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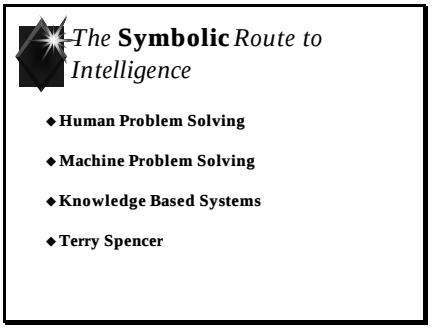

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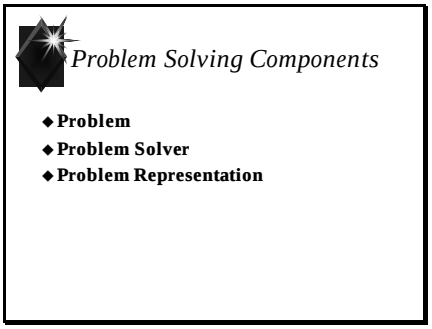

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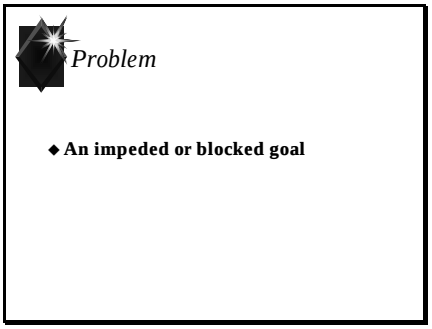


Slide 4

Problem solving

- **Attempting to overcome the obstacles**
- **Relies on recognition**
- **Relies on inference**

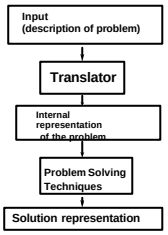
Slide 5

Reasoning and Problem Solving

- **Reasoning**
- **What follows on from this?**
- **Deriving new facts from those already known**

Slide 6

The Problem Solving process(Simon)



Slide 7

Simons Model

Interaction between the problem and the problem Solver

- **Problems exists in a** *Task Environment* **(Problem properties)**
- **Abstraction translates the 'external' problem to an internal one**
- **The internal model is based upon** symbols
- **Collectively these symbol structures are the** problem space
- *Only what's internal can be used to solve the problem*

Slide 8

Recap Problem solving

- **State the Goal**
- **Attempt to reach that Goal**

Slide 9

The Problem Space(Representation)

- States
  - Initial
  - Intermediate
  - Goal
- Concepts **describing the situation**

Slide 10

Problem Solution

- **Solving means**
- *Searching* **the internal problem space**
- **I.e.** *A systematic exploration of the range of possibilities*

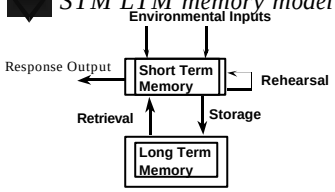
Slide 11

A memory Model for Problem Solving

- **There exist** *constants* **in human problem solving**
- **Expressed as a** *Memory Model*
- **Long Term Memory(**LTM**)**
- **Short Term Memory(**STM**)**
- **These store** *Symbols*

Slide 12

STM LTM memory model



Slide 13

Intelligence: The physical symbol hypothesis

- **The** necessary **and** sufficient **condition for a** physical **system to exhibit** general intelligent action **is that it be a** physical symbol system

Slide 14

The symbolic route to Achieving intelligent behaviour

- Necessary
- ***An analysis of any system exhibiting general intelligence would show that the system is a physical symbol system***
- Sufficient
- ***Any physical symbol system of sufficient complexity could be organised to exhibit general intelligence***

Slide 15

General Intelligent action

- **The same order of intelligent and purposeful activity** that we see in people **- planning speaking reading books problem solving**

Slide 16

A Physical Symbol System

- **Is a** machine **such as a computer that operates on symbol structures**
- **It can** read recognise **and** write **symbols**
- A symbol system **creates, modifies, copies and destroys symbol expressions**

