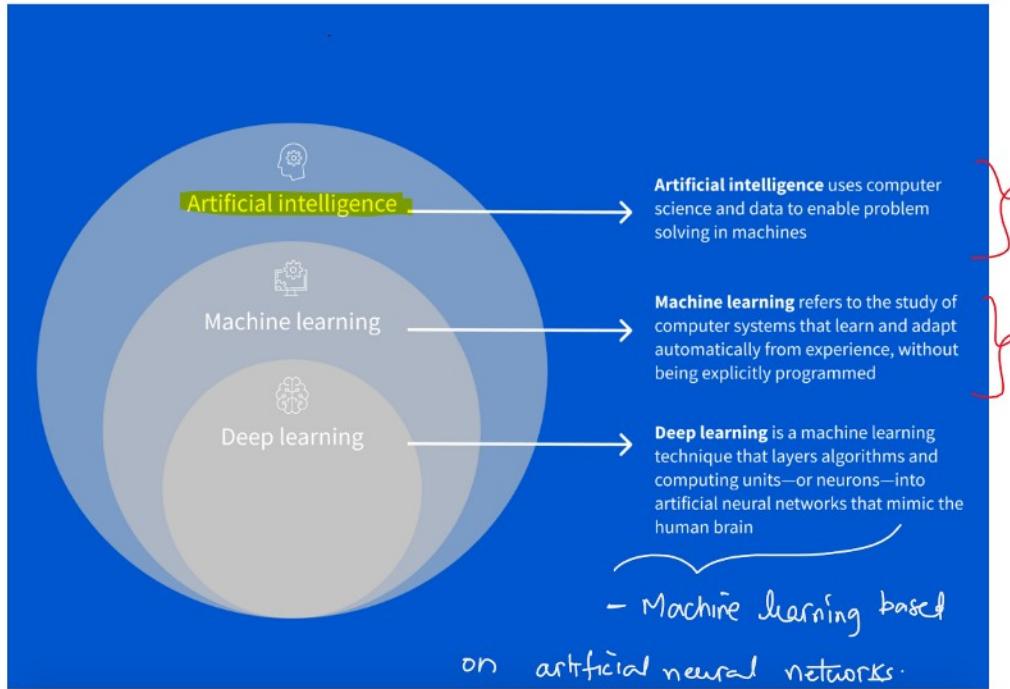


Introduction to Deep Learning

07 September 2025 11:52



What is Deep Learning ?

Both DL and ML are subsets of AI.
DL ⊂ ML ⊂ AI

DL < ML < AI

Deep learning is a subset of machine learning (ML)

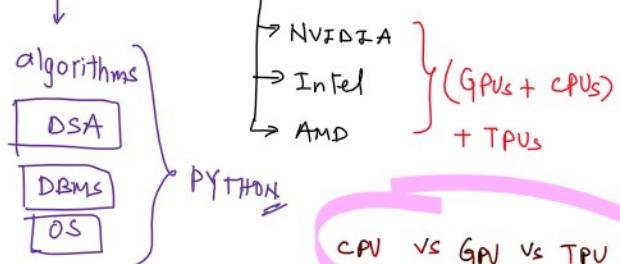
that uses **artificial neural networks** (ANNs)

to **mimic** the learning process of the human brain.

↓
ANN

Artificial Neural Networks (ANNs)

↓
(man-made
neural nw) → Using **software** and **hardware**.



