Geometric Interpretation of ML

Introduction

- Steps:
  - Idea (elevator pitch)
  - Proof (formalize, correctness, existence, unique)
  - Compute (implementation, runtime, Big-O)
  - Useful (real application, type of question)
- Algorithm development
  - Generalization
  - Extension

Introduction

1. **Fit**
   - Average
   - Linear regression
   - Piecewise linear regression
   - Exponential curve
2. **Axis transformation**
   - PCA
   - Kernel methods
3. **Separation**
   - LDA
   - Logistic regression
   - SVM, perceptron

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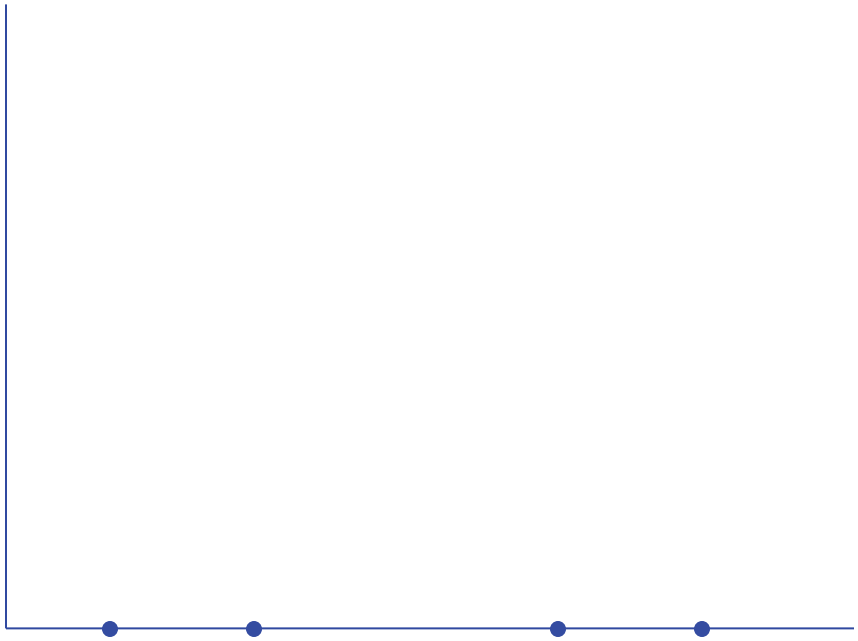
Fit

