Attribute Adaptation for Personalized Image Search

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Introduction
Attribute: Formal? Sporty? Feminine?
Introduction

Binary attribute  < Vacationing >

Relative attribute  < Feminine >
Introduction

Formal? User labels: 50% “yes” 50% “no”

More ornamented? or

User labels: 50% “first” 20% “second” 30% “equally”

Everyone has their own standard for each attribute.

Sporty?

No!

Yes!
Introduction

We need a personalized decision model for each person.

<table>
<thead>
<tr>
<th></th>
<th>Cute?</th>
<th>Little?</th>
<th>Comfortable?</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Car]</td>
<td>O</td>
<td>O</td>
<td>X</td>
</tr>
<tr>
<td>[Male]</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>[Female]</td>
<td>O</td>
<td>O</td>
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</tr>
<tr>
<td>[Male]</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Approach

Collect labeled data \rightarrow Train generic model \rightarrow Adapt personalized attributes

Collect labeled data from multiple annotators.
Approach

Collect labeled data → Train generic model → Adapt personalized attributes

Train a generic model of an attribute using majority vote from multiple annotators.

Sporty?

What is sporty?

O O X O O X

Sporty!
Approach

Collect labeled data → Train generic model → Adapt personalized attributes

Same procedure for ranking problems.

Sporty?
Approach

Use linear SVM for generic binary attribute classifier.

\[ f_b'(x) = x^T w'_b \]

Use Rank SVM for relative attribute classifier.

\[ f_r'(x) = x^T w'_r \]
Approach

Collect labeled data → Train generic model → Adapt personalized attributes

Rank SVM

P: B, A, C, D

Q: A, B, C, D
Approach

For a given user, adapt the parameters of the generic model to account for any user-specific labeled data.
Approach

Collect labeled data → Train generic model → Adapt personalized attributes

For binary attribute classifiers (Adaptive SVM)

$$\min_{\mathbf{w}_b} \frac{1}{2} \|\mathbf{w}_b - \mathbf{w}'_b\|^2 + C \sum_{i=1}^{N} \xi_i$$

For relative attribute classifiers (Ranking Adaptation SVM)

$$\min_{\mathbf{w}_r} \frac{1 - \delta}{2} \|\mathbf{w}_r\|^2 \frac{\delta}{2} \|\mathbf{w}_r - \mathbf{w}'_r\|^2 + C \sum_{i=1}^{N} \xi_i$$
Approach

Collect labeled data → Train generic model → Adapt personalized attributes

User-specific data

overfitted

User-specific model

Generic model
Experiments
Experiments

Figure 4. Example learned generic (top row per example) and user-specific (bottom row per example) attribute spectra.
Experiments

<table>
<thead>
<tr>
<th></th>
<th>generic</th>
<th>generic+</th>
<th>user-exclusive</th>
<th>user-adaptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoes-B</td>
<td>31.5 (0.13)</td>
<td>36.3 (0.14)</td>
<td>40.3 (0.15)</td>
<td>43.6 (0.13)</td>
</tr>
<tr>
<td>SUN</td>
<td>34.3 (0.19)</td>
<td>47.3 (0.15)</td>
<td>51.9 (0.24)</td>
<td>64.5 (0.16)</td>
</tr>
</tbody>
</table>

(a) Multi-attribute keyword search

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Shoes-R</td>
<td>70.96 (0.12)</td>
<td>72.70 (0.10)</td>
<td>72.75 (0.14)</td>
<td>74.70 (0.12)</td>
</tr>
</tbody>
</table>

(b) Relative attribute search feedback

Figure 6. Personalized image search accuracy
Summary

Main contribution
- Adapting attributes to account for user-specific perception
- Set existing generic model as a prior

Limitations
- Need extra data for personalizing
- Easily fails with personal attributes which are far from generic model
Thank you!