


Introduction to Artificial Intelligence

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http//www.ags.uni-sb.de/~omega/teach/KI0607

At The End Of The Century The Use Of Words And General Educated Opinion Will Have Changed So Much That One Will Be Able To Speak Of "Machines Thinking" Without Expecting To Be Contradicted.

Alan Turing ; 1950

Artificial Intelligence an Introduction

Part I: Motivation and Overview

Part II: Methods of Artificial Intelligence

Part III: Main Subareas of Artificial Intelligence

Part I: Motivation and Overview

Introduction: Structure and Overview of AI

Chapter 1 - Four Basic Topics in AI:

- 1.1 Intelligent Agents
- 1.2 Representation
- 1.3 Search
- 1.4 Learning

Part II: Methods of AI

Chapter 2 - Problemsolving

2.1 Uninformed Search

2.2 Informed Search

2.3 Constraint Satisfaction Problems

Chapter 3 – Knowledge Representation and Reasoning

See also: special lectures on logic and reasoning

Chapter 4 - Planning

- 4.1 State Space Planning
- 4.2 Partial Order Planning
- 4.3 Planning in the Real World

Part II: Methods of AI

Chapter 5 – Uncertainty and Reasoning

5.1 Uncertainty

5.2 Probabilistic Reasoning

5.3 Probabilistic Reasoning over Time

5.4 Making Decisions

Part II: Methods of AI

Chapter 6 – Learning

6.1 Learning from Observations

6.2 Knowledge in Learning

6.3 Reinforcement Learning

Part III: The Main Subareas of AI

7 Natural Language Processing: Overview

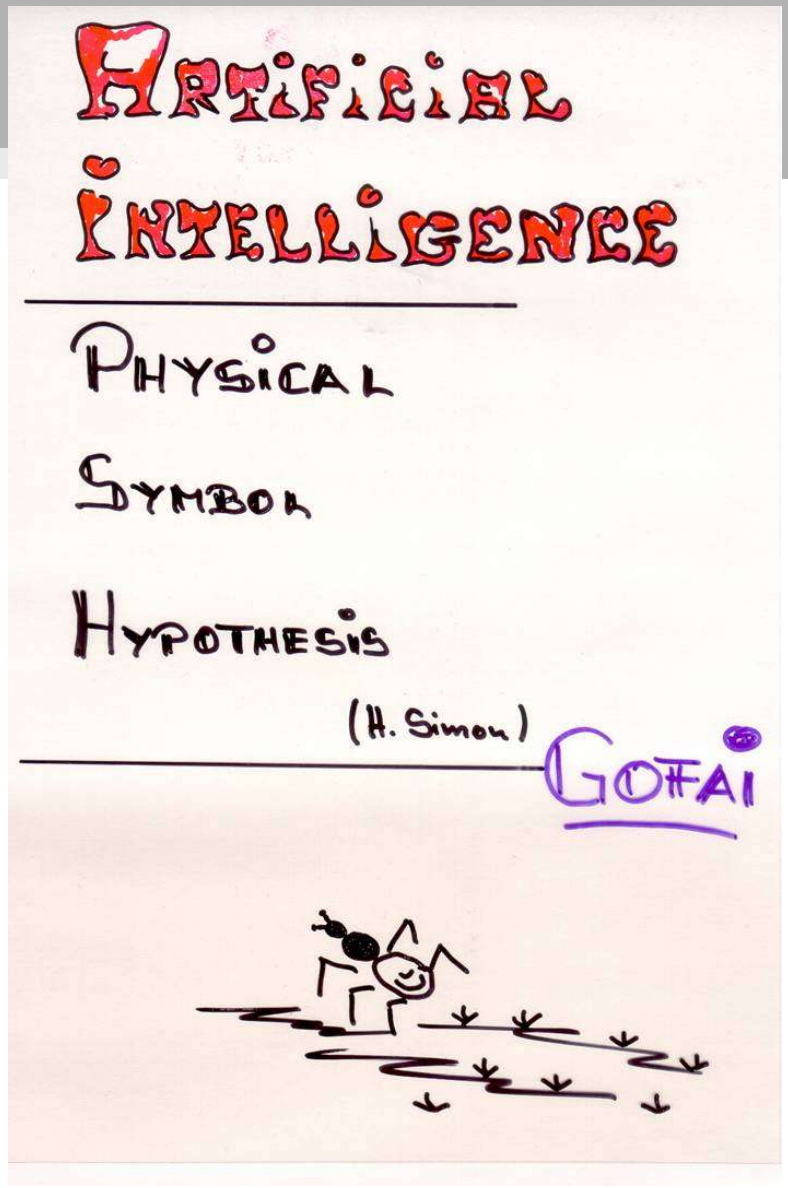
8 Computer Vision: Overview

9 Robotics: Overview

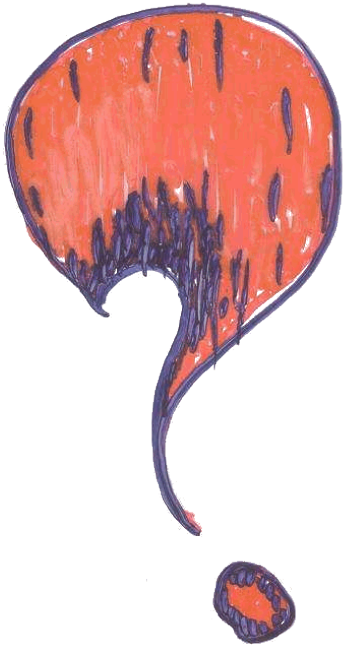
10 Automated Reasoning Systems: Overview

