

Introduction to RNN

Recurrent Neural Networks

↳ RNNs are a class of **artificial neural networks** designed specifically for **sequential or time series data**

↳ RNNs are widely used in applications that involve a sequence or order such as **language modeling**, **speech recognition**, **machine translation**, **time-series prediction**, and many more.

Pro-tip

Q# Why use RNNs when we already have CNNs??

Hello Guys, How are you?
How was the week?

→

~~Are week Guys Hello
You the How~~

non-understandable
as there is no sequence.

↳ CNNs are extremely effective for processing data with a **fixed spatial structure** - like **images** - However CNN lacks the ability to **maintain context** or **process sequential data effectively**.



↳ CNNs excel in tasks where the **spatial relationships between pixels** matter but they are not designed to capture relationships in sequences.

Francis - Can CNNs deal with moving images like videos??

1 2 ... 32 → 32 frames/sec → becomes a video.

CNN + LSTM
CNN + RNN
+ etc. → to analyze the video.

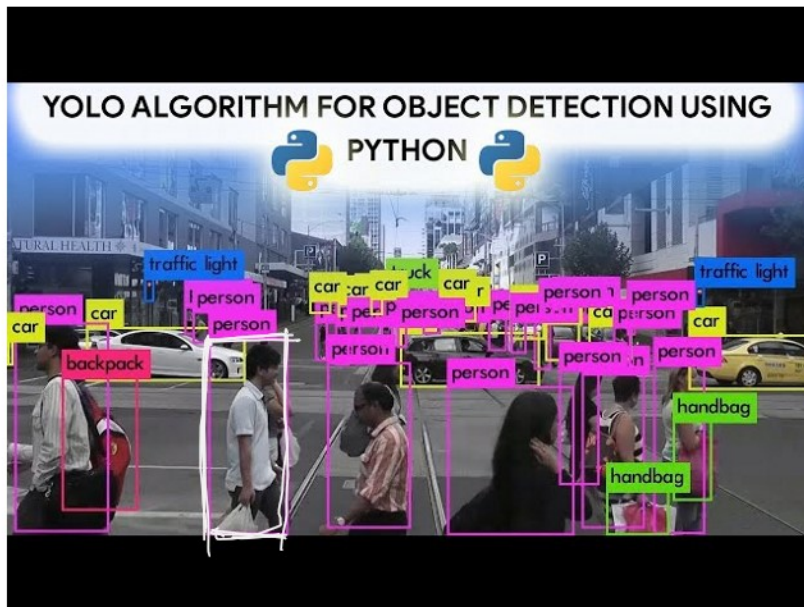
YOLO → [You only Look once]

↓

... ..

YOLO → [You only Look once]

↓
is a real time object detection
algorithm that uses a CNN
to predict the class and bounding
box coordinates of objects in an image



Karthikeya - can we use YOLO for FER2013 dataset?

↓
<https://datasets.activeloop.ai/docs/ml/datasets/fer2013-dataset/>

↓
CNN is more preferred as it's
an image classification task //

Google Translation

English

Hindi

did you eat biryani
with Aamir?

English

क्या आपने आमिर के
साथ बिरयानी खाई?

kya aapane aamir ke saath
birayaanee khatee?

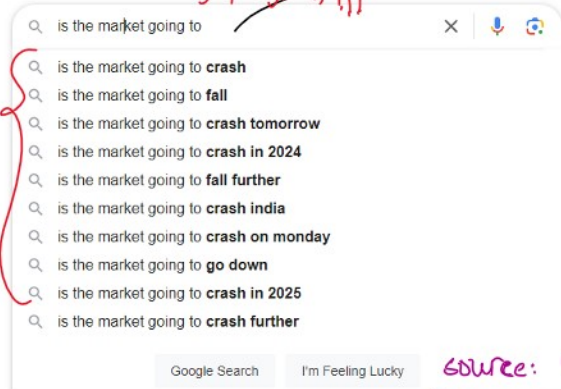
Hindi



RNNs imitate the function of human brain where it tries to model the sequence data like human conversation and it can identify (anticipate) sequential data in a way that other algos can't.

