Methods and Algorithms

Spring 2026

1. Problem
2. Method
3. Solution
4. Practice
5. Decision Framework
6. Summary

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

1. Apply KNN for classification with appropriate K selection
2. Implement K-Means clustering and evaluate cluster quality
3. Compare distance metrics and their effects on results
4. Distinguish between supervised (KNN) and unsupervised (K-Means)

**Finance Applications:** Customer segmentation, fraud detection

*From parametric models (regression) to instance-based methods*

**Two Distinct Problems**

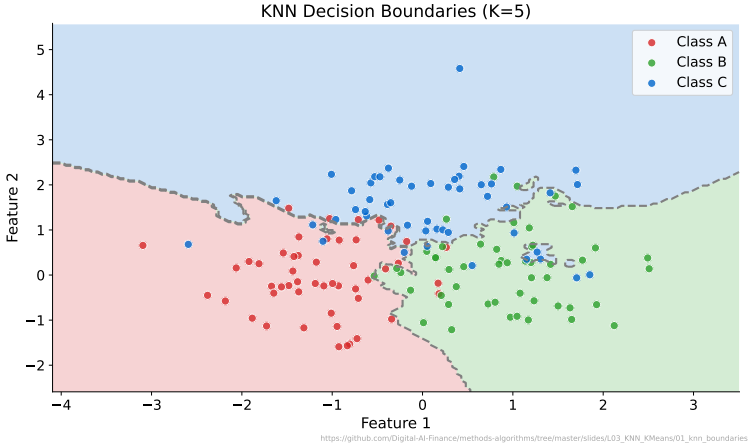
**1. Classification (Supervised)**

- Given labeled examples: is this transaction fraudulent?
- "Show me similar past transactions and their outcomes"

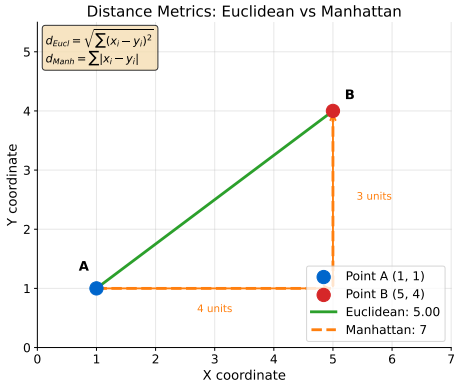
**2. Clustering (Unsupervised)**

- No labels: what natural customer segments exist?
- "Group customers by behavior for targeted marketing"

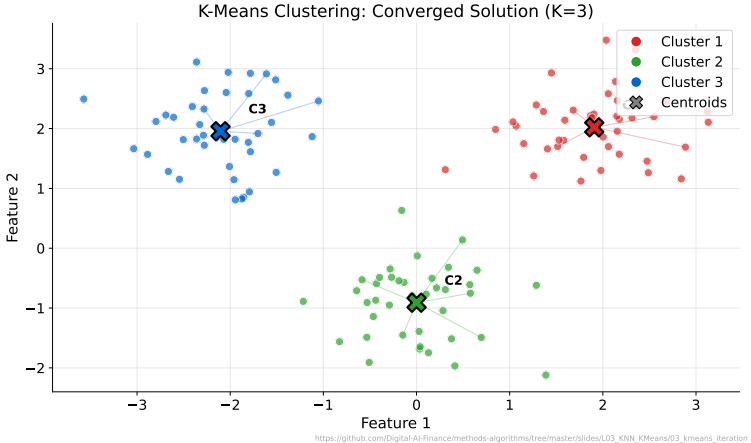
*KNN = classification with labels, K-Means = clustering without labels*