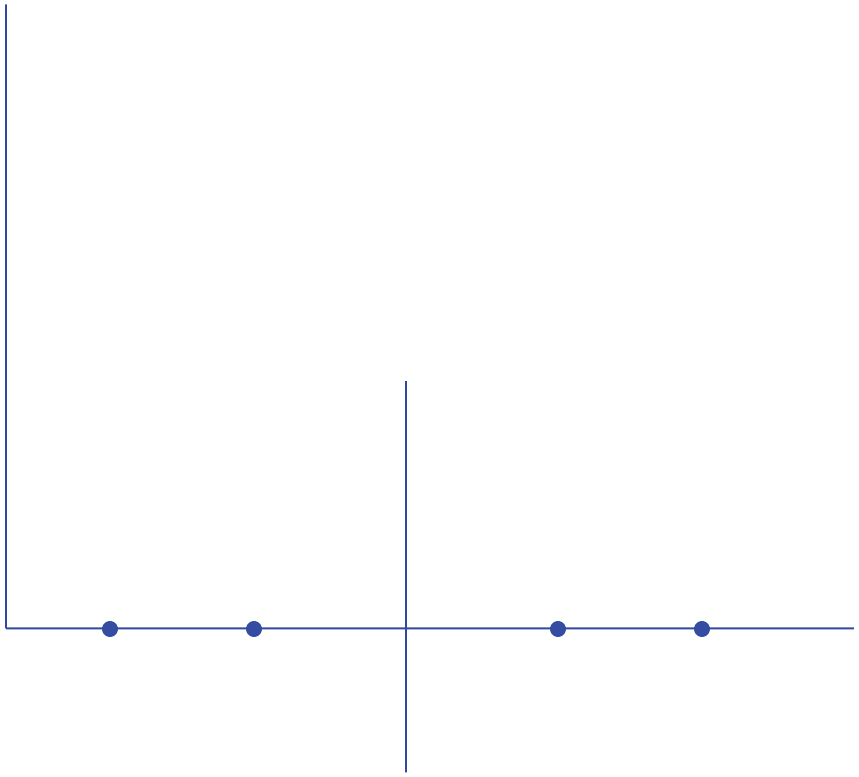
Fit the Middle

Average



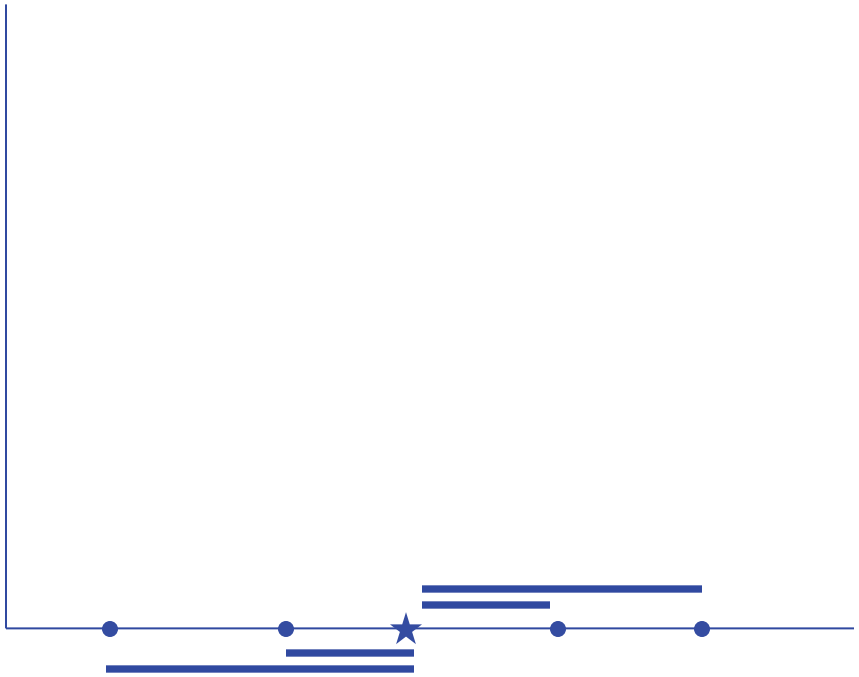
Fit the Middle

Average



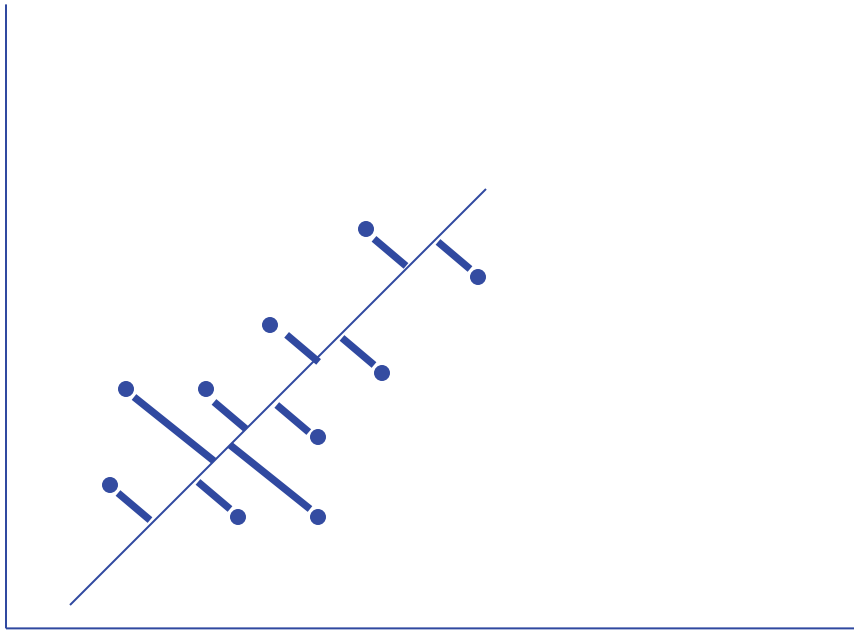
Fit the Middle

