L01: What is Deep Learning

CSci 560 Deep Learning w/ Python (Chollet) Ch. 1

Derek Harter

Department of Computer Science
East Texas A&M University

Summer 2025

EAST TEXAS A&M

Artificial Intelligence, Machine Learning, Deep Learning, Generative AI

- **Artificial Intelligence** (AI): *the effort to automate intellectual tasks normally performed by humans*
- **Machine Learning** (ML): *machine looks at input and answer and figures out the rules*
- **Deep Learning** (DL, DNN): *learning successive layers of increasingly meaningful representations*
- **Generative AI** (GenAI): *extend from reactive to creative activities*

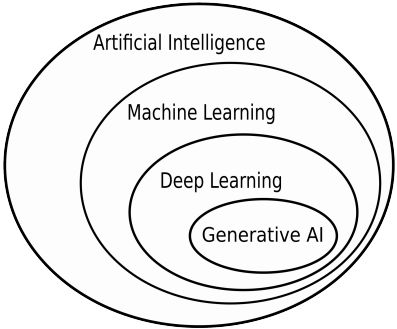


Figure 1: Relation of AI with ML, DL and GenAI. Each is a more specialized subset of the larger discipline. (Chollet, 2021, pg.2)

EAST TEXAS A&M

Machine Learning

- Usually have human programmer write down rules (a computer program) that turns input into appropriate answers.
- In ML paradigm, you give a ML algorithm the input and answers, and it "learns" the rules.

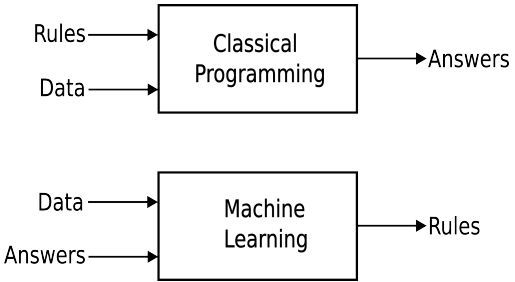


Figure 2: Machine Learning coordinate change and learning representations.. (Chollet, 2021, pg.4)

EAST TEXAS A&M

Learning Rules and Representations from Data

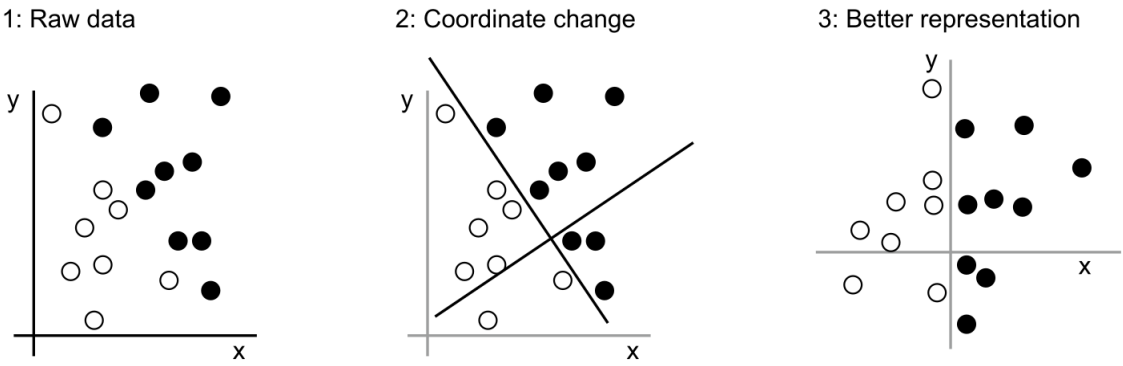
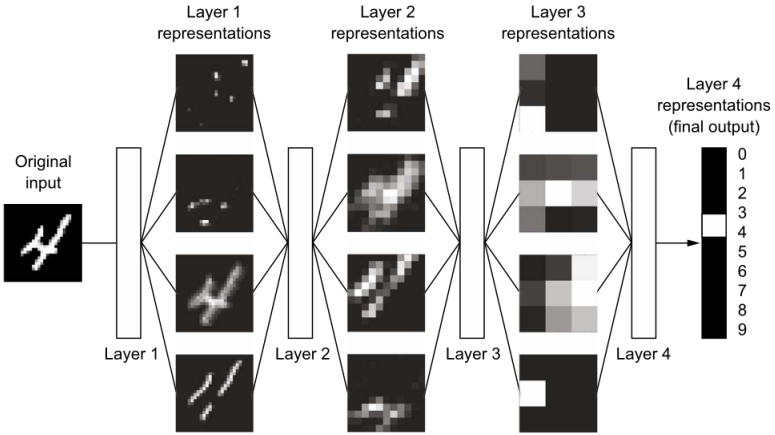


Figure 3: ML a new programming paradigm. (Chollet, 2021, Fig. 1.4)

Neural Networks and Deep Learning: The "Deep" in "Deep Learning"



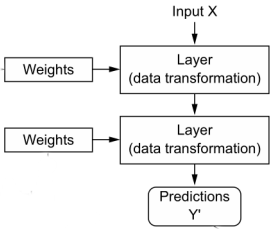
- **layered representations learning** or **hierarchical representations learning**
- Information goes through successive filters and comes out increasingly *purified*.
- Deep Learning is a multistage way to learn data representations.

