

AI Deep Learning: Recurrent Neural Networks

Fundamentals of Sequence Data

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AI Deep Learning: Fundamentals of Sequence Data



AI Deep learning (Source: mindovermachines.com)

AI Deep Learning: Fundamentals of Sequence Data

1. Sequence Data: What is a Sequence?
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AI Deep Learning: Fundamentals of Sequence Data

What is a Sequence?

- A **sequence** is an ordered list of symbols, things, events, or values.
- The **order** can be determined by **positions** in **space** or **time**.
 - If the elements of a sequence are ordered in time, the sequence is a time series.



Sequence (Source: m.trinitrolley.com)

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Examples of Sequence

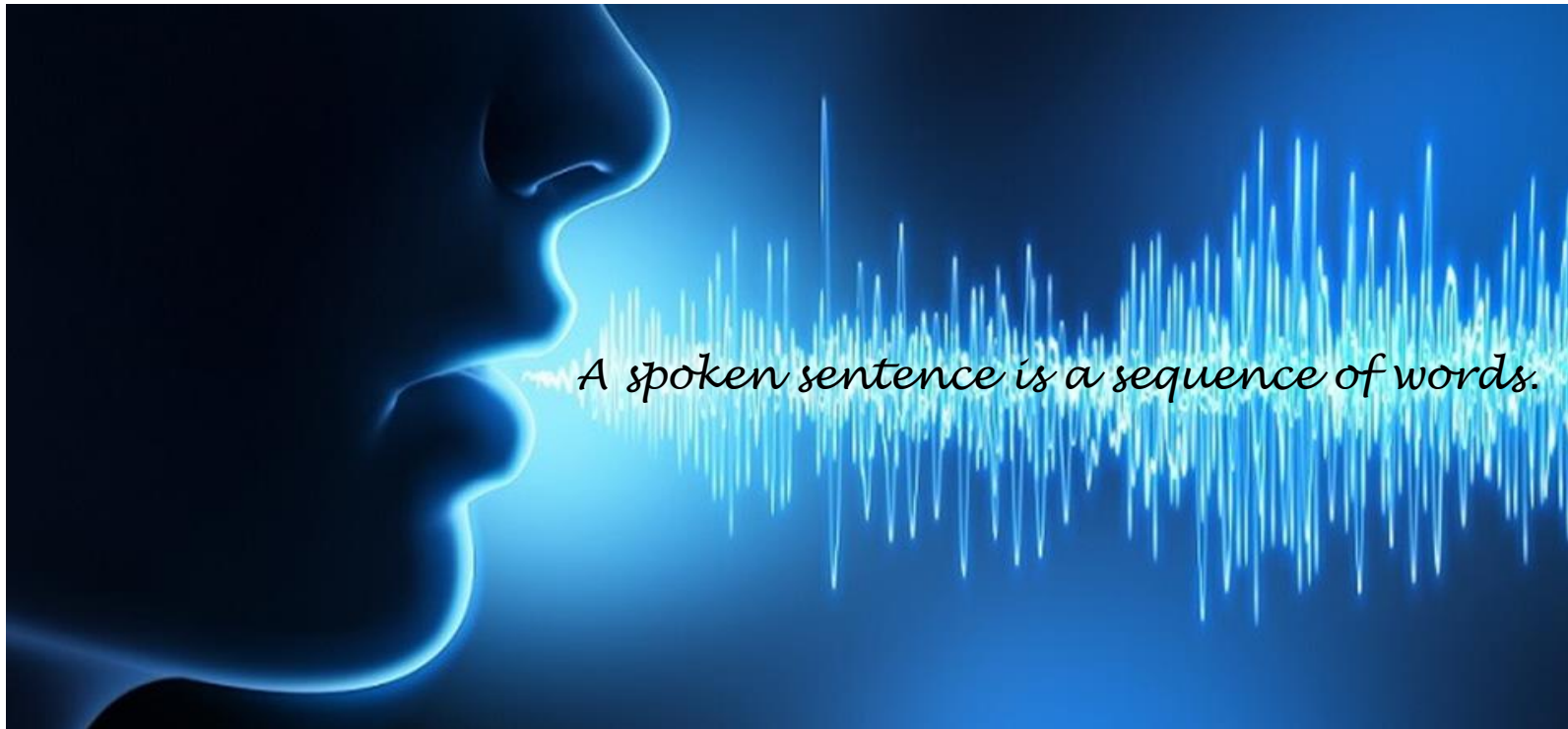
- 1, 2, 3, 4, 5, 6, 7, 8, 9
 - Each data point is a number or value.
 - **NOTES**: *Each element can also be considered as a character or a symbol.*
 - Sequence data points are **ordered** by their **values** or **positions**.