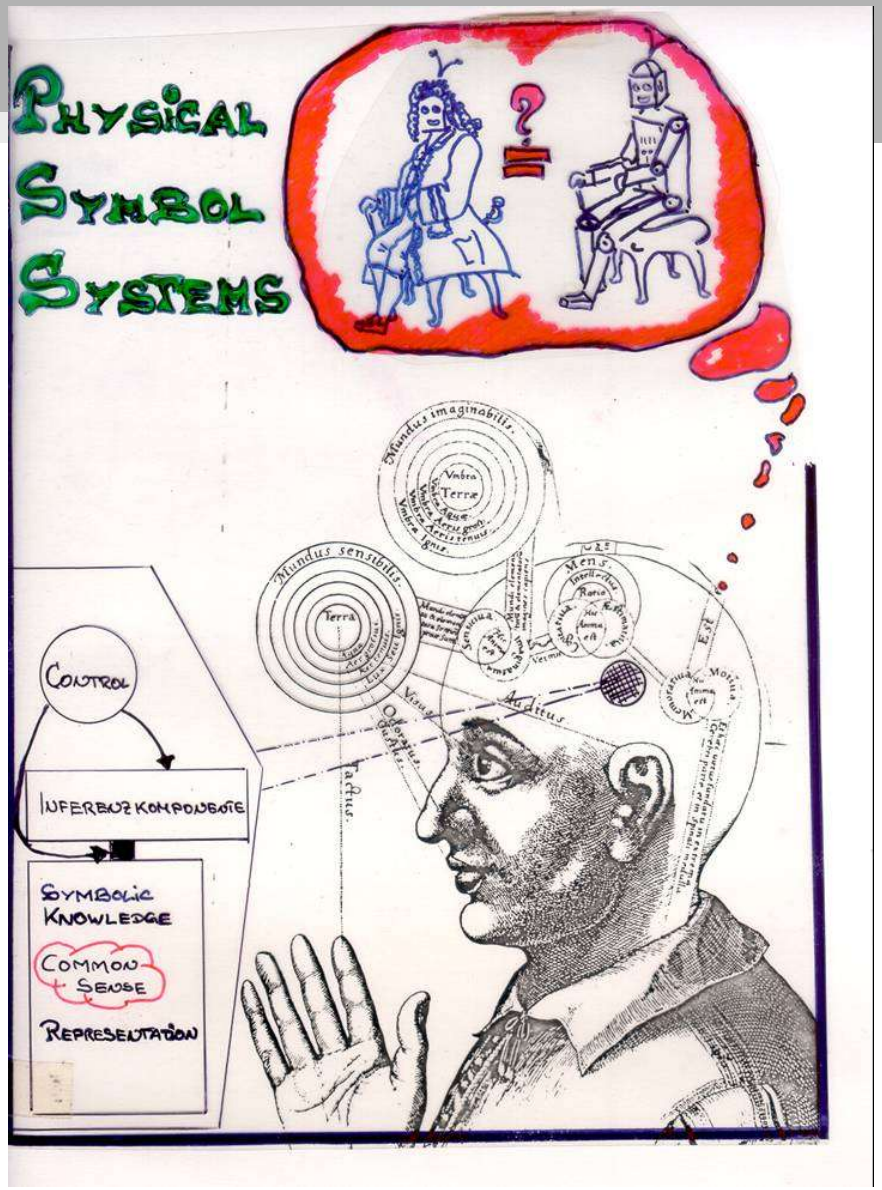
11 Expert Systems: Overview

12 Multiagent Systems: Overview


ARTIFICIAL
INTELLIGENCE
PHYSICAL
SYMBOL
HYPOTHESIS
(H. Simon)
GOFAI

What is AI



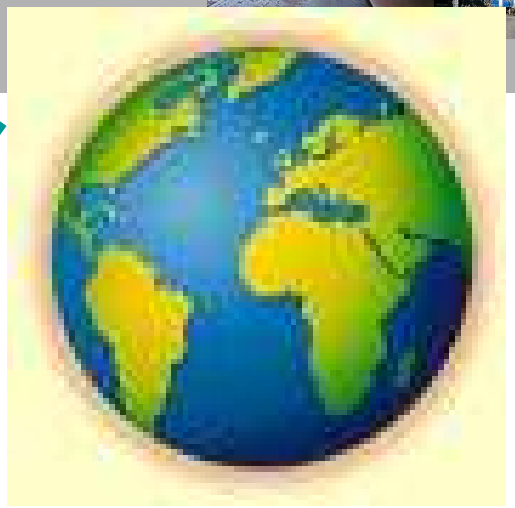


"The fundamental hypothesis of AI is that the properties of a physical symbol system (like e.g. the computer and the human brain) are just the prerequisites for the capabilities it requires to exhibit intelligence"

H. Simon in: "Encyclopedia of Artificial Intelligence", 1987


AI magazine
VOLUME 22, NO. 1
Spring 2001
Herbert A. Simon
1916 – 2001
An official publication of the
American Association for Artificial Intelligence

Symbolic Knowledge Representation and Inference



Symbolic Knowledge Representation

Reasoning Inference Component

$Fact_1$

$Fact_2$

$Fact_3$

$Fact_n$

AI: The Structure of the Field

Program Synthesis

Robotics

Knowledge Representation

Deduction Systems

Heuristic Search

AI-Languages AI-Systems

Computer Vision

Expert Systems

Inferential Processes

Learning Acquisition of Knowledge

Natural Language Processing

Games playing

Planning and Problem Solving

e-Learning Systems

AI-Areas

AI-Methods and AI-Techniques

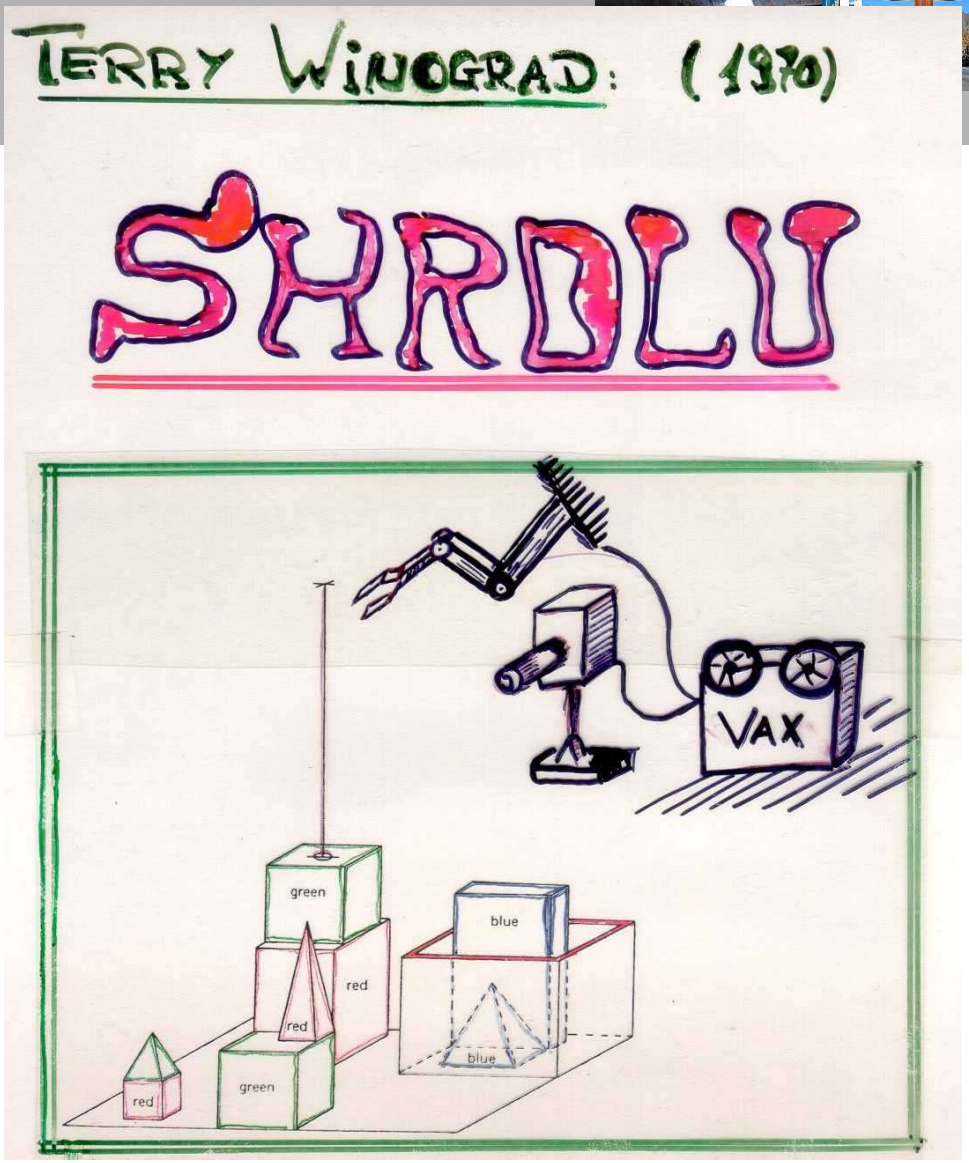
AI-Areas

Natural Language Processing

The 1970s: 

Today: → **(excursion)**

“Will you please stack up both of the red blocks and either a green cube or a pyramid.“



Man-Machine Dialoge (I)

