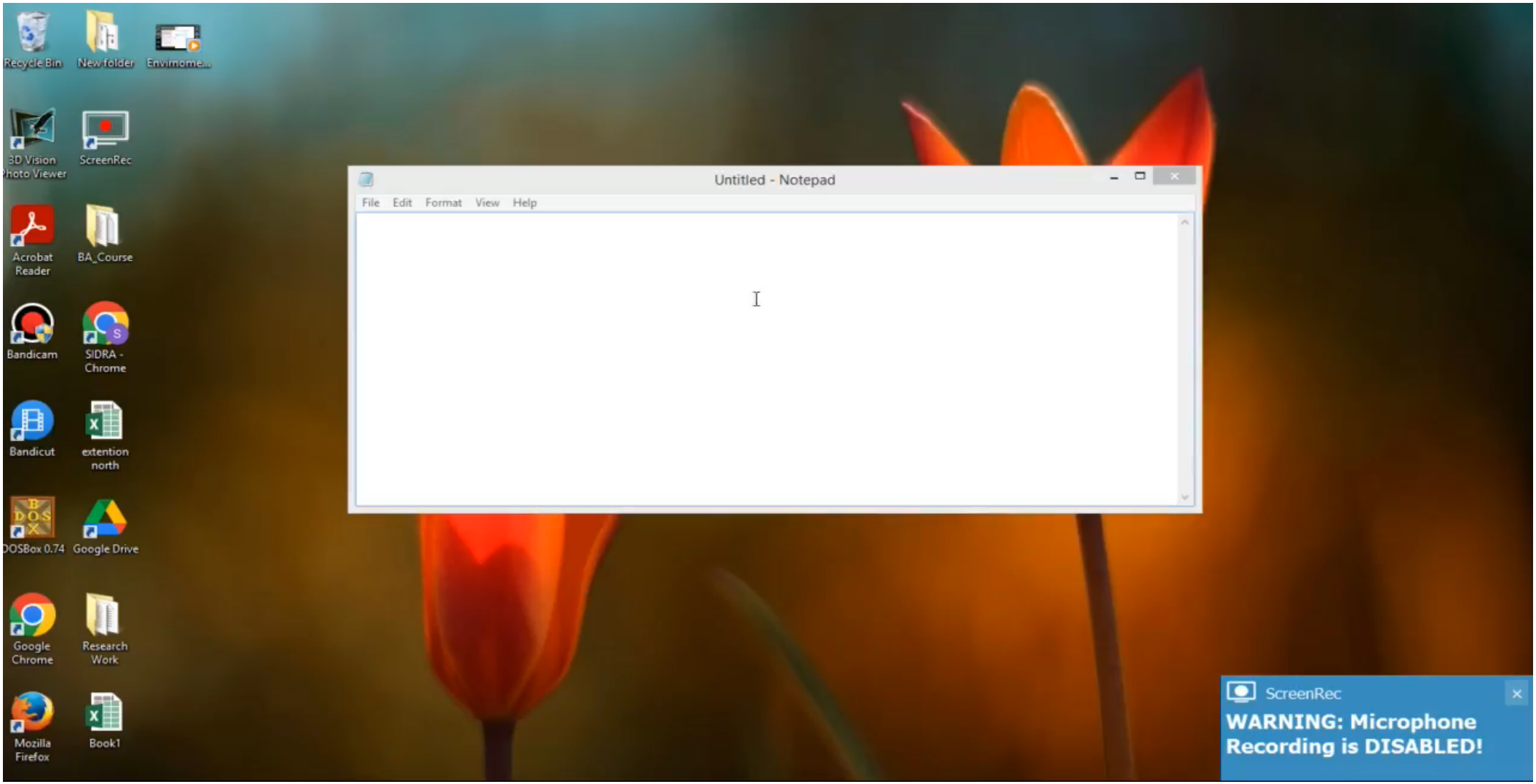

This PC
Local Disk (C:)
Program Files
jdk-17.0.5
bin

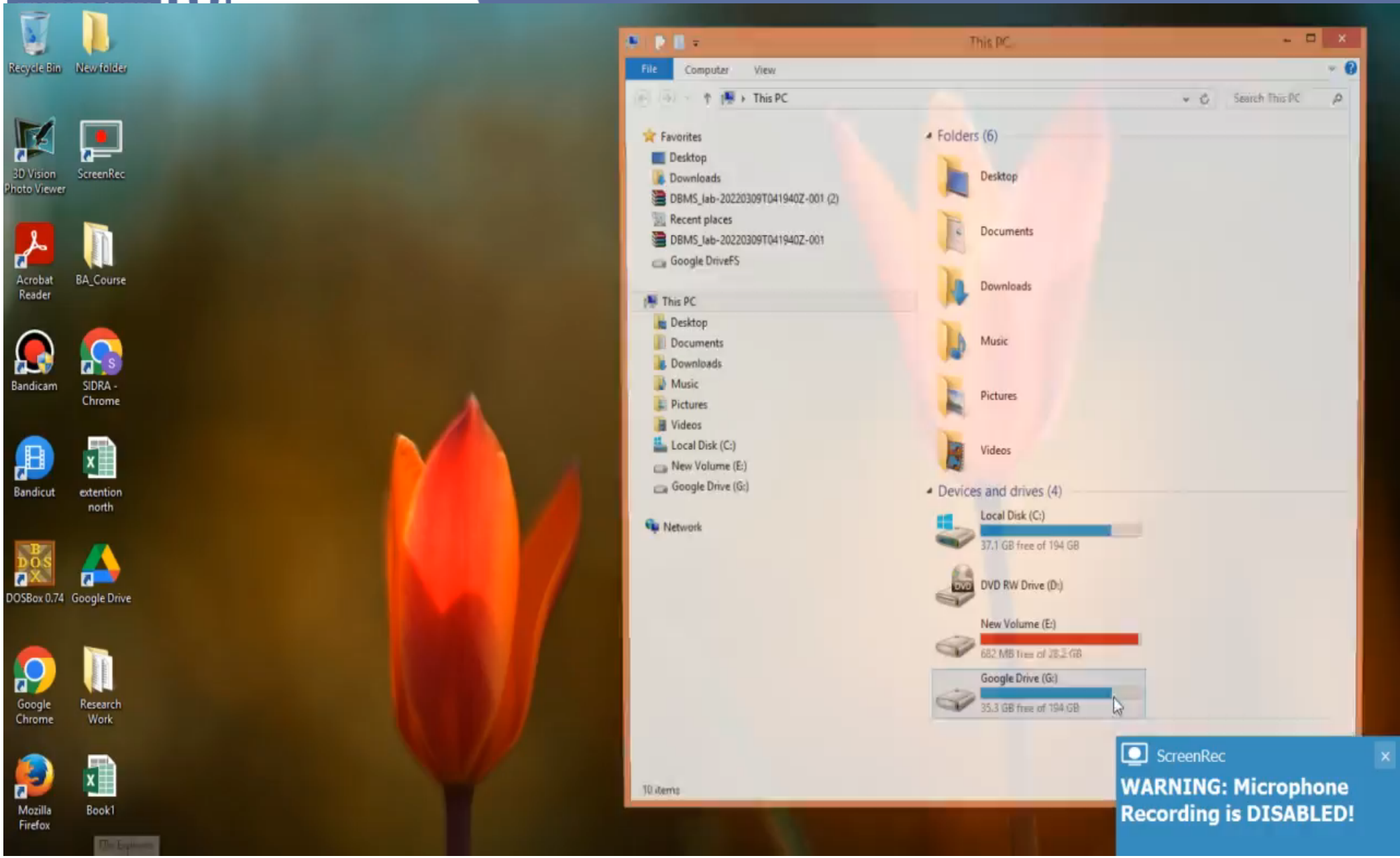

Save As
This PC
New Volume (E:)
Search New Volume (E:)
Organize
New folder
Music
Pictures
Videos
Local Disk (C:)
New Volume (E:)
Google Drive (G:)
Network
Name
Date modified
assembly Engr Shumail 3/10/2022 1:36 PM
automat alectures 11/26/2021 11:00 ...
caaal spring 2021 1/10/2022 9:25 AM
caal lab 12/28/2021 10:11 ...
caal lab spring 2020 12/14/2021 12:09 ...
compiler lectures 1/13/2022 2:21 PM
cp and pf 7/5/2022 2:20 PM
File name: simple.java
Save as type: All Files
Hide Folders
Encoding: ANSI
Save
Cancel


simple - Notepad
File Edit Format View Help
class Simple{
public static void main(String args[])
{
System.out.println("hello java");
}
}


Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.
C:\Users\sidra.rehman>cd..
C:\Users>cd..
C:\>e:
E:\>set path=C:\Program Files\jdk-17.0.5\bin
E:\>javac simple.java


E:\>java Simple
hello java
E:\>


Recycle Bin
New folder
Envimome...
3D Vision Photo Viewer
ScreenRec
Acrobat Reader
BA_Course
Bandicam
SIDRA - Chrome
Bandicut
extention north
DOSBox 0.74
Google Drive
Google Chrome
Research Work
Mozilla Firefox
Book1
Untitled - Notepad
File Edit Format View Help
ScreenRec
WARNING: Microphone Recording is DISABLED!


Recycle Bin
New folder
3D Vision Photo Viewer
ScreenRec
Acrobat Reader
BA_Course
Bandicam
SIDRA - Chrome
Bandicut
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DOSBox 0.74
Google Drive
Google Chrome
Research Work
Mozilla Firefox
Book1
This PC
File
Computer
View
Favorites
