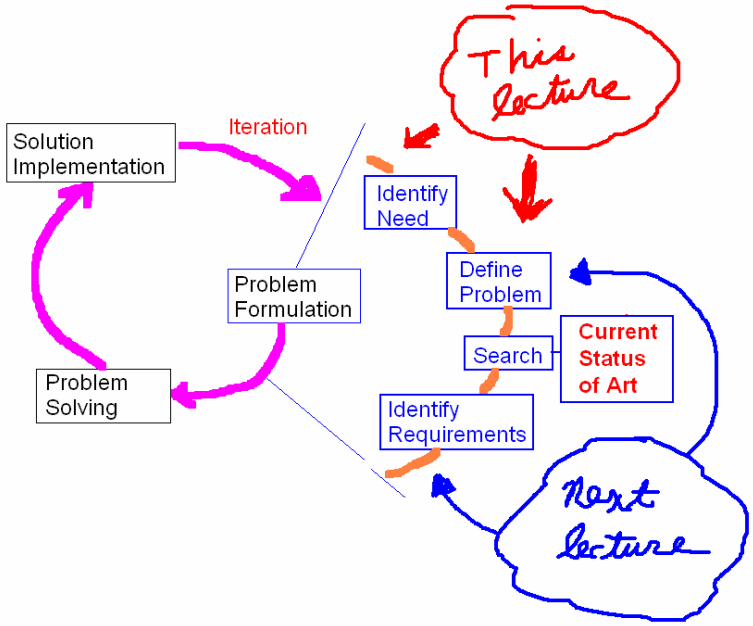
Problem Formulation and Design Requirement

- **Contents**
  - Identify Needs
  - Define Problems
  - Current Status of Art
  - Identify Requirements



- **Goals**
  - Why need identification and problem definition are important
  - Strategies for gathering information about a problem
  - Develop a set of requirements for a problem (next lecture)

Problem Formulation

- "The process of converting a dissatisfied situation into a well-understood problem"
  - Understanding the problem, Not finding solution to the problem
  - Einstein: "*The mere formulation of a problem is far more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science*"
  - It's result?
    - Need Identification and Problem Definition
    - Clear set of Requirements that can guide the design process through to its completion

Identifying Needs and Defining Problem

- **Identify Needs**
  - Dissatisfied situation
  - Need exists
  - Accept responsibility for corrective actions
  - "Attitude"?
    - Pioneer Mentality
    - Identifying a need and accepting responsibility for meeting it
    - Commit time, energy, and resources
- **No Rush to get a solution** after Needs Identified:
  - A wrong problem may be solved!
  - A symptom may be solved!
  - **A part** of the problem may be solved!
  - Or a partial solution is obtained

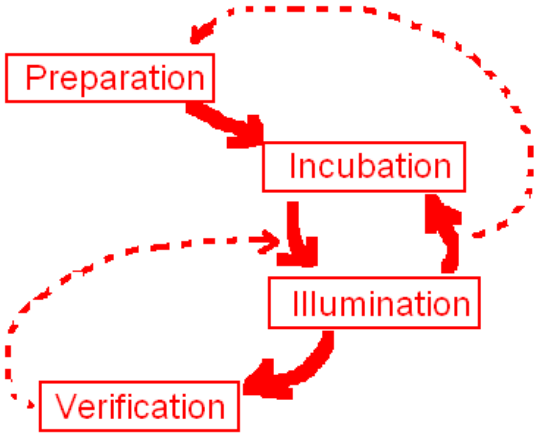
The Blind Men and the Elephant

- Pillar? Rope?
  Tree branch?
  Hand fan?
  Wall? Pipe?
- Parts vs. Whole
- Need of communication

Creativity

- Unleashing Your Creativity- "How can one gain better access to his or her creative energy?"

- **Creativity** as Process
  - **Preparation**: Ground work. Background of the situation
  - **Incubation**: Taking time out. A rest period.
  - **Illumination**: Getting the answer (Aha!). The light bulb is on! Generate Ideas.
  - **Verification**: Does the idea work? Confronting and solving the practical problems.



Answer:

- Nothing--it just let out a little whine.

Mental Barriers and Puzzles

- Mental Barriers
  - a collection of misconceptions, misunderstandings, biases, mindsets, predispositions, assumptions, and emotions that prevent a person from understanding, identifying, or comprehending a problem and solving it.
- Puzzles
  - Puzzles are fun and educational
  - They usually have a simple solution
  - They usually represent one or more mental barriers

- Soure: S. B. Niku

Types of Mental Barriers

- Many different types of mental barriers, including, but not limited to:
  - False assumptions and nonexistent limitations
  - Typical solutions
  - Making things more difficult than they are: being overwhelmed
  - Incomplete or partial information
  - Information and sensory saturation
  - Associative thinking
  - Misunderstanding
  - Inability to communicate properly
  - Emotions-, culture-, and environment-related barriers
  - Fear
  - Orderly vs. chaotic; Analysis/synthesis dilemma
  - Falling in love with an idea
  - Improper methods of solution
  - Over-abundance of resources

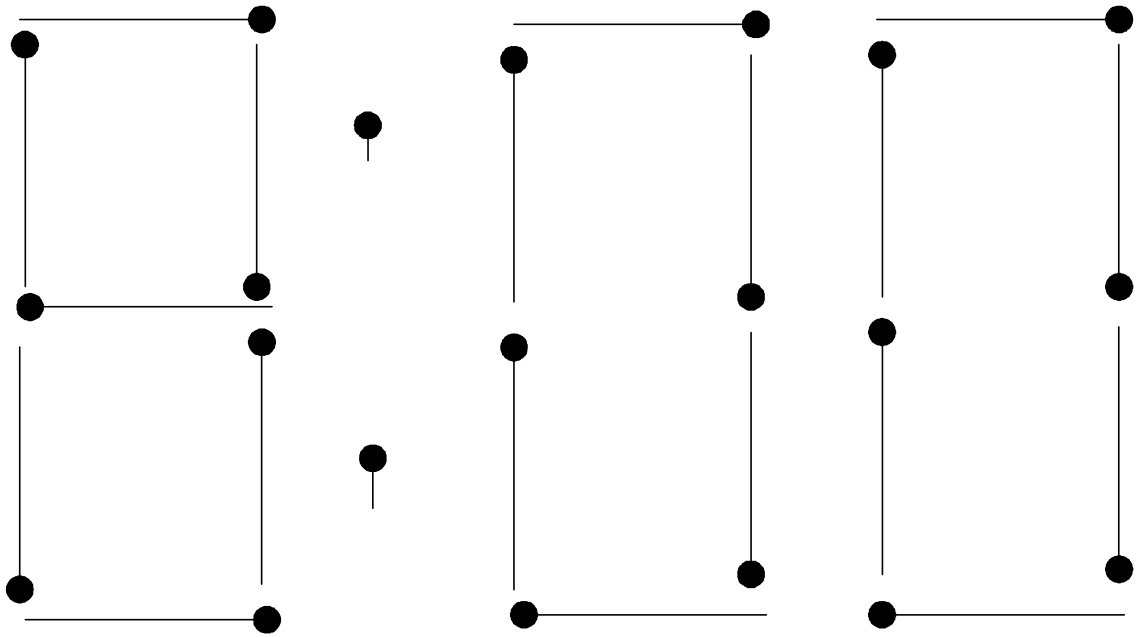
- Source: S. B. Niku

Attributes of Creative People

- Discipline and Self-Confidence
- Adaptability and Resilience
- Conceptualization and Recall
- Flexibility and Fluency
- Visualization Ability
- Curiosity
- Comfort with Complexity
- Mental Agility, detachment, and playfulness
- Skeptical of Accepted Ideas
- Persistence and Capacity
- Informality
- Originality

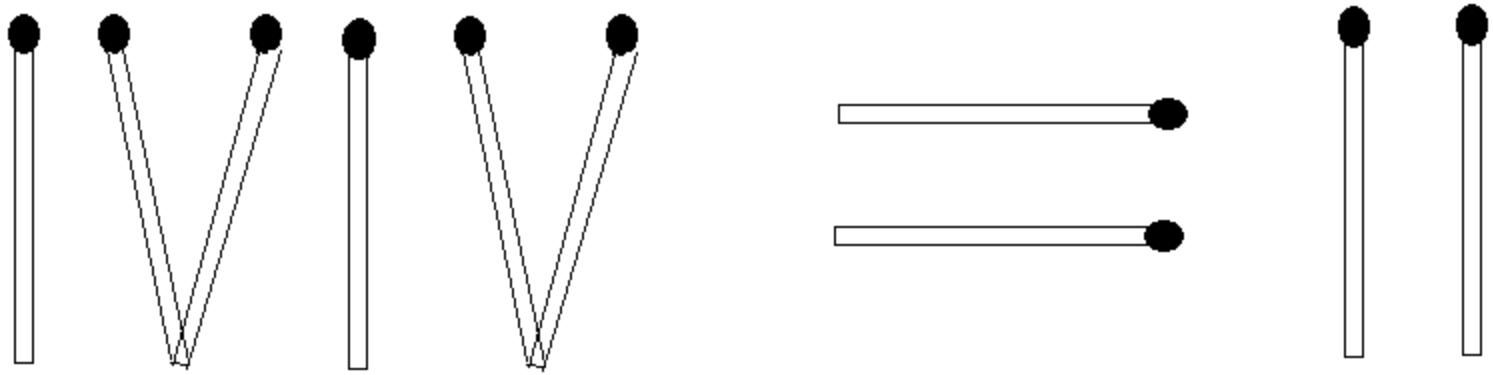
Puzzle

- Moving only two matches, haw can you change the time to half the current value?
  - (source: S. B. Niku)



