Enabling Trust-Aware Semantic Web Service Selection - A Flexible and Personalized Approach

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Motivation
Motivation
Motivation
Agenda

(1) Eliciting Feedback
(2) Utilizing Feedback
(3) Experimental Results
(4) Conclusions
SWS Request

```
:ServiceProfile
  effect
  Owned
    product
    Product
      price
      Product
        productType
        Price
          currency
          Double
            amount
            <=50
            Currency
              ==usd
            Battery
              ...
            MobilePhoneStyle
              in {bar, slider}
            MobilePhoneType
              phoneType
              color
            MobilePhoneType
              manufacturer
              model
            Company
              in [nokia[1.0], sonyEricsson[0.8]]
        Color
          in {silver, black}
```
Eliciting Feedback

```plaintext
:ServiceProfile
  effect
  Owned
    product
      Product
        price
        productType
          Price
            currency
            amount
              Currency
                ==usd
              Double
                  <=50
                    Battery
                        ...  
                    MobilePhoneStyle
                        in {bar, slider}
                    MobilePhoneType
                        phoneType
                            color
                              Company
                                  in [nokia[1.0], sonyEricsson[0.8]]
                              model
                                Model
                        manufacturer
```
Eliciting Feedback

```
:ServiceProfile
  effect
  Owned
    product
  Product
    price
    productType

Price
  currency
  amount
  Double
    == usd
    <= 50

MobilePhone
  0.3 * (battery mul style mul color) +
  0.7 * (phoneType mul battery mul color)

Battery

MobilePhoneStyle
  in {bar, slider}

MobilePhoneType
  manufacturer
  model
  Color
    in {silver, black}

Company
  in {nokia[1.0], sonyEricsson[0.8]}
```
Eliciting Feedback
Eliciting Feedback

Feedback Structure

:ServiceProfile
  effect
  Owned
    product
      Product
        price
        productType
      MobilePhone
        battery
        style
        phoneType
        color
      Battery
      MobilePhoneStyle
      MobilePhoneNumber
      Color
Utilizing Consumer Feedback

candidate services

service
service
service

service request

rating ?
Utilizing Consumer Feedback

candidate services

service
service
service

service

service provider p

service request

rating ?

Rating Prediction

feedback item
feedback item
feedback item

feedback items related to p
Feedback Relevance

candidate services

service
service
service

service of p

Rating Prediction

service request

feedback item
feedback item
feedback item

service of p

service request
Feedback Relevance

candidate services

service
service
service

service of p

service request

Rating

Service Similarity

feedback item
feedback item
feedback item

service request
Feedback Relevance

- Candidate services
- Service
- Service
- Service
- Service of p

- Service request
- Rating Prediction
- Provider Similarity
- Feedback item
- Feedback item
- Feedback item

- Service of p
- Service request
### Provider and Service Similarity

<table>
<thead>
<tr>
<th>feedback items</th>
<th>services</th>
</tr>
</thead>
<tbody>
<tr>
<td>( f_1 )</td>
<td>( r_1 )</td>
</tr>
<tr>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>( f_i )</td>
<td>( r_i )</td>
</tr>
<tr>
<td>. . .</td>
<td>. . .</td>
</tr>
<tr>
<td>( f_n )</td>
<td>( r_n )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>request ( r )</th>
<th>( \cdot ) ... ( \cdot ) ... ( \cdot )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \cdot ) ... ( \cdot ) ... ( \cdot )</td>
<td></td>
</tr>
<tr>
<td>( \cdot ) ... ( \cdot ) ... ( \cdot )</td>
<td></td>
</tr>
<tr>
<td>( \cdot ) ... ( \cdot ) ... ( \cdot )</td>
<td></td>
</tr>
</tbody>
</table>

\( \text{MV}(r, s_j) \)
Provider and Service Similarity

feedback items

request

services of \( p \)

feedback provider

similarity to the feedback provider

\[ f_1 \rightarrow r_1 \]

\[ \ldots \]

\[ f_i \rightarrow r_i \]

\[ \ldots \]

\[ f_n \rightarrow r_n \]
Provider and Service Similarity

services of p

S_1 \cdot S_j \cdot \ldots \cdot S_k

feedback items

f_1 \quad \quad r_1
\ldots \quad \quad \ldots

f_i \quad \quad r_i
\ldots \quad \quad \ldots

f_n \quad \quad r_n

request  r

service judged by f_i

service whose rating shall be predicted

similarity to the service judged by f_i
Provider and Service Similarity

- used the correlation-based similarity measure

$$sim(\vec{x}, \vec{y}) = \frac{\sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \bar{x})^2 \sum_{i=1}^{n} (y_i - \bar{y})^2}}$$

- relevance = provider similarity \cdot service similarity
Feedback Integration

request

MobilePhone

0.3 * (battery mul style mul color) + 0.7 * (phoneType mul battery mul color)

MobilePhoneStyle

in {bar, slider}

MobilePhoneType

in {silver, black}

Company

in [nokia[1.0], sonyEricsson[0.8]]

Model

Feedback structure

:ServiceProfile

effect

 Owned

product

Product

MobilePhone

MobilePhoneType

Battery

Price

Currency

==usd

Double

<=50
Feedback Integration

request

MobilePhone

0.3 \times (\text{battery} \times \text{style} \times \text{color}) + 0.7 \times (\text{phoneType} \times \text{battery} \times \text{color})

