KNOWLEDGE ACQUSITION

Table of Content

- Introduction
- Scopes of knowledge
- Knowledge Acquisition
- Problems in Knowledge Acquisition
- Knowledge Acquisition Techniques
- Structuring Knowledge Graphically

Introduction

- Where success is concerned, people are not measured in inches, or pounds, or college degrees, or family background; they are measured by the size of their thinking
  - J.M. Cupello
- Knowing ignorance is strength; ignoring knowledge is sickness
  - Lao Tsu

Introduction

- Knowledge is understanding gain through experience.
- It is “know how” or a familiarity with the way to do something that enables a person to perform task.
- It may also be accumulation of facts, procedural rules, or heuristics

Introduction

- Knowledge is not the same as information
- For example:
  - “Today’s temperature is expected to exceed 100 degrees” is information
  - “There is 80% chance that people with heart trouble will faint from exhaustion when temperature rises over 100 degrees” is knowledge

Introduction

Facts

- A statement of some element of truth about a subject matter or a domain, for example:
  - That milk is white
  - Sun rises in the east and sets in the west

Introduction

Procedural Rules

- A rule that describes a sequence of relation relative to the domain, for example:
  - Always check the traffic when entering a freeway
  - If the gas gauge shows quarterly-full or less, then look for a petrol station

Introduction

Heuristics

- A rule of thumb based on years of experience, for example:
  - If a person drives more than 10 km above the speed limit, then that person is not likely to be stopped for speeding

Scopes of knowledge

- Sources of Knowledge
- Levels of Knowledge
- Types of Knowledge

Scopes of knowledge

Sources of Knowledge

- Sources will includes books, films, computer databases, pictures, maps, flow diagrams, stories, case studies or observed behaviour.
- Divided into 2:
  - **Documented:** books, flow diagrams etc
  - **Undocumented:** Resides in people mind

Scopes of knowledge

Levels of Knowledge

- Shallow knowledge:
  - Representation of only surface level information that can be used to deal with very specific situations.
- Deep Knowledge
  - Human problem solving is based on deep knowledge of a situation. It that can be applied to different tasks and different situations.

Scopes of knowledge

Types of Knowledge

- Procedural knowledge
- Declarative knowledge
- Meta-Knowledge
- Heuristics Knowledge
- Structural Knowledge

Scopes of knowledge

Types of Knowledge

Procedural knowledge

- Describe how to solve a problem.
- Provides direction on how to do something.
- May include explanation and how to make inference.
- Consider deep knowledge.

Scopes of knowledge

Types of Knowledge

Declarative knowledge

- Describe what is known about a problem. It tells us facts-what things are. Express in factual statement such as ‘Smoking can cause cancer’, ‘Don’t drink and drive’.
- Consider shallow information that expert can verbalize.
- Important in the initial stage of knowledge acquisition.

Scopes of knowledge

Types of Knowledge

Meta-Knowledge

- Describe knowledge about another knowledge.
- Used to pick other knowledge that is best suited for a solving a problem.
- Expert use this type of knowledge to enhance efficiency of problem solving by directing their reasoning into the most promising areas.

Scopes of knowledge

Types of Knowledge

Heuristics Knowledge

- Describe rules of thumb that guides the reasoning process.
- Often called shallow knowledge compile by expert through experience.

Types of knowledge

Types of Knowledge

Structural Knowledge

- Describe an expert overall mental model of the problem.
- The expert mental model of concepts, sub-concepts, and objects; and how are they related.

