Lecture 10

Part One:
Connectionist vs Symbolic

Dennett (Again)

- Intentional action
  - A way of viewing behavior (from the intentional stance) such that it is the product of a rational believer
- Examples
  - Hailing a taxi
  - Requesting to speak
  - Ordering 500 shares in General Motors

Dennett (Again)

- I can order 500 shares in General Motors by…
  - Picking up the phone with my left hand
  - Picking up the phone with my right hand
  - Emailing my bank
  - Emailing General Motors
  - Emailing my Mother
  - Going to see my stockbroker…
- Someone who fails to see that these are all ways of ordering the shares is missing a real pattern

Dennett (Again)

- If I know you desire to get rich…
- And I know you believe the value of GM shares are about to go up…
- Then I can predict that you will order shares in General Motors!
- But I can’t predict whether you will pick up the phone with your left or your right hand or whether you will phone…

Where we are at:

- Introduced folk-psychology and the idea that mental states are propositional attitudes
- Folk-psychology, autism, and modularity
- The nature of mental states
  - Can computers have whatever it is that we have that allows us to have mental states?
- What would that computer be like?
  - Aka: What is it that we have?

Symbol Systems

- Based on the notion that the structure of language, logic, and thought is the same
  - That it is propositional in structure
    - Meaningful units (symbols or symbols structured into meaningful bigger units - propositions)
    - That mental states (belief, desire, hope etc) are attitudes (relations) to those propositional contents

Symbol Systems

- Symbols (meaningful units)
  - Cat, John etc
- Rules of combination (to build bigger meaningful units)
  - John likes the cat
  - The cat likes John
  - Cat John the likes - not allowed
- Rules of inference / deduction / state transition
  - If George is a cat and all cats are mammals… then George is a mammal
  - If input 50c then goto state 2

Symbol Systems

- Symbol string encoding
  - Body of declarative statements written in formal notation based on the structure of language and logic (e.g., LISP programming language)

Symbol Systems

- Serial, feed-forward processing
  - One processing stream
  - Feeds sequentially forwards from input to internal state to internal state to output
- In a discrete state (symbol or proposition) then transition to another discrete state

Connectionist

- Also known as:
  - Parallel Distributed Processing (PDP)
  - or Artificial Neural Networks
  - Units (input, hidden, output)
  - Weighted connection

Connectionist

- The number of units, the number of connections, and which units are connected are decided by the architect
- The initial weightings are often randomly set
- The designer then gives the network a series of training cases… And the network learns

Connectionist

- To begin with the outputs tend not to be the desired outputs
- BACKWARDS PROPOGATION LEARNING ALGORITHMS can then be used to adjust the weight so that it gets the case right
- Large number of training cases
- Eventually gets new cases right

Connectionist

- Processing is DISTRIBUTED as activation over different units
  - Symbolic architectures are in discrete states
- Processing occurs in PARALELL with many connections participating in producing the output
  - Symbolic architectures had only one seriel processing stream of state transitions
- Connectionist networks aren't explicitly programmed with a knowledge database and series of rules for state transitions
  - Symbol systems had knowledge databases and rules programmed into them in symbolic languages

DECtalk (symbolic)

- A model of grapheme (letter) to phoneme (sound) transition (text to speech)
  - Program a knowledge database of rules and exceptions

NETtalk (connectionist)

- A model of grapheme (letter) to phoneme sound transition (text to speech)
- Fix the architecture (number of units and connections between units)
- Use a learning algorithm (backwards propogation)
- Feed cases

NETtalk (connectionist)

- Outputs initially babble
- Then semi-recognizable words and syllable structure
- Then it got pretty good

NETtalk (connectionist)

- NETtalk had:
  - Trained input of 7 letters
  - 7 groups of input units
    - Each group comprising 29 individual units whose overall activation specified one letter
  - 80 hidden units
  - 26 output units
  - 18,829 weighted connections