Average



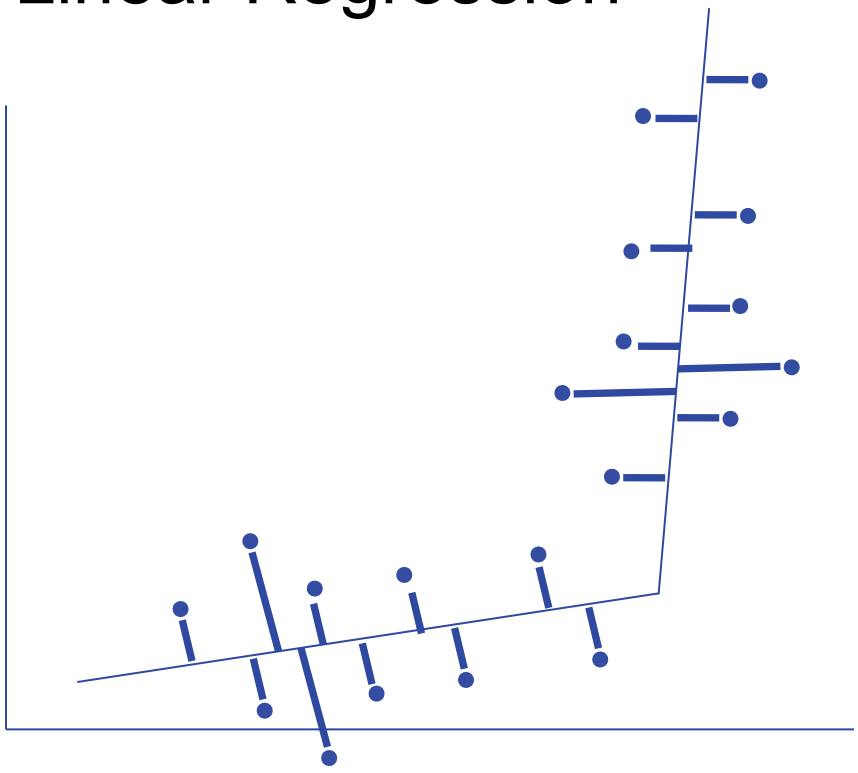
Fit the Middle

Least Squares



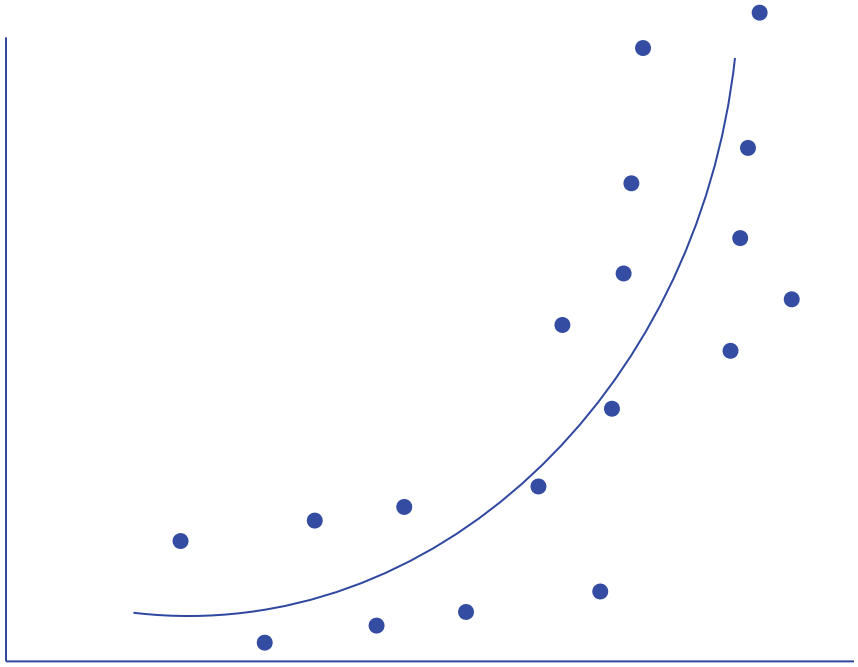
Fit the Middle

Piecewise Linear Regression



Fit the Middle

Logarithmic Curve



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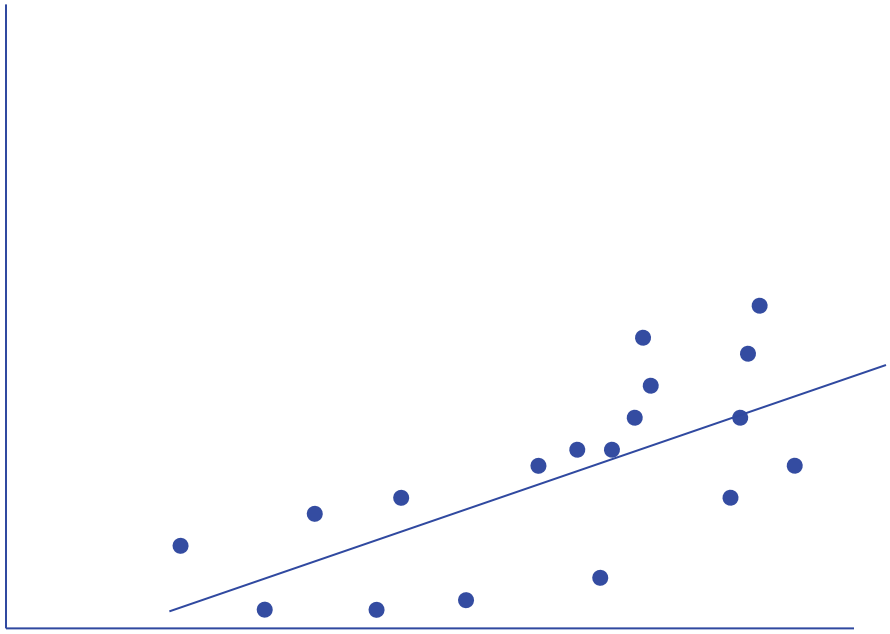
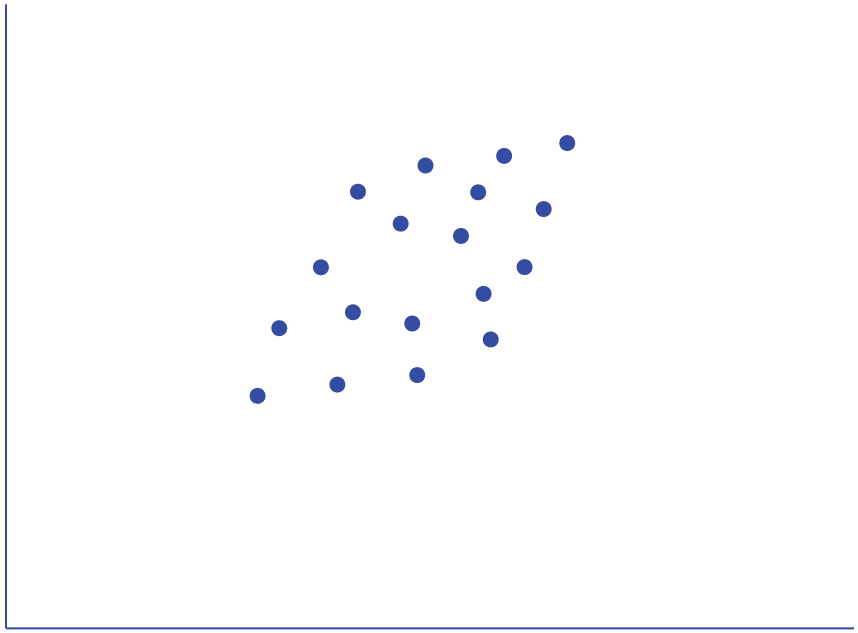
Axis Transformation

