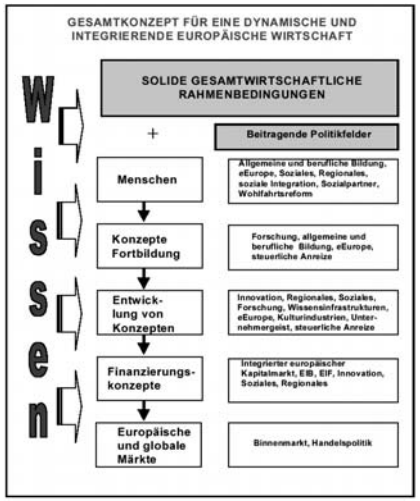
Vorlesung Künstliche Intelligenz Wintersemester 2006/07

# Teil III: Wissensrepräsentation und Inferenz

# Kap.4: Einführung

„In the knowledge lies the power." (Feigenbaum)






Aus: Der Europäische Rat von Lissabon: *Eine Agenda für die wirtschaftliche und soziale Erneuerung Europas. 28. Februar 2000*

**Wolf-Michael Catenhusen (BMBF, 1999):**

Deutschland steht mitten in einem weltweiten Prozess, in dem der Rohstoff Information, seine Erzeugung, Speicherung, und Verarbeitung, die Gewinnung und der richtige Umgang mit Wissen eine strategische volkswirtschaftliche und gesellschaftliche Größe geworden ist.

**G. Schröder (CEBIT 2000):**

Wir müssen den Menschen [...] die notwendigen Hilfestellungen geben, damit sie sich Zugang verschaffen können in die Wissens- und Informationsgesellschaft.



(Davenport & Prusak, 1998)

**Data** is a set of discrete, objective facts about events. [...] Data by itself has little relevance or purpose.

**Information** is a message, usually in the form of a document or an audible or visible communication. Information is meant to change the way the receiver perceives something, to have an impact on his judgment and behavior. It must inform; it is data that makes a difference.





(Davenport & Prusak, 1998)

**Knowledge** is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms.

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|---|---|---|
| Daten | = | Zeichen + Syntax |
| Information | = | Daten + Bedeutung |
| Wissen | = | Internalisierte Information + Fähigkeit, sie zu nutzen |

[Devlin 1999]

## Prinzipien für Wissensrepräsentations-Formalismen

Davis, Shrobe, und Szolovits (1993) diskutierten **fünf Prinzipien für Wissensrepräsentations-Formalismen:**

„A knowledge representation is
- a **surrogate**,
- a **medium of human expression**,
- a **set of ontological commitments**,
- a **fragmentary theory of intelligent reasoning**,
- and a **medium for pragmatically efficient computation**."

- Die Art und Weise, wie eine Wissensrepräsentation diese Prinzipien adressiert, charakterisiert ihren „Spirit".
- Jede Wissensrepräsentation muss sich zu diesen teilweise gegensätzlichen Prinzipien positionieren.

## KR as a surrogate

„Knowledge representation is most fundamentally a *surrogate,* a substitute for the thing itself, used to enable an entity to determine consequences by thinking rather than acting. [...] Reasoning is a process that goes on internally [of a person or program], while most things it wishes to reason about exist only externally." [DSS93]

## KR as fragmentary theory of intelligent reasoning

„The initial conception of a knowledge representation is typically motivated by some insight indicating how people reason intelligently, or by some belief about what it means to reason intelligently at all." [DSS93]

The authors consider five fields which have provided notions of intelligent reasoning:
- Mathematical Logic (e.g., Prolog)
- Psychology (e.g., frames)
- Biology (e.g., neural networks)
- Statistics (e.g., bayesian networks)
- Economics (e.g., rational agents)



## Unterschiedliche Modelle von Wissen

Diese verschiedenen Wurzeln der Wissensverarbeitung führten zu **unterschiedlichen Modellen von Wissen**:

- Biologie: **Vernetzung** → Neuronale Netze

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- Mathematische Logik: **Deduktion** → Logikkalküle, Prolog
- Statistik: **Unsicherheit** → Fuzzy-Logik, Bayessche Netze

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- Philosophie/Psychologie: **Begriffe** → Semantische Netze, Frames, Begriffshierarchien, Thesauri, Ontologien, Beschreibungs-logiken, Semantic Web
- Ökonomie: **Ziele** → Fallbasiertes Schließen, Agenten

Diese Einteilung gibt die Themen der weiteren Vorlesungen vor.

## KR as a medium of human expression

„Knowledge representations are [...] the medium of expression and communication in which we tell the machine (and perhaps one another) about the world. [...] Knowledge representation is thus a medium of expression and communication for the use by *us.* [...] A representation is the language in which we communicate, hence we must be able to speak it without heroic effort.“ “ [DSS93]

[DSS93] ask: „What things are easily said in the language and what kind of things are so difficult as to be pragmatically impossible?“



## KR as ontological commitment

A knowledge representation “is a *set of ontological commitments*, i.e., an answer to the following question: ‚In what terms should we think about the world? [...] In selecting any representation, we are [...] making a set of decisions about how and what to see in the world. [...] We (and our reasoning machines) need guidance in deciding what in the world to attend to, and what to ignore.“ [DSS93]



## KR as a medium for efficient computation

Knowledge representation „is a *medium for pragmatically efficient computation*, i.e., the computational environment in which thinking is accomplished. One contribution to this pragmatic efficiency is supplied by the guidance a representation provides for organizing information so as to facilitate making the recommended inferences.“ [DSS93]