Joint Reasoning for Multi-Faceted Commonsense Knowledge

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Commonsense knowledge bases (CSKBs)

Store structured knowledge about general-world concepts

Lions; eat; chicken

Lions; attack; humans

Lions; drink; water

CSKBs a major effort in (A)KBC in recent years

- ConceptNet (MIT), TupleKB (AllenAI), Quasimodo (MPII), …
- Shortcomings:
  1. Underspecified or narrow semantics
  2. Statements extracted/consolidated independently

Semantics

Lions; eat; chicken

Lions; attack; humans

Lions; drink; water

Semantics

The semantics we apply to tuples (and which we explain to Turkers) is one of plausibility: If the fact is true for some of the arg1's, then score it as true.

[TupleKB]

In WebChild's evaluations we asked for plausibility

[WebChild coauthor, personal communication]

/r/CapableOf	Something that A can typically do is B.
/r/AtLocation	A is a typical location for B, or A is the inherent location of B. Some instances of this would be considered meronyms in WordNet.
/r/Causes	A and B are events, and it is typical for A to cause B.
/r/LocatedNear	A and B are typically found near each other. Symmetric.
/r/Desires	A is a conscious entity that typically wants B. Many assertions of this type use the appropriate language's word for "person" as A.

[ConceptNet]

The goal of this paper is to advance the automatic acquisition of salient commonsense properties from online content of the Internet.

[Quasimodo]

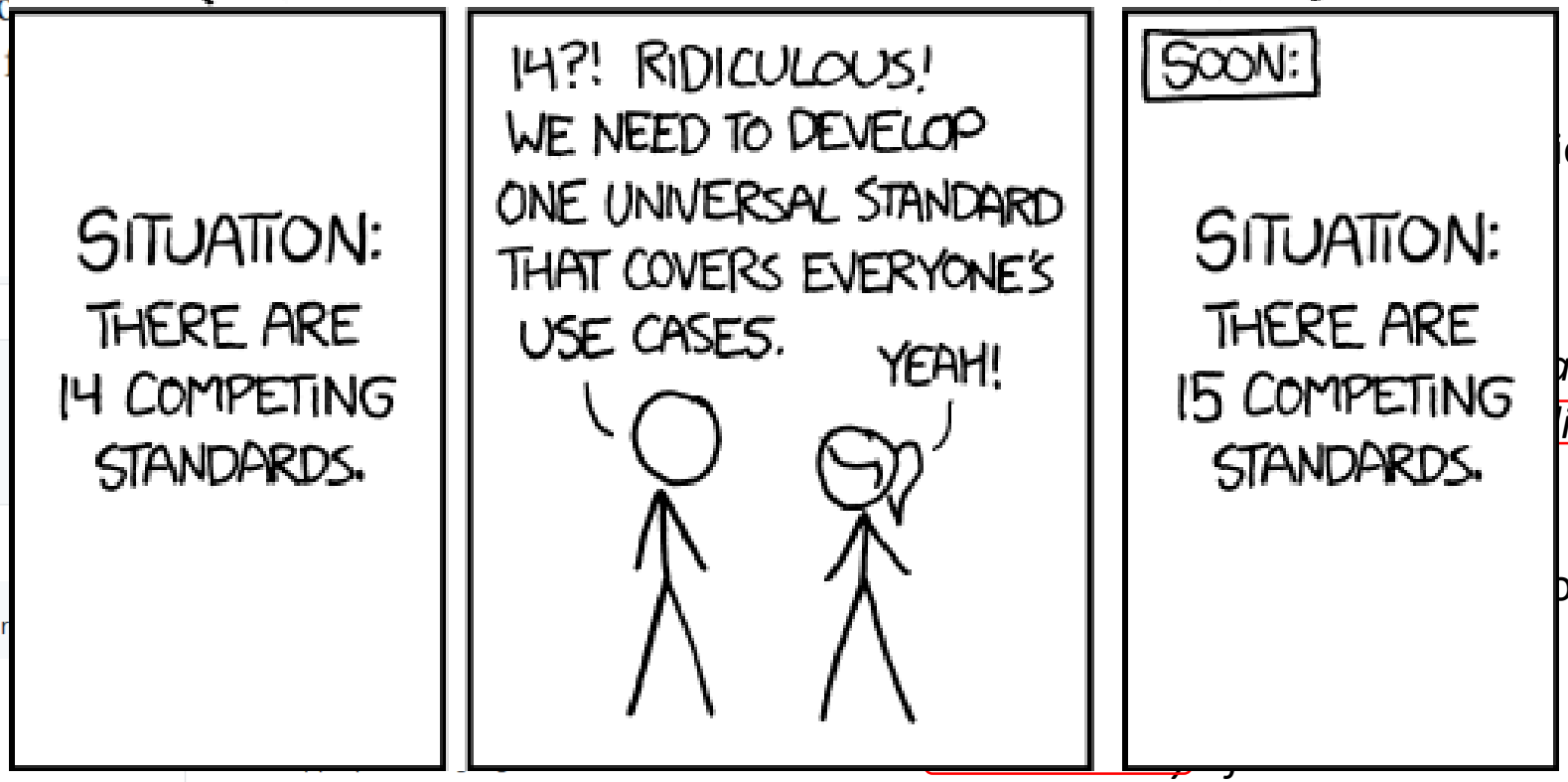
Remarkability of terms is captured via inverse document frequency (IDF)

