SNS COLLEGE OF TECHNOLOGY
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
UNIT- 5
DEEP LEARNING

Recursive Neural Network

Recursive Neural Networks are a type of neural network architecture that is specially designed to process hierarchical structures and capture dependencies within recursively structured data. Unlike traditional feedforward neural networks (RNNs), Recursive Neural Networks or RvNN can efficiently handle tree-structured inputs which makes them suitable for tasks involving nested and hierarchical relationship

Recursion is very preliminary concept of DSA where a function or a structure is defined in terms of itself in such way that during execution it calls itself still the used defined criteria or condition is satisfied. When it is used in neural networks, it is just an ability to process data in a hierarchical or nested manner. Here, information from lower-level structures is used to form representations at higher levels. By using this concept, models can capture more complex patterns present in the nested data.

RvNN is a special Deep Learning which has the ability to operate on structured input data like parse trees in natural language processing or molecular structures in chemistry. The network processes the input recursively, combining information from child nodes to form representations for parent nodes. RvNN mainly used in some NLP tasks like sentiment analysis etc. by processing data which is in the format of parse tree. RvNN processes parse trees by assigning vectors to each word or subphrase based on the information from its children which allows the network to capture hierarchical relationships and dependencies within the sentences.

Working Principals of RvNN

Some of the key-working principals of RvNN is discussed below:

1. **Recursive Structure Handling:** RvNN is designed to handle recursive structures which means it can naturally process hierarchical relationships in data by combining information from child nodes to form representations for parent nodes.
2. **Parameter Sharing:** RvNN often uses shared parameters across different levels of the hierarchy which enables the model to generalize well and learn from various parts of the input structure.
3. **Tree Traversal:** RvNN traverses the tree structure in a bottom-up or top-down manner by simultaneously updating node representations based on the information gathered from their children.
4. **Composition Function:** The composition function in RvNN combines information from child nodes to create a representation for the parent node. This function is crucial in capturing the hierarchical relationships within the data.

Best suited neural network models for recursive data

There are several popular neural network models which are widely used for handling recursive data. Some models are discussed below:

- **Recursive Neural Network (RvNN):** This is already discussed in the article. This model is specifically designed for processing tree-structured data, capturing dependencies within nested or hierarchical relationships.
- **Tree-LSTM (Long Short-Term Memory):** It is an extension of the traditional LSTM architecture, adapted to handle tree structures more effectively.
- **Graph Neural Networks (GNNs):** This model is particularly designed for processing graph-structured data, which includes recursive structures. GNNs are particularly useful for tasks involving relationships between entities.

Now, choosing best model is fully depends on which task we are performing. For simple recursive data where no extensive complex pattern is there and limited machine resources are in concern then the best model is Recursive Neural Network (RNN). Similarly, if there are more complex patterns and messy graph-like data is there then we need to opt for GNN or tree-LSTM. However, GNN requires GPU otherwise execution will take deadly high time.