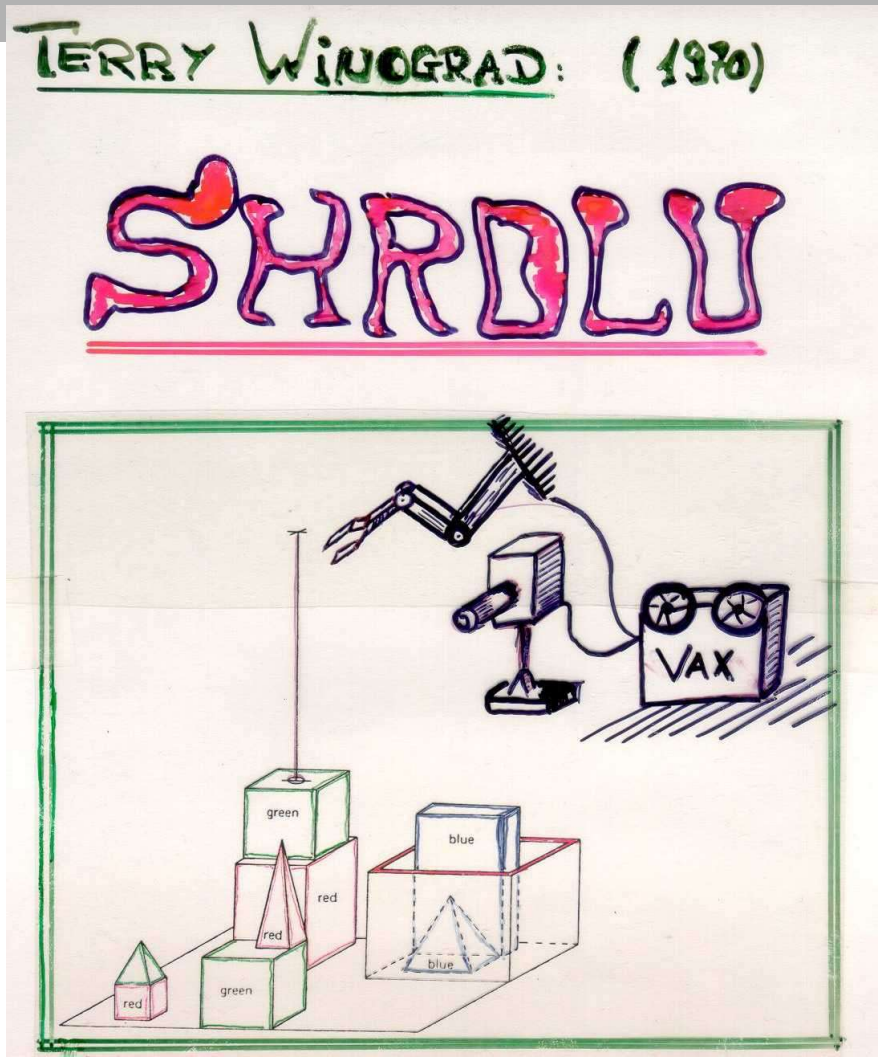
Man: red colour
Machine: green colour
Comments: *grey colour*

1. Pick up a big red block

Ok

2. Grasp the pyramid

I don‘t understand which pyramid you mean



Man-Machine Dialoge (II)

3. Find a block which is taller than the one you are holding and put it into the box

The system has to figure out what is meant by „one“ and „it“, as well as using deduction to decide which block it is holding

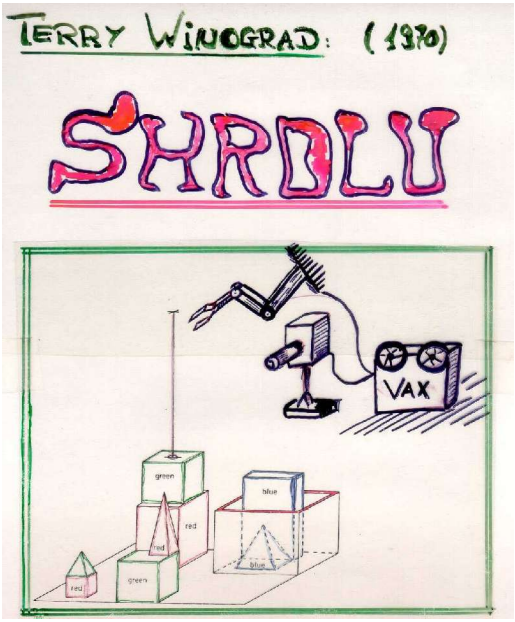
By „it“, I assume you mean the block which is taller than the one I am holding.

Printed out to keep us informed.

Ok

4. What does the box contain?

The blue pyramid and the blue block.



Man-Machine Dialoge (III)

5. What is the pyramid supported by?

Earlier the system responded to „the pyramid“ by saying „I don‘t understand which pyramid you mean“. Now, it assumes that we mean the one just mentioned.

The box.

6. How many blocks are not in the box?

Negatives such as „not“ and „no“ are handled whether they appear in clauses or noun groups (such as „no boxes“).

Four of them.

Man-Machine Dialoge (IV)

7. Is at least one of them narrower than the one which I told you to pick up?

The phrase „at least one of them“ must be analyzed to refer back to the previous question, and „the one which...“ must also refer to blocks.Noun groups can have complicated numbers such as „at least one“, „more than three“, „exactly seven“, etc. The memory of past events is used to deduce which block is „the one which I told you to pick up“. Notice the complicated syntactic structure in which „the ones“ is actually the object of a clause embedded two levels deeper.

Yes, the red one.

Man-Machine Dialoge (V)

8. Is it supported?

Passives can be used without a „by“ - phrase.

Yes, by the table.

9. Can the table pick up blocks?

No.

……

19. Is there a large block behind a pyramid?

Yes, three of them: a large red one, a large green cube and the blue one.

Man-Machine Dialoge (VI)

20. **Put a small one onto the green cube which supports a pyramid.**

„A small one“ must contrast with the earlier phrase „a large block“, so this means „a small block“

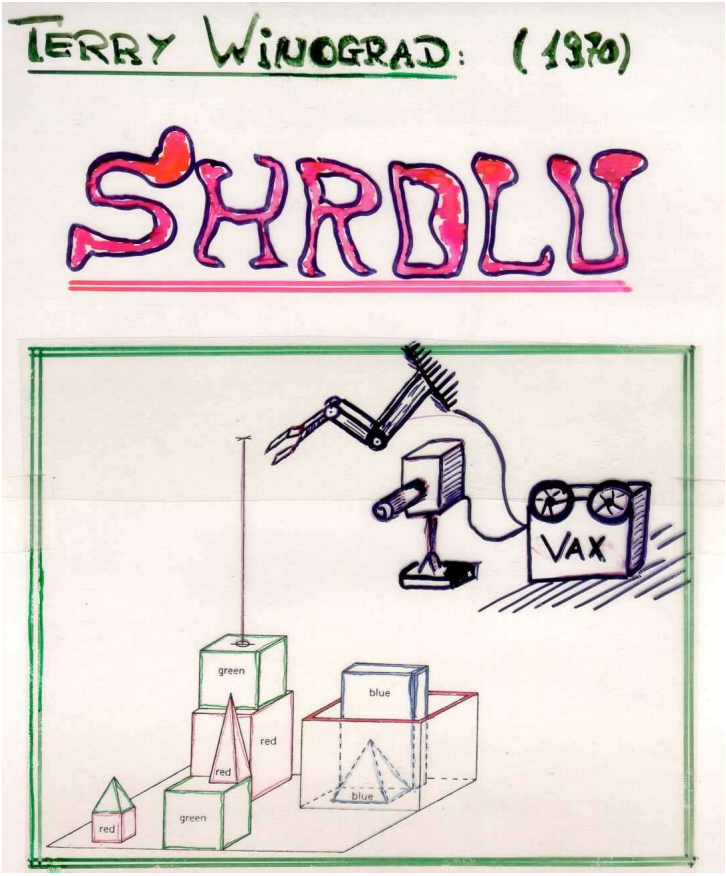
Ok.

