Input layer

Output layer

Types of Learning in Neural Networks

Exploring Supervised, Unsupervised, Semi-supervised, Reinforcement, and Self-supervised Learning

Multiple hidden layer

Introduction to Learning in Neural Networks

Neural networks can learn in various ways, each suited for different types of problems and data. Understanding these **learning approaches** is crucial for applying AI effectively.

Supervised Learning
Learns from labeled data

Unsupervised Learning
Finds patterns in unlabeled data

Semi-supervised Learning
Combines labeled and unlabeled data

Reinforcement Learning
Learns through rewards and penalties

Self-supervised Learning
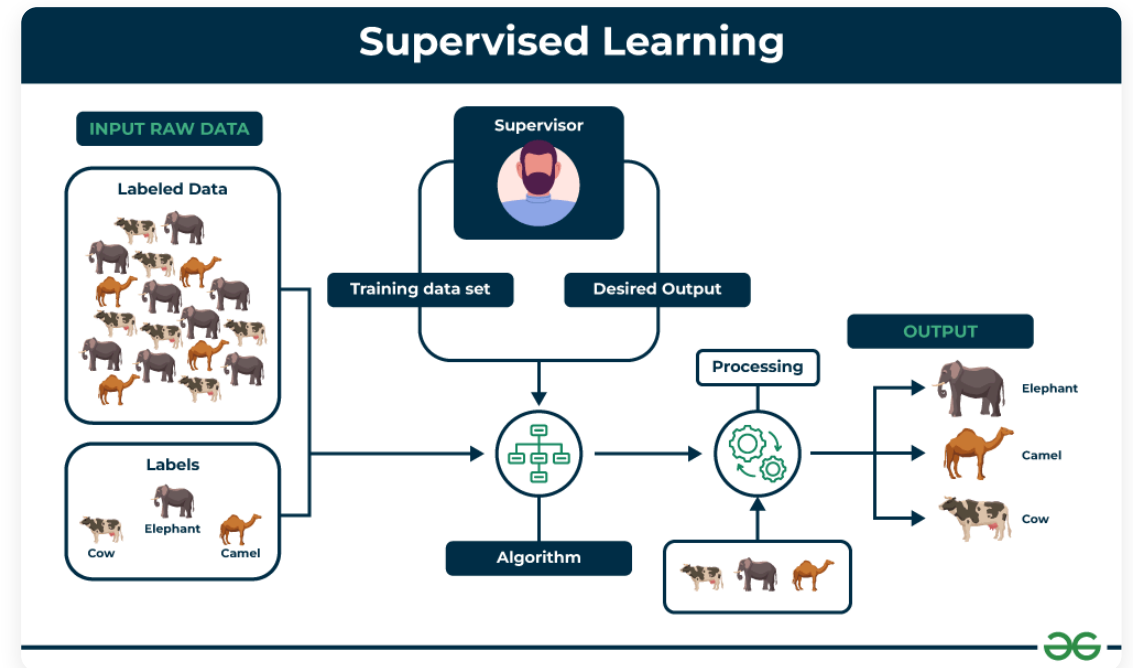Creates its own learning tasks

☷ Supervised Learning

Learning with labeled data

Network trained with **input data** and **correct answers** (labels)

☷ Example: Cat vs Dog Classification

- Show network images of cats and dogs
- Provide labels for each image
- Network learns to distinguish features
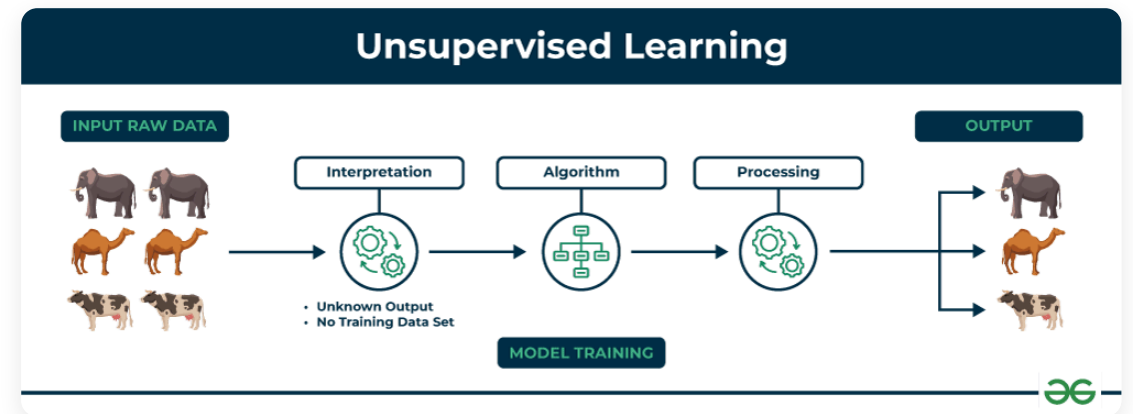- Can classify new unlabeled images

