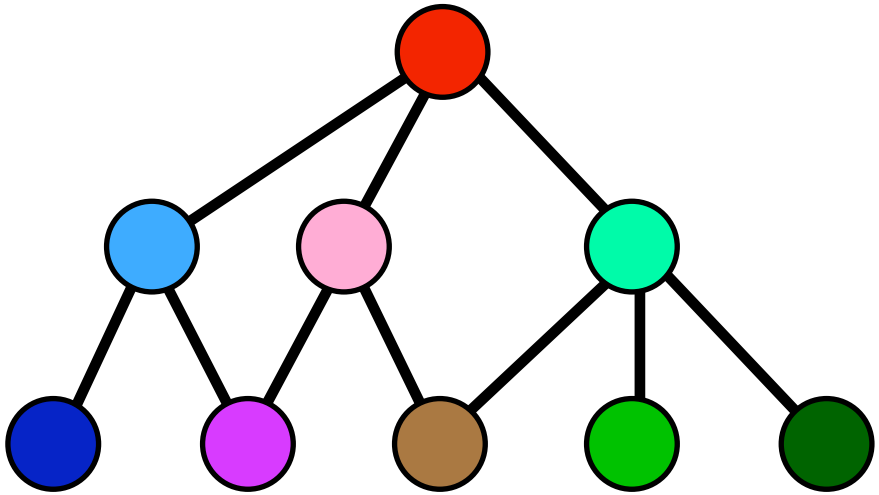
Background

Description Logic Systems



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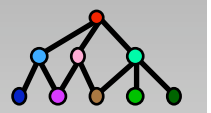
Historic Background



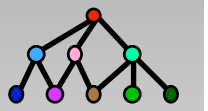
Semantic Links

Provide a method of organizing knowledge in a computer system that relied on links between objects to convey meaning.

Structural Classification

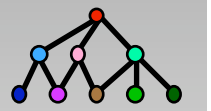
Observation that by attaching formal meanings to particular links, one could make useful inferences about the relationship between different objects.

Loom is a Description Logic with a Classifier



- ***Description Logic***
  - ***Declarative Formalism***
  - ***Specialized for Writing Descriptions***
  - ***Has Well-defined Semantics***
  - ***Supports Automated Inference***
- ***Classifier***
  - ***Computes Subsumption***
    Subsumption = Superset
  - ***Automatically Manages Type Hierarchy***

Definitions

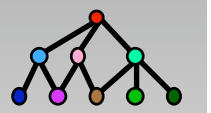


A definition is a description of a concept or a relationship. It is used to assign a meaning to a term.

In description logics, definitions use a specialized logical language.

Description logics are able to do limited reasoning about concepts expressed in their logic. One important inference is classification (computation of subsumption).

Necessary versus Sufficient



Necessary properties of an object are those properties that are common to all objects of that type.

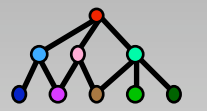
`Being a man is a necessary condition for being a father.`

Sufficient properties are those properties that allow one to identify an object as belonging to a type. They do not have to be common to all members of the type.

`Speeding is a sufficient reason for being stopped by the police.`

Definitions are often necessary and sufficient

Subsumption



Meaning of Subsumption

A more general concept is said to subsume a more specific concept. Members of a subsumed concept are necessarily members of a subsuming concept