23. **Had you touched any pyramid before you put the green one on the little cube?**

Yes, the green one.

44. **Thank you.**

You‘re welcome!



Natural Language Processing Today

Excursion: Computer Linguistics

Typical Industrial Applications:

Currrent Research Issues:

Lectures on NL Processing in SB:


Expert Systems

The 1970s: MYCIN

Today: → **(excursion)**

Bacterial infection of the blood and brain

E.H.Shortliff **Computerbased Medical Consultations:MYCIN** Elsevier,Amsterdam,1976

Example: Mycin - Medicin

ampicilinn	ethambutal	penicillin
bacitracin	gentamicin	polymyxin
carbenicillin	IHN	rifampin
cephalothin	kanamycin	streptomycin
chloramphenicol	methicillin	sulfisoxazole
clindamycin	nalidixic-acid	tetracycline
colistin	nitrofurantoin	vancomycin
erythromycin	PAS	

Example: Typical Bacteria

arizona
bacteroides
borrelia
brucella
citrobacter
clostridium-botulinum
clostridium-species
clostridium-tetani
corynebacteria-diphteriae
diplococcus-species
diplococcus-pneumoniae
e.coli
edwardsiella
enterobacter
fusobacterium
hafnia
hemophilus-influenzae
hemophilus-non-influenzae
herrellea
klebsiella
listeria
mima
moraxella
mycobacterium-atypical
mycobacterium-balnei
mycobacterium-leprae
mycobacterium-tb
neisseria-genorrhea
neisseria-meningitidis
neisseria-species
pasteurella
peptococcus
proteus-mirabilis
proteus-non-mirabilis
providence
pseudomonas
salmonella
serratia
shigella
staphylococcus-coag+
staphylococcus-coag-
streptobacillus
streptococcus-alpha
streptococcus-anaerobic
streptococcus-beta (group-A)
streptococcus-beta (non-group-A)
streptococcus-gamma
streptococcus-group-D
streptococcus-microareophillic
treponema
vibrio

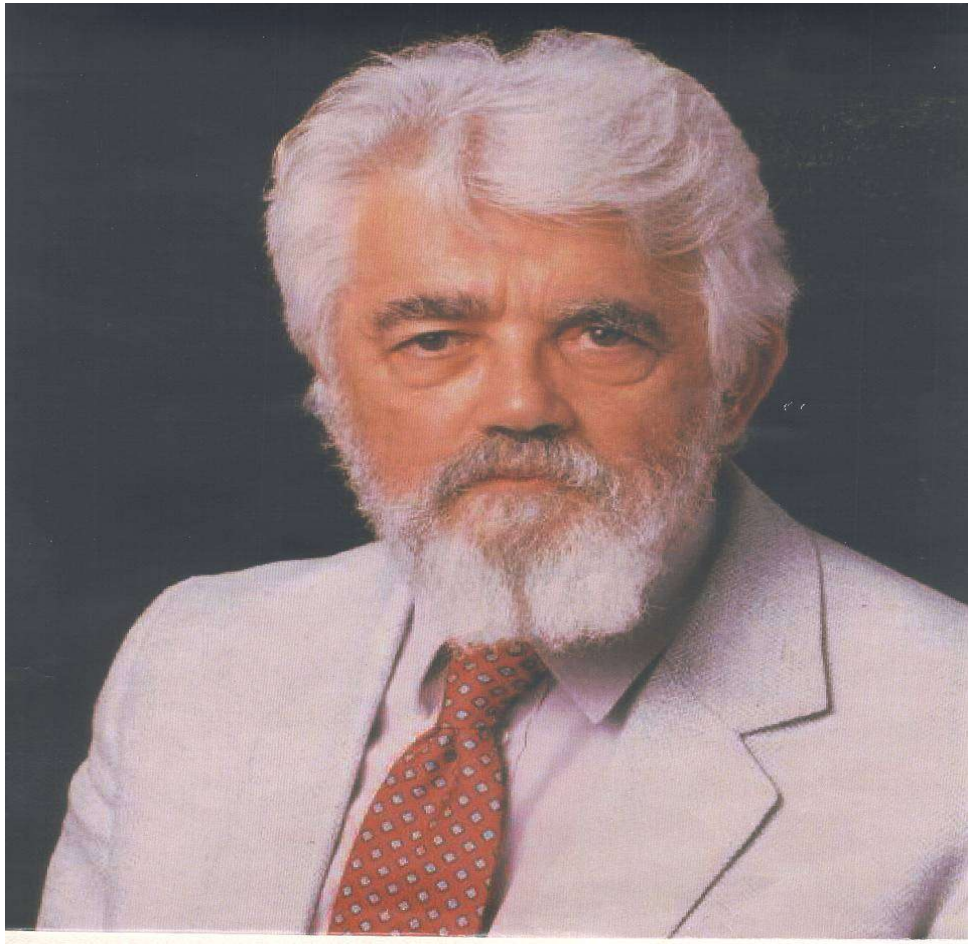
XPS TODAY

- Typical industrial applications:

- Current Research Issues:

- Lectures on XPS in SB:

Logical Foundations of AI-Research



John McCarthy

LOGIC AND AI

- INFERENCE ENGINE for AI-Systems
  - Natural language processing
  - Question-answering systems
  - XPS
  - Computer Vision
- DEDUCTION SYSTEMS
  - Program verification
  - Mathematics
  - Deductive databases
  - Logical programming languages
- ASSISTENCE SYSTEMS
  - Active Math
  - ΩMEGA

Logical Methods for Knowledge Representation

History of Ideas

We believe that human intelligence depends essentially on the fact that we can represent in language facts about our situation, our goals and the effects of the various actions we can perform.

J. McCarthy, Advice Taker, 1959

• J. McCarthy:	Programs with Common Sense	1958
• J. McCarthy, P. Hayes:	Some Problems from the Standpoint of AI	1969
• P. Hayes:	Computation and Deduction	
• P. Hayes:	Problems and Nonproblems of Representation Theory	1975
• P. Hayes:	In Defense of Logic	1977

Logical Methods for Knowledge Representation

History of Ideas (Continued)

• H. Kowalski:	Logic for Problem Solving	1979
• P. Hayes:	Logic of Frames	1979
• R. Brachmann:	On the Epistemological Status of Semantic Networks	1979
• R. C. Moore:	The Role of Logic in Knowledge Representation	1982
• K. Konolige:	Resolution and Quantified Epistemic Logic	1982
• R.J. Brachmann, H.J. Levesque	Readings in Knowledge Representation	

CSLI SRI EDINBURGH ESSEX SAARBRÜCKEN CMU

J. McCarthy: Award for Reseach Excellency IJCAI, 1985
IJCAI 1987: 144 contributions, more than 60 in the field of Logic
IJCAI today: between 30 and 50%

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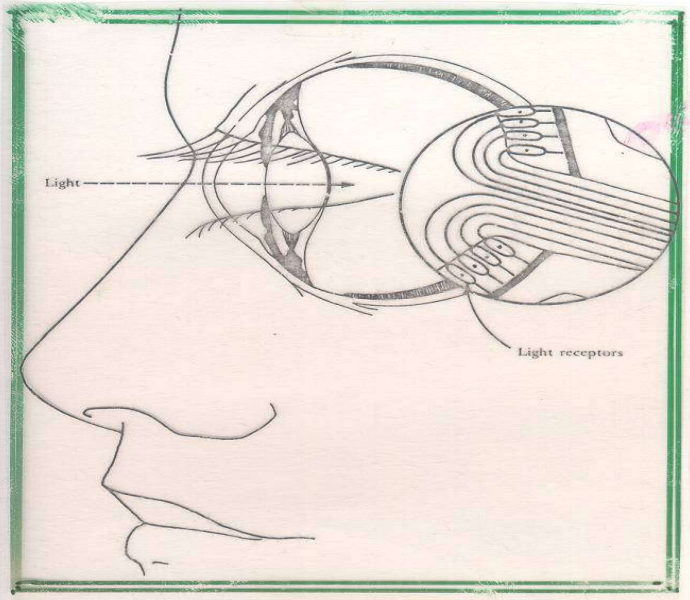
Computer Vision

