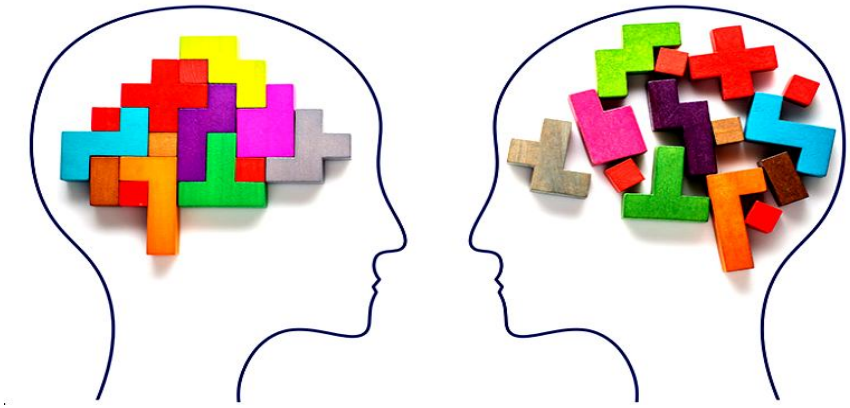
Polymath Pedagogy

Logics of Knowledge Transfer



Mosh
Properly
2019-10

Background: Beliefs and Myths

- AI / Technology can replace teachers.
- Highly rated free science videos can replace teachers / professional texts.
- Print versus web.
- Knowledge is culture independent.
- Playing math games is learning math.
- Passive versus active learning.
- Critical Thinking (asking the right questions, Socratic learning) versus bulk rote learning.

Background - learners

- All students are similar learners.
- measures of success (grades).
- motivation – self or external.
- Communication and people skills
- Team work
- Ability to learn
- Self learning
- Innovating, thinking out of the box.

Logic of Knowledge Transfer

- Knowledge is ubiquitous – wikipedia, google, books, youtube, facebook, people.
- Classification of knowledge and learners
- Knowledge representation as a DAG, polytope.
- Dimensions of knowledge.
- Customizing of knowledge into level, subject, culture, country, ethnicity, gender, language, student.