MobilePhoneStyle

\text{Company}

\text{MobilePhoneType}

\text{Model}

\text{Feedback structure}

:ServiceProfile

effect

\text{Owned}

\text{Product}

\text{Price}

\text{Currency}

==\text{usd}

\text{Double}

\leq 50

\text{Company}

\text{in \{nokia[1.0], sonyEricsson[0.8]\}}

\text{MobilePhoneType}

\text{Model}

\text{Battery}

\text{Currency}

\text{Double}

\text{manufacturers}

\text{phoneType}

\text{style}

\text{color}

\text{phoneType}

\text{color}

\text{price}

\text{amount}

\text{price}

\text{feedback structure}
Feedback Integration

(request)

:ServiceProfile
  effect
    Owned
      product
        Product

MobilePhone

0.3 * (battery mul style mul color) + 0.7 * (phoneType mul battery mul color)

MobilePhoneStyle

in {bar, slider}

MobilePhoneType

Company

in {nokia[1.0], sonyEricsson[0.8]}

Model

in {silver, black}

price

Product

price

MobilePhone

Currency

==usd

Double

<=50

phoneType

color

feedback structure
Feedback Integration

request

feedback structure

MobilePhone

0.3 * (battery mul style mul color) +
0.7 * (phoneType mul battery mul color)

MobilePhoneStyle
in \{bar, slider\}

MobilePhoneType
in \{silver, black\}

Company
in \{nokia[1.0], sonyEricsson[0.8]\}

Model

Currency
==\text{usd}

Double
<=50

phoneType

color

style

manufacturer

model

price

product

 Owned

Product

 :ServiceProfile

effect

MobilePhone

MobilePhoneType

Battery

Price

productType

price

Currency

amount

model

phoneType

color

price

effect
Feedback Integration

request

:ServiceProfile

\( f_1 \ldots f_i \ldots f_n \)

overall service

inferred ratings

relevance values

MobilePhone

0.3 \((\text{battery mul style mul color}) + 0.7 \((\text{phoneType mul battery mul color})\)

MobilePhoneType

MobilePhoneStyle

Company

in \{nokia[1.0], sonyEricsson[0.8]\}

MobilePhoneStyle

style

in \{bar, slider\}

MobilePhoneType

phoneType

color

in \{silver, black\}

Company

manufacturer

Model

Model

currency

\( \text{==} \text{usd} \)

Price

Double

\( \leq 50 \)

price

inferred ratings

relevance values
Rating Prediction

attribute a

<table>
<thead>
<tr>
<th>inferred ratings</th>
<th>provider similarities</th>
<th>service similarities</th>
</tr>
</thead>
<tbody>
<tr>
<td>f₁  ⋯  fᵢ  ⋯  fₙ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

rating prediction (for attribute a)

\[
\text{rat}(a) = \overline{\text{rat}(a)} + k \cdot \sum_{f \in F} \text{rel}(f) \cdot (\text{rat}_f(a) - \overline{\text{rat}(a)})
\]

\[
\overline{\text{rat}(a)} \quad - \quad \text{average rating for a}
\]

\[
k \quad - \quad 1/\text{sum of relevances}
\]
Improved Similarity Calculation

\[ \text{Price} = 0.3 \times (\text{battery} \times \text{style} \times \text{color}) + 0.7 \times (\text{phoneType} \times \text{battery} \times \text{color}) \]
Improved Similarity Calculation

**attribute a**

<table>
<thead>
<tr>
<th>$f_1$</th>
<th>...</th>
<th>$f_i$</th>
<th>...</th>
<th>$f_n$</th>
</tr>
</thead>
</table>

- **inferred ratings**
- **provider similarities**
- **service similarities**

**Rating Prediction (for attribute a)**

\[
\text{rat}(a) = \overline{\text{rat}(a)} + k \cdot \sum_{f \in F} \text{rel}(a,f) \cdot (\text{rat}_f(a) - \overline{\text{rat}(a)})
\]

- $\overline{\text{rat}(a)}$ - average rating for a
- $k$ - $1/ \text{sum of relevances}$

\[
\text{rel}(a,f) = \text{sim}_{\text{attribute}}(a,f) \cdot \text{sim}(f)
\]

- $\text{sim}(f)$ - $\sum_{a \in f} \text{sim}_{\text{attribute}}(a,f) / |f|$
Experimental Results

- Random Generator
- Service
- Modified Service
- Service Provider
- Service Request
- Semantic Matchmaker
- Matching Value
- Rating
## Experimental Results

<table>
<thead>
<tr>
<th></th>
<th>leveraged ratings</th>
<th>used similarity information</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFb0</td>
<td>overall</td>
<td>no</td>
</tr>
<tr>
<td>SFb</td>
<td>overall</td>
<td>yes (overall)</td>
</tr>
<tr>
<td>DFbOvSim</td>
<td>attribute</td>
<td>yes (overall)</td>
</tr>
<tr>
<td>DFbCombSim</td>
<td>attribute</td>
<td>yes (attribute)</td>
</tr>
</tbody>
</table>
Experimental Results

- Increasing provider similarity threshold
- Increasing service similarity threshold
Experimental Results

correlation-based similarity measure
Conclusion

- presented a trust-establishing technique for SWS that
  - is personalized and context-dependent
  - allows to infer trust information for specific service aspects
  - is flexible
  - explores available feedback effectively
Thank you for your attention!

Questions?
Comments?
Suggestions?

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