Ontology Languages (COMP321)
Exercise 6

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

\begin{align*}
\text{Clownfish}(Nemo), & \quad \text{Clownfish}(Karl) \\
\text{Surgeonfish}(Dory), & \quad \text{has\_friend}(Nemo, Dory)
\end{align*}

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

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

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

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

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

For each query $F_i$, give

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

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