Rule Systems

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Reading

- Rules Systems: 427-459
What does a Rules System Look Like?

Rules

- IF ammo < 10 THEN...
- IF healthy THEN...
- ...
- ...
- ...

(Arbitrator)

Database

- Ammo = 4
- Healthy
- Enemy-sighted
What does a Rules System Look Like?

Expert system

Inference engine

Knowledge base

User interface

Answer

Teach-ICT.com
What does a Rules System Look Like?

Coriosolite staters (coins)

http://pasttimesandpresnttensions.blogspot.com/2013/10/an-example-of-transdisciplinarity_3.html
Dendral

• First expert system

• Project began at Stanford in mid 1960's, and is still being used.

• Domain: Organic chemistry - mass spectrometry

• Task: identify molecular structure of unknown compounds from mass spectra data

• Input: Histogram giving mass number/intensity pairs

• Output: Description of structure of the compound

• Architecture: plan-generate-test with constrained heuristic search

• Tools: production rules implemented in Lisp

• Results: "Discovery" of knowledge engineering. Many published results.

MACSYMA

- Developed at MIT since 1968 onwards
- Domain: high-performance symbolic math (algebra, calculus, differential equations,...)
- Task: carry out complex mathematical derivations
- Input: formulae and commands (interactive)
- Output: Solutions to tough problems
- Method: Brute force (expert techniques are encoded as algorithm)
- Architecture: programmed in Lisp (300,000 lines of code)
- Results: Widely used, powerful system.
- Newest version: Maxima
  - Free! Open source.
  - works on Windows, linux, MacOS
  - maxima.sourceforge.net

INTERNIST/CADUCEUS

• Developed at U of Pittsburgh in early 1970's thru mid 80's
• Domain: diagnostic aid for all of internal medicine
• Task: medical diagnosis given interactive input
• Input: Answers to interactive queries
• Output: ordered set of diagnoses
• Architecture: forward chaining with "scores" for diseases
• Tools: programmed in Lisp
• Results: ambitious project; inspired other systems

Prospector

• Developed at SRI international in late 1970's
• Domain: exploratory geology
• Task: evaluate geological sites
• Input: geological survey data
• Output: maps and site evaluations
• Architecture: rule-like semantic net with uncertainty
• Tools: programmed in LISP, and is a descendant of MYCIN
• Results: In one blind test, the program identified a previously undiscovered site, thus showing commercial viability of expert systems.

Puff

- Developed at Stanford in 1979
- Domain: Diagnosis of obstructive airway diseases using MYCIN's inference engine and a new knowledge base
- Task: Take data from instruments and dialog, and diagnose type and severity of disease
- Input: instruments, queries
- Output: Written report for physician to review and annotate
- Architecture: rule-based, exhaustive backward chaining with uncertainty
- Tools: EMYCIN (Empty MYCIN)
- Results: Reports correct 86% of the time. A 55-rule system is in daily use, running in Basic!

XCON

• Originally called R1, developed at Carnegie Mellon and DEC in late 70's

• Domain: configure computer hardware

• Task: configure VAX systems by projecting the need for subassemblies given a high-level description of the system

• Input: Vax system description

• Output: list of parts, accessories, and a plan for assembly

• Architecture: forward-chained, rule-based, with almost no backtracking

• Tools: OPS5, a production system tool

• Results: Used by DEC and performed better than previous experts (since fired)
  - by 1986, processed total of 80,000 orders with 95-98% accuracy
  - saved DEC $25 million a year

Winter Cometh

http://gameofthrones.wikia.com/wiki/The_Wall?file=The_Wall.jpg
Meanwhile, in games...

Simple Rules, Fast Execution

Captain’s health is 51
Johnson’s health is 38
Sale’s health is 42
Whisker’s health is 15
Radio is held by Whisker
Meanwhile, in games...

Shared database of facts

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Meanwhile, in games...

Little to no inference.

Always forward chaining.

Emphasis on speed.

Overall, K.I.S.S.

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http://www.kissonline.com/
Rule Arbitration

First Applicable

Least Recently Used

Random Rule

Most Specific Condition

Dynamic Priority
  how important am I now?
Unification

Friends(Doug, x) and HighRomance(x, Buzz) then Jealous(Doug, Buzz)

Rule is checked against set of all possible character bindings.

Rule is true for all bindings that match.
Tic-Tac-Toe

- Database: (row col me|them|nothing)
  - For each row
- Rule example:
  - (2 2 them) (1 2 nothing) then (1 2 me)
DIY: Author Rules

Orc vs Elf

- Orc - Health: 120, max energy: 9
  - **Block**: 1 energy, take 5 damage if attacked
  - **Chop**: 2 energy, deal 10 Damage
  - **Smash Chest**: 6 energy, deal 40 damage

- Elf - Health: 100, max energy 12
  - **Parry**: 1 energy, take 5 damage if attacked
  - **Slice**: 2 energy, deal 10 damage
  - **Blade Dance**: 6 energy, deal 40 damage

- +2 energy at end of turn
- Start with max energy.