[Information theory 101]

Semantics

The semantics we apply to tuples (and which we ex-
plain to
is true

In WebChild's evaluations



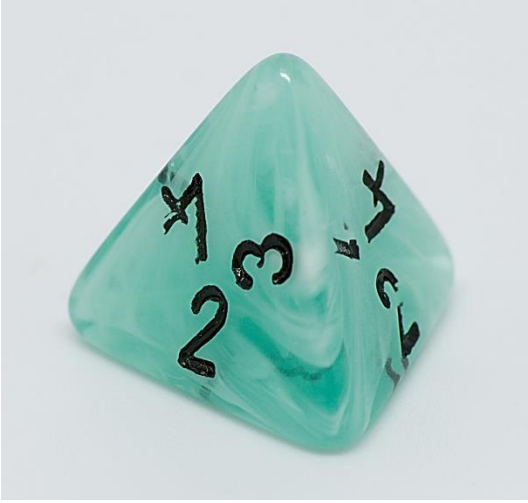
/r/CapableOf
/r/AtLocation
/r/Causes
/r/LocatedNear
/r/Desires

for "person" as A.

[ConceptNet]

captured via inverse document frequency (IDF)
[Information theory 101]

Our approach: Semantics



- Each statement (s, p) has four facets:
  1. Plausibility
  2. Typicality
  3. Remarkability
  4. Salience

- Lions; eat; chicken – Plausible, not typical nor salient
- Lions; attack; humans – Salient, plausible but not typical
- Lions; drink; water – Plausible and typical but not salient

Isolated statement treatment

Problem: For each candidate statement, evidence is collected independently

→ Resulting CSKBs incoherent and sparse

Our approach: Joint reasoning

1. Taxonomical relations
   - *lions, tigers, leopards subclass bigCats*
   - *bigCats; eat; meat → lions; eat; meat*
   - *lions; liveIn; prides ∧ ¬ (tigers, leopards; liveIn; prides) → salient(Lions; liveIn; prides)*
2. Statement similarity
   - *lions; hunt; antelopes → lions; eat; antelopes*
   - *elephants; can; dive → Elephants; can; swim*
3. Facets coupling
   - *salient(X, P) → plausible (X, P) and remarkable (X, P)*
   - *typical(X, P) ∧ typical(Y, P) ... ∧ X subclass S ∧ Y subclass S ... → ¬salient(X,P)*

Can ensure coherence!

Can combat sparsity!

Implementation and results

- Constraint reasoning encoded into MaxSAT
- Efficient solving via ILP

- **Results**: Outperforms unidimensional ConceptNet/TupleKB/Quasimodo scores by 8..16 percentage points in pairwise statement preference

Crowd task:

Which of the following is more **typical**?

1. Lions drink water.
2. Lions kill humans.

- Web interface: dice.mpi-inf.mpg.de