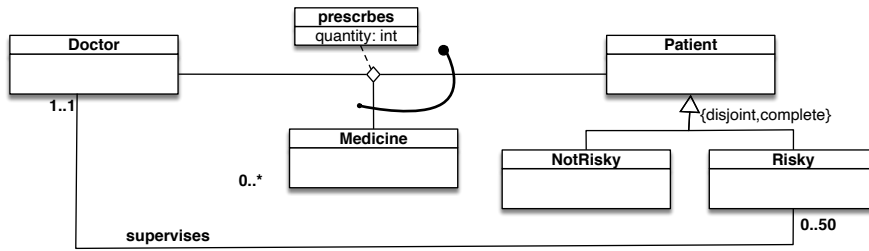
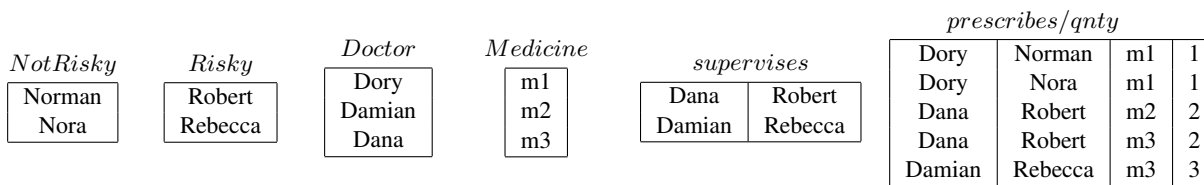


Exercise 1. Express the following UML class diagram in FOL:

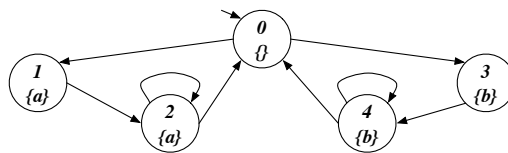


Exercise 2. Consider the above UML class diagram and the following (partial) instantiation:



1. Check whether the above instantiation, once completed, is correct, and explain why it is or it is not.
2. Express in FOL the following queries, and evaluate them over the completed instantiation:
 - (a) Return patients who have been prescribed at least two medicines.
 - (b) Return risky patients who have been prescribed medicines by the doctor who supervises them.
 - (c) Check that risky patients have medicines prescribed only by the doctor who supervises them.
 - (d) Return doctors who have prescribed some medicine to all patients who they supervise.

Exercise 3. Model check the Mu-Calculus formula $\nu X. \mu Y. ((a \wedge [next]X) \vee (b \wedge \langle next \rangle Y))$ and the CTL formula $AF(EG(a \supset AXEX\neg a))$ (showing its translation in Mu-Calculus) against the following transition system:



Exercise 4. Check whether the following FOL formula is valid, by using tableaux:

$$(\forall x.(A(x) \not\equiv (\exists y.B(y)))) \supset ((\forall x.A(x)) \vee (\forall x.\neg A(x)))$$

Exercise 5. Consider the transition system TS below. Model check the LTL formula $\square \diamond a$, by considering that the Büchi automaton BA for $\neg \square \diamond a$ (i.e., $\diamond \square \neg a$) is the one below:

