

Lesson 03 Demo 07

Implementing an Abstract Class

Objective: Using abstract classes in Java

Tools required: Eclipse IDE

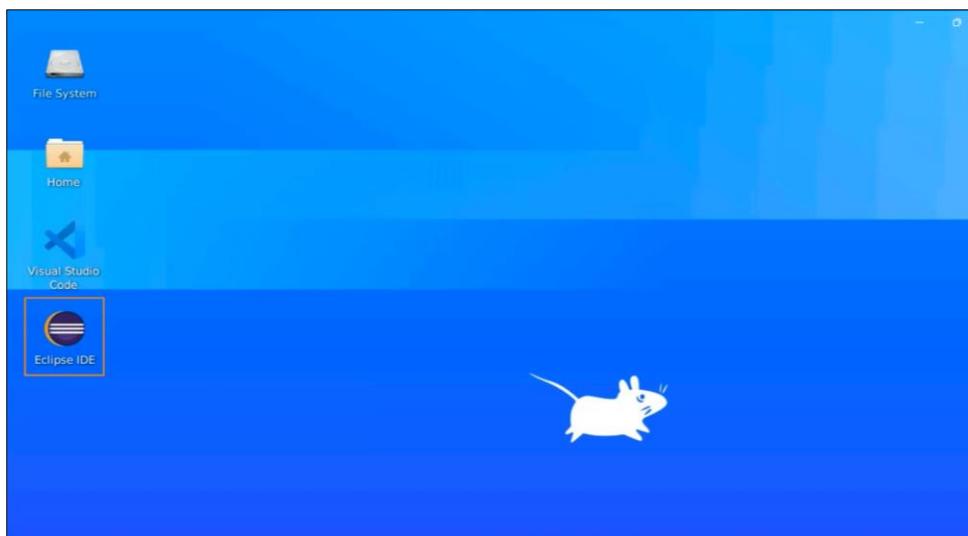
Prerequisites: None

Steps to be followed:

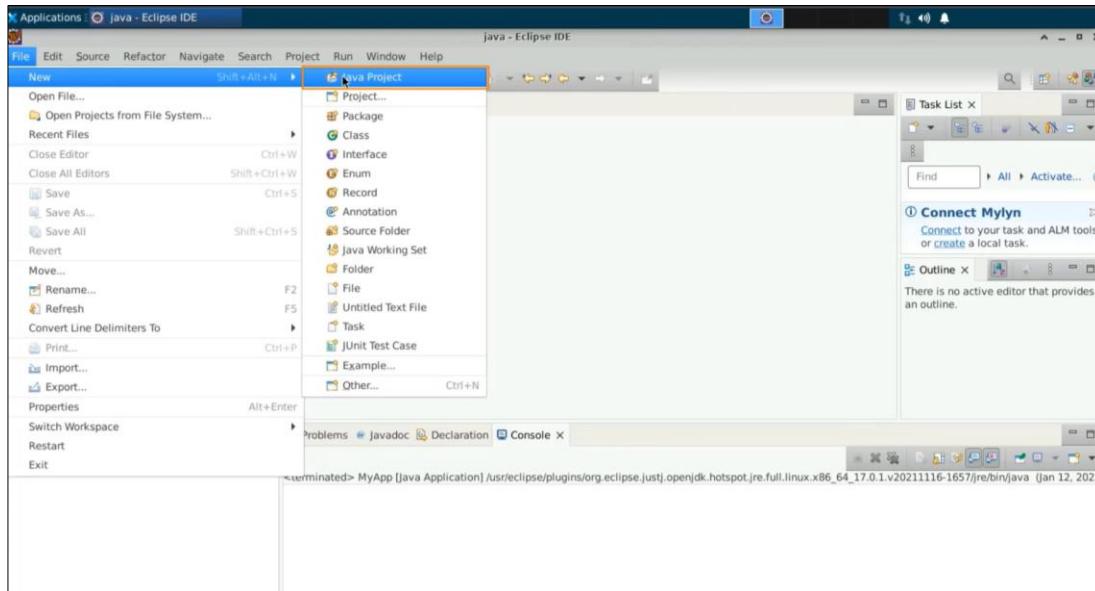
1. Create a class called AbstractDemo, followed by selecting the main method
2. Write a class called cab and create a constructor for cab class
3. Create the object of a regular class
4. Understand the concept of abstract class with examples
5. Execute the code, along with the use of regular methods

Step 1: Create a class called AbstractDemo, followed by selecting the main method