1, 2, 3, 4, 5, 6, 7, 8, 9

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Examples of Sequence

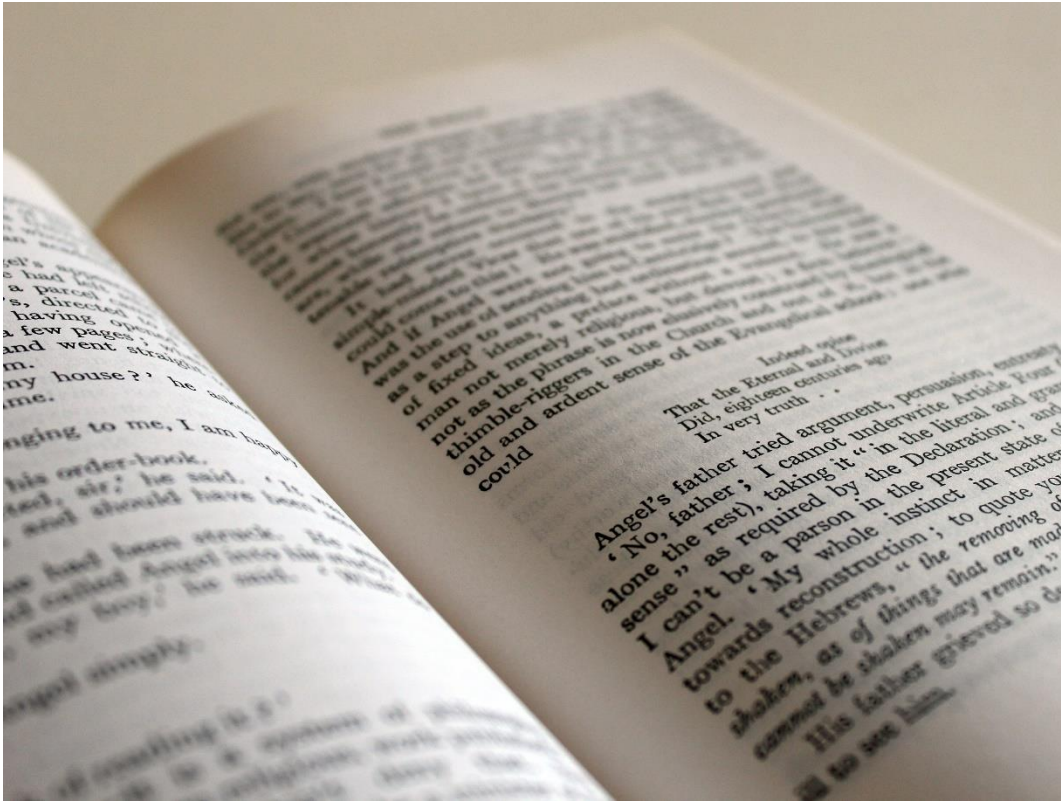
- A sequence of words spoken by a person
 - Each data point is a word, a symbol or thing.
 - Sequence data points are ordered by the time of being spoken.



