

## Phenomena in Problem Solving

- Insight Problems
- Functional Fixedness
- Using external representations

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## Why study problem solving?

- Important questions
  - How do great problem solvers work?
  - How do people solve very difficult problems?
    - Could we get a computer to do this?
  - What are people's limitations in solving problems?
- Separate fact from fiction in problem solving.
  - There are many stories about the way great problem solvers work that are just not true.

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## Myths of insight

- Weisberg has debunked a number of myths
  - Coleridge and Xanadu
    - The story is that the poem was written in a single (perhaps drug-induced) session
  - Kekulé and the benzene ring
    - Chemists were search for the structure of benzene
    - Kekulé was said to have visualized a snake eating its tail.
- These stories are just myths.
  - There are many surviving drafts of Xanadu
  - The story of the snake biting its tail was told 35 years after Kekulé discovered the structure of benzene

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## So what do we know about insight?

- Many studies of insight problems (Duncker)

Suppose you are a doctor faced with a patient who has a malignant tumor in his stomach. It is impossible to operate on the patient, but unless the tumor is destroyed the patient will die. There is a kind of ray that can be used to destroy the tumor. If the rays reach the tumor all at once at a sufficiently high intensity, the tumor will be destroyed. Unfortunately, at this intensity the healthy tissue that the rays pass through on the way to the tumor will also be destroyed. At lower intensities the rays are harmless to healthy tissue, but they will not affect the tumor either. What type of procedure might be used to destroy the tumor with the rays, and at the same time avoid destroying the healthy tissue?

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## Characteristics of insight problems

- People initially have no idea how to solve the problem.
- There is no linear “feeling of warmth”
  - There is no sense that one is getting closer to solving the problem.
- Often, there is a period of “incubation”
  - Perhaps you walk away from the problem for a while.
- The solution comes in a flash
  - Often, it feels as though the solution is fully formed.

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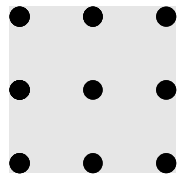
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## How to study insight?

- Insight problems are hard to study.
  - Cannot ask people for their intuitions
  - There is no feeling of warmth
    - People have an “aha” experience
    - What we want to know is what causes the “aha”
  - Insight problems are rare
    - There are only a few laboratory examples that work
    - There are also rare in real life.



Connect all 9 dots with four lines without lifting your pen from the page.

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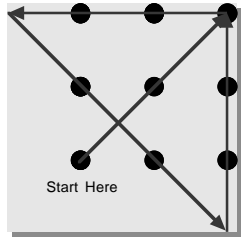
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## A solution



The problem only seems well-defined (as in the previous class)  
Most people do not think of going outside the lines.

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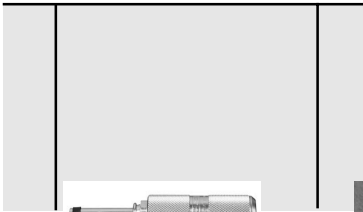
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## Functional Fixedness

- Why does incubation help?
  - We may get locked into a way of thinking about the objects in a problem.



Tie the two ropes together. They are too far apart to grasp them both.



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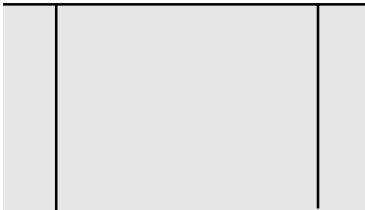
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## Time away from the problem

- We may eventually be able to see objects in a new way.



Scissors are heavy.  
Tie them to one rope and swing it.



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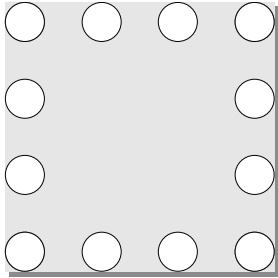
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### What drives insight?

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



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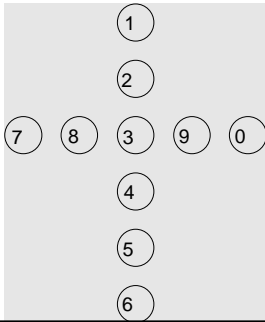
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### Prior knowledge

- This problem might remind you of one you saw before.

Move one coin so that there are two straight lines of six coins which cross each other at the center point of each line.



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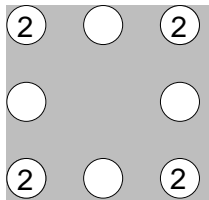
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### Prior knowledge

- You might try a similar solution for the new problem.



We will discuss access of prior knowledge more next class.

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## Using External Representations

- Sometimes organizing information is the problem.

Nurse A can only work after 2pm  
Nurse B can only work Monday, Wednesday and Friday  
Nurse C can work Tuesday and Thursday before Noon  
Nurse D can work any day between 10am and 4pm  
...

- How should this schedule be arranged?
  - An external representation would be useful.

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## A matrix

- Times can be organized into a matrix
  - An external representation of the problem.

	Monday	Tuesday	Wednesday	Thursday	Friday
9-10am					
10-11am					
11am-Noon					
Noon-1pm					
1pm-2pm					
2pm-3pm					Nurse A
3pm-4pm					
4pm-5pm					

Minimizes the information that must be kept in the head.

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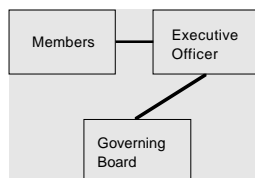
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## Structure of problem

- Type of representation used must match structure of problem.
- Matrix
  - Good for scheduling
    - Days of the week along the columns
    - Times along the rows
    - Entries are events.
- Network
  - Good for relationships



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## Summary

- **Insight problems**
  - Solution is not obvious
  - No feeling of warmth until “aha” experience
  - Incubation may help get beyond functional fixedness.
- **External representations may help**
  - Representation must have the same structure as the problem.

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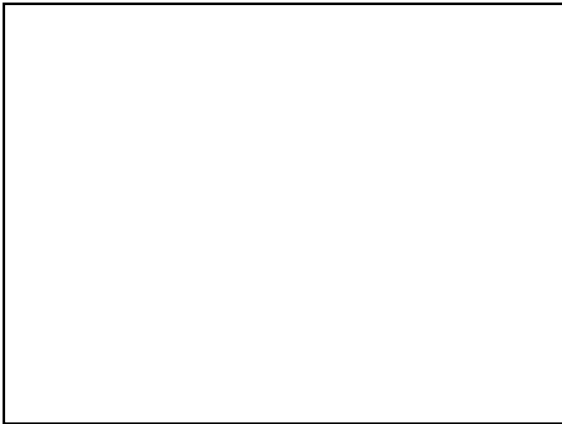
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