Figure 4: Data representations learned by a digit-classification model (Chollet, 2021, Fig. 1.6)

EAST TEXAS A&M

Understanding how Deep Learning Works

Goal: finding the right values for these weights

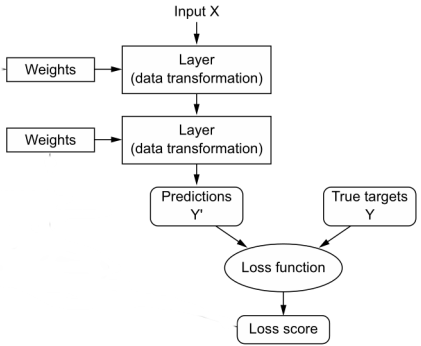


- A neural network is parameterized by its weights.

EAST TEXAS A&M

Understanding how Deep Learning Works

Goal: finding the right values for these weights

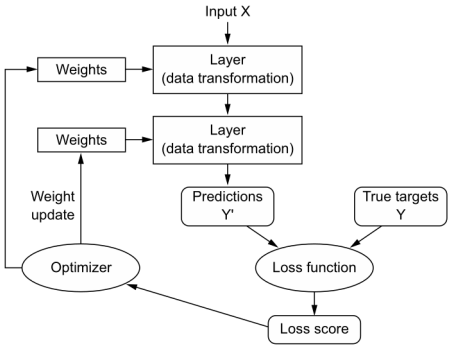


- A neural network is parameterized by its weights.
- A loss function measures the quality of the network's output.

EAST TEXAS A&M

Understanding how Deep Learning Works

Goal: finding the right values for these weights



- A neural network is parameterized by its weights.
- A loss function measures the quality of the network's output.
- The loss score is used as a feedback signal to adjust the weights.

EAST TEXAS A&M

AI Boom / Bust and AI Winter

1. First AI Winter: 1970s Symbolic AI, Minsky: "In from three to eight years we will have a machine with the general intelligence of an average human being."
2. Second AI Winter: 1990s Expert Systems boom/bust
3. Third AI Winter? Deep Learning / Generative AI

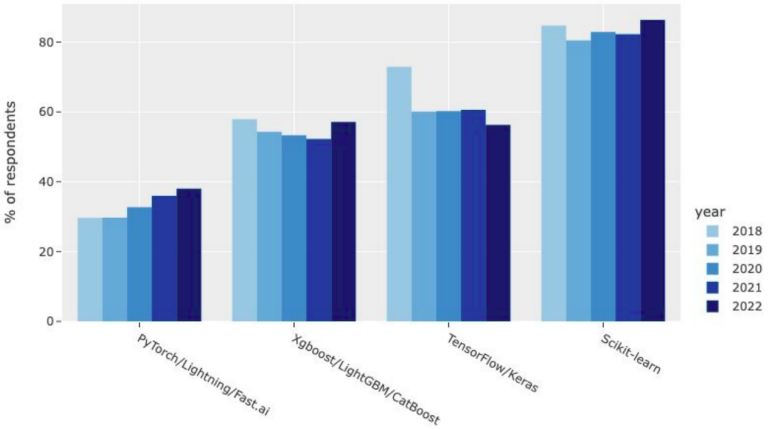
I recommend reading Dr. Mitchel's Science article (Mitchell, 2025) for a recent measured take on the state of the art in Generative AI.

AI Winter

Although deep learning (and generative AI) has led to remarkable achievements in recent years, expectations for what the field will be able to achieve in the next decade tend to run much higher than what will likely be possible.

EAST TEXAS A&M

The Modern Machine Learning Landscape



- Scikit-learn still most popular tool across ML and data science industry.
- TensorFlow/Keras has dropped a bit in popularity since 2020 survey, still more users than PyTorch.
- PyTorch has been growing in use and popularity however.

Figure 5: Scikit-learn most popular ML framework, PyTorch has been growing. (Kaggle, 2022)

EAST TEXAS A&M

Why Deep Learning? Why Now?

Hardware

- 5,000 times speedup of CPU performance
- GPUs: HPC supercomputers on a card.

Data

If deep learning is the steam engine, then (big) data is its coal: the raw material that powers our intelligent machines.

Algorithms

gradient propagation: feedback signals fade as number of layers increased.

- Better *activation functions*
- Better *weight-initialization schemes*
- Better *optimization schemes*
- Batch Normalization
- Depthwise separable convolutions

Bibliography

- Chollet, F. (2021). *Deep learning with python* (second). Manning.
- Kaggle. (2022). Kaggle data science and machine learning survey [Online; posted October-2022]. https://www.kaggle.com/kaggle-survey-2022
- Mitchell, M. (2025). Artificial intelligence learns to reason. *Science*, *387*(6740), eadw5211. https://doi.org/10.1126/science.adw5211

EAST TEXAS A&M