

Lecture 10

Part Two: Connectionism: Features and Problems

Plan

- Features
 - Neurologically
 - Behaviorally
 - learning
- Problems
 - Folk psychology
 - systematicity
 - Commonality
 - post-training analysis
 - biologically

Features - Neurologically

- Seems more neurologically plausible than symbolic architectures
 - Units bear a striking resemblance to neurones
 - Connections bear a striking resemblance to axon / dendrite connections between neurones
 - Distributed activation (parallel processing) seems more neurologically plausible than serial feed-forward

Features - Behaviorally

- Neural networks seem to be good at the things we are good at
 - Generalizing to new cases
 - Recognizing objects and patterns
- Neural networks seem to be bad at the things we are bad at
 - Sequential logical (or mathematical) derivation

Features - Learning

- Networks seem to recapitulate our learning
 - Similar sorts of errors to human infants
 - Eventually gets generalizations right
- Networks seem to recapitulate the way we unlearn
 - More damage results in worse performance (graceful degradation)
 - Gradually gets generalizations wrong

Problems - Folk Psychology

- Our common-sense folk-psychological intuition:
 - Mental states are FUNCTIONALLY DISCRETE, SEMANTICALLY INTERPRETABLE, INNER STATES (symbols)
 - That play a causal role in inference and behavior

Problems - Folk Psychology

- A neurologically plausible feature of PDP networks...
 - Distributed rather than discrete states
 - Paralell rather than sequential processing
- Seems to sit badly with our folk-psychological intuition about mental states

Problems - Systematicity

- (Fodor)
- Thought is systematic
- So internal representations are structured
- Connectionist models lack structured neural representations
- So connectionist models aren't good models of thought

Problems - Systematicity

- To know a language involves knowing the parts (e.g., Cat, John etc) and how they fit together
- If you can think 'the cat loves John' then you are capable of thinking 'John loves the cat'
 - Maybe connectionist architectures can support this
 - Or maybe thought derives its systematicity from language and not the other way around

Partial Response

- Empirical question whether connectionist architectures can support systematicity
- Lions might not have systematicity. If they can think 'I want to eat the puppy' they might not be capable of thinking 'the puppy wants to eat me'

Problems - Can't Capture Commonality

- Could have a network that can store 16 propositions and the same network updated to store 17
- There might be no overlap in node activation or weightings
- Doesn't seem to be anything in common between the networks (but they have common propositional contents)

The Problem of Post-Training Analysis

- How do we figure out what kinds of representations the network has acquired?
- Cluster analysis (statistical technique)
- Damage

Cluster Analysis

- Microstructural content e.g., black cat in the visual field with minor variations for different orientations
- Panther and cat aren't semantically overlapping (though black cat and black panther are) but might have overlapping features
- Sale and sail should overlap (same output) whereas pint and hint (despite substantial letter overlap are quite different phonetically)

Cluster Analysis

- The idea is then that cluster analysis can help us recover more traditional symbolic contents from connectionist architectures
- Concern that connectionist architectures might just be fancy symbol systems
- Clarke thinks that adding temporality prevents this

Response to Problems

THREE RESPONSES

- 1) Look harder to cluster profiles for discrete symbolic content (Clarke)
- 2) Folk psychology doesn't commit us to discrete symbolic content (Dennett)
- 3) So much the worse for folk-psychology for committing us to discrete symbolic content (Churchland's eliminativism)

Biological Problems

- Very simple models
 - Limited PERCEPTUALLY (typically to only one domain e.g., verbs, letters, pictures)
 - Limited BEHAVIORALLY (typically not actual motor action)
- More neurological detail might be important
- Might be able to join them up...