Unsupervised Learning

Learning without labels

Network receives **only data** without any labels and discovers patterns on its own

Example: Image Clustering

- Present network with unlabeled images
- Groups similar images together
- Identifies shared features
- Creates clusters based on similarities

Unsupervised Learning

INPUT RAW DATA

Interpretation

Algorithm

Processing

OUTPUT

- Unknown Output
- No Training Data Set

MODEL TRAINING

Semi-supervised Learning

Combining labeled and unlabeled data

Uses **small labeled dataset** and **large unlabeled dataset** for training

Example: Image Classification

- 1,000 images total
- Only 100 labeled (10%)
- 900 unlabeled (90%)
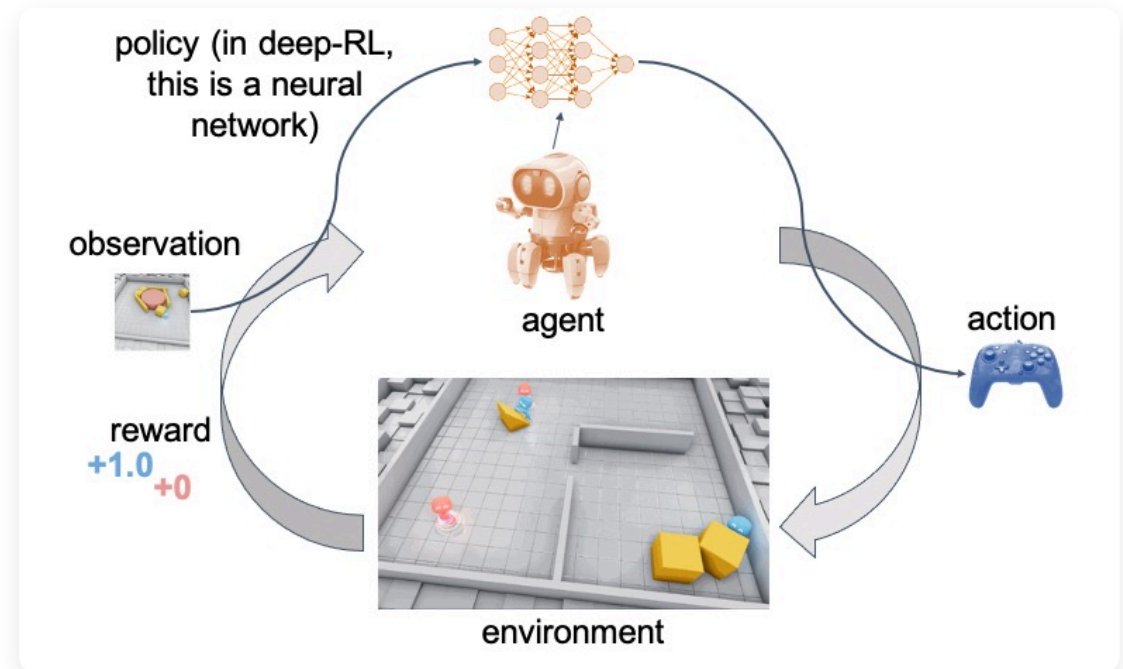- Network learns from both to classify all images
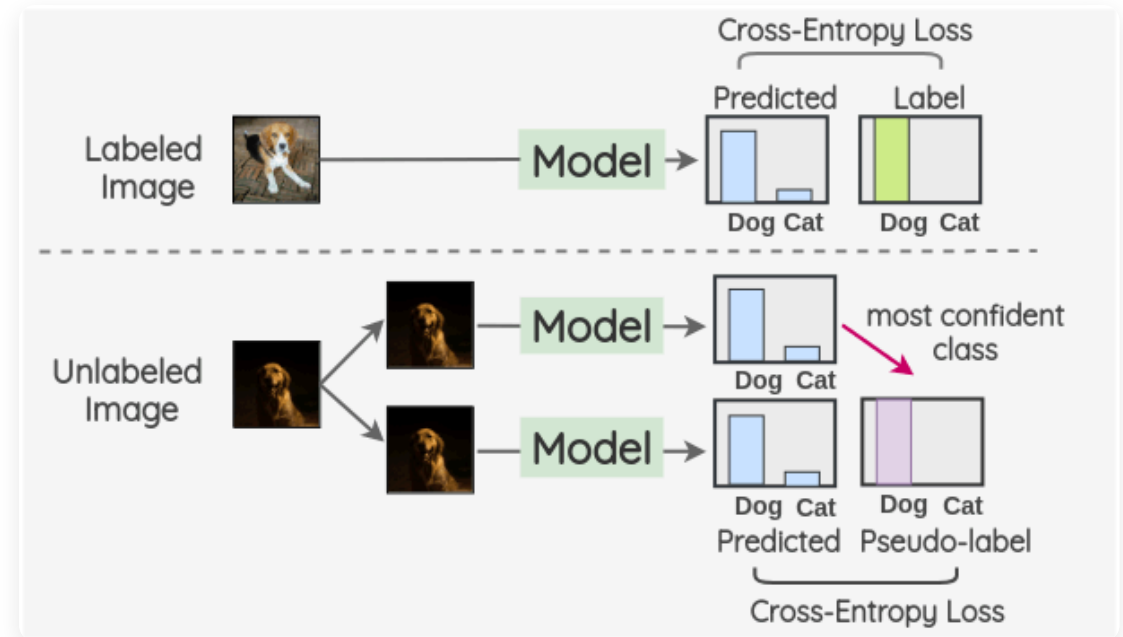
🎮 Reinforcement Learning

