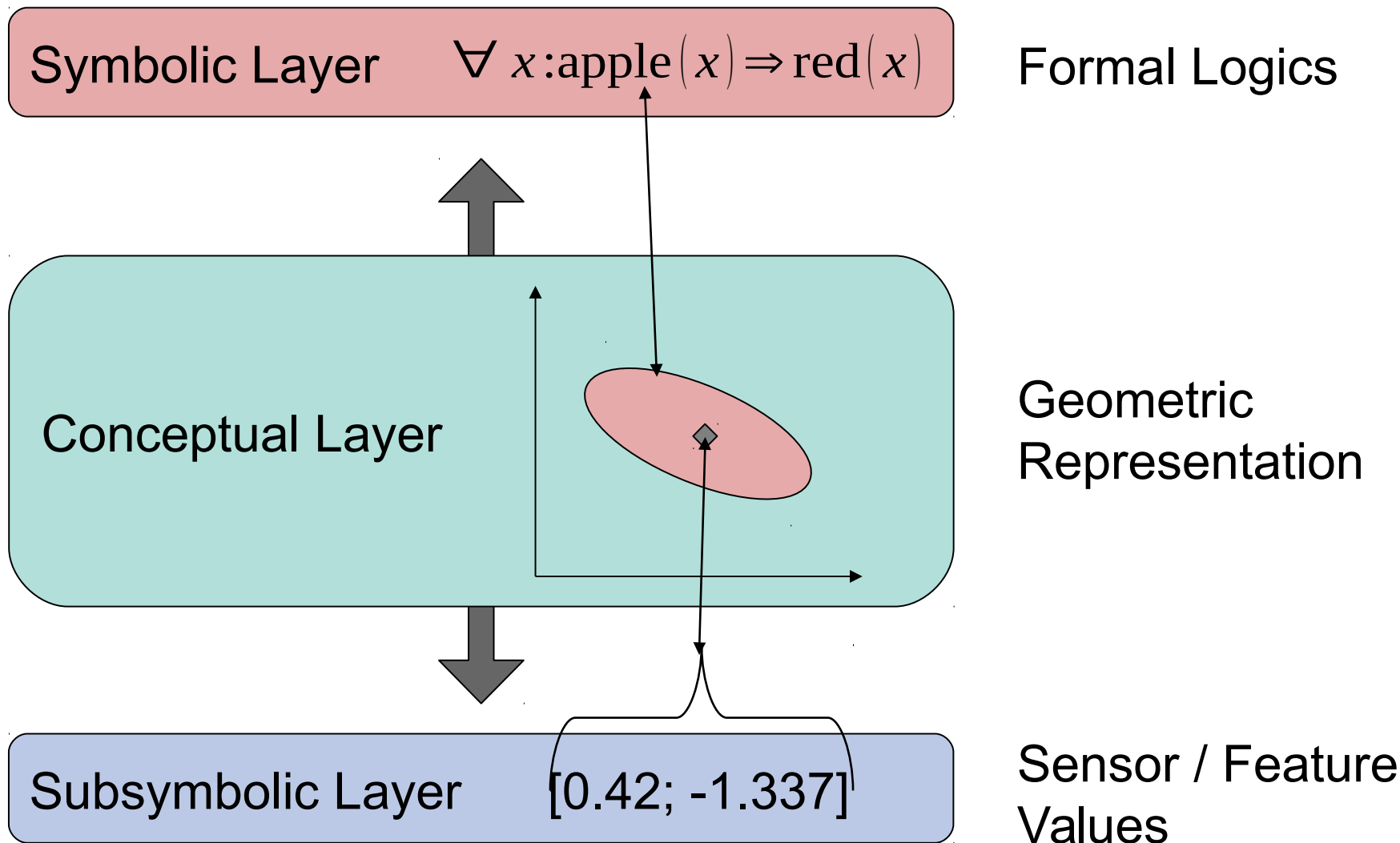


# A Comprehensive Implementation of Conceptual Spaces

Lucas Bechberger and Kai-Uwe Kühnberger

<https://www.lucas-bechberger.de>

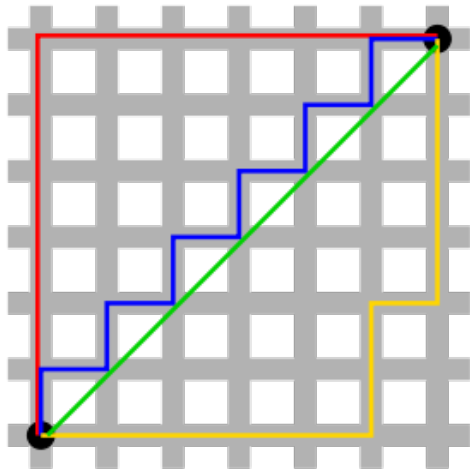




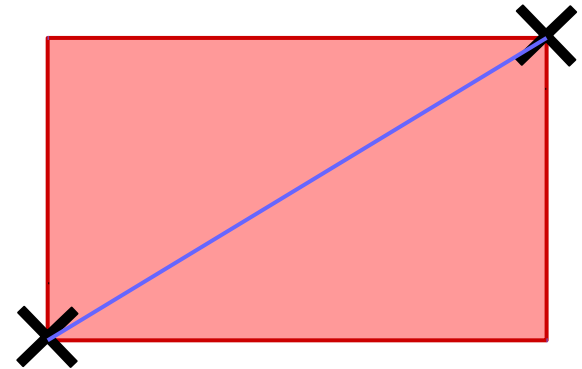
- Quality dimensions
  - Interpretable ways of judging the similarity of two instances
  - E.g., temperature, weight, brightness, pitch
- Domain