Knowledge Representation

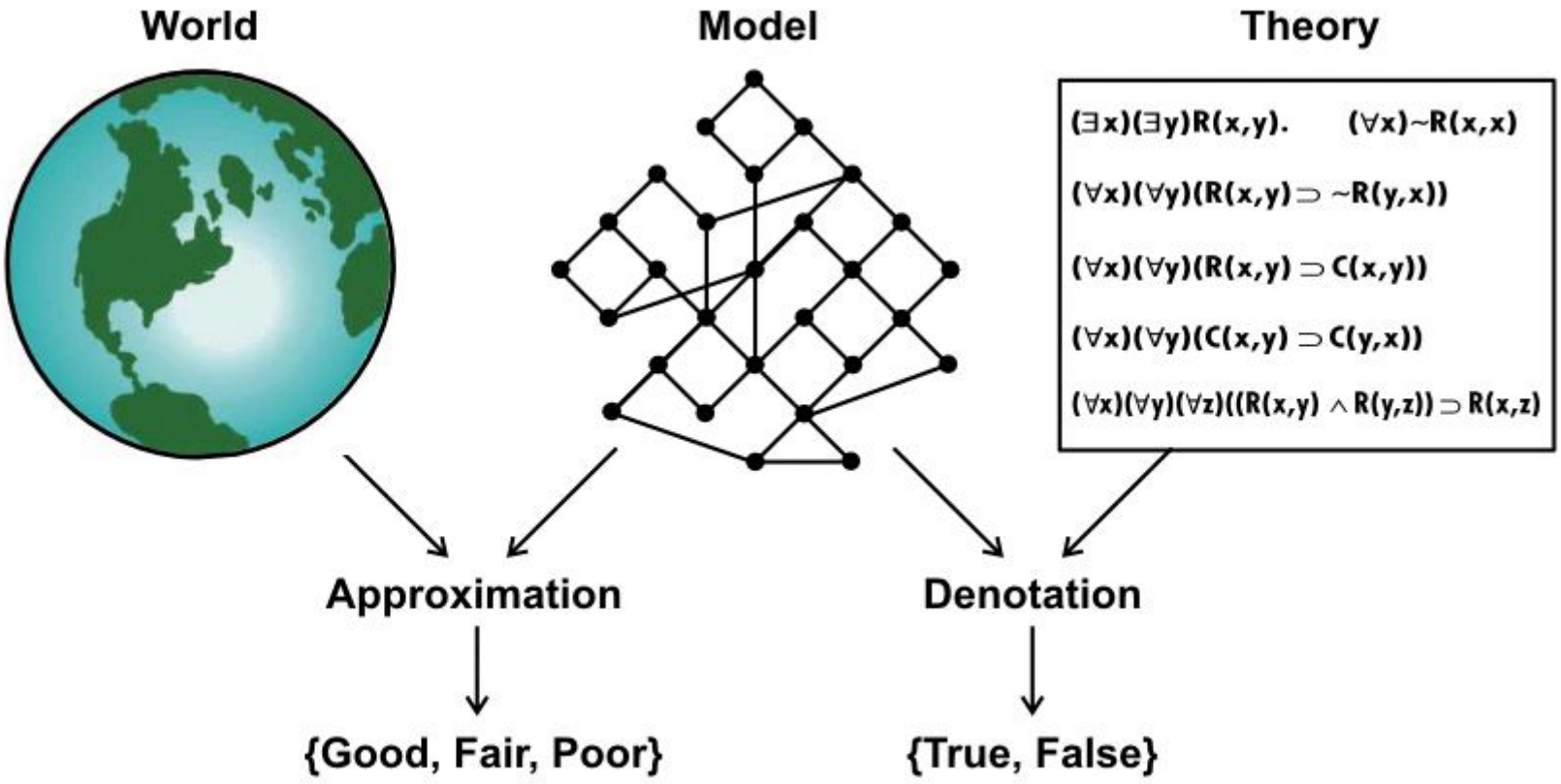
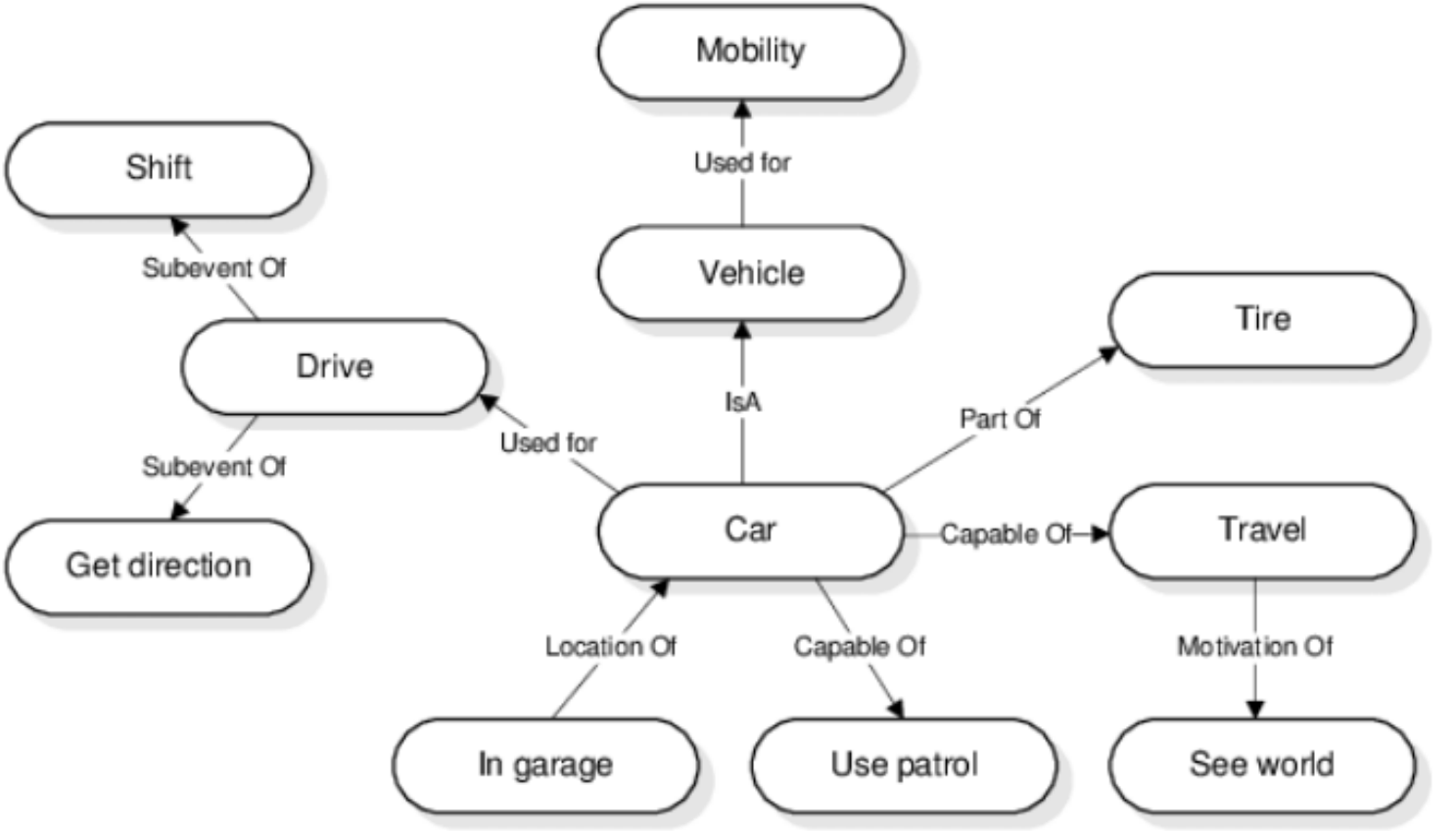


