L06: Embeddings & RL

Text Representations and Sequential Decision Making

Methods and Algorithms – MSc Data Science

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

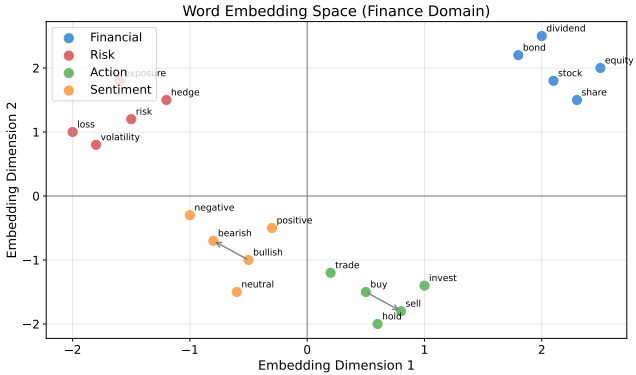
- Financial news, reports, social media contain valuable signals
- Text is unstructured—how to feed it to ML models?
- Need to capture semantic meaning ("bullish" similar to "positive")

Sequential Decision Challenge

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

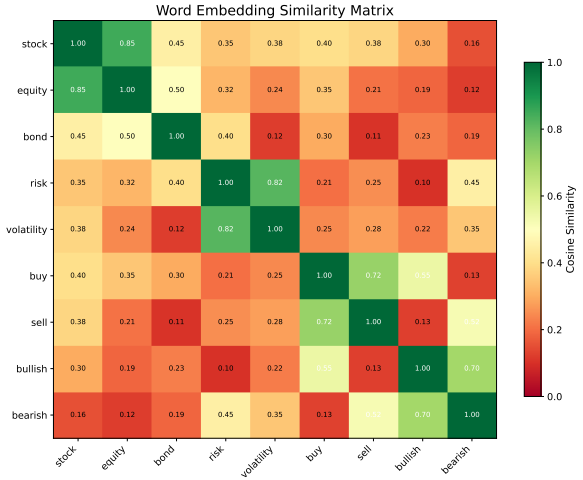
Embeddings solve text, RL solves sequential decisions

Word Embedding Space



Similar words cluster together in embedding space

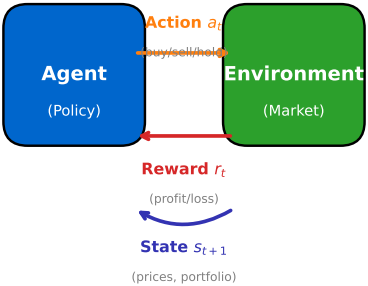
Embedding Similarity



Cosine similarity captures semantic relationships

RL: Agent-Environment Loop

Reinforcement Learning: Agent-Environment Interaction

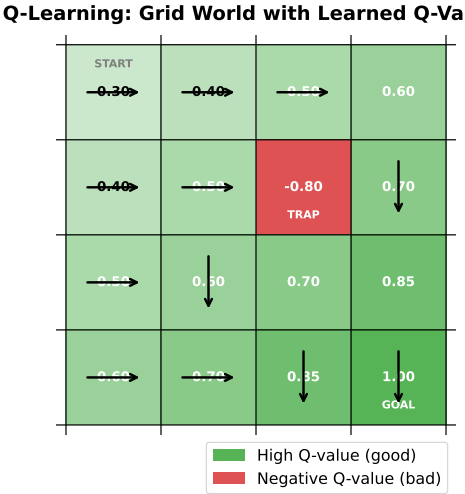


At each time step t:

Agent observes state, takes action, receives reward

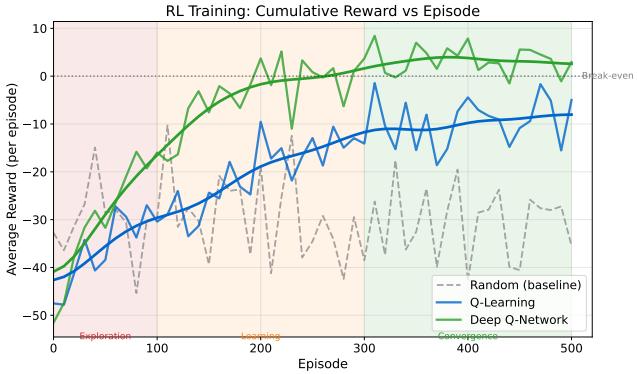
Agent takes actions, receives rewards, learns optimal policy

Q-Learning: Value Function



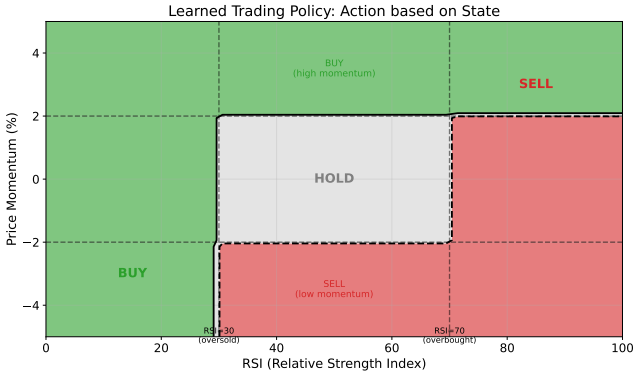
Q-values indicate expected future reward from each state-action

Learning Progress



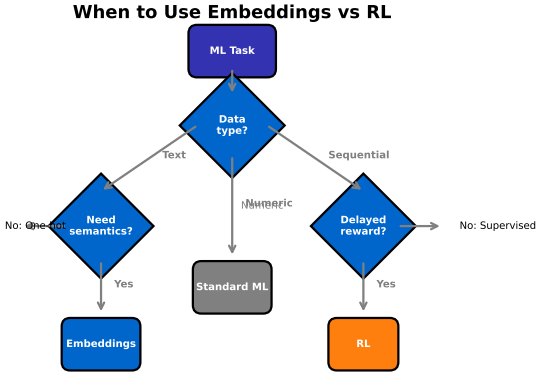
RL agents improve through exploration and exploitation

Learned Trading Policy



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

Decision Framework



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

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

Embeddings for text, RL for sequential decisions with delayed rewards