How Minds Work
The IDA Cognitive Cycle

Stan Franklin
Computer Science Division &
Institute for Intelligent Systems
The University of Memphis
Memory Systems

Human Memory Systems

- Sensory Memory
- Working Memory
- Transient Episodic Memory
- Long-term Memory
  - Conceptual Memory
  - Declarative Memory
    - Autobiographical Memory
    - Semantic Memory
  - Procedural Memory
Global Workspace Theory I

- The nervous system is a distributed parallel system with many different specialized processors
- Coalitions of processors compete for access to a Global workspace
- Contents are broadcast globally to all other processors
Global Workspace Theory II

- Recruit other processors needed for any degree of novel or problematic situation
- Unconscious contexts and context hierarchies influence consciousness
- Learning requires only consciousness
Cognitive Cycle Processing

- **Hypothesis** — Like IDA's, human cognitive processing is via a continuing sequence of Cognitive Cycles
- **Duration** — Each cognitive cycle takes roughly 200 ms with steps 1 through 5 occupying about 80 ms
- **Overlapping** — Several cycles may have parts running simultaneously in parallel
- **Seriality** — Consciousness maintains serial order and the illusion of continuity
- **Start** — Cycle may start with action selection instead of perception
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Sensation

• Sensory receptors are directed by action
  – Saccades of the eyes
  – Sniff
  – Turing of an ear
  – Sending of an echolocation signal

• The environment impinges on receptors
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Perception

- Filters sensory input based on expectation
- Simultaneously attaches meaning to it
- Identifies individuals, categories, relations and feelings
- Produces a percept including individuals, categories, relations, ideas, and some interpreted sensory data, i.e., qualia
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Percept to Working Memory

• Preconscious working memory buffers
• One for each sensory modality (?)
• One for binding (?) Controversial—may occur during perception
• Decays over a relatively few cycles (a few tens of seconds in humans)
Local Associations

• Working memory contents cue
  – Transient episodic memory
  – Declarative memory
• Produces local associations in long-term working memory
• Including prior feelings and actions
• Long-term WM includes WM
• Working memory = long-term WM?
Codelets

- Small pieces of code each performing a simple, specialized task
- Often waits as a demon, watching for a chance to act
- Implement processors from Global Workspace theory
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Competition for Consciousness

• Attention—process of bringing to consciousness
• Looking at L-TWM, attention codelets form coalitions with information codelets
• Coalitions compete for consciousness
• Relevance, importance, urgency, insistence, etc., measured by affect
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Conscious Broadcast

- Winning coalition of codelets occupies the Global Workspace (a tautology)
- The contents of Global Workspace are broadcast to every codelet
- The result is learning of several kinds, and the recruitment of resources
Episodic Learning

• Encoding of conscious contents in Transient Episodic Memory
• As events — what, when and where
• Includes current feelings
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Perceptual Learning

- Using the broadcast contents of consciousness
- Strengthen (or weaken) existing objects, categories, ideas, relations, feelings, etc.
- Create new objects, categories, relations,
Procedural Learning

• Using the contents of consciousness
• Reinforce those schema that were successful in recently prior acts
• Amount and valence of reinforcement depends on arousal level and degree of success
• Learn new parallel and sequential schema
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Attentional Learning

• Successful attention codelets are reinforced
• New attention codelets are created as needed
Behaviors & Behavior Streams

- Behavior—a coalition of behavior codelets (goal contexts)
- Underlying behavior codelets can accomplish the goal
- Behavior stream—a stream of related behaviors (goal context hierarchies), best thought of as partial plans
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Recruitment of Resources

- Behavior codelets in priming mode respond to specific contents and
  - Instantiate behavior streams
  - Bind variable in behaviors
  - Allocate environmental activation
  - Allocate motivational activation
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Action Selection & Action

• IDA’s behavior net chooses among competing behavior in competing streams
• A single behavior is chosen
• Its underlying behavior codelets perform their tasks—IDA’s action during that cycle
• The internal or external environment is affected
Readings

• Read about Global Workspace Theory in

• Read about IDA’s Cognitive Cycle in
Email and Web Addresses

• Stan Franklin
  – franklin@memphis.edu
  – www.cs.memphis.edu/~franklin

• “Conscious” Software Research Group
  – www.csrg.memphis.edu/