

## Ontology Languages (COMP321)

### Exercise 6

Consider the database instance  $\mathcal{D}_{\text{Nemo}}$  given by

Clownfish(Nemo), Clownfish(Karl)

Surgeonfish(Dory), has\_friend(Nemo, Dory)

We query  $\mathcal{D}_{\text{Nemo}}$  under closed world assumption (standard relational database semantics) and under open world assumption. Recall that under the closed world assumption we consider the interpretation  $\mathcal{I} := \mathcal{I}_{\mathcal{D}_{\text{Nemo}}}$  defined as follows:

- $\Delta^{\mathcal{I}} = \{\text{Nemo}, \text{Karl}, \text{Dory}\};$
- $\text{Clownfish}^{\mathcal{I}} = \{\text{Nemo}, \text{Karl}\};$
- $\text{Surgeonfish}^{\mathcal{I}} = \{\text{Dory}\};$
- $\text{has\_friend}^{\mathcal{I}} = \{(\text{Nemo}, \text{Dory})\}.$

Consider the following Boolean queries (in description logic notation).

- Clownfish(Karl)
- Clownfish(Dory)
- Fish(Nemo)
- $\neg\text{Fish}(\text{Nemo})$
- $(\exists\text{has\_friend}.\top)(\text{Nemo})$
- $(\exists\text{has\_friend}.\text{Fish})(\text{Nemo})$
- $(\text{Clownfish} \sqcap \neg\text{Surgeonfish})(\text{Karl})$
- Fish(Dory)
- $(\text{Surgeonfish} \sqcap \neg\text{Fish})(\text{Dory})$

- $(\exists \text{has\_friend.Clownfish})(\text{Karl})$ .

1. Write those Boolean queries in first-order predicate logic (FOPL) notation. (Note that for many queries there is no difference between description logic notation and FOPL notation).
2. Query answering under closed world assumption: check for each Boolean query  $F$  whether the answer to the query  $F$  given by  $\mathcal{D}_{\text{Nemo}}$  is “Yes” or “No”. In other words, check whether  $\mathcal{I} \models F$  or  $\mathcal{I} \models \neg F$ .
3. Query answering under open world assumption: check for each Boolean query  $F$  whether the certain answer to  $F$  given by  $\mathcal{D}_{\text{Nemo}}$  is “Yes”, “No”, or “Don’t know”. In other words, check whether  $\mathcal{D} \models F$  or  $\mathcal{D} \models \neg F$  or neither of these two hold.

Consider the following non-Boolean queries  $F_i$ :

- $F_1(x) = \text{Clownfish}(x)$
- $F_2(x) = \neg \text{Surgeonfish}(x)$
- $F_3(x, y) = \text{has\_friend}(x, y)$
- $F_4(x) = \text{Clownfish}(x) \wedge \neg \text{has\_friend}(x, \text{Dory})$

For each query  $F_i$ , give

1. for closed world assumption:  $\text{answer}(F_i, \mathcal{D}_{\text{Nemo}})$ ;
2. for open world assumption:  $\text{certanswer}(F_i, \mathcal{D}_{\text{Nemo}})$ .