Heuristics for Problem Solving
(in the small)

- Heuristic: A rule of thumb, a way of doing things that might or might not work
- Goal of problem-solving heuristics: Help us to overcome our own limitations
  - Motivation
  - Working memory
  - Insight
  - Process
  - Emotions.

The Mind

Three things that your mind does:
1. Receives/processes external information
2. "Displays" stored information
3. Manipulates information

It tends not to do more than one of these well at a time

Limited "bandwidth" of attention

Externalizing

- After motivation and mental attitude, the most important limitation on your ability to solve problems is biological:
  - Working memory is 7 +/- 2 "pieces of information."
- You can't change this biological fact. All you can do is take advantage of your environment to get around it.
- That means, you must put things into your environment to manipulate them.
- Externalize: write things down, manipulate aspects of the problem (correct representation).

Example

A rubber ball has the property that, on any bounce, it returns to one-third of the height from which it just fell. Suppose the ball is dropped from 108 ft. How far has the ball traveled the fourth time it hits the ground?

Externalizing

- In this example, drawing the picture left your mind free to concentrate on problem solving.
- Not drawing is probably hopeless, too much to keep track of.
- To be effective, the drawing needs to be set up right – a diagram of some sort makes a big difference.

Example

- Remember these numbers: 483 and 627
- Now, look away and multiply them in your head.

Example

A rectangular board is sawed into two pieces by a straight cut across its width. The larger piece is twice the length of the smaller piece. This smaller piece is cut again into two parts, one three times the length of the other. You now have three pieces of board. The smallest piece is a 7-inch square. What was the original area of the surface of the board?

Straight-line Problems

Problems along one dimension: distance, money, etc.

John has a pretty good salary. In fact if the salary of his older brother, Bob, were suddenly doubled, John would make only 100 dollars less than Bob. Bob's current salary is 50 dollars more than that of the youngest brother, Phil. John makes 600 dollars per week. What is Phil's salary?

Draw a line and put the information onto the line.

A Logic Problem

Tom, Dick, Harry, and Al are married to May, Jane, Sue, and Bea, though not necessarily in that order. Jane, who is Dick's sister, has five children. Tom and his wife want to wait a few more years before starting a family. Tom has never introduced his wife to Sue, who is carrying on an extramarital affair with Dick. (May is considering telling Dick's wife about it.) Dick and Harry, by the way, are twin brothers. Who is married to whom?

Matrix Problems

- How can we organize this information?
  - Matrix works well in this case
- Can work on one row/column (e.g., figure out who X is married to.
- Can work one fact at a time.
  - In this case, we will get pretty far. But we'll be left with a 2 by 2 box for Harry/Al and Jane/Sue. How do we break it?
  - We need to relate two facts to infer that Dick, Harry, Jane are all siblings.

Example

Three boys, Joey, Jimmy, and Pete, have between them nine quarters and a total of $2.55 in quarters and nickels. Joey has three nickels, and Jimmy has the same number of quarters. Jimmy has one coin more than Joey, who has four coins. How many nickels each do Jimmy and Pete have?

Hand-Shaking Problem

An anthropologist and her husband attended a party with four other married couples. Whenever two people shook hands, the woman recorded that each of the two people shook hands one time. In that way, for all of them (including herself and her husband), she obtained the total number of times that each person shook hands. She noted that one didn't shake hands with one's own spouse. Then she observed: If she didn't count herself, the other nine people all shook hands a different number of times. That is, one person didn't shake any hands, one shook only once, up to one shaking hands of all eight of the others.

Q: How many times did her husband shake hands?

Hand-Shaking Problem

- This one is difficult. Its tough to engage.
- But there are things that can be figured out. You need to play with it awhile.
- Hint: Can the anthropologist's husband be the one who shook hands 8 times?
- Bigger hint: Draw out a table!