Analysis of Trends and Patterns

- The goal is to identify the trend or pattern precisely
  - Don’t stop at simply identifying the “next step”.
  - Explicitly state what the pattern is that defined the next element in the series.
Sample Problems

• ABACADAE ___ ___

• 3 4 6 7 9 10 12 13 15 16 ___ ___ ___

• 2 7 4 9 6 11 8 13 ___ ___ ___

• 1 z 3 w 9 t 27 q 81 ___ ___ ___

• JKLMNO JKLMON JKLOMN JKOLMN ___ ___
You have 3 jars, of sizes 11 quarts, 9 quarts, and 4 quarts. You would like to use these jars to collect 6 quarts of water in one jar. How?

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Goal</th>
</tr>
</thead>
</table>
| 11 | 9   | 4  | 6    | A – B + C  
| 21 | 127 | 4  | 98   |
| 15 | 90  | 4  | 67   |
| 14 | 163 | 25 | 99   |
| 18 | 43  | 10 | 5    |
| 9  | 43  | 6  | 22   |
| 20 | 59  | 4  | 31   |
| 14 | 36  | 8  | 6    |
| 28 | 76  | 3  | 25   |
Don’t be Blind

• For most problems, people use a relevant strategy from habit.
  – There’s an excellent reason for this: It usually works!!
• Sometimes, the habit strategy is a bad match for the problem.
• In this case, people can act like they are “blind” to the solution.
• Example: Water jar problem.
Einstellung

• “Einstellung” is the state of being “blind” or “tuned-in” to something.
• “Functional Fixedness”: People often fail to see alternate uses to an object once they assign it a role.
• People are fairly predictable in their susceptibility to functional blindness.
• Awareness of the problem helps to avoid it.
• This is real issue for students and in “real life”
  – Example: Debugging, algorithm design
Lateral Thinking

• “Vertical thinking” is sticking with the current approach, being rigid.
• “Lateral thinking” is coming at a problem from a different (perhaps nonstandard) direction.
• Often, just realizing that this should be done is enough to find a good solution (getting out of the old approach).
• Of course, it can be hard to tell when you are in the trap! It helps to have a “flexible” mindset.
Examples of Lateral Thinking

• Unsticking a car lock on a cold night
  – Approach 1: Heat the key
  – Approach 2: Unfreeze the lock (with alcohol)

• Need to iron a shirt, but no iron
  – Iron with something else (a frying pan)

• Sheep in front of the truck
  – Approach 1: Beep horn, try to push or scare sheep
  – Approach 2: Lead the sheep behind the truck
How to Facilitate Flexibility?

• Brainstorming (Chapter 6 in Fogler/LeBlanc)
  – Generate ideas
  – Usually done in groups
  – Don’t judge – respect crude ideas
  – Quantity is important

• Brainstorming is a skill that can be developed
  – Skills are developed by practice

The Intermediate Impossible

• For really hard problems
• Generate an impossible solution
• “Play with” that solution
  – Expand on it, modify it
• Thus, the “impossible” solution is an intermediate step to a feasible solution
Example Problems

• Unloading cargo ships takes a long time.
  – Unload at sea?

• New (taller) cargo ships cannot enter a port city due to a bridge.
  – Lower river?

• A factory dumps pollution into a river.
  – If the factory had to suffer from the pollution, they would be motivated to clean it up. So, put factory intake downstream from factory discharge?
Random Associations

• Pick an (interesting) word out of the dictionary.
• Let it stimulate your mind.
• Problem: Noise pollution
• Word: Anthracite
  – Comes from under ground
    • Put noise underground?
    • Put quiet places underground?
  – Black
    • Eyelids cover eyes… cover ears?
Analogies and Metaphors

• Many inventors take analogies from nature
  – Tunnels underwater: worms tunneling in wood
  – Microphone (for telephone) from the ear
  – Infection cause deduced from observing fermentation of wine
  – Spider nets lead to fishing nets
Sleep On It

• Passage of time can unstick many problems.
• The mind “incubates” the problem.
  – Perhaps works on problem unconsciously.
• Each of us has circumstances in which we are most creative:
  – lying in bed, taking a shower, waiting for an appointment.
  – Take advantage of this.
• Must give yourself time to solve the problem.
• Example: debugging a computer program.
Sleep On It (cont)

• It gives you a chance to come at the problem with another approach
  – Does the solution occur to you?
  – Perhaps a new approach that immediately leads to the solution?

• Promotes (allows) lateral thinking