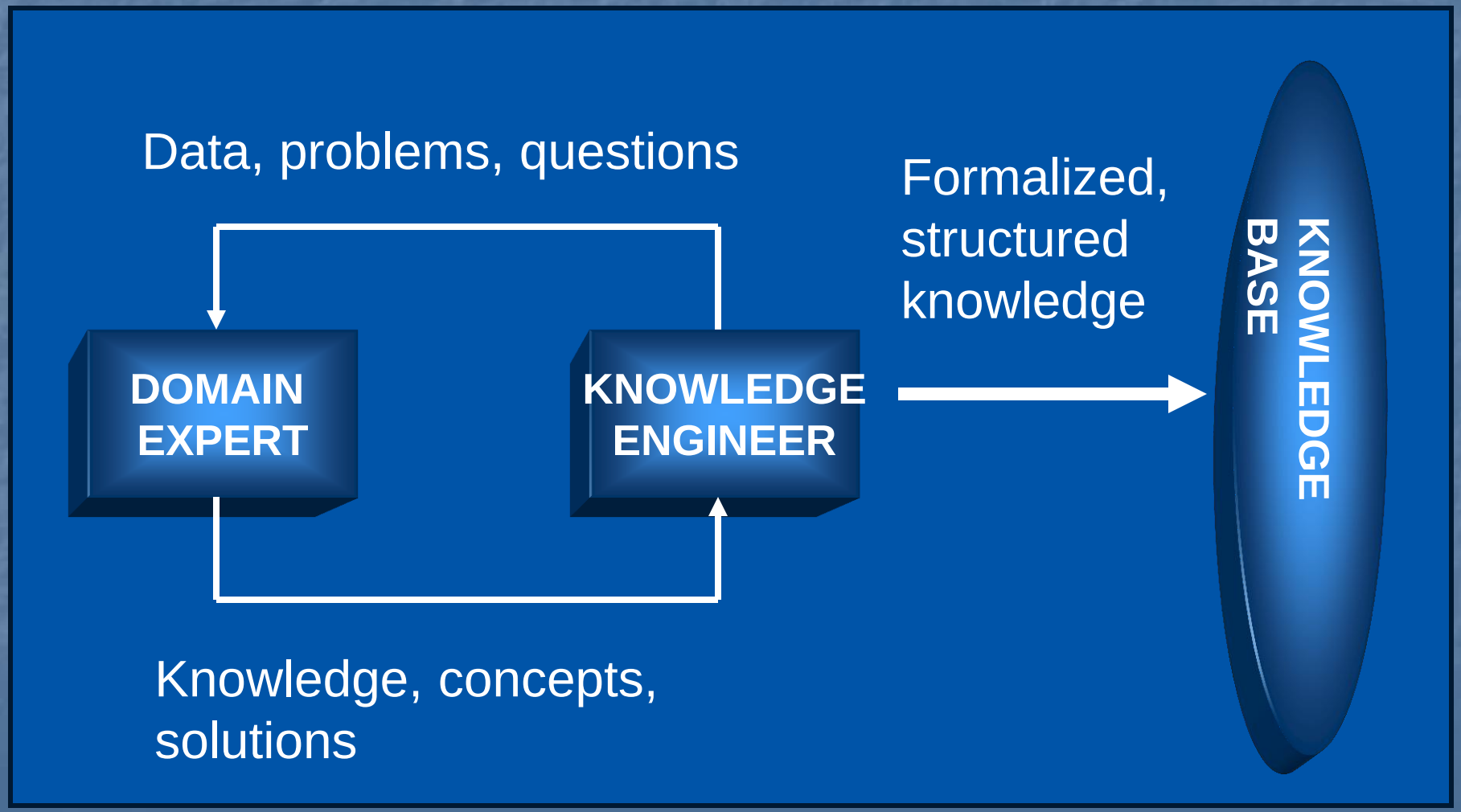
Knowledge Acquisition

- Knowledge acquisition is the extraction of knowledge from sources of expertise, and transfer to the knowledge base.
- In broader view, knowledge acquisition may also include acquiring knowledge from other sources such as books, technical manuscript and drawings.

Knowledge Acquisition

- Another term is knowledge elicitation.
- However, knowledge elicitation is the subset of knowledge acquisition where knowledge is acquired directly from a human (domain) expert.

Knowledge Acquisition



PREREQUISITES FOR ACQUISITION

- Knowledge engineer faces three important tasks:
  1. Identifying the problem domain.
  2. Choosing the right expert.
  3. Preparing for knowledge acquisition.

