Module 2: Distances

Lecture 7: Earth Mover's Distance (EMD)

Prev topic Next topic Prev page
Next page

The Lecture Contains:

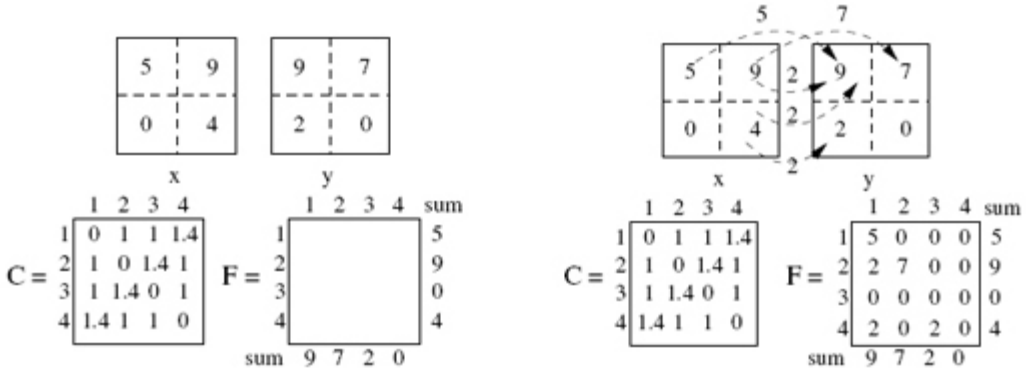
- Earth mover's distance (EMD)
- EMD formulation

Earth mover's distance (EMD)

- Distance function that takes into account both
  - Feature value
  - Feature location
- Useful for images, trees, music, shapes, etc.
- Considers each feature value as "mass" in that spatial location
- EMD tries to find out minimum "work" done in transforming object x to object y
  - Moving 1 unit of mass through 1 unit of distance is equivalent to performing 1 unit of work
- Concept of ground distance from each feature location of object x to each feature location of object y
  - Matrix $\mathbf{C}$ of size $m \times n$
  - m and n are number of features (or regions from where features are calculated from) in object x and object y respectively

EMD formulation

- Similar to $\mathbf{C}$, there is a flow matrix $\mathbf{F}$ of size $m \times n$
- f_{ij} denotes the amount of mass moved from region i of x to region j of y



$$EMD(x, y) = \min_{F} \sum_{i=1}^{m} \sum_{j=1}^{n} (c_{ij} f_{ij})$$

$$\text{s.t.} \quad \forall i, j, f_{ij} \geq 0; \ \forall i, \sum_{j=1}^{n} f_{ij} = x_i; \ \forall j, \sum_{i=1}^{m} f_{ij} = y_j$$