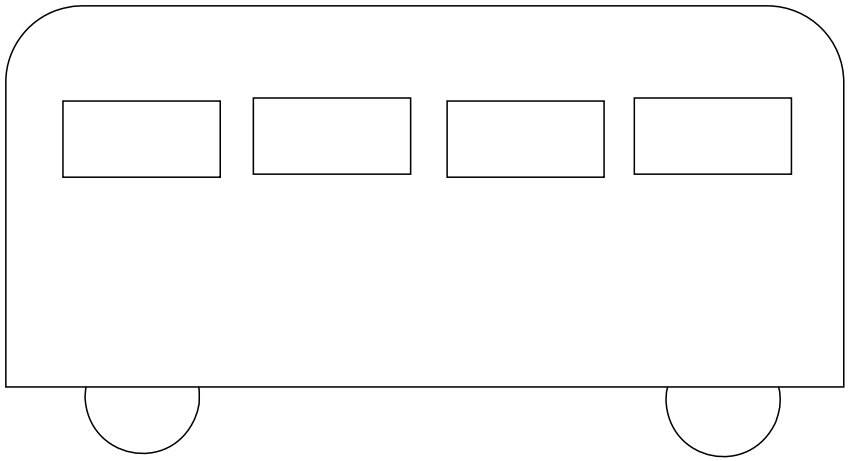
Puzzle

- Change only one stick to make a true equality (no unequal sign accepted)



Puzzle

- In what direction does this bus go?



Approaches for Creative Solution

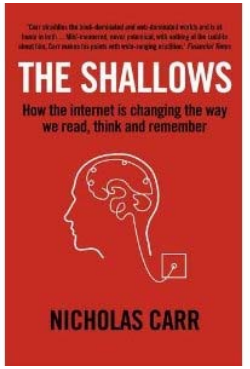
- Powerful approaches
  - Brainstorming
    - Creation of Affinity Diagram
    - Creation of Cause-and-Effect Diagram
  - Synectics
    - "joining together different and seemingly irrelevant elements"
    - Analogy (Personal, Direct, Symbolic, Fantasy)
  - TRIZ
    - The Theory of Inventive Problem Solving
    - Systematic method based on the hypothesis that creative innovations follow universal principles which can be followed.

Brainstorming

- A group process
- Popularized but misunderstood –
  - Not just “sitting down and thinking of ideas”
- A process with guiding principles
- Primary Goal
  - Generation of a large quantity of ideas – “quantity breeds quality”
- Core Elements
  - No judgment of other people’s ideas is allowed
  - No judgment of your own ideas is allowed
  - Build onto the ideas of others
  - Welcome wild ideas
- People Involvement
  - Gather a diverse team of people
  - Designate a facilitator
  - Keep everyone involved

But can 'I' give a storm to my brain?

- "I'm, therefore, I'm right": Opinion by Jim Sollisch in Christian Science Monitor, July 21, 2011
  - The culture of 'I'
  - Base our thinking and behavior almost exclusively on personal experience
  - "I experience, therefore, I am right"
  - Result: Lack of critical thinking
  - What accelerated Americans to become shallow thinkers? Internet's segregation by their interests
- "The Shallows: What the Internet is doing to our brains" –by Nicholas Carr
  - "The Internet rewards shallow thinking: One search leads to thousands of results that skim over the surface of a subject."
  - People skim on line; they don't read.
  - And there is tangible evidence, based on studies of brain scans, that the medium is changing our physical brains, strengthening the synapses and areas used for referential thinking while weakening the areas used for critical thinking.



Problem Definition (Answer to “what is THE problem?”)

- Process of Defining Problem
  - Outline why the present situation is so dissatisfying
  - Asking questions about it
  - Comparing it to other situations that are familia or where experience already exists
  - Gaining and understanding what caused it.
  - Then “*one sentence problem statement*” which includes every element
- **Needs from customer:**
  - **“Actually, we need help figuring out how to fit everything in our room… it’s way too small for all of our stuff,’**
  - **And your problem statement is?**

Gathering Information

- Search for Current Status of Art
  - Patent Search
  - Web Search
  - Market Search
- Customer Interview
  - Customer Interview
  - Focus group interview
  - Objective is to define needs not to wring out a solution
- Gathering Information from Within the Design Team
  - Draw insight from previous experiences
  - Focus on customers needs NOT team's own needs
  - Use Creativity

Class Activity

- Form a Group (temporary)
- *Define the needs* and *Identify the problem*
  - "Individual Idea Generation (10 minutes)
  - Brainstorming (10 minutes)
- Writing and Submission (10 min)
  - Problem Definition --- 1 complete sentence