



Recursive Neural Networks (RvNNs) are a type of deep neural network that process hierarchical or structured data by recursively applying the same set of weights to different parts of the input structure, enabling them to learn and predict based on the relationships within the data.

Here's a more detailed explanation:

- **Hierarchical Data Processing:**

RvNNs are designed to handle data with a hierarchical or tree-like structure, such as sentences, code, or protein structures.

- **Recursive Weight Application:**

The core concept is that the same set of weights is applied repeatedly to different parts of the input structure, allowing the network to learn patterns and relationships at various levels of the hierarchy.

- **Learning Structured Information:**

RvNNs excel at learning and representing structured information, making them suitable for tasks like natural language processing, code analysis, and understanding complex data structures.

- **Applications:**

- **Natural Language Processing:** RvNNs can learn representations of phrases and sentences based on word embeddings, helping with tasks like sentiment analysis and machine translation [1, 3, 5, 6].

- **Code Analysis:** They can be used to understand code structure and identify patterns in programming languages.

- **Image Analysis:** RvNNs can process images by breaking them down into hierarchical structures, allowing them to learn features and relationships.

- **Protein Topology:** They can be used to learn the structure and function of proteins.

- **Advantages:**

- **Model Hierarchical Data:** RvNNs excel at modeling hierarchical data structures.

- **Learn Structured Information:** They can learn detailed and structured information.



- **Share Weights:** They can share weights across different parts of the input structure.

What Is a Recursive Neural Network?

Deep Learning is a subfield of machine learning and artificial intelligence (AI) that attempts to imitate how the human brain processes data and gains certain knowledge. Neural Networks form the backbone of Deep Learning. These are loosely modeled after the human brain and designed to accurately recognize underlying patterns in a data set. If you want to predict the unpredictable, Deep Learning is the solution.

Recursive Neural Networks (RvNNs) are a class of deep neural networks that can learn detailed and structured information. With RvNN, you can get a structured prediction by recursively applying the same set of weights on structured inputs. The word recursive indicates that the neural network is applied to its output.

Due to their deep tree-like structure, Recursive Neural Networks can handle hierarchical data. The tree structure means combining child nodes and producing parent nodes. Each child-parent bond has a weight matrix, and similar children have the same weights. The number of children for every node in the tree is fixed to enable it to perform recursive operations and use the same weights. RvNNs are used when there's a need to parse an entire sentence.

To calculate the parent node's representation, we add the products of the weight matrices (W_i) and the children's representations (C_i) and apply the transformation f :

$$h = f \left(\sum_{i=1}^c W_i C_i \right), \text{ where } c \text{ is the number of children.}$$