AI Vs. ML Vs. DL

What is Machine Learning:

Machine learning is a type of artificial intelligence that enables computers to learn from data and improve with experience without being explicitly programmed for every task, finding patterns to make predictions or decisions.

Key Features:

Uses Algorithms
Learns from past data
Improves performance over time

Types of Machine Learning:

Supervised Machine Learning (KNN, Linear Regression)
Unsupervised Machine Learning (K-Means , Clustering)
Reinforcement Learning (Game AI)

Examples:
Email Spam detection
Movie Recommender System
Price prediction models

What Is Deep Learning:

Dl is a subset of ML that uses neural networks with many layers (deep neural networks).

Key Features:
Uses Artificial Neural Networks (ANN)
Requires Huge Data
High Computational Cost (GPUs)

Types of Deep learning (categorised by model architectures):
CNN (for images)
Recurrent Neural Networks (RNNs) like(Long Short-Term Memory (LSTMs) / Gated Recurrent Unit (GRUs) for sequences (text/speech)

Advanced models like Transformers (NLP) and Generative Adversarial Networks (GANs) for creations (Images, audio, video)

Examples:

Speech-to-text-systems
Chatbot
Self-Driving Cars

DIFFERENCE IN MACHINE LEARNING AND DEEP LEARNING, AND JUSTIFY WHY THE NEED FOR DEEP LEARNING AROUSE , WHEN ALREADY THERE WAS MACHINE LEARNING

MACHINE LEARNING (ML)
Uses traditional algorithms
Requires manual feature extraction
Works well with small to medium datasets
Less computational power needed
Performance depends heavily on human expertise
Works well with structured data only
Accuracy : 60-70%

DEEP LEARNING (DL)

Uses deep neural networks
Automatically extracts features
Requires very large datasets
Needs high computational power (GPU)
Learns complex patterns on its own
Works well with both structured as well as unstructured data too.
Accuracy: Upto 99%

WHY DO WE NEED DEEP LEARNING WHEN MACHINE LEARNING ALREADY EXISTS?????

This is the justification part:

Limitations fo Traditional Machine Learning

1. Manual Feature Engineering: ML requires human to define features.
Example: Face Recognition : edge detection, nose width, eye distance manually

This is time-consuming and error-prone

ML FAILS WHEN FEATURES ARE COMPLEX OR UNKNOWN

2. Poor Performance on Unstructured Data

ML Struggles with: Images, Audio, Video, Natural Language

Real World data is mostly unstructured.

3. Scalability Issues:
As data size increases: MI model saturate, Accuracy stops improving

WHY DEEP LEARNING WAS INTRODUCED:

1. Automatic Feature Learning

- DL **learns features directly from raw data**
- No need for human-designed features

📌 Example (Image):

- Layer 1 → edges
- Layer 2 → shapes
- Layer 3 → objects

2. Handles Unstructured Data Efficiently

DL excels in :

Computer Vision, Speech Recognition, NLP

Example: Google Translate, Face Unlock, Self-driving cars

3. Better Performance with Big Data:

DL performance keeps improving with more data

ML plateaus after a point

MORE DATA + DL = Better Accuracy

SO WHY MACHINE LEARNING IS STILL TAUGHT AND A MUST TO LEARN?????

1. Machine Learning is the foundation of Deep Learning

Deep Learning is built on ML concepts

Without ML, DL makes no sense

ML teaches:

Loss functions, optimisation, Bias-variance tradeoff, Overfitting and underfitting, Model evaluation

YOU CANNOT UNDERSTAND DL PROPERLY WITHOUT THESE ML BASICS.

2. MANY REAL-WORLD PROBLEMS DON'T NEED DEEP LEARNING AS DEEP LEARNING IS POWERFUL BUT EXPENSIVE:

ML is enough when:

Data is small or medium, Data is structured (tables, numbers)

Problem is simple

Example:

Student marks prediction -> Linear Regression

Loan approval -> Decision Trees

Sales forecasting -> Random Forest

3. MACHINE LEARNIGN IS CHEAPER AND FASTER:

Aspect	ML	DL
Data Needed	Low	Very High
Training Time	Minutes	Hours / Days
Hardware	CPU	GPU/TPU
Cost	Low	High

Companies **prefer ML** when it gives **good-enough accuracy**.