

# Chapter 18. Consulting Systems

The Quest for Artificial Intelligence, Nilsson, N. J., 2009.

## Lecture Notes on Artificial Intelligence

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# Overview of Chapter 18

- Computer-based consultants are systems that incorporate specialized bodies of knowledge and make this knowledge conveniently available to users who are not experts.
- The first expert systems were created in the 1970s and then proliferated in the 1980s.
  - MYCIN
  - PROSPECTOR
  - Others

## Chapter 18. Consulting Systems

# 18.1 The SRI Computer-Based Consultant

# Computer-Based Consultant (CBC)

- A computer system can reduce expenditures for equipment maintenance, repair, and training, and lessen the need for utilizing scarce human experts.
- Eg. An apprentice repair person would be given advice about how to take apart and reassemble a small air compressor.

## A Sample of interaction with the system

System: Please assemble air compressor.

Apprentice: How?

S: Install pump.

A: OK.

S: Install pump brace

A: How?

S: Connect pump brace to pump

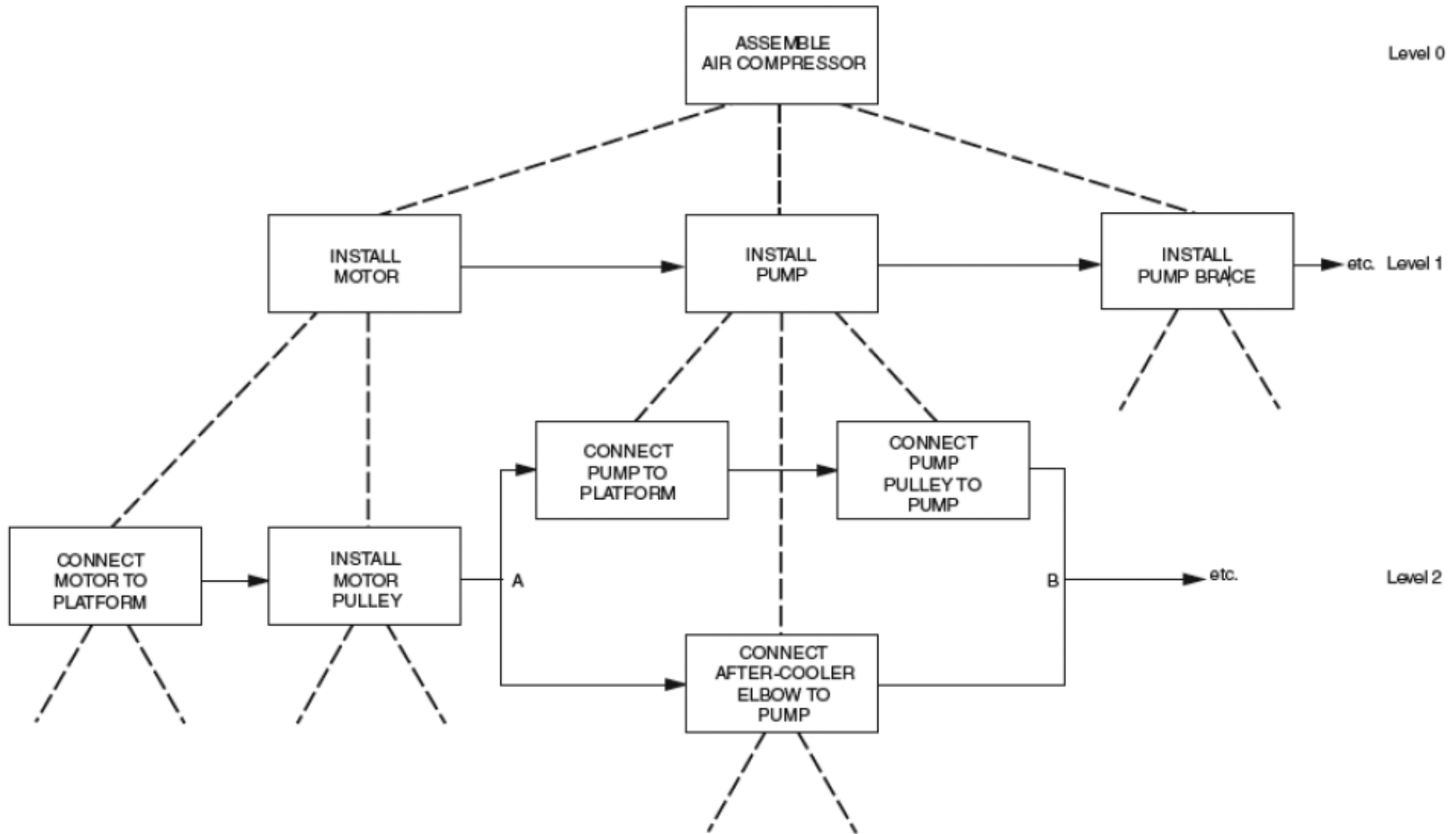
A: OK.