Axis Transformation

Logistic Axis

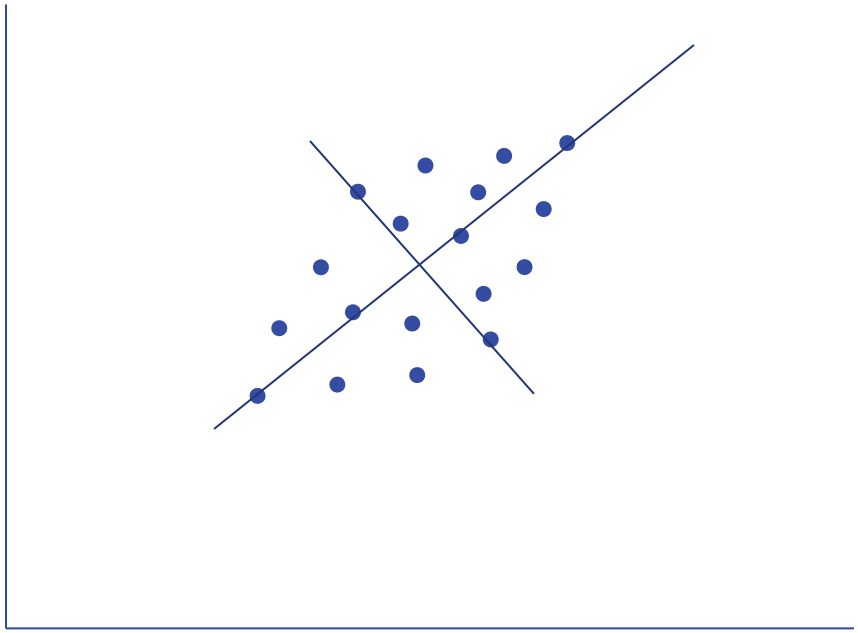


Axis Transformation



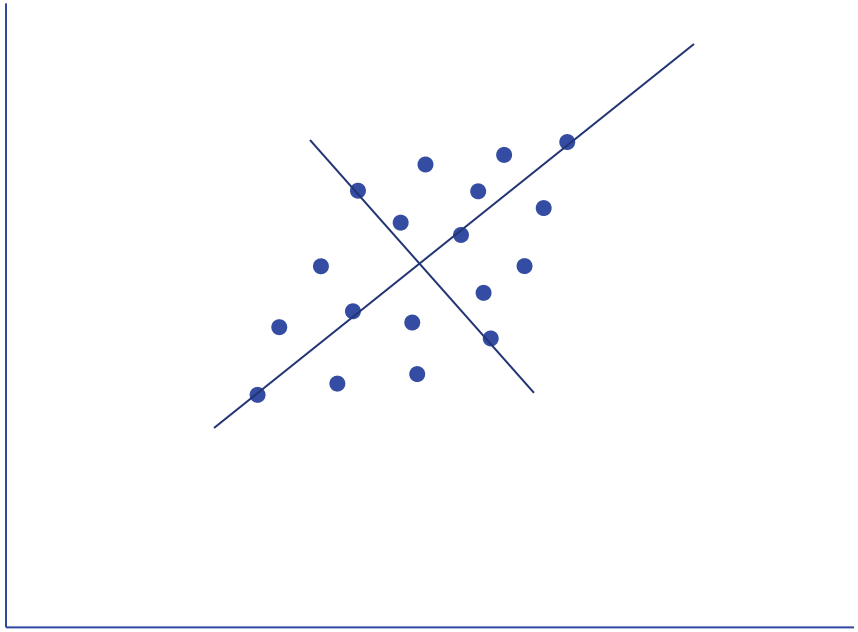
Axis Transformation

Principle Component Analysis (PCA)