Figure 12. Relating a theory to the world

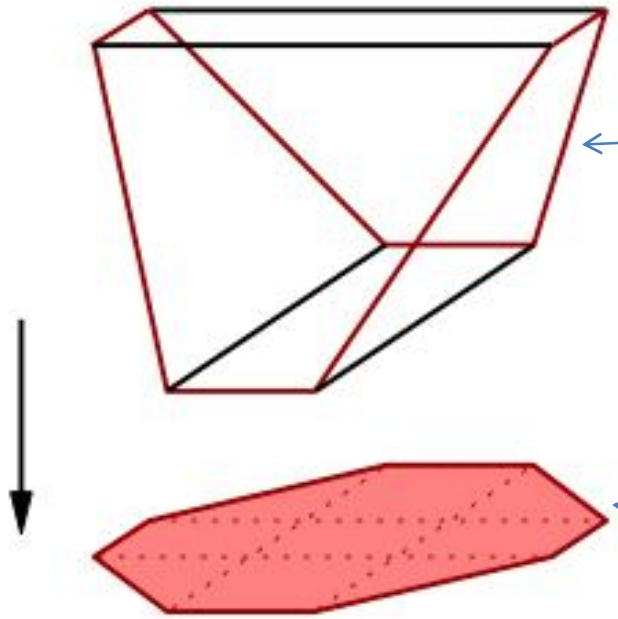
Classification of Resources

- Using AI, Tensor flow (google).
- Multi label, fasttext (facebook).
- Word vectors (stanford), word2Vec, cosine similarity of sentences
- Term Frequency, Tf-Idf (web search).
- SIP (statistically improbable phrases) (Amz product search).

ConceptNet and Yago
based on Wikipedia

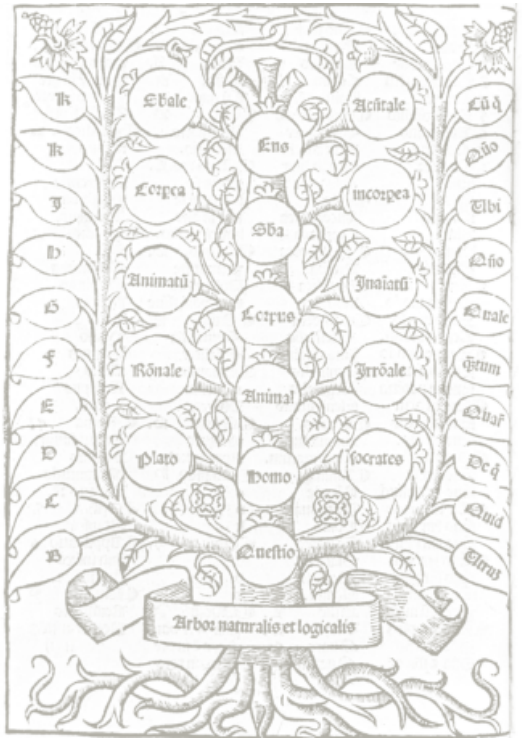


Projecting to lower dimensions



Textbook

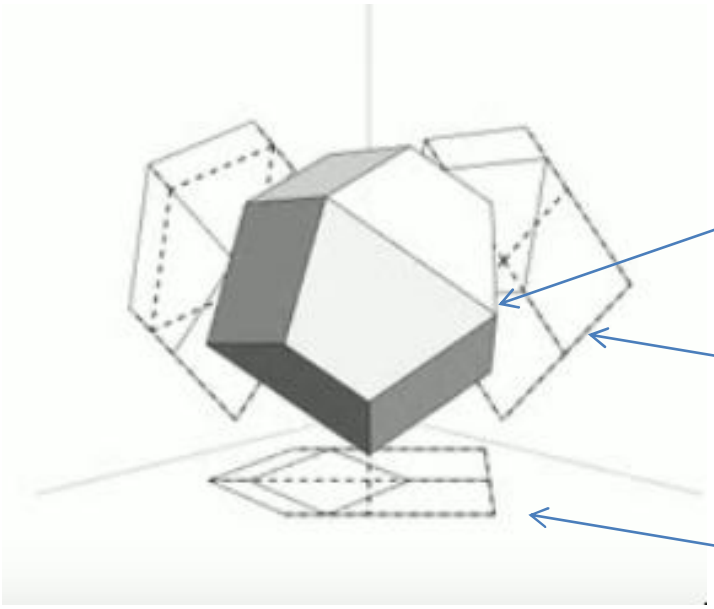
Tree of knowledge



Student space of knowledge

Different views of knowledge

Teacher's job is to know all the spaces, and project information into the spaces
Of the common (different) spaces of the student(s) knowledge.