S: Connect pump brace to belt-housing frame.



Proposed arrangement for helping an apprentice. (Used with permission of SRI International)

# Part of a procedure net for assembling an air compressor



## Chapter 18. Consulting Systems

# 18.2 Expert Systems

# 18.2.1 MYCIN

- Shortliffe, Buchanan, and Cohen conceived the idea of building a computer program, MYCIN, that would consult with physicians about bacterial infections and therapy.
- To represent expert knowledge, MYCIN used IF-THEN rules.

One example of MYCIN rules

RULE036

PREMISE: (\$AND (SAME CNTXT GRAM GRAMNEG)  
(SAME CNTXTM MORPH ROD)  
(SAME CNTXT AIR ANAEROBIC))

ACTION: (CONCLUDE CNTXT IDENTITY BACTEROIDES TALLY 0.6)

IF: 1) The gram stain of the organism is gramneg, and  
2) The morphology of the organism is rod, and  
3) The aerobicity of the organism is anaerobic

THEN: There is suggestive evidence (0.6) that the identity of the organism is bacteroides

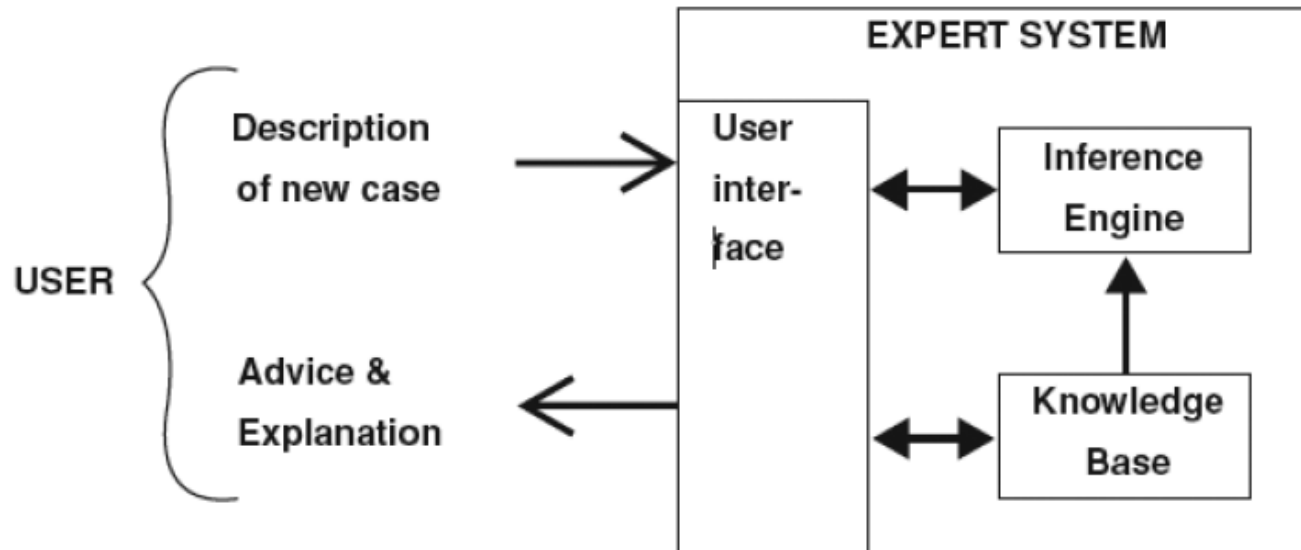


Bruce Buchanan and Ted Shortliffe



# 18.2.1 MYCIN

- One of MYCIN's innovations was that its reasoning process (using the rules) was quite separate from its medical knowledge (the rules themselves).
- This separation suggests that one could construct expert systems for other applications simply by replacing the medical knowledge with some other knowledge base without having to change the inference engine.