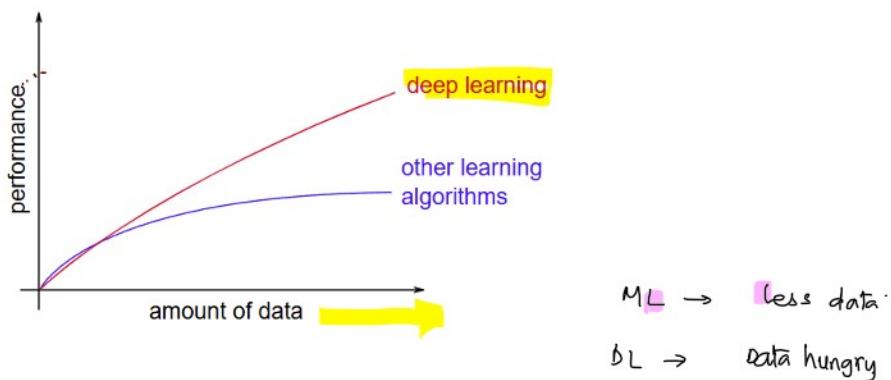
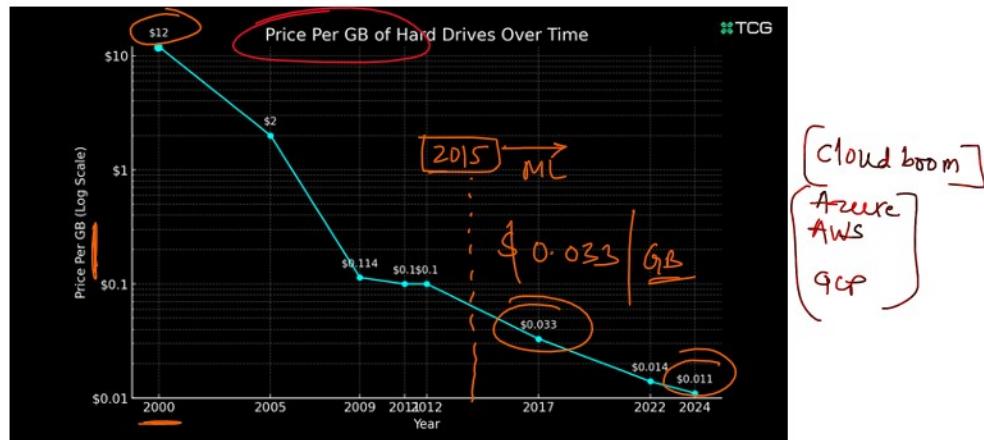
- Wait for module #3

Neural Network (single layer perceptron) → in **lecture**

Neural Network (single layer perceptron) → in 1950s

Why it took almost 5 decades to start using DL//LLMs at scale?

- Amount of data
- cheaper compute power.
- Data storage cost.



- ANN is a computational model inspired by the structure and function of the brain

→ There are ~86 billions of neurons

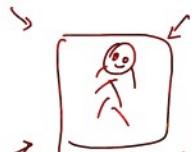
- ANN is the interconnected layers of neurons that process information and learn patterns from the data.

Scenario: A baby is born to a Tamilian family based out of London.

British accent

→ can the baby pick the British accent -

Y.u.



(surrounding / environment)

(data / signals) → (Qualitative data)

Tier-1 colleges



surrounding

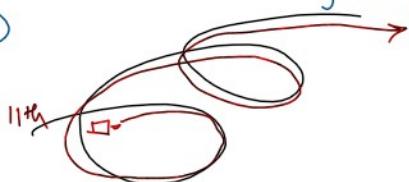
Driving

Aug' 25

10 days session | capability of human brain

7th session onwards → started feeling confident.

MT



Gen-AI →

a buzz word
hype

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MIT study shatters AI hype: 95% of generative AI projects are failing, sparking tech bubble jitters

By Paurush Omar, ET Online - Last Updated: Sep 09, 2025, 06:23:00 PM IST

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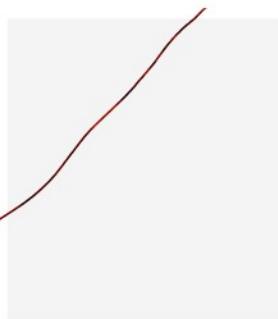
COMMENT

Synopsis

Despite over \$44 billion invested in AI startups in the first half of 2025, a new MIT report reveals that 95% of generative AI business efforts are failing, with only 5% achieving meaningful revenue growth. Productivity gains remain elusive as AI struggles with real-world tasks and verification needs. Concerns over bias, mental health, and ethical

Synopsis

Despite over \$44 billion invested in AI startups in the first half of 2025, a new MIT report reveals that 95% of generative AI business efforts are failing, with only 5% achieving meaningful revenue growth. Productivity gains remain elusive as AI struggles with real-world tasks and verification needs. Concerns over bias, mental health, and ethical dilemmas deepen. While some leaders predict massive future gains, experts warn that AI's hype may be inflating an unsustainable bubble.



AI terminologies are not only confusing but are buzzwords?

