Module XII: Problem Solving

- Definition of a problem
  - Unfulfilled goal
- Newell & Simon (1972): Four Features of a Problem
  - Goal
  - Objects
  - Operations/Actions
  - Constraints
  - Well-Defined vs. Ill Defined problems
  - Initial State, Goal State, Operators
- Problem of representation
  - Duncker’s Buddhist Monky Problem
  - Carroll, Thomas, Malhorta (1880): Spatial vs. Temporal Organizing
  - Mutiated Checkerboard
  - Adams’ example of paper folding (71 million miles!!)
- Algorithms
- Four Types of Heuristics
  - Inference
    - Train/Bird Problem
  - Means-End Analysis/Difference Reduction (working forward)
    - Hobbits and Orcs (or... Missionaries and Cannibals)
  - Working Backwards (math problems, proofs)
    - Only works if operators and goal-state are well-defined
  - Analogy (Gick & Holyoak, 1983)
    - Army, Radiation, Fire
- Functional Fixedness
  - Duncker’s Matchbox & Candle example
  - Maier’s String Problem
- Set Effects
  - Luchin (1942 water jug problem
  - Anagrams & Series completion
  - Drinking Glass Problem
  - Nine Dot Problem
- Cultural/Taboo effects: ping pong ball
- Incubation
  - Cheap Necklace Problem
  - Explanations
    - Fatigue
    - Memory
- Unconscious Processing
  - Insight
    - Metcalfe & Wiebe (1987): warmth ratings
    - Corn Maze
    - Riddles
  - Ways to improve problem solving

**Module XIV: Reasoning**
- Normative vs. Descriptive theories
- Deduction vs. Induction
- Logic
- Conditional Statements
- Validity (deductive) vs. Truth (inductive)
- Valid Rules of Inference
  - Modus Ponens
  - Modus Tollens
- Confirmation Bias
- Wason Selection Task
  - Twist on Wason (Evans & Lynch)
    - Matching Bias
  - Concrete examples (context) for Wason Selection
    - Johnson-Laird, Legrenzi, & Legrenzi (1972): Postage Rule
    - Griggs & Cox (1982): Postal Rule with dif. age groups
      - Memory-Retrieval Explanation
    - Pragmatic Reasoning Schemata (Cheng & Holyoak, 1985)
      - Permission Schema
      - Obligation Schema
    - Social Contract Theory (Cosmides)
- Descriptive Reasoning
  - Role of contradictory evidence
    - Sweeney & Gruber (1984): Nixon/Watergate study
    - Lord, Lepper, & Ross (1979): Capital punishment study
    - Vallone, Ross, & Lepper (1980): Hostile media effect
      - Palestinians vs. Israelis
      - Carter vs. Reagan debate

**Module XV: Judgment & Decision Making**
- Judgments of Similarity
- Common vs. Distinctive Features
  - Alligators, Crocodiles, & Elephants
- Tversky's Contrast Model
  - Weighting of features
  - Less known objects judged more similar because less distinctive features are known.
- Estimates of Probability
- Representativeness Heuristic
  - Coin toss & Die roll examples
  - Hollywood actress...democrat or divorced 5 times.
- Gambler’s Fallacy
- Base-Rate Neglect
- Conjunction Fallacy
  - Linda is a bank teller. (Kahneman & Tversky, 1983)
- Availability Heuristic
  - [-_N_] vs. [-]:[N] words example
  - Married couples & household chores (Ross & Sicoly, 1970)
  - Frequency of reported deaths (Slovic, Fischhoff, & Lichtenstein, 1979)
- Decision Making
  - Relation to Classical Economics
  - Description Invariance
  - Framing Effects
    - Ratio-Difference Principle
      - Employment vs. Unemployment (Quattrone & Tversky, 1988)
    - Pseudo-Certainty Effect
      - Vaccine example (Slovic, Fischhoff, & Lichtenstein, 1982)
      - Probabilistic Insurance
        - Odd vs. Even days
    - Risk Aversion
      - People are risk averse in the domain of gain
      - Lives saved vs. lost (Kahneman & Tversky, 1984)
    - Loss Aversion
      - People are risk seeking in the domain of loss
      - Endowment Effect (Kahneman, Knetsch, & Thaler, 1990)

Module XVI: Cognitive Neuroscience
- Complexity ("most mysterious thing in the world," William James)
- Plasticity
- Neurons
  - Structure of the Neuron
    - Soma (Cell Body)
    - Dendrites
    - Axon
    - Myelin
    - Terminal Buttons
    - Neurotransmitters
  - Action Potentials (All or None)
  - Synapse
- Transduction
  - Visual transduction
  - Role of the corpus callosum
    - Gazzaniga’s Split-Brain Studies
- Specificity coding vs. distributed processing
- Localization of function
- Hemispheric Specificity
  - Rule of thumb: Left is Language
- Location and Function of Lobes
  - Occipital: Vision
- Temporal: Hearing & “What” system
- Parietal: “Where” system & Sensory integration
- Frontal: Attention & Cognitive control

- Additional important structures of the cerebral cortex
  - Hippocampus
  - Amygdala
  - Primary motor cortex
  - Primary somatosensory cortex
  - Broca’s area
    - Broca’s aphasia: production problem
  - Wernicke’s area
    - Wernicke’s aphasia: comprehension problem

- Measuring brain activity
  - Lesion studies
  - Single-Unit Recordings (microelectrodes & in-situ)
  - EEG: great time lock, poor spatial resolution
  - MEG: great time lock, slightly better spatial resolution
  - PET: poor temporal resolution, good spatial resolution
  - fMRI: decent time lock, excellent spatial resolution