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please send me
- name
- email address(es)
- program you are in
- background (optional)
  - related course work
  - interests
  - work experience
  - etc.

quizes, assignments, final
participation, attendance

academic integrity / plagiarism

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Introduction to Human Information Processing

OUTLINE

1. Motivations

2. Cognitive Psychology and Science

3. History of Cognitive Psychology / Science

4. Role of Neuroscience

1. Motivations

Intellectual Curiosity

Foundations for Other Fields
- clinical, social psychology
- political science
- economics
- sociology
- linguistics

Practical:

Information Science:

Humans are at center of information systems (which are extensions of human functionality)

- What are those functions
- Human Factors Issues

Information Systems carry out or involve human functionality

- Intelligent Systems Issues

Human Information Processing

- Inputs
  - Sensation
  - Attention
  - Perception
  - Pattern Recognition
- Storage
  - Interpretation
  - Memory Storage and Retrieval
  - Knowledge Representation
- Processing & Utilization
  - Learning
  - Decision Making
  - Problem Solving
  - Reasoning
  - Planning
- Communication
  - Language

Information Systems Involve:
- problem solving & decision making
- information storage and retrieval
  - databases
  - text retrieval
  - knowledge representation
    - declarative knowledge
    - procedural knowledge
- analysis of textual information and knowledge

Cognitive engineering:
- information capacity
- limits of attention
- pragmatics of communication
- cognitive task analysis

Direct Applications and Implications

- Education, training and performance
  - Computer-based education
    - Computer Aided Instruction
    - Intelligent Computer Aided Instruction
    - Intelligent Tutoring Systems (ITS)
  - testing
- Human Computer Interaction (HCI),
  - interface design
  - natural language interfaces
  - visual interfaces
  - multimedia/multimodal interfaces
- Human Factors
- Expert Systems, Knowledge Engineering, Robotics
- Implications, e.g.,
  - Law, Moral & Political Issues

2. Cognitive Psychology and Cognitive Science

Mature Systems vs. Research Science

Need for Abstract Analysis

Formal Information Processing Models

- separation from physical instantiation
- patterns and manipulations of patterns
  - finite "rules" ⇒ infinite applicability
- representational aspect:
  - structural isomorphism:
    - between structures
    - between processes

Cognitive Psychology vs Cognitive Science

Research Techniques:

1. Experimental
   - Independent and Dependent Variables
     - patterns of errors
     - reaction time
   - functional relations between variables
   - data for (causal) model construction
2. Formal Theories
   - linguistics, philosophy, comp. science
3. Computer Simulation

3. History of Cognitive Psychology & Science

3.1 Greeks: Plato and Aristotle

memory and thought
empiricist vs. nativist (rationalist) views
associationism

3.2 Classical Philosophy:

Nativism — Descartes, Kant

Rationalism — Leibniz, Hobbes
- thinking as formal reasoning,
  - manipulation of non-numeric symbols
    - e.g., Boole

British Empiricism — Locke, Hume, Mill, Berkeley
- associationism
  - direct perceptions
    - faint copies of percepts
      - associations of copies

3.3 Structuralist Psychology (19th century)

Wundt 1879 first laboratory
- elementatrism, reductionism
  - reduction screen, introspection,
  - close to raw sensory data

Wurzburg School, Kulpe
- imageless thought debate
  - (Mayer & Orth, 1901)

 need for objective methods

3.4 Behaviorism — Watson, Skinner

anti-mentalism,
stimulus-response bonds,
reinforcement
associationism

3.5 Reemergence of Cognitive Psychology
Effects of WWII, Developments in 1950's

- Failure of Behaviorism
  - WWII evaluation and training of personnel
- Human Factors
  - instrumentation, aviation, detection
- Information Theory
  - information theory: Shannon
    - coding, translation etc.
    - signal detection theory
  - cybernetics (Wiener), technology
    - missiles, radar, communication etc.
- Broadbent - theories of attentions
  - active role of individual
- Computer Science
  - flow and structure of information
  - control analogies
  - neural analogy: perceptrons
  - formal algorithms for cognitive procedures
    - 1956 Newell and Simon
- Linguistics
  - Chomsky 1957
    - productivity, regularity
    - formal theoretic nature
      - rules, plans, organization
    - deep vs surface structure
    - criticism of Skinner (behaviorism)
      - lack of objectivity
    - unanimity in linguistics

4. Neuroscience and Cognition

differentiating between cognitive theories

vs. explaining how

neural representation?

computer analogy

levels of abstraction/analysis

example: perception