

AI, machine learning and deep learning

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What you'll learn

- Defining AI
- What's machine learning?
- Supervised, unsupervised and reinforcement learning
- Defining deep learning
- Traditional machine learning vs deep learning
- Deep learning applications in audio



A Venn diagram illustrating the relationship between Artificial intelligence, Machine learning, and Deep learning. It consists of three concentric circles. The outermost circle is red and labeled 'Artificial intelligence'. Inside it is a green circle labeled 'Machine learning'. Inside the green circle is an orange circle labeled 'Deep learning'. This visualizes that Deep learning is a subset of Machine learning, which is a subset of Artificial intelligence.

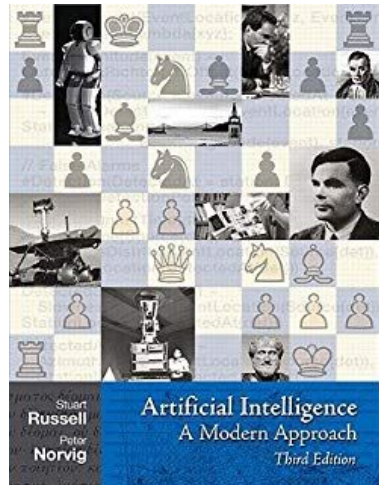
Artificial
intelligence

Machine
learning

Deep
learning

Artificial intelligence

“The designing and building of intelligent agents that receive percepts from the environment and take actions that affect that environment.”



Intelligent agent = Rational agent

Rationality = Acting to achieve one's goals, given
one's beliefs

Artificial intelligence

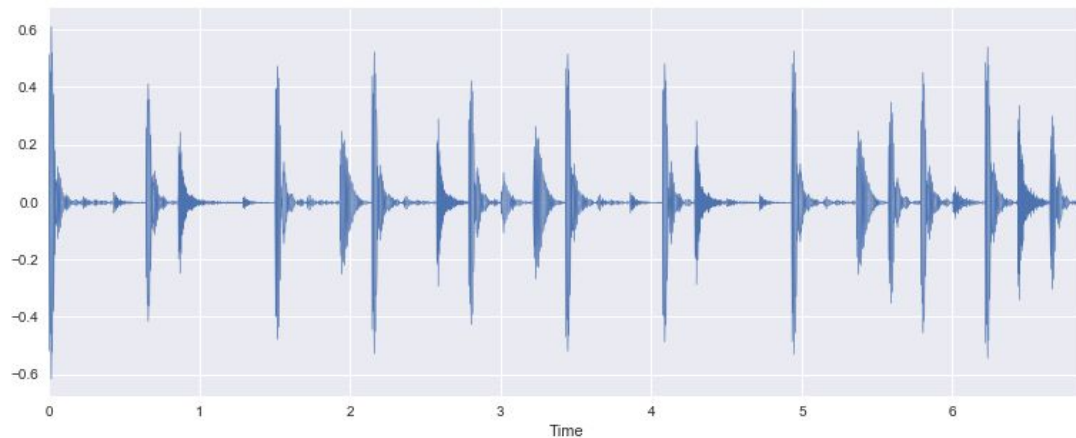
- Many AI techniques/algorithms
- Evolutionary algorithms
- Expert systems
- Search (e.g., A*)
- Machine learning
- ...

Machine learning (ML)

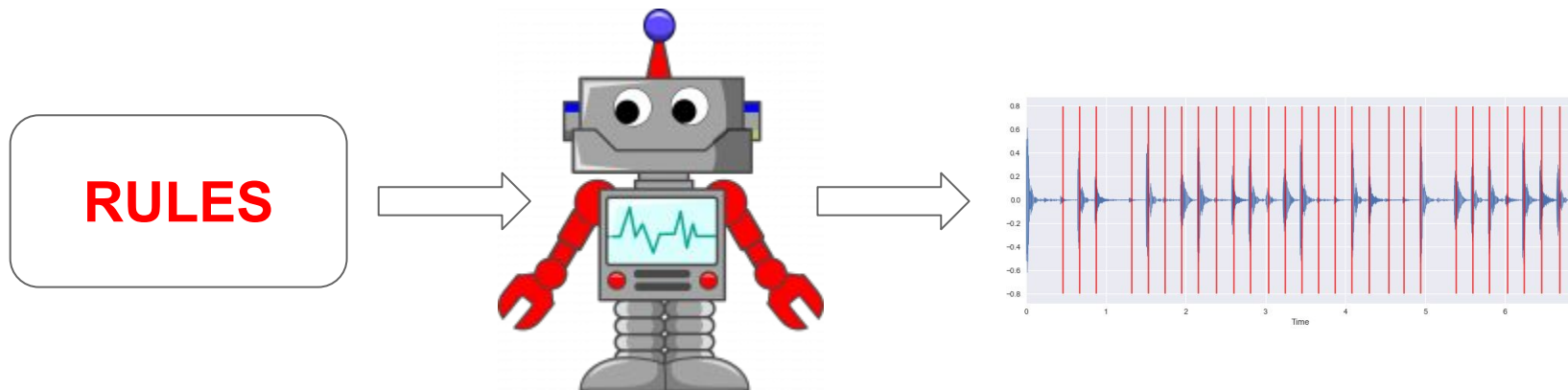
- Computer performs a task without using explicit instructions
- Computer learns from data