Disclaimer: No intention to undermine the brand's identity.



it doesn't mean anything with AI.
(99% sure)

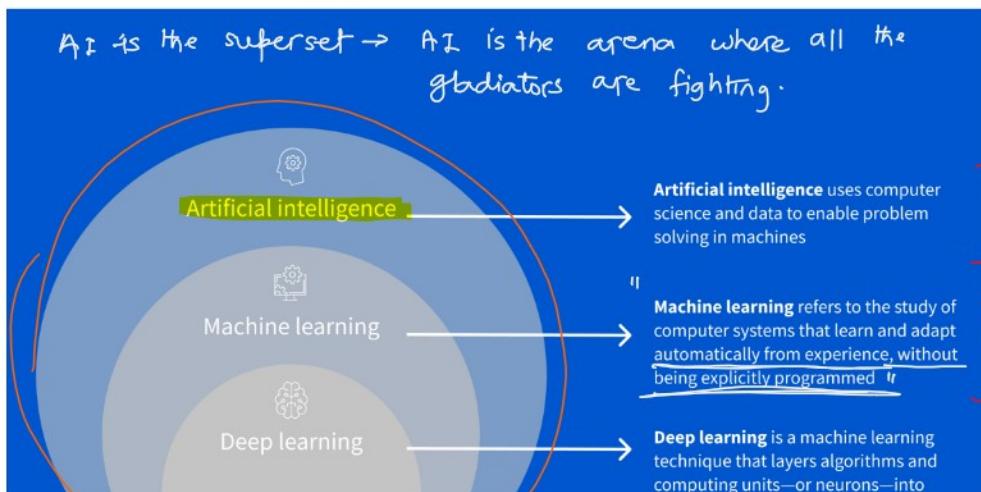
[control systems] Marketing Gimmick

AI is needed for sales & marketing.

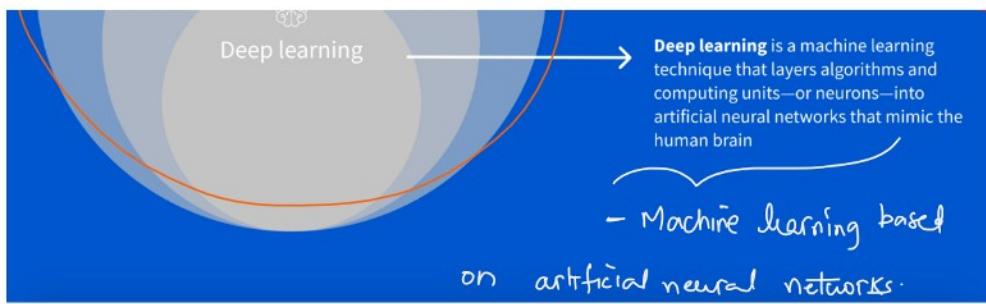
Part (drink water)
APC
→ AI powered bottle

Difference between AI, ML and DL

AI is the superset → AI is the arena where all the gladiators are fighting.



→ AI is the playground to engineer machines empowered by data to mimic cognitive abilities
Data is the new oil
Human Intelligence



Human Intelligence

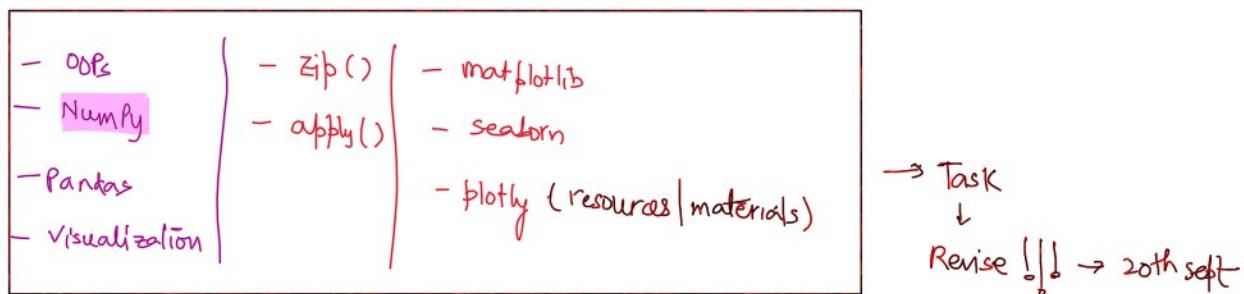
Pro-tip** software development vs Machine learning

