Lecture Summary: Categories and Concepts

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1 Introduction

In this lecture, we explored the concept of categories, which are more abstract than words and play a crucial role in cognitive processes. We began by reviewing the previous lecture's content on vector semantics and word embeddings.

2 Vector Semantics and Word Embeddings

2.1 Word Representations

We discussed how words can be represented using context vectors or word embeddings. A classic model for computing these embeddings is *Word2Vec*, which uses one-hot vectors to represent words in a vocabulary. Each word is represented as a vector of zeros with a single one indicating its position in the vocabulary.

2.2 Neural Network Architecture

The architecture consists of:

- Input layer: One-hot vectors representing context words.
- Hidden layer: A smaller, dense representation of words.
- Output layer: One-hot representation of the target word.

Training is performed using backpropagation on large text datasets to derive dense word embeddings.

2.3 Applications of Word Embeddings

Word embeddings allow for:

- Semantic priming in psycholinguistics.
- Modeling lexical processes through tasks like lexical decision tasks.
- Solving synonym tasks, such as identifying synonyms in language tests.

3 Categories and Concepts

3.1 Definition of Categories

Categories are classes of objects or events that share common properties. They can be concrete (e.g., dogs, cats) or abstract (e.g., numbers, democracy). The process of assigning an object to a category is called categorization.

3.2 Importance of Categorization

Categorization is useful for:

- Cognitive economy: Reducing the amount of information processed.
- Efficient perception: Distinguishing features that help in recognition.
- Making predictions about behavior based on category membership.
- Facilitating communication by establishing shared meanings.

4 Theories of Categorization

4.1 Classical Theory

The classical theory posits that categories are defined by a set of necessary and jointly sufficient features. However, this theory has limitations, such as:

- Difficulty in defining necessary features.
- Inflexibility in category boundaries.
- Inability to account for atypical category members.

4.2 Similarity-Based Theories

Two main similarity-based theories are:

- **Prototype Theory**: Categories are organized around a prototype, which is a summary of the typical features of category members. This theory allows for fuzzy boundaries and accounts for typicality effects.
- **Exemplar Theory**: Instead of a prototype, all encountered instances (exemplars) are stored. New instances are classified based on their similarity to stored exemplars.

5 Limitations of Similarity-Based Theories

Both prototype and exemplar theories face challenges:

- Difficulty in determining which features to compare.
- Context effects that influence similarity judgments.
- The need to account for functional properties in categorization.

6 Conclusion

In summary, categories and concepts are fundamental to cognitive processes, allowing for efficient information processing and communication. While classical theories provide a foundation, similarity-based theories offer more flexibility in understanding how we categorize the world around us.