UE21CS343BB2

Topics in Deep Learning

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Topics in Deep Learning

Sequence Learning Problem

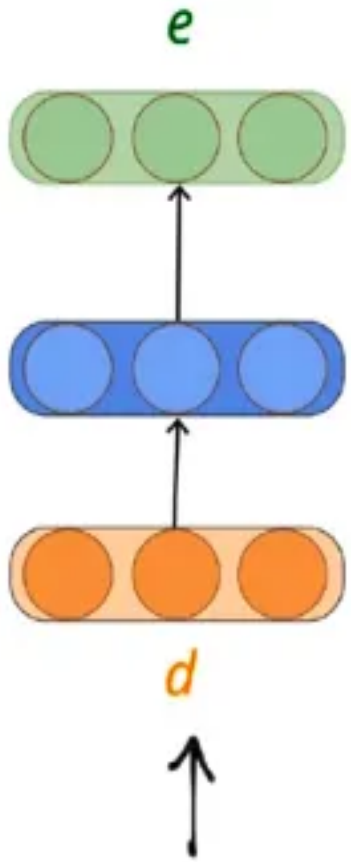
Recap of FCNNs and CNNs

In FCNNs(Fully Connected Neural Networks) and CNNs(Convolutional Neural Networks):

- the output at any time step is independent of the previous layer input/output
- the input was always of the fixed-length/size

Sequence Learning Problems

- But what if the output at any time step is dependent on the previous layer input/output?



Let’s consider the case of Auto-completion.

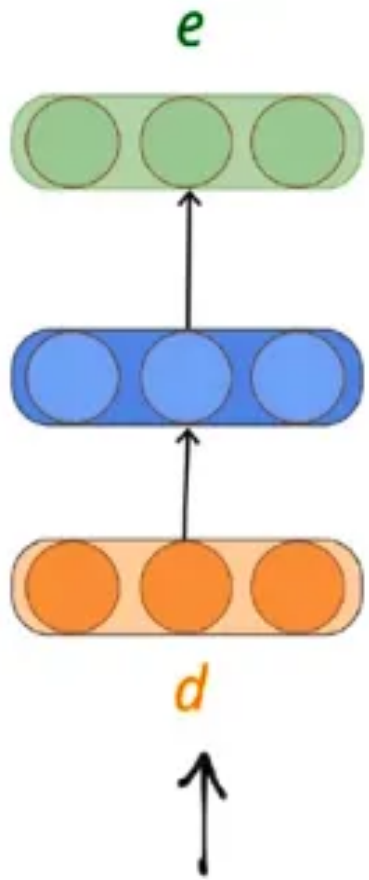
- Say the user types in the alphabet ‘d’, and the model tries to predict the next character.
- The job is to identify the next character from the 26 alphabets given the input is ‘d’.

Sequence Learning Problems

- The predicted output ŷ is also going to be a distribution over these 26 characters.

Say there is one hidden layer and then the final output layer.

The way Auto-completion works is that it takes the top 3–4 entries from this ŷ distribution and it suggests those characters.