ML vs expert system for onset detection

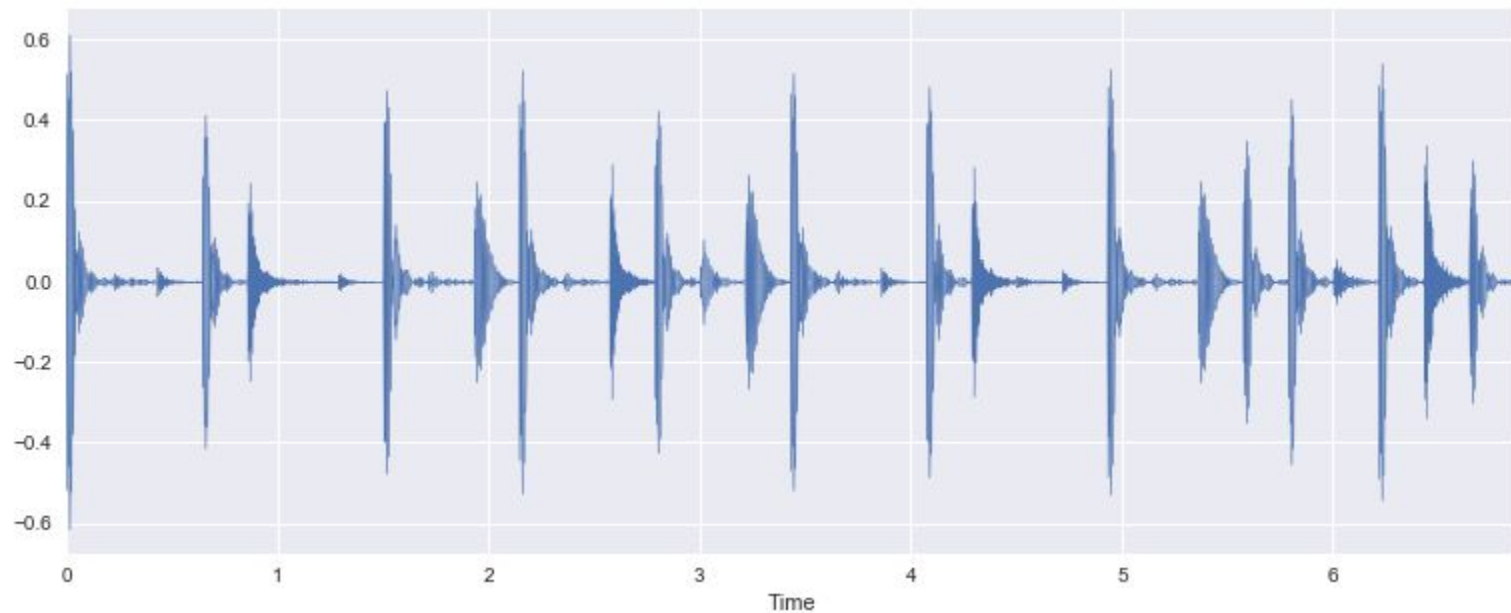
- Onset detection task: identify start of a musical note



