*Implement KNN Classifier for Sequence Prediction*

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*Abstract*—Machine learning comes out as an advanced and significant technology, evolving in our daily lives. The focus of Machine Learning is to enable computers to learn from the data and make predictions or decisions based on that data, enabling informed decision-making without the need for extra instruction or explicit programming for the system to perform tasks better. The sectors in which machine learning is involved include education, telecommunication, retail, research and development, finance, healthcare, and transportation through data-driven insights. Machine learning has three basic types: Supervised Learning, Unsupervised Learning, and Reinforcement learning. In the domain of supervised machine learning, a variety of classifiers abound, including decision trees, support vector machines, Naive Bayes, and K-nearest neighbors (KNN), each tailored to address specific data analysis challenges. Among the numerous machine learning algorithms, the K-Nearest Neighbors (KNN) classifier is the simplest and most effective for classification problems. This paper presents the implementation of the k- k-nearest neighbor (KNN) machine learning algorithm for predicting outcome variables based on input variables. Leveraging the capabilities of Hierarchical Temporal Memory (HTM) for learning complex temporal patterns, our study focuses on predicting types of sequences: even number sequences, odd number sequences, and decimal number sequences. We integrate the KNN model with the Neocortex API to efficiently classify sequences. The KNN model receives input data in the form of Sparse Distributed Representations (SDR) from HTM. We construct a dataset comprising multiple sequence SDRs, each with varying values within a defined threshold. The KNN model processes a stream of sequence SDRs, with the dataset split into 70% training data and 30% testing data. During testing, the model accurately classifies sequences, achieving a 90.9% accuracy rate with some SDR testing data, and consistently predicts matches with 100% accuracy in most cases. The paper discusses the KNN design procedure, challenges encountered, and potential enhancements to further improve model accuracy.

Keywords— Machine Learning, Hierarchical Temporal Memory, K-Nearest Neighbors, Sequence Classification, Integration, Neocortex API, Accuracy Enhancement.

# **Introduction**

KNN was first developed by Joseph Hodges and Evelyn Fix in the year 1951[1] where further development and we can say modification were led by Thomas Cover [2], in statistics the concept of k-nearest neighbors’ algorithm(k-NN) is involved in the non-parametric supervised learning method. KNN is commonly used for regression and classification. The input consists of K-neighbor training examples in both regression and classification. Remember the output depends on whether the use case is either regression or classification of K-NN.

## Regression

The main difference between classification and regression is that in regression, the output that we get will become the object’s property value. The value is the sum of the nearest neighbor’s values averaged together. If k=1, the output is assigned from that single nearest neighbor.

## Classification

The primary difference between the classifier and regression outputs is that in the former case, the output is the class membership. In classification, the object is classified based on the votes of its nearest neighbors. If k = 1, then the object will be in the class of that single nearest neighbor. The simple function of the KNN model is to predict the target class label. In other words, the class label is often described as a majority voting. The most common terms are technically considered” plurality voting” and” majority vote” The term” majority voting” means the majority needs to be greater the 50% for making decisions. The classification problems with only two classes, like binary predictions, there is always a majority. A majority vote is also automatically a plurality vote. We don’t require multi-class settings to make predictions via KNN in multi-class settings.

# Methods

This section should describe your work in detail. Here you can use references to your work and external sources. This section includes multiple subsections including a description of KNN in detail, The second section tries to focus on the Theoretical background including how the values determined the accuracy and complexity of the classifier. The last section of this section is regarding Hierarchical Temporal Memory (HTM).

# Results

This Part of the text describes results of your works. There can only be mentioned references, MUST point back to Methods and Intro chapter. No more external references.

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# Discussion

Conclusion of your work should be precise and concise. How was the project, what is done, what is the result... There can be discussion on further work and direction.

# Ease of Use

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*a**b* 

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1. Table Type Styles

| Table Head | Table Column Head | | |
| --- | --- | --- | --- |
| Table column subhead | Subhead | Subhead |
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1. Sample of a Table footnote. (*Table footnote*)



Figure 1 Example Figure Caption

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## Code References:

Referencing Code in your text should be avoided unless necessary. In such cases it can be inserted as a listing as shown in **Error! Reference source not found.**

Listing 1 Code Reference Example

Console.WriteLine(“Referencing code”, var);

// using tab can be replaced with 4 spaces

Do not pass code as image. When referring to variable in **Error! Reference source not found.**, italics should be used for example *var.* Code flows and logic should be presented better as Graph or Diagram instead of words.

Code Block which is too big to put in the textbox can be reference as Listing 2.

Listing 2 Unit Test [EncodeDateTimeTest](https://github.com/ddobric/neocortexapi/blob/0348ffb99739ddf8c8c3a875f8162a18073938ca/source/UnitTestsProject/EncoderTests/DateTimeEncoderExperimentalTests.cs#L34-L49)

public void EncodeDateTimeTest(int w, double r, …)

{

…

DateTimeEncoderExperimental encoder = new…

var result = encoder.Encode(input);

…

Assert.IsTrue(result.SequenceEqual(expected…

}

##### Acknowledgment *(Heading 5)*

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