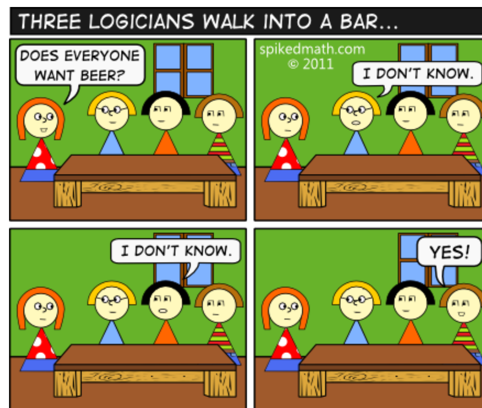
Assignment 4: Object creation and logic

ETH Zurich

Hand-out: Monday, 8 October 2012
Due: Wednesday, 17 October 2012



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Goals

- Create new objects.
- Use boolean operators to express interesting conditions.
- Write contracts.

1 Creating objects in Traffic

Up until now you were either working with predefined objects, such as *Zurich* or *Polybahn*, or you asked a *CITY* object to create an object for you, as in *Zurich.add_station* (**"Zoo"**, 1800, 500). In this assignment, you will create new objects yourself and add them to *Zurich*. To achieve that, use the following general scheme:

1. Declare an *attribute* [Touch Of Class, page 238] or a *local variable* [Touch Of Class, page 233] of the required type. For example:

```
class
    OBJECT_CREATION

feature -- Explore Zurich
    building: BUILDING
            -- An example of an attribute.
```

```
    explore
            -- Create new objects for Zurich.
        local
            p: VECTOR -- An example of a local variable.
        do
            ...
        end
end
```

Prefer local variables over attributes unless the object is used by more than one feature or you need to retain the object value between feature executions.

2. Create the object using one of the creation procedures [Touch Of Class, page 122] declared in the corresponding class. For example:

```
class
    VECTOR

create
    make, make_polar

feature {NONE} -- Initialization
    make (a_x, a_y: REAL_64)
            -- Create a vector with coordinates 'a_x' and 'a_y'.
        ...
        end

    make_polar (a_length, a_angle: REAL_64)
            -- Create a vector with polar coordinates 'a_length' and 'a_angle'.
        ...
        end
end
```

To create an object you can use an instruction such as:

```
create p.make (250, -20)
```

You don't have to create the object if its type is *expanded*. In this case the object will be automatically created for you. Examples of expanded types are *INTEGER*, *BOOLEAN* and *REAL_64*.

3. Add the object to the city by calling an appropriate command on the city, for example:

```
Zurich.add_building (building)
```

Note that only real components of the city, such as stations, lines, buildings, routes and public transportation units, have to be added to the city. There is no need to add helper objects, which are only used to build other objects, such as vectors, colors, route segments and so on.

To do

1. Download `http://se.inf.ethz.ch/courses/2012b_fall/eprog/assignments/04/traffic.zip`, unzip it and open `assignment_4.ecf`. Open class *OBJECT_CREATION* in the editor.

2. Declare a command *add_buildings* in *OBJECT_CREATION*, which adds a couple of buildings to Zurich, for example the ETH main building and the Opera house.

   Note that in order to create an object of class *BUILDING*, you first have to create two objects of class *VECTOR* that denote positions (with respect to the city center) of two opposite corners of a building, with respect to the city center.

3. Add a call to *add_buildings* from *explore* and check that the new buildings now appear on the map (see Figure 1 for an example).

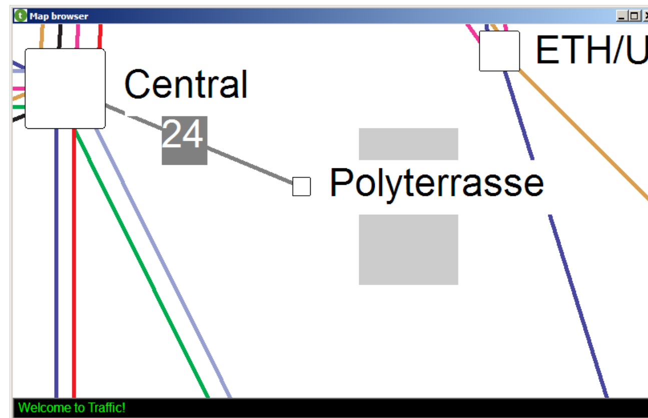

Figure 1: ETH main building on the map of Zurich

4. Imagine that a friend of yours needs to get from the ETH main building to the Opera house, and also wants to pass by Confiserie Sprüngli at Paradeplatz on the way. You decided to help him and show him the public transportation directions on the map of Zurich. Declare a command *add_route* in *OBJECT_CREATION*, which creates a route starting at station Polyterrasse, passing through Paradeplatz and ending at Opernhaus.

   Note that in order to create an object of class *ROUTE* you first have to create one or more objects of class *LEG*: segments of the route that go along a particular line. For example, a route from Sihlpost to Bellevue can consist of two legs: the first going from Sihlpost to Central along tram line 3, and the second one going from Central to Bellevue along tram line 4. You can call queries *station* and *line* on *Zurich* to get the objects representing stations and lines that each leg goes through. To connect the legs to each other use either the *link* command of class *LEG* or the *append_leg* command of class *ROUTE*.

   Don't forget to add the new route to Zurich.

