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

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Model Space

- 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...)

⋮

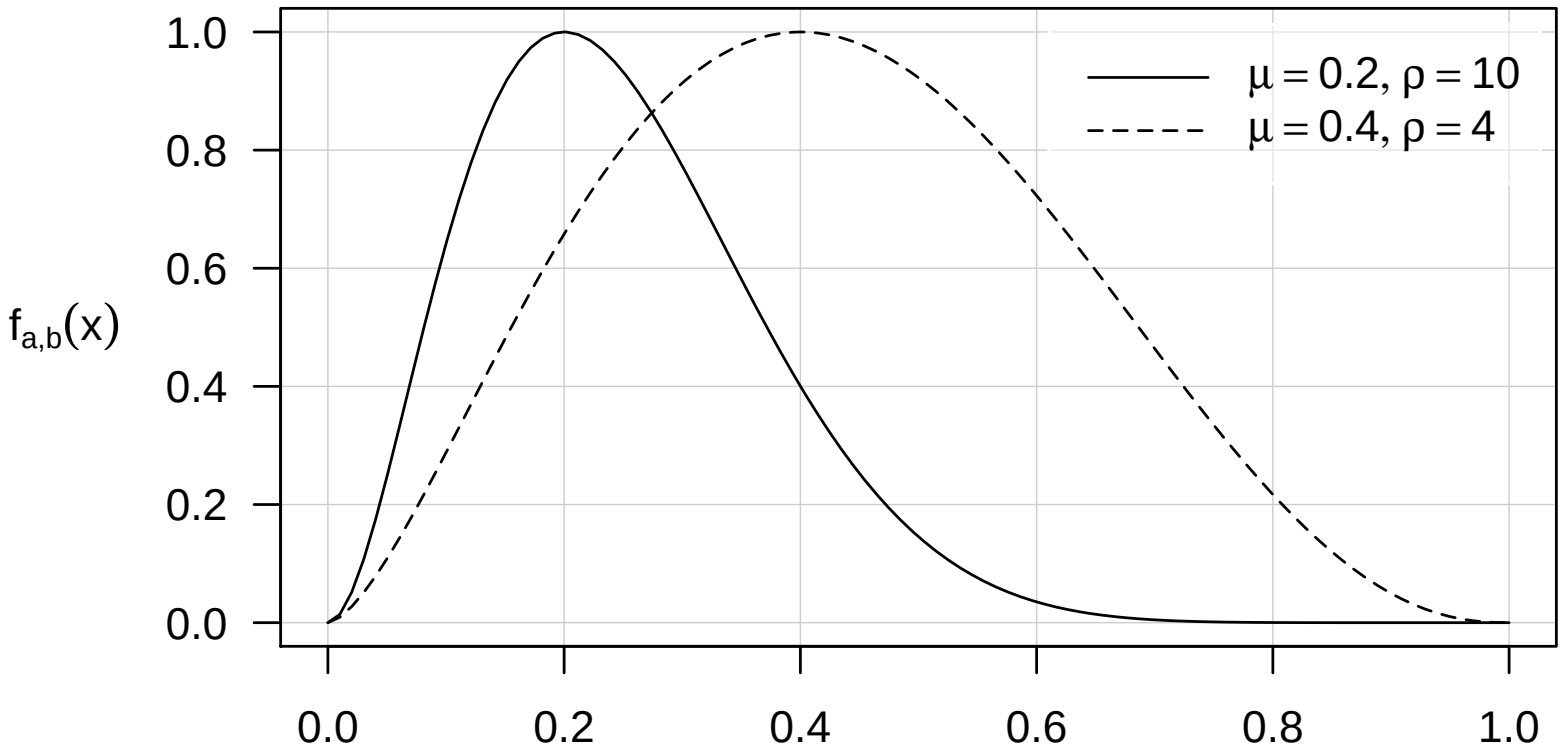
⋮

1.00 := Exitement (e.g. skydiving, cycling down the "dead road")

Assign yourself a value between 0 and 1!

Association Function

Association functions express the degree of accordance between entities and model-dimensions. (like a membership-function in fuzzy logic).



