

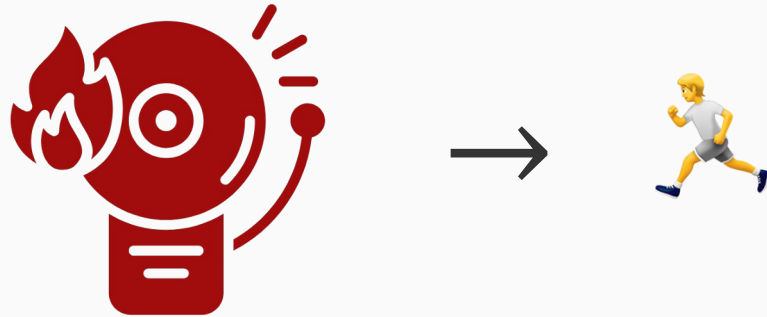
Symbolic Logic: An Introduction



Knowledge Representation & Reasoning

Knowledge and intelligent behavior

At least some of our behavior depends on what we believe about the world



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Knowledge and intelligent behavior

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We want our AI systems to represent and reason about knowledge as well

- What is representation?
- What is reasoning?

What are representations?

A representation is...

...a name that we can associate with a concept

...a relationship between two domains, where one domain “stands in” for another

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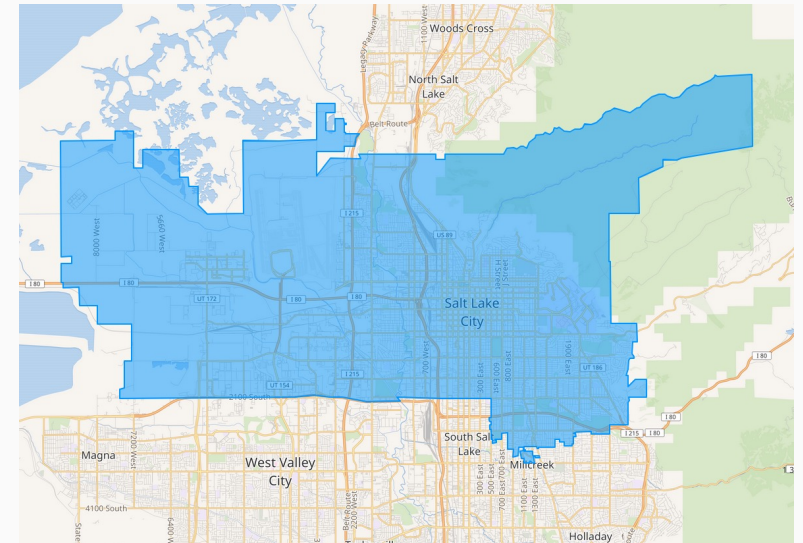


represents

Female, womanhood, ...

“Salt Lake City”

represents



Today's lecture: Symbolic representations

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1. **Objects**: parrots, eggs, New York, Mordor, Iron Man 3, the theory of relativity, wisdom,...

These could be real or imaginary, and could be concrete or abstract

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These could be real or imaginary, and could be concrete or abstract

2. **Facts** or **propositions**: *“It is raining today”*, *“Alice saw the hare”*, *“New York City is the capital of a nation”*, ...

These could be true or false

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Suppose we have some representation of knowledge

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Example: If we know that

1. All blops are freec
2. Alfredi is a blop

We can conclude that Alfredi is a freec

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Symbolic reasoning:

- The knowledge is represented in a symbolic fashion
- The resulting knowledge is also symbolic

Why reasoning?

Reasoning allows the capability to work with knowledge that was not explicitly stated

Imagine a system that was trained to incorporate the following two facts:

1. Any patient who is allergic to item A is also allergic to item B
2. Patient X is allergic to item A

We would like this system to behave as if it has seen the following information:

3. Patient X is allergic to item B

But how could it arrive at the conclusion even though it has never seen the statement? [Logical entailment](#)

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Sidenote: Is this sufficient? Is this all we do? No

We have to deal with exceptions, contradictions, invalid knowledge, etc. Purely deductive reasoning is not necessarily sufficient for intelligent behavior

The role of logic

Logic is the study of entailment relations

- Logic defines formal languages
- Logic defines truth conditions of statements in the languages
- Logic defines rules of inference that allow new entailed statements to be derived from existing ones

There are different kinds of logic:

- Propositional logic
- First order logic
- Real valued/Fuzzy logic
- Description logics
- ...and more

We will primarily look at propositional logic in this lecture