Group	Name	39	40	41	42	43	44	45	$\sum$
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Technical Neural Networks Assignment Sheet 7

December 2022

Assignment 39

1. Deal with noncontiguous input areas by introducing a group of partners, treated as a model of its own.
2. Speed improvement, because each partner model is usually small.

Assignment 40

Good cluster is a cluster with good ratio of inter- and intra-cluster distances. Meaning that clusters should be at the same time far apart from each other and can be clearly distinguishable. Silhouette coefficients measures for each data point how well it is matched by its own cluster and poorly by others, its value ranges from -1 to 1.
For point i $a(i)$ is average dissimilarity of i to other objects in its cluster, and $b(i)$ is minimum for all other clusters average dissimilarity of i to all objects in this cluster. Therefore, $s(i) = \frac{b(i)-a(i)}{\max\{a(i),b(i)\}}$ where $s(i) = 1$ denotes good clustering and -1 a bad one.

Reference:
Rousseeuw, P. J. (1987). Silhouettes: a graphical aid to the interpretation and validation of cluster analysis. Journal of computational and applied mathematics, 20, 53-65.

Assignment 41

SOM: The amount of learning for a neuron is determined by neighborhood function.

$$0.0 \leq h(\mathrm{dist}(i,j),t) \leq 1.0$$
$$\Delta C_j = n(t) \cdot h(\mathrm{dist}(i,j),t) \cdot \left({}^{P}X - C_j\right)$$

The winning neuron i is learning the most with increasing distance $\mathrm{dist}(i,j)$ between i and j on the grid. The h function is designed explicitly time dependent.

Neural-Gas: $\Delta C_j = \eta(t) \cdot h\left(dit_L(l, j), t\right) \cdot \left({}^P X - C_j\right)$ The learning rule is almost identical to SOM. Difference: the way the distance dist (i, j) between neuron i and neuron j is defined. The neural-Gas is sorting all neurons with respect to the achieved response r_k. The neuron i is the first position within the list L.

M-SOM: Only the neurons j have to be updated that belong to the SOM where the winner neuron i belongs to winner SOM.

M-N-Gas: Only the neurons j have to be updated that belong to the Gas where the winner neuron i belongs to winner Gas.

LVQ1: Learning rule is based on the comparison of the teacher vector and the class of the winner Y_i neuron.

$$\begin{cases} \Delta C_l = \eta \cdot (+1) \cdot \left({}^P X - C_i\right) \text{ if } Y_i = {}^P Y \\ \Delta C_i = \eta \cdot (-1) \cdot \left({}^P X - C_i\right) \text{ if } Y_i \neq {}^P Y \\ \Delta C_l = 0 \text{ if } k \neq i \end{cases}$$

LVQ2.1:Learning rule takes the winner i, and the second winner j. Learning is performed only if: teacher belongs to class of winner or second $Y_i = {}^P Y$ or $Y_j = {}^P Y_;$; stimulus is close to the border classes Y_i, Y_j; classes of winner and second are different $Y_i \neq Y_j$.

$$\begin{cases} \Delta C_i = \eta \cdot (+1) \cdot \left({}^P X - C_i\right) \text{ if } \Delta C_k = 0 \\ \Delta C_i = \eta \cdot (-1) \cdot \left({}^P X - C_l\right) \text{ else} \end{cases}$$

Assignment 42

Total number of centers $F = M \prod_{i=1}^{g} f_{m,g}$ does not depend on N. For this example $F = 7{\cdot}2{\cdot}3 = 42$.

Assignment 43

We can partition each dimension of this cube into three parts. For example, uniformly with step $\frac{1}{3}$ to $\{x_1, x_2, x_3\}$ such that every $x \in [0, \frac{1}{3}) = x_1 = \frac{1}{6}; x \in [\frac{1}{3}, \frac{2}{3}) = x_2 = \frac{1}{2};; x \in [\frac{2}{3}, 1] = x_3 = \frac{5}{6}$. This way $3^8 = 6561$ points.

Assignment 44

1. For each pattern p with position ${}^p X$ calculate the distance $d = \|{}^p X - C_i\|$ where i is closest neuron.
2. Move center C_i towards stimulus ${}^p X$. $C_i(t+1) = C_i(t) + \eta_c({}^p X - C_i)$ where η_c is the learning rate for the centers.
3. Move size σ_i towards distance d. $\sigma_i(t+1) = \sigma_i(t) + \eta_\sigma(d - \sigma_i)$ where η_σ is the learning rate for the sizes.

Assignment 45

1. Init-σ. Use the same initial value σ_{init} for all new neurons σ_{k+1}.

2. Minimum-σ. Use the minimum value of all σ_k.
3. Maximum-σ. Use the maximum value of all σ_k.
4. Mean-σ. Use the mean value of all σ_k.