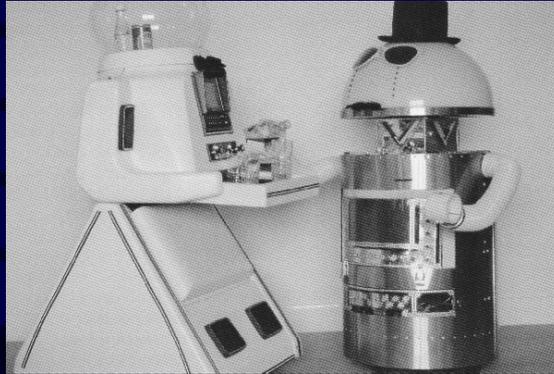


Foundations of Artificial Intelligence



Knowledge Acquisition

Knowledge Acquisition

To introduce knowledge acquisition and knowledge engineering.

To explain how knowledge is taken from a human before being stored within a machine.

To try out some of the techniques used in knowledge acquisition.

Techniques investigated will include interviewing, spider diagrams and decision trees.

Knowledge Issues

Knowledge provides power:

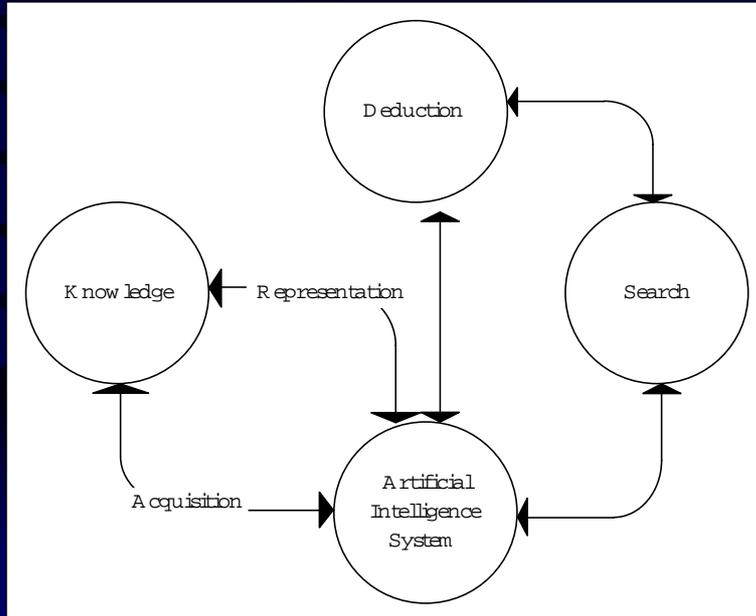
*power to inform, power to decide and
power to control.*

*In order for a knowledge based system to
provide an acceptable level of support it
must have access to this power.*

Knowledge

An **artificial intelligence** system is capable not merely of storing and manipulating data, but also of acquiring, representing, and manipulating knowledge.

Knowledge Based System



Knowledge Issues

Key issues confronting the designer of an AI system are:

- knowledge acquisition
- knowledge representation
- knowledge manipulation

Knowledge Acquisition

the transfer and transformation of potential problem-solving expertise from some knowledge source to a program

Buchanan et al. 1983

Knowledge Acquisition

Elicitation must carry out several operations, the most important of which are the following:

- Extracting the knowledge by externalising it.
- Rendering it explicit by accumulating sufficient detail to make it clear.
- Record it in a symbolic form.
- Verify it by checking the symbolic form against the original statement.

Knowledge Engineering

The field of **knowledge engineering** can be defined as the process of assessing problems, acquiring knowledge and building **knowledge based systems**.