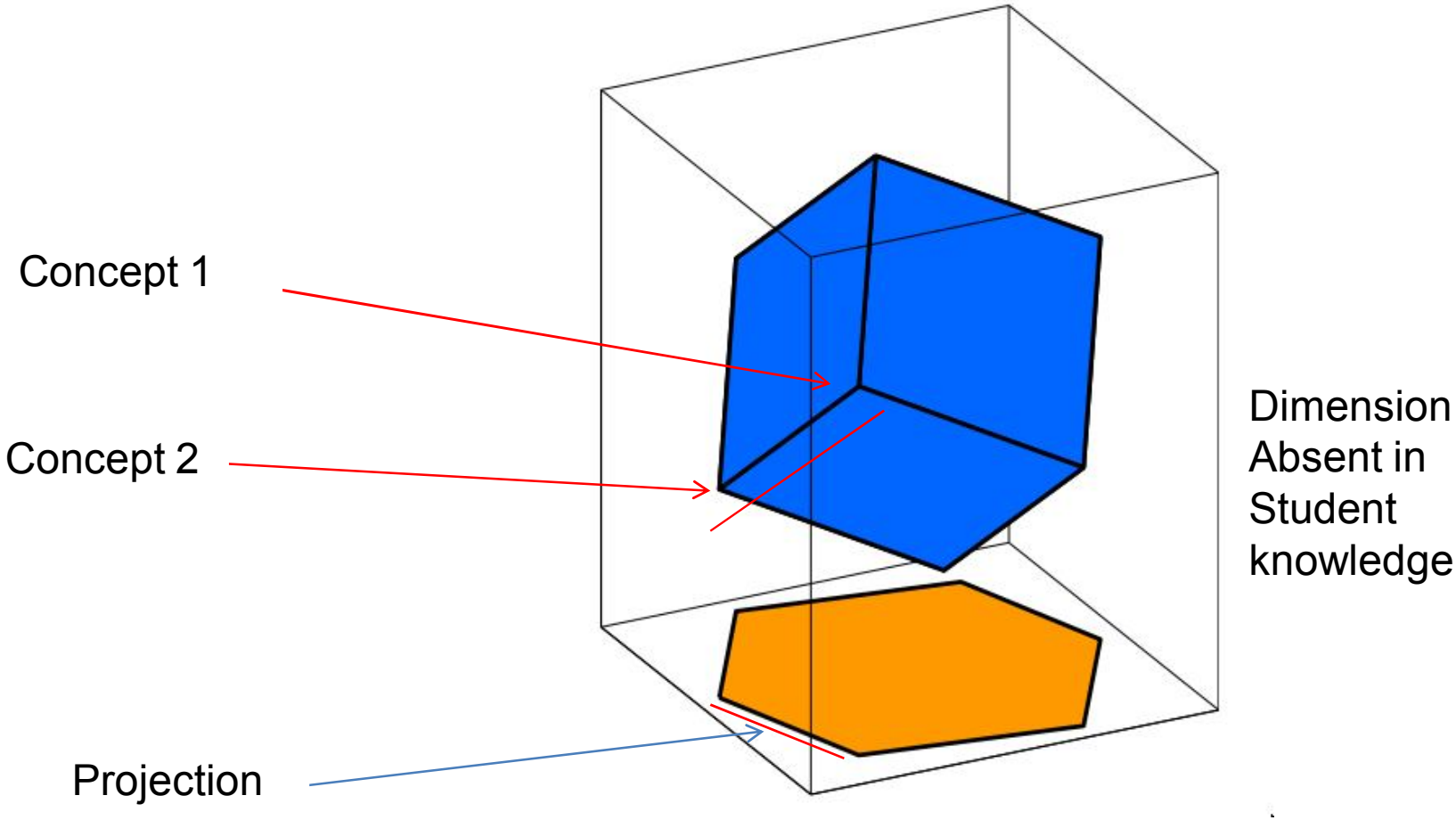


Teacher 1 understanding of topic

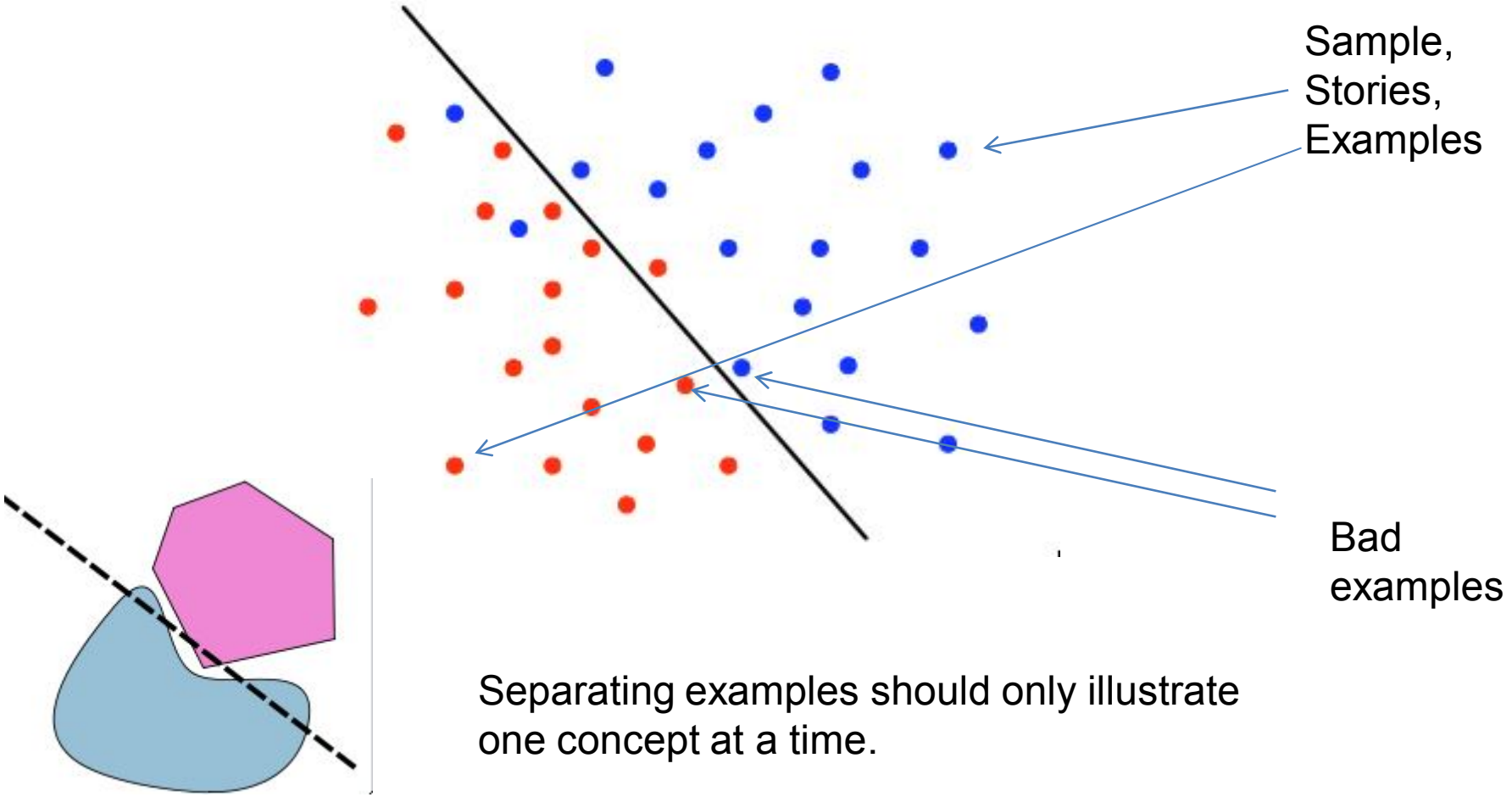
Student 2 background

Student 1 background

Separation of relevant concepts with smart projections

