The Knowledge Base Exchange Framework

We study the knowledge base (KB) exchange problem for OWL-QL KBs.

Let \( M = (\Sigma_1, T_1, A_1) \) and \( M' = (\Sigma_2, T_2, A_2) \) be two KBs. A tuple \( (T_1, A_1) \) is a desired solution for \( K_1 = (T_1, A_1) \) under \( M = (\Sigma_1, T_1, A_1) \).

We consider computational problems along three dimensions:

1. Non-emptyness
2. Membership
3. Universal solution

Universal solution: preserves all models.

\( T_1 \) is a universal solution. For every \( A_1 \) and \( \text{UCQ} g \) over \( L(T_1 \cup T_2, A_1) \) and \( T_1, T_2, A_1 \) give the same answers to \( g \).

It is easy to check the homomorphism from \( U_1 \) to \( U_2 \). For the opposite direction, we employ the technique of reachability games on graphs known to be PTime-complete.

\( T_1 = (R \subseteq \mathcal{R}, A_1 \subseteq \mathcal{A}), A_1 = (\{\text{AuthorOf}, \text{WrittenBy}\}) \).

There exists a homomorphism from \( U(T_1, A_1) \) to \( U_2 \). If \( \text{Duplicator}\) has a strategy in \( G \) from \( U(T_1, A_1) \), then \( \text{Spiller}\) has a strategy against \( \text{Duplicator}\) to avoid \( F \).

The upper bound is obtained by using two-way alternating tree automata (2ATA).

- 2ATA \( \Delta^{\mathcal{L}} \) accepts \( U_2 \), arbitrarily labeled with a reserved symbol \( G \).

There exists a universal solution for \( K_2 = (T_2, A_2) \) under \( M = (\Sigma_1, T_1, A_1) \).

Consider \( T_1 = \{A \subseteq \mathcal{R}, \Sigma_1 \subseteq \mathcal{A}\} \), \( T_1 = \{A \subseteq \mathcal{R}, \Sigma_1 \subseteq \mathcal{A}\} \), \( T_2 = \{A \subseteq \mathcal{R}, \Sigma_2 \subseteq \mathcal{A}\} \). In particular, these conditions are satisfied:

- \( T_1 \cup T_2 \models A \subseteq \mathcal{R} \)
- \( T_1 \cup T_2 \models \Sigma_1 \subseteq \mathcal{A} \)
- \( T_1 \cup T_2 \models \Sigma_2 \subseteq \mathcal{A} \)

The membership problem for universal UCO-solutions with simple \( \text{Albox} \) is PSpace-hard.

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