Slide 17

Consequences of the hypothesis

- **The** use of symbols **and collections of symbols(representations)** to describe the world
- **The design of** search **mechanisms**
- **Ignore medium of implementation**
- **Empirical view**
  - Understand intelligence by building working models of it
- **Symbols are** central to knowledge **systems**

Slide 18

Intelligent Knowledge Based Systems IKBS

capture an enterprises intellectual capital its expertise and experience and distributes such a resource throughout the company

Slide 19

IKBS

- **Data Processing**
  - **Captures Magnifies and distributes access to *Arithmetic***
- **Decision Support Systems**
  - **Captures Magnifies and distributes access to *Information***
- **Knowledge based Systems**
  - **Captures Magnifies and distributes access to *Judgment***

Slide 20

Problem Solving Effectiveness

- **Recognition and reasoning encoded as symbols**

Slide 21

Symbols

- **A symbol is a name or sign which acts as a substitute for something else**
- **Concepts**
- **Objects**
- **Properties of objects**
- **Relationship between objects Fianchettoed short castle position!!**

Slide 22

Symbol processing

- **Manipulation by a machine of information and knowledge *re presented* as symbols yielding competent appropriate behaviour**

Slide 23

Knowledge

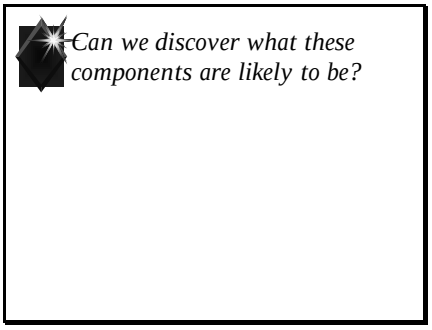
- **Acquired**
- **Elicited**
- **Re presented**
- **Implemented**

Slide 24

What then is a KBS?

- **An assembly of components connected in some principled fashion for the purpose of mimicking intelligent performance**

Slide 25



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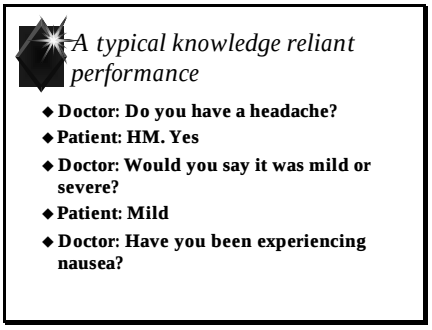

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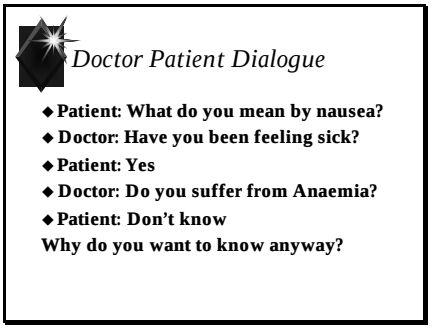

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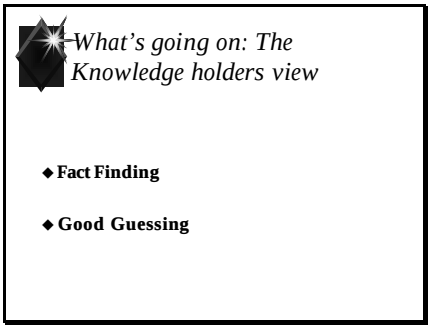

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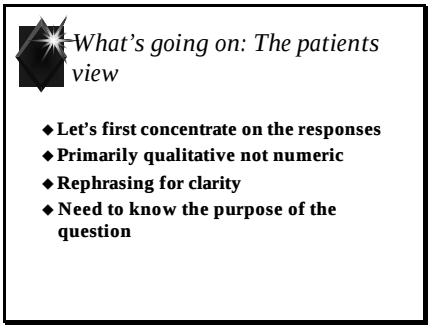

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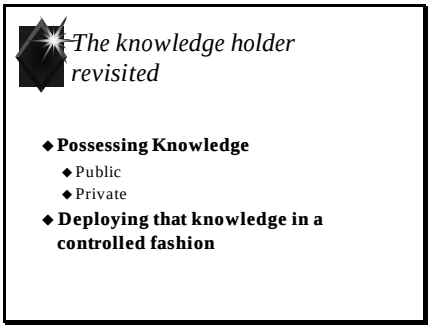