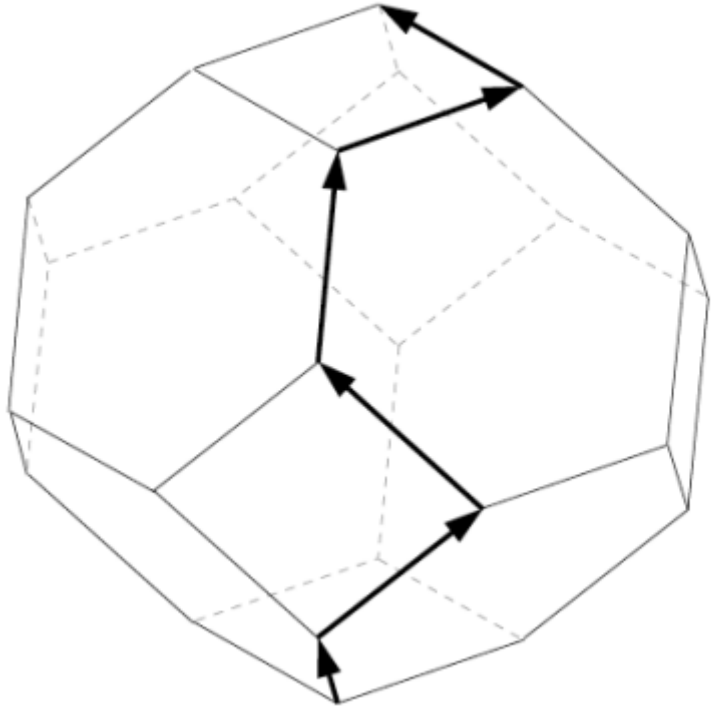


Separating concepts with examples, ideas, insights

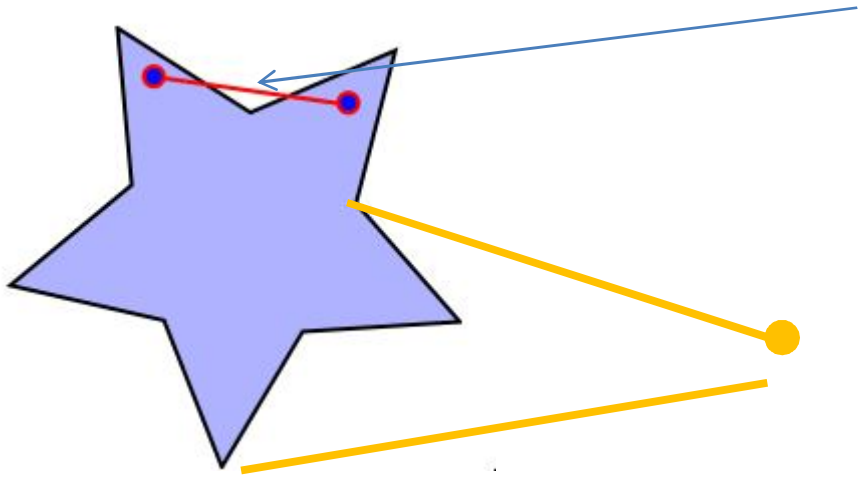


Separating examples should only illustrate one concept at a time.

