Memory

- *Memory* is the capacity to retain information over time.
- Memory allows us to learn from previous experiences.
- Memory systems can be characterized by duration, capacity, and coding.
Sensory Memory

- Information from the different sensory modalities is stored in separate sensory memories.

- **Iconic memory** is a visual sensory store with a short duration of less than one second.

- **Echoic memory** is an auditory sensory store with a duration several seconds long.
Sensory Memory

- Sperling (1960) presented letter arrays.
- In the whole report condition, participants attempted to recall the entire array but could only remember several letters.
- In the partial-report condition, they were cued after the display to report the letters in one row only. They could remember all the letters.
- This shows iconic memory has a high capacity, capable of storing most of the information seen in the visual field.
Working Memory

- Sometimes also called *short-term memory*.
- Has a limited capacity. Can only hold a small number of items.
- Capacity can be increased by grouping items into meaningful wholes called *chunks*. Limit is about $7\pm2$ chunks.
- Has a limited duration. Information can decay in seconds.
- Duration can be increased by repeating items, a process called *rehearsal*.
- Coding can be acoustic, visual, or semantic.
Working Memory Duration

Peterson and Peterson (1959).
Long-Term Memory

- Consists of several distinct subtypes.
- Implicit or *procedural memory* holds knowledge for skills such as riding a bicycle. It is demonstrated by doing and occurs without conscious recall.
- Explicit or *declarative memory* holds memory for facts or events. It is demonstrated by saying and occurs with conscious recall.
Declarative Memory

- Declarative long-term memory consists of two types.
- *Semantic memory* contains factual knowledge and can be organized hierarchically. Example: George Washington was the first president of the United States.
- *Episodic memory* contains personally experienced events and is organized temporally or spatially. Example: What you did on your last birthday.
Semantic Memory Duration

The Modal Memory Model

- Formulated by Atkinson and Shiffrin (1971).
- Shows how information is transferred between the major memory types.
- The first major process model.
The ACT* Memory Model

The Working Memory Model

- Shows interactions between components of working memory.

- Visuo-spatial sketchpad
  Processing of visual information

- Executive control system
  Supervises and controls processes

- Articulatory loop
  Rehearsal and processing of auditory information
Visual Imagery

- A visual image is a mental representation of an object or scene that preserves metric spatial information.
- Images are constructed internally from information in memory.
- Imagery and perception utilize the same neural machinery.
The Kosslyn-Schwartz Theory of Visual Imagery

- A *surface representation* of an image is quasi-pictorial and occurs in a spatial medium.
- A *deep representation* consists of the information in long-term memory used to generate the surface representation.
Image Processes

- *Image generation* refers to the formation or construction of an image. Examples: part placement and resizing.

- *Image inspection* is reading off the image to extract information. Examples: scanning, zooming, and panning.

- *Image transformation* is an operation that is applied to an image. Examples: rotation about different axes.
Problem Solving

- Transforming a given situation into a desired situation or goal.

Characteristics of problem solving:

1. Goal directedness
2. Sequence of operations
3. Cognitive operations
4. Subgoal decomposition
The Problem Space

- Represents possible steps toward solving the problem.
- States are nodes. Operators that transform a state produce paths to other states.
The Tower of Hanoi

- Get all the discs onto peg 3 in the same order.
- Move only one disc at a time.
- Can only place a smaller disc on top of a larger one.
A Block-World problem
An example of a cognitive architecture used to solve problems (Newell, 1991).

Knowledge in LTM selects operators and guides search through the problem space.

Goes through a decision cycle based on acquiring evidence and then executing a decision.

Operators can be selected based on preferences.

Can create novel subgoals when unable to proceed further.
How SOAR Might Solve a Block-World problem

[Diagram showing the process of solving a block-world problem using SOAR, with initial, intermediate, and final states, and permissible operators at each step.]

- Initial state: A beside B, B beside C, C beside A
- Intermediate states:
  - B moved to A
  - A moved to C
  - C moved to B
- Final state (Goal state): A, B, C in that order