Biological Vision and Applications
Module 06-07: Long Term Memory

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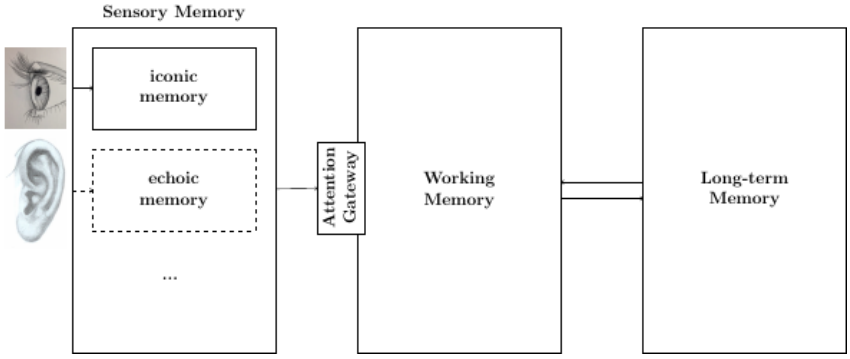
Memory pipeline



Long-term and short-term memory

- Short-term memory (STM)
  - Stores sensory information, current context (internal)
  - Can recall data from Long term memory
  - Used for deliberation
- Long-term memory (LTM)
  - Stores information for a longer term
    - ... indefinitely ?
  - Stores knowledge, experience
  - Unlimited capacity
    - Accessibility (recall) can be a constraint

Long-term memory (LTM)

- **Declarative Memory (Explicit)**: *What*
  - Stores declarative (explicit) form of knowledge
  - Recalled consciously and reasoned with
    - A banana is yellow
    - An apple is round
    - Sampled marbles in bag no. 1 are all blue
- **Procedural Memory (Implicit)**: *How*
  - Stores the (implicit) knowledge about how to solve a problem
    - A machine learned image classifier
  - Knowledge is not recalled consciuosly – cannot be explicitly described

Declarative Memory

- Semantic:
  - General facts that universally hold good
    - A banana is yellow
  - Independent of personal experience
- Episodic:
  - Memory of previous experiences, including
    - context (time, place, associated events, emotions)
  - Can be recalled after it has happened
    - Sampled marbles in bag no. 1 are all blue
- Episodic knowledge may be abstracted to Semantic knowledge
  - All marbles in bag no. 1 are blue
  - All bags contain marbles of same color

Retention in Long-term Memory

Is LTM "permanent"?

- Sometimes we fail to recall experience / knowledge
  - Decay in episodic memory (permanent)
  - Retrieval failure (temporary – some time, can recover with cues)
- Decay
  - We generally tend to remember experiences that evoke extreme emotions longer
    - ... Not always true
  - LSTM is an attempt to implement selective retention of episodic memory
  - Modeling decay in semantic memory is even more complex
- Retrieval failure – difficult to model

Associative Memory

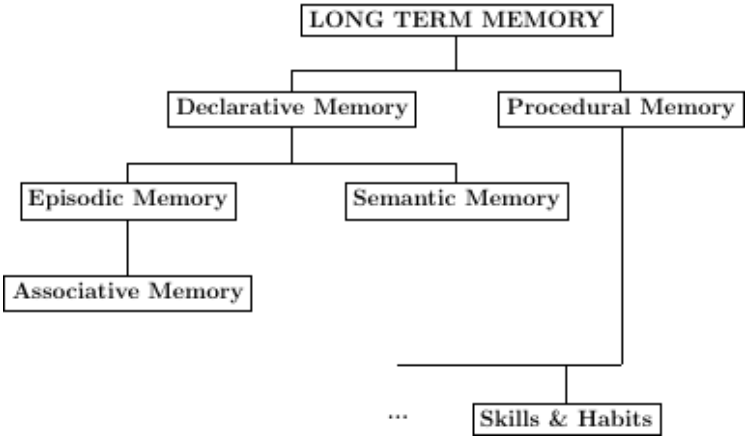
A class of Episodic Memory

- Particularly useful for sensory perceptions
- Associates entities (e.g. objects) with sensory properties (e.g. shape, color, ...)
- The object can be quickly recalled from the perception
- Also known as Content Addressable Memory (CAM)
- Why is associative memory episodic (not semantic)?

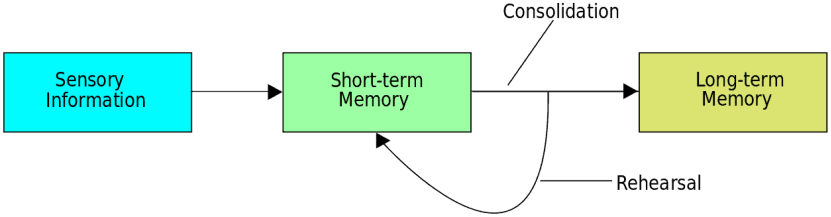
Procedural Memory

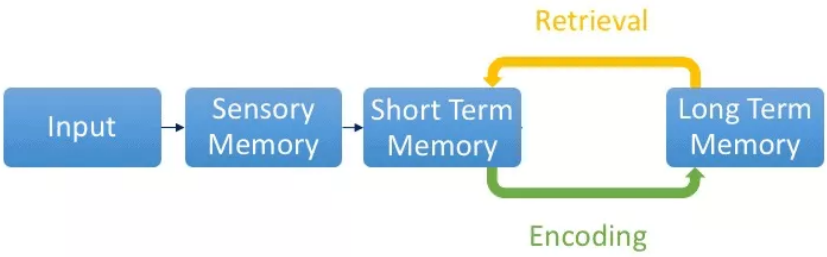
- Can be hold various types of procedural information
  - Skills and habits (how-to's)
    - Example: How to recognize an object
    - Implemented as a classifier (black-box)
    - Done this way by an agent ... could be done in a different way too
  - ...

Long-tem Memory



STM and LTM


Consolidation
Sensory Information
Short-term Memory
Long-term Memory
Rehearsal


Retrieval
Input
Sensory Memory
Short Term Memory
Long Term Memory
Encoding

Quiz

Quiz 06-07

End of Module 06-07