

# Knowledge Representation and Engineering

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## 1 Info

## 2 IN-PROGRESS Introduction and Concepts

### 2.1 Introduction

We introduce two different areas dealing with “knowledge”

**Knowledge Representation** Artificial Intelligence area concerned with how to represent and manipulate knowledge in an automated way.

**Knowledge Engineering** Computer Engineering area concerned with procedures and methods helping developers to systematically and formally construct knowledge bases.

A generic knowledge-based system deals with an input  $I$  and an output  $O = f(I, K)$

- e.g.  $I = \text{Symptoms}$ ,  $K = \text{Medical knowledge}$ ,  $O = \text{Drug}$
- The knowledge is provided by a **knowledgebase**
- The system behaves in an **intelligent** way

But why should we use a knowledgebase instead of a database? Consider a database having the following tables:

- PERSONS table

Id	Name
A	Albert
B	Beth
C	Cindy
...	...

- PARENTSHIPS table

X	Y
A	B
B	C
B	D
...	...

We can ask the following questions

- Is A a parent of B?
  - `SELECT X FROM PARENTSHIPS WHERE X="A",Y="B";`
- Who are the parents of B?
  - `SELECT X FROM PARENTSHIPS WHERE Y="B";`
- Who are the sons of A?
  - `SELECT X FROM PARENTSHIPS WHERE Y="B";`
- Who are the ancestors?
  - With a table of ANCESTORS
    - \* With  $n$  people, ANCESTORS is in  $O(n^2)$
    - \* If 1 generation has (on average) 2.36 ancestors, then 20 generations have 28.7 million ancestors
  - With some explicit “knowledge” (e.g. intelligence)
    - \* ANCESTOR
      - If X is a parent of Y then X is an ancestor of Y

- If X is an ancestor of Z and Z is a parent of Y then X is an ancestor of Y
- \* We can rely on this knowledge base to answer the question
 

```

      if PARENT(X,Y) then return true;
      else
      search Z: PARENT(Z,Y)
      if Z does not exist then return false;
      else
      return Ancestor(X,Z.father) or Ancestor(X,Z.mother);
      
```

**Decision Support Systems** are computer systems helping users to make decisions in complex domains.

## 2.2 Data, Information, and Knowledge

**Data** Raw and without context, it simply exists in its form (either usable or not)

**Information** Data + Meaning, it can change the perception of the receiver about something

**Meaning** For Davenport and Prusak, the five C's describe what gives meaning

**Contextualization** Purpose of data

**Categorization** Classified or generalization to concepts

**Calculation** Mathematical or statistical analysis

**Correction** Removal of errors

**Condensation** Removal of unnecessary elements

**Knowledge** Information + “something”, generalized to increase applicability. What is “something”?

- For Davenport and Prusak, the four C's describe it as

**Comparison** Similarity to other contexts

**Consequence** Implication in decision taking

**Connection** Relationship with other information

**Conversation** Feedback of people

- For Tobin, “something” is an application

**Wisdom** Knowledge + Intuition + Experience

**Expertise** Wisdom + Selection + Principles + Constraints + Learning

**Capability** Expertise + Integration + Distribution + Navigation

- 2.3 **TODO** Types and Uses of Knowledge
- 2.4 **TODO** Knowledge Representation
- 2.5 **TODO** Knowledge Engineering
- 2.6 **TODO** Syntax and Semantics
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- 3 **TODO** Knowledge Representation
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- 4 **TODO** Knowledge Engineering
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- 5 **TODO** Knowledge Representation in the Web