



# Unsupervised Learning

An Overview



Clustering



Pattern Discovery



Dimensionality Reduction

# What is Unsupervised Learning?



## Definition

Learning from unlabeled data to discover hidden patterns



## Key Difference

No predefined labels or target variables

## Core Concepts



### No Labeled Data

Works with raw, unlabeled datasets



### Pattern Discovery

Identifies hidden structures in data



### Dimensionality Reduction

Reduces data complexity while preserving information



### Data Exploration

Understands data distribution and characteristics

# Types of Unsupervised Learning



## Clustering

- **K-Means**  
Partition into K clusters
- **Hierarchical**  
Build cluster tree
- **DBSCAN**  
Density-based clustering



## Dimensionality Reduction

- **PCA**  
Principal Component Analysis
- **t-SNE**  
t-Distributed Stochastic Neighbor Embedding
- **Autoencoders**  
Neural network-based reduction



## Association Rules

- **Apriori**  
Frequent itemset mining
- **FP-Growth**  
Efficient pattern discovery
- **Eclat**  
Equivalence class clustering

# Applications

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## Customer Segmentation

Group customers based on behavior patterns



## Anomaly Detection

Identify unusual patterns or outliers



## Recommendation Systems

Suggest products based on preferences



## Image Compression

Reduce data size while preserving features



## Topic Modeling

Discover abstract topics in documents



## Market Basket Analysis

Find product associations in transactions

# Advantages & Disadvantages



## Advantages

- ✓ **No Labeled Data Needed**  
Works with unlabeled datasets
- ✓ **Discovers Hidden Patterns**  
Reveals unknown structures
- ✓ **Handles Complex Data**  
Processes high-dimensional data
- ✓ **Cost Effective**  
No manual labeling required



## Disadvantages

- ✗ **Harder to Evaluate**  
No clear success metrics
- ✗ **Less Accurate**  
Results can be subjective
- ✗ **Requires Expertise**  
Needs domain knowledge
- ✗ **Interpretability Challenge**  
Results may be difficult to explain