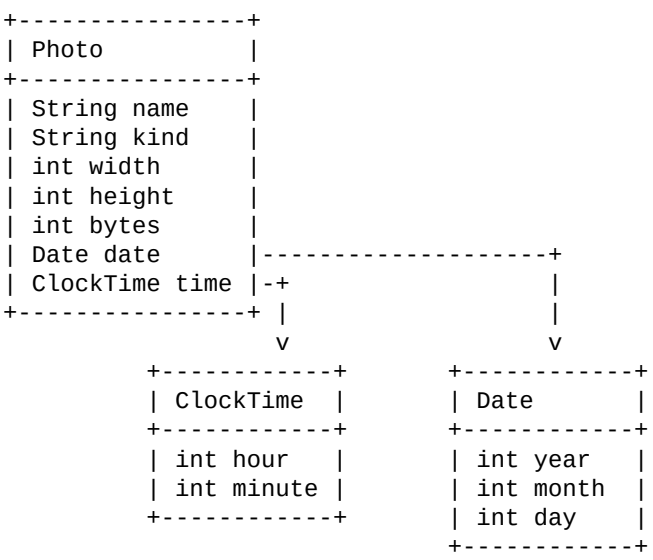
3.1 Design Recipe for Methods: Simple Classes

We use the following classes to illustrate the use of the DESIGN RECIPE FOR METHODS:



Here are some some examples of the information we wish to represent:

- Picture of a river (jpeg) that is 3456 pixels wide and 2304 pixels high, using up 3,614,571 bytes

  — taken on September 23, 2007 at 9:50 am.

- Picture of a mountain (jpeg) that is 2448 pixels wide and 3264 pixels high, using up 1,276,114 bytes

  — taken on November 11, 2007 at 11:30 am.

- Picture of a group of people (gif) that is 545 pixels wide and 641 pixels high, using up 13,760 bytes

  — taken on November 11, 2007 at 9:30 pm.

- Picture of a plt icon (bmp) that is 16 pixels wide and 16 pixels high, using up 1334 bytes

  — taken on September 23, 2007 at 11:30 pm.

Note: Make sure you understand the data definitions, can translate these examples to data, and converesely, translate any instance of data defined for these classes into the information the data represents.

Recall from the lectures that in a class based language every method is defined in a class that is most relevant, it is then invoked by the instance of that class, and *this* instance becomes the first argument for the method.

Below is an example of the design of a method that computes the number of pixels in a photo image:

- Step 1: Problem analysis and data definition.

  The method deals with `Photo`s and so it needs to be defined in the class `Photo`. Each instance of a `Photo` has all the information we need to solve the problem - we do not need any additional data to be given. The result is an integer.

  We will use the following data in our examples. For your work add at least one more instance of each class.

```
// Examples for the class ClockTime
ClockTime ct1 = new ClockTime(21, 50);
ClockTime ct2 = new ClockTime(11, 30);
ClockTime ct3 = new ClockTime(9, 50);

// Examples for the class Date
Date d1 = new Date(2007, 9, 23);
Date d2 = new Date(2007, 11, 7);
Date d3 = new Date(2007, 9, 25);

// Examples for the class Photo
Photo river = new Photo("River", "jpeg", 3456, 2304,
                        3614571, this.d1, this.ct3);
Photo mountain = new Photo("Mountain", "jpeg", 2448, 3264,
                           1276114, this.d2, this.ct2);
Photo people = new Photo("People", "gif", 545, 641,
                         13760, this.d2, this.ct1);
Photo icon = new Photo("PLTicon", "bmp", 16, 16,
                       1334, this.d1, this.ct2);
```

- Step 2: The purpose statement and the header.

```
// to compute the number of pixels in this photo
int pixels(){...}
```

- Step 3: Examples.

```
people.pixels() --->  349345
icon.pixels() --->  256
```

- Step 4: The template.

```
int pixels(){
 ... this.name ...   --- String
 ... this.kind ...   --- String
 ... this.width ...  --- int
 ... this.height ... --- int
 ... this.bytes ...  --- int
 ... this.date ...   --- Date
 ... this.time ...   --- ClockTime
```

We will only need `this.width` and `this.height`.

- Step 5: The method body.

```
// to compute the number of pixels in this photo
int pixels(){
  return this.width * this.height;
}
```

- Step 6: Tests.

ProfessorJ provides a special way of running the tests. A `check` expression

check *test method invocation* expect *expected test result*

produces the test result as a `boolean` value and all test results are reported in a separate display. The following code:

```
// Tests for the method pixels:
boolean testPixels =
  (check this.people.pixels() expect 349345) &&
  (check this.icon.pixels() expect 256);
```

