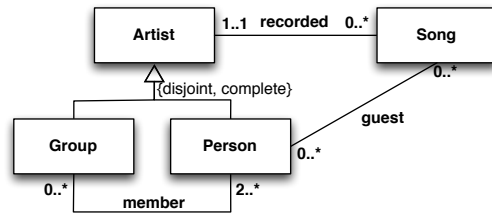
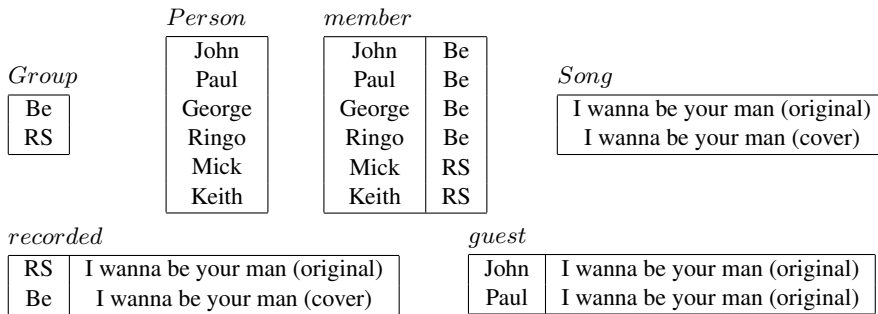


Exercise 1. Express the following UML class diagram in *FOL*.

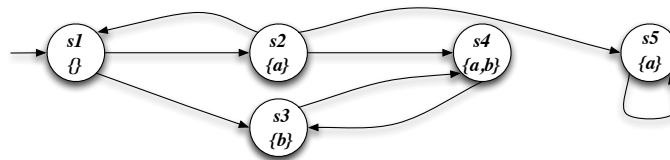


Exercise 2. Consider the above UML class diagram and the following (partial) instantiation.

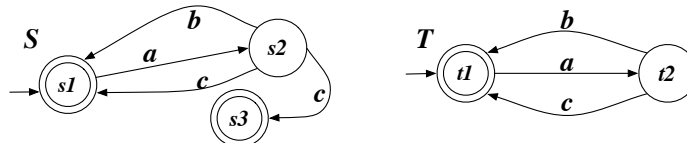


1. Check whether the above instantiation, once completed, is correct, and explain why it is or it is not.
2. Express in FOL and evaluate the following queries:
 - (a) Return groups to with more that 3 members.
 - (b) Return person that are guest of all songs that they, or group they are member of, did not recorded.
 - (c) Check whether there are no songs recoded by groups whose members also participated as guests to the song.

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



Exercise 4. Consider the following two transition systems:



Write the definition of bisimilarity and compute the bisimilarity relation for the two transition systems.

Exercise 5. Check whether the following Hoare triple is correct, using as *invariant* $i \leq 10$.

```
{i=0} while(i<10) do i:= i+1 {i=10}
```