1. Identifying the problem domain

- Key domain characteristics:
  - A narrow, well-defined focus.
  - Moderate solution.
  - Symbolic knowledge and reasoning.
  - A stable domain.
  - Available test cases.
  - Complexity of the domain.
  - Scarce expertise.
  - Appropriate depth of required knowledge.

2. Choosing The Right Expert

- Several indicators:
  - Peers regard the expert decisions as good decisions.
  - Whenever problem arises, people consult the expert.
  - The expert admits not knowing that answer to a problem. This honesty indicates self-confidence and a realistic view of limitations.
  - The expert avoids information that is irrelevant to the domain and instead sticks to the facts and works with a focus
  - The expert is not arrogant about personal credentials, years of experience, or strong ties with people in power.

2. Choosing The Right Expert

- Desirables characteristics of an expert:
  - Knows when to follow heuristics and when to make exceptions.
  - Sees the big picture.
  - Possesses good communication skills.
  - Tolerates stress.
  - Think creatively
  - Exhibits self-confidence
  - Maintains credibility.
  - Operates within a schema-driven orientation
  - Uses chunked knowledge.
  - Generates motivation and enthusiasm.
  - Shares expertise willingly.
  - Emulates a good teacher.

3. Preparing for knowledge acquisition.

- The K.E. should know something about both the expert (personality, temperament, job experience), familiarity with the domain and the problem domain (understanding the domain terminology).

The tasks in Knowledge Acquisition

1. Collect.
   - Acquiring the knowledge from expert.
   - Iterative style like a funnel effect - moving from the general to specific.
2. Interpret.
   - Review the collected information and identify the key pieces of knowledge.
3. Analyze.
   - Forming theories and problem solving strategies from the knowledge identified.
4. Design.
   - Should have form better understanding of the problem that can aid further investigation.

Problems in Knowledge Acquisition

- Unaware of the knowledge used
- Unable to verbalize the knowledge
- May provide irrelevant knowledge
- May provide incomplete knowledge
- May provide incorrect knowledge
- May provide inconsistent knowledge

Statement from an expert

- *"In the US if you are under 60 years of age, you are not entitled"*
- Simple rule

Statement from an expert

- *“ If you are at least 60 years old and have been a state employee for at least 25 years or at least 62 years of age and have worked full-time for more than 5 continuous years, then you are entitled to collect social security benefits provided that you are not handicapped or you are not receiving a salaried income greater than RM10,000 or collecting unemployment compensation from a state agency*

Statement from an expert

- I don’t expect heart trouble in a 20-year old. The occurrence is so rare I would say

Knowledge Acquisition Techniques

- The development of an expert system is entirely dependent upon the knowledge provided by the chosen expert.

Knowledge Acquisition Techniques

- Introspection.
- Observation.
- Induction.
- Protocol Analysis.
- Prototyping.
- Interviewing.

Knowledge Acquisition Techniques

Introspection.

- This is where the expert acts as expert and knowledge engineer.
- By examining his own thought processes the expert builds a system which he believes effectively replicates the thinking processes.

Knowledge Acquisition Techniques

Observation.

- The expert is closely observed whilst at work.
- The most obvious, straightforward approach to knowledge acquisition.
- Involves the use of video recordings for subsequent analysis.

Knowledge Acquisition Techniques

Induction.

- This is the process of converting a set of examples into rules.
- A process of reasoning from the specific to the general.
- In expert system terminology it refers to the process in which rules are generated by a computer program from example cases.
- Software programs exist which can carry out this procedure.

Knowledge Acquisition Techniques

Protocol Analysis.

- Borrowed from psychology.
- Expert is asked to perform a task and to verbalize his thought process.
- The task is recorded, transcribed, and analyzed. The knowledge engineer then has to deduce the decision process.

Knowledge Acquisition Techniques

Prototyping.

- An extension of the interviewing technique.
- Here the expert works with the knowledge engineer in building a system.
- Both parties contribute to the system design;
- The expert uses the system to test the knowledge to be included
- Knowledge engineer aims at getting the structure right by modifying the system while interacting with the expert.

Knowledge Acquisition Techniques

Interviewing

- This is the most often used technique in the early stages of acquisition
- The knowledge engineer extract the knowledge provided and build the system in a manner which he believes is similar to the way the expert thinks.
- The expert verify whether the system is an accurate reflection of his knowledge.

