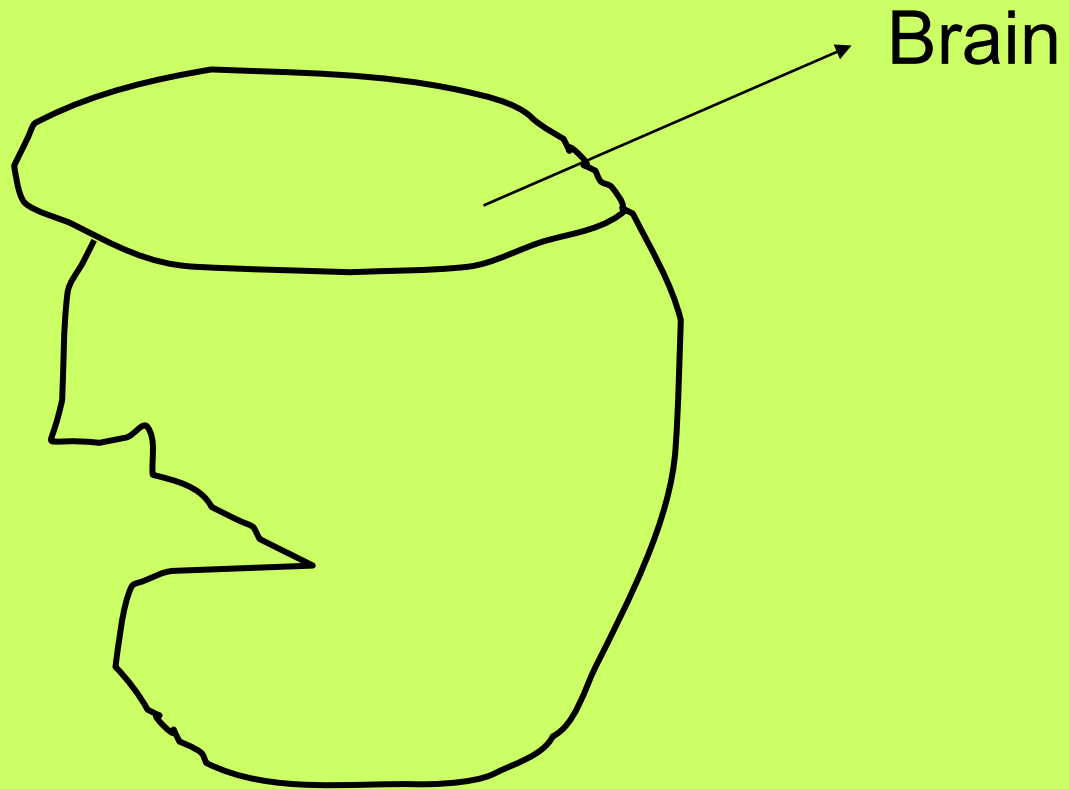# CS623: Introduction to Computing