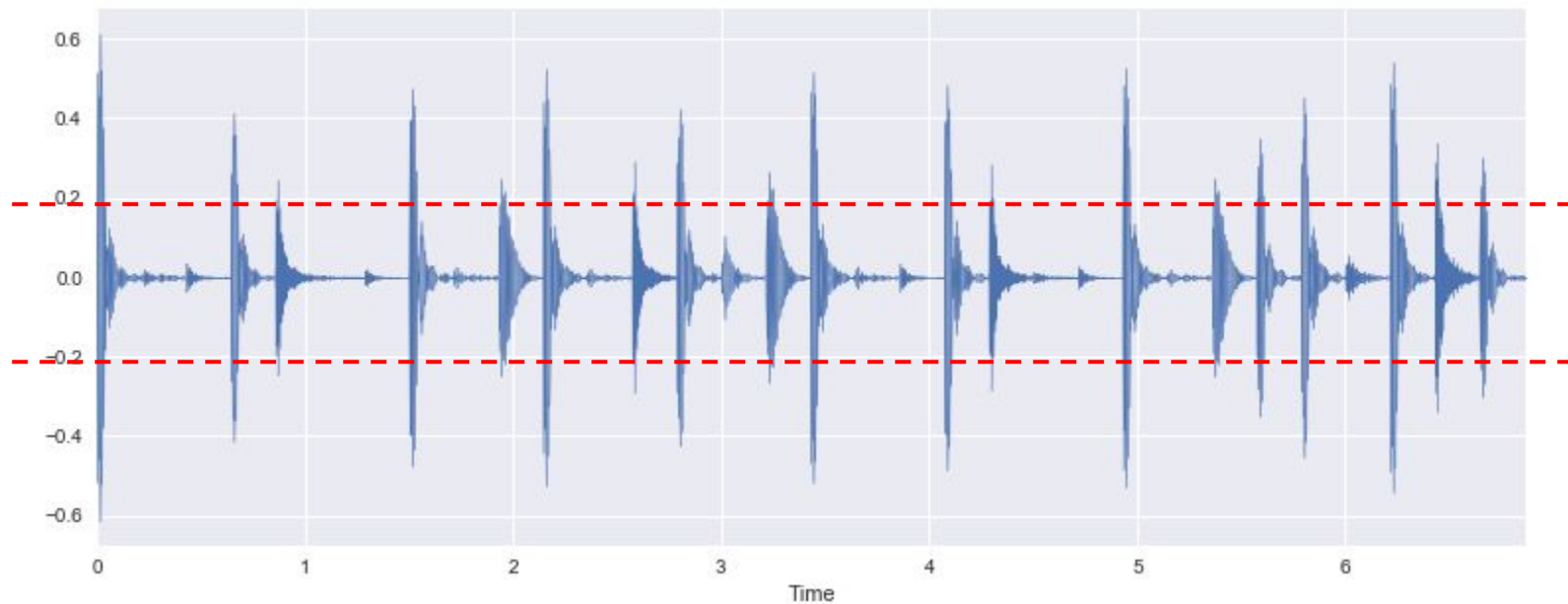
Expert system: Onset detection



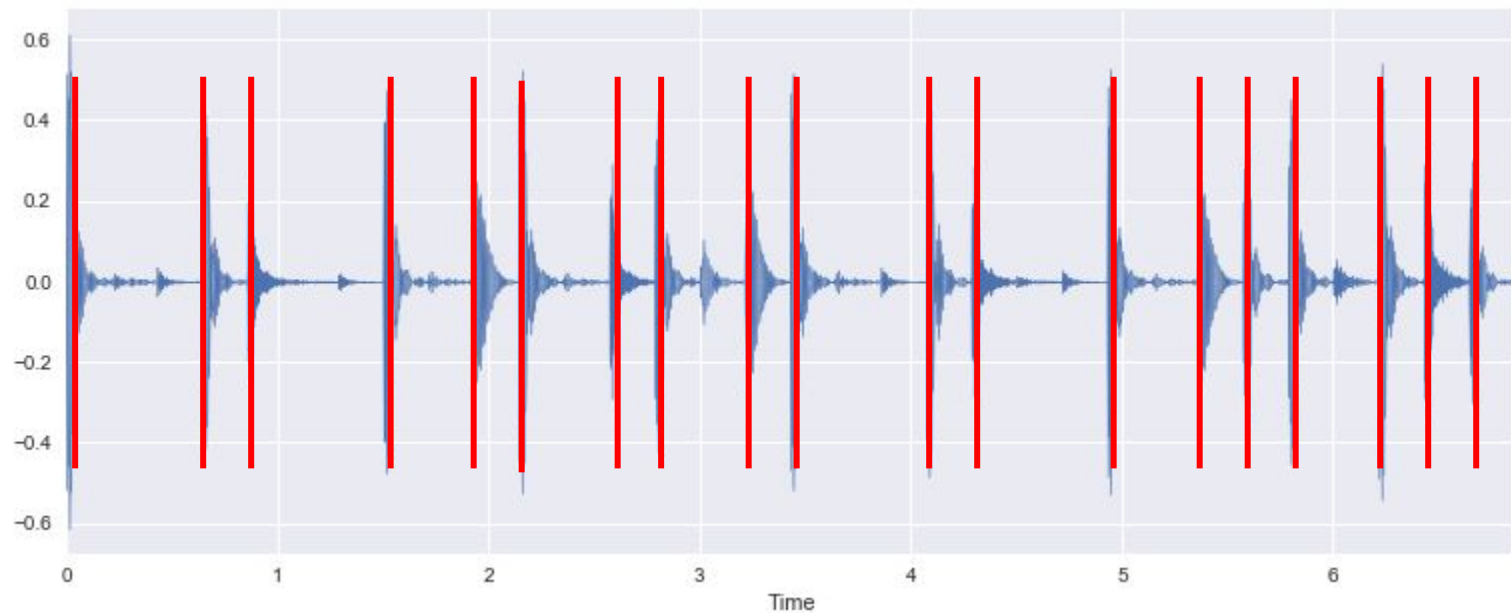
Expert system: Onset detection



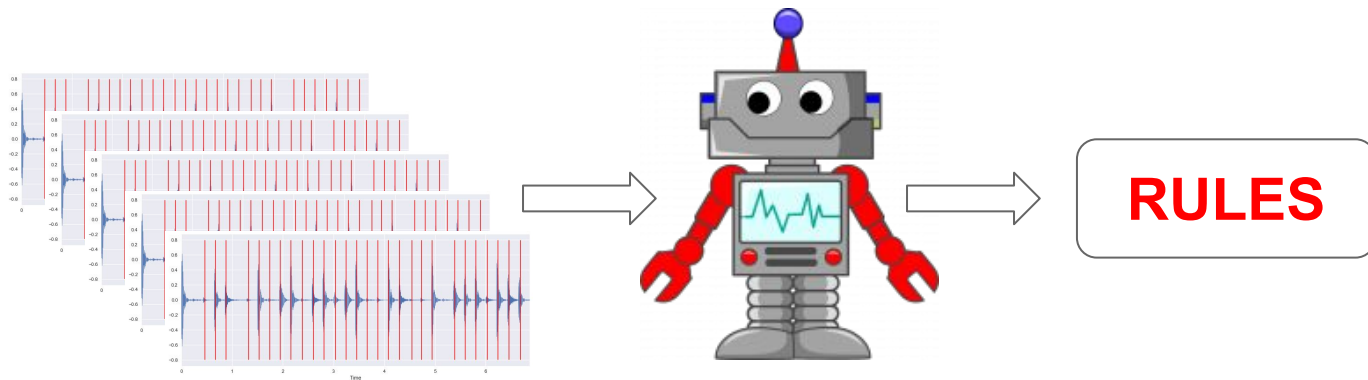
