

## Ontology Languages (COMP321)

### Exercise 5

1. Translate the following assertions to concept inclusions in the description logic  $\mathcal{SHOIQ}$ . State which symbols are used as concept names, role names, and nominals.
  - Every student at Liverpool University is a Human being;
  - Liverpool University has at least 10,000 students;
  - Every citizen of France is a European;
  - The EU consists of at least 10 states;
  - The domain of the relation “citizen of” consists of human beings;
  - The range of the relation “citizen of” consists of states;
  - There are at least 50,000,000 French citizens.

Ensure that it follows from your translation that France is a state.

2. Translate the assertions from (1) into FOPL.
3. Recall that an inclusion  $C \sqsubseteq D$  follows from a TBox  $\mathcal{T}$ , in symbols  $\mathcal{T} \models C \sqsubseteq D$ , if every  $\mathcal{I}$  that satisfies  $\mathcal{T}$  satisfies  $C \sqsubseteq D$  as well.

Consider the following statements.

- $\{\forall r. B \sqsubseteq A\} \models \{A \sqsubseteq B\}$ ;
- $\{A \sqsubseteq B, B \sqsubseteq E\} \models A \sqsubseteq E$ ;
- $\{\top \sqsubseteq \exists r.(A \sqcap B), E \sqsubseteq A\} \models E \sqsubseteq B$ ;
- $\{\top \sqsubseteq \exists r.(A \sqcap B)\} \models A \sqsubseteq B$ ;
- $\{\top \sqsubseteq \exists r.(\{a\} \sqcap B)\} \models \{a\} \sqsubseteq B$ ;
- $\{A \sqsubseteq \exists r.B, A \sqsubseteq \forall r.E\} \models A \sqsubseteq \exists r.(B \sqcap E)$ .

- (a) Translate all inclusions in those statements into FOPL.
- (b) Check whether the statements hold. If a statement does not hold, provide an interpretation that satisfies the TBox but not the concept inclusion on the right hand side.