LECTURE 6: Knowledge Acquisition and Manipulation

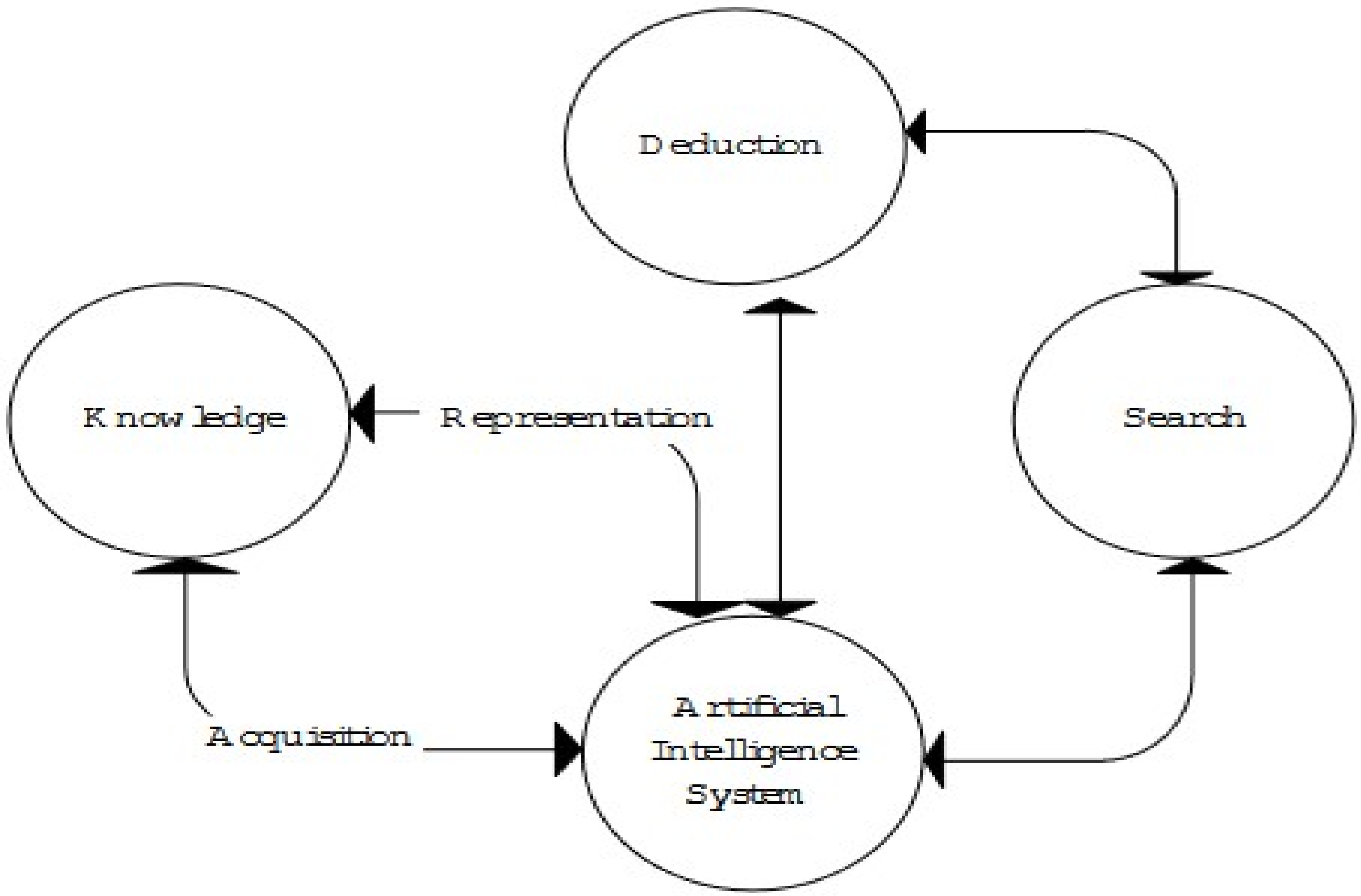
Knowledge Acquisition:

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

An AI system is capable of:

- Acquiring,
- Representing,
- Manipulating knowledge

Knowledge Based System



Phases of knowledge acquisition

- Knowledge elicitation

-The knowledge is extracted from the expert or source

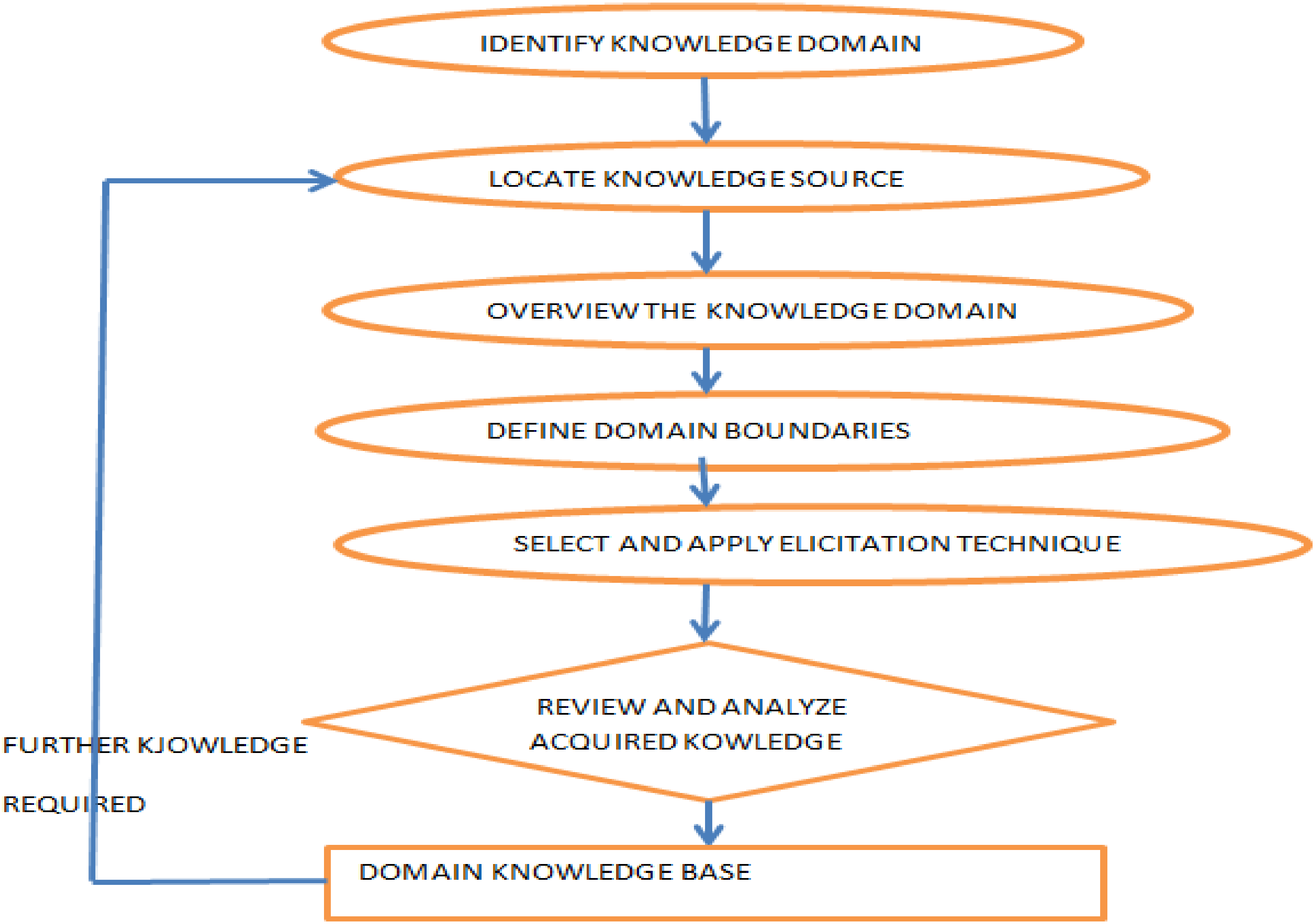
- Knowledge representation

-The knowledge is put into the expert system in a form which system can manipulate

Techniques for Knowledge Elicitation

1) The unstructured interview;
2) The structured interview;
3)Focused discussion,
4) Critiquing
5) Role reversal and
6) Think aloud.

Knowledge Acquisition steps



Sources of Knowledge

Expert Opinion

•Historic Data

•Codes of Practice

•Standard Engineering Procedures

•Experimental Data

•Technical Literature, Text , Journals

Manuals

Manufacturers Information

•Established Engineering Equations

Problems associated with acquiring knowledge

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 associated with acquiring knowledge

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

Complete 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.

Iterative procedure with Experts

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:

Interview session with the expert

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.

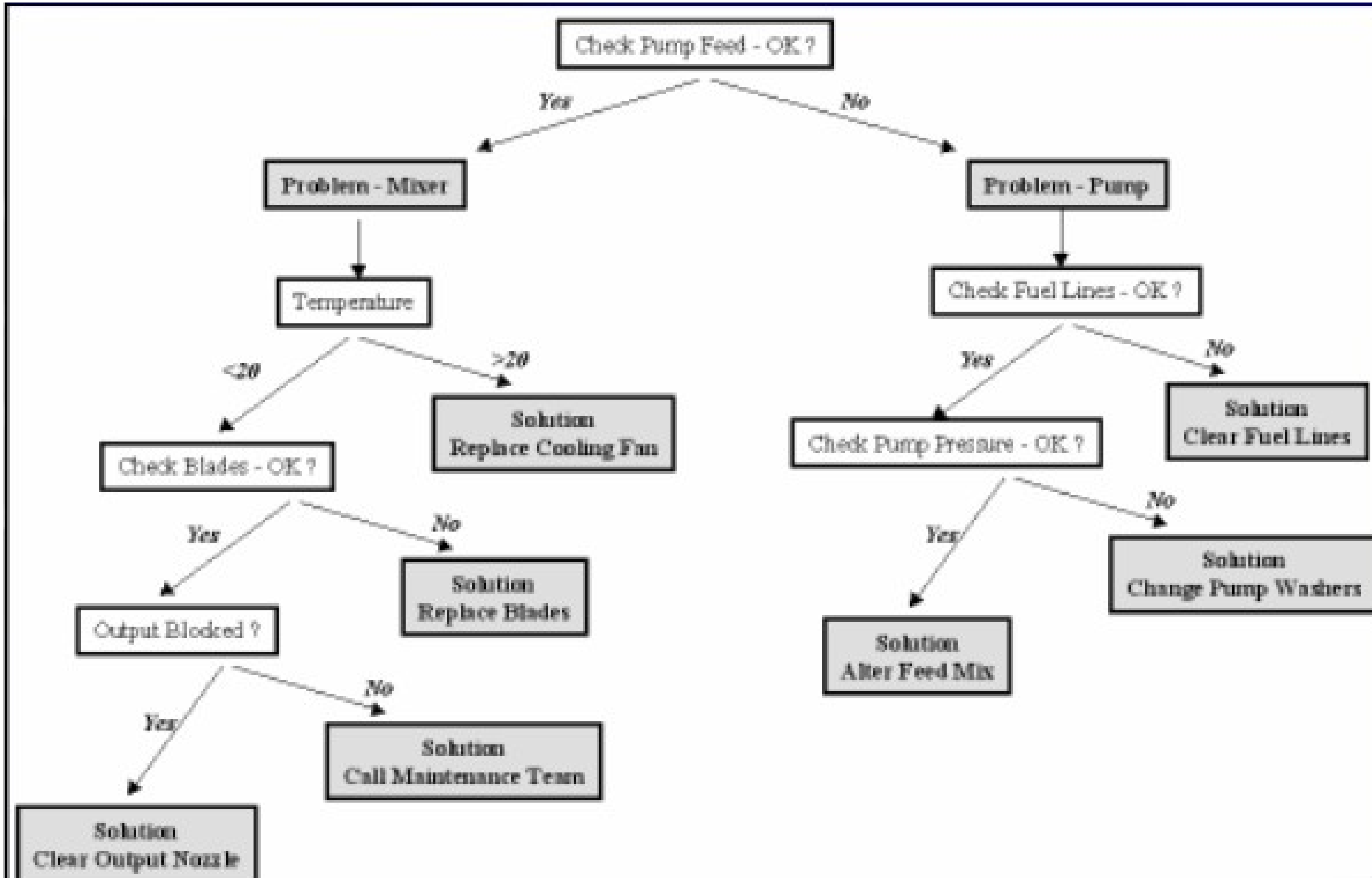
”YOU: “What happens if the problem is in the pump?”

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

Create an expert system domain dictionary for the above problem.

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.

Build a decision tree (s) for the above system



STATE SPACE SEARCH

Most AI is about Search

Search can be applied to many problems such as:

- Solution to a puzzle
- Shortest path on a map
- Proof of a theorem
- Sequence of moves to win a game
- Sequence of moves to achieve a desired goal

State space

of the “state space” is a set of states of the problem which we can get by applying operators to a state of the problem to get a new state.

State space of the problem to get a new state

State Space can be Huge(Combinatorial explosion) examples:

Chess game 10^{120} (in an average length game)

Checkers 10^{40} Eight puzzle:181,440

The Search Problem

Consider given the following:

Given:

- An initial state
- A set of operators(actions the agent can take)
- A set of goal states
- (Optional) a path cost function

Find a sequence of operators that leads from the initial state to the goal state

The 8-Puzzle

Initial State

1	2	3
	4	6
7	5	8

Goal State

1	2	3
4	5	6
7	8	

Rules to be used to move from initial state to goal state is the blank space and the arrows:

↑ Up → Right

↓ Down ← Left

Rules to be used to move from Initial State to Goal State

Rules to be used to move from initial state to goal state is the blank space and the arrows:

↑ Up → Right

↓ Down ← Left

Rules

The rules are: space up (↑), space down(↓), space left (←) and space right(→).

The number of steps needed to move from initial state to goal state can be calculated by looking at each square position in initial state and comparing with its position in goal state.

Consider the Initial and Goal states:

Calculating the number of steps

1	2	3
	4	6
7	5	8

1	2	3
4	5	6
7	8	

Calculating the number of steps

Consider tile number 1 position in initial state and tile number 1 in goal state. The positions are the same in both cases so movement = 0

Compare tile number 2 position in initial state and its position in goal state. Tile number 2 does not move. We do the same for the remaining tile numbers:

Calculating the number of steps

Example:

Initial State No. of steps to Goal State

Tile No. 1 0 Tile No. 7 0

Tile No. 2 0 Tile No.8 1

Tile No. 3 0

Tile No. 4 1

Tile No. 5 1

Tile No. 6 0

Total number of steps needed to move from initial state to goal state = 1+1+1 = 3

Illustration

1	2	3
	4	6
7	5	8

1	2	3
4	5	6
7	8	

Illustration

Step 1: Blank Right (space) →

1	2	3
4		6
7	5	8

Step 2: Blank Down (↓)

1	2	3
4	5	6
7		8

Illustration

Step 3: Blank right (→)

1	2	3
4	5	6
7	8	