Pragmatic Knowledge Acquisition

6.871 - Lecture 12
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
The Dream: Version 1
The Dream: Version 2

Figure by MIT OCW.
Modes of Learning

• Learning by being programmed
• Learning by being told
• Learning from selected examples
• Learning from unselected examples
• Learning by discovery
Learning by Being Programmed

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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
  – …
What This Lecture Is Not About

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

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A Key Hard Problem

CREDIT (BLAME) ASSIGNMENT
Pragmatic Techniques

• Interviews

• Observe (Record) Performance

• Protocol Analysis
Basic Interaction

Listen
Understand
Reformulate
Explain
The Nature of the Task

Knowledge Engineering

Knowledge Engineering

Knowledge Representations

Rules
Frames
Procedures
Semantic Nets
Logic
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?*