TensorFlow for Deep Learning

TensorFlow

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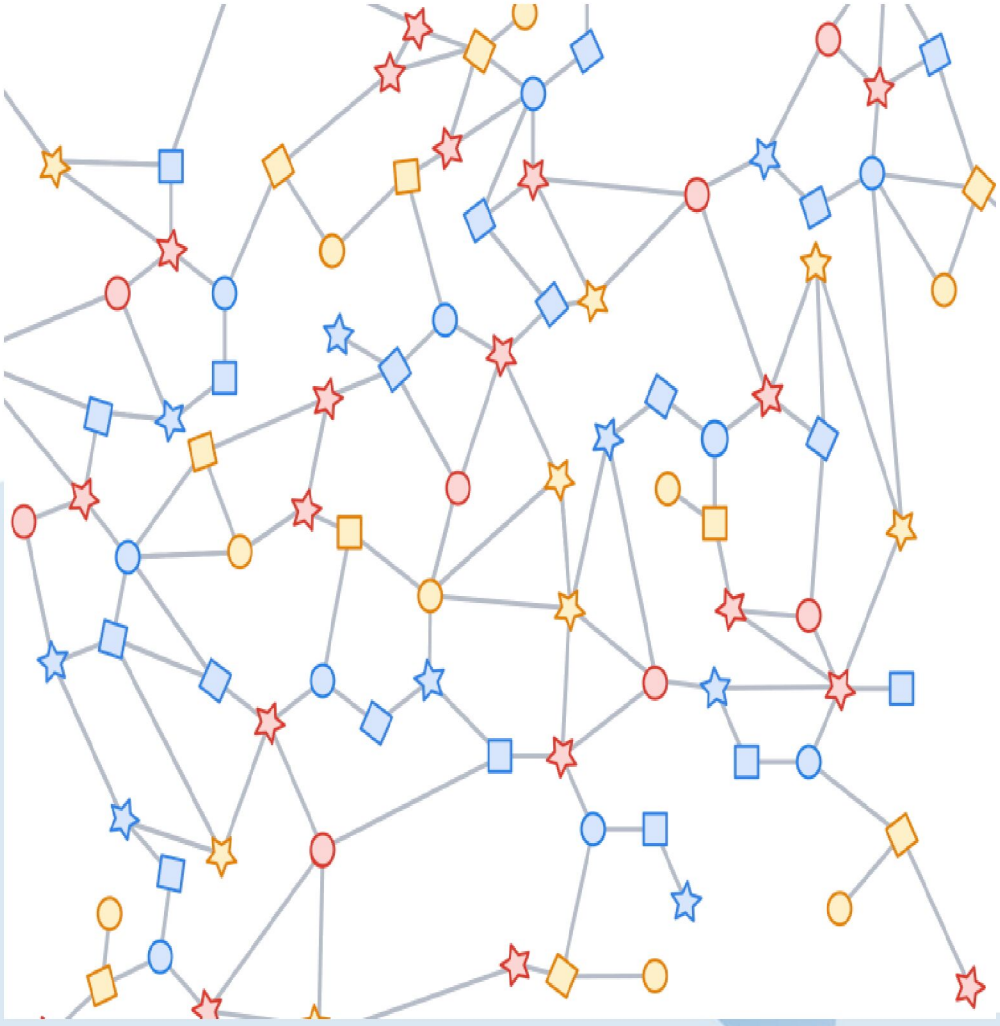


TensorFlow

About the Author

- Created By: Mohammad Salman
- Experience: 19 Years +
- Designation: Corporate Trainer

Microsoft CERTIFIED Professional

Microsoft Specialist

Microsoft CERTIFIED Solutions Developer

Icons Used

Questions

Tools

Hands-on Exercise

Coding Standards

Questions?

Reference

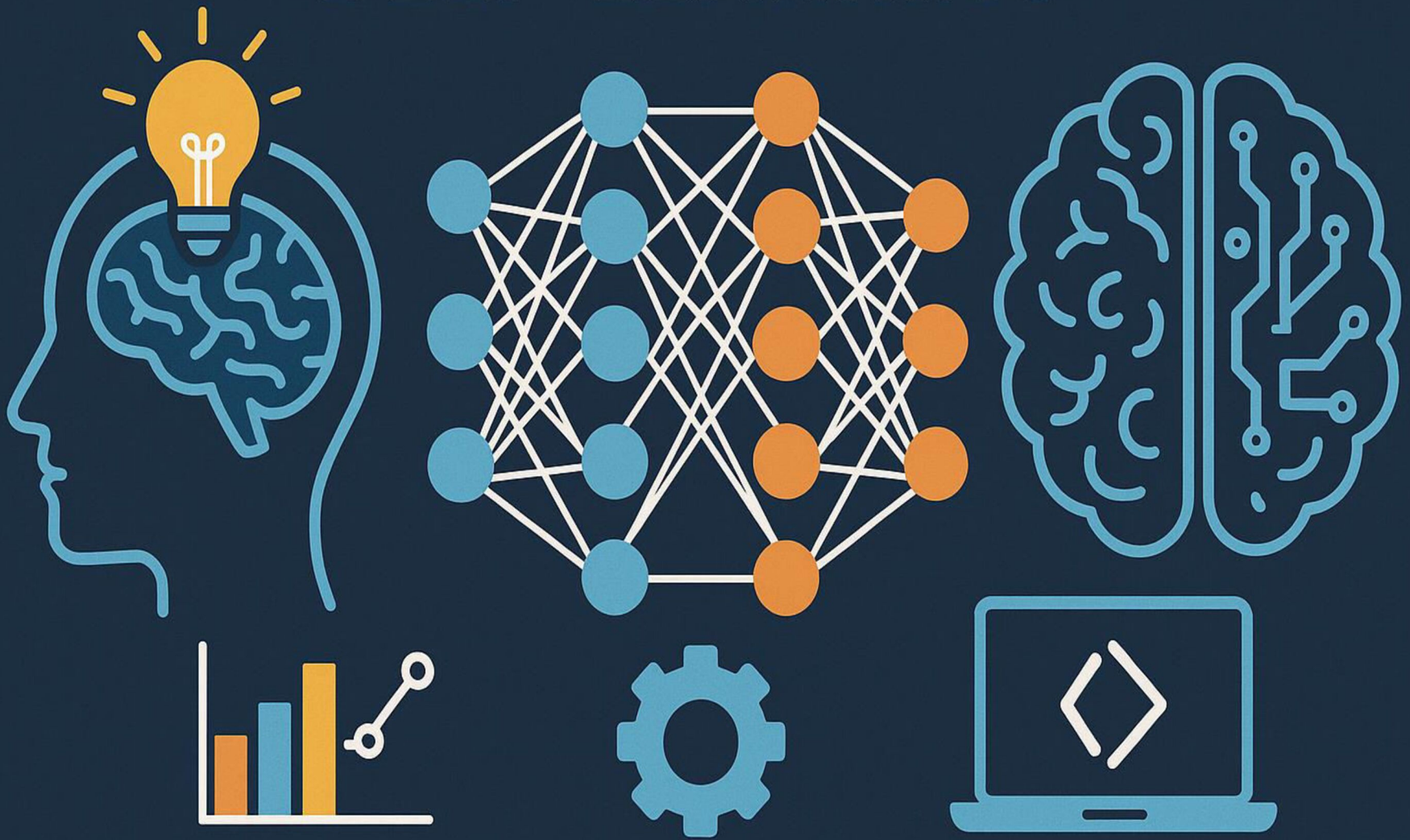
Try it Out

Informative Slide

Mandatory Slide

Welcome Break

DEEP LEARNING



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“WHATISDEEPLEARNING?”

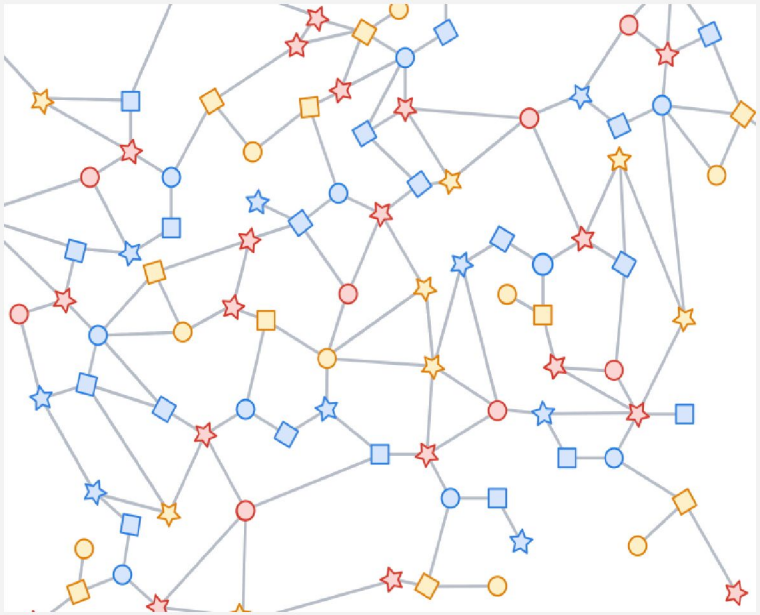
WHAT IS MACHINE LEARNING

- Machine Learning (ML) is a subset of Artificial Intelligence that enables systems to learn from data and make predictions without explicit programming.

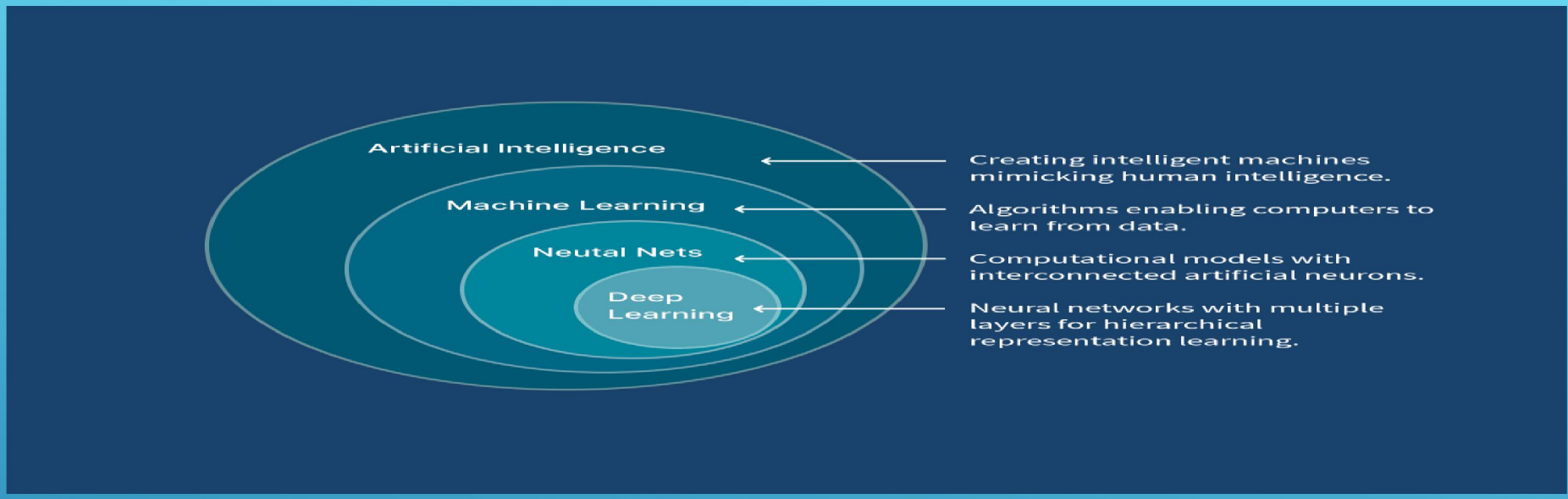
- Flow diagram → Data → Model → Prediction → FeedbackKey Point:
- ML = Learning patterns from data.

1. Deep learning uses multi-layered neural networks.

2. Learns from large datasets to make predictions automatically.



WHAT IS DEEP LEARNING



- **DEEP LEARNING (DL)** IS A SUBFIELD OF **MACHINE LEARNING (ML)** THAT USES **ARTIFICIAL NEURAL NETWORKS (ANNS)** WITH MULTIPLE LAYERS.

AUTOMATICALLY LEARN COMPLEX PATTERNS AND REPRESENTATIONS FROM LARGE AMOUNTS OF DATA.

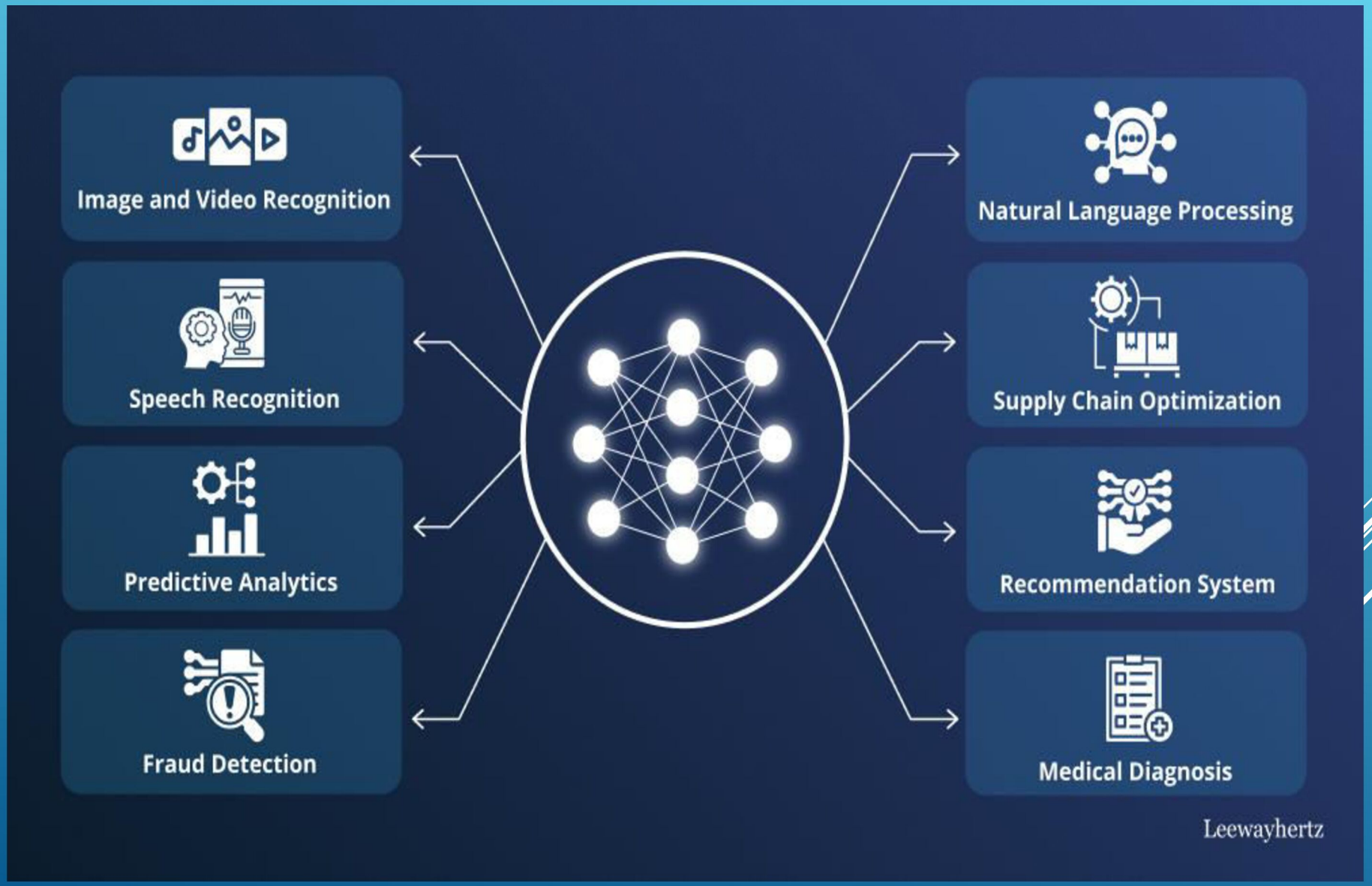
IT MIMICS THE STRUCTURE AND FUNCTION OF THE HUMAN BRAIN — EACH NEURON PROCESSES INPUTS AND PASSES THE RESULT TO OTHER NEURONS, ENABLING THE SYSTEM TO *LEARN* HIERARCHIES OF FEATURES FROM RAW DATA.

DEEP LEARNING USE CASES

- **Problems with long lists of rules—when the traditional approach fails, machine learning/deep learning may help.**
- **Continually changing environments—deep learning can adapt ('learn') to new scenarios.**
- **Discovering insights within large collections of data—can you imagine trying to hand-craft rules for what 101 different kinds of food look like?**

“WHAT IS DEEP LEARNING ACTUALLY USED FOR?”

DEEP LEARNING USE CASES



DEEP LEARNING IS NOT PERFECTLY FIT FOR

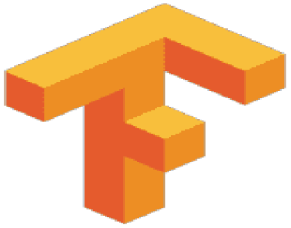
- **When you need explainability—the patterns learned by a deep learning model are typically uninterpretable by a human.**
- **When the traditional approach is a better option — if you can accomplish what you need with a simple rule-based system.**
- **When errors are unacceptable — since the outputs of deep learning model aren't always predictable.**
- **When you don't have much data — deep learning models usually require a fairly large amount of data to produce great results.**

(though we'll see how to get great results without huge amounts of data)

TensorFlow

TENSORFLOW IS AN OPEN-SOURCE MACHINE LEARNING FRAMEWORK BY GOOGLE.
USED FOR BUILDING AND TRAINING NEURAL NETWORKS.

Tensorflow



User Fetches Outputs

ReLu

TensorFlow Flows
tensors

Add

TensorFlow performs
operations

b

MatMul

TensorFlow Flows
Trains Variables

w

x

User Feeds
Inputs

AGENDA

- TensorFlow basics & fundamentals
- Preprocessing data (getting it into tensors)
- Building and using pretrained deep learning models
- Fitting a model to the data (learning patterns)
- Making predictions with a model (using patterns)
- Evaluating model predictions
- Saving and loading models
- Using a trained model to make predictions on custom data

INTRODUCTION TO TENSORFLOW

- TensorFlow is an open-source machine learning framework by Google.
- Used for building and training neural networks.
- Supports both CPU and GPU computation.
- Integrates easily with NumPy and Keras.

WHAT ARE TENSORS?

- Core data structure in TensorFlow.
- Represents data as multidimensional arrays.
- Types: Scalar (0D), Vector (1D), Matrix (2D), and Higher-D tensors.
- Tensor attributes: shape, rank, dtype.

CREATING TENSORS

- Use tf.constant(), tf.Variable(), tf.zeros(), tf.ones(), tf.random().
- Example: tensor = tf.constant([[1, 2], [3, 4]])
- Variables can change; constants cannot.
- Random tensors are often used to initialize model weights.

TENSOR OPERATIONS

- Arithmetic operations: +, -, *, /, tf.square(), tf.sqrt().
- Matrix operations: tf.matmul() or '@' operator.
- Element-wise vs matrix operations.
- TensorFlow tracks operations for automatic differentiation.

TENSOR PROPERTIES

- Rank: Number of dimensions.
- Shape: Size along each dimension.
- Data Type: Numeric type (float32, int64, etc.).
- Device placement: Runs on CPU or GPU automatically.

RANDOM AND SPECIAL TENSORS

- tf.random.Generator.from_seed() for reproducibility.
- tf.zeros(), tf.ones(), tf.eye() for initialization.
- Use seeds for repeatable experiments.
- Helps initialize model parameters randomly.

RESHAPING AND TRANSPOSING

- Reshape tensors using tf.reshape(tensor, new_shape).
- Transpose tensors with tf.transpose().
- Important for aligning tensor dimensions before multiplication.
- Does not alter data — only the view of it.

Operation	TensorFlow API	What it does	Shape rule
Matrix Multiplication	`tf.matmul(A, B)`	Dot product of rows and columns	For 2D, `(m, n)` @ `(n, p)` → `(m, p)`
Transpose	`tf.transpose(X)`	Swaps axes (for 2D, rows ↔ columns)	`(m, n)` → `(n, m)`
Reshape	`tf.reshape(X, new_shape)`	Changes shape (data unchanged)	Product of dims must match original size

MATRIX MULTIPLICATION RESHAPING AND TRANSPOSING

TENSORFLOW AND NUMPY INTEGRATION

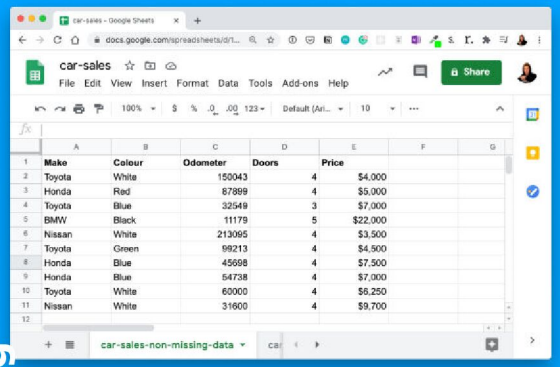
- Tensors can be converted to NumPy arrays using .numpy().
- NumPy arrays can be converted to tensors with tf.constant().
- TensorFlow operations are compatible with NumPy syntax.
- Seamless interoperability between the two frameworks.

PRACTICAL EXAMPLES

- 1. Creating a tensor and performing arithmetic.
- 2. Reshaping and slicing tensors.
- 3. Using random tensors for weight initialization.
- 4. Converting between TensorFlow and NumPy.

“WHY USE MACHINE LEARNING (OR DEEP LEARNING)?”

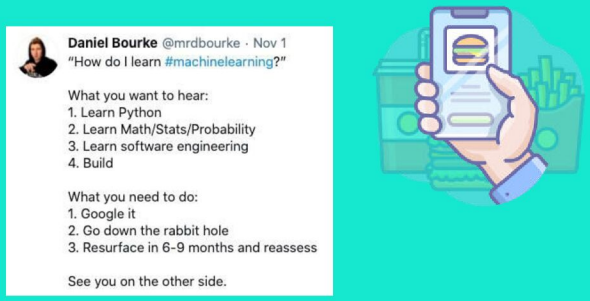
Machine Learning

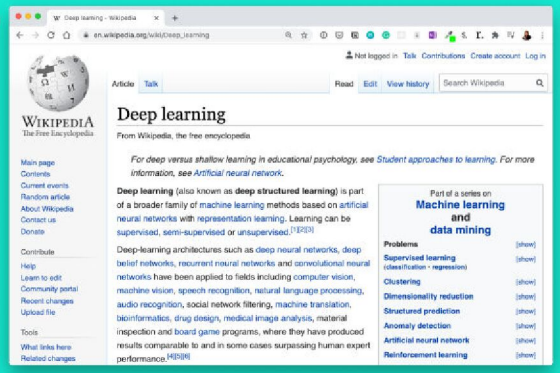


Make	Colour	Odometer	Doors	Price
Toyota	White	150043	4	$4,000
Honda	Red	87899	4	$5,000
Toyota	Blue	32549	3	$7,000
BMW	Black	11179	5	$22,000
Nissan	White	213095	4	$3,500
Toyota	Green	99213	4	$4,500
Honda	Blue	45698	4	$7,500
Honda	Blue	54738	4	$7,000
Toyota	White	60000	4	$6,250
Nissan	White	31600	4	$9,700

Structured data

Deep Learning

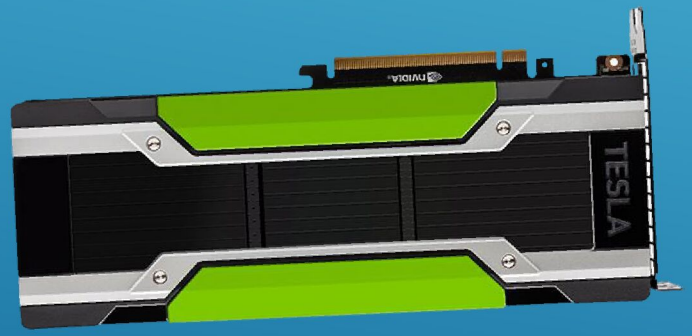




Unstructured data

TensorFlow

“WHATISTENSORFLOW?”



GPU (Graphics Processing Unit)

TPU (Tensor Processing Unit)

Easy model building

Build and train ML models easily using intuitive high-level APIs like Keras with eager execution, which makes for immediate model iteration and easy debugging.

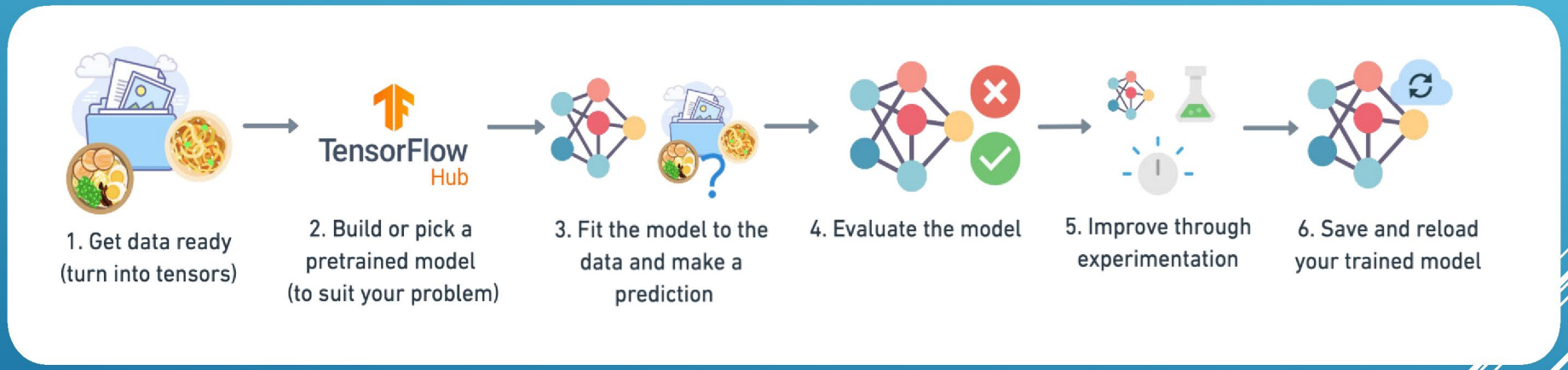
Robust ML production anywhere

Easily train and deploy models in the cloud, on-prem, in the browser, or on-device no matter what language you use.

Powerful experimentation for research

A simple and flexible architecture to take new ideas from concept to code, to state-of-the-art models, and to publication faster.

WHY TENSORFLOW



TENSORFLOW WORKFLOW

SUMMARY — KEY TAKEAWAYS

Tensors are the fundamental building blocks in TensorFlow.

Tensor operations allow efficient numerical computation.

TensorFlow integrates well with NumPy.

Next: Apply these concepts in Neural Network Regression.

THANK YOU!

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