

Problem from the September 2006 exam

Complete the following UML state diagram, according to the textual specification appearing below it, by giving the text for the label on each of the state-machine transitions t_1 to t_7 and for the actions a_1 and a_2 . The text on the initial transition is provided for you (indicating, at the same time, the syntax to be used for assignments in the action language).

Your solution *must* use the following trigger events:

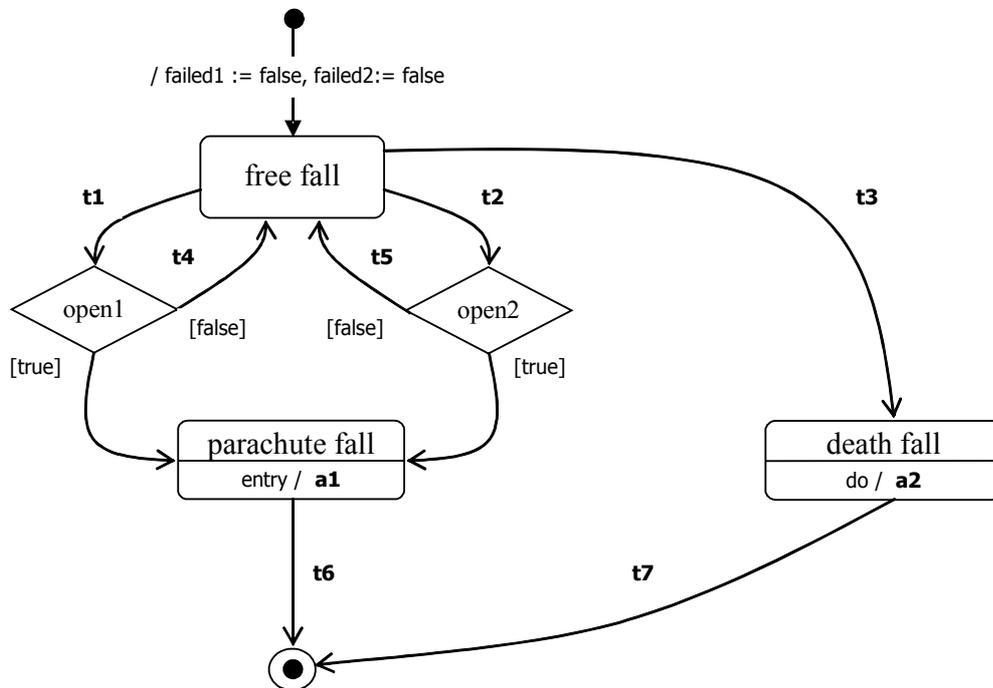
`pull_ripcord, reach_ground`

the following boolean variables:

`failed1, failed2, open1, open2`

and the following method calls:

`hallucinate(), shout(String cry), expire().`



A parachutist jumps out of a plane and is in free fall from that moment. He can then pull the ripcord to open the main parachute (*note: but not that to open the reserve parachute*). On doing so, two things can happen: either it opens, in which case he shouts "yes!" and starts to fall slowly, or it doesn't open, in which case he remains in free fall. If the main parachute doesn't open (*note: but not otherwise*), he can pull the ripcord to try and open the reserve parachute with the same two possible outcomes. If he remains in free fall for longer than `max_freefall_time` (*note: whether or not he has tried to open zero, one or two parachutes*) the fall becomes a death fall and he sees his entire life flash by in front of his eyes. In all cases, he eventually reaches the ground, shouting "aaah!" in the case of a parachute fall and expiring in the case of a death fall.

Problem from the September 2007 exam

Suppose we wish to develop an information management system for Spanish universities according to the following description.

A **University** is characterised by a *name* and a *town*, and *has relation* with two types of **Person: Staff**, that the **University** *employs*, and **Students**, that *study* at the **University**. Each **Person** has a *DNI* and a *name*.

There are two types of **Staff: PDI** and **PAS**. Each member of **Staff** has a *start_date* of their contract. **PDI** also have a *category* while **PAS** have a *post*. The **PDI** may, or may not, be **Doctores**. The activities carried out by the **PDI** are: *research* and *teach*, while the activity carried out by the **PAS** is: *administer*.

A **University** *is composed of* several **Departments**, each of which has a *name* and an attached set of members of **Staff**. A member of staff cannot be attached to more than one department. A **PDI** must be *attached to* a **Department** while a **PAS** may, or may not, be. Each **Department** is *managed by* a head of **Department** who is a **Doctor**.

A **Student** is either an **Undergraduate**, studying on a given *degree program*, or a **Postgraduate**, studying on a given *PhD program*. An **Undergraduate** may have a *collaboration* relation with a **Department** and may be writing a PFC *supervised by* a **PDI**. A postgraduate must be writing a thesis *supervised by* a **Doctor**.

