- Thinking, Problem Solving and Language
- 1. Thinking: Elements of thought

1.1 Thinking: a cognitive process in which the brain uses information from senses, emotions, and memory to create mental representations, such as concepts, images, schemas, and scripts.

1.1.1 *Concepts*

- ✓ Mental grouping of similar objects, ideas, or experiences
- ✓ Disparate experiences into familiar mental categories
- ✓ Organize experiences

  Genus (common ancestor, *Panthera*)
- ✓ Further examples of concepts: Bags, Birds, chairs, truth, love.
- ✓ Mental structures, hence unobservable
- ✓ Inferring concepts from their influence on behavior

1.1.1.1 Two kinds of concepts: Natural concepts and artificial concepts

- ➢ Natural concepts: Mental representations of objects and events drawn from our direct experience
- ✓ Birds, Mother's face, Red Fort
- ✓ Imprecise. Example: prototype.
- ▸ Artificial concepts: Concepts defined by rules, such as word definition and formulas

1.1.1.2 Concept hierarchies: Levels of concepts from most general to most specific, in which a more general level includes more specific concepts

1.1.1.3 Cultural variations in concepts and thoughts

- ✓ Does your culture think in terms of logic/reason or experiences?
- ✓ What is time?
- ✓ What is interpersonal space?
- ✓ What is democracy?
- ✓ What is secularism?

1.1.2 Imagery and cognitive maps:

1.1.3 Schemas: cluster of related concepts providing a framework for thinking about objects, events, ideas, or even emotions.

- ➢ Expectations: example – terminal
- ➢ Making inferences: New but incomplete information can make sense if you relate it to existing knowledge in your stored schemas

1.1.4 Scripts: schemas about roles, persons, and ourselves.

- ▸ 1. System 1 and system 2: Two actors in the acting of mind
- ▸ What is system 1 and system 2?
- ➢ System 1: Automatic, quick, no effort, and no sense of voluntary control. Includes reflexes and learned skills.
- ➢ System 2: Allocating attention to effortful mental activities, complex tasks, and demanding concentration and control

  Please answer following questions as fast as possible:

1. Capital of India_____
2. Bread and _____
3. 2 X 2 = _____

- ▸ Are these two systems independent or connnected?

  Attention to a loud sound or offensive remark or waiting for a relative

- Attention is a budget: Excessive expenditure is costly!
- Task: Write from your unused hand (right/left) your name in a neat handwriting while computing 16 X 37
- Intense focusing/attention can make you blind
- Minimizes effort and optimizes performance
- Conflict between system 1and system 2

Instructions:

1. Go down both the columns, calling out whether each word is printed in lowercase or uppercase

- Conflict between system 1and system 2

Instructions:

1. Go down both columns again, saying whether each word is printed to the left or to the right of center by saying “LEFT” or “RIGHT”

- What if system 1and system 2 speak in different tones?
- You need to mistrust your impressions (system 1) by recalling what you know about the illusion (system 2)
- There are illusions that have no presence in outer world and they are also not hallucination!!!!! **That is COGNITIVE ILLUSIONS**
- 2. Attention and effort: Exploring the ‘might’ and ‘night’ of system 2
- System 2 is effortful, but lazy. Think about the situation when you have to control your temptations and impulses….
- Study by Edward Hess, published in Scientific American that “pupil of the eye as a window of the soul”
- Excessive mental overload leads System 2 protect the most important activity
- Proficiency reduces energy taken. Fewer brain regions involved when skill increases.
- Law of least effort
  - Selecting least demanding course of action
  - Effort is a cost
  - Skill acquisition driven by benefits and costs
- Capabilities of system 2: follow rules, comparing objects on several attributes, and making deliberate choices between options, task sets (programming memory to obey instructions)
- Capabilities of system 1: simple relations, need for order and structure
- 3. Mental energy
- What would be your reaction when you are walking in speed and suddenly some tells you to compute 25 X 79 immediately?

  Physical Reactions:

  You will stop walking

  Stay still and then compute

  Psychological Reactions:

  Exert self-control to slow down

  Deliberate/voluntary information processing
- Is there a possibility that we engage in cognitive tasks effortlessly or without exertion of willpower?

- “Flow” by Mihaly Csikszentmihalyi (pronounced as six-cent-mihaly) : “a state of effortless concentration so deep that they lose their sense of time, of themselves, of their problems”. Its an optimal experience
- Flow separates two forms of effort: concentration and deliberate control of attention
- Both self-control and effort are forms of mental work
- Ego depletion: when you exert self-control in a first task, you are more likely to be less willing to exert self-control in the next task. Study by Roy Baumeister

First group	**Second group**
Highly negative film	Not shown

Task: Both groups were asked to maintain a strong grip on a dynamometer in spite of increasing discomfort

Result: Reduction in the ability to withstand the pain of sustained muscle contraction in the first group than second group.

- Why this occurs:
- ✓ Loss of motivation
- ✓ Cognitively busy and depleted self-control
- ✓ Mental energy reduction
- ✓ Consumption of glucose
- ➢ Finding: Tired and hungry judges tend to fall back on the easier default position of denying requests for parole. (Published in the Proceedings of the National Academy of Sciences)
- Experiment by Baumeister et al.

Case: Of 100 people having surgery, on average, 10 will die during treatment, 32 will have died by one year and 66 will have died by five years.

Of 100 people having radiation therapy, on average, none will die during treatment, 23 will die by one year and 78 will die by five years.

Case: Of 100 people having surgery, on average, 90 will survive the treatment, 68 will survive for one year and 34 will survive for five years.