Language as Sequence Data (Source: epsiloneg.com)

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Examples of Sequence



Text: A Sequence of Words (Source: wikihow.com)

- A sequence of words in a sentence of a book
 - Each data point is a word, a symbol or thing.
 - Sequence data points are ordered by their position in the sentence.

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Examples of Sequence

- A sequence of YouTube video clips watched by a web user.
 - Each data point is a video clip, i.e., a **thing** (a video clip) or an **event** (watching a video)
 - Sequence data points are **ordered** by the **time** of being accessed.



YouTube Clips (Source: pixabay.com)

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Examples of Sequence



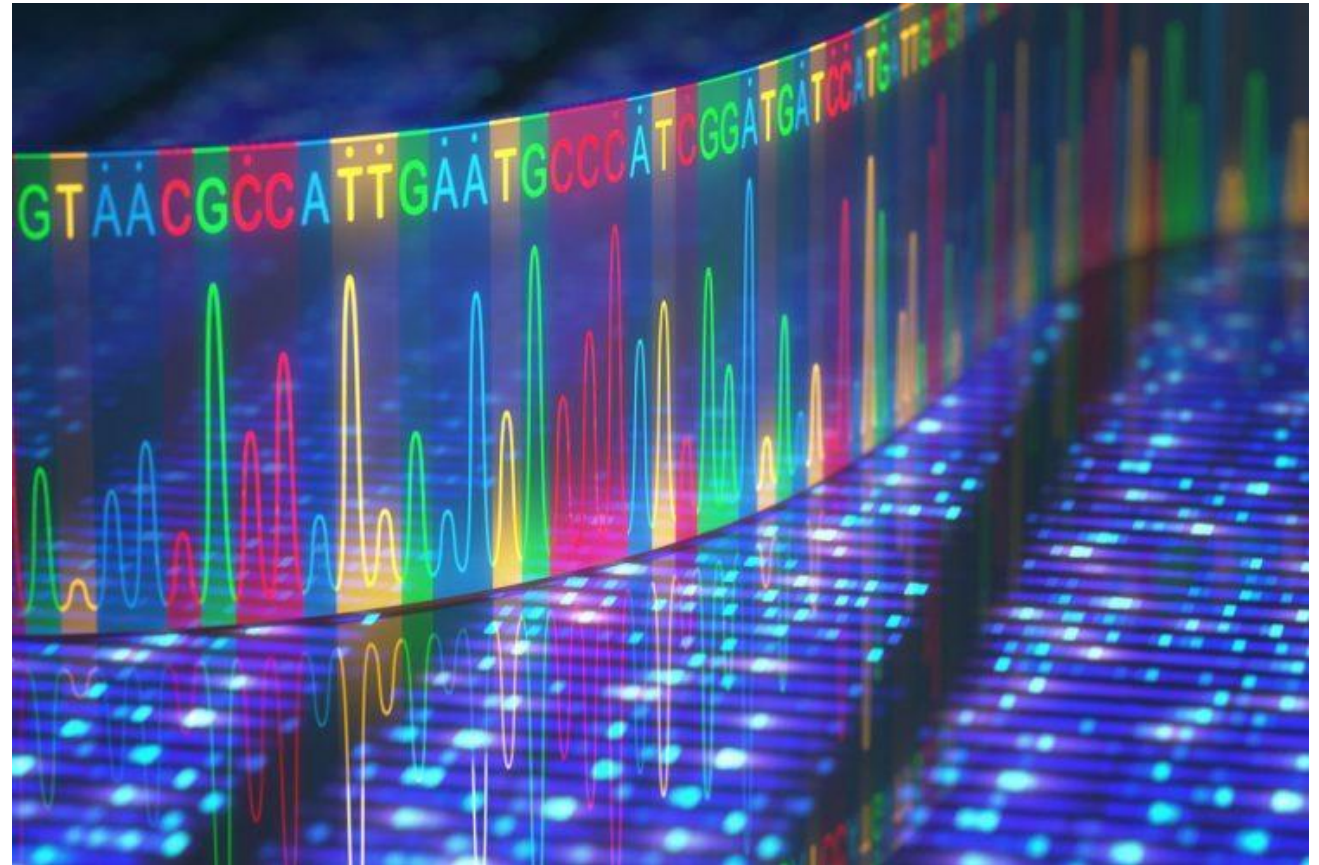
Products (Source: qualitynametag.com)