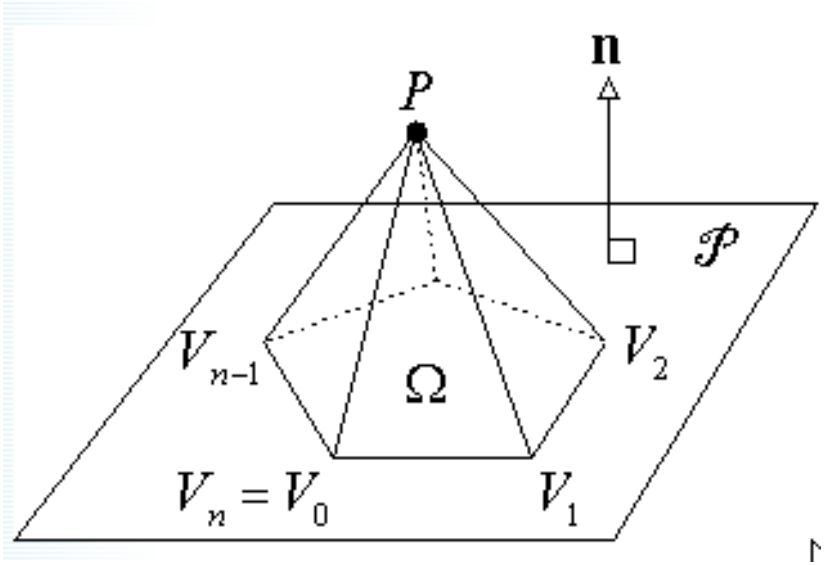
Learning in the Knowledge Graph

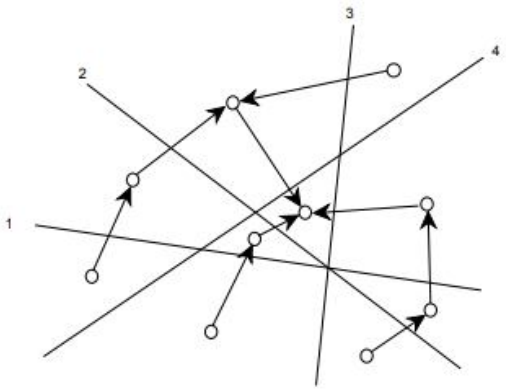


Interpolation, Imagination and ideas extend the polytope in size, space and dimension (lifting)