Formalization of Meaning

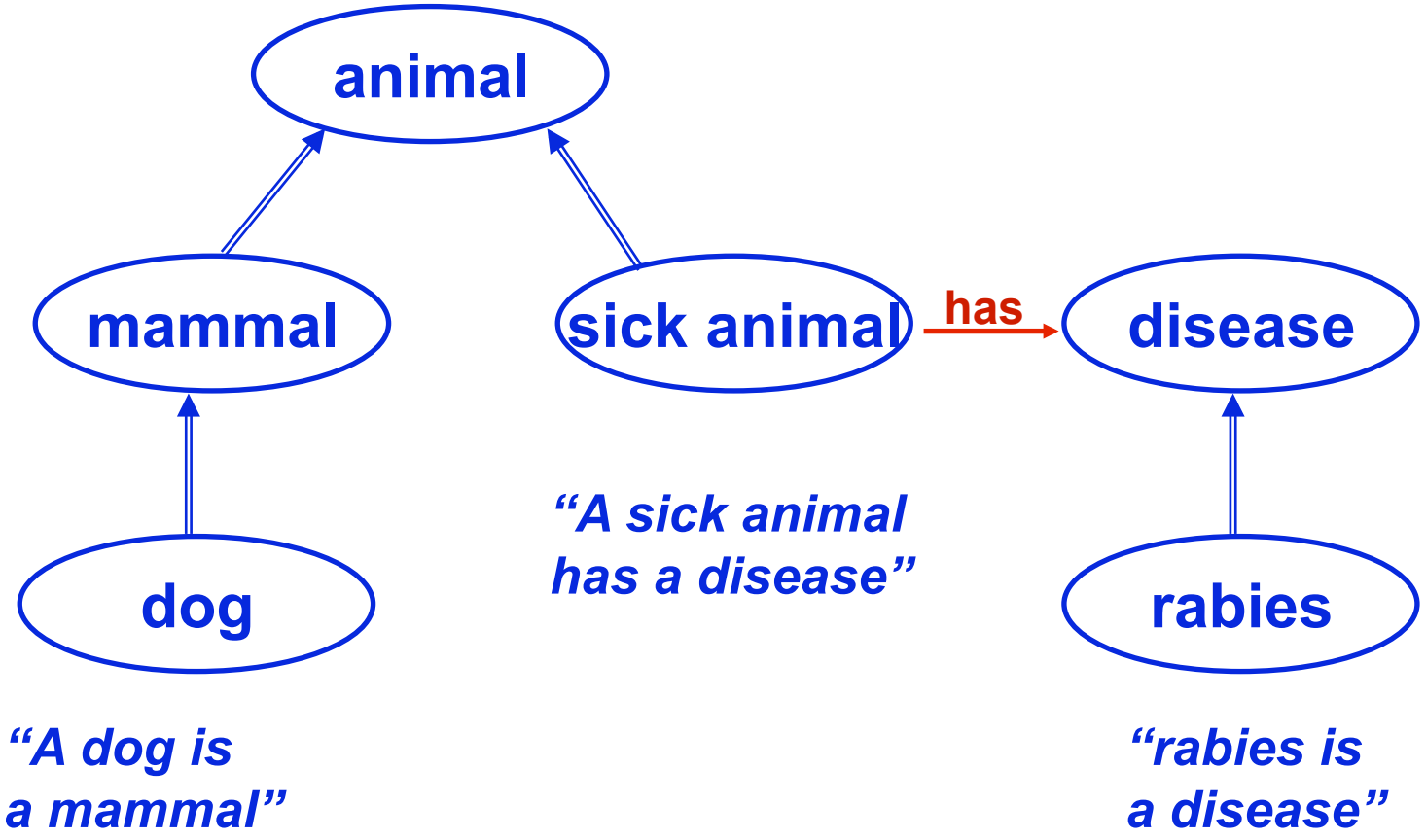
Logic

Satisfying a subsumed concept implies that the subsuming concept is satisfied.

Sets

The instances of subsumed concept are necessarily a subset of the subsuming concept's instances.

How Does Classification Work?