  - Set of dimensions that inherently belong together
  - Color: hue, saturation, and brightness
- Distance in this space is inversely related to similarity
  - Within a domain: Euclidean distance
  - Between domains: Manhattan distance
- Concepts
  - Region + correlation information + salience weights

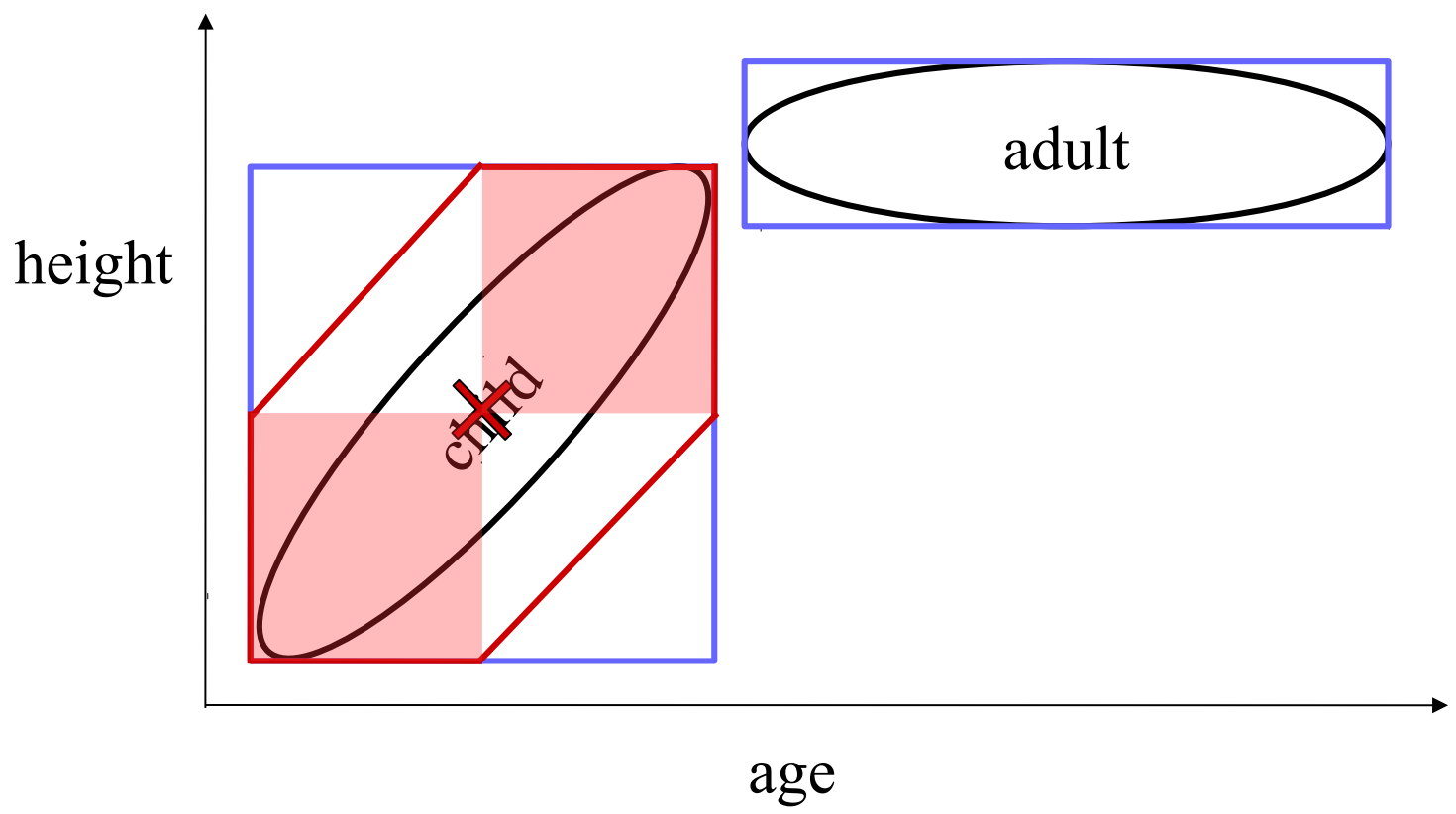
[Gärdenfors2000] Gärdenfors, P. *Conceptual Spaces: The Geometry of Thought*. MIT press, 2000