Association Function

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

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

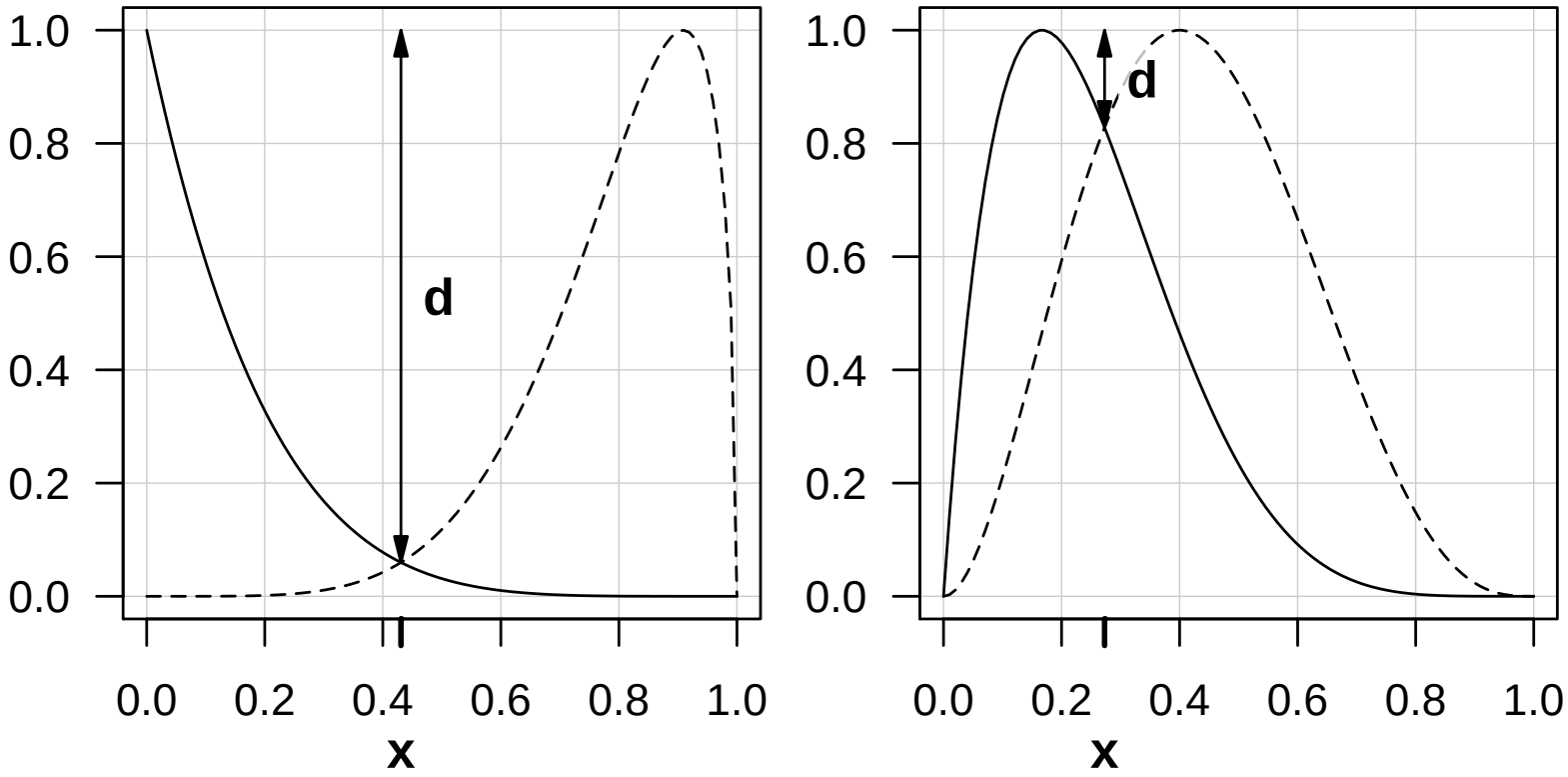
An alternative, more human comprehensible parametrization is given by the *location* parameter $\mu \in [0, 1]$ and the *precision* parameter $\rho \geq 0$. Both parametrizations can easily be converted into each other.

Association Function
Mapping

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

Distance



Determining $\boldsymbol{x}$ requires numerical optimization, therefore we replace $\boldsymbol{d}$ by an approximation d with a straight forward solution.

Overall Distance

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...

Learning Procedure

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

References

[Neidhardt u. a. 2014] Neidhardt, Julia ; Schuster, Rainer ; Seyfang, Leonhard ; Werthner, Hannes: Eliciting the Users' Unknown Preferences. In: *Proceedings of the 8th ACM Conference on Recommender Systems*. New York, NY, USA : ACM, 2014 (RecSys '14), S. 309–312. – ISBN 978-1-4503-2668-1

[Neidhardt u. a. 2015] Neidhardt, Julia ; Seyfang, Leonhard ; Schuster, Rainer ; Werthner, Hannes: A picture-based approach to recommender systems. In: *Information Technology & Tourism* 15-1 (2015), S. 49 – 69