Interviewing

- Definition:
  - An interview is a verbal and non-verbal interaction between two parties, with the mutual agreed purpose of one party obtaining information from, or about the other, in order that it may be used for a particular purpose.

Interviewing

- Guideline for Obtaining Initial Cooperation:
  - Expert system is not a replacement
  - Provide brief overview of expert systems and successful expert system on similar applications
  - Don't oversell, explain limitation as well
  - Explain how they can help to further development and acceptance of this technology
  - Make expert aware that they are important for the project success

Interviewing: Types of Questions

- The basic tool of interview technique.
- 4 types of questions:

Types	Purpose:	Form
Direct	Obtain specific information on some known issue	▪ What does … mean? ▪ Is … true ? ▪ What is the value of … ?
Indirect	Obtain general information on concepts and problem solving strategies	▪ What issues are considered for …? ▪ How do you determine … ? ▪ What do you look for when .. ?
Probes	Probe deeper into an establish issue	▪ Can you explain … ? ▪ Can you discuss … ?
Prompt	Direct interview into a new area	▪ Can you discuss … ? ▪ Can you return to … ?

Interviewing: Types of Interview

- There are two types of interview:
  a. Unstructured Interview
  b. Structured Interview

Interviewing: Types of Interview

- Unstructured Interview
  - Use early in the project.
  - Expert discuss a topic in a natural manner.
  - Try to get:
    - conceptual understanding of the problem
    - general problem solving strategies
- Generally ask general question about some broad problem issues, using prompt or indirect question.
- Example: "How do you determine when the satellite is malfunction?"

Interviewing: Types of Interview

- Example Excerpt from Unstructured Interview

KE:	How do you determine when the satellite is malfunctioning? **{starter prompt}**
DE:	I notice that the messages **{CONCEPT}** are garbled, or the **BER {CONCEPT, domain vocabulary}** is high **{RULE}**. This makes me sick when I think of all the money we invested in the thing and it still works worst than the radios I have a home **{irrelevant}.** And it always seems to come down to a couple of things that go wrong. The modulator **{OBJECT}** is the pits. This thing drift drifts on off us it seem every other day **{HEURISTIC}.** I think it mainly has something to do with its power supply **{OBJECT}.** Oh wait a minute, that **matrix switch {OBJECT}** may even be worst **{conflict}.** It hangs up on us and sometimes doesn't make a good contact **{HEURISTIC}**, and it's actually funny when it does. Ah… I remember a time when…
KE:	Excuse me, can you tell me a little more why the matrix switch is such a problem? **{prompt question}**

Interviewing: Types of Interview

- Knowledge obtained from unstructured Interview

Concepts	Messages, BER
Objects	Matrix switch, output attenuator, modulator, modulator power supply
Rules	IF message is garbled OR BER is high THEN A faults exist
Heuristics	▪ modulator drifts ▪ matrix switch sometimes doesn't make good contact ▪ output attenuator rarely a problem

Interviewing: Types of Interview

- Structured Interview
  - Use later in the project after identified problem's key topics.
  - Maintain a focus on one issue at a time.
  - Elicits specific details on a given issue before moving on to another points.
  - Probes deeper in a depth-first type fashion and uncovers important problem details.
  - Can be view as concept-driven elicitation because it probes deeper into some discovered concept.

Interviewing: Types of Interview

- Example Excerpt from Structured Interview

KE:	In a prior session you mentioned that eliminating harmful pest is important. You also said that the first step in elimination is pest identification. Can you tell me what major characteristics you consider for identifying pest? **{focused prompt on characteristic}**
DE:	You can tell what kind of pest problem you have if you catch one of the little suckers and examine its **appearance {CONCEPT}.** Most farmers can identify the pest by looking at it, and … ah … or y inspecting the **crop damage {CONCEPT}.** Some of these guys will eat the leaves or roots **{HEURISTIC} {RULE}.** But before you try any pesticides you better be sure what it is. **{HEURISTIC}**
KE:	Can you explain how you use the pest appearance in identifying the pest? **{probe on appearance}**
DE:	You can look at the **size {CONCEPT}**, its **color {CONCEPT}**, or its **shape {CONCEPT}. {RULE}** Sometimes you can identify the pest from just one of these characteristics or other times you have to look at all of them. **{HEURISTIC}**
KE:	Can you explain the size issue? **{probe on size}**