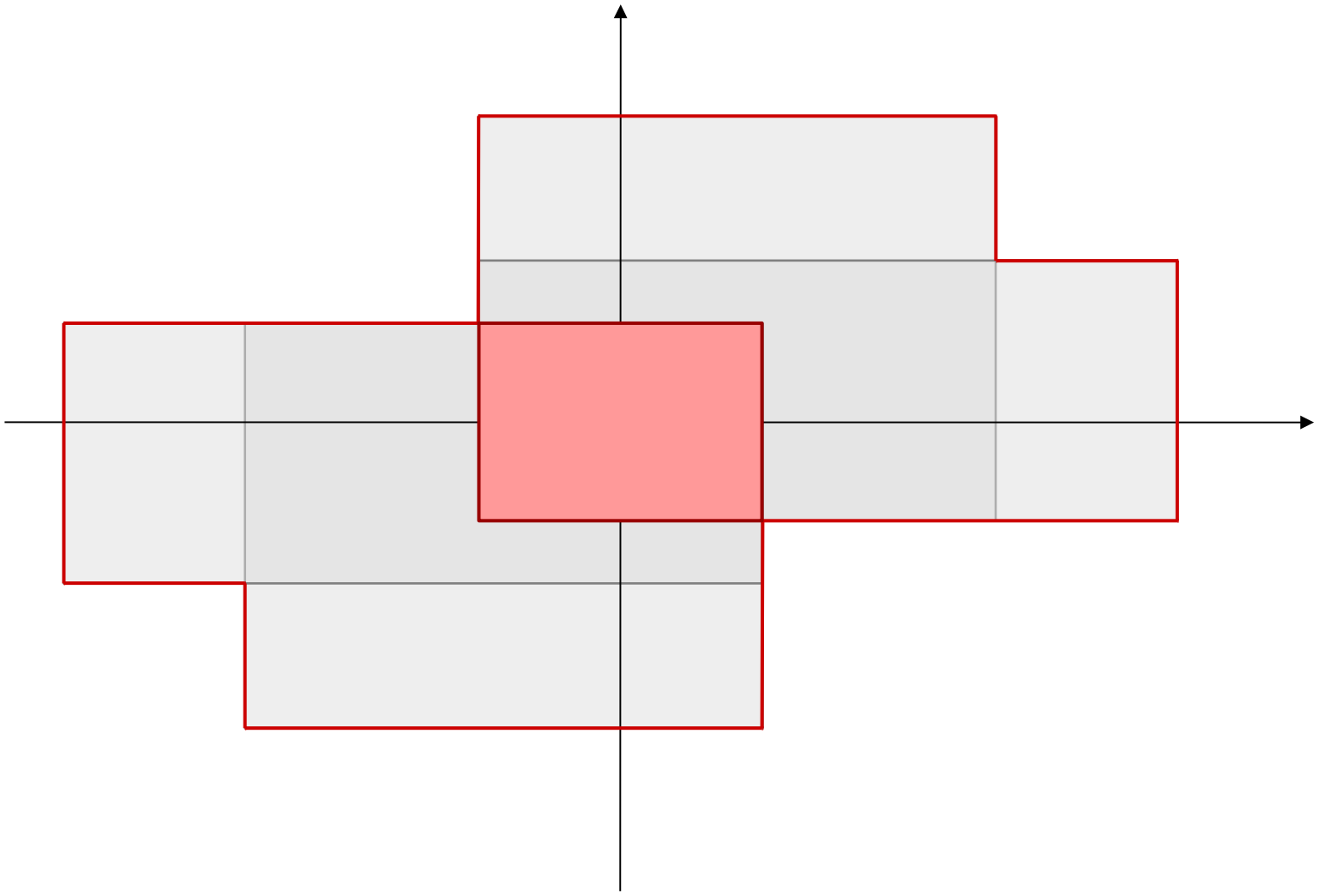
- $B(x,y,z) :\leftrightarrow d(x,y) + d(y,z) = d(x,z)$
- Convex region  $C$ :  $\forall x,z \in C : \forall y : B(x,y,z) \Rightarrow y \in C$
- Star-shaped region  $S$ :  $\exists p \in S : \forall z \in S : \forall y : B(p,y,z) \Rightarrow y \in S$



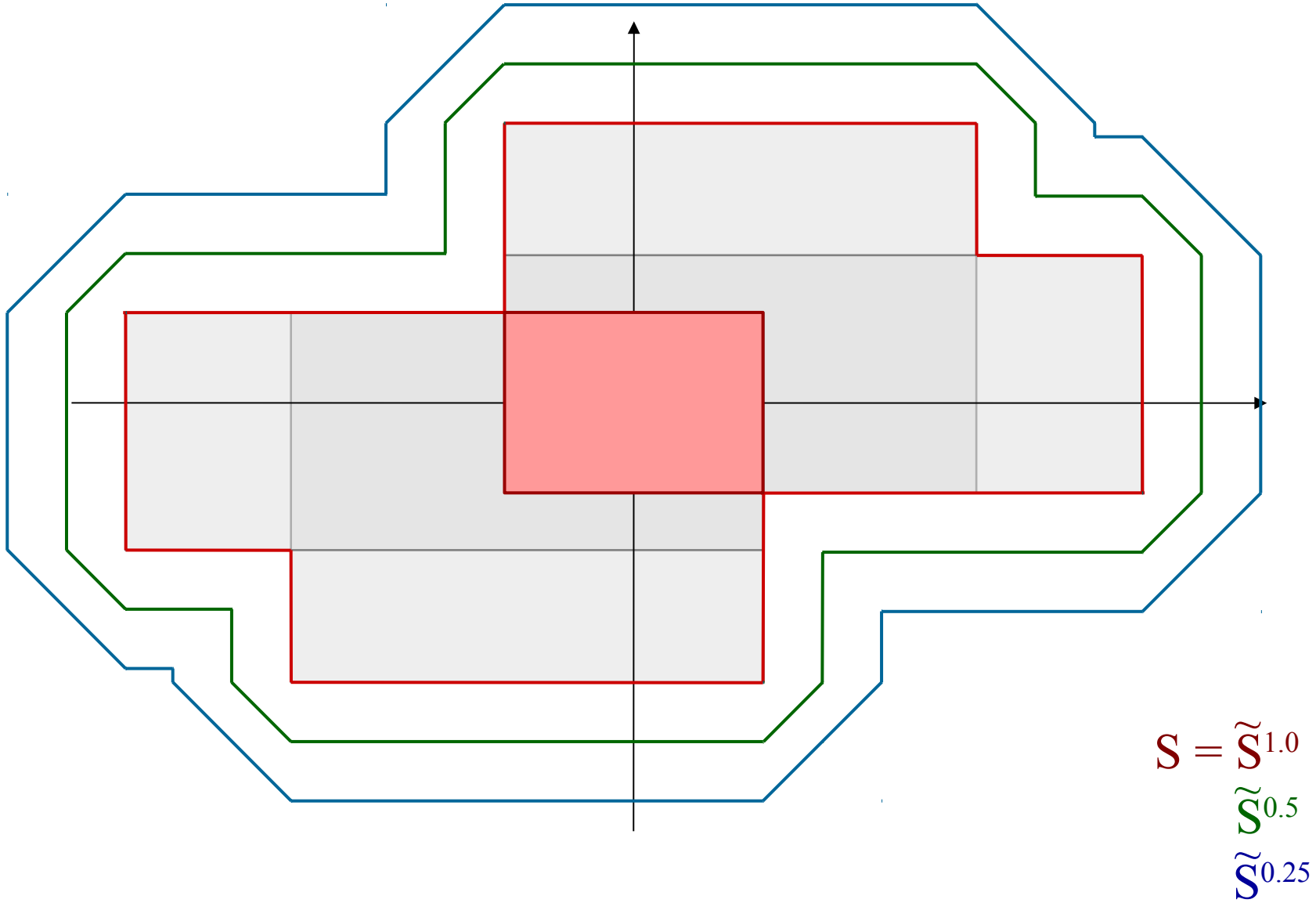
[https://en.wikipedia.org/wiki/Taxicab\\_geometry#/media/File:Manhattan\\_distance.svg](https://en.wikipedia.org/wiki/Taxicab_geometry#/media/File:Manhattan_distance.svg)

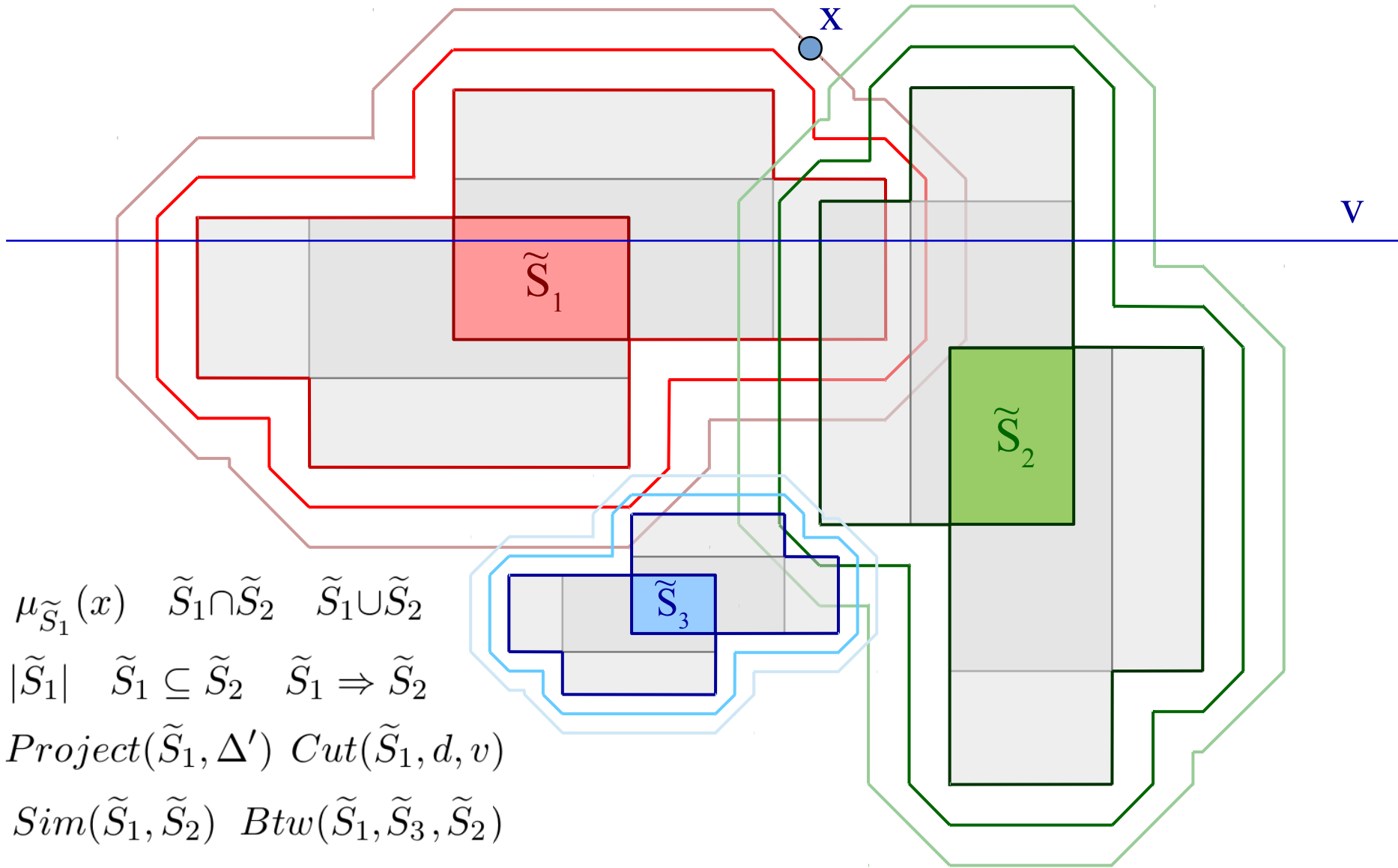






# Formalizing Star-Shaped Concepts







**DEMO TIME!**

- We can encode correlations in a geometric way
  - Most formalizations of conceptual spaces ignore cross-domain correlations
- Publicly available implementation
  - <https://github.com/lbechberger/ConceptualSpaces>
  - Comes with source code → easily modifiable
  - Comprehensive set of supported operations
  - Visualization tool
  - Starting point for future research

# Thank you for your attention!

Questions? Comments? Discussions?



<https://www.lucas-bechberger.de>

 @LucasBechberger