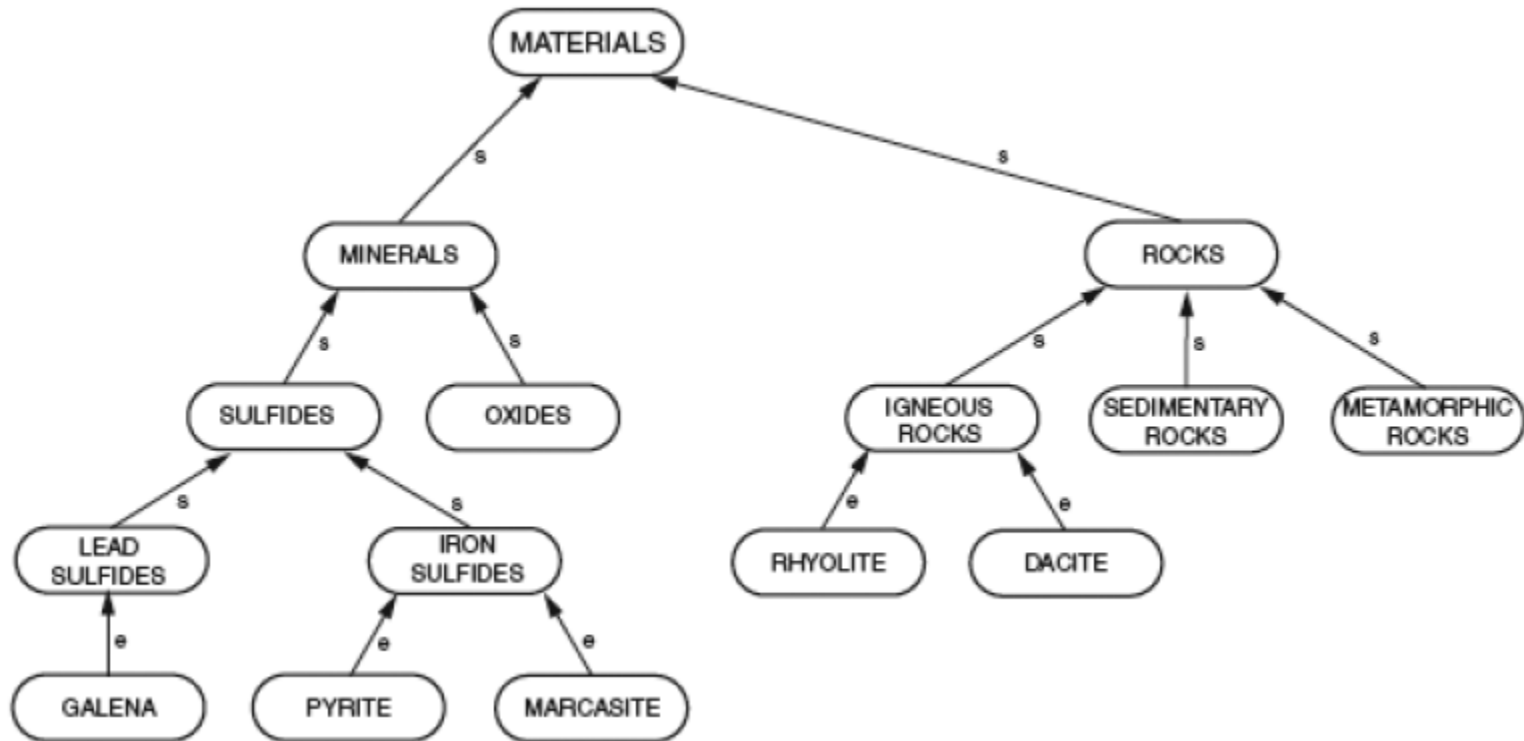
The structure of a MYCIN-style expert system

# 18.2.2 PROSPECTOR

- Peter Hart and Richard Duda developed PROSPECTOR expert systems for consultation about mineral deposits.
- PROSPECTOR used rules to make inferences and to guide the consultation process.
  - Examples
    - Rule 3: “Barite overlying sulfides suggests the possible presence of a massive sulfide deposit.”
    - Rule 22: “Rocks with crystal-shaped cavities suggest the presence of sulfides.”