with Neural Nets
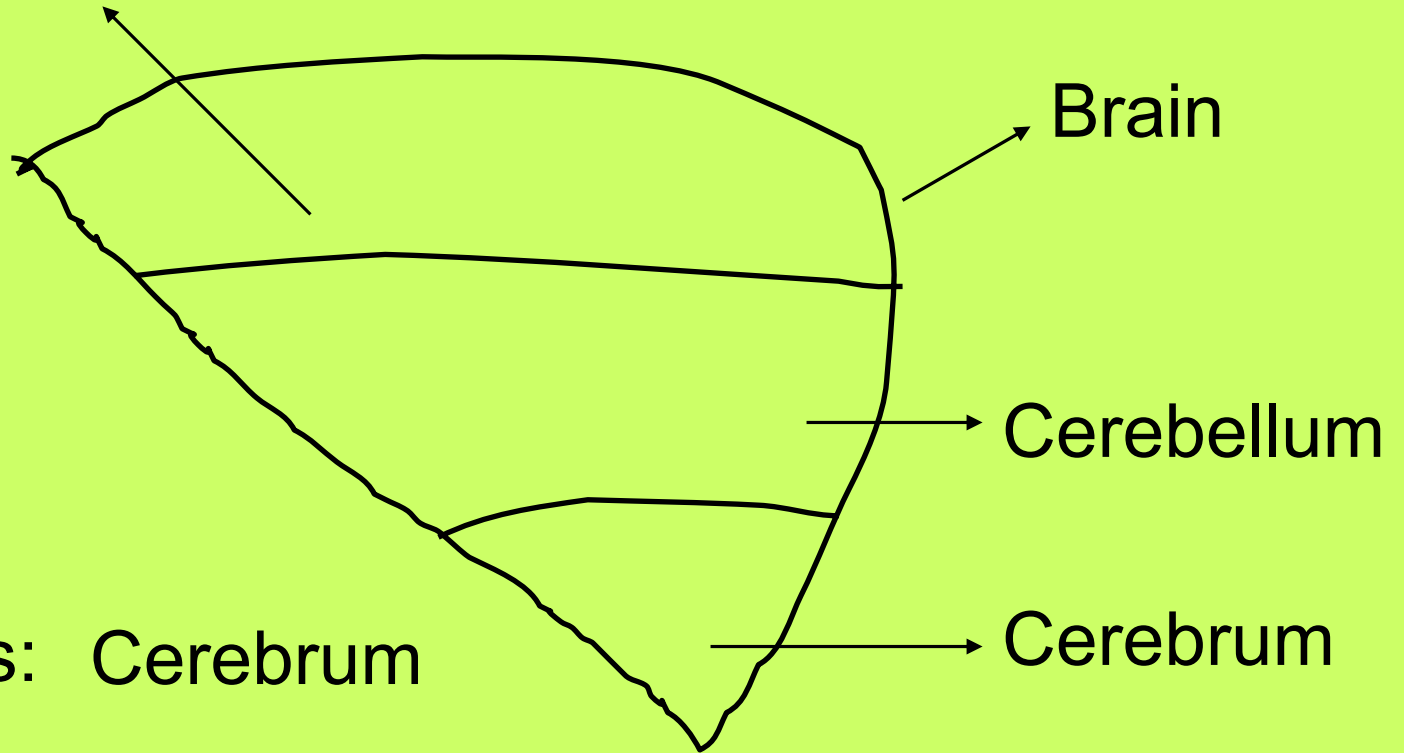## *(lecture-20)*

Pushpak Bhattacharyya

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Self Organization

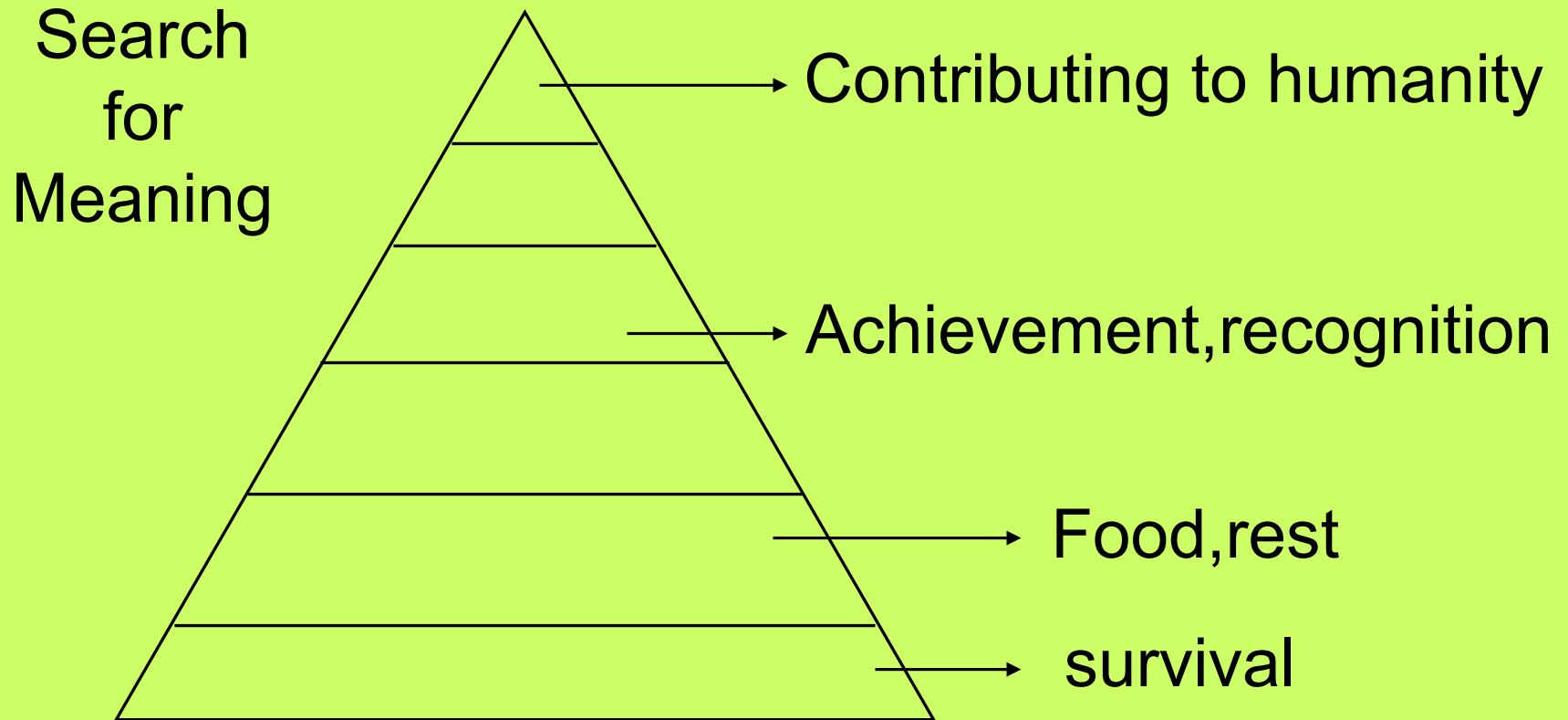Biological Motivation

Higher brain

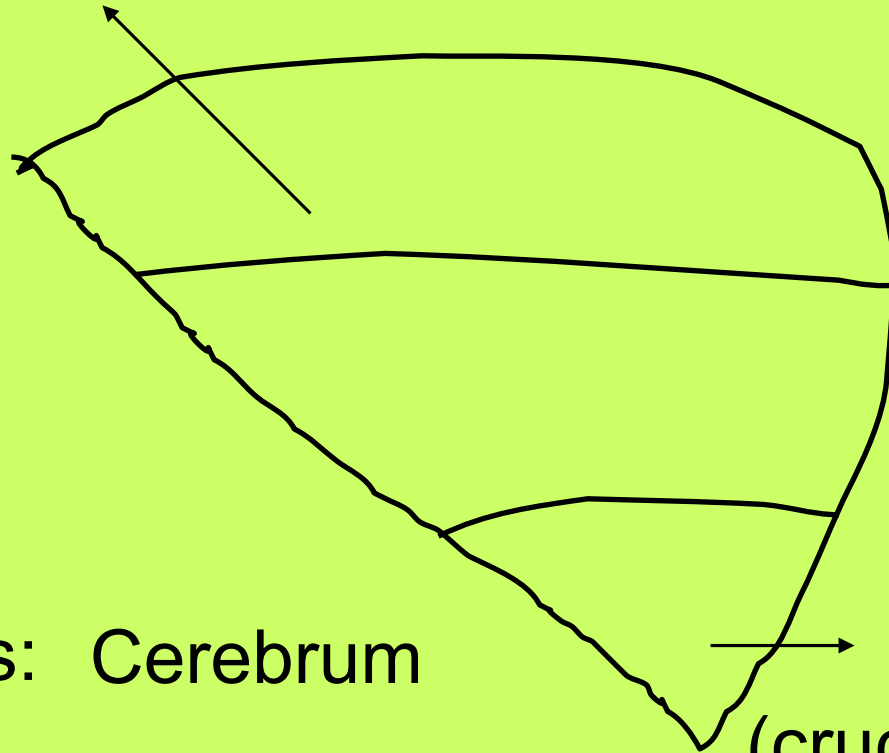Brain

Cerebellum

Cerebrum

