L06: Embeddings & RL

Text Representations and Sequential Decision Making

Methods and Algorithms

MSc Data Science

Spring 2026

Outline

Learning Objectives

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

The Business Problem

Text Data Challenge

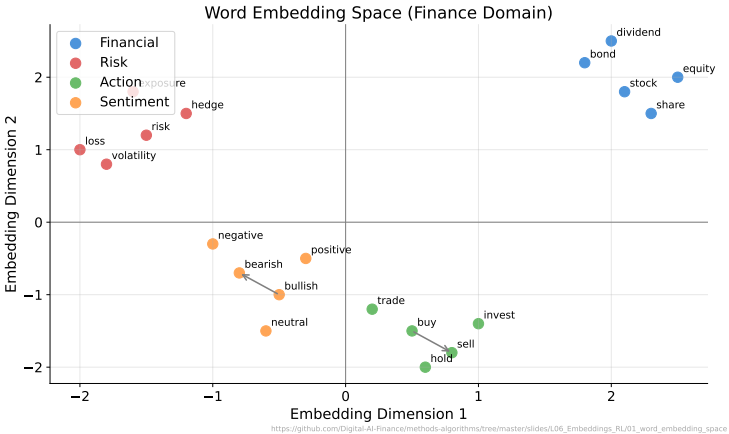
- Financial news, reports, social media contain valuable signals
- Text is unstructured—how to feed it to ML models?
- Need to capture semantic meaning ("bullish" similar to "positive")

Sequential Decision Challenge

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

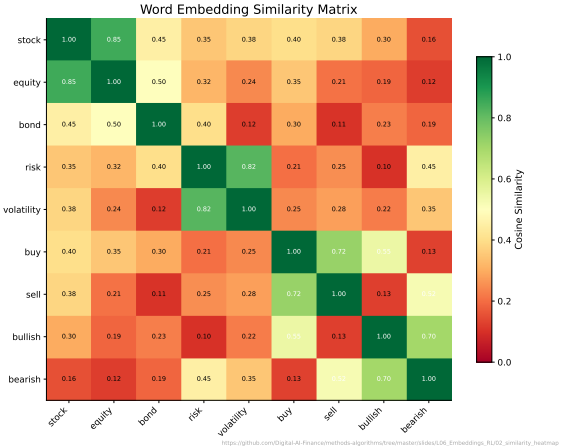
Embeddings solve text, RL solves sequential decisions

Word Embedding Space



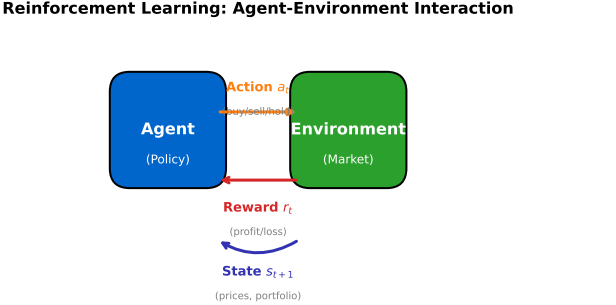
Similar words cluster together in embedding space

Embedding Similarity



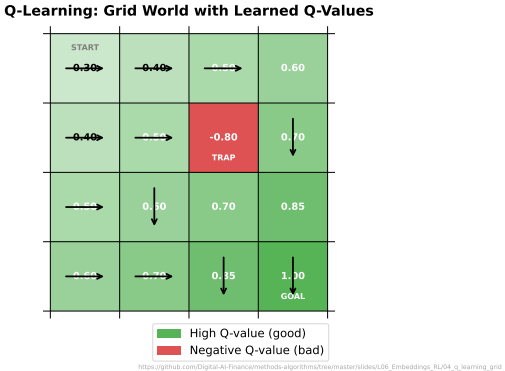
Cosine similarity captures semantic relationships

RL: Agent-Environment Loop



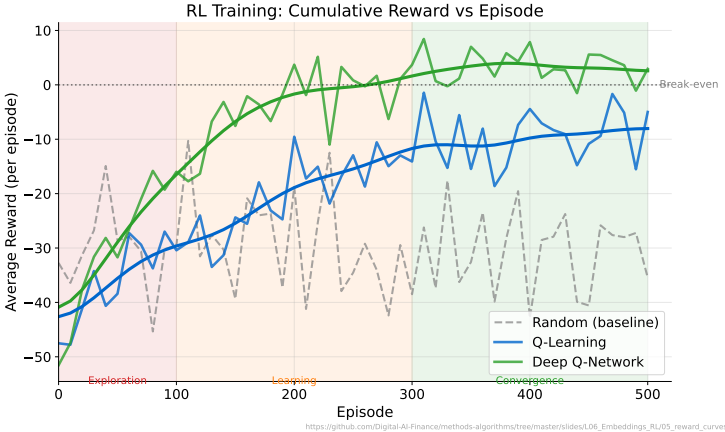
Agent takes actions, receives rewards, learns optimal policy

Q-Learning: Value Function



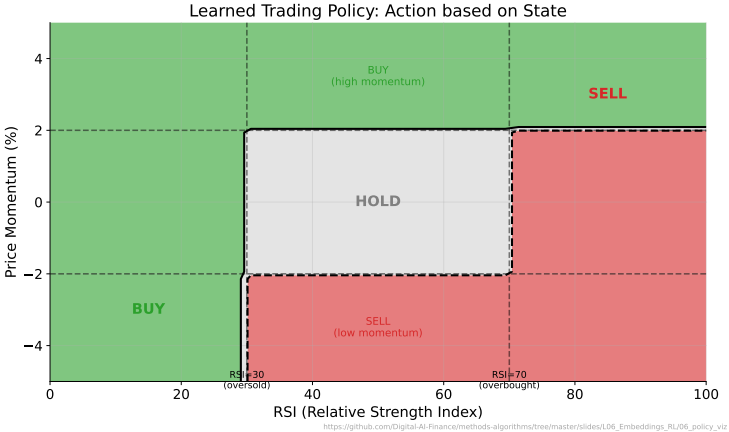
Q-values show expected reward from each state-action

Learning Progress



RL agents improve through exploration and exploitation

Learned Trading Policy



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

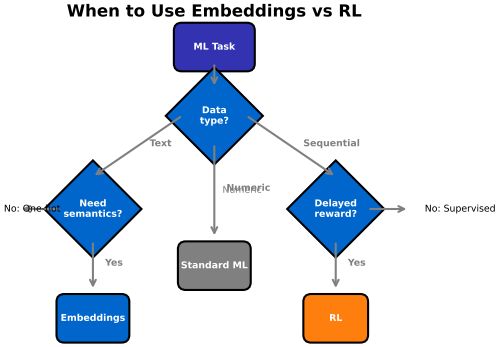
Hands-on Exercise

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]

Decision Framework



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

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

https://github.com/Digital-AI-Finance/methods-algorithms/tree/master/slides/L06_Embeddings_RL/07_decision_flowchart

Embeddings for text, RL for sequential decisions with delayed rewards

References

- 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/`