- A sequence of products bought by a consumer in a retail store.
 - Each data point is an item, i.e., a **thing**.
 - Sequence data points are **ordered** by the **time** of purchase.

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Examples of Sequence

- A sequence of protein in bioinformatics
 - Each data point is a thing, i.e., a **protein**.
 - Sequence data points are **ordered** by the **position** of the protein in a sequence.



DNA (Source: drugtargetreview.com)

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Examples of Sequence

Sequence Data:

Any other examples?

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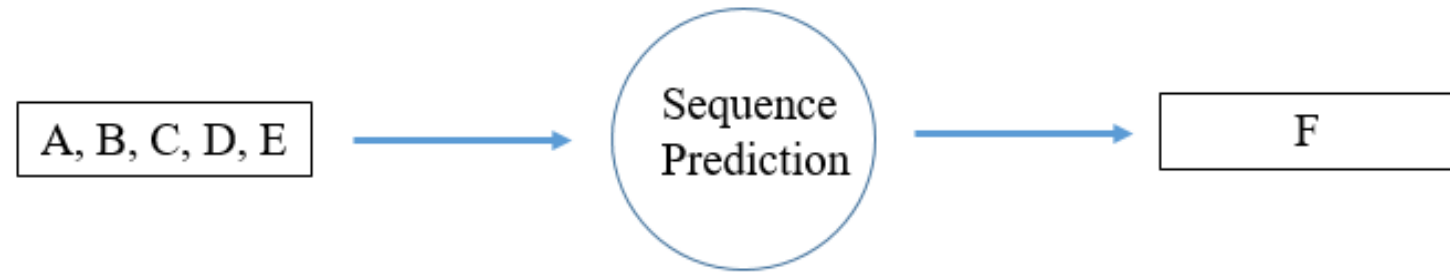
Sequence Data: Prediction Problems: Overview

- The nature of sequencing imposes **an order** of the data points in a sequence.
- If an AI deep learning model is used to train on the sequence and make prediction, the **order** of the data points must be **preserved**.
- There are **four types** of data analytic problems related to sequence data:
 1. Sequence Prediction
 2. Sequence Classification
 3. Sequence Generation
 4. Sequence to Sequence Prediction
- Generally, all the four types of problems are referred to as **sequence prediction problems**.

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Sequence Data: Prediction Problems: Sequence Prediction

- Sequence prediction aims to predict the next symbol, thing, event, or value in a sequence based on the preceding ones.