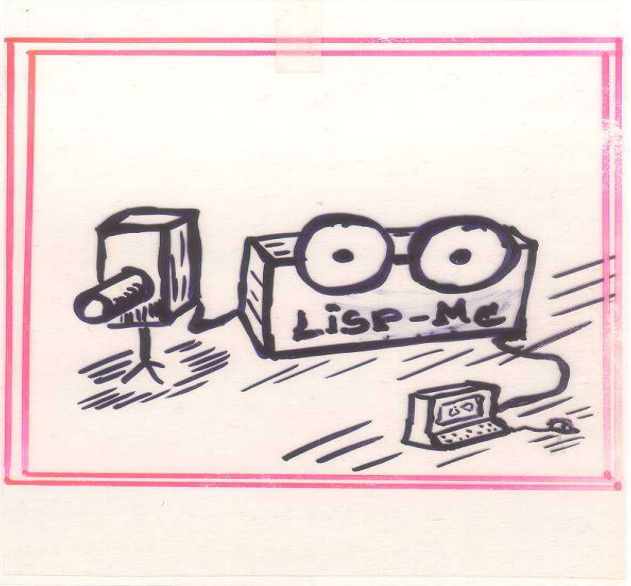
The Problem

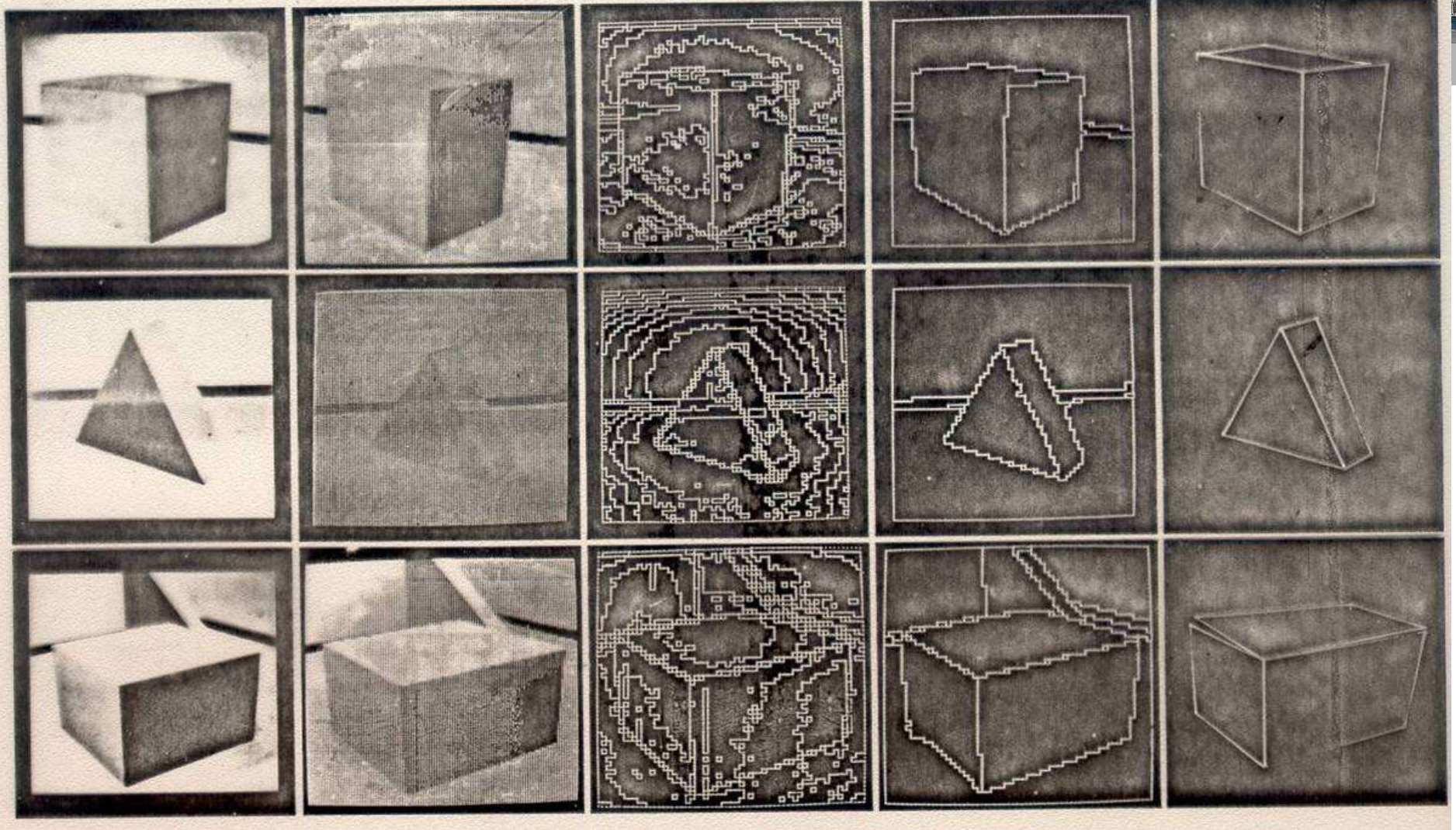
The Field Today: → **(excursion)**

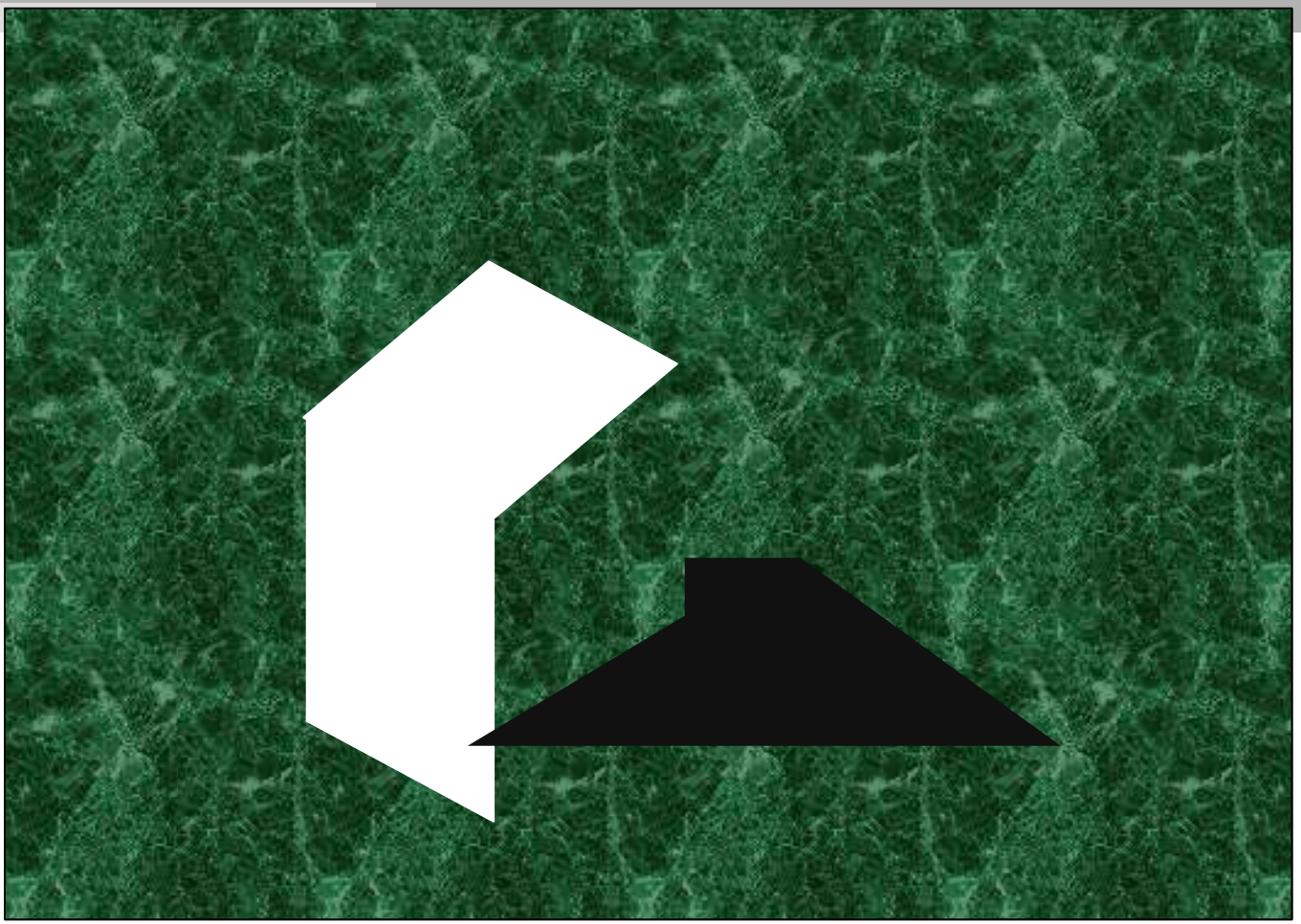
COMPUTER-SEHEN

(VISION)









