Digital Image & Video Processing

Lecture 9 (cont)

Image Segmentation

KHOA CÔNG NGHỆ THÔNG TIN
TRƯỜNG ĐẠI HỌC KHOA HỌC TỰ NHIÊN

9.2. Method

9.2.3. HAC (Hierarchical Agglomerative Clustering)

Suppose that

$X = \{x_i, i = 1..N\}$ *is the set of* l-dim*ensional feature vectors should be clustered.*

$R = \{C_j, j = 1..M\}, C_j$ *is cluster of feature vectors, M is the number of clusters.*

- Image Segmentation

Generalized Agglomerative Scheme

$Step\ 1.\ Suppose\ R_0 = \{C_i = \{x_i\}, i = 1..N\},\ N\ is\ the\ number\ of\ feature\ vectors.$

$Step\ 2.\ t = 0,$

$Step\ 3.\ \mathrm{Re}\ peat$

$Step\ 4.\ t = t + 1$

$Step\ 5.\ Select\ cluster\ pair\ (C_i, C_j)\ in\ R_{t\text{-}1}\ such\ that$

$$d_N(C_i, C_j) = \min_{r,s=1..N;\, r \neq s} d_N(C_r, C_s),\ d_N\ is\ dissimilarity\ distance\ between\ the\ clusters.$$

$Step\ 6.\ Suppose\ C_q\ is\ the\ cluster\ created\ by\ merging\ cluster\ pair\ (C_i, C_j),$

$C_q = C_i \cup C_j,$

$Create\ new\ cluster\ partition\ R_t = (R_{t-1} - \{C_i, C_j\}) \cup \{C_q\}$

$Step\ 7.\ Until\ t = N\text{-}1$

9.2.3. HAC

- Image Segmentation

$Tree\ Generative\ Scheme\ (inherited\ from\ Generalized\ Agglomerative\ Scheme)$

$Step\ 1.\ Suppose\ T_0 = \{n_i = \{x_i\}, i = 1..N\},\ N\ is\ the\ number\ of\ feature\ vectors.$

$Step\ 2.\ t = 0,$

$Step\ 3.\ \mathrm{Re}\ peat$

$Step\ 4.\ t = t + 1$

$Step\ 5.\ Select\ node\ pair\ (n_i, n_j)\ in\ T_{t\text{-}1}\ such\ that$

$$d_N(n_i, n_j) = \min_{r,s=1..N;\, r \neq s} d_N(n_r, n_s),\ d_N\ is\ dissimilarity\ dis\tan ce\ between\ the\ nodes.$$

$Step\ 6.\ Suppose\ n_q\ is\ the\ node\ created\ by\ merging\ node\ pair\ (n_i, n_j),\ n_q = n_i \cup n_j,$

$Create\ new\ tree\ T_t = (T_{t-1} - \{n_i, n_j\}) \cup \{n_q\}$

$Step\ 7.\ Until\ t = N\text{-}1$

9.2.3. HAC

❖Image Segmentation

Cluster Generative Scheme

Step 1. Re*duce hierarchical tree based on DM between parent node and child node*

Step 2. *The leaf nodes with the same parent node will be put to one cluster.*

The criteria to remove the nodes based on DM between the child nodes and their parent.

Suppose a,b are two nodes (not be leaf nodes),

$d_{\min}(a,b) = \min\{d(l_a, l_b)\}$

$d_{\max}(a,b) = \max\{d(l_a, l_b)\}$

l_a, l_b *are the leaf nodes.*

9.2.3. HAC

❖ Image Segmentation

Cluster Generative Scheme

During the hierarchical tree generating process, we have:

Node p_l is created and linked two values:

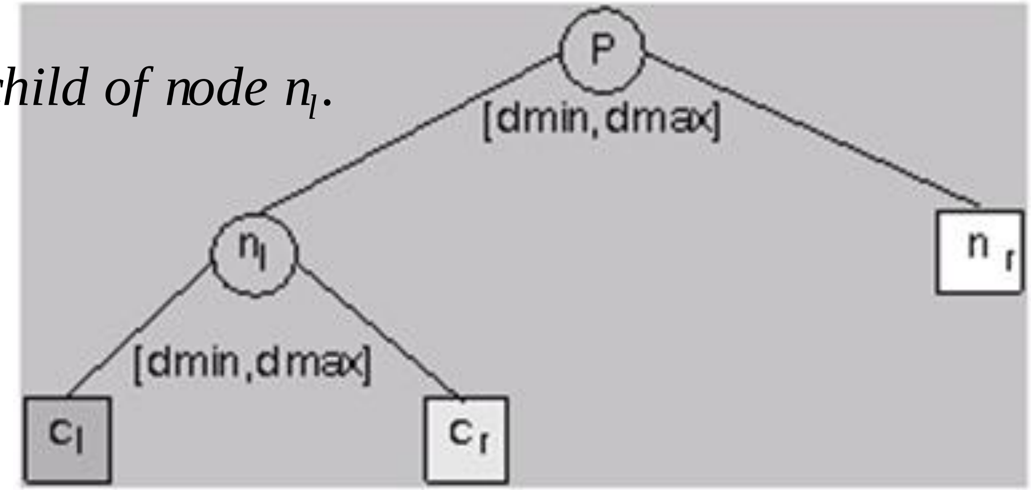
$d_{\min}(n_l, n_r), d_{\max}(n_l, n_r)$,

n_l, n_r are the left child and right child of node p_l.

Node n_l is created and linked two values:

$d_{\min}(c_l, c_r), d_{\max}(c_l, c_r)$,

c_l, c_r are the left child and right child of node n_l.



9.2.3. HAC

❖ Image Segmentation

Suppose node n is the child of node p, consider the following quantities

$$\Delta_{\min}(p,n) = \frac{d_{\min}^{p} - d_{\min}^{n}}{d_{\min}^{n}}$$ The relative difference of d_{min} at node n and p

$$\Delta_{\max}(p,n) = \frac{d_{\max}^{p} - d_{\max}^{n}}{d_{\max}^{n}}$$ The relative difference of d_{max} at node n and p

Node n will be removed if

$$\Delta_{\min} < \varepsilon \quad \text{và} \quad |\Delta_{\max}| < \varepsilon$$

After node n is removed, the child of node n is node c is not lost but it is linked to node p.