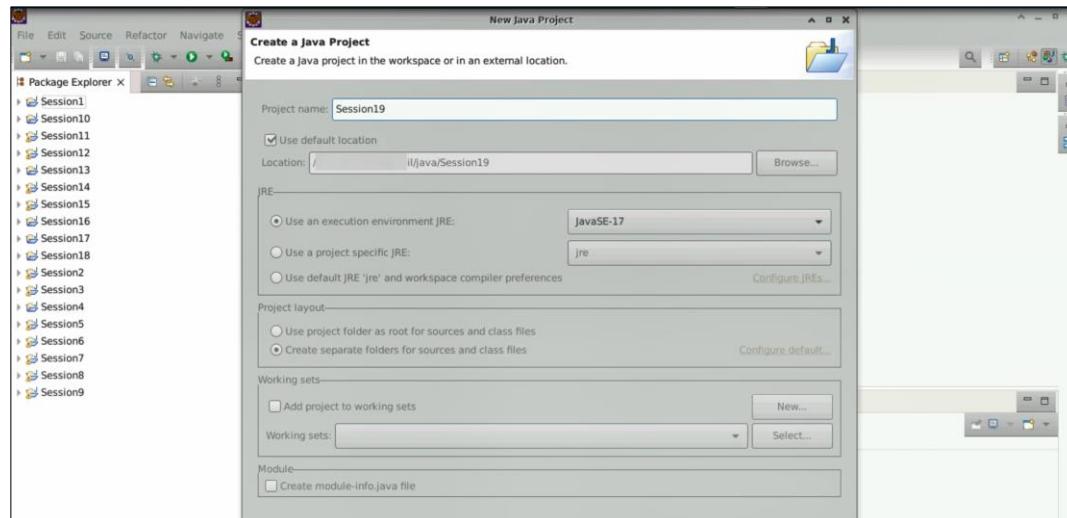
1.1 Open the **Eclipse IDE**



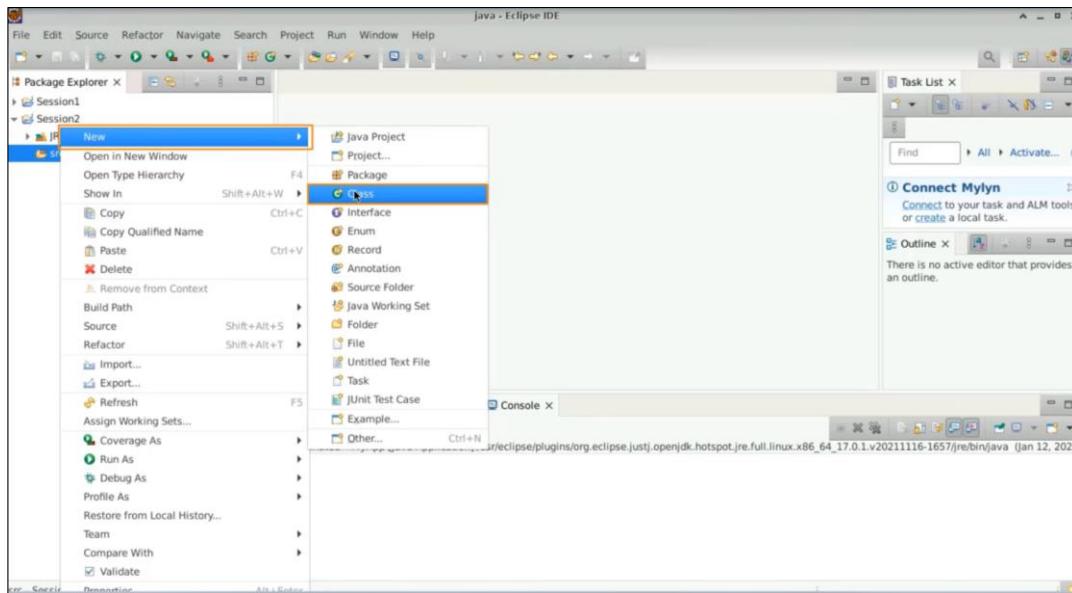
1.2. Select File, then New, and then Java project



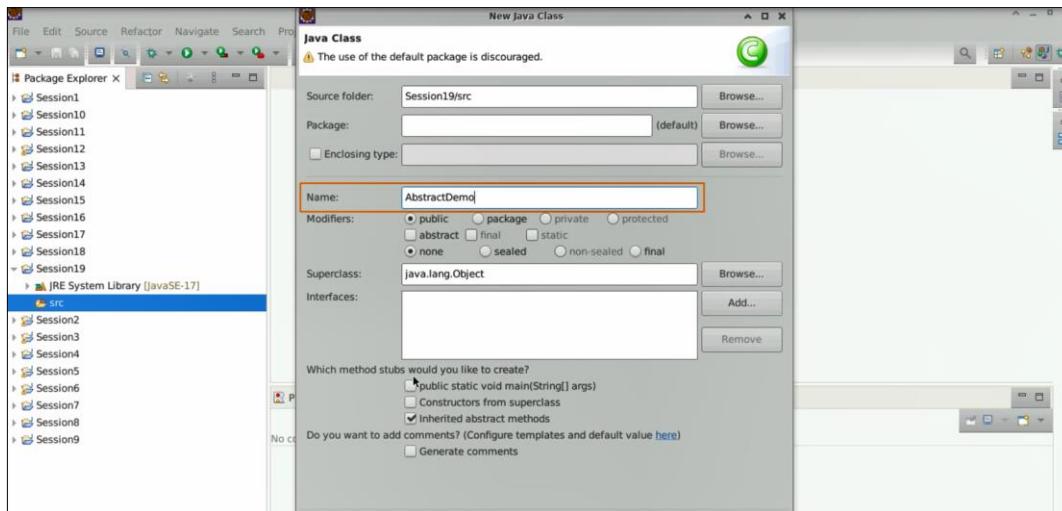
1.3 Name the project “Session19”, uncheck “Create a module info dot Java file”, and press Finish



