What is a problem?

❖ Trying to reach a goal when the path is not immediately obvious

❖ Parts
   ❖ Initial state
   ❖ Goal state
   ❖ Obstacles
   ❖ Operations
   ❖ Problem space

Example

❖ Rearrange these letters to make a word:

   G S HOLY COPY

❖ Identify:
   ❖ Initial state
   ❖ Goal state
   ❖ Obstacles
   ❖ Operations
   ❖ Problem space

Characteristics: Degree of Constraint

❖ Well-defined
   ❖ Accuracy of solution judged easily
   ❖ Initial state, goal state, operations clearly defined

❖ Ill-defined
   ❖ Accuracy of solution less clear
   ❖ Goal state, operations not always clear

Well defined or Ill defined?

❖ Solving a maze

❖ Writing a novel

❖ Doing a crossword puzzle

❖ Choosing the best career

❖ Determining the best work schedule for your employees

Characteristics: Knowledge

❖ Knowledge-rich
   ❖ Require background knowledge
   ❖ fix a car, diagnose a medical condition, decide on a chess move

❖ Knowledge-lean
   ❖ Do not require specialized knowledge
   ❖ unscramble a word, find the next item in a sequence

Obstacles to problem solving

❖ Mental set

❖ Functional fixedness

Mental Set

❖ Keep using same solution even though there are simpler ones

Functional fixedness

❖ See objects as having only their typical functions

Duncker's candle problem

❖ Use these objects to attach the candle to the wall so that it doesn't drip on the table below

Solution

❖ Use the tack box as a shelf

Solving problems

❖ Algorithm
  ❖ Guaranteed to find solution
  ❖ Practical only if problem space is small
❖ Heuristic
  ❖ Rule of thumb
  ❖ Shortcut to solution
  ❖ Often work, but no guarantee

Heuristics

❖ Hill-climbing
  ❖ Choose the option that moves you toward your goal

Heuristics

Hobbits and Orcs problem

- ❖ 3 hobbits & 3 Orcs on the east bank of a river
- ❖ Goal - get them all to the west bank
- ❖ Boat can carry 3 at a time
- ❖ Orcs can never outnumber Hobbits, on the boat or on either bank
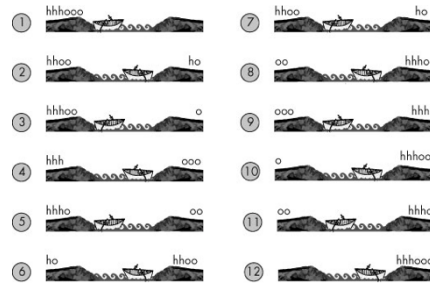
Heuristics

- ❖ Means-ends analysis
  - ❖ compare current state with the goal state
  - ❖ determine how to reduce this space

Heuristics

- ❖ Generate-test
  - ❖ Generate potential solution
  - ❖ Test whether it works
  - ❖ Repeat until a solution works

The truthteller problem

- ❖ You are visiting a strange country where there are just two kinds of people – truthtellers and liars. Truthtellers always tell the truth. Liars always lie. You run into two people on the street, and ask them "*Are you truthtellers or liars?*" The <u>first</u> person just mumbles: *"I am a #$#%$&#"* and you can't understand him. The <u>second</u> says "*He says he is a truthteller. He is a truthteller, and so am I.*"

- ❖ Are these people truthtellers or liars?

The truthteller problem

- ❖ Generate hypothesis about what each person would say if he was a truthteller (TT) or liar (L)