Axis Transformation

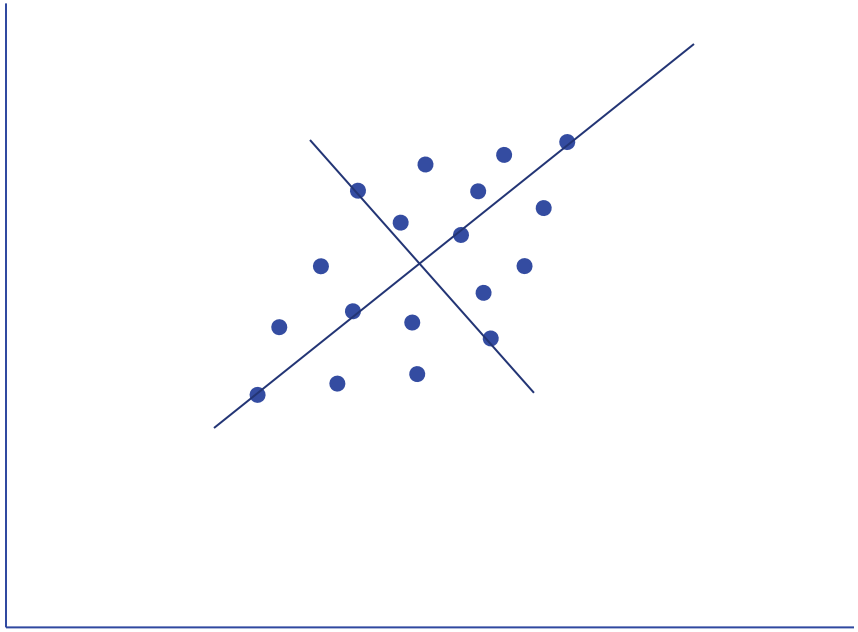
Principle Component Analysis



```
data = [[1,    5,   10,   300],
        [10, 50, 100, 3000],
        [2,   10,   20,   600]]
```

Axis Transformation

Principle Component Analysis (PCA)



```
data = [[1,    5,   10,   300],
        [10, 50, 100, 3000],
        [2,   10,   20,   600]]
```

```
data = [[1,0,0,2,3,2],
        [1,0,0,0,0,0],
        [5,0,0,0,0,0],
        [3,0,0,4,6,4],
        [2,0,0,6,9,6],
        [0,0,0,2,3,2],
        [8,0,0,2,3,2]]
```

Motivating Example

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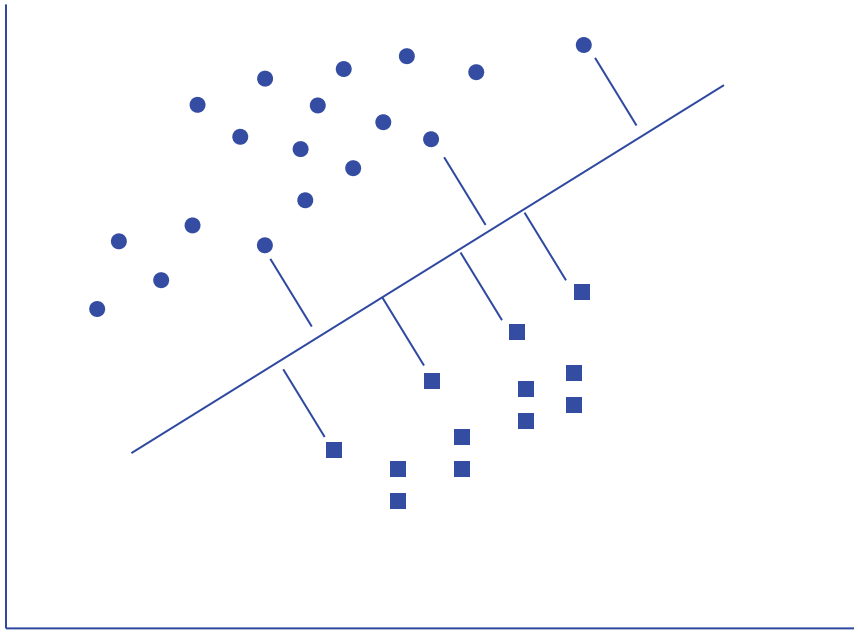
Separation