Expert system: Onset detection



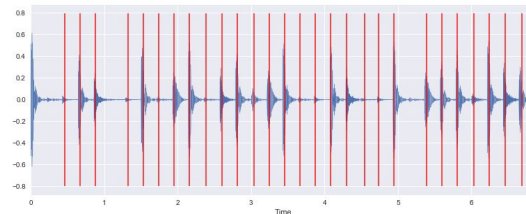
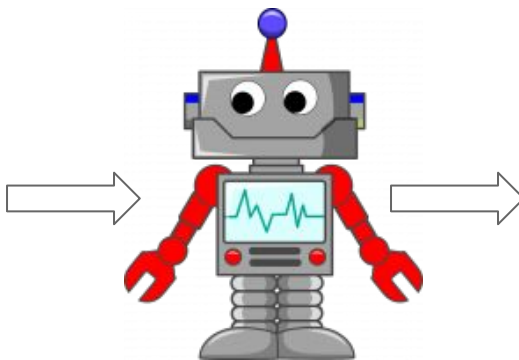
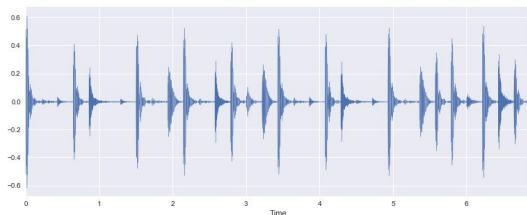
Expert system: Onset detection