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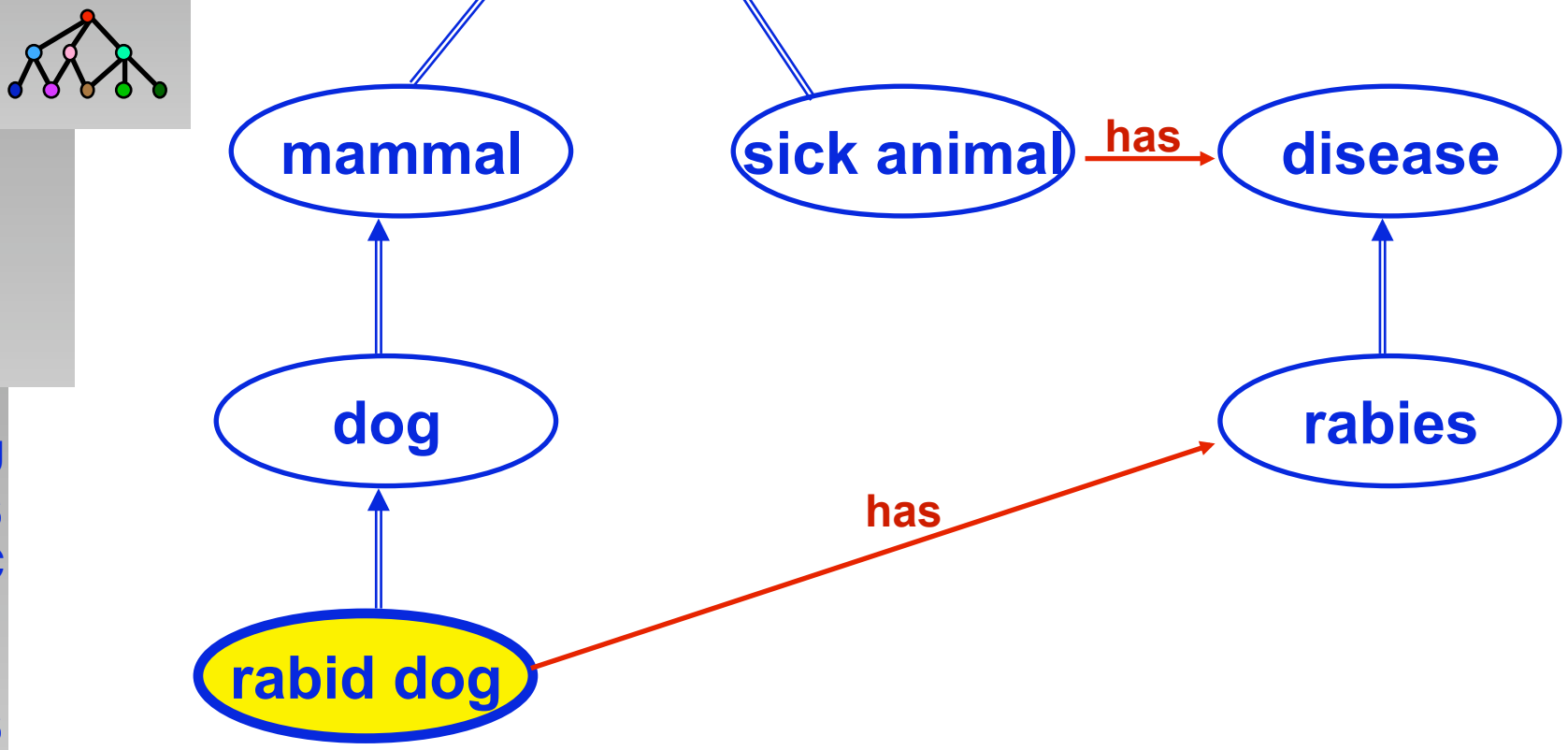
Defining a "rabid dog"



