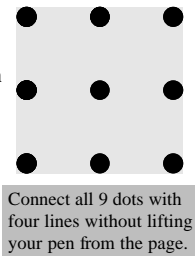


Problem solving

- Using background knowledge
- Analogical problem solving and access
- Case-based reasoning

When is a problem not a problem?

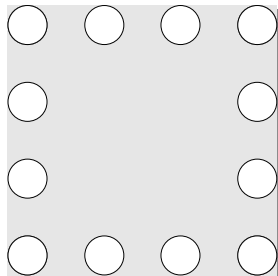
- Solving the 9-dot problem
 - You just saw this last class
 - You can just retrieve the solution
- Problems are only problems if you do not already know the solution.



Using background knowledge

- The new problem need not be identical to one seen before.

Using twelve coins, create a square that has five coins along each side.



When you saw this problem for the first time, it led to a reminding of a previous similar problem.

Access failure

- About 10% of people solve the radiation problem spontaneously
- About 30% of people solve it if they first read the story about the general
 - Not much of a gain.
- Is this an access problem or a use problem?
- If given a hint to use the earlier stories, about 90% of people solve the problem.
 - Suggests that it was an access problem.

Analogical access

- Finding relevant background knowledge is hard
- There are many possible experiences that might be relevant
 - Which ones are most likely to be relevant?
- Situations that are similar to ones you have seen before.



Similarity is good

- In many cases, using highly similar background knowledge is good.
- Purchase decisions
 - Knowing what brand of pickles you buy will not help you decide what ketchup to buy.
- Science (Dunbar)
 - Microbiologists use results from one bacterium to decide what studies to do on another bacterium.
- It is rare that distant similarities are useful.

Retrieving analogs

- Gentner, Rattermann, & Forbus
 - People read a story
 - Hawk gives feathers to hunter for arrows in exchange for hunter not shooting hawk.
 - Later, people read another story:
 - Similar (S): Eagle gives feathers to archer...
 - Mere Appearance (MA): Eagle flies near archery tournament
 - Analogy (AN): One country gives missile guidance systems to another in exchange for not attacking it.
 - No Match (NM): One country has rivers, another does not.
- People given S and MA retrieve story
- People rate S and AN as similar

Models of access

- How do we access analogies?
 - Many models have been developed
 - Most of them are two-stage models.
- Stage 1: Search through memory to find things that are generally similar
 - Things from the same domain are often retrieved
 - Only a small number of items pass this filter
- Stage 2: Find things that are analogous
 - Determining analogies is effortful
 - Do this task only on items that pass stage 1

Access and use

- Similarities may also affect use of knowledge
 - Word problems (Ross)

Type:	Example	Similar	Cross-mapped	Other domain
Context	Golf	Golf	Golf	Pizza
Thing assigned	Caddies	Caddies	Players	Children
Who assigned to	Players	Players	Caddies	Cups

- Retrieval affected by domain similarity
 - Both similar and cross-mapped examples retrieved
- People found it hard to apply cross-mapped examples.

Overcoming access problems

- Experts are better at analogical retrieval
 - They are better at finding good analogies
 - They are less influenced by cross-mappings
- Forming a schema may help access
 - Comparing a few analogs during learning helps retrieval
- Learning about subgoals may help access
 - An example may be indexed by the sub-problems that it helps to solve.

Case-based reasoning

- An Artificial Intelligence technique
 - Solves problems based on known episodes
- Stages of Case-based reasoning
 - Access
 - Adaptation
 - Evaluation
 - Updating of memory

CHEF: An example

- Szechuan cooking (Hammond)
- Had a failure cooking beef and broccoli
 - Broccoli came out soggy
- Retrieve past knowledge about similar failures
 - Other cases of soggy vegetables
- Find a case of beef and snow peas
 - When cooking beef, notice that meat sweats
 - Solution in that case: Cook vegetables first, put them aside, then cook beef.
- Adapt case to current situation

Summary

- Background knowledge is important for solving problems (Strong methods)
- Accessing background knowledge is hard
- Analogical access
 - Driven by surface similarities
- Case-based reasoning
