

Machine Learning Sequence Models

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Sequential Data

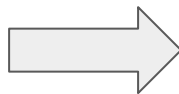
- Data where the **order** of the elements is meaningful and the **relationship** between elements is often as important as the elements themselves
 - CV example: **Sequence** of frames from a video / animation
 - NLP examples: **Sequence** of words (e.g. a sentences and paragraphs) - source code
 - Audio and Speech
 - Biological **Sequences** (Genetic Data (DNA or RNA), Protein Sequences)
 - **Time Series Tabular Data:**
 - Financial Data: Stock prices (over time)
 - Weather Data: Temperature, humidity, and precipitation measurements
- Some of these examples are processed with **deep learning** and others are **tabular-like data**

Sequence Models

- Models designed for sequential data
- Per sequence, the sequence items are not IID
 - So the models need to model these items [dependencies on previous step](#)
- Popular models: RNNs, LSTMs, GRUs, [Transformers](#)
- Challenges
 - **Handling Long Sequences** due to the vanishing gradient problem
 - **Transformer** can process the **data in parallel**, but others are sequential (slow)

Video Classification Task

- Given a GIF (typically of 100 frames), classify to running, walking or standing



Running

Next Word Prediction Task

- A fundamental NLP problem: a model predicts the **most likely word** to follow a given sequence of words
- Example: The Israeli-Palestinian conflict dates XXX?
 - back
- Example: The Israeli-Palestinian conflict dates **back** XXX?
 - to
- Example: The Israeli-Palestinian conflict dates **back to** XXX?
 - Several most likely words:
 - 1948
 - the ⇒ **the** late 19th century
 - early ⇒ **early** 20th century
- As you see, we can keep giving the model **its output** to **generate** one more output!

“Acquire knowledge and impart it to the people.”

“Seek knowledge from the Cradle to the Grave.”