You may assume that a **Student** can only *study* at one **University** and that a member of **Staff** can only be *employed* by one **University**

Provide a model of this description in the form of a UML class diagram using only the words appearing in bold in the above description as class names. The words appearing in italics are hints to help you with defining the other elements of the diagram. You do not need to provide any typing information for any properties you define.

For extra marks, add the necessary elements to your model to take into account the following:

- a **Person** can be both a member of **Staff** and a **Student**
- a **Student** cannot be both a **Postgraduate** and an **Undergraduate**
- there are no other types of **Staff** other than **PDI** and **PAS**
- a member of **Staff** cannot be both **PDI** and **PAS**

Problem from the September 2008 exam

(a) The UML diagrams in Fig. 1 constitute a simplified model of a cashpoint (in U.S. Terminology, an ATM) connected to a bank. They comprise a class diagram with two classes, and two state diagrams, each describing the behaviour of one of these classes. Study the diagrams and then answer the following questions:

- (i) What is the meaning of the black vertical rectangles in the state diagram for the `Bank` class? What behaviour of the bank is described by the transition from the `CardValid` state to the lower-right one of these rectangles?
- (ii) What is the meaning of the diamond shapes located inside the `Verifying` state of the state diagram for the `Bank` class? Why is it that there is no guard on either of the outgoing transitions of the lower of these two rectangles?
- (iii) What is the meaning of the horizontal discontinuous line located inside the `Verifying` state of the state diagram for the `Bank` class and what is the difference between this type of state and a state such as `Giving Money` of the state diagram for the `ATM` class?
- (iv) Briefly describe each of the three parts which can appear in a label on a UML state diagram transition. What is the meaning of the text beginning with the “^” character located in the labels on several of the transitions of both state diagrams? Explain what each of the two transitions of the `ATM` state diagram whose label contains the text

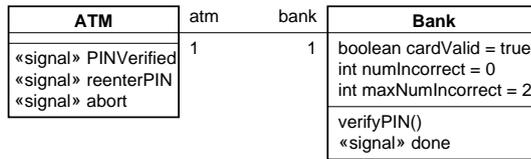
`^bank` and each of the three transitions of the `Bank` state diagram whose label contains the text `^atm` represent [*Hint*: study the class diagram].

- (b) Now provide a UML sequence diagram showing the communication between an object playing the `atm` role and an object playing the corresponding `bank` role. [*Hints*: the diagram should reflect whether the communication is synchronous or asynchronous; it is suggested that you use interaction operators].

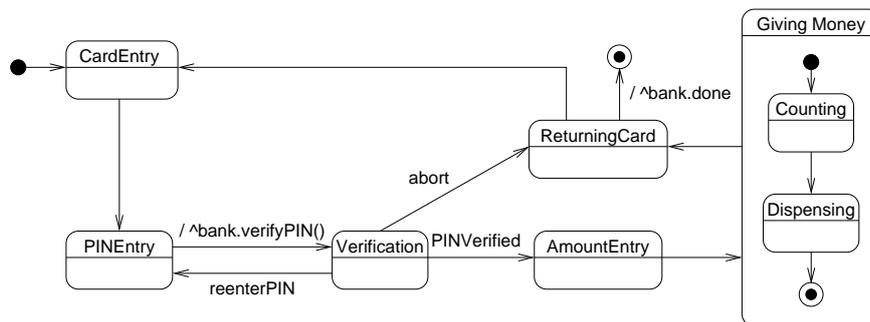
Problem from the January 2009 exam

Study the UML class diagram of Figure 3 and then answer the following questions:

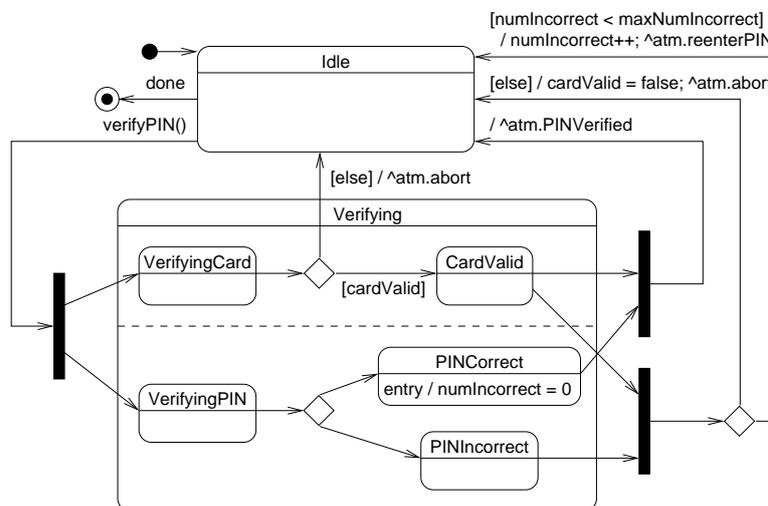
- (i) Describe in natural language the domain modelled in this UML specification; if you do not have time to give an exhaustive description, ensure that you at least illustrate each of the syntactic elements appearing in it.
- (ii) What other information could have been provided in the boxes?
- (iii) What is special about the box with the text "TimeInterval" in it?