Of 100 people having radiation therapy, on average, all will survive the treatment, 77 will survive for one year and 22 will survive for five years.

All roses are flowers
Some flowers fade quickly
Therefore some roses fade quickly

- The Lazy system 2

Problem: A bat and ball cost Rs. 70.
The bat costs Rs 60 more than the ball.
How much does the ball cost?

Conclusion:

- ✓ System 2 supported system 1
- ✓ System 2 did not engage in effort
- ✓ System 2 did not check answer because cost is low
- ✓ Followers of law of least effort

- ✓ More than 50 % of Harvard, MIT, and Princeton gave intuitive answer
- ✓ Cognitive effort mildly unpleasant
- ▸ Experiment by Walter Mischel on 4 year old children. Children were given a choice between a small reward (one cookie) which they could have at any time or a larger reward (two cookies) for which they had to wait for 15 minutes.

Result: About half of the children managed and controlled the temptation. 10 or 15 years later, they had higher score on executive measures of cognitive control, especially reallocating attention; less likely to take drugs; higher score on intelligence

- ▸ 4. Forming associations: Domain of system 1

S O __ P

- ➢ **MOBILE FAULT**
- ➢ Interesting study by John Bargh on young students presenting words Florida, forgetful, bald, gray, or wrinkle, and told them to assemble these words into a sentence. Then the researchers measured the time they took to reach one end of the corridor.

Result: Younger people were slower than others who were not shown these words.

- ▸ Forming associations is a task of system 1. Immediate and sometimes below conscious awareness.
- ▸ The fact is, we are not rational and conscious decision makers, and making choices largely occur below conscious awareness.

- ▸ 5. Judging and decision making
- ▸ Confirmation bias
- ▸ Hindsight bias
- ▸ Anchoring bias

Q: Was Gandhi more or less than 105 years old when he died?
How old Gandhi was when he died?

1 X 2 X 3 X 4 X 5 X 6 X 7 X 8=
8 X 7 X 6 X 5 X 4 X 3 X 2 X 1=

- ➢ Representative bias
- ▸ Availability bias

Q : Do more English words begin with ***r*** than have ***r*** in the third position?

- ➢ Tyranny of choice
- ▸ 5. Problem solving
- ➢ General aspects of thinking:
- ✓ Being conscious, especially of product
- ✓ Varying in the extent of direction
- ✓ Amount and nature of the knowledge used vary enormously (the distinction between knowledge rich and knowledge poor situations/tasks)
- ➢ Behaviorist perspective to problem solving
- ✓ Trial- and-error
- ✓ Reproduction of learned responses
- ▸ Gestalt perspective to problem solving

- ✓ Problem solving is more than mere associations
- ✓ Restructure the problem
- ✓ Reproductive problem solving
- ✓ Productive problem solving
- ✓ Kohler ape study
- ✓ Mental set and functional fixedness by Karl Duncker
- ❖ Mental set: the tendency to respond to a new problem in the manner used for a previous problem
- ❖ Functional fixedness: The inability to perceive a new use for an object associated with a different purpose
- ❖ Self-imposed limitations
- ▸ Problem-space theory
- ➢ Studies done by Allen Newell and Herb Simon, leading to the discoveries in cognitive psychology and artificial intelligence
- ▸ Abstract structure of a problem
- ✓ A set of states
- ✓ Initial state: standing outside the maze
- ✓ Intermediate states: Many; moving through the maze
- ✓ Goal state: being at the centre of the maze
- ✓ Operators: actions
- ➢ Implications for problem solving in mind
- ✓ Knowledge states in head
- ✓ Operations: algorithm, trail and error, and heuristics, breaking goal into subgoals
- ▸ How experts solve problems?
- ➢ Difference between experts and novice
- ➢ Origin of problem-solving expertise
- ✓ Examination of the chess game, fitting well into problem-space theory
- ✓ Newell and Simon (1972) reported a program called MANIAC that makes 1,000,00 moves at each turn. But ineffective
- ✓ Deep blue vs. Gary Kasparov in 1997. Deep blue won by processing 9 billion moves at each turn per second
- ✓ Insight for expertise: limited searching capacity
- ▸ DeGroot (1965,66) study on chess playing between grandmasters and experts, using *thinking aloud*
  Result: Grandmasters took less time than experts
- ✓ Revisiting old moves
- ➢ Study by DeGroot
- ✓ Presented chess masters and experts board presentation (from 2 to 15 seconds)
- ✓ Chess masters recalled positions very accurately (91 % correct) whereas less expert players made more errors (41 % correct)
- ✓ Chess masters better at recognizing and encoding configuration of pieces
- ▸ Chunking in chess: Study by Simon and associates
- ✓ Found that masters divided board into seven units containing more information in short-term memory
- ▸ Creativity

Robert Weisberg:
Our society holds a very romantic view about the origins of creative achievements. This is the genius view, and at its core is the belief that creative achievements come about through great leaps of imagination which occur because creative individuals are capable of extraordinary thought processes. In addition to their intellectual capacities, creative individuals are assumed to possess extraordinary personality characteristics which also play a role in bringing about creative leaps. These intellectual and personality characteristics are what is called “genius,” and they are brought forth as the explanation for great creative achievements.

- Knowledge and understanding (Weisberg veiw)
- Aptitudes- innate potentialities
- Personality traits
    - Independence and individuality assertion
    - Intense interest in a problem
    - Willingness to restructure the problem
    - Preference for complexity
    - A need for stimulating interaction