Slide 31

Knowledge representation

- **The Rule**
  - capturing a relationship between facts

Slide 32

An example diagnostic rule

IF TEMPERATURE = HIGH
AND SYMPTOM1 = COUGHING
AND SYMPTOM2 = ACHE-IN-JOINTS
THEN DIAGNOSIS = FLU

Slide 33

A more complex rule

IF A1 IS KNOWN AND
A2 IS DEFINITE AND
A3 IS THOUGHT NOT TO OCCUR AND
A4 MIGHT NOT BE THE CASE
THEN
CONCLUDE B1 WITH CONFIDENCE 0.7
AND B2 WITH CONFIDENCE 0.3

Slide 34

Heuristic

- **A rule of thumb**
- **An aid to help guide on how to proceed**
- **Does not guarantee an correct answer**

Slide 35

What then is the system to capture these needs?

- **Must be able to**
- **Handle vagueness and uncertainty**
- **Offer clarification** **HELP**
- **Explain the purpose of a question** **WHY**
- **Justify its conclusions** **HOW**

Slide 36

What then is the system to capture these needs?

It has to:

***Reason* with incomplete information**

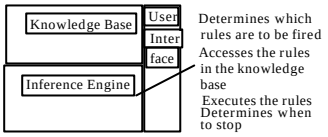
In a *controlled* fashion to give

Justifiable* conclusions based upon an *extensive body of heuristic knowledge

Slide 37

The components

- **Control the Inference Engine**



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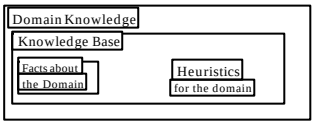
Knowledge Base Components

- **Public and Private knowledge**
- **Domain-- Specific problem area**



Slide 39

The KBS holds symbolic knowledge

- **Facts**
- **The knowledge of a field commonly agreed among practitioners**
- **Widely available in texts books lectures journals**

Slide 40

Symbolic knowledge

Heuristics

- **Experiential judgmental knowledge**
- **The art of good guessing**
- **Usually held privately**
- **Must be found and refined by knowledge miners**

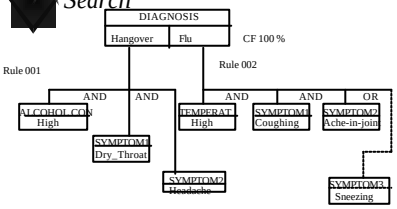
Slide 41

The shell

- **Separating knowledge from the means to apply it**

Slide 42

Search



Slide 43

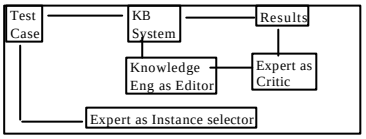
Using shells

- **Diffuse**
- **Narrow**
- **Modular**
- **Moderate**
- **Explicit**
- **Stable**

Slide 44

The KE Development Process

- **Need Knowledge holder and KE**
- **Need test cases**



Slide 45

Knowledge Engineers

- **Knowledge Elicitation describes interactive processes used to capture user needs**

Slide 46

Summary

- **Expertise is often a matter of knowing a lot about a particular domain**
- **KBS are built around such knowledge**
- **Rules are one approach to encoding knowledge**

Slide 47

KBS are characterized by

- **Separation of inference engine and knowledge base**
- **Reliance on large stores of task-specific knowledge**
- **Explicit representation of that knowledge**
- **The ability to make multiple use of that knowledge**
- **Familiar forms of reasoning**
- **The time spent selecting a problem is well worth it**
- **The important result is the Knowledge**

Slide 48

Bottlenecks

- **Knowledge acquisition**
- **Knowledge Engineer acquisition**

Slide 49

Areas of use

- **Prediction: What will happen next?**
- **Configuration: Designing objects under constraints**
- **Interpretation: What does this mean?**
- **Diagnosis: What is wrong?**
- **Instruction: This is wrong. This is what you should do**
- **Control: Combining some or all of the above**

Slide 50

Kbs's create value by

- **Capturing refining packaging distributing expertise**
- **Solving problems whose complexity (reasoning) exceeds most human ability**
- **Solving problems where the required scope of knowledge exceeds any individuals**
- **Fusing several areas of expertise**
- **Competitive edge**

Slide 51

Benefits

- **Availability**
- **Consistency**
- **Assistance**
- **Economics**
- **Archiving**

Slide 52

What about the knowledge holder?