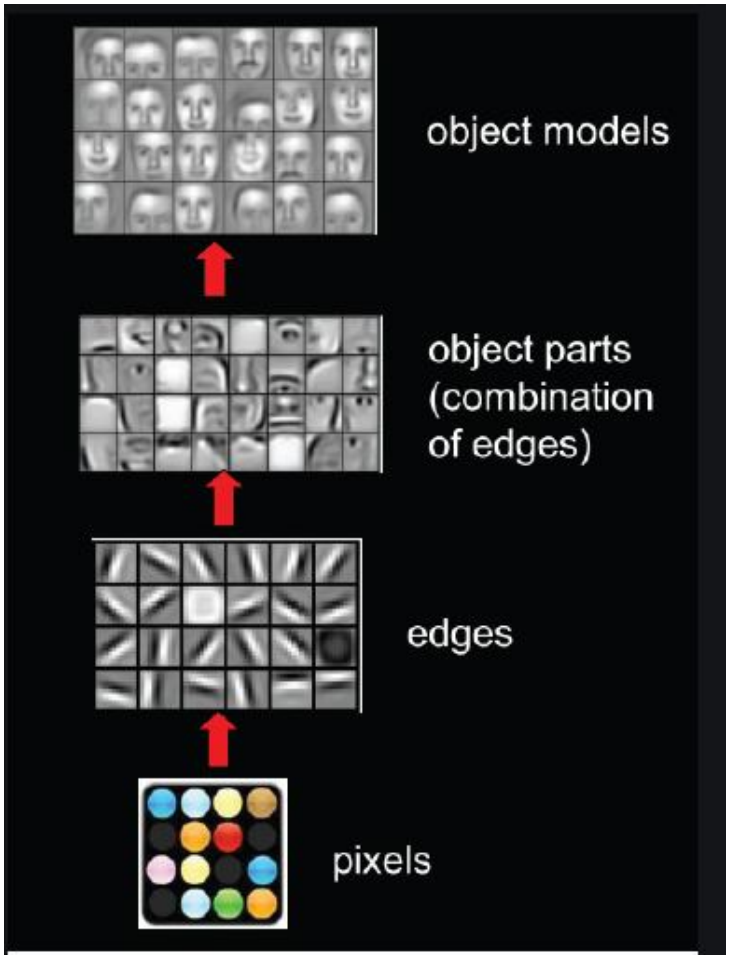
Lifting Dimension
Moving up Grade levels





If a lion could speak, we could not understand him **– Ludwig Wittgenstein**.
Language depends on a common frame of reference and cultural background.

CNN layers



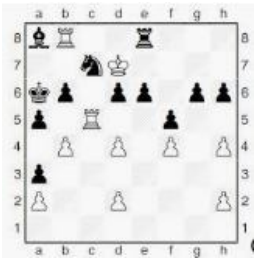
CNN
Features

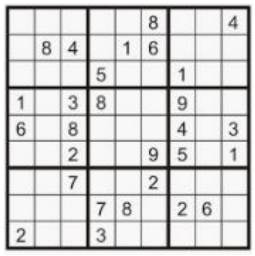
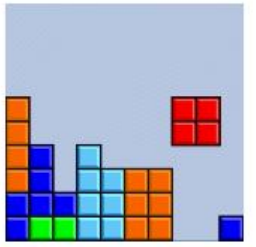
Layers

Dimensions

Quizzes and Learning Games

- Games of rote memory recall and quizzes.
- Combinatorial games of thought.
- Repetitive games based on quick timing / time sinks.




Measuring learning

- Analytics (timing of clicks in multimedia)
- Quizzes
- Games

- Hardest to measure
  - problem solving skills with unseen problems
  - creative skills.
  - Common sense

Matching Learners and Content

- Rating of content.
- Multi labels, grading, tags, transcripts, comments, rating on content.

- Rating of learners.
- Define learning path for learners in the graph.