Desktop
Downloads
DBMS_lab-20220309T041940Z-001 (2)
Recent places
DBMS_lab-20220309T041940Z-001
Google DriveFS
This PC
Desktop
Documents
Downloads
Music
Pictures
Videos
Local Disk (C:)
New Volume (E:)
Google Drive (G:)
Network
Folders (6)
Desktop
Documents
Downloads
Music
Pictures
Videos
Devices and drives (4)
Local Disk (C:)
37.1 GB free of 194 GB
DVD RW Drive (D:)
New Volume (E:)
682 MB free of 28.2 GB
Google Drive (G:)
35.3 GB free of 194 GB
10 items
ScreenRec
WARNING: Microphone Recording is DISABLED!

Classes

- *A class defines the properties and behaviors for objects.*
- *In OOP terminology we say, class of an object contains collection of*
    1. *Methods*
    2. *Data.*
- Classes are structures that defines objects.
- A class is a template, blueprint, or contract that defines what an object's data fields and methods will be.
- A Java class uses variables to define properties and methods to define actions.
- A class is a programmer-defined type and is a reference type.

class Syntax


```
class classname {
    type instance-variable1;
    type instance-variable2;
    // ...
    type instance-variableN;

    type methodname1(parameter-list) {
      // body of method
    }
    type methodname2(parameter-list) {
      // body of method
  }
  // ...
  type methodnameN(parameter-list) {
      // body of method
  }
}
```

Simple Program to Add two numbers:

```
public class AddTwoNumbers
{
public static void main(String[] args) {
int num1 = 5, num2 = 15, sum;
sum = num1 + num2;
System.out.println("Sum of these numbers: "+ sum);
}
 }
```

Output:

Sum of these numbers: 20