- **Articulate**
- **Committed**
- **Co-operative**

Slide 53

Certainty Factors

- **A mechanism to represent A *suggests* B**
- **OR C AND D *tend to rule out* E**

Slide 54

Certainty Factor: Range

- **Range from -1 through 0 to + 1**
- **-1. 0 Definitely not**
- **-0.8 Almost certainly not**
- **-0.6 Probably not**
- **-0.2 to 0.2 Ignored**
- **0.3 Slight evidence**
- **0.6 Probably**
- **0.8 Almost certain**
- **1.0 Definite**

Slide 55

Certainty Factors: Conditions

- **Suppose a patient is asked about an allergy to a medicine**
- **The patient *may not be entirely sure* but if the only options available are yes or no he will choose yes**
- **Using CF's the patient *could respond* with 90 % confidence**

Slide 56

Certainty Factors: Rules

- **Suppose a rule concludes a treatment for a particular allergy**
- **Assigning a certainty factor in the rules** THEN statement **allows the treatment to be suggested with less than absolute certainty**

- **IF MUMPS** THEN **Test_Needed = Series_A** cf 90
- **IF SEASON = SUMMER** THEN **HOT** cf 80
- **IF SEASON = SUMMER** THEN **WEATHER = HOT** cf 80 **AND SCHOOL** cf - 90

Slide 57

Combining Certainty Factors(CFs):

- **CF's can be** adjusted **as more information becomes available**
- **A new CF for a value in the THEN statement is calculated using**
  - The CF of the IF statement
  - The CF of the THEN statement
  - Any previous CF for the value

Slide 58

IF certainty factor:

- **If the AND function combines IF statement clauses and the premise is true then**
  - **CF of the** IF statement **is the *minimum CF of the clauses***
- **If the OR function combines IF statement clauses and the premise is true then**
  - **CF of the** IF statement **is the *maximum CF of the clauses***

Slide 59

THEN certainty factors:

- **The CF is assigned by adding the cf value to the parameter.**
- **Note that when the conditions of the IF statement are met the appropriate CF's are *combined including the CF assigned in the rules THEN statement.***
- **Consequently**
- **If the cf of the IF statement is less than 100 the CF assigned in the THEN statement is proportionally reduced**

Slide 60

THEN certainty factors continued

- **IF CLOUDS AND MUD (Passes with CF 80 instead of 100)**
  THEN BOOTS CF 60 AND UMBRELLA
- **The assigned CF's would be**

BOOTS CF 48 (80% of 60)
UMBRELLA CF 80 (80% of 100)

Slide 61

Previous Certainty factors

- **If a value is concluded for a parameter that already has had the same value concluded**
  - The cf is adjusted to reflect the evidence provided by both conclusions
- **The cf is calculated using one of the following four equations**

Slide 62

Non Monotonic reasoning

- **Fundamental to classical logic is the belief that deduction is an adequate model of human reasoning**

Slide 63

Non Monotonicity

- **Monotonicity says that it is never necessary to withdraw any conclusions when further facts become known.**
- **If we had proved P--> R**
- **Then R will continue to be true given any additional fact C i.e., P & C --> R**

Slide 64

Non Monotonicity example

- **IF** **Engine is overheating**
- **THEN** **Switch off engine**

- **IF** **Engine is overheating AND Driving in fast lane**
- **THEN** **Switch off engine**

Slide 65

Truth Maintenance

- **If we retract some of our conclusions we also need a means of retracting any conclusions that have been drawn based on these conclusions:** *the problem of truth maintenance*

Slide 66

TMS approaches include

- Justification
- Logic based
- Assumption based (the most popular by Kleer)
- Truth Maintenance