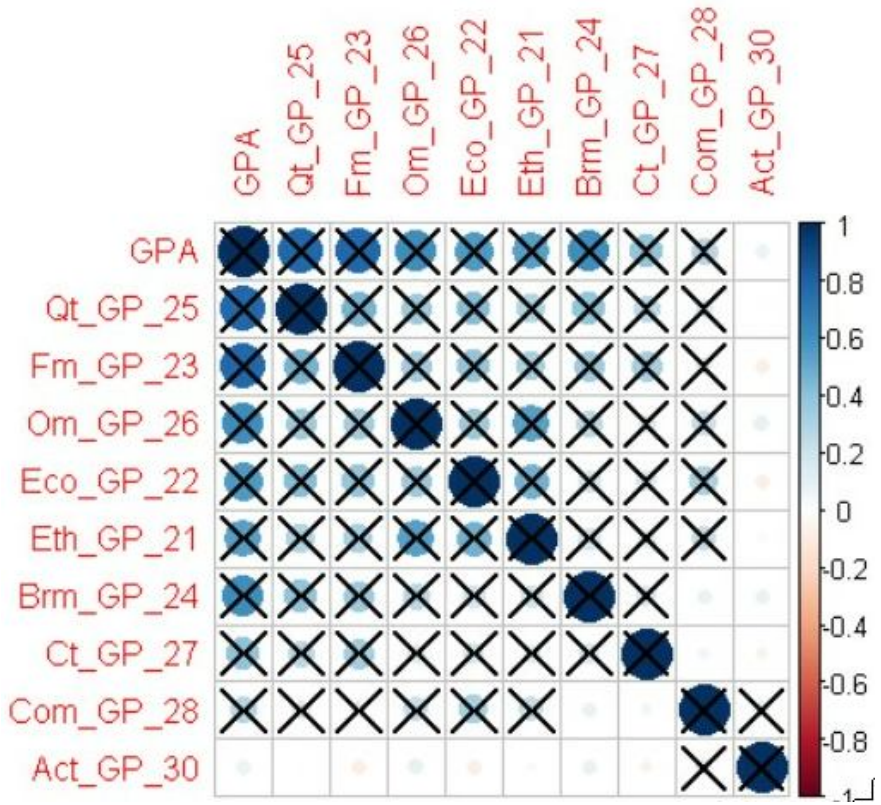
Adaptive Learning

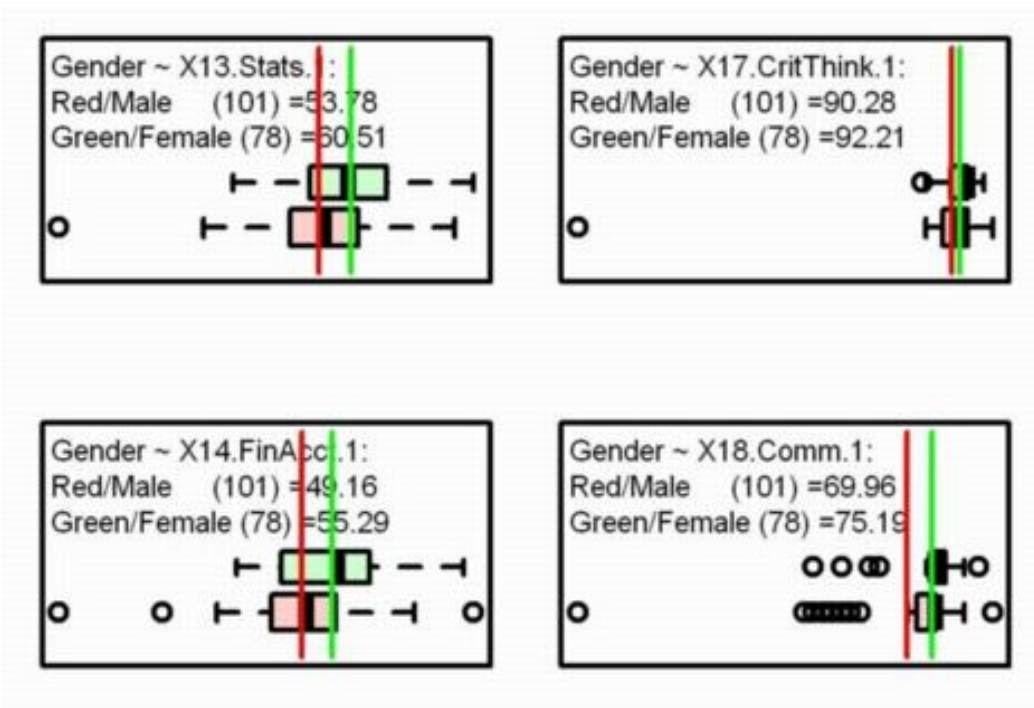
- Squirrel AI Adaptive learning (China)
  https://www.technologyreview.com/s/614057/china-squirrel-has-started-a-grand-experiment-in-ai-education-it-could-reshape-how-the/

- Socratic questioning (methodology)

Small data analysis with R

- Correlations in grades with factors
- Distribution of answers





Common Sense Reasoning

- Winograd common sense challenge.
- Can’t be solved by statistical data mining/AI.
- Hard to measure common sense.

References for topics discussed *(For details search Google)*

- Wikipedia, *Knowledge Representation* - Sowa, Yago, Knol
- Everybody Lies, Freakanomics*, R Lang Programming.*
- *W*inograd common sense challenge.
- Logic/modal/temporal/proof - *Enderton,* Boolos, Barwise*,* Smullyan; Linear Algebra by Strang.
- *AI Deep Learning* - Goodfellow, Tensorflow, Fasttext, CNN

Questions?

Thank you

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