(a) Class diagram



(d) State machine diagram for class ATM



(e) State machine diagram for class Bank

Fig. 1. UML model of an ATM

This example is taken from the following article:
 Model Checking and Code Generation for UML State Machines and Collaborations.
 Alexander Knapp and Stephan Merz.
 In Dominik Haneberg, Gerhard Schellhorn, and Wolfgang Reif, editors,
 Proc. 5th Wsh. Tools for System Design and Verification, pages 59-64.
 Technical Report 2002-11, Institut für Informatik, Universität Augsburg, 2002.

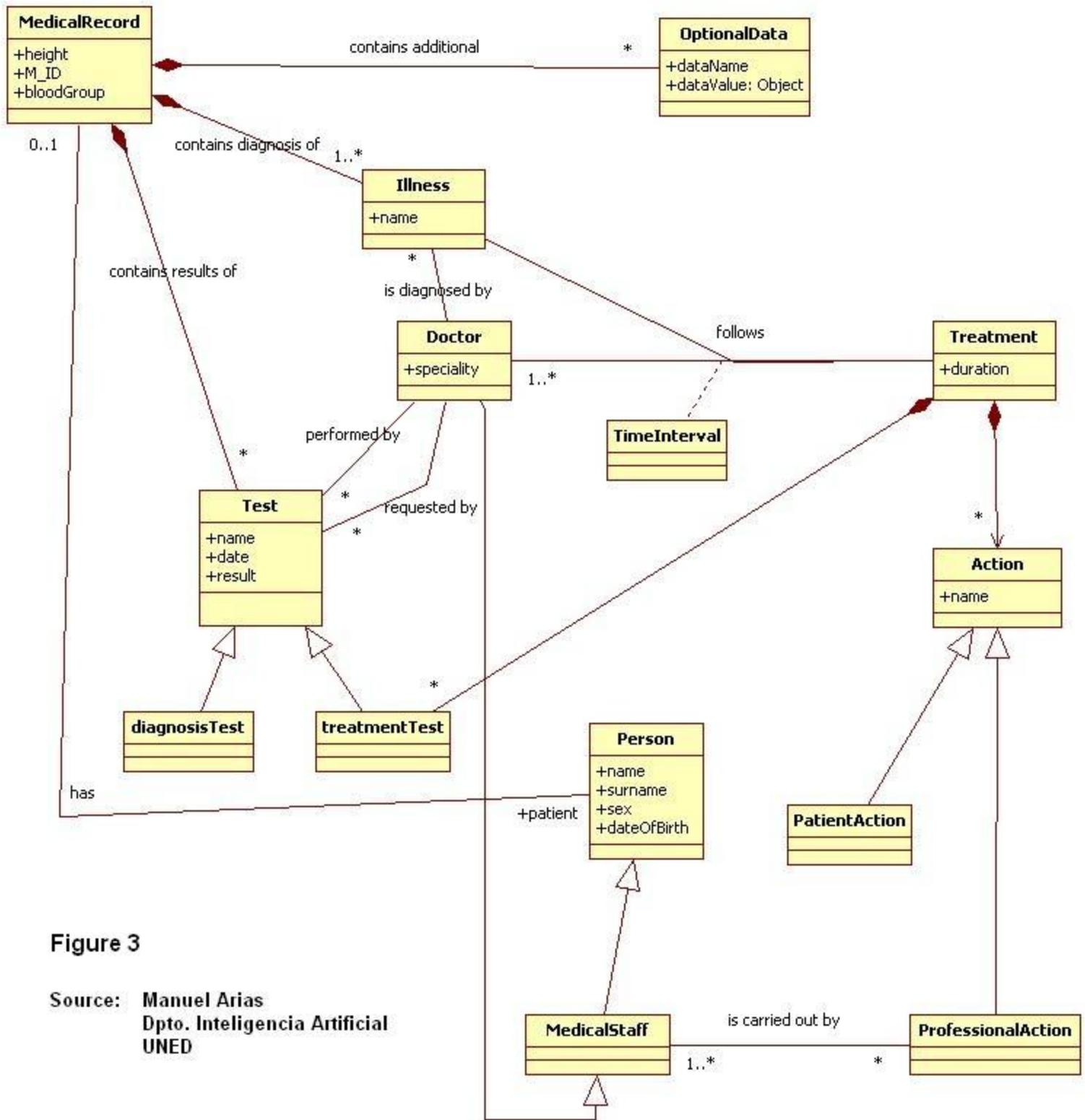


Figure 3

Source: Manuel Arias
 Dpto. Inteligencia Artificial
 UNED