3- Layers: Cerebrum

Cerebellum

Higher brain

Maslow's hierarchy

Search
for
Meaning

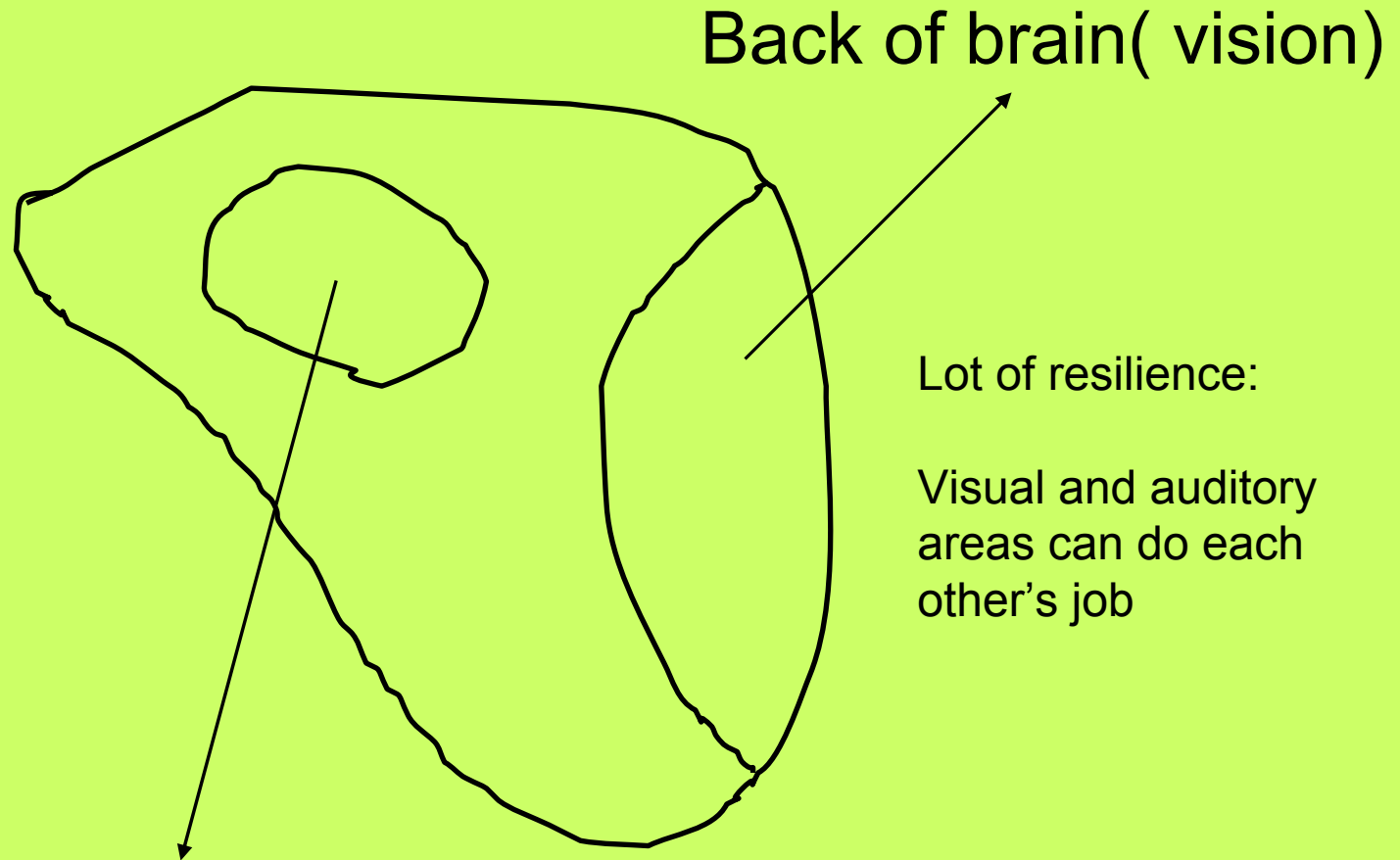Contributing to humanity

Achievement,recognition

Food,rest

survival

Higher brain (responsible for higher needs)