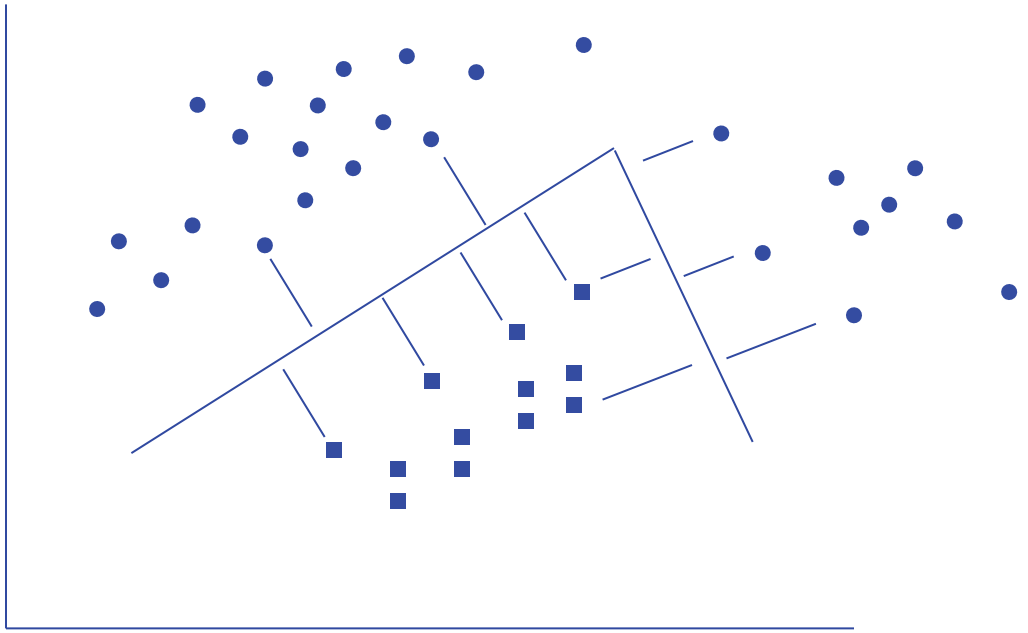
Separation

Linear Discriminant Analysis



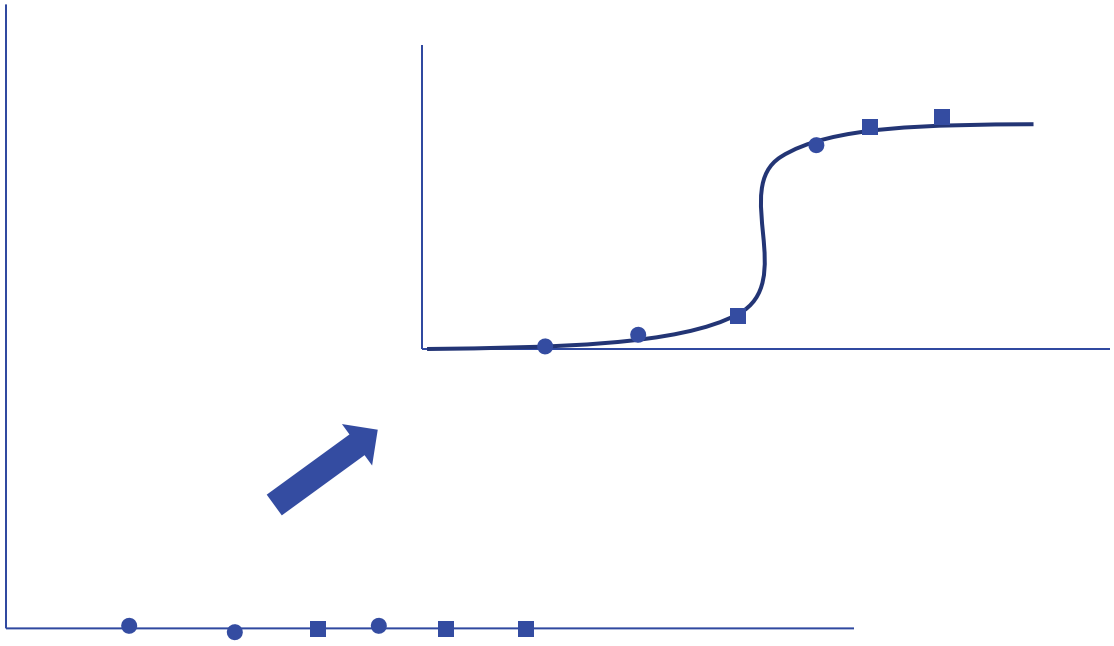
Separation

Linear Discriminant Analysis



