Knowledge-Based Systems

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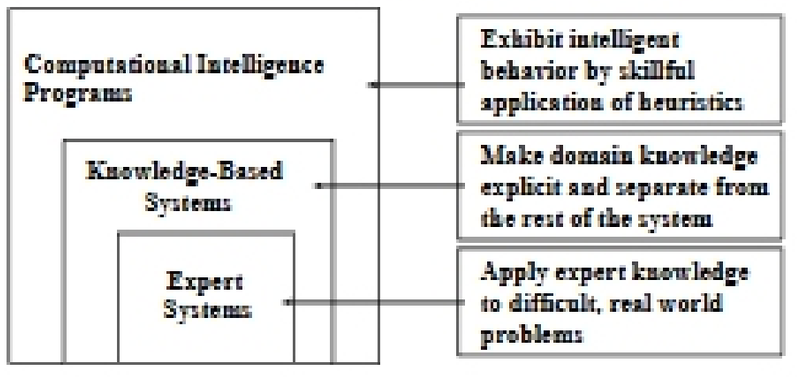
Outline 1

- INTRODUCTION
- KNOWLEDGE REPRESENTATION
  - First-Order Logic
  - Production Rules
  - Frames
  - Semantic Networks
- INFERENCE ENGINE
  - Basic Reasoning Strategies
  - Uncertainty in Rule Bases
  - Other Search Strategies

Outline 2

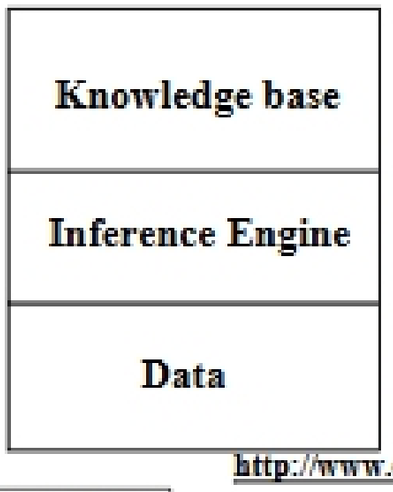
- KNOWLEDGE ACQUISITION
- KNOWLEDGE CONSISTENCY
  - Grouping Rules with Simple Action Clauses
  - Inference Anomalies in Rule Bases
- SUMMARY

Expert Systems, Knowledge-Based Systems, and CI



CI = Computational Intelligence

Expert System

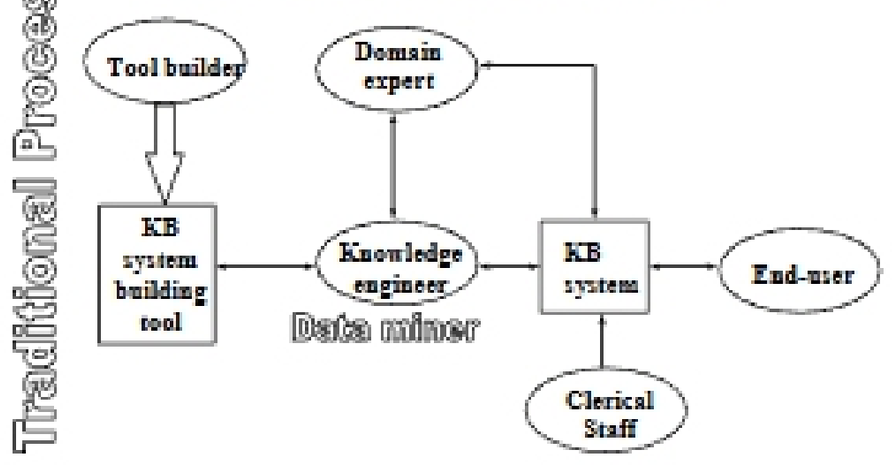


Expert system = Structured computer program

http://www.ez-xpert.com/

http://www.ez-xpert.com/samples.html

Development of KB Systems



Selecting the right application is important!

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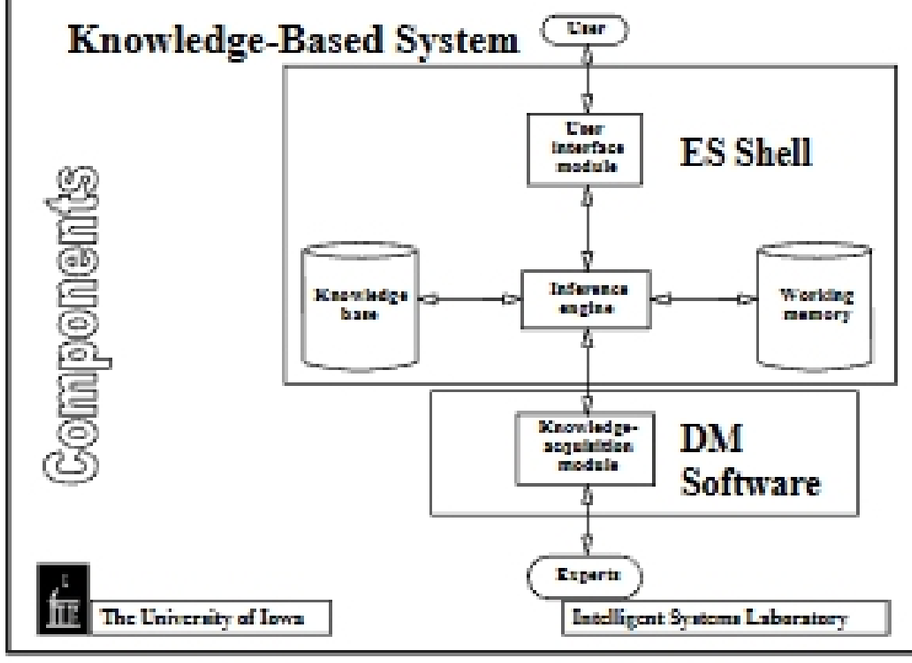
Knowledge-Based System