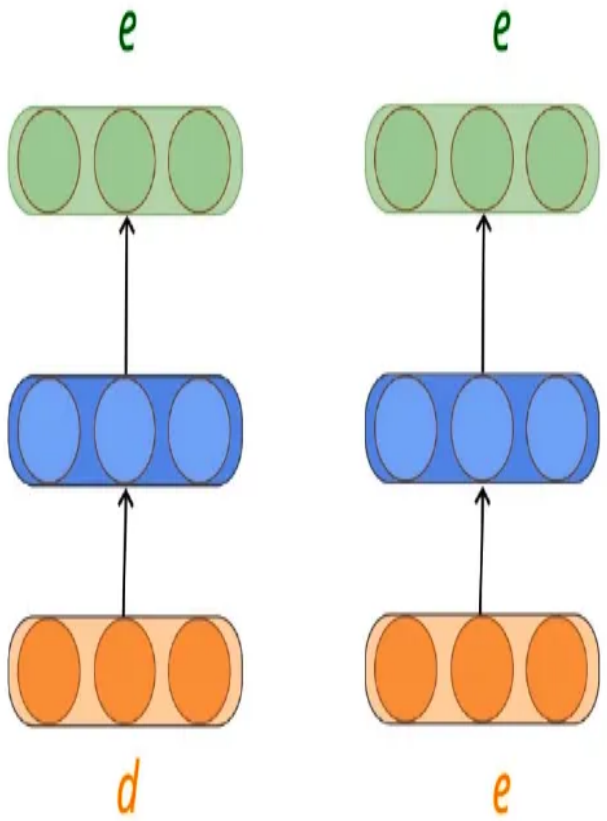
Sequence Learning Problems

- Let’s say out of these top 3, ‘e’ was there and user-selected ‘e’ as the second character(after ‘d’).

Now this ‘e’ acts as the input and the model again try to predict an output.

The output in this case depends on:

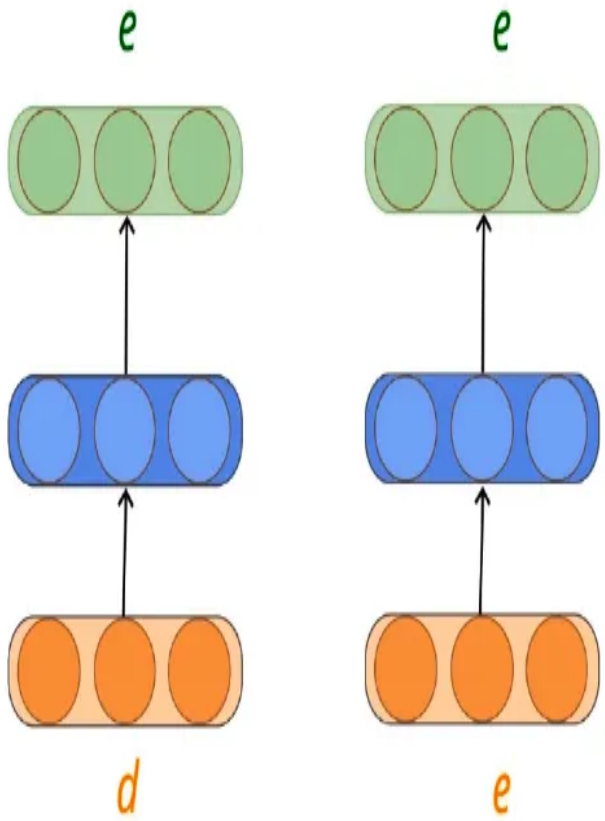
- Input ‘e’.
- Input in the previous layer.



Sequence Learning Problems

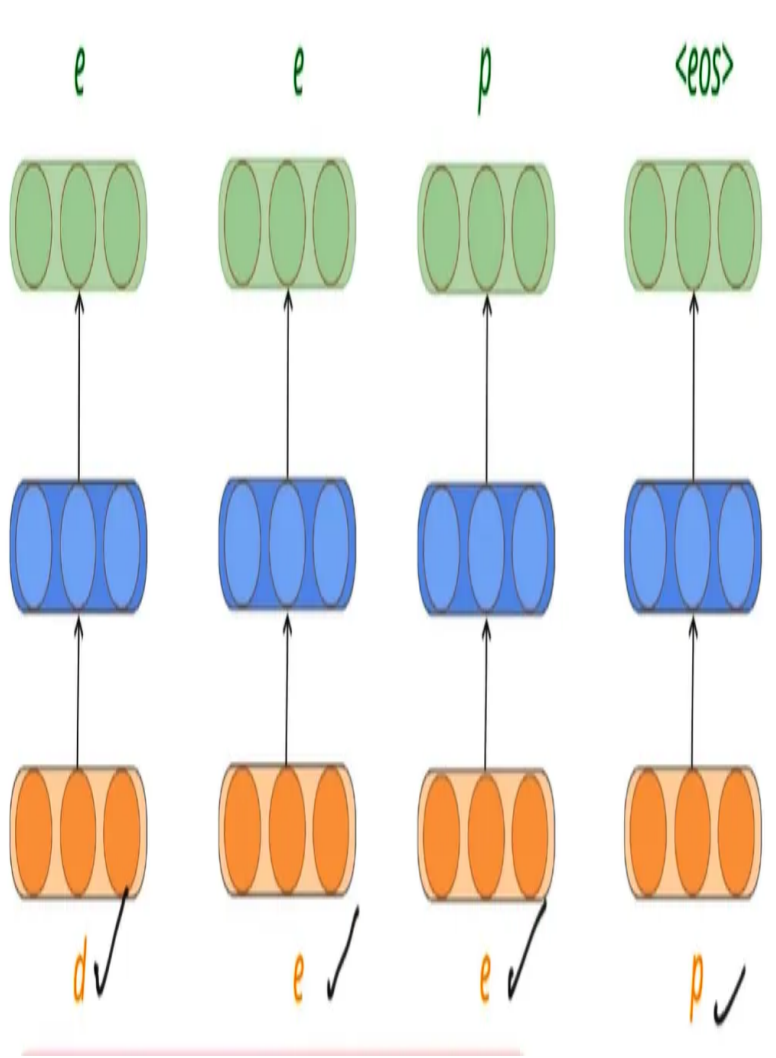
For example:

- if the input in the first layer is “d” followed by “e” (as the output of the first layer), then it is very likely the second layer output would be “c” (deceive) or “e” (deep/deer) and not “b”.



Sequence Learning Problems

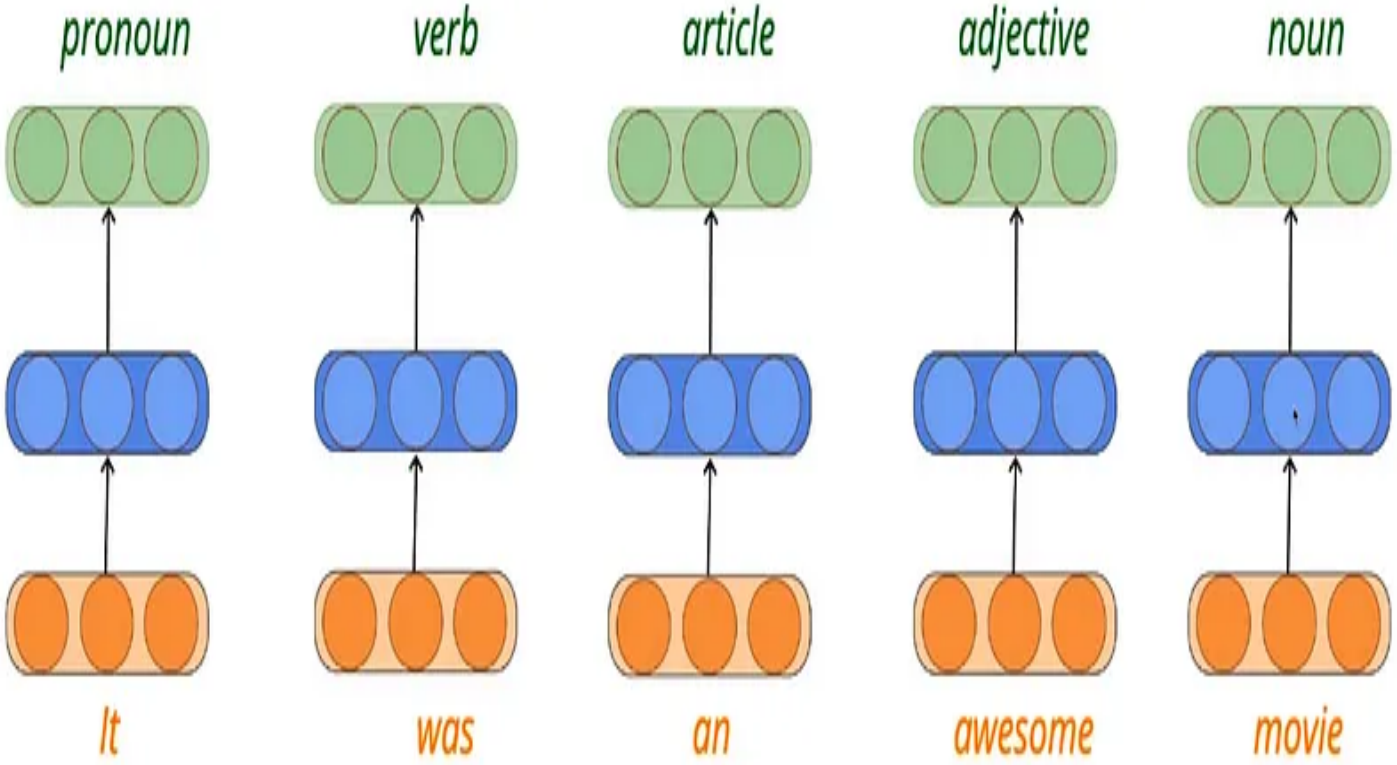
- We have a sequence of inputs and the output depends on all previous sequences of inputs or at least some sequence of inputs.
- The length of the input is not fixed and would vary based on if the word is long or short.