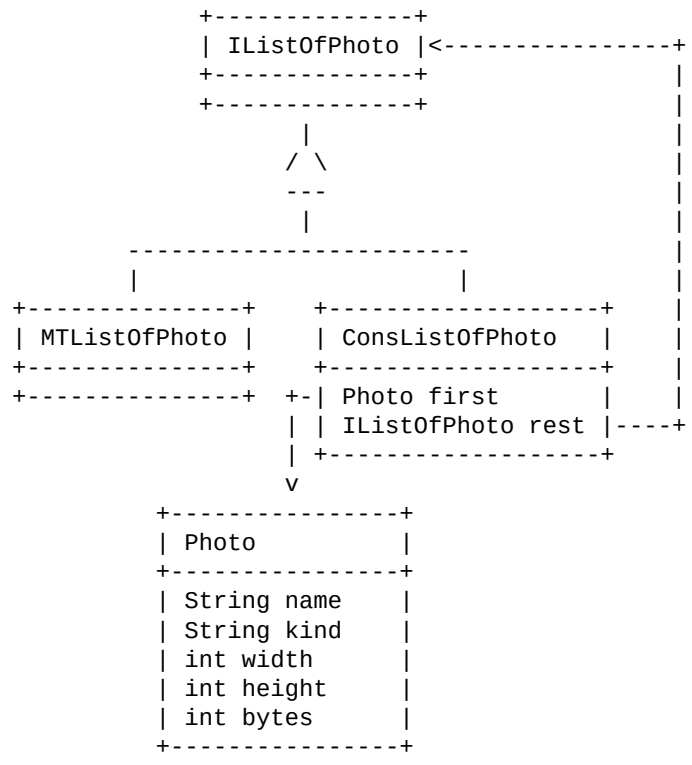
shows the tests for our method.

3.2 Design Recipe for Methods: Self-Referential Data

Let us now consider the class hierarchy that represents a list of photo images. We first design the method that counts the images in our list. (We use the simpler version of the class `Photo`.)

Note: Of course, you will quickly realize that this method will look the same regardless of what are the pieces of data contained in the list. We will address that issue later on, once we are comfortable with dealing with lists that contain specific items.

The class diagram for a list of photo images is shown below:



Design Recipe for a method definition for self-referential data

Below is an example of the design of a method that counts the number of pictures in a list of photo images.

The method deals with `IListOfPhotos`. We have an interface `IListOfPhotos` and two classes that implement the interface:

`MTListOfPhotos` and `ConsListOfPhotos`. When the DESIGN RECIPE calls for the method purpose statement and the header, we include the purpose statement and the header in the interface `IListOfPhotos` and in all the classes that implement the interface.

Including the method header in the interface serves as a contract that requires that all classes that implement the interface define the method with this header. As the result, the method can be invoked by any instance of a class that implement the interface - without the need for us to distinguish what is the defined type of the object.

We can now proceed with the DESIGN RECIPE.

- Step 1: Problem analysis and data definition.

  The only piece of data needed to count the number of elements in a list is the list itself. The result is an integer.

  We will use the following data in our examples. For your work add at least one more instance of each class.

```
// Examples for the class Photo
Photo river =
        new Photo("River", "jpeg", 3456, 2304, 3614571);

Photo mountain =
        new Photo("Mountain", "jpeg", 2448, 3264, 1276114);

Photo people =
        new Photo("People", "gif", 545, 641, 13760);

Photo icon =
        new Photo("PLTicon", "bmp", 16, 16, 1334);

IListOfPhotos mtlist = new MTListOfPhotos();

IListOfPhotos list1 =
  new ConsListOfPhotos(this.river, this.mtlist);

IListOfPhotos list2 =
  new ConsListOfPhotos(this.mountain,
   new ConsListOfPhotos(this.people,
    new ConsListOfPhotos(this.icon, this.mtlist)));
```

- Step 2: The purpose statement and the header.

```
// to count the number of pictures in this list of photos
int count(){...}
```

In the interface `IListOfPhotos` we write:

```
// to count the number of pictures in this list of photos
int count();
```

indicating there is no definition for this method.

We now have to design the method separately for each of the two classes.

- Step 3: Examples.

  We make examples for the empty list, a list with one element and a longer list:

```
mtlist.count() --->  0
list1.count()  --->  1
list2.count()  --->  3
```

- Step 4: The template.

  We need to look separately at the two classes that implement the method.

  `class MTListOfPhotos`: The class has no member data and there is no other data available. It is clear that the method will always produce the same result, the value `0`.

  We can finish the steps 4. and 5. right away — the method body becomes:

```
// to count the number of pictures in this list of photos
int count() {
  return 0;
}
```

The template for the class `ConsListOfPhotos` includes the two fields: `this.first` and `this.rest`. However, just as in HtDP, we recognize that `this.rest` is a data of the type `IListOfPhotos` and so it can invoke the method `count` that is now under development. The template then becomes:

```
In the class ConsListOfPhotos:
TEMPLATE:
  int count(){
   ... this.first ...           --- Photo
   ... this.rest ...            --- IListOfPhotos

   ... this.rest.count() ...    --- int
```

Recall the purpose statement for the method `count`:

```
  // to count the number of pictures in this list of photos
```

The purpose of the method invocation `this.rest.count()` then becomes:

```
  // to count the number of pictures
  // in the rest of this list of photos
  //    ---------------------
```

When designing methods for self-referential data, make sure you say out loud (or at least understand clearly) the purpose statement as applied to the self-referential method invocation.

- Step 5: The method body.

  We have already finished the method body for the class `MTListOfPhotos`. In the class `ConsListOfPhotos` the method body is:

```
  // to count the number of pictures in this list of photos
  int count(){
    return 1 + this.rest.count();
  }
```

- Step 6: Tests.

  We can now convert our examples into tests:

```
  // Tests for the method count:
  boolean testPixels =
          (check this.mtlist.count() expect 0) &&
          (check this.list1.count() expect 1) &&
          (check this.list2.count() expect 3);
```