©abc

Aspect	Traditional Programming (Chef with strict recipe)	Machine Learning (ML Chef)
Approach	Follows a strict recipe (explicit rules)	Experiments and self-improves (self-adjusting rules)
Example Steps	1. Add 2 cups flour. 2. Add 1 cup sugar. 3. Bake at 180°C for 30 min	Bake a cake → Get feedback → Adjust next time
Consistency	Always produces the same result	Result improves over time based on feedback
Ability to Learn from Mistakes	Does not learn from past mistakes	Learns and adjusts based on feedback
Flexibility	Rigid, rule-based	Flexible, adaptive
Outcome over time	Same cake every time	Better cake over time
Nature of Rules	Explicit, hand-coded (IF-ELSE, loops)	Self-adjusting, data-driven
Core Analogy	Chef blindly following a recipe	Chef who learns and adapts based on experience

[Premise: Baking a cake → 'recipe']

Gaurav - programming is like running regression using OLS technique whereas ML is like running regression gradient descent method

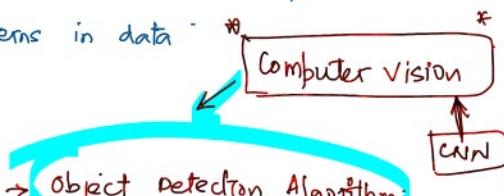


Pro-tip** What is 'deep' in deep learning?

DL is a subset of ML(AI) that uses ANNs with

multiple layers (deep networks) to model complex

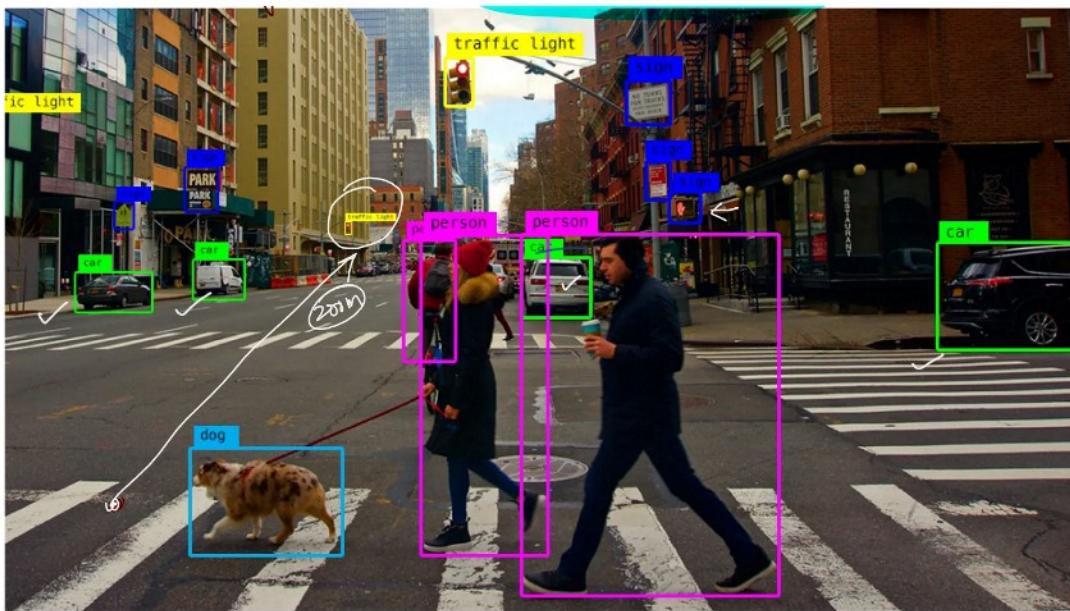
(~50-150 layers) patterns in data



<https://opencv.org/>

YOLO: You only look once → Object detection Algorithm





many layers in YOLO
 (hidden)
 ↓
 [deep neural nw model]

Machine Learning vs Deep Learning

*P6 - HP

Feature	Machine Learning (ML)	Deep Learning (DL)
Definition	Algorithms that learn patterns from data without explicit programming.	Subset of ML that uses deep neural networks to model complex patterns. <i>(big datasets)</i>
Data Requirements	Works well with small to medium datasets.	Requires large datasets for better performance.
Feature Engineering	Requires manual feature extraction by domain experts.	Automatically extracts features from raw data.
Model Complexity	Uses simpler models like Decision Trees, SVM, and Random Forests.	Uses complex neural networks (CNNs, RNNs, Transformers).
Training Time	Faster training (minutes to hours).	Slower training (hours to weeks). <i>> need big infrastructure</i>
Computational Power	Works on CPUs; does not require high-end GPUs.	Requires GPUs/TPUs due to heavy computations.
Interpretability	More explainable and interpretable.	Harder to interpret (black-box nature). <i>>> it's true but will try to open the blackbox</i>
Use Cases	Fraud detection, recommendation systems, structured data analysis.	Image recognition, speech processing, NLP, self-driving cars. <i>Image classification</i>
Generalization	Works well on structured/tabular data	Works best with unstructured data (text, images, audio)

book on
feature
engg.)