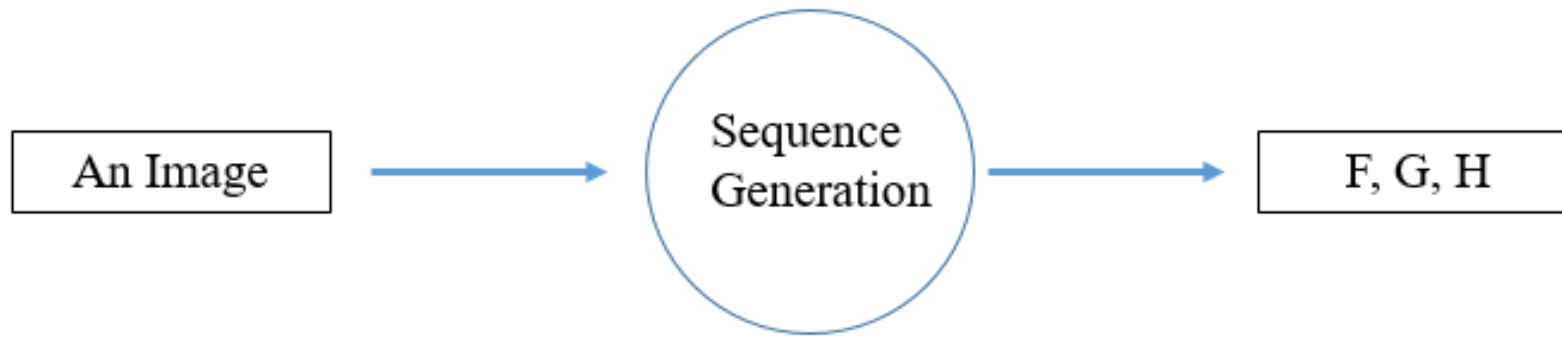


- Scenario:
 - If a web user has accessed some web pages, e.g., A, B, and C in that order, a marketing firm may want to predict what is the next web page D that the user wants to open.
- Examples of Sequence Prediction
 - Sales or revenue forecasting
 - Stock price prediction
 - Product recommendation
 - Weather forecasting

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Sequence Data: Prediction Problems: Sequence Generation

- Sequence Generation aims to generate a new output sequence.



- Scenario:
 - Based on the pixels of an image, a sequence of words may be generated to describe the image.
- Examples of Sequence Prediction
 - Text generation
 - Music generation
 - Image caption generation
 - Hand-writing prediction

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Sequence Data: Prediction Problems: Sequence Classification

- Sequence Classification aims to predict a class label for a given input sequence.

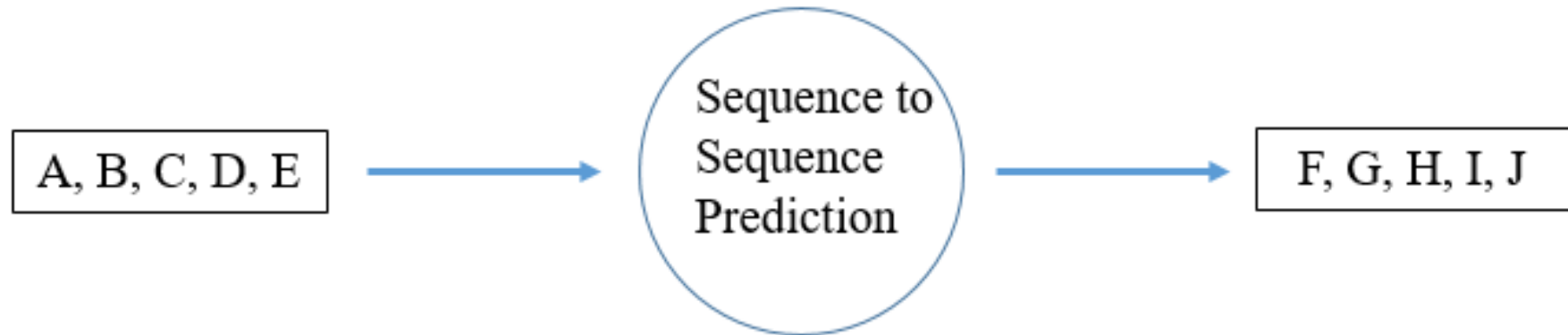


- Scenario:
 - Based on viewers' tweets, a marketing firm may try to predict how much a movie is liked.
- Examples of Sequence Prediction
 - Sentiment Analysis
 - DNA sequence classification
 - Anomaly/Fraud Detection

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Sequence Data: Prediction Problems: Sequence-to-Sequence Prediction

- Sequence-to-Sequence Prediction aims to predict an output sequence given an input sequence.



- Scenario:
 - Based on the pixels of an image, a sequence of words may be generated to describe the image.
- Examples of Sequence Prediction
 - Text Summarization