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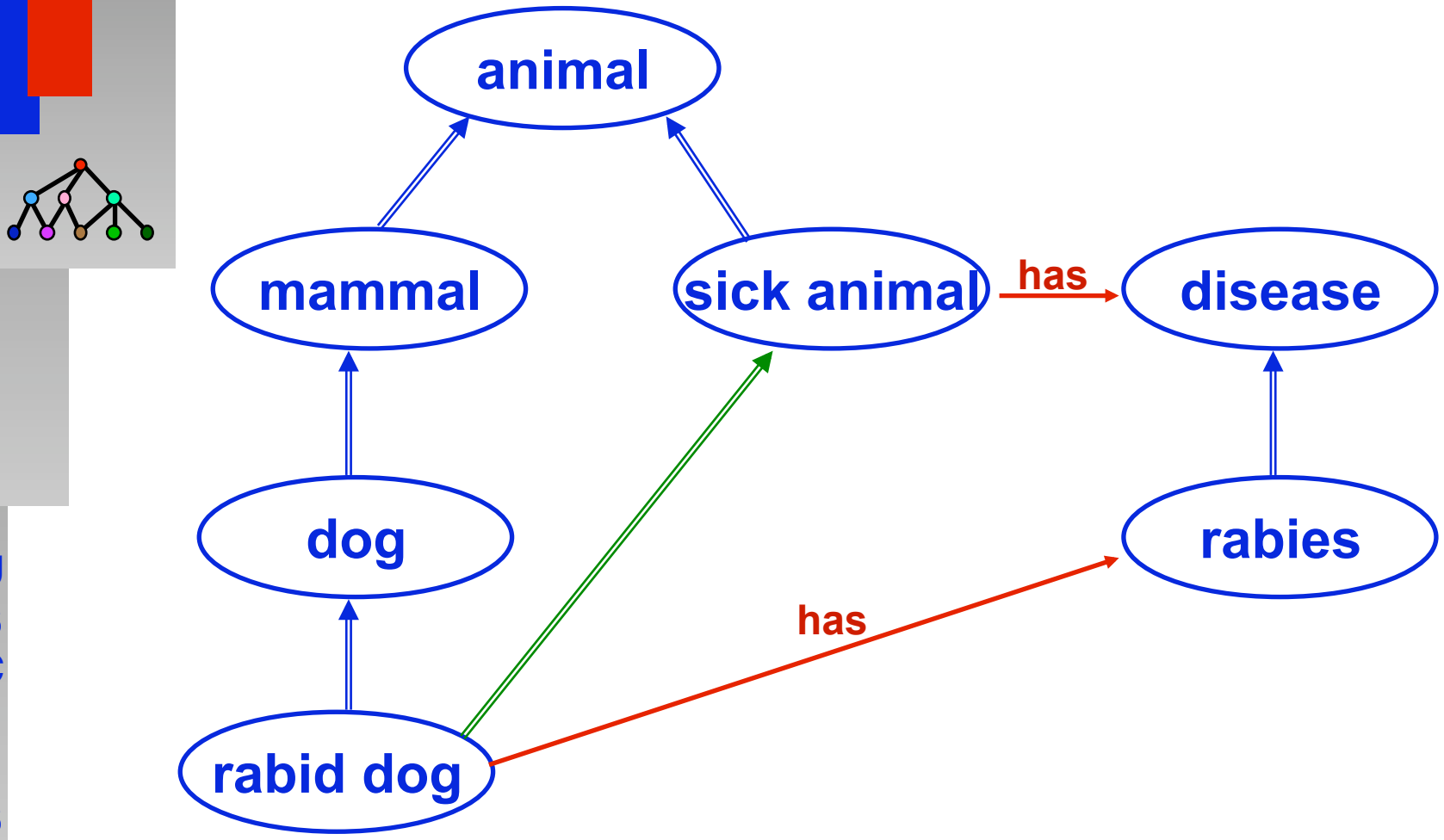
Loom Concludes "sick animal"