Sequence Learning Problems

Some more examples of such problems include:

- Part of speech tagging.



Given a sequence of words, predict part of speech tag for each word.

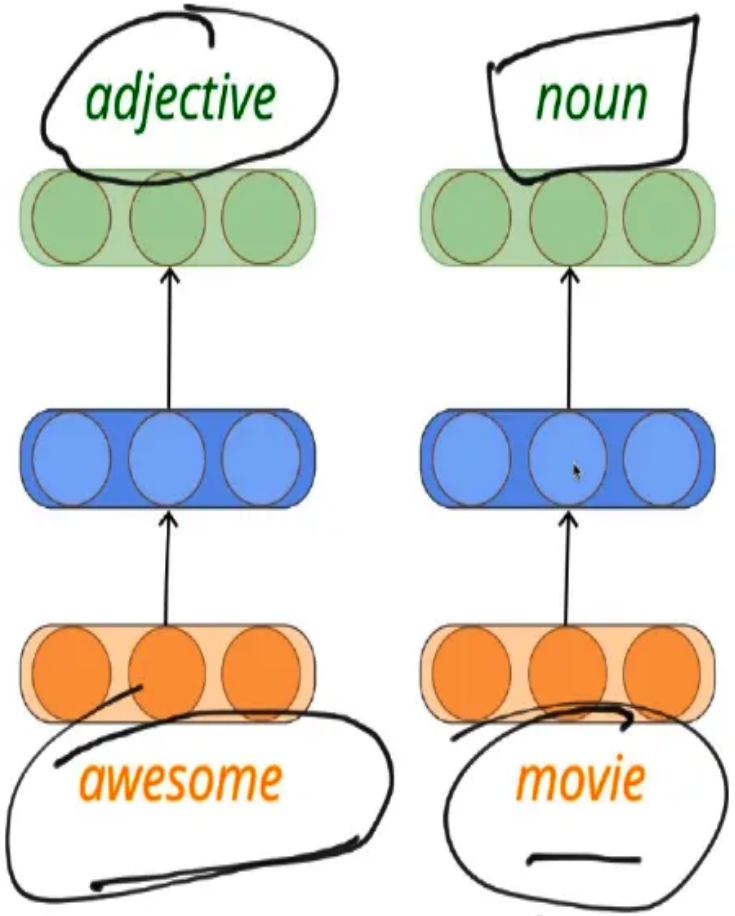
Sequence Learning Problems

Some more examples of such problems include:

- Part of speech tagging.

Say the current input as ‘movie’ and the previous input was ‘awesome’ which is an adjective.

The moment the model sees an adjective it would be more or less confident that the “next word is actually going to be a noun”.



Sequence Learning Problems

Some more examples of such problems include:

- Part of speech tagging.

Let's say the input is the word 'bank' in a sentence - this "could be a Verb" (I can bank on him) "or a Noun" (I had gone to a bank).

In the "Noun case", the "previous word is an article", from "which it is very unlikely" that the "following word would be a verb", and "it is going to be a Noun".

So, even in this type of ambiguous case, the previous sequence of words i.e. the context, helps us to predict the output/make this decision.

