Semantic Web

Tutorial 9

Iryna Dubrovska

WeST
People and Knowledge Networks

Task 1. OBDA

Consider the following Global Schema (G):

$$
\begin{aligned}
G = \ \{ & \\
& \mathsf{Product} && \sqsubseteq && (\exists \mathsf{hasName}.\top) \sqcap (\exists \mathsf{belongsToBrand}.\top) \sqcap (\exists \mathsf{hasPrice}.\top) \\
& \mathsf{ElectronicProduct} && \sqsubseteq && \mathsf{Product} \\
& \mathsf{Customer} && \sqsubseteq && \exists \mathsf{buys}.\mathsf{Product} \sqcap \exists \mathsf{hasGender}.\top \ \}
\end{aligned}
$$

and the following data sources:

$S_1 = R_1(productName, brand, price)$, where electronic products' prices are less than 1000 euros;
$S_2 = R_2(productName, customer)$, where products' prices range from 50 to 800 euros.

Task 1. Ontology Matching

1.1 GAV. Formalise GAV mappings for the global schema (G) and data source (S).

$$
\begin{aligned}
G = \ \{ & \\
& \text{Product} && \sqsubseteq && (\exists \text{hasName}.\top) \sqcap (\exists \text{belongsToBrand}.\top) \sqcap (\exists \text{hasPrice}.\top) \\
& \text{ElectronicProduct} && \sqsubseteq && \text{Product} \\
& \text{Customer} && \sqsubseteq && \exists \text{buys}.\text{Product} \sqcap \exists \text{hasGender}.\top \ \}
\end{aligned}
$$

$S_1 = R_1(productName, brand, price)$, where electronic products' prices are less than 1000 euros;

$S_2 = R_2(productName, customer)$, where products' prices range from 50 to 800 euros.

GAV: for each concept in G, M associates a view over S:

```
SELECT R1.productName as x from R1                  → x: ElectronicProduct

SELECT R1.productName as x from R1                  → x: Product
UNION SELECT R2.productName as x from R2

SELECT R2.customer as x from R2                     → x: Costumer

SELECT R1.productName as x from R1                  → (x,x): hasName
UNION SELECT R2.productName as x from R2

SELECT R1.productName as x from R1,                 → (x,y): belongsToBrand
SELECT R1.brand as y from R1

SELECT R1.productName as x from R1,                 → (x,y): hasPrice
SELECT R1.price as y from R1

SELECT R2.Customer as x from R2,                    → (x,y): buys
SELECT R2.productName as y from R2

SELECT R2.Customer as x from R2                     → (x, g(x)): hasGender
```

Task 1. Ontology Matching

1.2 LAV. Formalise LAV mappings for the global schema (G) and data source (S).

$$
\begin{aligned}
G = \ \{ & \\
& \text{Product} && \sqsubseteq && (\exists \text{hasName}.\top) \sqcap (\exists \text{belongsToBrand}.\top) \sqcap (\exists \text{hasPrice}.\top) \\
& \text{ElectronicProduct} && \sqsubseteq && \text{Product} \\
& \text{Customer} && \sqsubseteq && \exists \text{buys}.\text{Product} \sqcap \exists \text{hasGender}.\top \ \}
\end{aligned}
$$

$S_1 = R_1(productName, brand, price)$, where electronic products' prices are less than 1000 euros;

$S_2 = R_2(productName, customer)$, where products' prices range from 50 to 800 euros.

LAV: for each table in S, M associates a view over G:

```
SELECT R1.productName as x, R1.brand as y, R1.price as z from R1
→ x: ElectronicProduct ∧
  (x,y): belongsToBrand ∧
  (x,x): hasName ∧
  (x,z): hasPrice ∧
   z ≤ 1000
```

```
SELECT R2.productName as x, R2.customer as y from R2
→ ∃p :                                  → ∃p,g :
  x: Product ∧                            x: Product ∧
  y: Customer ∧                           y: Customer ∧
  (x,x): hasName ∧                        (y,g): hasGender ∧
  (x,p): hasPrice ∧                       (x,x): hasName ∧
  (y,x): buys ∧                           (x,p): hasPrice ∧
  p ≥ 50 ∧ p ≤ 800                        (y,x): buys ∧
                                          p ≥ 50 ∧ p ≤ 800
                                          g = "male"
```

Task 2. Query Formalism

$$
\begin{aligned}
G = \{ & \\
& \text{Product} \sqsubseteq (\exists \text{hasName}.\top) \sqcap (\exists \text{belongsToBrand}.\top) \sqcap (\exists \text{hasPrice}.\top) \\
& \text{ElectronicProduct} \sqsubseteq \text{Product} \\
& \text{Customer} \sqsubseteq \exists \text{buys}.\text{Product} \sqcap \exists \text{hasGender}.\top \ \}
\end{aligned}
$$

$S_1 = R_1(productName, brand, price)$, where electronic products' prices are less than 1000 euros;

$S_2 = R_2(productName, customer)$, where products' prices range from 50 to 800 euros.

2.1 Show customers who purchased Samsung products

$$q1 = Customer(x) \wedge buys(x,y) \wedge Product(y) \wedge belongsToBrand(y, Samsung).$$

2.2 Show all the products priced less than 60 Euro that were purchased by female customers

$$fem(x) = Customer(x) \wedge hasGender(x,female)$$
$$q2 = \exists y\ fem(y) \wedge Product(x) \wedge buys(y,x) \wedge hasPrice(x,z) \wedge z \leq 60$$

OR

$$q2 = Customer(x) \wedge Product(y) \wedge hasGender(x, female) \wedge buys(x, y) \wedge hasPrice(y, z) \wedge z < 60$$

Task 2. Query Formalism

$$
\begin{aligned}
G = \ \{ & \\
& \text{Product} && \sqsubseteq && (\exists \text{hasName}.\top) \sqcap (\exists \text{belongsToBrand}.\top) \sqcap (\exists \text{hasPrice}.\top) \\
& \text{ElectronicProduct} && \sqsubseteq && \text{Product} \\
& \text{Customer} && \sqsubseteq && \exists \text{buys}.\text{Product} \sqcap \exists \text{hasGender}.\top \ \}
\end{aligned}
$$

$S_1 = R_1(productName, brand, price)$, where electronic products' prices are less than 1000 euros;

$S_2 = R_2(productName, customer)$, where products' prices range from 50 to 800 euros.

2.3 Show Apple products which were bought by male customers

```
male(x) = Costumer(x) ∧ hasGender(x,male)
q3 = ∃y Product(x) ∧ belongsToBrand(x,Apple) ∧ buys(y,x) ∧ male(y).
```

2.4 Show all the products priced less than 60 Euro that were purchased by female customers

```
q4 = ∃y fem(x) ∧ Product(y) ∧ buys(x,y) ∧ hasPrice(y,750)
```

Questions?