Learning through trial and error

Network learns by receiving **rewards** for correct actions and **penalties** for mistakes

> ⚽ **Example: Robot Soccer Player**
> • Robot learns to play soccer
> • Correct moves: +2 points (reward)
> • Incorrect moves: -2 points (penalty)
> • Learns optimal actions over time

policy (in deep-RL, this is a neural network)

observation

reward
+1.0
+0

agent

action

environment

🧠 Self-supervised Learning

Learning through self-created tasks

Model learns from data by **creating its own learning tasks** without external supervision

💬 **Example: ChatGPT Language Model**

- Learns by predicting next word in text
- Creates its own learning objectives
- No human-provided labels needed
- Builds understanding of language patterns

Self-Supervised Learning Workflow
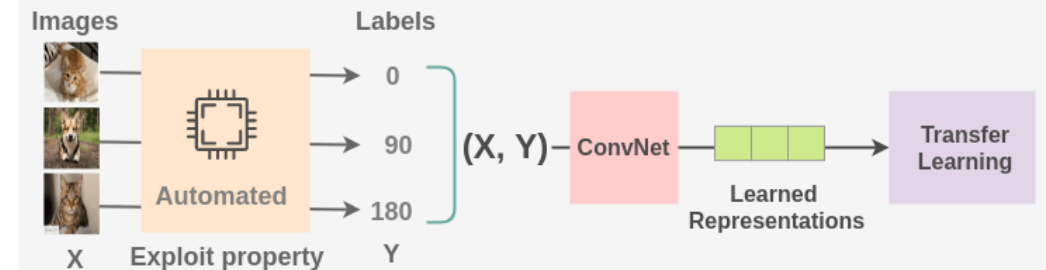
✦⤴ Conclusion

80%+ | ## Economic Value from Supervised Learning
Most economic value generated from neural networks comes from **supervised learning**, making it the most commercially successful approach in machine learning applications.

Next Topic: Types of Data
In our next discussion, we'll explore the different types of data used in these learning processes and how they impact model performance.

Supervised   Unsupervised   Semi-supervised   Reinforcement   Self-supervised