1.4 With a Session19 on the src, do a right-click and create a new class

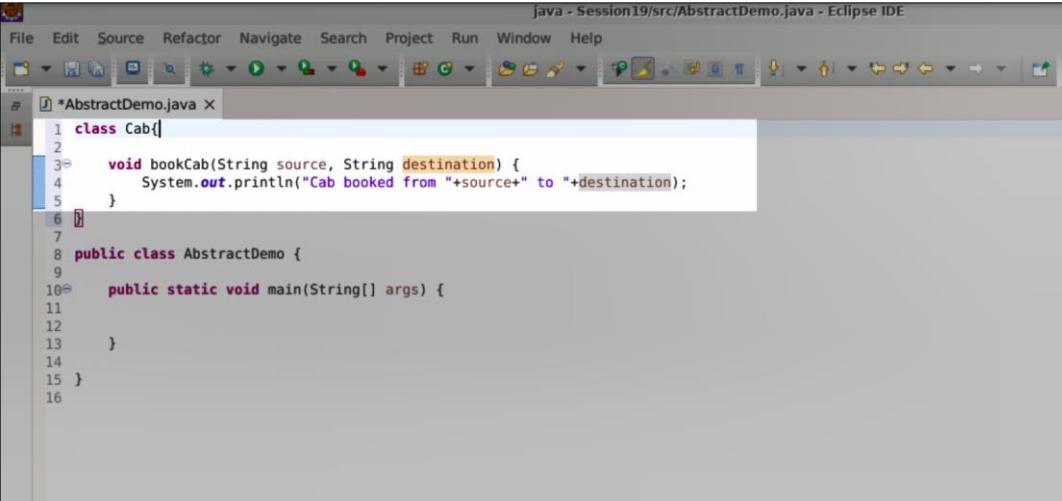


1.5 Name this class as an AbstractDemo, then select the main method, and then select finish



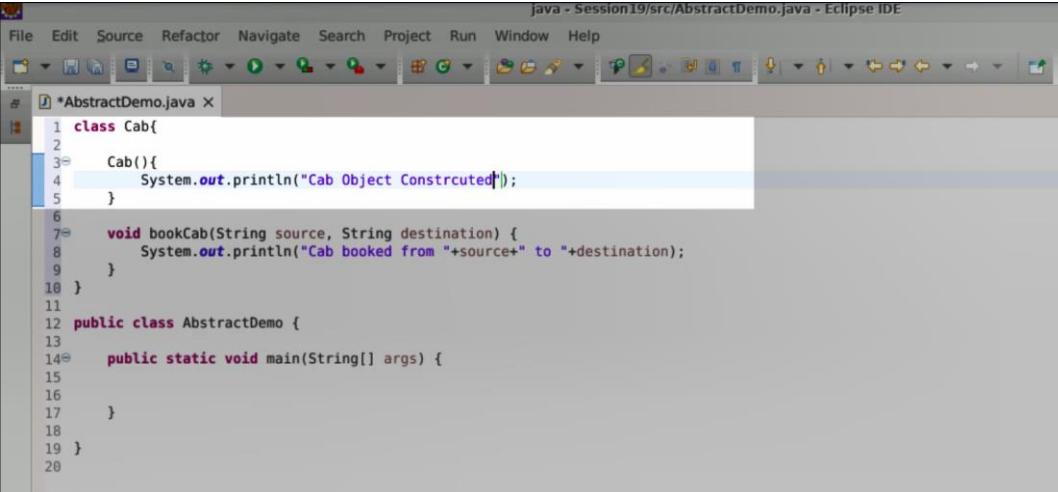
Step 2: Write a class called cab and create a constructor for cab class

2.1 Create a class known as **Cab**. This is a regular class with a method called **bookCab**. Let us specify that it has a source and a destination. Then, write **System.out.println("Cab booked from " + source + " to " + destination);**



```
java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
*AbstractDemo.java X
1 class Cab{
2
3     void bookCab(String source, String destination) {
4         System.out.println("Cab booked from "+source+" to "+destination);
5     }
6 }
7
8 public class AbstractDemo {
9
10    public static void main(String[] args) {
11
12
13    }
14
15 }
16
```

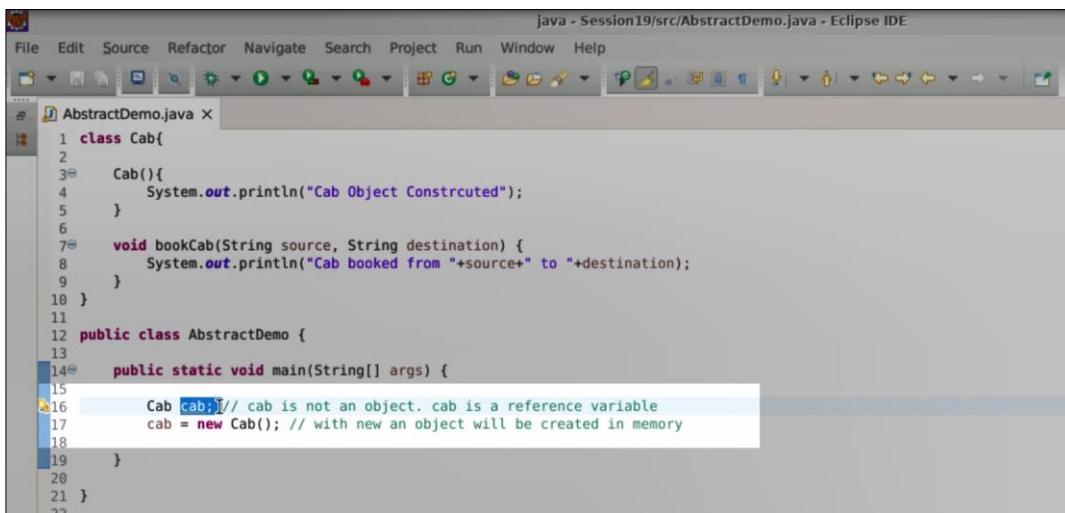
2.2 Create the constructor for the cab class, which is a regular class and you can write as cab object constructed



```
java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
*AbstractDemo.java X
1 class Cab{
2
3     Cab(){
4         System.out.println("Cab Object Constrcuted");
5     }
6
7     void bookCab(String source, String destination) {
8         System.out.println("Cab booked from "+source+" to "+destination);
9     }
10 }
11
12 public class AbstractDemo {
13
14    public static void main(String[] args) {
15
16
17    }
18
19 }
20
```

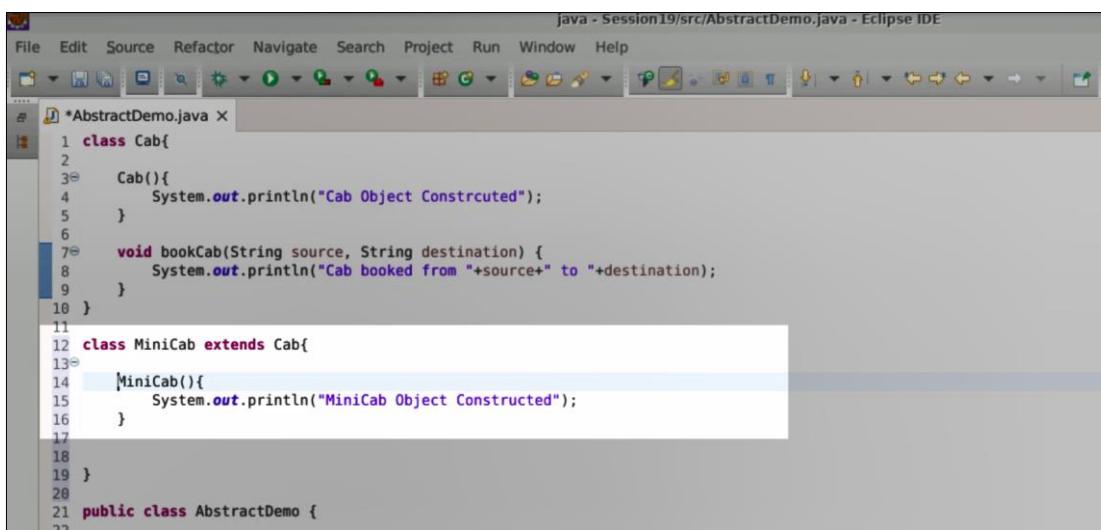
Step 3: Create the object of a regular class