Sequence Learning Problems

Some more examples of such problems include:

- Sentiment Analysis

It’s not mandatory to produce an output at each step(time step/layer).

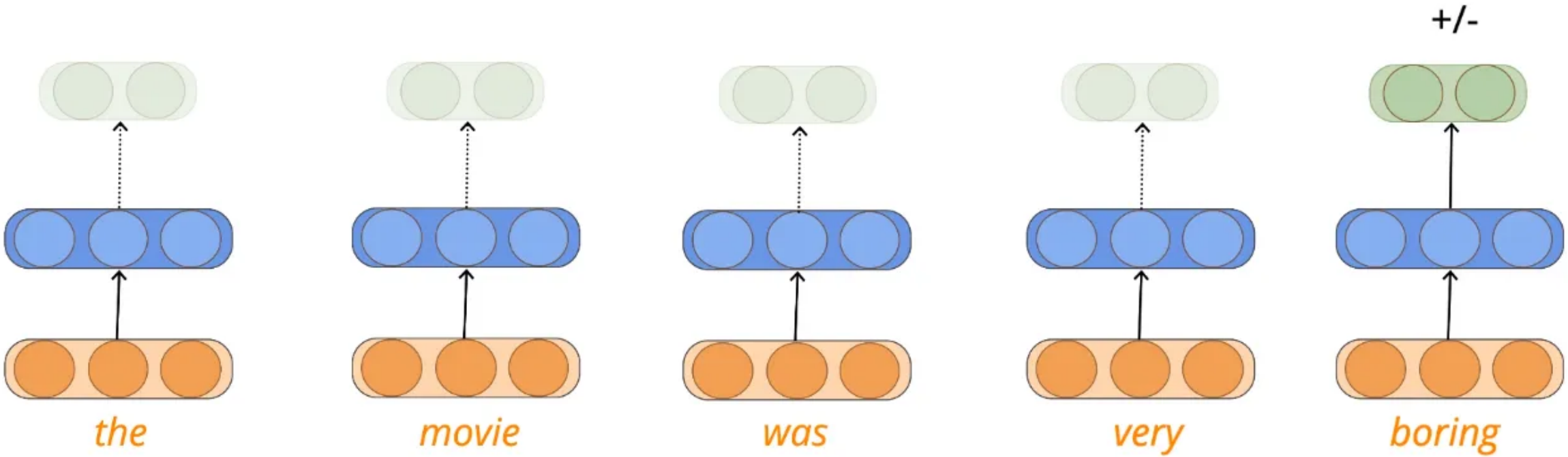
In sentiment analysis, the model looks at all the words in a sentence and predicts a final output as positive/negative sentiment conveyed by the sentence.

This could be considered as output is produced at every time step but the model ignores those output and reports only the final output (this final output is dependent on all previous inputs).

Sequence Learning Problems

Some more examples of such problems include:

- Sentiment Analysis

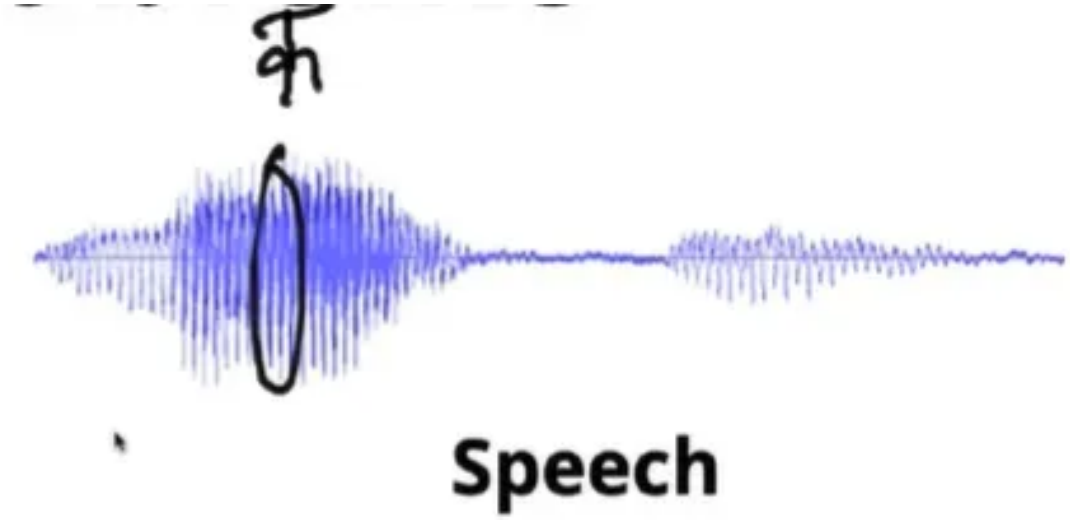


Sequence Learning Problems

Some more examples of such problems include:

- Speech Recognition

Think of speech as a sequence of phonemes and give the speech signal as the input, the idea would be to map each signal to its respective phoneme in the language.



Sequence Learning Problems

Some more examples of such problems include:

- Speech Recognition

Another task could be to look at the entire sequence of speech and predict if tone/emotion of the person (say whether the person is speaking angrily, is happy/sad and etc.)

Sequence Learning Problems

Some more examples of such problems include:

- Video Labeling

A video is a sequence of frames (there might be some processing on these frames), one task could be to label every frame in the video (say which of 12 steps of Surya namaskar a frame corresponds to)

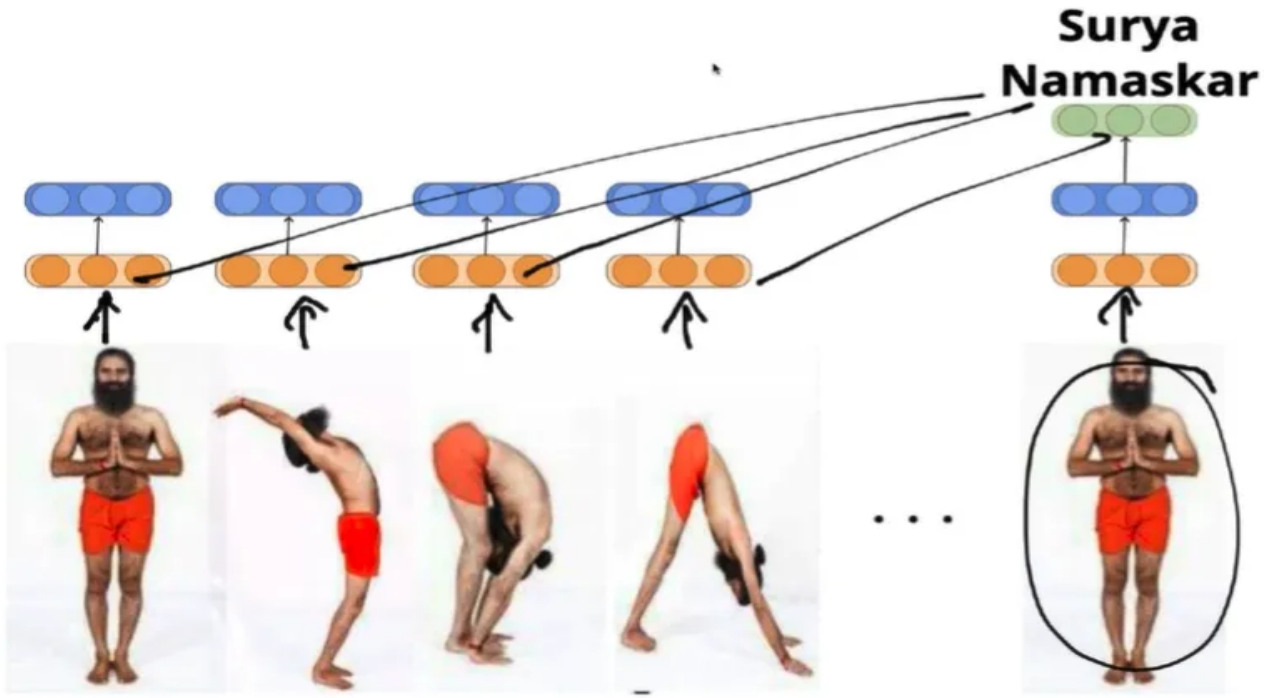
Video

Sequence Learning Problems

Some more examples of such problems include:

- Video Labeling

The other task could be to look at all the frames and give the label for the entire video sequence.