அமீருடன் பிரியாணி
சாப்பிட்டீர்களா
Tamil

No market insights given!!!



auto completes
↓
[Google Smart Compose]

source: Google

Google Smart Compose

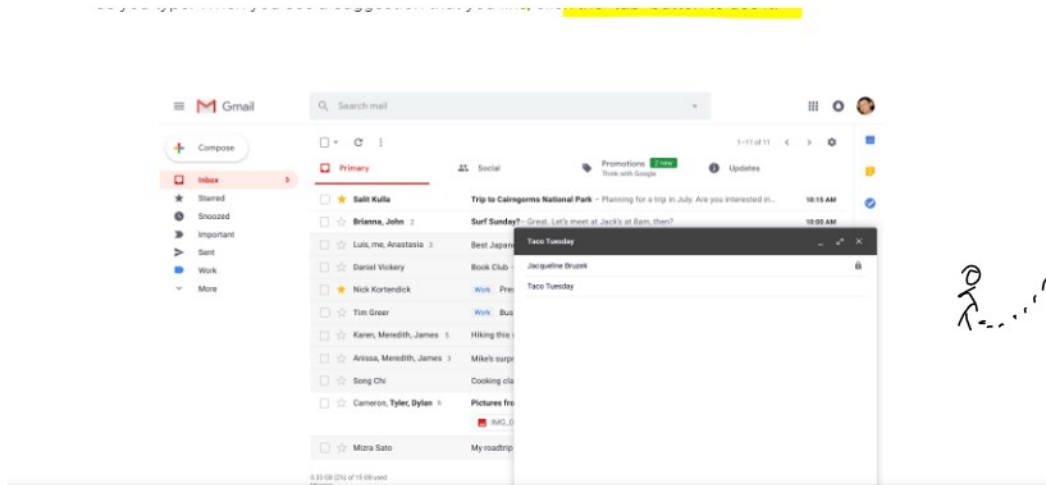
Smart Compose → real life use-case -

Email makes it easy to share information with just about anyone—friends, colleagues and family—but drafting a message can take some time. Last year, we introduced [Smart Reply](#) in Gmail to help you quickly reply to incoming emails. Today, we're announcing Smart Compose, a new feature powered by artificial intelligence, to help you draft emails from scratch, faster.

Draft emails quickly with confidence

From your greeting to your closing (and common phrases in between), Smart Compose suggests complete sentences in your emails so that you can draft them with ease. Because it operates in the background, you can write an email like you normally would, and Smart Compose will offer suggestions as you type. When you see a suggestion that you like, click the "tab" button to use it.





- Google's smart Compose feature suggests | anticipates the words or phrases to complete sentences while typing.
 - It was originally built using a form of **RNNs** with **Long-Short-Term Memory (LSTM)**
- RNN + LSTM** - advanced deep learning

Evolution of Smart Compose

Google first launched smart Compose leveraging RNN + LSTM to handle long-term dependencies.

LSTMs can keep track of earlier words in a sequence, which allows them to better predict subsequent words.

Later as **transformers based models** such as BERT / GPT emerged and showed significant improvements over RNNs and LSTMs, Google transitioned to using these models for text prediction tasks.

[Grammarly]

<https://www.grammarly.com/>

Responsible AI that ensures your writing and reputation shine

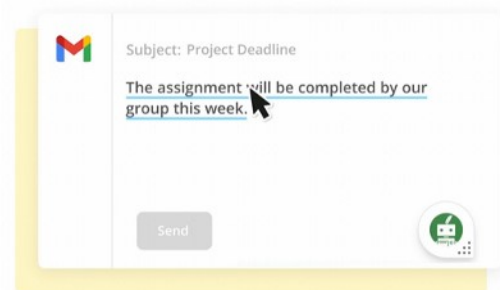
Work with an AI writing partner that helps you find the words you need—to write that tricky email, to get your point across, to keep your work moving

Quillbot

Your ideas, better writing









We use AI to strengthen writing and boost productivity—without sacrificing authenticity.

Sign up now. It's free!