Interpretability	More explainable and interpretable.	Harder to interpret (black-box nature). → it's true but will try to open the blackbox.
Use Cases	Fraud detection, recommendation systems, structured data analysis.	Image recognition, speech processing, NLP, self-driving cars.
Generalization	Works well on structured/tabular data.	Image classification Works best with unstructured data (text, images, audio).
Cost	Lower cost due to lower hardware needs.	Higher cost due to expensive training and hardware.
Popular Libraries	Scikit-learn, XGBoost, LightGBM, H2O.ai.	TensorFlow, PyTorch, Keras, Theano
Real-World Examples	Netflix recommendations, spam filtering, credit scoring.	Face recognition, self-driving cars, chatbots (ChatGPT).

[TensorFlow + Keras → PyTorch]

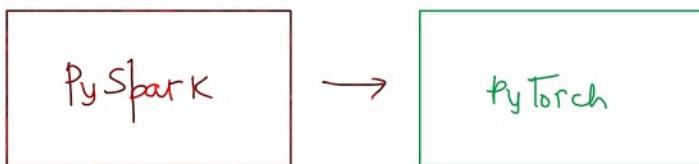
PyTorch

vs

PySpark

Just like TensorFlow, PyTorch is a deep learning framework.

- all algorithms such as ANN, CNN, RNN, LSTM etc.
- Think of PyTorch as the brain for AI models.
- Big data processing framework (Python API for Apache Spark)
- Handles big data using large-scale distributed data processing
- Think of PySpark as the engine to handle massive data



Deep learning use-cases / industrial applications

* HEALTH CARE

a) Medical Imaging: AI models are being used in research to detect tumors, lesions or any other abnormalities in medical images using CNN

[MRI, CT, Ultrasound, Sonography, Doppler's Test, X-rays]

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Diabetic Retinopathy



Diabetes leads to blindness.



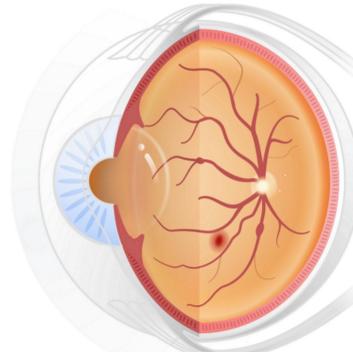
Diabetes leads to blindness

(1)

Using AI to help doctors address eye disease

Helping doctors prevent blindness

Automated Retinal Disease Assessment (ARDA) is being used to help clinicians detect diabetic retinopathy, a leading cause of blindness, in India and across the world. With widespread adoption, perhaps millions of patients with diabetes could keep their vision in part to ARDA assisting doctors. Our research was published in [JAMA](#) and [Ophthalmology](#). Additional research, published in [Lancet Digital Health](#), showed that we can predict whether patients will develop diabetic retinopathy in the future, which can help doctors customize both treatment and eye screening frequencies for their patients. The solution is currently being evaluated in clinical studies in the United States as well as in Thailand. [Learn more](#).



Developing a diabetic retinopathy screening solution

In research published in [JAMA](#), Google's artificial intelligence accurately interpreted retinal scans to detect diabetic retinopathy. To do this, Google worked with a large team of ophthalmologists who helped us train the AI model by manually reviewing [more than 100,000](#) de-identified retinal scans. This led to a development of an AI-based application called Automated Retinal Disease Assessment. This application can help doctors expand high-quality diabetic retinopathy screening programs in countries without enough eye specialists, such as India and Thailand.

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Google AI tool for retinal scan can predict cardiovascular risk

The technology could reveal the heart's health condition after matching the eye scans with a matrix for cardiovascular risks. The algorithm has proved to be correct in 70 per cent of the cases where it has been tested so far.

Written by [Ananya Dutt](#)
 Updated: July 2, 2023 12:31 IST



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Why should Google tie-up with Aravind Eye hospital, Madurai?



Jagan N
 Learn → Teach → Grow



October 15, 2023

In the recent [Google I/O](#), there was an announcement about Google's tie-up with [Aravind Eye hospital in Madurai](#) to develop and deploy machine learning and [artificial intelligence capabilities](#) to help eliminate needless blindness.