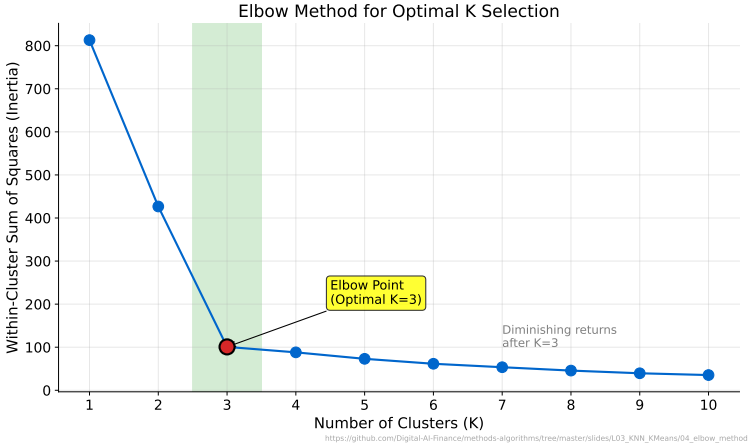

*KNN creates non-linear, flexible decision boundaries based on local data*



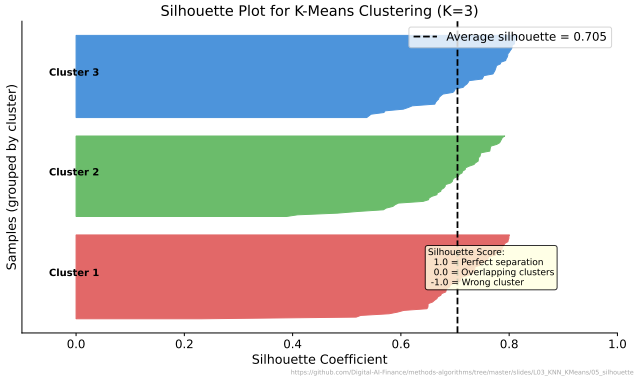

*Choice of metric affects which points are considered "nearest"*



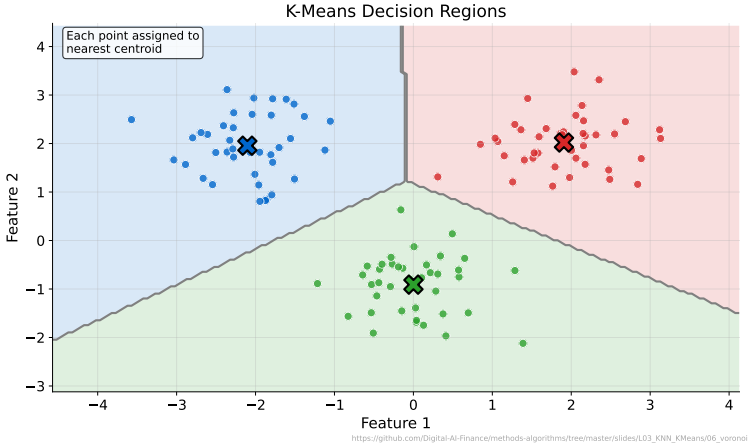

*Iteratively assign points and update centroids until convergence*




*Look for the "elbow" where adding clusters gives diminishing returns*




*Silhouette score measures how similar points are to their own cluster*



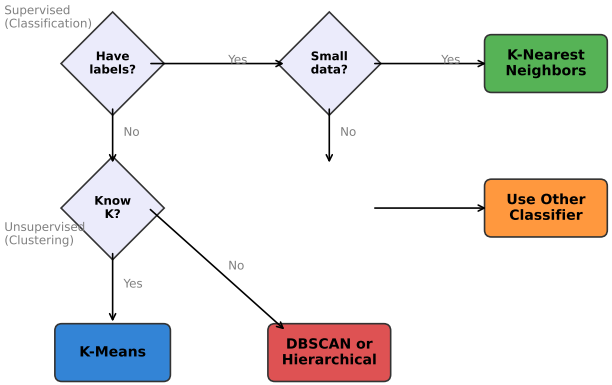

*Each region contains all points closest to one centroid*

**Open the Colab Notebook**

- Exercise 1: Implement KNN classifier from scratch
- Exercise 2: Apply K-Means to customer segmentation data
- Exercise 3: Compare distance metrics and k values

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

## KNN vs K-Means Decision Guide




https://github.com/Digital-AI-Finance/methods-algorithms/tree/master/slides/L03_KNN_KMeans/07_decision_flowchart

*KNN for labeled data classification, K-Means for unlabeled clustering*

**Remember**

- KNN: supervised classification using nearest neighbors
- K-Means: unsupervised clustering with iterative centroids
- Distance metrics and K selection are critical choices
- Finance use cases: fraud detection, customer segmentation

*Next lecture: L04 Random Forests*