Methods and Algorithms

Spring 2026

By the end of this lecture, you will be able to:

1. Explain word embeddings and their applications
2. Apply pre-trained embeddings for text analysis
3. Understand the reinforcement learning framework
4. Implement basic Q-learning for decision problems

Finance Applications: Sentiment analysis, algorithmic trading

From text to numbers, from decisions to optimal policies

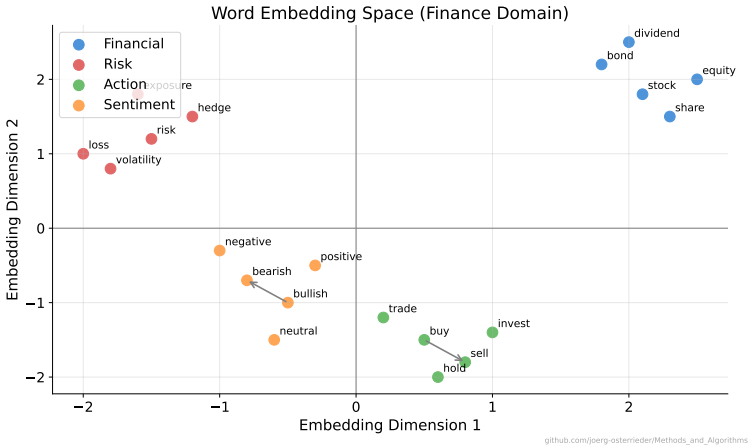
Text Data Challenge

- Financial news, reports, social media contain valuable signals
- Text is unstructured—how to feed it to ML models?
- Need to capture semantic meaning (“bullish” similar to “positive”)

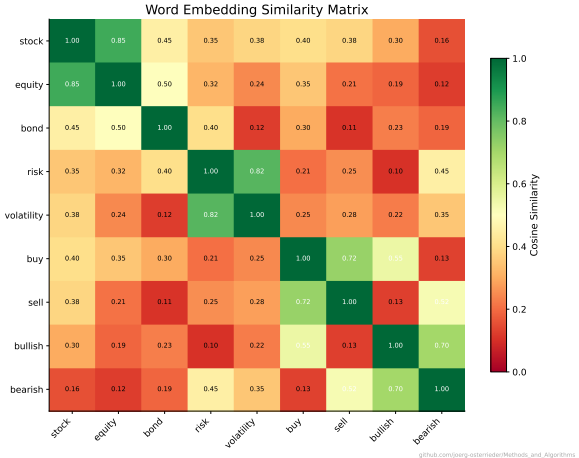
Sequential Decision Challenge

- Trading requires sequences of buy/sell/hold decisions
- Actions have delayed consequences (profit realized later)

Embeddings solve text, RL solves sequential decisions

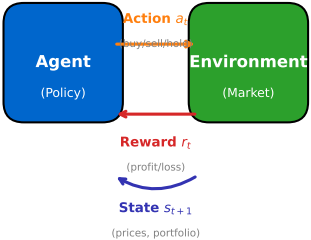


Similar words cluster together in embedding space



Cosine similarity captures semantic relationships

Reinforcement Learning: Agent-Environment Interaction

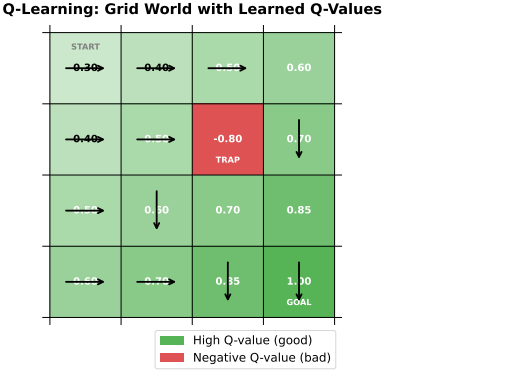


At each time step t:

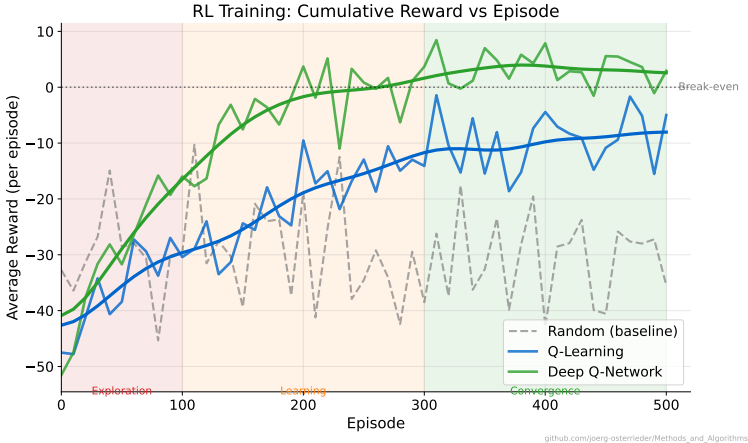
Agent observes state, takes action, receives reward

github.com/joerg-osterrieder/Methods_and_Algorithms

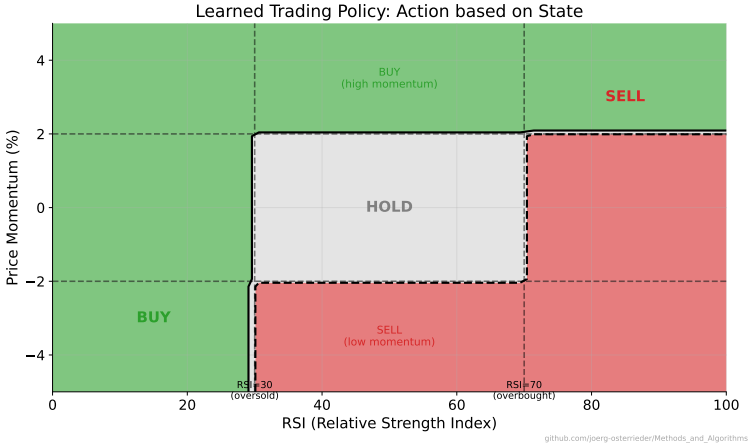
Agent takes actions, receives rewards, learns optimal policy



Q-values show expected reward from each state-action



RL agents improve through exploration and exploitation

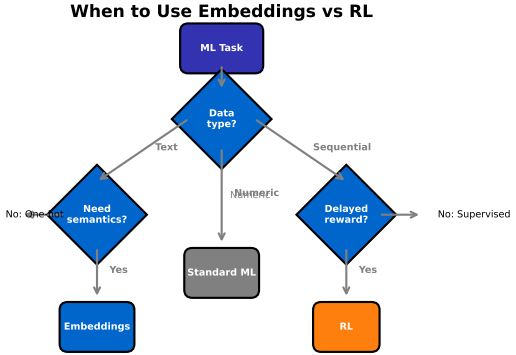


Policy maps states to actions (when to buy/sell/hold)

Open the Colab Notebook

- Exercise 1: Explore word embeddings with Word2Vec
- Exercise 2: Implement basic Q-learning
- Exercise 3: Apply RL to a simple trading environment

Link: `https://colab.research.google.com/` [TBD]



Embeddings: Text, categorical -> dense vectors (Word2Vec, BERT)

RL: Sequential decisions with delayed rewards (trading, games)

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Embeddings for text, RL for sequential decisions with delayed rewards

- Mikolov et al. (2013). *Efficient Estimation of Word Representations in Vector Space*. arXiv.
- Sutton, R. & Barto, A. (2018). *Reinforcement Learning: An Introduction*. MIT Press.
- James et al. (2021). *Introduction to Statistical Learning*. https://www.statlearning.com/