### Recurrent Neural Networks

* RNNs are specifically designed to work with sequential data
* RNNs have been able to produce state-of-the-art results in fields such as natural language processing, computer vision, and time series analysis

**In this session:**

1. What are sequences?
2. The architecture of an RNN
3. Types of RNNs
4. Drawbacks of RNN and motivation for its other variants

#### What are Sequences?

* In sequential data, entities occur in a particular order. If you break the order, you don’t have a meaningful sequence anymore
  + sequence of images which makes up a video
  + music which comprises of a sequence of notes. If you change the notes, you’ll mess up the melody.
  + Image
  + Time Series
* Recurrent neural networks are variants of the vanilla neural networks which are tailored to learn sequential patterns.

Neural Network vs RNN:

* NN can approximate any given function
* RNN can simulate any given algorithm

Example -

input - unsorted set of integers

Output - sorted set of integers

### What Makes the Network Recurrent

How a normal feedforward network can be modified to work with sequences -

* The main difference between normal neural nets and RNNs is that RNNs have two 'dimensions'

1. Time (t), along the length of sequence
2. Depth of layers (l)

* One way to think about RNNs is that the network changes its state with time (as it sees new words in a sentence, new frames in a video etc.). For e.g. we say that the state of alt changes to  as it sees the next element in the sequence (word, image etc.)

GRU (Gated Recurrent Unit)

- No explicit State Unit (Ct)

- Forget Gate(Ft) and Update Gate(Ut) are combined into one