We are collaborating with Aravind Eye Hospital in India, in our development and deployment of machine learning and artificial intelligence capabilities for retinal imaging, with a focus on diagnosing diabetic retinopathy, to help eliminate needless blindness.

② Which continent is the most prone to skin diseases?

Australia (UV rays are more dangerous there due to Africa depleted ozone layer)



Improving access to skin disease information

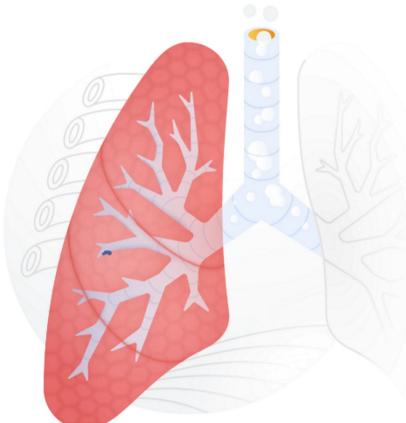
Through computer vision AI and image search capabilities, we are developing a tool to help individuals better research & identify their skin, hair, and nail conditions. The tool supports hundreds of conditions, including more than 80% of the conditions seen in clinics and more than 90% of the most commonly searched conditions. The work was highlighted in both [Nature Medicine](#) and [JAMA Network Open](#). [Learn more](#)

This product has been CE marked as a Class I medical device in the EU. It is not available in the United States. This research is not related to the DermAssist tool, which is no longer in development.

V n h l i : lung det ct m

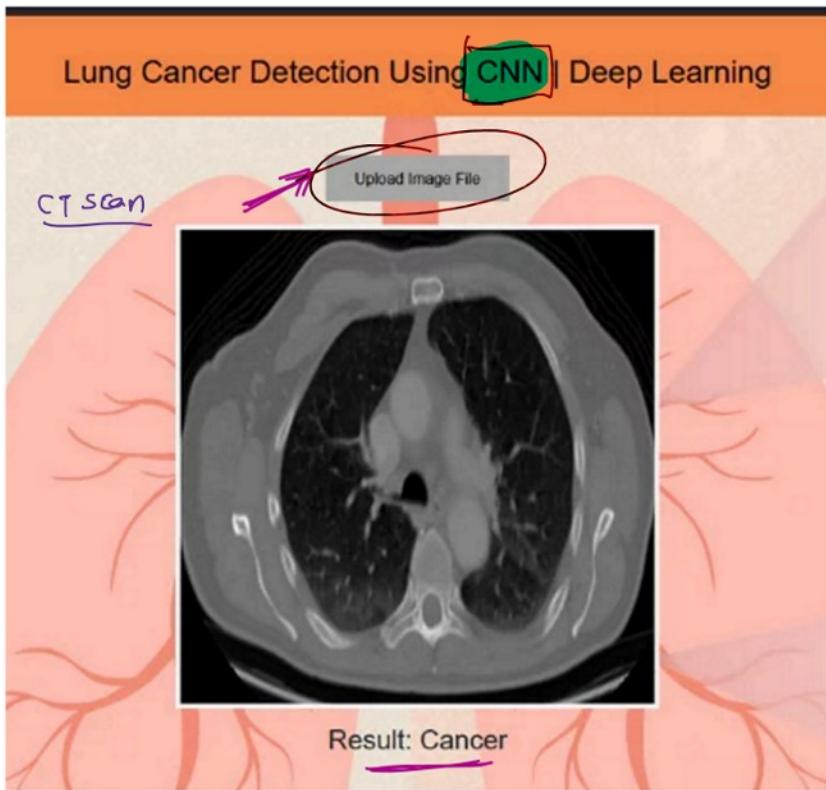
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Using AI to improve lung cancer detection

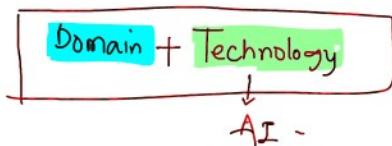


A promising step forward for predicting lung cancer

Lung cancer leads to [over 1.8 million deaths](#) per year world wide, accounting for almost one in five cancer deaths, and is the largest cause of cancer mortality. Our research, published in [Nature Medicine](#), shows that deep learning may eventually help physicians more accurately screen for lung cancer and identify the disease even in incidental lung cancer detection workflows. [Read the post](#)



Remind me to share - journal paper for the above



*

FINANCE