

# What is Knowledge Representation?

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Presentation for CMSC 771 by Brandon Corfman

2/11/2002

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## Outline of the paper

- Five roles of a KR
  - Surrogate
  - Ontological commitments
  - Theory of intelligent reasoning
  - Medium for efficient computation
  - Medium for human expression
- Why the five roles are useful

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## KR as a surrogate

- A KR is used to model objects in the world.
  - The desire is to be able for an agent to think about the world before acting.
  - Since a KR cannot possibly represent everything in the world, a KR must necessarily focus on certain objects and properties while ignoring others.
  - Result? Only objects and properties that are relevant to reasoning are modeled.

### Consequences:

- Since a KR cannot perfectly describe the world, at least some inferences with the KR will also be imperfect.
- In light of this, unsound inferences with a knowledge base may be useful under some circumstances.

## KR as ontological commitments

- Since KRs focus on only a subset of objects and properties in the world, there is necessarily a “view of the world” that is imposed by a particular set of KRs.
  - This view is referred to as an *ontological commitment*.
- This “view of the world” is established early-on by the knowledge engineer and affects all layers of the knowledge base.

## KR as a theory of intelligent reasoning

- Since we do not know how to build intelligent machines yet, various notions of the nature of intelligence have been proposed.

- These views of intelligence normally come from fields outside of AI: mathematics, psychology, biology, statistics and economics.

These alternate views of intelligence means that there are

“... deep-seated differences in the character and goals of various research efforts ... different conceptions of ... intelligent reasoning lead to different goals, definitions of success, and different artifacts being created.”

## More on intelligent reasoning

- Once a theory of reasoning has been chosen, it will affect the methods of and possibilities for inference on the KB.
  - Only certain facts can be correctly inferred from the KB, so some methods of inference are *sanctioned* or illegal.
  - A theory of reasoning also implies that there is a better method of inference than undirected search. The theory answers what inferences are *recommended* to pursue.
- Of all the various theories, the logical view says the least about the “correct” way to recommend inferences.

Three approaches are normally employed: 1) have the user tell the system what to do, 2) have the user guide the system, and 3) build in inference strategies into code.

## KR as a medium for efficient computation

- Often in the past, knowledge bases were built with considerations only for knowledge content and no concern for efficiency.
- However, since reasoning in computers is a computational process, it makes sense to talk about how to make the process more efficient.
- There appears to be a trade-off between representation languages with “significant speed but restricted expressive power”.

## KR as a medium for human expression

- An intelligent system must have KRs that can be interpreted by humans.
  - We need to be able to encode information in the knowledge base without significant effort.
  - We need to be able to understand what the system to knows and how it draws its conclusions.

## Why are the five roles of KR useful?

- Consequences for practice
  - Researchers should document ontological commitments, recommended inferences, and approaches for matching representations to tasks. This facilitates reuse of KRs.
  - KRs should be used only in ways that they are intended to be used – that is the source of their power.
- Consequences for research
  - Representation and reasoning are intertwined, i.e. a recommended method of inference is needed to make sense of a KB.
  - More work should be done to combine theories of intelligent reasoning, with various representations strengthening weaknesses of others.

## Why are the five roles of KR useful?

- More consequences for research
  - Some researchers claim equivalence between KRs, i.e. “frames are just a new syntax for first-order logic”. However, such claims ignore the important ontological commitments and computational properties of a representation.
  - All five roles of a KR matter. Without consideration of all five, KBs will have “significant deficiencies”.