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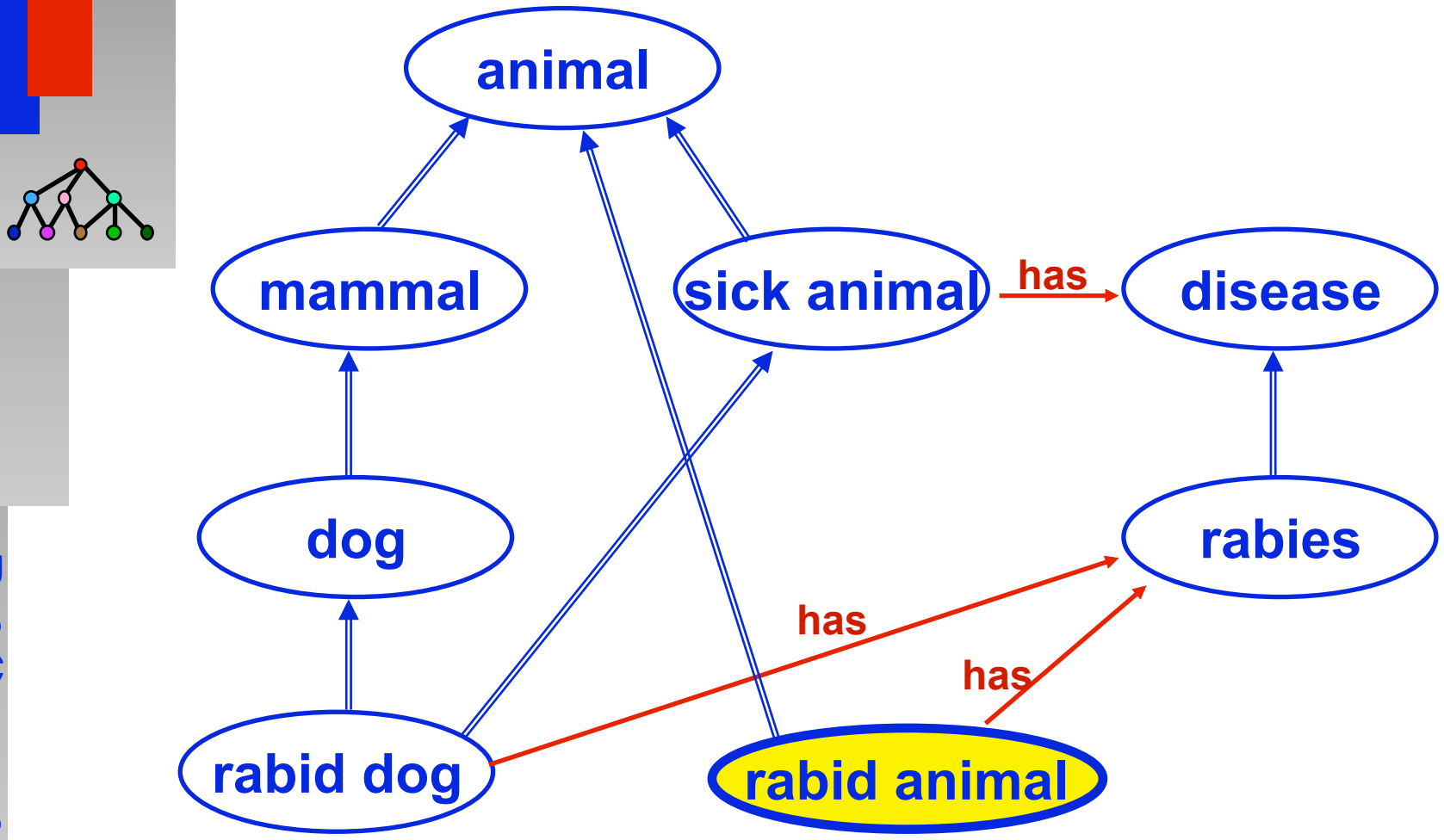
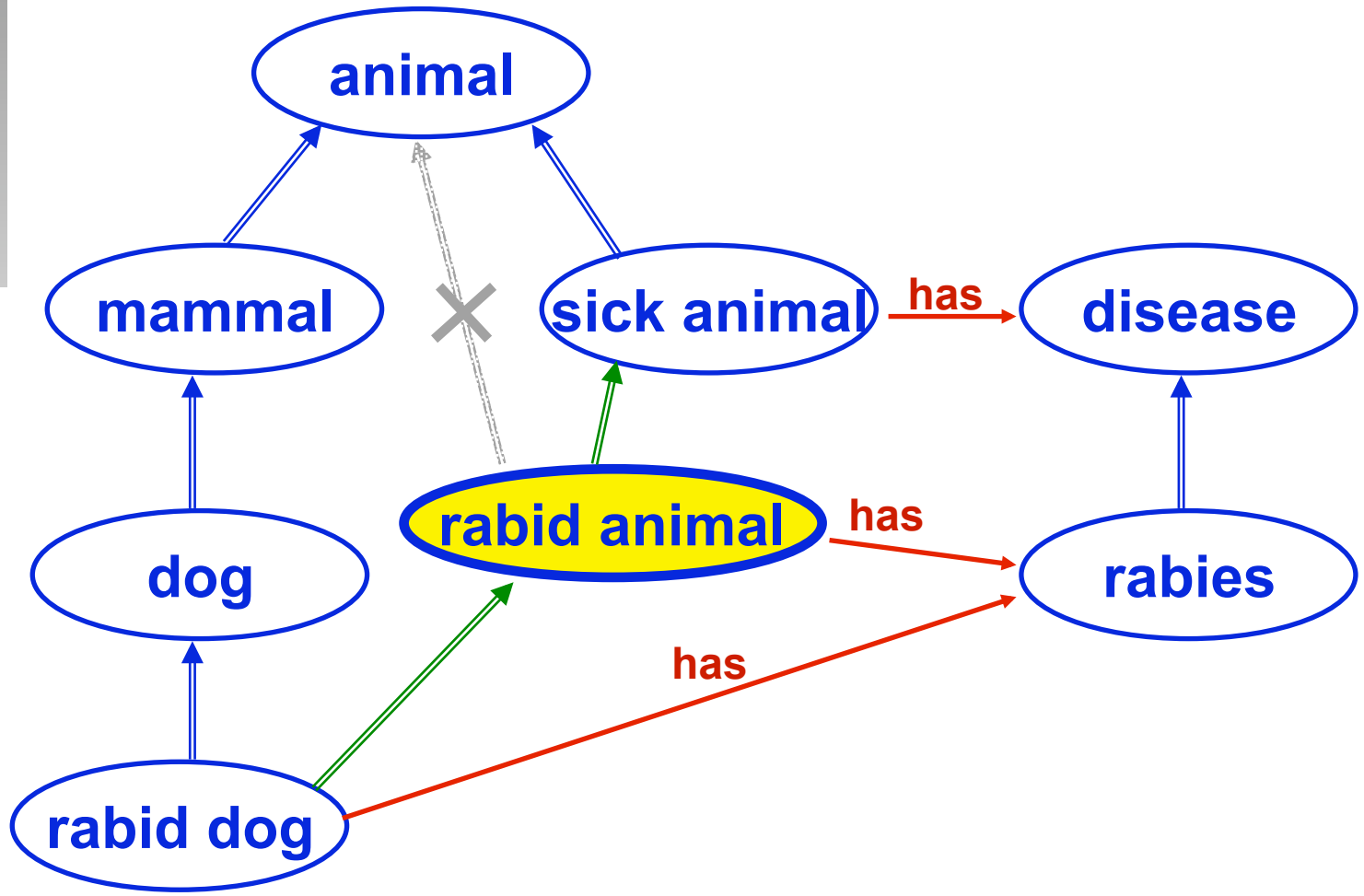
Defining "rabid animal"



