Problem Solving

• A Major Category of Human Cognition
• What is Problem Solving?
  – The pursuit of a goal when the path to that goal is uncertain
• Distinct from Algorithmic Performance
  – No rule or recipe to guarantee success
  – Tying shoelaces is not problem solving
    • Or is it?

Heuristics Can Help

• Heuristics
  – Are "rules of thumb"
  – Not algorithms
  – Because success is not guaranteed
• Polya’s Heuristics for Mathematical Problem Solving
  – Think of a related problem
  – Try to solve part of problem
  – Draw a picture
Heuristic Search

- Search Through Problem Space
  - Beginning state
    - What's the situation?
    - Westley: What are our assets?"
  - Ending state
    - What are we trying to accomplish?
    - Legal moves
    - What's permitted?
- Metaphor: Navigating a Maze

General and Domain-Specific Heuristics

- General Heuristics
  - Hill climbing
  - Working backward
  - Means-ends analysis
  - Working forward (experts)
  - Subgoaling is a common feature
- Domain-Specific Heuristics
  - Math: Polya’s heuristics
  - Writing: Save words

Experts and Novices

- How Much Knowledge?: 50,000 Chunks
- How Much Time?: 10 Years
  - But what about Mozart?
- Problem Solving Characteristics
  - Working forward heuristic
  - Deep structure vs. surface features
  - More up-front time in problem representation
- When Would Experts Rely on General Heuristics?
Insight

• Sudden Solution of a Problem
• Stages of Insight
  – Preparation
  – Incubation
    • Bed, bath, bus phenomenon
  – Illumination “Aha”
  – Verification
• Even Apes: Gestalt Theory
  – Sultan on Tenerife

Implications of Problem Solving

• Problem Solving is Important to Human Purpose.
  – Being successful in ________ .
• Some Problems Are Ill-Defined
  – Where the ultimate goal and means are not clear.
• Problem Solving Involves Regulation of Emotion
  – “I don’t know what I’m doing”
  – And that’s okay
• Errors and Inefficiency
  – Are they always bad?
  – Are they compatible with the school culture