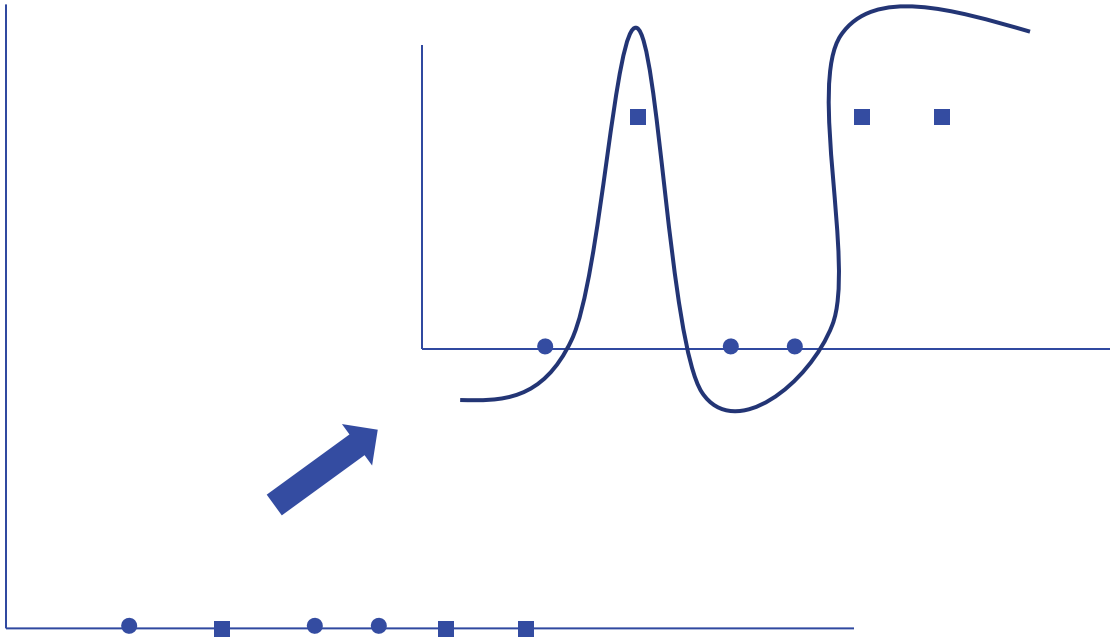
Axis Transformation

Logistic Regression



Axis Transformation

Support Vector Machine/Perceptron



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