Pragmatic Knowledge Acquisition

6.871 - Lecture 11

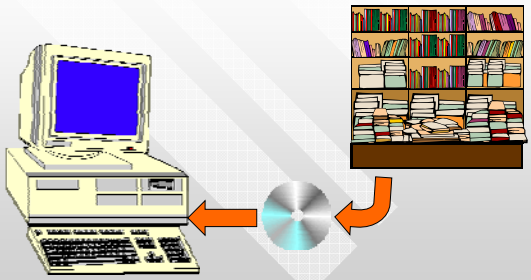
Outline

- The intent of this lecture
- The longstanding dream
- What do we mean “learn”?
- What this lecture is not about
- The nature of the task
- Predictable difficulties
- Pragmatics of debriefing

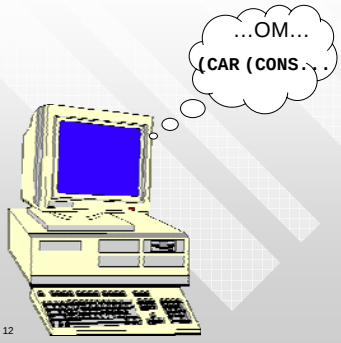
Knowledge Acquisition

- What is it?
  - Explication and formalization of knowledge
- What is its goal?
  - To externalize knowledge in a form that can be implemented in a computer

The Dream: Version 1



The Dream: Version 2



Modes of Learning

- Learning by being programmed
- Learning by being told
- Learning from selected examples
- Learning from unselected examples
- Learning by discovery

But Where Does the Knowledge Come From?

- Documents
- Human experts
- Machine learning techniques

What This Lecture Is Not About

- The variety of machine learning techniques:
  - PAC learning
  - Neural nets
  - ID-3
  - Genetic algorithms
  - Nearest neighbor
  - Knowledge discovery and data mining
  - Bayes' Nets, HMMs, SVM's
  - …

What This Lecture Is Not About

- The variety of cognitive science oriented techniques:
  - Multi-dimensional scaling
  - Personal construct theory
  - Ordered Trees from Recall
  - …

Knowledge Elicitation

- Original view: extracting information
  - Mining metaphor
- Current view: modeling information
  - Construction metaphor

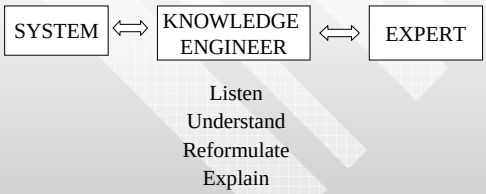
Pragmatic Elicitation Techniques

- Interviews
  - Unstructured: early sessions, elicitor needs skill
  - Structured: systematic, elicitor needs knowledge
  - Can automate
- Observe and record performance
  - Minimal interference with expert
  - But difficult to interpret data, elicitor may influence
- Process tracing
  - Protocol analysis

A Key Hard Problem

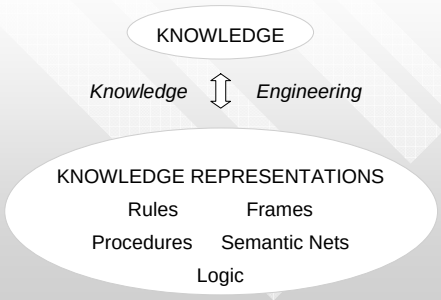
CREDIT (BLAME) ASSIGNMENT

Basic Interaction



Listen
Understand
Reformulate
Explain

The Nature of the Task



Nature Of The Task

- Bridging the gap
- Building a formal a language
  - "sentences," "nouns," "verbs," …
  - rules, attributes, objects, values
- Working from both directions
  - kinds of knowledge
  - kinds of reps

Predictable Difficulties

- The expert…
  - … knows more than he says
  - … says more than he knows
  - … lies to you
  - … disagrees with other experts

Predictable Difficulties

- Knowledge engineers…
  - … rush to structure
  - … need social skills
  - … need AI skills

Getting The Knowledge: Sources

- Books
- People
  - *Finding* one
  - Finding *one*
    - » Level of aspiration
  - Finding *the* one
    - » Confident
    - » Introspective & Reductionistic
    - » Intrigued

What Representation to Use?

- Medical diagnosis
- Getting out of the supermarket

What Representation to Use?

- Medical diagnosis
- Getting out of the supermarket

ASK YOURSELF: *WHAT DO YOU KNOW?*

Then listen to the answer.

Getting The Knowledge: Debriefing

- Signing on
- Work from examples
  - dead center cases
  - marginal cases
- Errors are wonderful
  - it's easier to modify than specify
- The relevance of the computer
  - mental hygiene
  - efficiency

Getting The Knowledge: Debriefing

- Be rabidly rational and reductionistic
- Be patient
- Get interested

Getting The Knowledge: Debriefing

- Meet the expert half way:
  - learn the expert's language
- Talk your language
  - it will be infectious
- Come at hard problems from several directions

Knowledge Acquisition:Getting Started

- Determine the size and structure of the solution space
  - How many categories of answers are there?
  - How many specific choices within each category?
- Select a category, select a specific choice
- What factors suggest that choice as the correct one?
- What factors differentiate among choices in that category?

Knowledge Acquisition:Getting Started

- Notice the vocabulary in use:
  - What are attributes, objects and values?
- Notice statements like
  - "if X and Y, then the best choice is Z"
- Look for chains of reasoning

Example: Selecting an Investment

- Frank's Financial Supermarket offers 7 kinds of investments
  - stocks, index funds, bonds, commodities, mutual funds, rare coins, tax shelters
- There are
  - 1500 stocks
  - 1000 bonds
  - 15 different mutual funds
- In the mutual funds:
  - consider the tax-free money market fund

Example: Selecting an Investment

- What factors suggest that choice as the correct one?
  "If your tax bracket is 42% or higher and you need to keep the money readily at hand, then the tax-free mm fund is a good choice."

Example: Selecting an Investment

- Notice the vocabulary in use
  "If your tax bracket is 42% or higher and you need to keep the money readily at hand, then the tax-free mm fund is a good choice."
- Look for chains of reasoning

Example: Selecting an Investment

- What factors differentiate among choices in that category?
  Why the tax free mm fund instead of the tax free bond fund?

Live Example?

Knowledge Acquisition

- It's hard work.
- It's also a lot of fun.