3.1 Create an object of a regular class. Write new **Cab()**, and assign it to a reference variable by writing **cab = new Cab();**. As you know, this is not an object; this is a reference variable. Hence, you can simply state, Cab is not an object. Cab is a reference variable. With new, an object will be created in memory, which is the definition of the new operator.



```
java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
AbstractDemo.java X
1 class Cab{
2
3    Cab(){
4        System.out.println("Cab Object Constrcuted");
5    }
6
7    void bookCab(String source, String destination) {
8        System.out.println("Cab booked from "+source+" to "+destination);
9    }
10 }
11
12 public class AbstractDemo {
13
14    public static void main(String[] args) {
15
16        Cab cab; // cab is not an object. cab is a reference variable
17        cab = new Cab(); // with new an object will be created in memory
18
19    }
20
21 }
22 }
```

3.2 If you try to create a class called **MiniCab**, which is the child of Cab, create the constructor and write '**MiniCab Object Constructed**'. You can choose to override the methods from the parent class or skip the override, depending on the requirement



```
java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
AbstractDemo.java X
1 class Cab{
2
3    Cab(){
4        System.out.println("Cab Object Constrcuted");
5    }
6
7    void bookCab(String source, String destination) {
8        System.out.println("Cab booked from "+source+" to "+destination);
9    }
10 }
11
12 class MiniCab extends Cab{
13
14    MiniCab(){
15        System.out.println("MiniCab Object Constructed");
16    }
17
18
19 }
20
21 public class AbstractDemo {
22 }
```

3.3 To create an object of **MiniCab**, you can write **MiniCab miniCab = new MiniCab();**. This creates a direct object and is not a polymorphic statement. With this **MiniCab** object, you can execute the method called **bookCab** from 'home' to 'work'

```

java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
# AbstractDemo.java X
1 class Cab{
2
3@   Cab(){
4     System.out.println("Cab Object Constructed");
5   }
6
7@   void bookCab(String source, String destination) {
8     System.out.println("Cab booked from "+source+" to "+destination);
9   }
10 }
11
12 class MiniCab extends Cab{
13
14@   MiniCab(){
15     System.out.println("MiniCab Object Constructed");
16   }
17
18
19 }
20
21 public class AbstractDemo {
22
23@   public static void main(String[] args) {
24
25     Cab cab; // cab is not an object. cab is a reference variable
26     cab = new Cab(); // with new an object will be created in memory
27
28     MiniCab miniCab = new MiniCab();
29     miniCab.bookCab("Home", "Work");
30
31   }

```

Step 4: Understand the concept of abstract class with examples

4.1 Let us understand what happens when you mark your Cab class as abstract. You will get an error indicating that it 'cannot instantiate the type Cab,' which means you cannot create objects of an abstract class. So, you can comment out the reference variable. This Cab reference can point to the child class. This means you can write **Cab cab = new MiniCab();**. Hence, with the abstract class, polymorphism will work in the same way

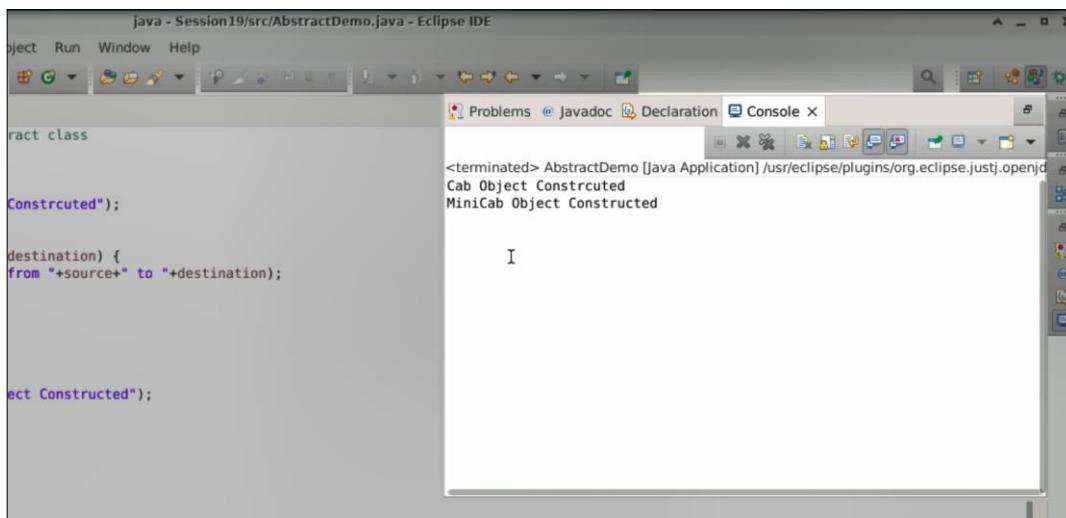
```

File Edit Source Refactor Navigate Search Project Run Window Help
# AbstractDemo.java X
1 // We cannot create the objects of Abstract class
2 abstract class Cab{
3
4@   Cab(){
5     System.out.println("Cab Object Constructed");
6   }
7
8@   void bookCab(String source, String destination) {
9     System.out.println("Cab booked from "+source+" to "+destination);
10 }
11
12 class MiniCab extends Cab{
13
14@   MiniCab(){
15     System.out.println("MiniCab Object Constructed");
16   }
17
18
19 }
20
21 public class AbstractDemo {
22
23@   public static void main(String[] args) {
24
25     Cab cab; // cab is not an object. cab is a reference variable
26     //cab = new Cab(); // with new an object will be created in memory
27
28     // Polymorphic Statements will work in same way
29     cab = new MiniCab();
30
31     //MiniCab miniCab = new MiniCab();
32     //miniCab.bookCab("Home", "Work");
33
34   }