Knowledge Engineering

Problem assessment

Data and knowledge acquisition

Bottleneck

Development of a prototype system

Development of a complete system

Evaluation and revision of the system

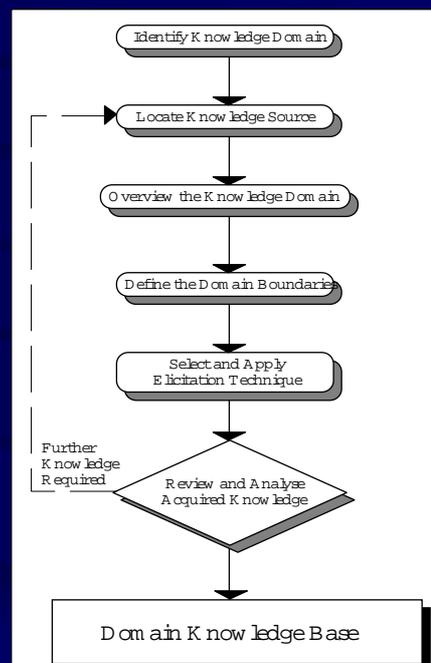
Integration and maintenance of the system

Knowledge Acquisition

End-users often have a difficult time verbalising all that goes on in performing their jobs.

Through observations and interactions in the working environment, we can identify what data, information, and knowledge are needed for end-users to perform their jobs better.

Knowledge Acquisition



Sources of Knowledge

- Expert Opinion
- Historic Data
- Codes of Practice
- Standard Engineering Procedures
- Experimental Data
- Technical Literature
 - ↳ Text Books
 - ↳ Journals
 - ↳ Manuals
 - ↳ Manufacturers Information
- Established Engineering Equations

Problems

A number of factors can complicate the acquisition process and create problems. This is particularly evident when dealing directly with experts.

Experts often have a subconscious hostility or fear to providing information.

Many experts have great difficulty in articulating knowledge.

Problems

Human knowledge is complex, unstructured and usually ill formulated.

Relating individual problem experience to abstracted rules in a systematic manner and in a rational structured form is a major difficulty.

Often the expert is so close to the problem under consideration they have difficulty in seeing it objectively.

This situation is worse when the knowledge source comprises of several experts

Stages of Acquisition

- Define task

Build-up Domain Vocabulary

Words, phrases, formulae that make up the natural language of the task.

Develop a Model of the Reasoning Involved and how it is applied.

Flowcharts and decision trees often used.

Protocol Analysis.

Paper exercise - no programming at this stage.

Iterative procedure with Experts

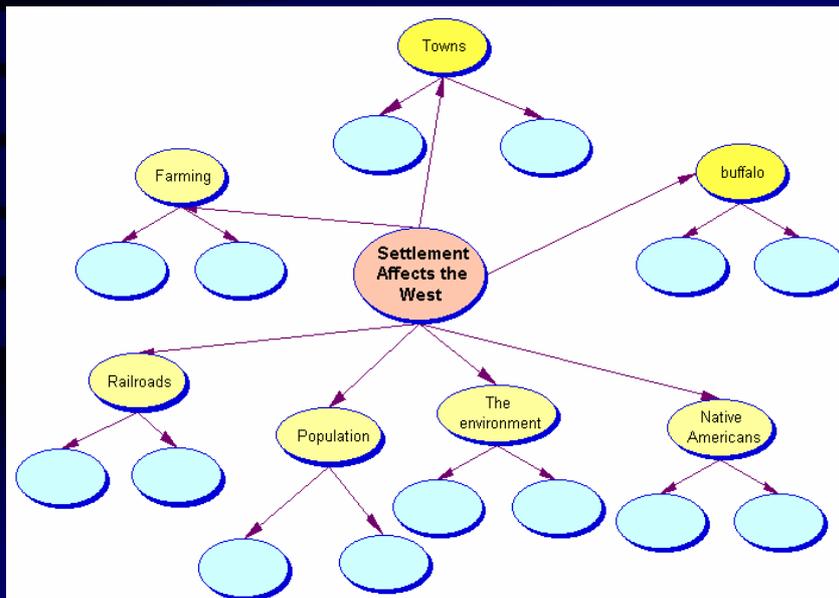
Spider Diagrams

Simple enough that the structure is self evident even to newcomers

Powerful enough to express complex structures

Flexible enough to accommodate the inevitable flow of changes and revisions

Spider Diagrams



Tutorial 1

The 'Begonia' likes bright light and survives best outdoors in natural sunlight, whereas 'Ivy' prefers dim light and is probably better indoors lit by a light bulb.

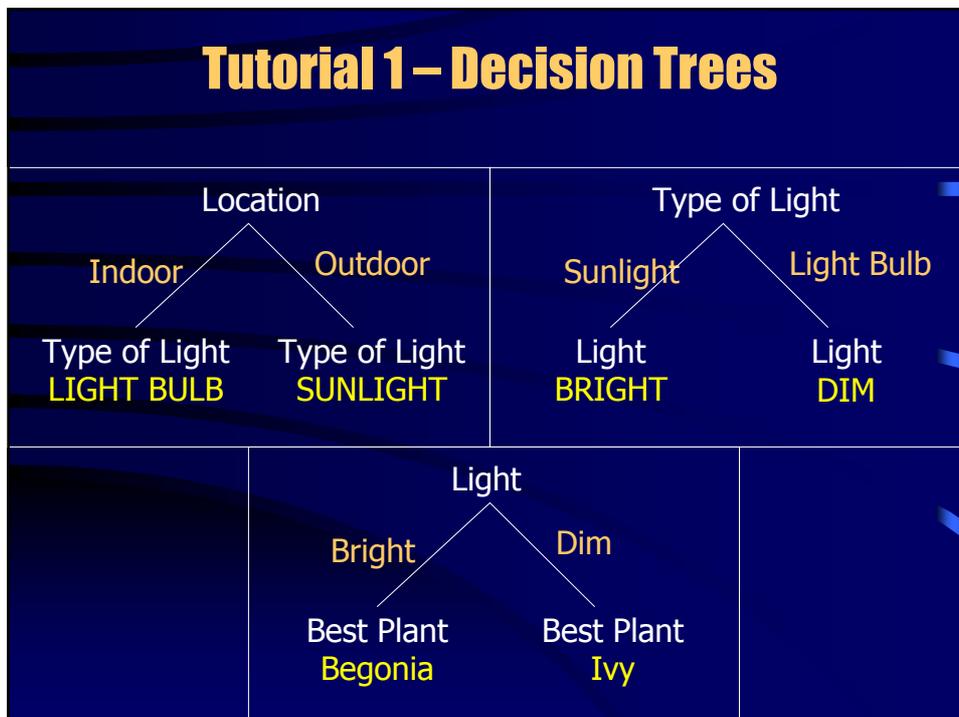
Tutorial 1 – Spider Diagram



Tutorial 1 – Domain Dictionary

Light : Bright or Dim
Type of Light : Sunlight or Light Bulb
Location : Indoor or Outdoor

Tutorial 1 – Decision Trees



Exam Question 1999

In a food processing plant the chief technician, Alf, is due to retire. He is the only one who understands how all the equipment works and how to repair it when faults occur. It is decided to attempt to capture the knowledge of this expert into a knowledge-based system. You are hired as the knowledge engineer, responsible for capturing this knowledge. You decide to approach the problem one step at a time, taking each piece of equipment in the plant in turn. Part of an interview session is shown below:

Exam Question 1999

YOU: "How do you set about fixing a problem with the mixer?"

ALF: "Well, the mixers are usually OK, so always check the feed pump first. If the feed coming in from the pump is OK, then check the mixer. Check the mixer temperature, if it's above 20C then the cooling fan has gone and needs replacing. If it's not that check the blades they may be broken and need replacing. If they're OK it has to be the mixer output that is clogged, so check that. If the output is not clogged then it is beyond me, call in the manufacturer's repair team."

YOU: "What happens if the problem is in the pump?"

ALF: "If the problem is in the pump, check the fuel line first – clear them if they are blocked that will fix it. If not check the pressure, if it is low replace the sealing washers on the pump. If none of this works then the feed mix coming through the pump is wrong and needs changing."

Exam Question 1999

Create an expert system domain dictionary for the above problem. (5 marks)

Pump Feed OK	Yes, No
Problem Machine	Mixer, Pump
Fuel Lines Clear	Yes, No
Pump Pressure	OK, Not OK
Temperature	Numeric value
Blades	OK, Not OK
Output	Blocked, Not Blocked
Problem Solution	Clear Fuel Lines, Change Pump Washers, Alter Feed Mix, Replace Cooling Fan, Replace Blades, Clear Output Nozzle, Call Maintenance Team.

Exam Question 1999

Draw a spider diagram for the above problem. (2 marks)

Any diagram linking the concepts from the left column of the domain dictionary above.

Build decision tree (s) for the above system. (8 marks)

Exam Question 1999