ML onset detection: Training



ML onset detection: Inference

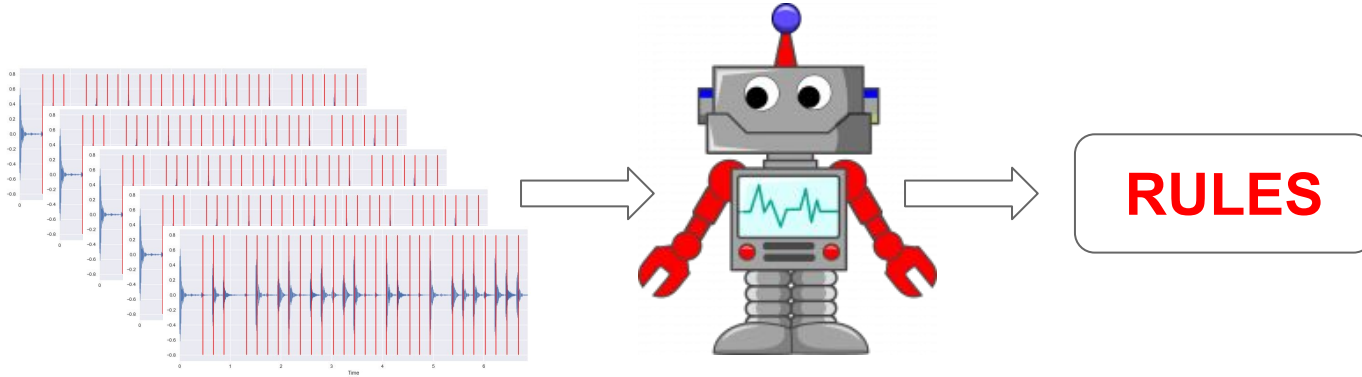


ML paradigms

- Supervised learning
- Unsupervised learning
- Reinforcement learning
- ...