5. Add a call to *add_route* from *explore* and check that the route appears on the map.

To hand in

Hand in the code of the class *OBJECT_CREATION*.

2 Temperature application

In this task you will write an application which converts temperatures between Celsius and Kelvin scales using the following formula:

$$T_{Celsius} = T_{Kelvin} - 273$$

The application should consist of two classes: *TEMPERATURE* and *APPLICATION*. Class *TEMPERATURE* encapsulates the notion of temperature; it hides from its clients implementation details such as how temperatures are converted between different scales. Class *APPLICATION* is a root class and a client of *TEMPERATURE*; it provides the user interface for the application.

To do

1. Launch EiffelStudio. Create a new project of type "Basic application (no graphics library included)", using the settings shown in Figure 2 (feel free to pick any location).

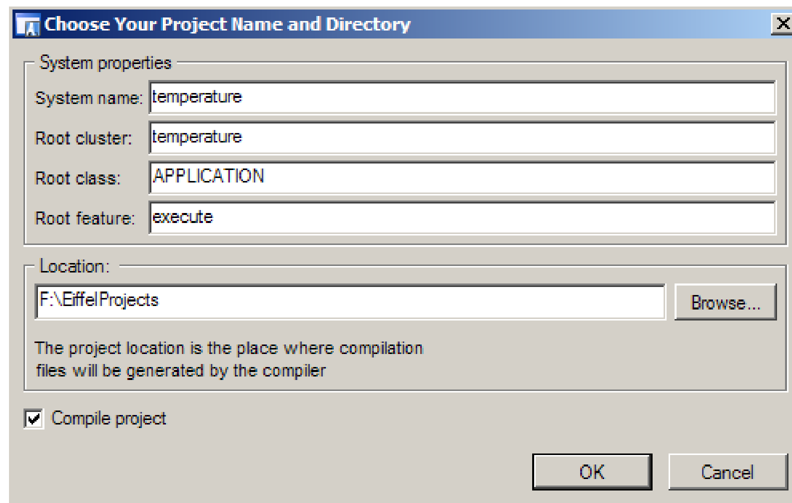

Figure 2: New project

2. Download the skeleton classes for *TEMPERATURE* and *APPLICATION* from `http://se.inf.ethz.ch/courses/2012b_fall/eprog/assignments/04/temperature.e` and `http://se.inf.ethz.ch/courses/2012b_fall/eprog/assignments/04/application.e` and put them into your project directory. From the `Project` menu in EiffelStudio choose `Find Added Classes & Recompile`; this way EiffelStudio will see the new classes you added.

3. Fill in the missing pieces of classes *TEMPERATURE* and *APPLICATION* according to the comments. Feature *execute* of class *APPLICATION* must use the class *TEMPERATURE* to perform the conversion.

4. Express the following properties using contracts:

   - *make_celsius* does not accept values below -273 and sets the Celsius temperature to the provided value;
   - *make_kelvin* does not accept values below zero and sets the Kelvin temperature to the provided value;
   - a temperature can never be below zero on the Kelvin scale.
   - *average* does not accept the **Void** reference and the resulting average temperature lies somewhere in between the two initial temperatures.

An execution of your application should look similar to this:

```
Enter the first temperature in Celsius: 0
The first temperature in Kelvin is: 273
Enter the second temperature in Kelvin: 283
The second temperature in Celsius is: 10
The average in Celsius is: 5
The average in Kelvin is: 278
```

To hand in

Hand in the code of *TEMPERATURE* and *APPLICATION*.

3 Ein Ticket für alles

Imagine that you work for ZVV and you are writing an application that allows customers to find out if they are eligible for a discounted seasonal ticket. ZVV decided to make the tickets more affordable and introduced a really tricky rule: you can get a discount in one of three cases: 1) you are younger than 25 or 2) you live in the city of Zurich and work anywhere outside the city or 3) you work in the city of Zurich and live in the canton of Zurich, but outside the city.

To do

1. Download `http://se.inf.ethz.ch/courses/2012b_fall/eprog/assignments/04/ticket.zip`, unzip it and open `ticket.ecf`. Open class *APPLICATION* in the editor.
2. This program first asks the user for some data: his birth date and the postal codes of his home and work place. Then it analyzes the data and decides if the user can get a discount. Your task is to implement a couple of functions that help it make the decision.
3. Implement function *in_zurich_city*: it should say that a postal code belongs to the city of Zurich if its first two digits are `80`. Use the function *in_zurich_canton* as an example.
4. Implement function *valid_postal_code*: it should say that a string represents a valid postal code if it's not a **Void** reference, it consists of four characters and represents a natural number. **Hint:** use query *is_natural* of class *STRING*.
5. Implement function *age* that determines a user's age based on his birth date. To achieve that, inside the function create another object of class *DATE* to represent today's date (check the list of creation procedures of class *DATE* to find an appropriate one). **Hint:** use function *relative_duration* of *DATE* to get the difference between two dates.
6. Implement function *gets_discount* that decides if a customer with the currently entered parameters is eligible for discount, according to the tricky rule described above.

An execution of your application should look similar to this:

```
Enter birth date as dd/mm/yyyy: 20/05/1985
Enter home postal code: 8051
Enter work postal code: 8600

Eligible for discount: True
```

To hand in

Hand in the code of class *APPLICATION*.