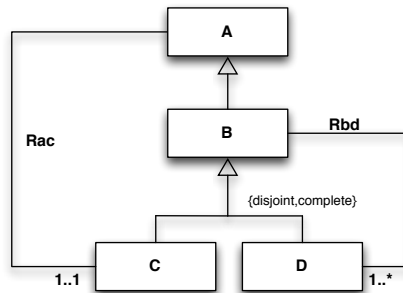
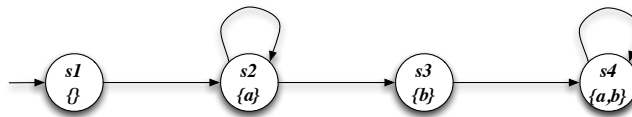


**Exercise 1.** Consider the following UML class diagram.



- Express it in *FOL*.
- Express it in *DL-Lite<sub>A</sub>*, highlighting parts that are not expressible.
- Given the ABox  $A = \{A(a)\}$  and the conjunctive query  $q(x) \leftarrow Rac(x, y), Rbd(y, z), A(z)$ , return the certain answer by exploiting the *DL-Lite<sub>A</sub>* rewriting algorithm.

**Exercise 2.** Model check the Mu-Calculus formula  $\nu X. \mu Y. (a \vee \langle next \rangle X) \wedge [next] Y$  and the CTL formula  $EG(\neg a \supset AXAFa)$  (showing its translation in Mu-Calculus) against the following transition system:



**Exercise 3.** Consider the following predicates *Employee*( $x$ ) saying that  $x$  is an employee, *Manages*( $x, y$ ) saying that  $x$  manages  $y$ , and *MSc*( $x$ ) saying that  $x$  is a person with master degree. Express in *FOL* the following boolean queries (stating which ones are CQs):

- There exists an employee with master degree that manages someone with the master degree.
- There exists an employee with master degree that manages at least two people with the master degree.
- There exists an employee that manages someone with the master degree and someone without the master degree.
- There exists an employee that manages only people with master degree.
- There exists an employee that manages all the people with master degree.

**Exercise 4.** Compute the certain answers to the CQ  $q(x) \leftarrow Employee(x), Manages(x, y)$  over the incomplete database (naive tables):

name
Smith
$null_1$
Brown

mgr	mgd
Green	Smith
Smith	$null_1$
$null_1$	Brown
Brown	$null_2$

**Exercise 5.** Compute the weakest precondition for getting  $\{x = y\}$  by executing the following program:

```

x := y + 1;
if (y > 0) then
  x := x + y
else x := y + 100;
x := x + y;

```