Loom Places Concept in Hierarchy



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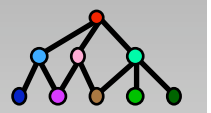
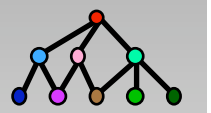
Primitive versus Structured (Defined)



- *Description logics reason with definitions. They prefer to have complete descriptions.*
- *This is often impractical or impossible, especially with natural kinds.*
- *A "primitive" definition is an incomplete definition with the missing element known as the primitiveness. This limits the amount of classification that the system can do automatically.*
- *Example:*

```
Primitive:  A Person
Defined:    Parent = Person with at
  least 1 child
```

Intentional versus Extensional Semantics



Extensional Semantics are a model-theoretic idea. They define the meaning of a description by enumerating the set of objects that satisfy the description.

Intensional Semantics defines the meaning of a description of based on the intent or use of the description.

Example:

`Morning-Star` **`Evening-Star`**

Extensional: Same object, namely Venus

Intensional: Different objects, one meaning venus seen in the morning and one in the evening.

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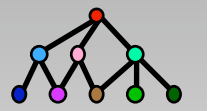
Definition versus Assertion



A definition is used to describe intrinsic properties of an object. The parts of a description have meaning as a part of a composite description of an object

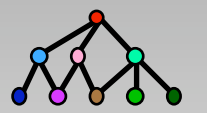
An assertion is used to describe an incidental property of an object. Asserted facts have meaning on their own.

Example

`A black telephone`

Could be either a description or an assertion, depending on the meaning and import of "blackness" on the concept telephone.

Open versus Closed World Semantics



Open world recognizes that all information is not available to the system.

Closed world assumes that all (relevant) information about the domain is known to the system.

- **"Negation as Failure"**
- **Common database semantics**

Loom offers a choice.

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