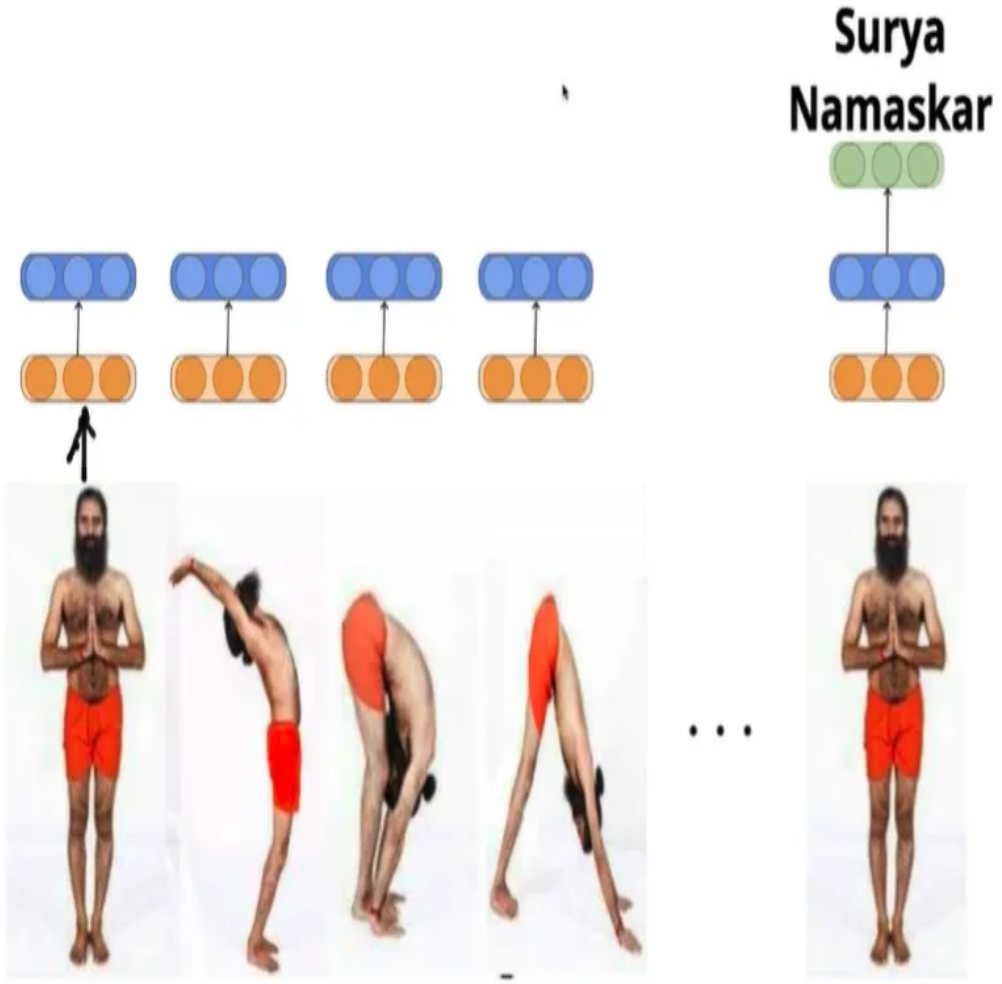
Sequence Learning Problems

Some more examples of such problems include:

- Video Labeling

Here the input is not fixed in length (as the no. of frames would be different for different videos).

And the output at the final time step would be dependent on all previous inputs (for example: just by the final frame, the model might label a video sequence as “Surya namaskar”, and this would inherently be dependent on all previous inputs)



Acknowledgements & References

- http://www.cse.iitm.ac.in/~miteshk/CS7015/Slides/Handout/Lecture14.pdf
- https://prvnk10.medium.com/sequence-learning-problems-6bea26399854

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