```

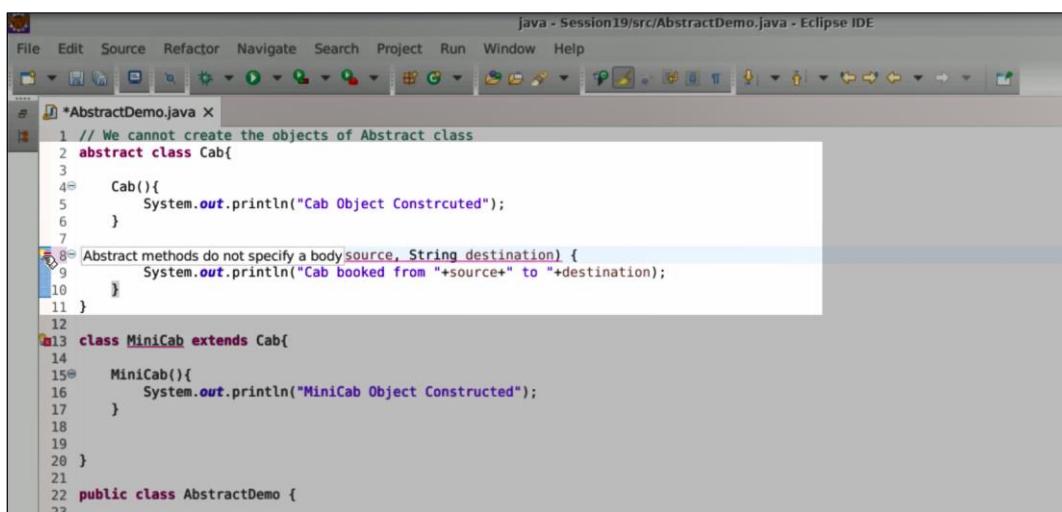
Step 5: Execute the code, along with the use of regular methods

5.1 Run the code. As you can see, the parent constructor is executed first, followed by the child constructor. This means that you cannot create a direct object of the abstract class, but the rule of inheritance is implemented. This means there will be two objects in memory: one from the abstract class Cab and another from the **MiniCab**



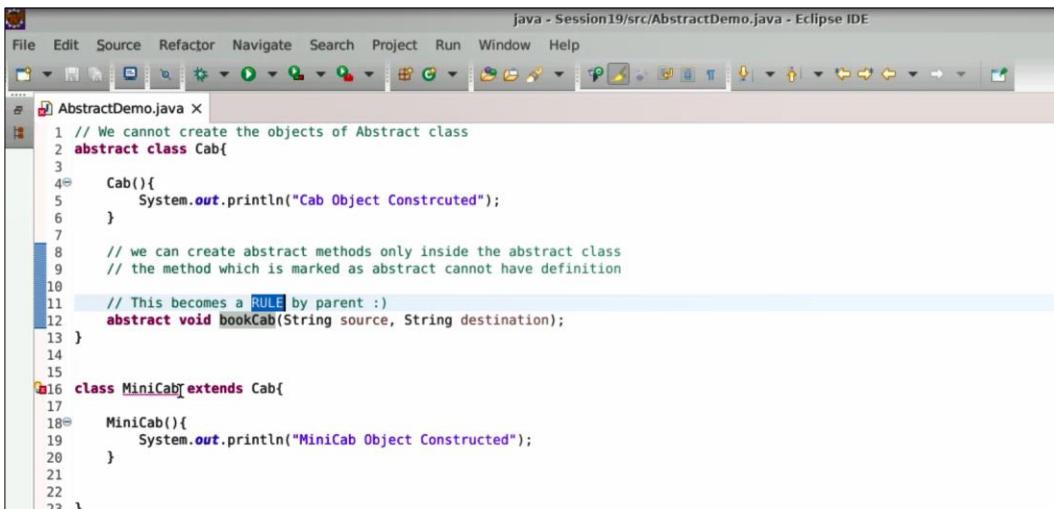
```
java - Session19/src/AbstractDemo.java - Eclipse IDE
File Run Window Help
File Edit Source Refactor Navigate Search Project Run Window Help
Problems Javadoc Declaration Console X
Abstract class
    Constrcuted");
    destination) {
        from "+source+" to "+destination");
    }
    ect Constructed");
<terminated> AbstractDemo [Java Application] /usr/eclipse/plugins/org.eclipse.justj.openj
Cab Object Constrcuted
MiniCab Object Constructed
```

5.2 Why do you need to create an abstract class? The reason is to prevent anyone from creating an object of that class, but this can also be done by marking your constructor as private. The **bookCab** method defined here will give you an error if you mark it as abstract because abstract methods cannot have a body. Therefore, a body for your method, like an abstract method, is not allowed



```
java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
File Edit Source Refactor Navigate Search Project Run Window Help
*AbstractDemo.java X
1 // We cannot create the objects of Abstract class
2 abstract class Cab{
3
4     Cab(){
5         System.out.println("Cab Object Constrcuted");
6     }
7
8     Abstract methods do not specify a body[source, String destination] {
9         System.out.println("Cab booked from "+source+" to "+destination);
10    }
11
12
13 class MiniCab extends Cab{
14
15     MiniCab(){
16         System.out.println("MiniCab Object Constructed");
17     }
18
19
20 }
21
22 public class AbstractDemo {
```

5.3 This abstract keyword is given with the class so that you can create the abstract methods only inside the abstract class. The next thing, which you need to understand is that the method which is marked as abstract cannot have a definition, you cannot define an abstract method. This becomes a rule by the parent

