A Framework for Recommender Systems Based on a Finite Multidimensional Model Space

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We use a multidimensional, finite model space. All entities are located in the very same model space.

For tourism seven factors have already been identified Neidhardt u. a. (2015), Neidhardt u. a. (2014).
Minimal Example

Dimension “Action”

0.00 := Relaxiation (e.g. remote cabin, quiet bay...)
  :
  :
  :
1.00 := Exitement (e.g. skydiving, cycling down the “dead road”)

Assign yourself a value between 0 and 1!
Association functions express the degree of accordance between entities and model-dimensions. (like a membership-function in fuzzy logic).

\[ f_{a,b}(x) \]

\[
\mu = 0.2, \, \rho = 10 \\
\mu = 0.4, \, \rho = 4
\]
Association Function

$f$ is fully specified by two real parameters $a \geq 0$ and $b \geq 0$:

$$f_{a,b}(x) = \begin{cases} 
1 & \text{if } a = b = 0 \\
\frac{x^a(1-x)^b}{\left(\frac{a}{a+b}\right)^a\left(1 - \frac{a}{a+b}\right)^b} & \text{otherwise}
\end{cases}$$

An alternative, more human comprehensible parametrization is given by the *location* parameter $\mu \in [0,1]$ and the *precision* parameter $\rho \geq 0$. Both parametrizations can easily be converted into each other.
There are several ways how an entity gets its association functions:

- **Mapping-Algorithm**: translates the available feature description into association function.
- **Manually (tedious for many products)**
- **Self-learning**: based on interaction with other entities that already have been classified
- **User controlled! (for users); User empowerment, transparency**
Determining $x$ requires numerical optimization, therefore we replace $d$ by an approximation $d$ with a straightforward solution.
The overall distance between two entities is the weighted mean of the distances of all individual dimensions.

The weights are chosen proportional to the importance of the corresponding dimension.

Other aggregation are possible like the (weighted) mean of squared distances...
The learning procedure allows entities (usually users) to adopt their location in the model space according to their interaction with other entities (usually products). It is based on the merge-operation.

The merge-operation translates an ordered set of association functions into a single association function.
Discussion

Advantages
- Flexible
- Learning
- Easy to understand
- No cold start problem
- Possibly cross-domain

Challenges
- Model-space must be defined in advance
- Mapping into the model space must be implemented