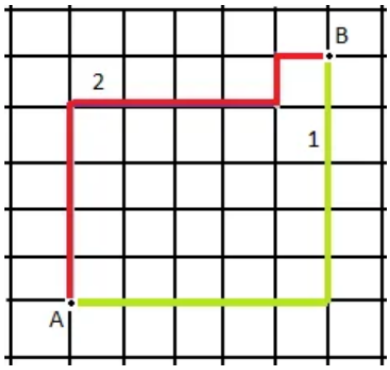
1. **Manhattan Distance**

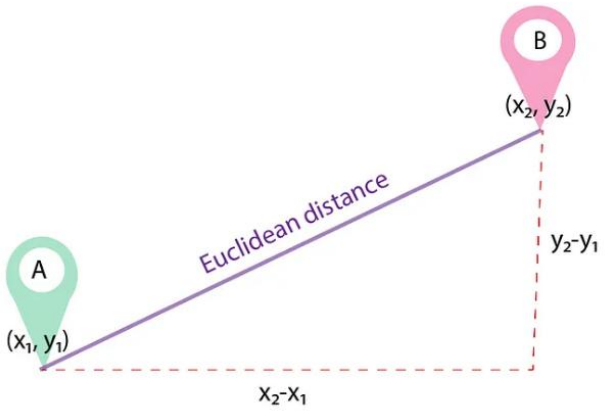


- **Definition:**
    - Also called Taxicab Distance or L1 Norm, this measure calculates the sum of the absolute differences between corresponding coordinates of two points.
- **Formula:**

$$d = \sum_{i=1}^{n} |x_i - y_i|$$

- **Example:**
    - Points: P(1, 2) and Q(3, 4)
    - Manhattan Distance: $|1-3|+|2-4|=2+2=4$
- **When to Use:**
    - Ideal for grids and city-like structures (like streets in a city).

2. Euclidean Distance



- **Definition:**
  - Euclidean distance is the straight line distance between 2 data points in a plane.
- **Formula:**

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

- **Example:**
  - Points: P(1, 1) and Q(4, 5)
  - $\sqrt{(1-4)^2} + (1-5)^2 = \sqrt{9+16} = \sqrt{25} = 5$
- **When to Use:**
  - Useful when you want to measure the "true" straight-line distance.

3. **Hamming Distance**

- **Definition:**
    - A measure of the difference between two strings of equal length. It counts the number of positions at which the corresponding elements are different.
- **Example:**
    - Strings: "101" and "100"
    - Hamming Distance: 1 (differing position: 3rd character)
- **When to Use:**
    - Ideal for comparing binary or categorical data, such as text or genetic sequences.
    - Its usuable for regex patterns and comparing strings.

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4. **Why Different Distance Measures?**

- **Different Data Types:**
    - Euclidean works well for continuous data.
    - Manhattan is useful for grid-based or discrete data.
    - Hamming is ideal for categorical or binary data.

Different measures highlight different aspects of the data.

For example, in clustering, you may want the data points to be close in a straight line (Euclidean) or aligned along the axes (Manhattan).