Interviewing: Types of Interview

- Knowledge Obtained from structured Interview

Strategies	View appearance of the pest first, then inspect the crops damage
Concepts	Pest characteristics: appearance, size, color, shape Crop damage: leaf damage, root damage
Rules	IF size is something AND the color is something AND the shape is something THEN the pest is known IF the leaf damage is something OR the root damage is something THEN the pest is known
Heuristics	▪ Some pest eat the leaves or roots ▪ Before trying pesticides make sure of the identification of the pest. ▪ Sometimes pest identification can be done using only one pest

Interviewing: Problems with Interviewing

- In interviewing expert discusses problem through introspection: examining his thoughts or understanding of the issue in question.
- Psychology studies have shown introspection may be ineffective.
- Some difficulties:
  - Recalling procedural knowledge
  - Ineffective long-term memory
  - Verbalizing manual task
  - Verbalizing compiled knowledge
  - Lacks context: not real problems, knowledge collected may represent general understanding of the problem.

Interviewing: Problems with Interviewing

- Thus, knowledge engineer turn to another methods called CASE STUDIES.
- A CASE is an actual problem solved in the past and contains steps taken to solve it and its final solution.

Interviewing: Problems with Interviewing

- 2 kinds of CASES:

a. Familiar Case
   - Well known to expert
   - Reveal typical knowledge used by expert
   - Early part of project when need general insight

b. Unusual Case
   - Uncommon to expert
   - Expert need to study in detail thus, providing deeper knowledge
   - Use later in the project to refine the system

Interviewing: Problems with Interviewing

- 2 ways of using CASE:

  a. **Retrospective:** Expert reviews the case and explains how he solves the problem.

  b. **Observational:** Ask expert to solve the case problem while you observes.

Structuring Knowledge Graphically

- Cognitive scientist and ES developers have used several techniques for graphically relating knowledge
- These techniques provide visual perspectives of the important knowledge and its organization
- They focus on 2 issues:
  - The discussion with the expert on some issues
  - Act as a resource for gathering additional information.