# 18.2.2 PROSPECTOR

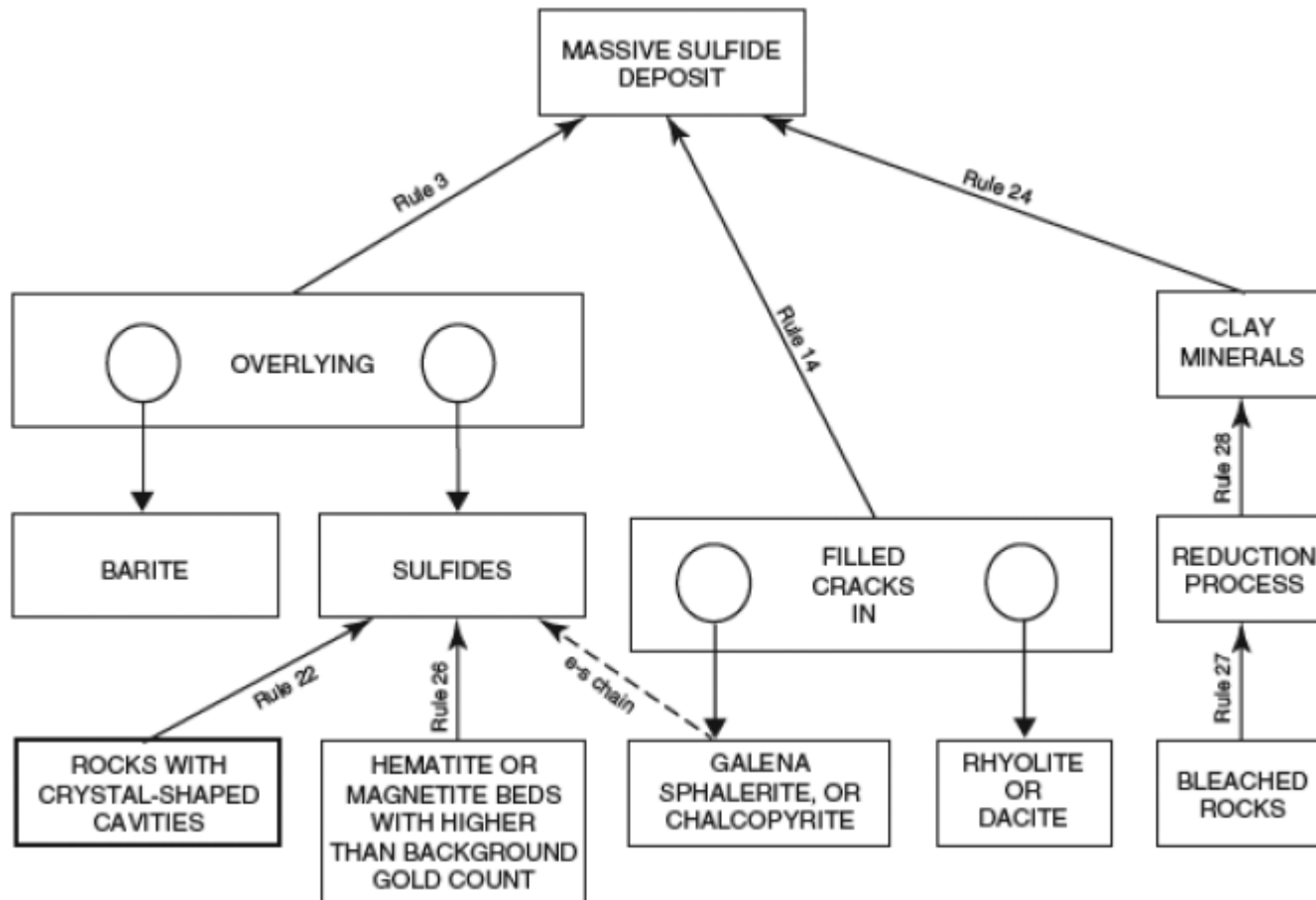
- Semantic networks were also used to represent the taxonomic knowledge.



A partial geologic taxonomy

# 18.2.2 PROSPECTOR

- The rules could be linked together in what was called an “inference network.”



Simplified version of a PROSPECTOR inference network

# 18.2.2 PROSPECTOR



Some of the Mount Tolman input maps

# 18.2.2 PROSPECTOR



Favorability maps

# 18.2.3 Other Expert Systems

## ■ INTERNIST-1

- Diagnosis programs contained expertise about internal medicine
- Part of the knowledge was represented in a kind of semantic network or taxonomy of disease states

## ■ CASNET

- In networks, inference rules linked observations, patho-physiological states, diagnostic states, and treatment states.

## ■ XCON (eXpert CONfigurer)

- Rule-based system
- Assist in the ordering and configuring of DEC's VAX computer systems

# 18.2.3 Other Expert Systems

- DELTA (Diesel Electric Locomotive Troubleshooting Aid)
  - A prototype system to assist railroad personnel in the maintenance of GE's diesel-electric locomotives.
- JETA (Jet Engine Troubleshooting Assistane)
  - The knowledge about jet engines and their possilbe faults and symptoms are encoded.
- CCH-ES
  - For credic analysis
  - It contained approximately 800 rules and could handle online transactions when CCH customers called in for service or when analysts wanted to review cases.



# 18.2.4 Expert Companies

## ■ Teknowledge

- Organized by a group of Stanford faculty and researchers
- Used EMYCIN as its basic technology

## ■ Syntelligence

- Founded by Peter Hart and Richard Duda

## ■ In business application

- Some developers concentrated on systems for acquiring and deploying “business rules”.
- Expert-system inference engines metamorphosed into business rule engines (BREs).
- Eg. RulesPower Inc. (founded in 2002)