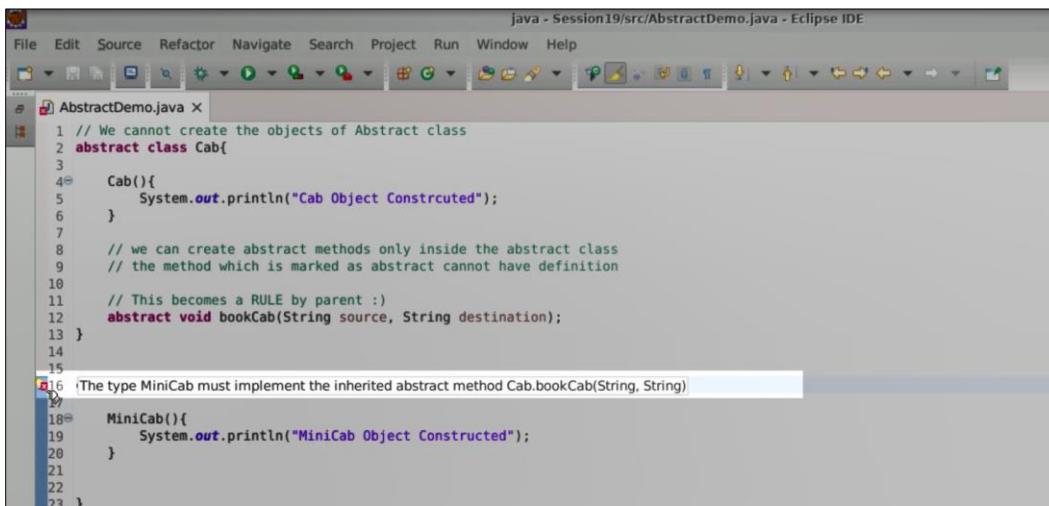


```

java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
AbstractDemo.java X
1 // We cannot create the objects of Abstract class
2 abstract class Cab{
3
4    Cab(){
5        System.out.println("Cab Object Constructed");
6    }
7
8    // we can create abstract methods only inside the abstract class
9    // the method which is marked as abstract cannot have definition
10   // This becomes a RULE by parent :
11   abstract void bookCab(String source, String destination);
12 }
13
14
15
16 class MiniCabextends Cab{
17
18    MiniCab(){
19        System.out.println("MiniCab Object Constructed");
20    }
21
22
23 }

```

5.4 Consider your **bookCab** method as a rule. You will observe that in the child class, **MiniCab**, you will get an error indicating that it must implement the inherited **bookCab** method. Therefore, the definition of the **bookCab** method must be provided inside the **MiniCab** class



```

java - Session19/src/AbstractDemo.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
AbstractDemo.java X
1 // We cannot create the objects of Abstract class
2 abstract class Cab{
3
4    Cab(){
5        System.out.println("Cab Object Constructed");
6    }
7
8    // we can create abstract methods only inside the abstract class
9    // the method which is marked as abstract cannot have definition
10   // This becomes a RULE by parent :
11   abstract void bookCab(String source, String destination);
12 }
13
14
15
16 class MiniCabextends Cab{
17
18    MiniCab(){
19        System.out.println("MiniCab Object Constructed");
20    }
21
22
23 }

```

The type MiniCab must implement the inherited abstract method Cab.bookCab(String, String)

5.5 The parent class has created a rule, and this rule must be defined by its children.

Whether there is one child or multiple children, any class that extends Cab must define the **bookCab** method. That is the main rule you need to follow. In addition to the **bookCab** method, you can have multiple abstract methods in the abstract class

```

2  abstract class Cab{
3
4@   Cab(){
5     System.out.println("Cab Object Constructed");
6   }
7
8   // we can create abstract methods only inside the abstract class
9   // the method which is marked as abstract cannot have definition
10
11  // This becomes a RULE by parent :)
12  // Which must be defined by child(ren)
13  abstract void bookCab(String source, String destination);
14  // we can have multiple abstract methods
15
16
17
18 }
19
20
21 class MiniCab extends Cab{
22
23@   MiniCab(){
24     System.out.println("MiniCab Object Constructed");
25   }
26
27@   void bookCab(String source, String destination) {
28
29   }
30 }
31
32 public class AbstractDemo {

```

5.6 At the same time, you can also have regular methods, such as a void show method. For example, write **System.out.println("This is show of Cabs")**; Thus, you can have regular methods. Then, write **System.out.println("MiniCab booked from " + source + " to " + destination)**; With this cab object, you will be able to execute the method **bookCab** with the source and destination, such as 'home' and 'work'

```

File Edit Source Refactor Navigate Search Project Run Window Help
AbstractDemo.java x I
12  abstract void bookCab(String source, String destination);
13  // we can have multiple abstract methods
14
15  void show() {
16    System.out.println("This is show of Cab");
17  }
18
19
20
21 class MiniCab extends Cab{
22
23@   MiniCab(){
24     System.out.println("MiniCab Object Constructed");
25   }
26
27@   void bookCab(String source, String destination) {
28     System.out.println("MiniCab Booked from "+source+" to "+destination);
29   }
30 }
31
32 public class AbstractDemo {
33
34  public static void main(String[] args) {
35
36    Cab cab; // cab is not an object. cab is a reference variable
37    //cab = new Cab(); // with new an object will be created in memory
38
39    // Polymorphic Statements will work in same way
40    cab = new MiniCab();
41
42    //MiniCab miniCab = new MiniCab();
43    //miniCab.bookCab("Home", "Work");
44
45    cab.bookCab("Home", "Work");
46
47  }
48

```

5.7 Run the program. It shows that the **MiniCab** object is constructed, the Cab is constructed, and the **MiniCab** is booked from home to work

The screenshot shows the Eclipse IDE interface with the following details:

- Menu Bar:** Source, Refactor, Navigate, Search, Project, Run, Window, Help.
- Toolbar:** Standard Eclipse toolbar icons.
- Left Panel (Code View):** The code editor displays `AbstractDemo.java` with the following content:

```
abstract class Cab {  
    abstract void bookCab(String source, String destination);  
    // we can have multiple abstract methods  
  
    void show() {  
        System.out.println("This is show of Cab");  
    }  
  
  
class MiniCab extends Cab{  
  
    MiniCab(){  
        System.out.println("MiniCab Object Constructed");  
    }  
  
    void bookCab(String source, String destination) {  
        System.out.println("MiniCab Booked from " +source+ " to "+destination);  
    }  
  
  
public class AbstractDemo {  
    public static void main(String[] args) {  
  
        Cab cab; // cab is not an object. cab is a reference variable  
        //cab = new Cab(); // with new an object will be created in memory  
  
        // Polymorphic Statements will work in same way  
        cab = new MiniCab();  
  
        //MiniCab miniCab = new MiniCab();
```
- Right Panel (Console View):** The Console tab is active, showing the output of the application:

```
<terminated> AbstractDemo [Java Application] /usr/eclipse/plugins/org.eclipse.jst.java.core/compositeResources/AbstractDemo.jar  
Cab Object Constructed  
MiniCab Object Constructed  
MiniCab Booked from Home to Work
```