Structuring Knowledge Graphically

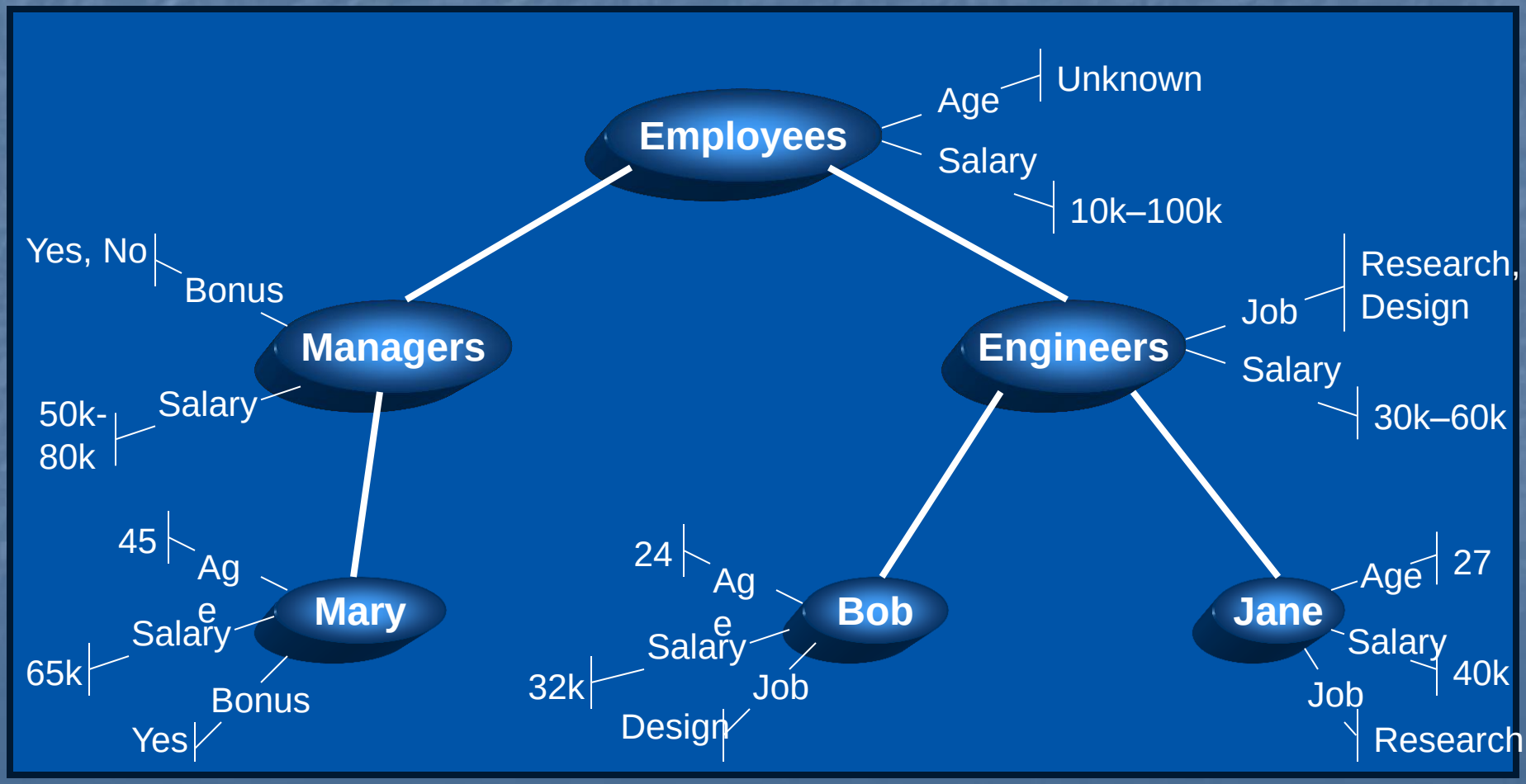
- Some of the techniques are:
  - Cognitive maps
  - Flowchart
  - Inference networks

Structuring Knowledge Graphically

- Cognitive maps
  - Graphically displaying the natural relationship between concepts or objects
  - Composed of nodes and arcs that link related node
  - The structure is hierarchy

Structuring Knowledge Graphically

- Cognitive map of employees:



Structuring Knowledge Graphically

- Flowchart
  - Presents a sequence of steps that will be performed
  - Consider the following consultation:

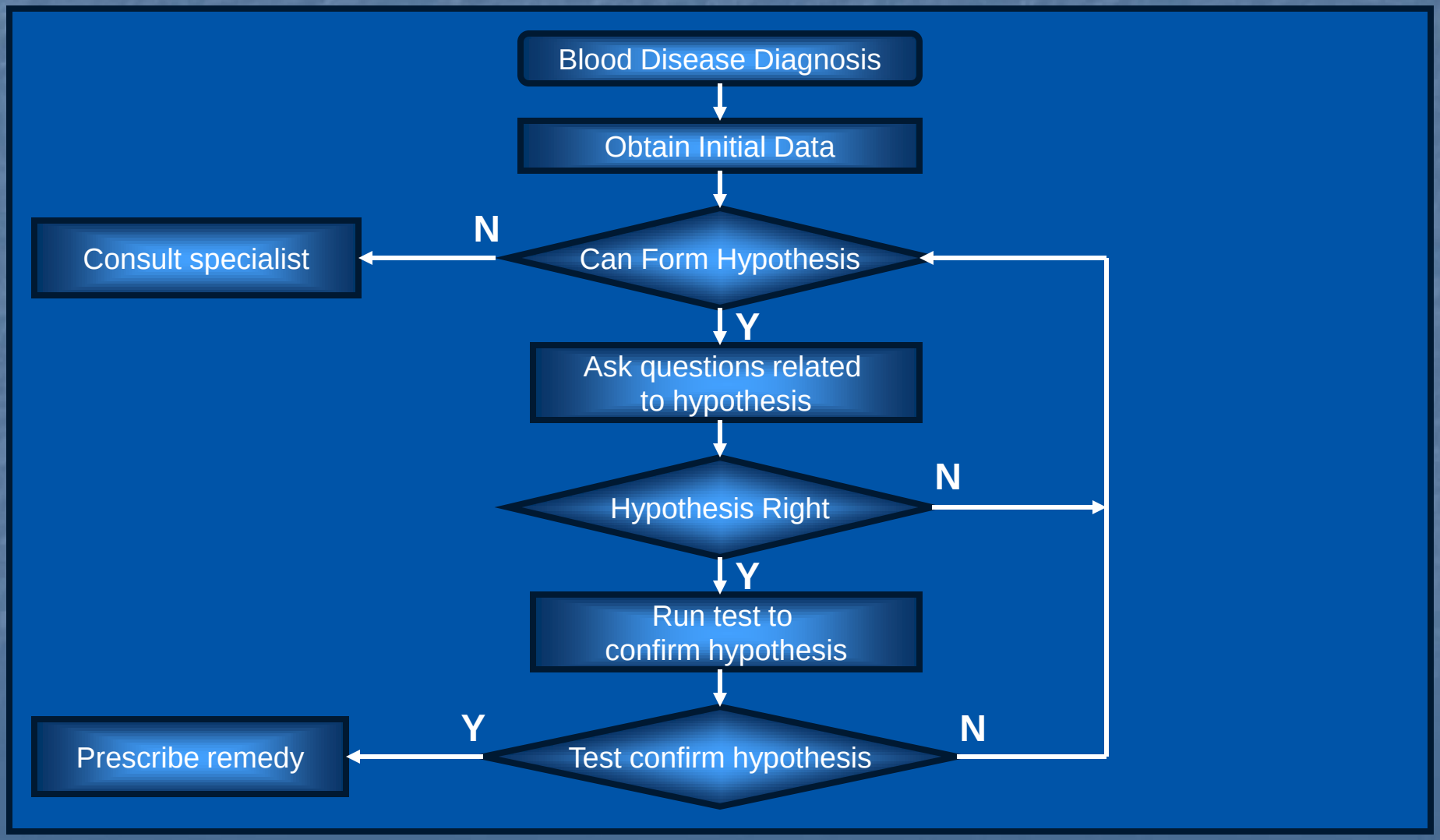
Structuring Knowledge Graphically

- Consultation:

KE:	Can you please explain how you diagnose a patient with an infectious blood disease?
Doctor:	I first ask the patient to describe his or her symptoms. From this information I would then see if I could form a belief of what might be wrong.
KE:	What do you do if you can't form a belief?
Doctor:	I would consult some specialist.
KE:	What do you do if you can form a belief?
Doctor:	I would begin to ask more specific question to confirm this belief. This might include things like … if I think I'm right then I would run some test to confirm it.
KE:	What happen if after you question the patient, the problem doesn't look like the one you thought?
Doctor:	Well, I would see if could form some new belief and ask more questions.
KE:	What do you do if you run some test and they come back negative?
Doctor:	I would pretty much have to rethink the problem again.

Structuring Knowledge Graphically

- Flowchart for above consultation:



Structuring Knowledge Graphically

- Inference networks
  - Provide graphical representation of the system rules, with the premise and conclusion of the rules drawn as nodes and their supporting relationship draws as links
  - The advantages:
    - Can visually see the relationships between the rules
    - Better manage the review and modification of rules