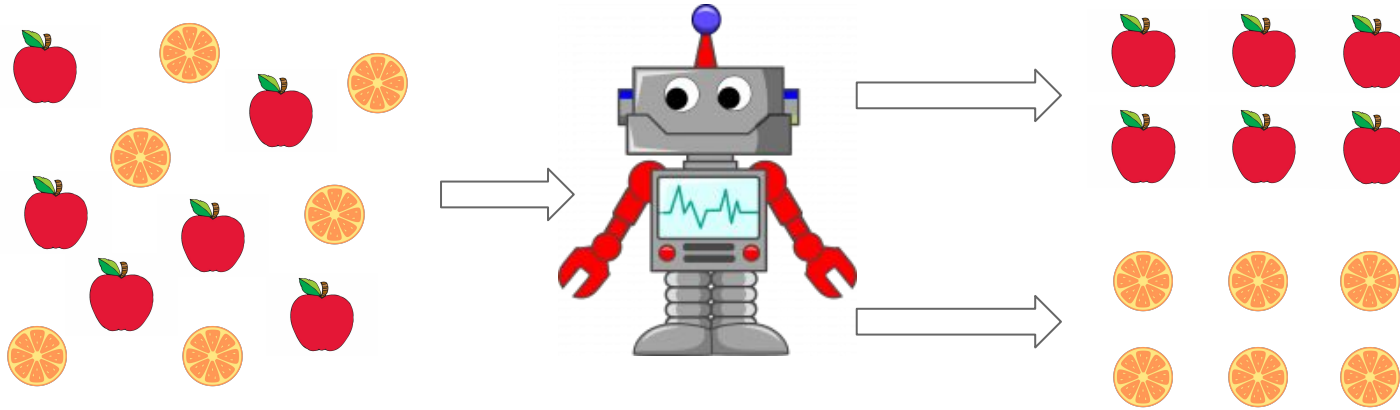
Supervised learning

- Model trained with *labelled* data



Unsupervised learning

- Model draws inferences from unstructured data

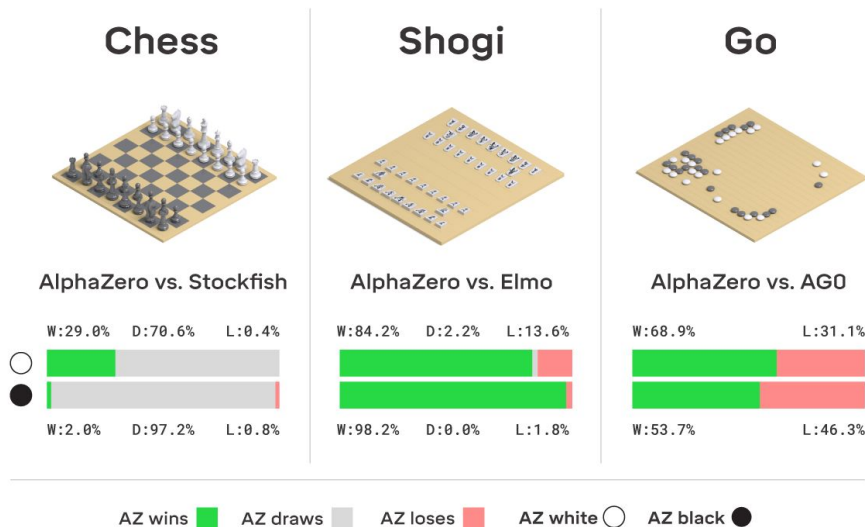


Reinforcement learning

- Agent takes actions in virtual environment and learns through rewards

Reinforcement learning

- Agent takes actions in virtual environment and learns through rewards

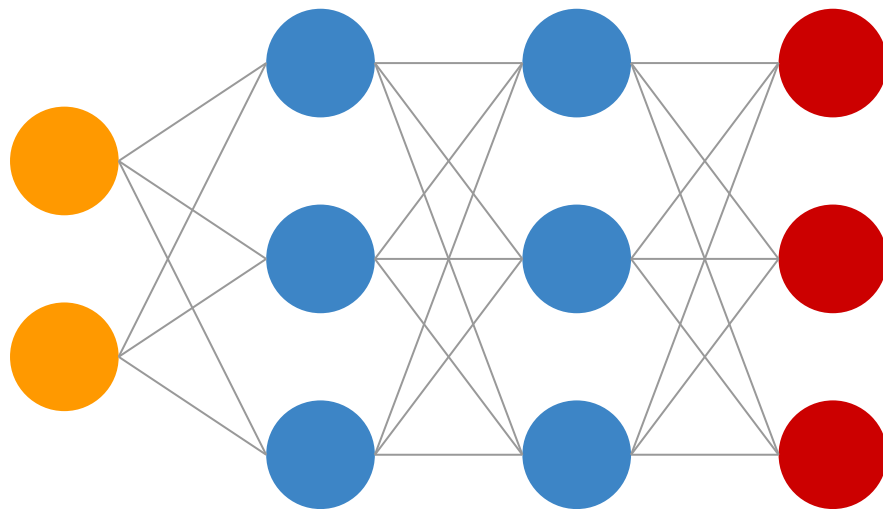


AlphaZero: Shedding new light on chess, shogi, and Go - DeepMind

ML algorithms

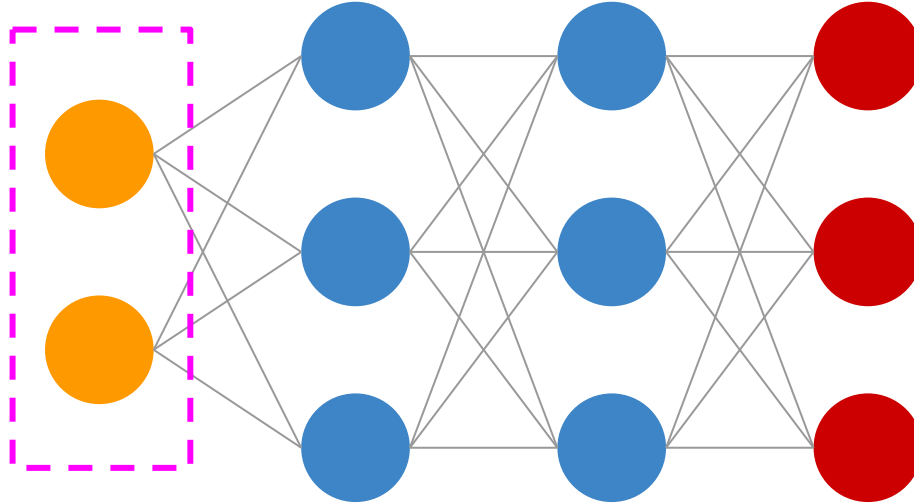
- Logistic regression
- Linear regression
- Random forest
- KNN
- Support vector machines
- ...

