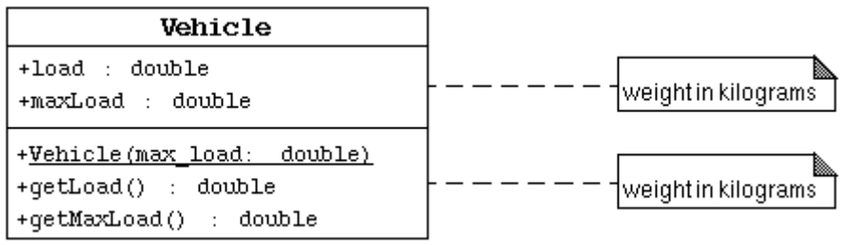
Computing Problem Number *1*
Computing Problem Title *Encapsulating Vehicle Class*

Objective

In this exercise, you will explore the purpose of proper *object encapsulation*. You will create a class in three steps demonstrating the use of information hiding.

Directions

Version 1: No Information Hiding



In this version of the `Vehicle` class, you will leave the attributes public so that the test program `TestVehicle1` will have direct access to them.

1. Change your working directory to `.../Computing Problem 1/version1`.
2. Create a class `Vehicle` that implements the above UML diagram.
    a. Include two public attributes:

    `load`, “the current weight of the vehicle's cargo", and

    `maxLoad`, "the vehicle's maximum cargo weight limit".

    b. Include one public constructor to set the `maxLoad` attribute.
    c. Include two public access methods:

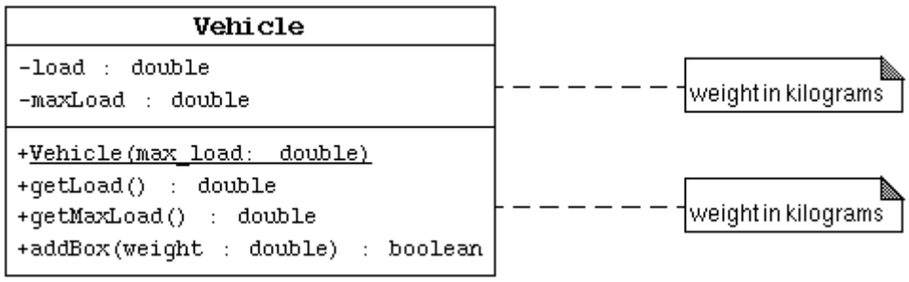
    `getLoad` to retrieve the load attribute, and

    `getMaxLoad` to retrieve the maxLoad attribute.

    Note that all the data are assumed to be in kilograms.
3. Read the `TestVehicle.java` code. Notice that the program gets into trouble when the last box is added to the vehicle's load because the code does not check if adding this box will exceed the maxLoad.
4. Compile the `Vehicle` and `TestVehicle` classes.
5. Run the `TestVehicle` class. The output generated should be:

```
Creating a vehicle with a 10,000kg maximum load.
Add box #1 (500kg)
Add box #2 (250kg)
Add box #3 (5000kg)
Add box #4 (4000kg)
Add box #5 (300kg)
Vehicle load is 10050.0 kg
```

Version 2: Basic Information Hiding



To solve the problem from the first version, you will hide the internal class data (`load` and `maxLoad`) and provide a method, `addBox`, to perform the proper checking that the vehicle is not being overloaded.

1. Change your working directory to `.../Computing Problem 1/version2`.
2. Create a class `Vehicle` that implements the above UML diagram.

   You may wish to copy the `Vehicle.java` file you created in version #1.

   a. Modify the `load` and `maxLoad` attributes to be private.
   b. Add the `addBox` method. This method takes a single argument, which is the weight of the box in kilograms. The method must verify that adding the box will not violate the maximum load. If a violation occurs the box is rejected by returning the value of `false`; otherwise the weight of the box is added to the vehicle load and the method returns `true`.

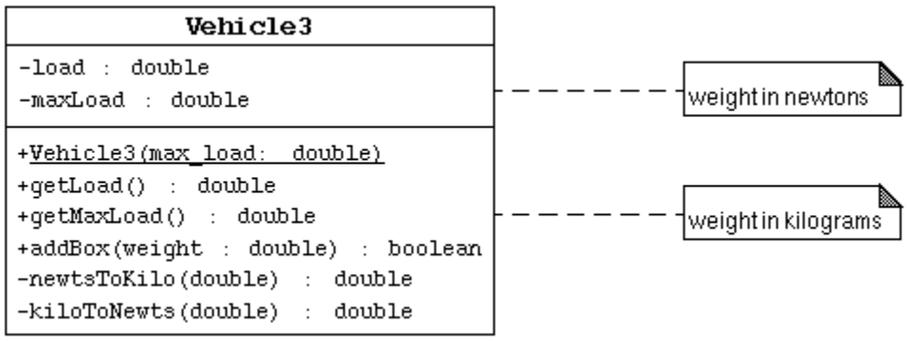
   Hint: you will need to use an "if" statement. Here is the basic form of the conditional form:

   ```
   if (<boolean_expression>) {
         <statement>*
   } else {
         <statement>*
   }
   ```

   Note that all the data are assumed to be in kilograms.
3. Read the `TestVehicle.java` code. Notice that the code cannot modify the `load` attribute directly, but now must use the `addBox` method. This method returns a true or false value which is printed to the screen.
4. Compile the `Vehicle` and `TestVehicle` classes.
5. Run the `TestVehicle` class. The output generated should be:

   ```
   Creating a vehicle with a 10,000kg maximum load.
   Add box #1 (500kg): true
   Add box #2 (250kg): true
   Add box #3 (5000kg): true
   Add box #4 (4000kg): true
   Add box #5 (300kg): false
   Vehicle load is 9750.0 kg
   ```

Version 3: Change Internal Representation of Weight to Newtons



Now suppose that you were going to write some calculations that determine the wear on the vehicle's engine and frame. These calculations are easier if the weight of the load is measured in Newtons.

1. Change your working directory to `.../Computing Problem 1/version3`.
2. Create a class `Vehicle` that implements the above UML diagram.

   You may wish to copy the `Vehicle.java` file you created in version #2.

   a. Modify the constructor, `getLoad`, `getMaxLoad`, and `addBox` methods to use a conversion from kilograms (the parameter weight measurement) to Newtons (the instance variable measurement). You might want to use the following private methods:

   ```
   private double kiloToNewts (double weight) {
         return (weight * 9.8);
   }
   private double newtsToKilo (double weight) {
         return (weight / 9.8);
   }
   ```

   Note that now the internal data of the vehicle objects is in Newtons and the external data (passed between methods) is still in kilograms.

3. Read the `TestVehicle.java` code. Notice that it is identical to the test code in version #2.
4. Compile the `Vehicle` and `TestVehicle` classes.
5. Run the `TestVehicle` class. The output generated should be:

```
Creating a vehicle with a 10,000kg maximum load.
Add box #1 (500kg): true
Add box #2 (250kg): true
Add box #3 (5000kg): true
Add box #4 (4000kg): true
Add box #5 (300kg): false
Vehicle load is 9750.0 kg
```

You should see no change in the output of the program. This demonstrates that the (private) internal changes to the version #3 `Vehicle` class did not change the code of the client class `TestVehicle`.