5.8 Whenever you create an abstract class, remember that you have the option to define some methods. When you extend the abstract class, you then work on the method that was abstract by creating its definition. In Eclipse, you will see a white triangle, indicating that it is an implementation of a rule rather than an override

```
8 // we can create abstract methods only inside the abstract class
9 // the method which is marked as abstract cannot have definition
10
11 // This becomes a RULE by parent :)
12 // Which must be defined by child(ren)
13 abstract void bookCab(String source, String destination);
14 // we can have multiple abstract methods
15
16④ void show() {
17     System.out.println("This is show of Cab");
18 }
19
20 }
21
22
23 class MiniCab extends Cab{
24
25⑤     MiniCab(){
26         System.out.println("MiniCab Object Constructed");
27     }
28
29⑥     implements Cab.bookCab(String source, String destination) {
30         System.out.println("MiniCab Booked form "+source+" to "+destination);
31     }
32 }
```

5.9 Let us write that there is a class called **YouTubeChannel**. And there is another class called User. When a user subscribes to a YouTube channel, the user should receive a notification whenever a new video is uploaded on the channel. For the notification, you will create an abstract class called Notification

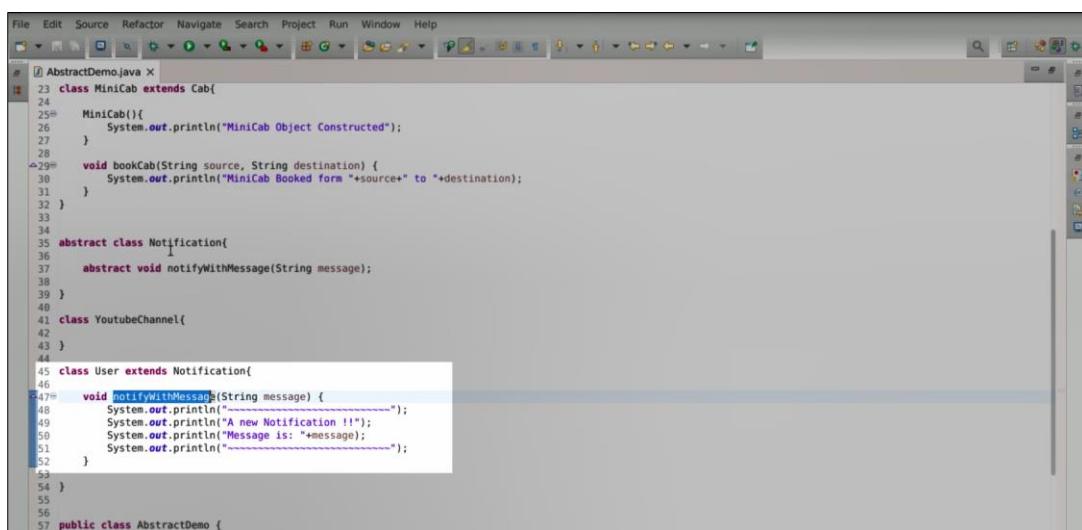
```

24
25  MiniCab(){
26      System.out.println("MiniCab Object Constructed");
27  }
28
29  void bookCab(String source, String destination) {
30      System.out.println("MiniCab Booked from "+source+" to "+destination);
31  }
32 }
33
34
35 abstract class Notification{    I
36
37 }
38
39 class YoutubeChannel{
40
41 }
42
43 class User extends Notification{
44
45 }
46
47
48 public class AbstractDemo {
49
50     public static void main(String[] args) {

```

5.10 Let us create this abstract method by writing abstract **void notify(String message);**.

However, the User class is getting an error. Therefore, in the User class, you need to define this method called notify. When you define this method and it is executed, you will create a new notification and then print out “Message is:” + message to make the presentation a bit more beautiful



```

File Edit Source Refactor Navigate Search Project Run Window Help
AbstractDemo.java X
23 class MiniCab extends Cab{
24
25  MiniCab(){
26      System.out.println("MiniCab Object Constructed");
27  }
28
29  void bookCab(String source, String destination) {
30      System.out.println("MiniCab Booked from "+source+" to "+destination);
31  }
32 }
33
34
35 abstract class Notification{
36
37     abstract void notifyWithMessage(String message);
38
39 }
40
41 class YoutubeChannel{
42
43 }
44
45 class User extends Notification{
46
47     void notifyWithMessage(String message) {
48         System.out.println("-----");
49         System.out.println("A new Notification !!");
50         System.out.println("Message is: "+message);
51         System.out.println("-----");
52     }
53
54 }
55
56
57 public class AbstractDemo {

```

5.11 If the User class is implementing the notify method with a message, then it means that you are extending the Notification class. This abstract class is meant for abstraction, allowing the child class to implement the rule. Therefore, we will not be able to create a direct object for this class

```
File Edit Source Refactor Navigate Search Project Run Window Help

# *AbstractDemo.java X
23 class MiniCab extends Cab{
24
25@    MiniCab(){}
26@        System.out.println("MiniCab Object Constructed");
27    }
28
29@    void bookCab(String source, String destination) {
30        System.out.println("MiniCab Booked form "+source+ " to "+destination);
31    }
32 }
33
34 // Not meant for extension, but for abstraction i.e. let the child implement the rule
35 // Further, we will not be able to create direct object of this class
36 abstract class Notification{
37
38     abstract void notifyWithMessage(String message);
39
40 }
41
42 class YoutubeChannel{
43
44 }
45
46 class User extends Notification{
47
48@    void notifyWithMessage(String message) {
49        System.out.println("-----");
50        System.out.println("A new Notification !!");
51        System.out.println("Message is: "+message);
52        System.out.println("-----");
53    }
54
55 }
56
57
```