Neural network (NN)

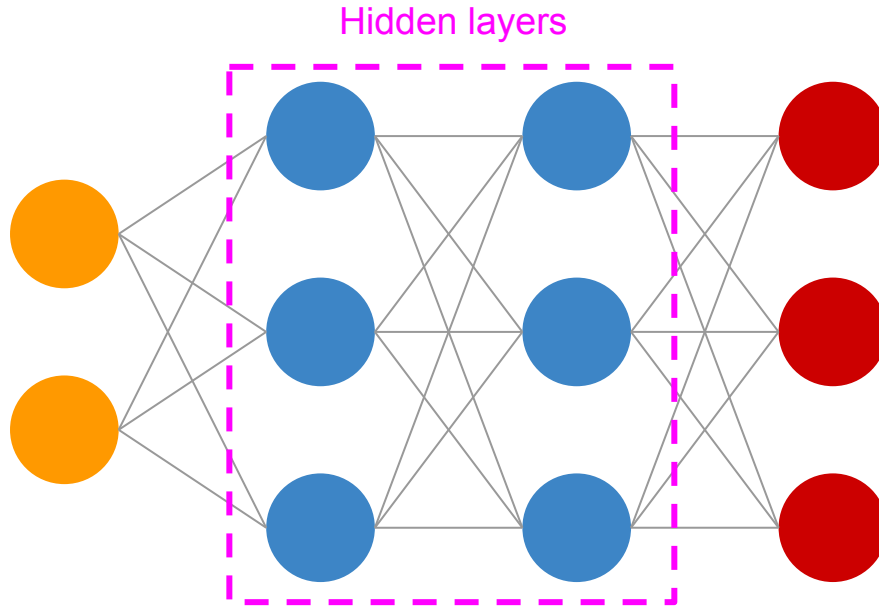


Neural network (NN)

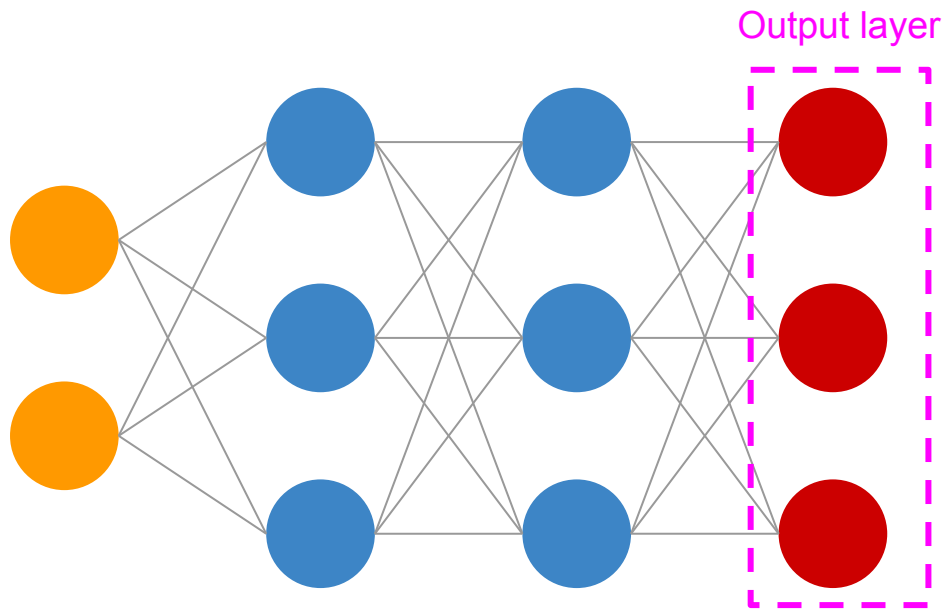
Input layer



Neural network (NN)



Neural network (NN)



