

Connectionism and Cognitive Architecture

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Abstract

- Methodological questions about levels of explanation
- Why connectionists and classical theories are incompatible?
- Arguments for classical architecture
- Lure of connectionism

What is Connectionism?

- Neural Networks or Neural Nets
- Semantic Information
- Structure Independent
- Distributed pattern

Classical Approach

- String of Symbols
- Explicit rules
- Central controller
- Digital Processing

Theories of mind

- Representationalist
- Eliminativist

Level of explanation

- World has casual relation at many levels of analysis.
- Any level at which states of system are taken to encode properties of world counts as cognitive level.

Nature of the dispute

- Assigning of semantic contents
- Primitive relations
- Architectural difference:
 - Combinatorial syntax and semantics for mental representations
 - Structure sensitivity of the process

Complex Mental Representations

- Role of labels in Connectionist theories
- Connectionist network and graph structures
- Distributed representations

Structure Sensitive Operations

- Learning
- Reasoning

Need for Symbolic Systems

- Productivity
- Systematicity
- Compositionality
- Inferential Coherence

Productivity

- Unbounded capacities of a representational system
- Connectionism cannot represent productivity
- Only symbolic system can represent

Systematicity of cognitive representations

- Learning a part without learning the rest
- Mastery of syntax of language
- Thought is systematic
- Ex: John loves the girl

Compositionality of representations

- Semantical relatedness and systematicity
- Parallelism between syntactical structures and their entailments
- Compositionality implies expressions have constituents

Systematicity of inference

- Exploiting the fact of combinatorial semantics and constituent structure
- Ex: $P \& Q \& R \rightarrow P \& Q \rightarrow P$
- Connectionist can model the above example, also the other inference

Summary

- Argument from systematicity
- Argument from compositionality
- Argument from influential coherence

The Lure of Connectionism

- Rapidity of cognitive processes
- Achieving large-capacity of pattern recognition
- Sensitivity to damage and noise
- “rule governed” and “exceptional” behavior

Replies to the arguments

- Objections are not intrinsic
- Implemented on present computers

Replies to the arguments(contd..)

- Parallel computation and issue of speed
- Resistance to noise and physical damage
- Explicitness of rule

Connectionism as Implementation

- Virtual machine
- Implemented in a certain kind of network
- More of a theory of cognition than a theory of implementation

Conclusion

- Holding out for connectionism than classical view
- Structured mental representation with an associationistic account
- Treat connectionism as an implementational theory