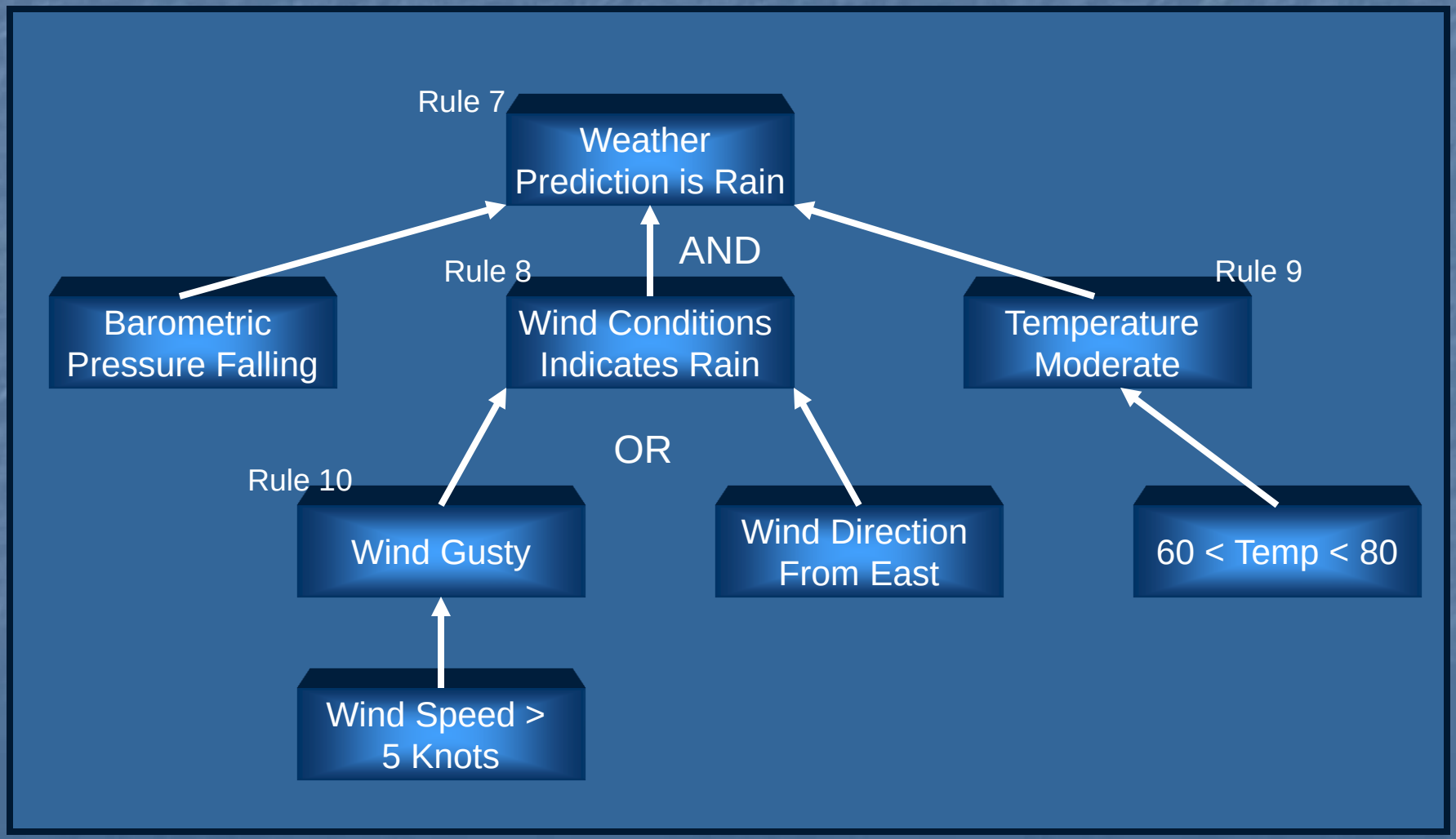
Structuring Knowledge Graphically

- Set of rules for rain prediction:

R1:	IF barometer pressure is falling AND Wind condition indicates rain AND temperature is moderate THEN Weather prediction is rain
R2:	IF Wind is gusty OR wind direction is from east THEN Winds condition indicate rain
R3:	IF wind speed is > 5 knots THEN wind is gusty
R4:	IF Temperature is between 60 and 80 degrees THEN temperature is moderate

Structuring Knowledge Graphically

- Inference Network for rain prediction:



Back to Main Menu