5.12 Let us now move further and understand the next part where the YouTube channel user has to subscribe. For this, you can create a reference variable of type Notification, which can be written as **Notification notification**; Create a method called **subscribe** and take this notification as input. You can write it as **void subscribe(Notification nf)**. You can then assign this notification to **nf**, which is a reference copy

```
34 // Not meant for extension, but for abstraction i.e. let the child implement the rule
35 // Further, we will not be able to create direct object of this class
36 abstract class Notification{
37
38     abstract void notifyWithMessage(String message);
39
40 }
41
42 class YoutubeChannel{
43
44     Notification notification; // reference variable to Notification
45
46     void subscribe(Notification nf) {
47         notification = nf; // Reference Copy
48     }
49
50 }
51
52 class User extends Notification{
53
54     void notifyWithMessage(String message) {
55         System.out.println("-----");
56         System.out.println("A new Notification !!");
57         System.out.println("Message is: "+message);
58         System.out.println("-----");
59     }
60 }
```

5.13 In the main method, let us create a **YouTubeChannel** object. Write **YouTubeChannel channel = new YouTubeChannel();**. For the user, write **User John = new User();**. This creates a new User object named John and a **YouTubeChannel** object. On the **YouTubeChannel** object, the subscription is for John. Here, you need to understand the polymorphic behavior: the reference variable John holds the hash code of the User object

```

59     }
60
61 }
62
63
64 public class AbstractDemo {
65
66    public static void main(String[] args) {
67
68        Cab cab; // cab is not an object. cab is a reference variable
69        //cab = new Cab(); // with new an object will be created in memory
70
71        // Polymorphic Statements will work in same way
72        cab = new MiniCab();
73
74        //MiniCab miniCab = new MiniCab();
75        //miniCab.bookCab("Home", "Work");
76
77        cab.bookCab("Home", "Work");
78
79        User john = new User();
80
81        YoutubeChannel channel = new YoutubeChannel();
82        channel.subscribe(john); // User john - AbstractDemo.main(String[])
83
84    }

```

5.14 In the **YouTubeChannel** class, you can create a method called **uploadVideo**. This method will take a video name as input and create a message that says '**A new video uploaded:**' followed by the name of the video. Using the notification reference variable, you will execute the **notify** method with this message

```

File Edit Source Refactor Navigate Search Project Run Window Help
AbstractDemo.java X
41
42 class YoutubeChannel{
43
44     Notification notification; // reference variable to Notification
45
46    void subscribe(Notification nf) { // Polymorphic Statement: nf has reference to the User Object
47        notification = nf; // Reference Copy -> notification now has reference to john i.e. the User Object
48    }
49
50    void uploadVideo(String name) {
51        String message = "A new Video Uploaded: "+name;
52        notification.notifyWithMessage(message);
53    }
54
55 }
56
57 class User extends Notification{
58
59    void notifyWithMessage(String message) {
60        System.out.println("-----");
61        System.out.println("A new Notification !!");
62        System.out.println("Message is: "+message);
63        System.out.println("-----");

```

5.15 All this content is generated for the user when a new video gets uploaded to the YouTube channel. If you call `channel.uploadVideo("Learning Java")`, it simulates uploading a video named 'Learning Java' to the channel

```

File Edit Source Refactor Navigate Search Project Run Window Help
File *AbstractDemo.java X
54
55 }
56
57 class User extends Notification{
58
59     void notifyWithMessage(String message) {
60         System.out.println("-----");
61         System.out.println("[User] A new Notification !!");
62         System.out.println("[User] Message is: "+message);
63         System.out.println("-----");
64     }
65 }
66
67
68
69 public class AbstractDemo {
70
71     public static void main(String[] args) {
72
73         Cab cab; // cab is not an object. cab is a reference variable
74         //cab = new Cab(); // with new an object will be created in memory
75
76         // Polymorphic Statements will work in same way
77         cab = new MiniCab();
78
79         //MiniCab miniCab = new MiniCab();
80         //miniCab.bookCab("Home", "Work");
81
82         cab.bookCab("Home", "Work");
83
84         User john = new User();
85
86         YoutubeChannel channel = new YoutubeChannel();
87         channel.subscribe(john);
88         channel.uploadVideo("Learning Java");
89
90     }
91

```

5.16 When you run this code, you will notice that you receive a new notification message: '**A new video uploaded named Learning Java**'. What is abstraction? Abstraction helps you hide complexity and provides a clear scenario where you can implement a beautiful concept using runtime polymorphism. What you have implemented here is a callback. This means that the notify method with the message is executed in the User object.

```

File Edit Source Refactor Navigate Search Project Run Window Help
File *AbstractDemo.java X
Problems Javadoc Declaration Console X
java - Session19/src/AbstractDemo.java - Eclipse IDE
54
55 }
56
57 class User extends Notification{
58
59     void notifyWithMessage(String message) {
60         System.out.println("-----");
61         System.out.println("[User] A new Notification !!");
62         System.out.println("[User] Message is: "+message);
63         System.out.println("-----");
64     }
65 }
66
67
68
69 public class AbstractDemo {
70
71     public static void main(String[] args) {
72
73         Cab cab; // cab is not an object. cab is a reference variable
74         //cab = new Cab(); // with new an object will be created in memory
75
76         // Polymorphic Statements will work in same way
77         cab = new MiniCab();
78
79         //MiniCab miniCab = new MiniCab();
80         //miniCab.bookCab("Home", "Work");
81
82         cab.bookCab("Home", "Work");
83
84         User john = new User();
85
86         YoutubeChannel channel = new YoutubeChannel();
87         channel.subscribe(john);
88         channel.uploadVideo("Learning Java");
89
90     }
91

```

<terminated> AbstractDemo [Java Application] /usr/eclipse/plugins/org.eclipse.justopened
Cab Object Constructed
MiniCab Object Constructed
MiniCab Booked from Home to Work

[User] A new Notification !!
[User] Message is: A new Video Uploaded: Learning Java I

By following the above steps, you have successfully implemented and used an abstract class in Java.