KNN Example: Food Classification

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Food Dataset for KNN

Dataset: Nutritional Information

Food Item	Calories	Fat (g)	Label
Apple	95	0.3	Healthy
Salad	150	7	Healthy
Chicken Breast	165	3.6	Healthy
Burger	354	19	Unhealthy
Pizza Slice	285	12	Unhealthy
Fries	365	17	Unhealthy

New Food Item: 250 calories, 10g fat (Unknown label)

Distance Calculation (Euclidean Distance)

Euclidean Distance Formula:

$$d(P, Q) = \sqrt{(P_{\text{calories}} - Q_{\text{calories}})^2 + (P_{\text{fat}} - Q_{\text{fat}})^2}$$

Example Calculation for Apple:

$$d(Apple, New) = \sqrt{(250 - 95)^2 + (10 - 0.3)^2}$$

$$d = \sqrt{24025 + 94.09} = \sqrt{24119.09} = 155.3$$

Distance Calculation for All Foods

Distances to New Food Item (250 cal, 10g fat):

Food Item	Distance
Apple	155.3
Salad	100.04
Chicken Breast	85.24
Burger	104.39
Pizza Slice	35.07
Fries	115.24

KNN Classification (K = 3)

K = 3 Nearest Neighbors:

- ▶ Pizza Slice (Unhealthy) - Distance: 35.07
- ▶ Chicken Breast (Healthy) - Distance: 85.24
- ▶ Salad (Healthy) - Distance: 100.04

Classification Result:

- ▶ 2 Healthy neighbors, 1 Unhealthy neighbor.
- ▶ The new food item is classified as **Healthy**.

Food Dataset for KNN

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New Food Item: 250 calories, 10g fat (Unknown label)

Manhattan Distance Formula

Manhattan Distance Formula:

$$d(P, Q) = |P_{\text{calories}} - Q_{\text{calories}}| + |P_{\text{fat}} - Q_{\text{fat}}|$$

Example Calculation for Apple:

$$d(Apple, New) = |250 - 95| + |10 - 0.3|$$

$$d = 155 + 9.7 = 164.7$$

Manhattan Distance Calculation for All Foods

Distances to New Food Item (250 cal, 10g fat):

Food Item	Manhattan Distance
Apple	164.7
Salad	103
Chicken Breast	91.4
Burger	113
Pizza Slice	37
Fries	122

KNN Classification (K = 3)

K = 3 Nearest Neighbors:

- ▶ Pizza Slice (Unhealthy) - Distance: 37
- ▶ Chicken Breast (Healthy) - Distance: 91.4
- ▶ Salad (Healthy) - Distance: 103

Classification Result:

- ▶ 2 Healthy neighbors, 1 Unhealthy neighbor.
- ▶ The new food item is classified as **Healthy**.

Conclusion

Using KNN with $K = 3$ and Manhattan Distance, the new food item (250 cal, 10g fat) is classified as **Healthy**, based on the majority of its nearest neighbors.

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