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Knowledge Representation Methods

- First-order logic
- Production rules
  (including structured production rules)
- Frames
- Semantic networks

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Production Rules

IF (conditions)
THEN (conclusions)

EXAMPLE

IF part Pi is to be dispatched to machine Ma that is occupied by another part Pj

THEN check availability of an alternative machine Mb

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Advantages of Production Rules

Simplicity

- The use of a rule can be easily explained to the system user
- Developers and users can modify some rules without breaking the entire system
- New knowledge can be incorporated into the system simply by adding new rules without concern of how they fit into the overall knowledge base

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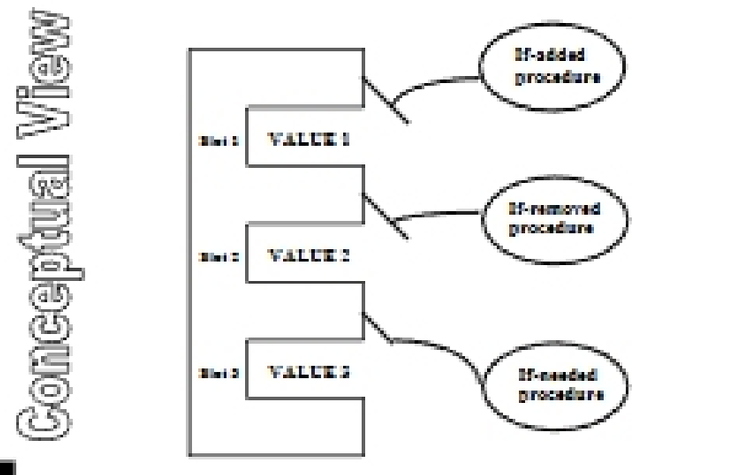
Frames "Objects"



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A frame is viewed here as a nested association list with a number of levels of embedding:

```
(Frame
        (slot  (facet  (datum (label message . . . ) )
                       (datum . . . ) . . . )
               (facet  . . . ) . . . )
               . . . )
        (slot  . . . )
```

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Frame

Example

```
(Freeze_MPS
        (AKO ($VALUE (Dampening_mechanism)))
        (Method_to_lot_size_MPS ($VALUE (Wagner_Whitin_method)))
        (Planning_horizon_length ($VALUE (N (unit: k multiple of
                natural cycle length))))
        (Replanning_frequency ($VALUE (R (unit: the number of
                periods between replanning cycle)))))
        (Freeze_interval ($VALUE (P (unit: the proportion of the overall
                planning horizon n that remains fixed in each
                planning cycle))))
        (Planning_information ($VALUE (Order_based))))
```

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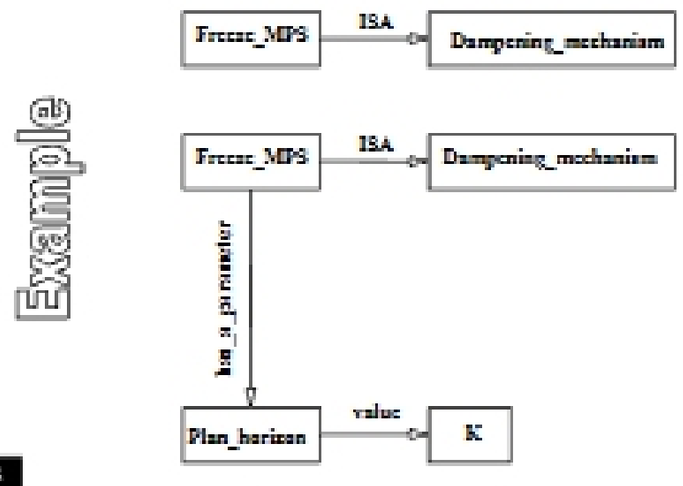
Semantic Network

Example



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Basic Reasoning Strategies

- Forward reasoning
- Backward reasoning

Example

Rules Base:
R1: IF a AND b THEN Goal
R2: IF c AND d THEN a
R3: IF e THEN c

http://www.exsys.com/

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R1: IF a AND b THEN Goal

IF subassembly a AND subassembly b
are available
THEN initiate the assembly process

R2: IF c AND d THEN a

IF part c AND part d have been assembled
THEN subassembly a is available

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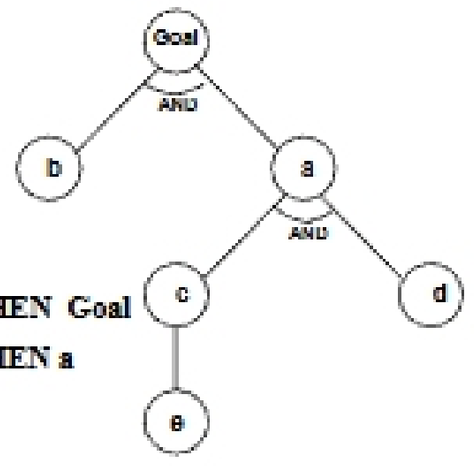
Inference (And/OR) tree



Rules: R1: IF a AND b THEN Goal
R2: IF c AND d THEN a
R3: IF e THEN c

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