

Education 173  
Cognition and Learning in  
Educational Settings

Problem Solving  
Fall Quarter 2007



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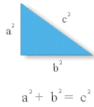
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### Problem Solving

- 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?



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### 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



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## Heuristic Search

- Search Through Problem Space

- Beginning state

- What's the situation?

- Westley: "What are our assets?"

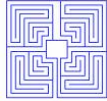


- Ending state

- What are we trying to accomplish?

- Legal moves

- What's permitted?



- Metaphor: Navigating a Maze

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## 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

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## 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?

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## 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



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## 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?



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