

Group	Name	46	47	48	49	50	51	52	Σ
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Technical Neural Networks Assignment Sheet 8

December 2022

Assignment 46

The centre c of the neuron will be adapted by presenting the pattern X with position p to the net. The current position of the centre at time t , $c(t)$ will be adapted towards the position p of the pattern. New position $c(t + 1)$:

$$c(t + 1) = c(t) + \eta_c(p - c(t))$$

The width of the neuron σ will be adapted towards the mean distance between the pattern X and the center of the neuron.

$$d = \|c(t) - p\|_2$$

$$\sigma(t + 1) = \sigma(t) + \eta_\sigma(d - \sigma(t))$$

Looking at the adaptations of the neuron center c and since $0 < \eta_c < 1$, the neuron is progressively moving towards the pattern never actually reaching it. We can assume that at after presenting the pattern a certain number of times $\sigma(t) \cong p$. $\sigma(t + 1)$ will get smaller and smaller until we reach:

$$\sigma(t + 1) = \sigma(t) - \eta_\sigma \sigma(t)$$

The perceptive area gets smaller if σ gets smaller, using this equation $r = \rho \cdot \sigma$. Where ρ is a constant.

Presenting the same pattern multiple times has bad effects on an ROLF neuron, because the neurons specialize for a certain pattern. When a new input is introduced, the algorithm is forced to produce additional neurons that might not have been needed.

Assignment 47

1. Pictures A (Aleksei Zhuravlev)

Ways to classify figures:

- (a) Has angles / does not have angles (circle / not circle)
- (b) By color: Red / other

(c) By number of instances: one / more than one

2. Pictures B (Svetlana Seliunina).

First classification that I could think of is whether or not it is a living tree. Than living trees are presented on all pictures except for 14 which makes its own group. Other possibilities to classify trees might be background (is the background empty, is it inside or outside, what season) or can we see the whole tree in the picture or no.

Assignment 48

Forward matrix is real values matrix w_{nm} mapping from comparison layer $F1$ to recognition layer $F2$ to value which neuron is the most active. Backward matrix is a binary matrix v_{mn} mapping from recognition layer $F2$ to comparison layer $F1$ to find out which class corresponds to this active neuron.

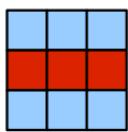
Assignment 49

The Laterally Primed Adaptive Resonance Theory (LAPART) neural networks couple two Fuzzy ART algorithms to create a mechanism for making predictions based on learned associations. The coupling of the two Fuzzy ARTs has a unique stability that allows the system to converge rapidly towards a clear solution. Additionally, it can perform logical inference and supervised learning similar to fuzzy ARTMAP.

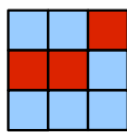
Source: Sandia National Laboratories (2017) Lapart-python documentation

Assignment 50

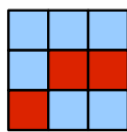
Simple feature extraction layer in the first module U_{s1} processes information from each neurons receptive field to find features such as simple lines. Only if the receptive field matches the desired feature the neuron will be active. Example can be found on slide 63 for 3x3 receptive field.



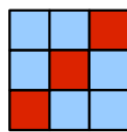
k=1



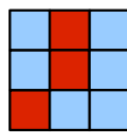
k=2



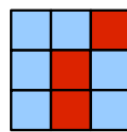
k=3



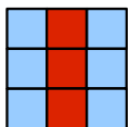
k=4



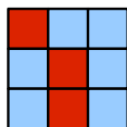
k=5



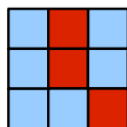
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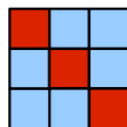
k=7



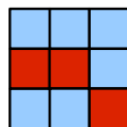
k=8



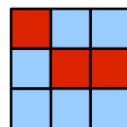
k=9



k=10



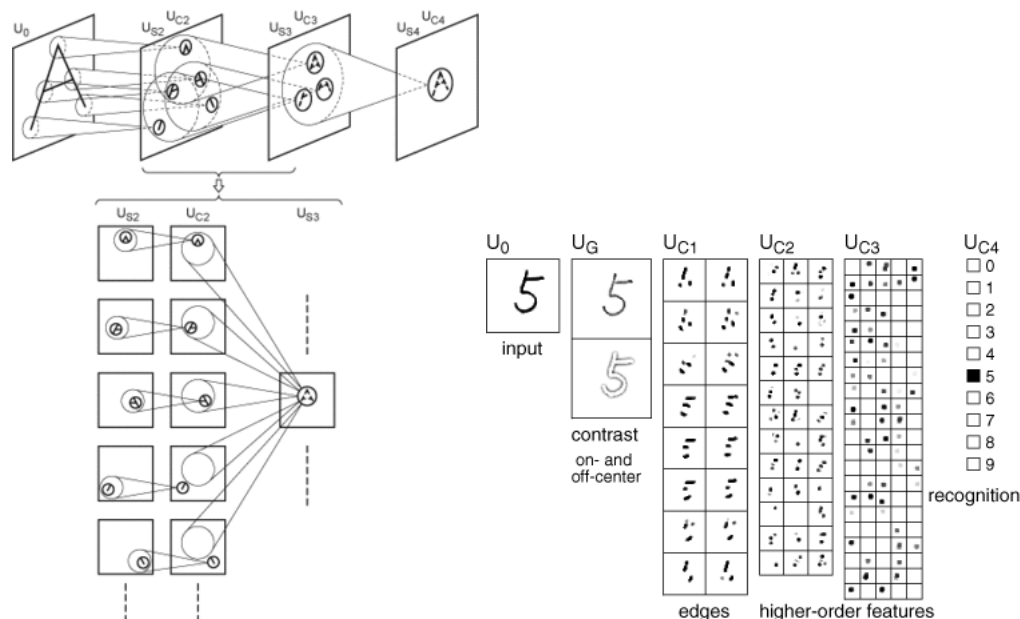
k=11



k=12

Assignment 51

C-cells, which resembles complex cells in the visual cortex, are inserted in the network to allow for positional errors in the features of the stimulus. The input connections of C-cells, which come from S-cells of the preceding layer, are fixed and invariable. Each C-cell receives excitatory input connections from a group of S-cells that extract the same feature, but from slightly different positions. The C-cell responds if at least one of these S-cells yield an output. Even if the stimulus feature shifts in position and another S-cell comes to respond instead of the first one, the same C-cell keeps responding. Thus, the C-cell's response is less sensitive to shift in position of the input pattern. We can also express that C-cells make a blurring operation, because the response of a layer of S-cells is spatially blurred in the response of the succeeding layer of C-cells.



Assignment 52

Each neuron in each layer has its own set of weights. In a new layer when it is decided whether or not the neuron will be active the weighted sum of neurons from its receptive field is calculated. After regularization and transfer function appliance the result determines if neuron is active or not. In other words, the receptive field is convoluted with the desired feature filter to produce the weighted sum.