

HAC Homework

Hierarchical Agglomerative Clustering (HAC) - Single Link with Manhattan Distance

Data Set:

| Pattern | x | y |
|---------|------|-----|
| a | 0.8 | 0.7 |
| b | -0.1 | 0.2 |
| c | 0.9 | 0.8 |
| d | 0.0 | 0.2 |
| e | 0.2 | 0.1 |

Manhattan Distance Formula:

$$d((x_1, y_1), (x_2, y_2)) = |x_1 - x_2| + |y_1 - y_2|$$

Initial Distance Matrix

| | a | b | c | d | e |
|---|-----|-----|-----|-----|-----|
| a | - | 1.4 | 0.2 | 1.3 | 1.2 |
| b | 1.4 | - | 1.6 | 0.1 | 0.4 |
| c | 0.2 | 1.6 | - | 1.5 | 1.4 |
| d | 1.3 | 0.1 | 1.5 | - | 0.3 |
| e | 1.2 | 0.4 | 1.4 | 0.3 | - |

Iterations

Iteration 1: Merge Closest Clusters

- **Clusters before merge:** {a}, {b}, {c}, {d}, {e}
- **Minimum Distance:** 0.1 between **b** and **d**
- **Merge:** {b, d} at distance 0.1

Updated Clusters: {a}, {c}, {e}, {b,d}

Distance Matrix after Iteration 1:

| | a | c | e | b,d |
|-----|-----|-----|-----|-----|
| a | - | 0.2 | 1.2 | 1.3 |
| c | 0.2 | - | 1.4 | 1.5 |
| e | 1.2 | 1.4 | - | 0.3 |
| b,d | 1.3 | 1.5 | 0.3 | - |

Iteration 2: Merge Closest Clusters

- **Clusters before merge:** {a}, {c}, {e}, {b,d}
- **Minimum Distance:** 0.2 between **a** and **c**
- **Merge:** {a, c} at distance 0.2

Updated Clusters: {a,c}, {e}, {b,d}

Distance Matrix after Iteration 2:

| | a,c | e | b,d |
|-----|-----|-----|-----|
| a,c | - | 1.2 | 1.3 |
| e | 1.2 | - | 0.3 |
| b,d | 1.3 | 0.3 | - |

Iteration 3: Merge Closest Clusters

- **Clusters before merge:** {a,c}, {e}, {b,d}
- **Minimum Distance:** 0.3 between e and b,d
- **Merge:** {e, b,d} at distance 0.3

Updated Clusters: {a,c}, {e,b,d}

Distance Matrix after Iteration 3:

| | | |
|--------------|------------|--------------|
| | a,c | e,b,d |
| a,c | - | 1.2 |
| e,b,d | 1.2 | - |

Iteration 4: Merge Closest Clusters

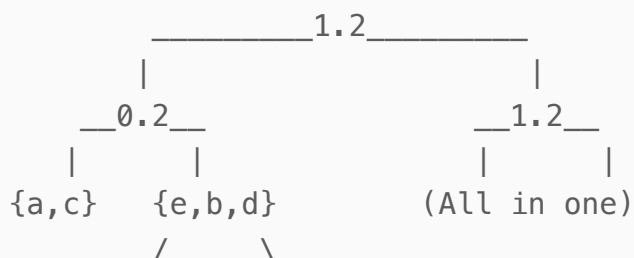
- **Clusters before merge:** {a,c}, {e,b,d}
- **Minimum Distance:** 1.2 between a,c and e,b,d
- **Merge:** {a,c, e,b,d} at distance 1.2

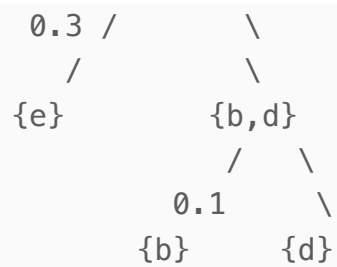
Updated Clusters: {a,c,e,b,d}

Distance Matrix after Iteration 4:

| | |
|-----------|-----------|
| | a,c,e,b,d |
| a,c,e,b,d | - |

Dendrogram





Dendrogram with Distances:

