Neural Network Project - ||

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Agenda

1. Introduction
2. Objectives
3. Scope
4. Assignment Modules
5. Data Flow Diagram
6. Conclusion

Introduction

This app combines semantic query expansion and neural network-based relevance ranking to simplify information retrieval in real-world scenarios. It dynamically computes relevance scores for articles, enabling efficient exploration of cutting-edge technology trends.

Objectives

- Goal:
  - Develop a search engine to rank documents using **a Neural Network based approach**.
  - Optimize user experience by providing relevant and accurate search results.

Scope

- Scope:
  - Implement a neural network to learn and predict results for user query.

Assignment modules

- Text Preprocessing
- Forward Propagation
- Activation Function
- Mean Squared Error
- Expand Query
- Search
- Ranking Documents

Pre-Processing

Preprocessing is a crucial first step in building a search engine or any system dealing with large text data. It involves cleaning and organizing text to make it more "search-friendly."

Pre-Processing Technique:

- Tokenization

Pre-Processing (Continued…)

Tokenization:

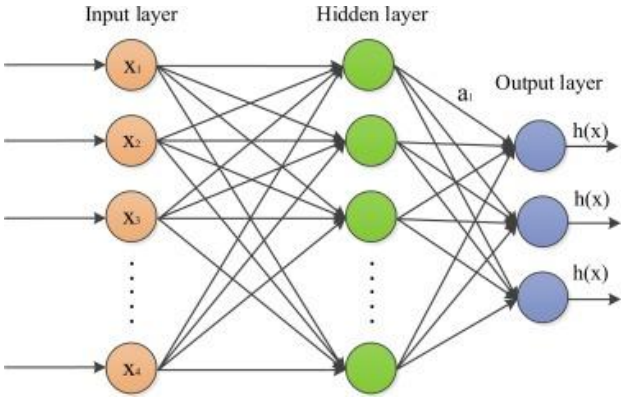
Split text into individual words or "tokens" that can be indexed.

Lets understand with an example:

“Ali plays video games in the evening” ⇨ [“Ali”, “plays”, “video”, “games”, “in”, “the”, “evening”]

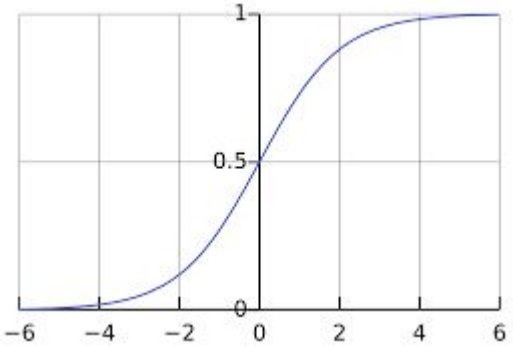
Forward Propogation

- Key Process
  - Input vector is passed to the hidden layer.
  - Neuron sums are computed using weights and biases.
  - Activation function applies non-linearity (Sigmoid).
  - Output layer predicts relevance score.
- Formula
  - Neuron Sum=∑(Input×Weights)+Bias



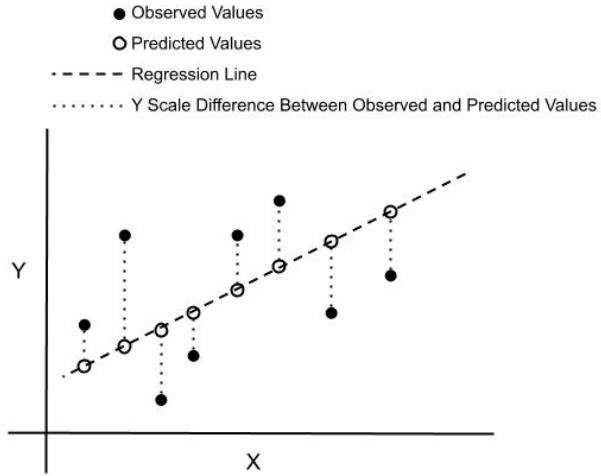
Activation Function (Sigmoid)

- Key Process
  - S-Shaped Curve.
  - Ensures non-linearity in predictions.
  - Transforms input to a probability-like output between 0 and 1
- Formula
  - $\sigma(x) = 1 / (1 + e^{(-x)})$
  - Components:
    - Divide by 1: To control baseline output.
    - Add 1: To avoid division by 0.
    - $e^{(-x)}$: for large x -> 0, small x -> becomes very large



Mean Squared Error (MSE)

- Key Process
  - Measure difference between predicted value and actual value.
  - Helps neural network imporve predictions.
- Formula
  - MSE = $(1/n) \sum_{i=1}^{n} (\hat{y}_i - y_i)^2$
  - $\hat{Y}_i$: Predicted Value
  - Y_i: Actual Value
  - N: no of datapoints.
- Why use MSE:
  - Penalizes large errors more heavily, ensuring accuracy.



Query Expansion

- Expands keywords using semantic relationships.
- Example:
  - Input: [‘ai’]
  - Expanded Terms: [‘ai’, ‘machine learning’, ‘neural networks’, ‘deep learning’]

Search and Document Ranking

- Search documents using expanded terms.
- Neural network predicts relevance scores based on features:
  - Length of terms
  - Diversity of terms
  - Average term length
  - Count of substring of keyword in semantic dictionary

Data Flow Diagram