The Brain is a Hallucinating Machine

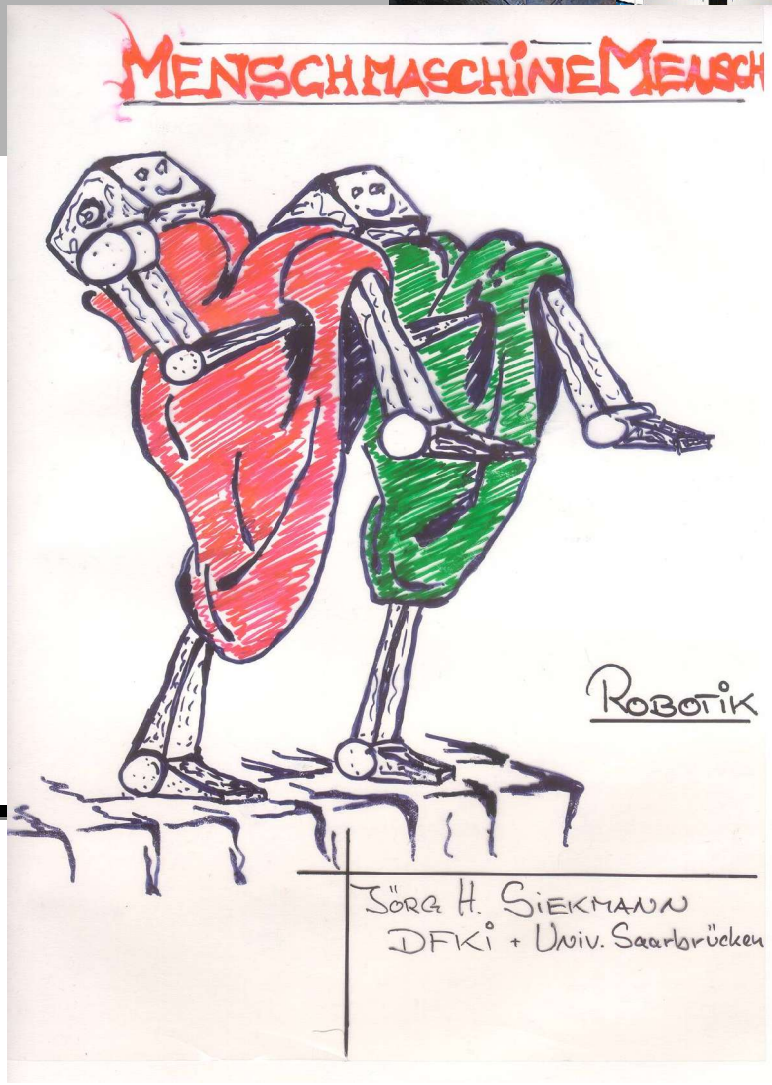
COMPUTER VISION TODAY

- Typical Industrial applications:

- Current research Issues:

- Lectures on Computer Vision in SB:

Robotics

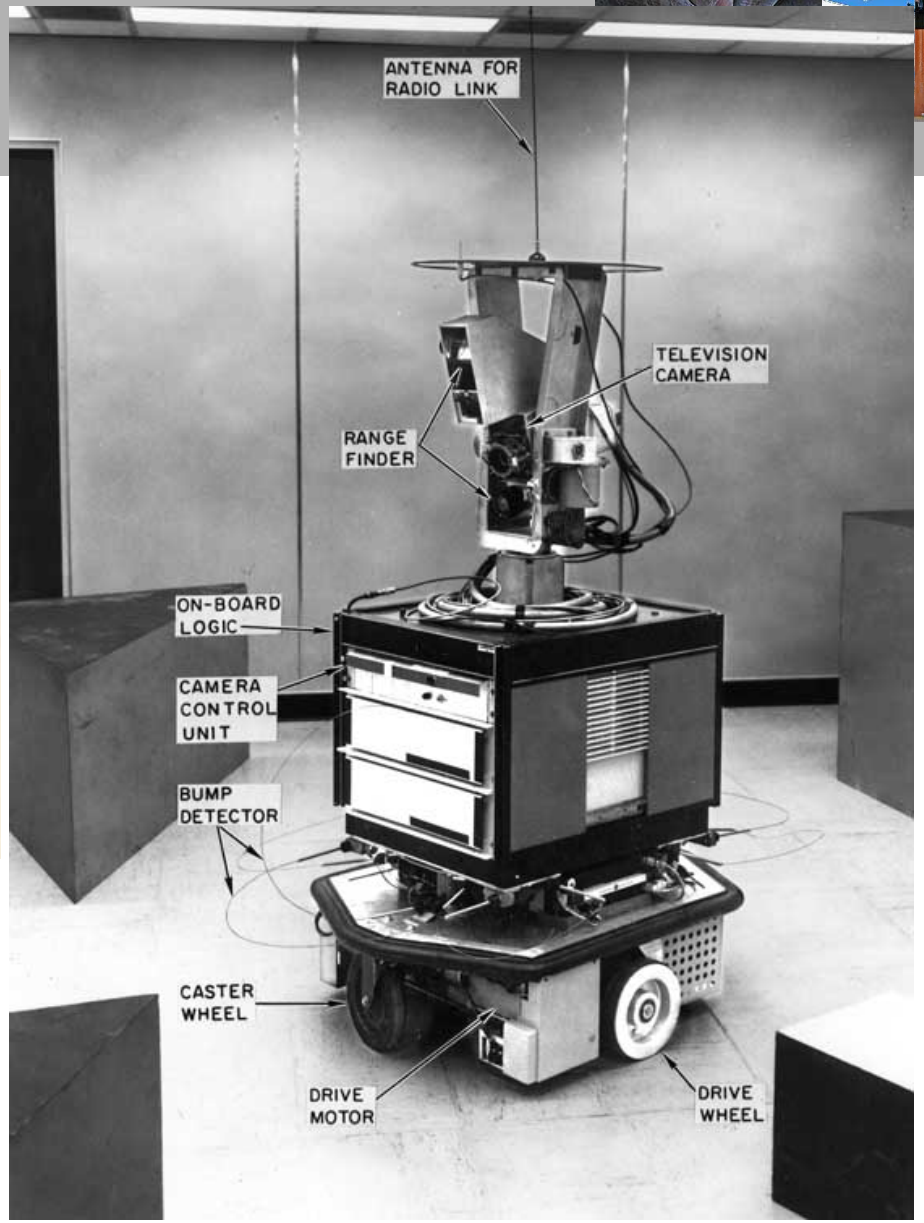


The 1970s: SHAKEY

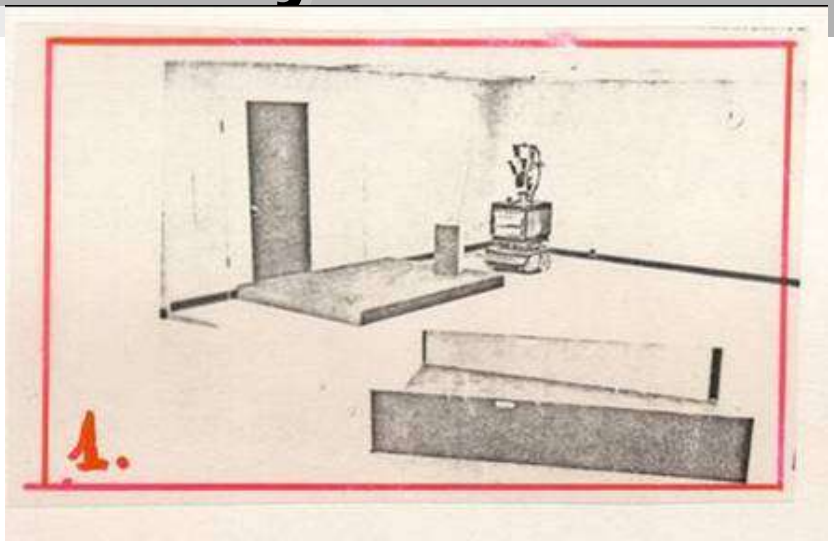
Today: → **(excursion)**

SHAKEY

(1970)


ANTENNA FOR RADIO LINK
TELEVISION CAMERA
RANGE FINDER
ON-BOARD LOGIC
CAMERA CONTROL UNIT
BUMP DETECTOR
CASTER WHEEL
DRIVE MOTOR
DRIVE WHEEL

Shakey



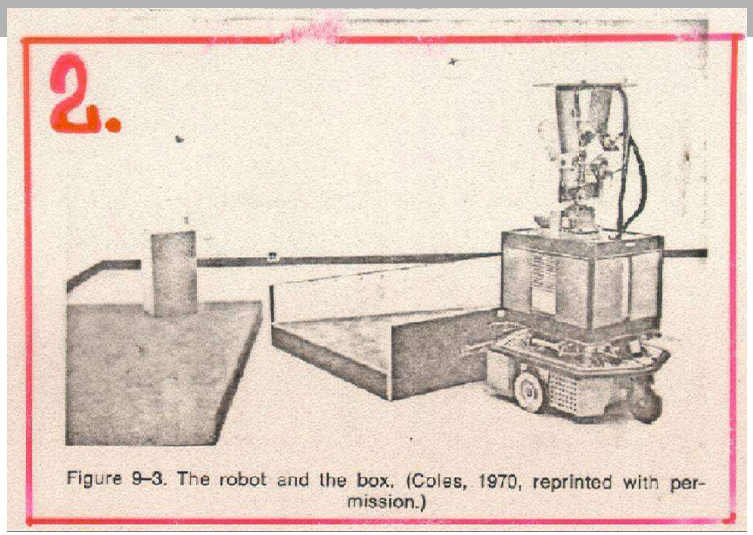
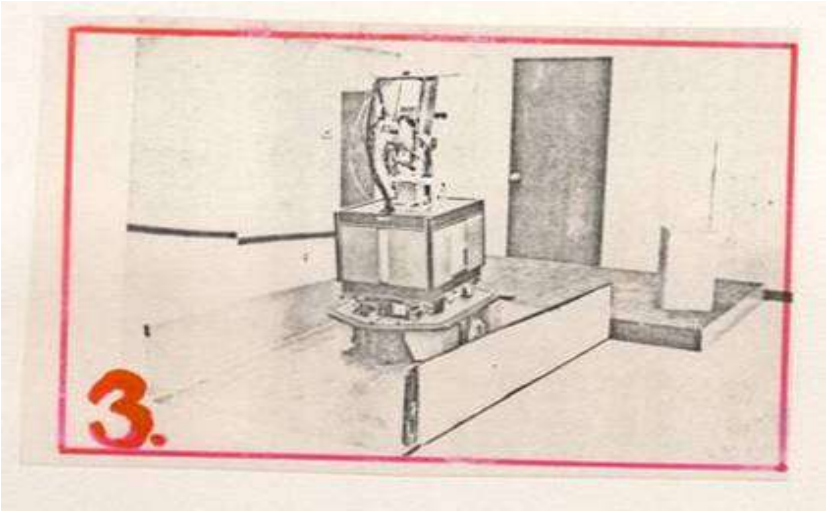


Figure 9–3. The robot and the box. (Coles, 1970, reprinted with permission.)



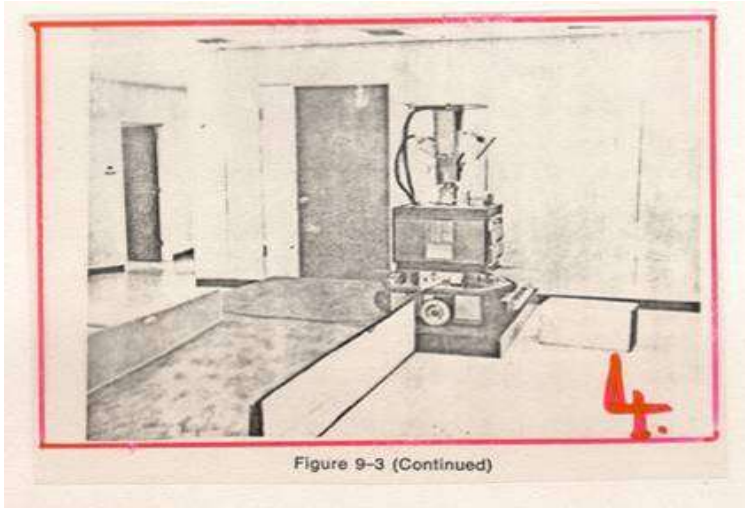


Figure 9–3 (Continued)

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DFKI

ROBOTICS TODAY

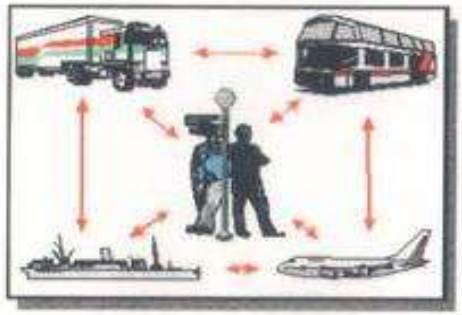
- Typical Industrial Applications:

- Current Research Issues:

- Main Research Centres in Germany:

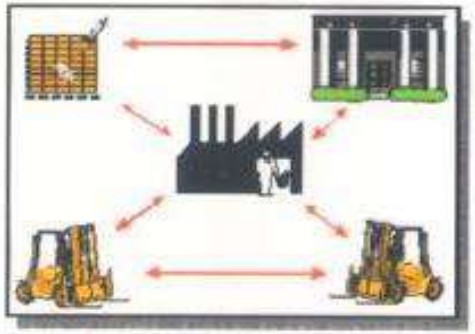
Multiagent Systems

Emergent Behaviour



Distributed Artificial Intelligence

Jörg H. Siekmann
DFKI GmbH, Saarbrücken
Project CoMMA-MAPS



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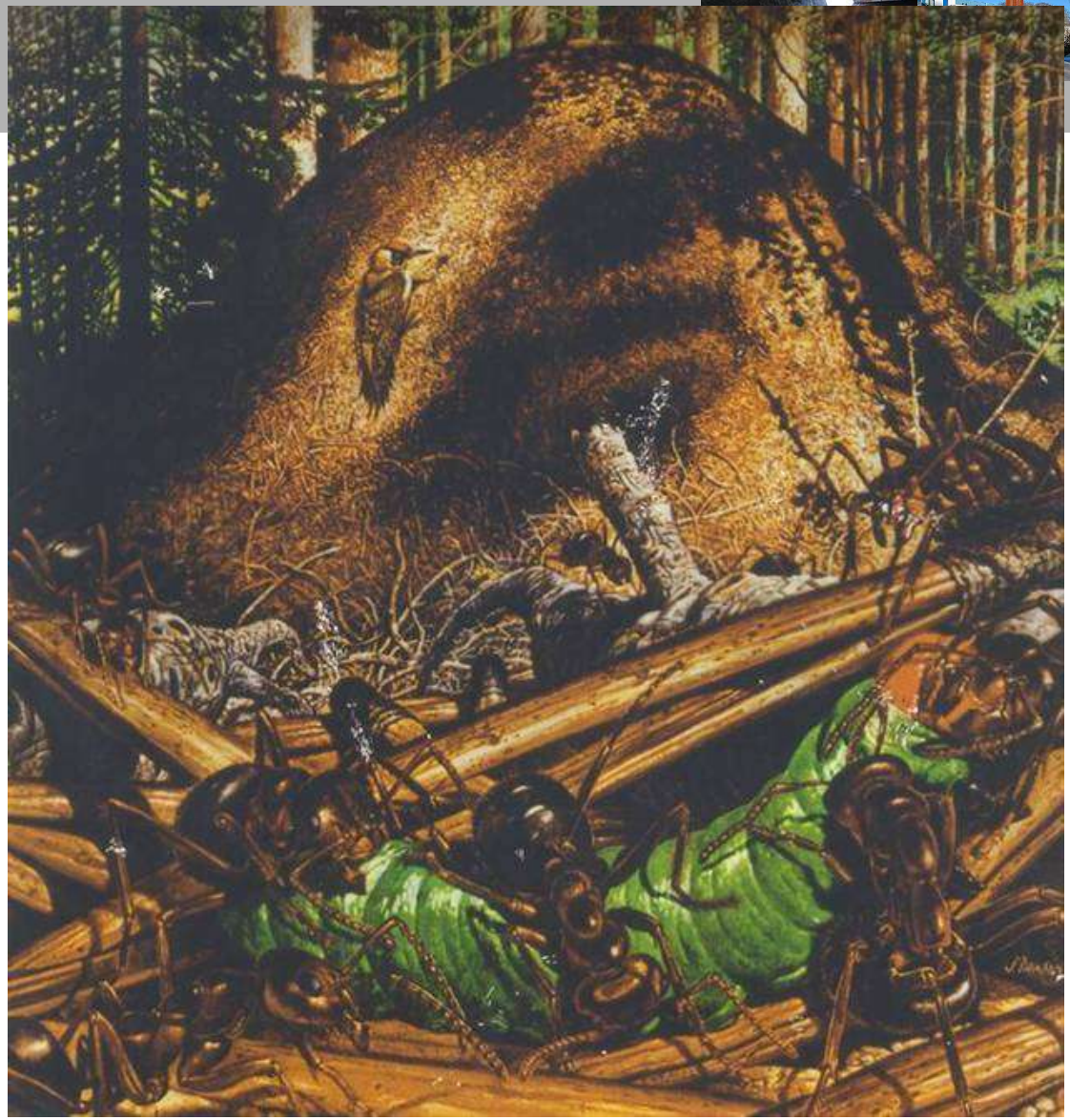
An Ant Hill



Formica polyctena in a German forest: Workers kill a sawfly larva (diprion) in the forground.

Neural Nets

Connection Machine

DAI-Languages like: Oz, LO etc.

Ant-Hill

Bee-Hive

Minsky's Society Theory of Mind

Net of Computer

XPS

Contract Net

DVMT

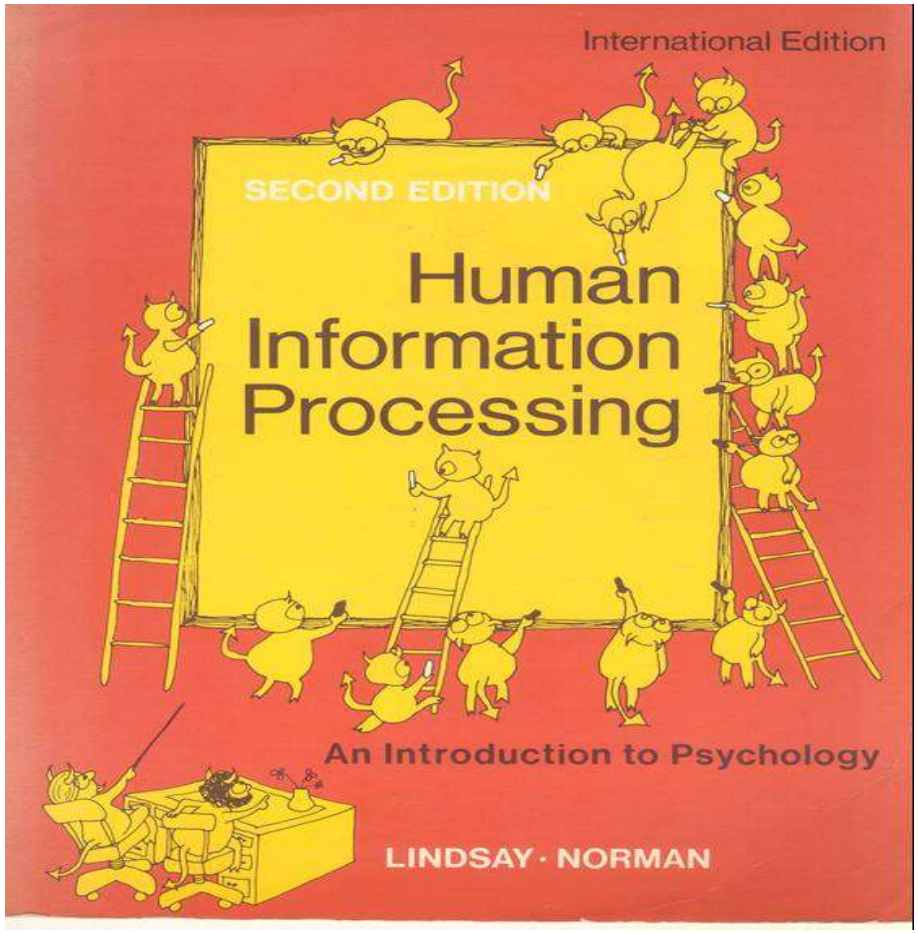
Society of Actors

Human Society & Info-bahn

DAI = Distributed Artificial Intelligence

Agent = cognitive entity with problem solving capacity

Cognitive Science



Cognitive Science

- Teaching in Saarbrücken:
- Main Research Centres in Germany
- Main Research Centres Internationally: