

# Measuring Relations between Concepts in Conceptual Spaces

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### **The Different Layers of Representation**



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#### **OSNABRÜCK** Formalizing Star-Shaped Concepts



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### OSNABRÜCK Formalizing Star-Shaped Concepts



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# OSNABRÜCK Formalizing Star-Shaped Concepts

- We can already create new concepts from old ones
  - Intersection (green ∩ banana = green banana)
  - Unification ( citrus fruit = orange ∪ lemon ∪ grapefruit ∪ ... )
  - Projection onto a subspace ( apple↓(size) = apple's typical size )
- We also want to talk about relations between concepts
  - Compare their sizes ( |apple| < |fruit| )</li>
  - Subsethood (apple ⊂ fruit ↔ apple is-a fruit )
  - Implication ( apple  $\rightarrow$  red )
  - (Similarity & Betweenness)

## Measuring the Size of a Concept



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- Size of an α-cut:
  - Original cuboid + Left/right part + Top/bottom part + Corners
  - 2D ellipse + 1D ellipse \* height + 1D ellipse \* width

+ 0D ellipse \* width \* height

- Integrate over α-cuts to get overall size of cuboid
- Use inclusion-exclusion principle on cuboids

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## **Degree of Subsethood & Implication**



## AT OSNABRÜCK Research Contributions

- Formalized ways of measuring relations between concepts
  - Size
  - Subsethood
  - Implication
- All of this has been implemented: https://github.com/lbechberger/ConceptualSpaces
- Future work: use this formalization in practice



# Thank you for your attention!

Questions? Comments? Discussions?



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