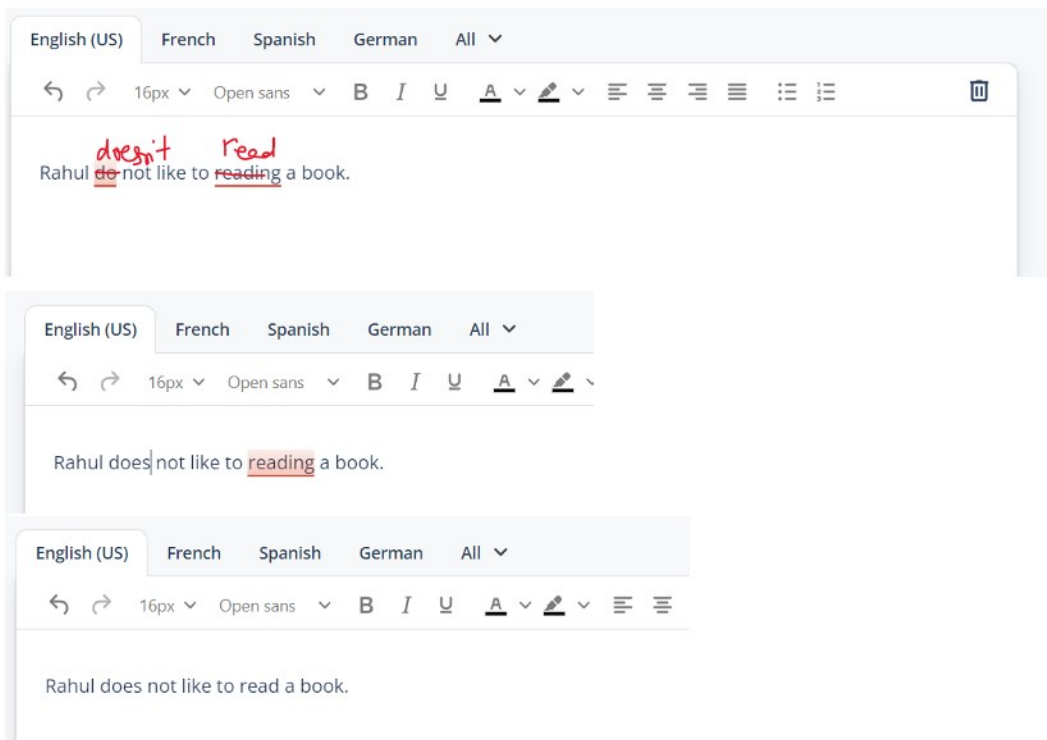


Eight tools. One platform.

article/blog

 <p>Paraphraser ></p> <p>Increase fluency</p>	 <p>Grammar Checker ></p> <p>Fix mistakes</p>	 <p>Plagiarism Checker ></p> <p>Prevent plagiarism</p>	 <p>AI Detector ></p> <p>Analyze text</p>
 <p>Summarizer ></p> <p>Summarize text</p>	 <p>Citation Generator ></p> <p>Cite sources</p>	 <p>Translator ></p> <p>Unlock languages</p>	 <p>Flow ></p> <p>Write with AI</p>

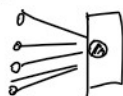
<https://quillbot.com/>



<https://www.sciencedirect.com/science/article/pii/S2665917422002227>

Why does feed-forward neural network not good at predicting text?

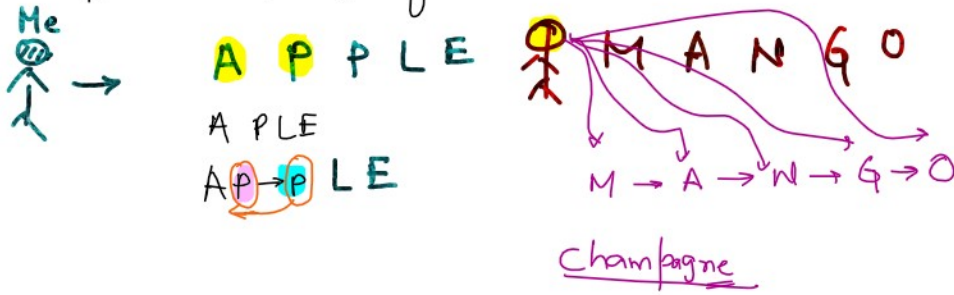
In feed-forward neural n/w, the information only move in one direction from the **input layer**, through the **hidden layer** to the **output layer**

Feed-forward neural network has **no memory** of the input or **order of the inputs** they receive and that's the $(x_1, x_2, \dots, x_{784})$ reason they are bad predicting  what's coming next

On contrary, RNN moves the information through a loop which basically means that the when it makes a decision, it considers **the current input** and also **what it has learnt from the inputs it received previously**.

Inputs it received previously.

let us explain the spelling of APPLE to a 3yr old.



Wikipedia
<https://en.wikipedia.org/wiki/Champagne>

Champagne

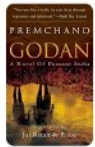
Champagne is a sparkling wine originated and produced in the Champagne wine region of France under the rules of the...
Champagne wine region · Champagne (disambiguation)



Working of RNNs

Let us say RNNs as a person reading a book one line at a time:

Books >



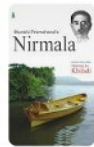
Godaan
1936



Idgah
1933



Kaphan
1936



Nirmala
1927



Do Bailon Ki
Katha
1931



Gaban
1928

At

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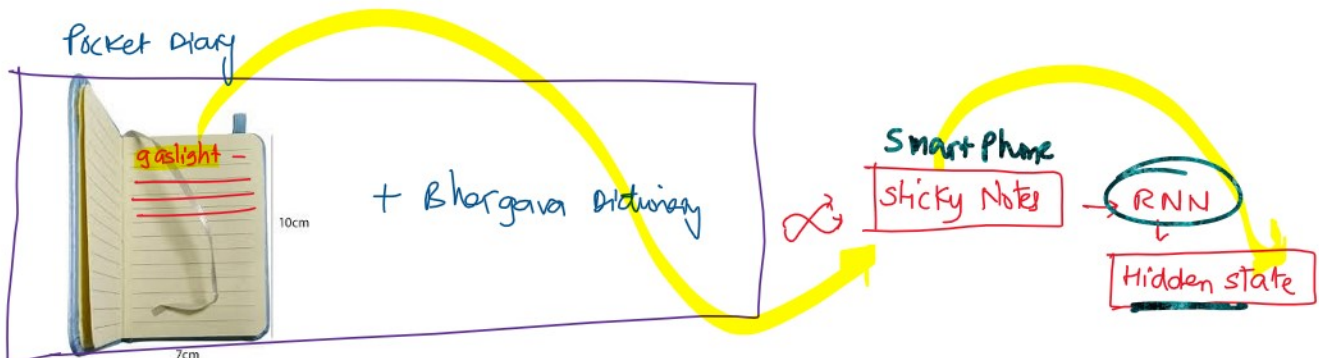
Breaking it down — step by step

Step #1 - Reading a word:

When RNN reads the first word in a sentence,

it processes the word and stores some information in the hidden state of the model.

[gaslight → psychologically manipulate
over an extended period of time]



Note: Hidden state is the RNN's way of remembering what it has seen so far.

step #2: Reading the next word:

The RNN moves to the next word and it updates its memory by combining what it remembers (hidden state) with the new word it just read.

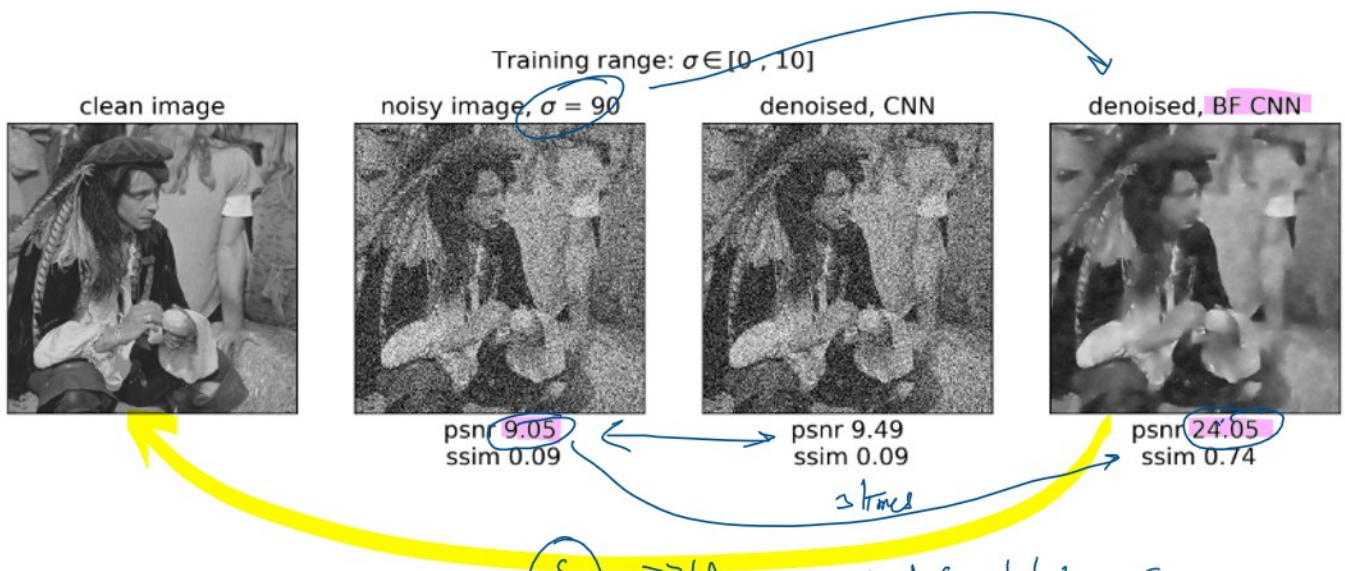
This combination helps the RNN understand the current word better.

step #3 Continue Reading:

RNN continues this process word by word, updating its hidden state each time. It keeps carrying forward and updating this hidden state to capture the context of the entire sequence.

step #4 Making predictions:

At the end of the sequence, RNN uses its final hidden state to predict the next word, classify the sentiment or perform other tasks like sentiment analysis.



power $\rightarrow \frac{S}{N}$ $\gg \gg$ large \rightarrow Good signal | less noisy Image

$\frac{S}{N} \ll \ll 1 \rightarrow$ Bad signal | Noisy Image