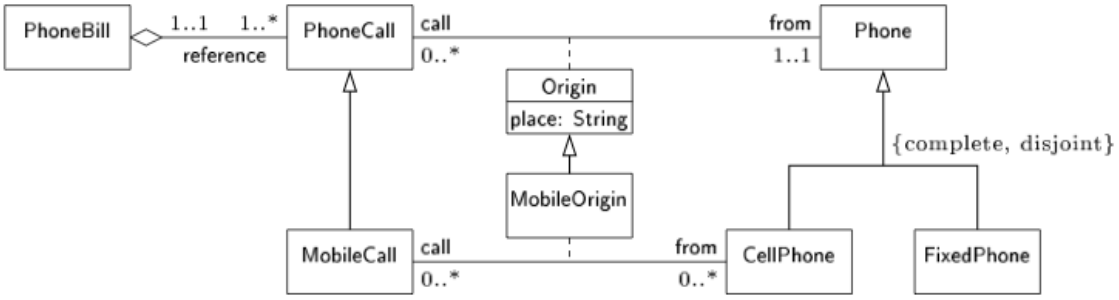
Knowledge Representation and Reasoning

Exercises on Ontologies

1 Converting from UML to First-Order Logic

Consider the following UML class diagram about different kinds of phones, and phone bills they belong to.



The diagram shows that a MobileCall is a particular kind of PhoneCall and that the Origin of each PhoneCall is one and only one Phone. Additionally, a Phone can be only of two different kinds: a Fixed Phone or a Cell Phone. Mobile calls originate (through the association MobileOrigin) from cell phones. The association MobileOrigin is contained in the binary association Origin: hence MobileOrigin inherits the attribute place of association class Origin. Finally, a PhoneCall is referenced in one and only one PhoneBill, whereas a PhoneBill contains at least one PhoneCall.

1. Convert the UML Diagram into Description Logics.
2. Convert the Description Logic result into first-order logic.
3. Suppose you add a generalization to the diagram asserting that each CellPhone is a FixedPhone. Which classes become inconsistent (i.e. they cannot be populated) and which pairs of classes become equivalent?

2 Constructing Models of Ontologies

Consider the following **TBox**:

$$
\begin{aligned}
&Cow \sqsubseteq Vegetarian \\
&MadCow \sqsubseteq Cow \sqcap \exists\ eat.BrainOfSheep \\
&Sheep \sqsubseteq Animal \\
&Vegetarian \sqsubseteq (\geq 1\ eat) \sqcap \forall eat.\neg(Animal \sqcup PartOfAnimal) \\
&BrainOfSheep \sqsubseteq PartOfAnimal
\end{aligned}
$$

1. Translate the TBox into natural language, and compare with the translation into first-order logic.
2. Construct a model for the ontology $\mathcal{O}_1 = (\mathbf{TBox}, Cow(mimosa))$.
3. Show that there is no model for the ontology $\mathcal{O}_2 = (\mathbf{TBox}, MadCow(mimosa))$.