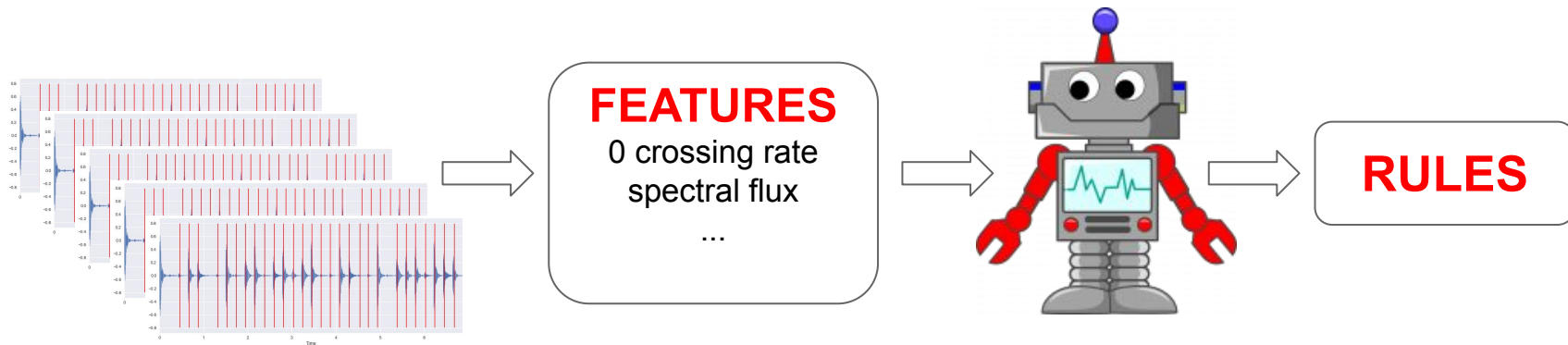
Deep learning

- ML subset
- (Deep) neural networks
- >1 hidden layer

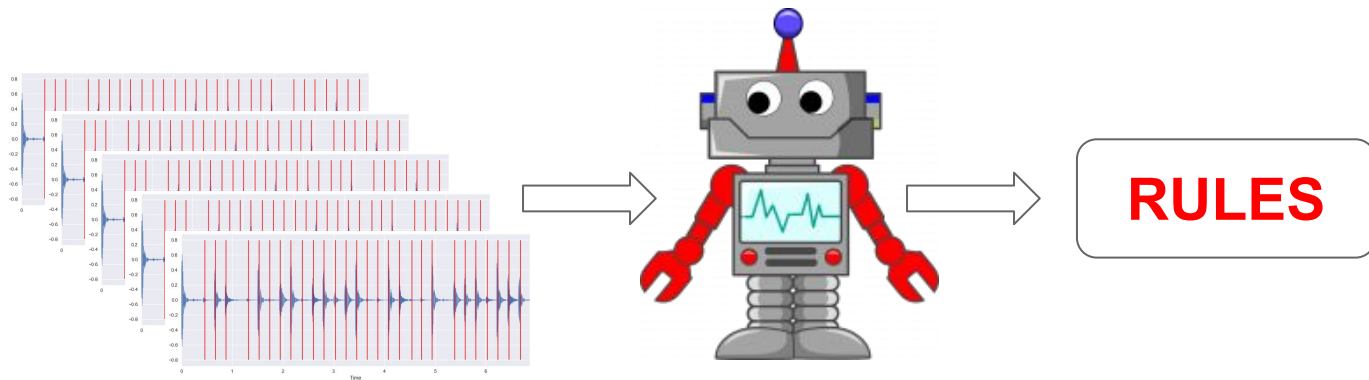
Traditional ML vs DL

- Feature engineering vs end-to-end

Traditional ML vs DL: Feature engineering



Traditional ML vs DL: End-to-end



Traditional ML vs DL

- Feature engineering vs end-to-end
- (Relatively) small dataset vs large dataset
- Less computation intensive vs very resource intensive
- Ideal for “simple” problems vs ideal for “complex” problems

When should you use DL?

- Very large dataset
- Complex problem where traditional ML fails
- Access to extensive computational resources

DL applications in audio

- Speech recognition
- Voice-based emotion classification
- Noise recognition
- Musical genre, instrument, mood classification
- Music tagging
- Music generation
- ...

Takeaway points

- AI = Building rational agents that act to achieve their goals given their beliefs
- ML is a subset of AI
- There are different flavours of ML and many ML algorithms
- DL is a subset of ML using DNNs
- DL isn't always the way to go!

What's up next?