3- Layers: Cerebrum

Cerebellum

Higher brain

Cerebrum
(crucial for survival)

Mapping of Brain
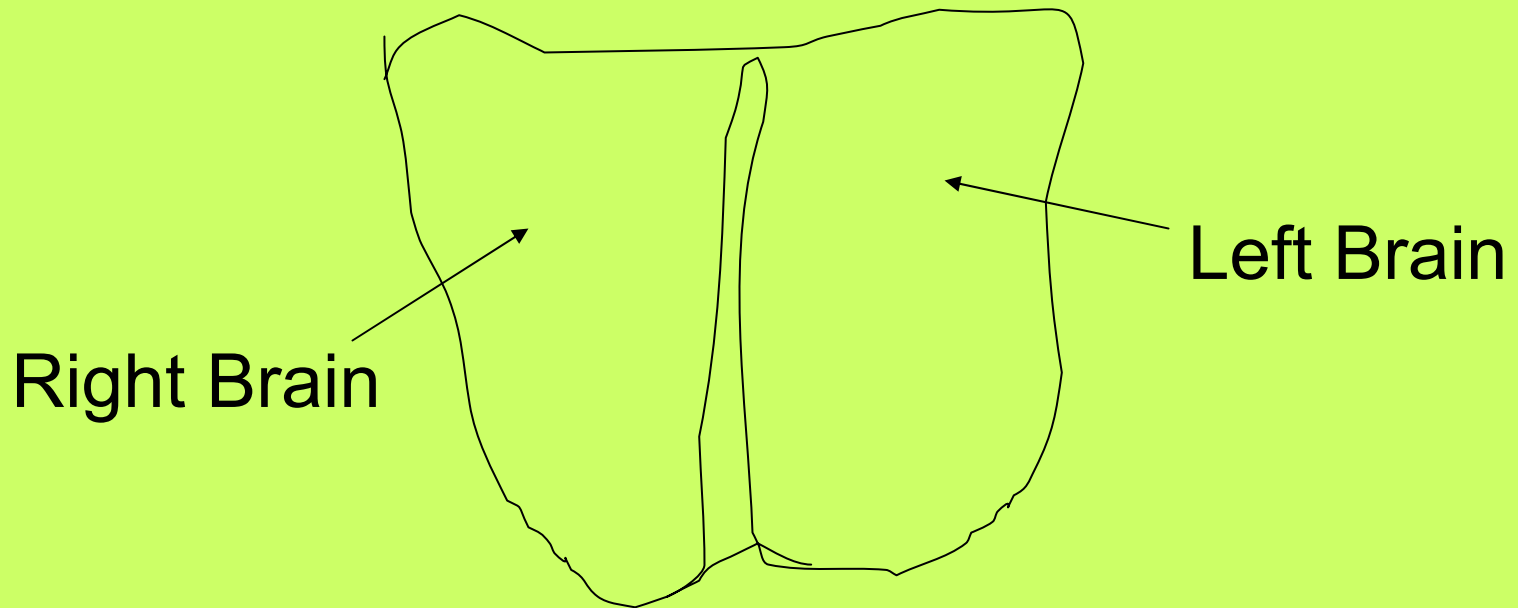

Back of brain(vision)

Lot of resilience:

Visual and auditory areas can do each other's job

Side areas
For auditory information processing

Left Brain and Right Brain

Dichotomy

Left Brain

Right Brain

Left Brain   – Logic, Reasoning, Verbal ability

Right Brain – Emotion, Creativity

Words – left Brain

Music

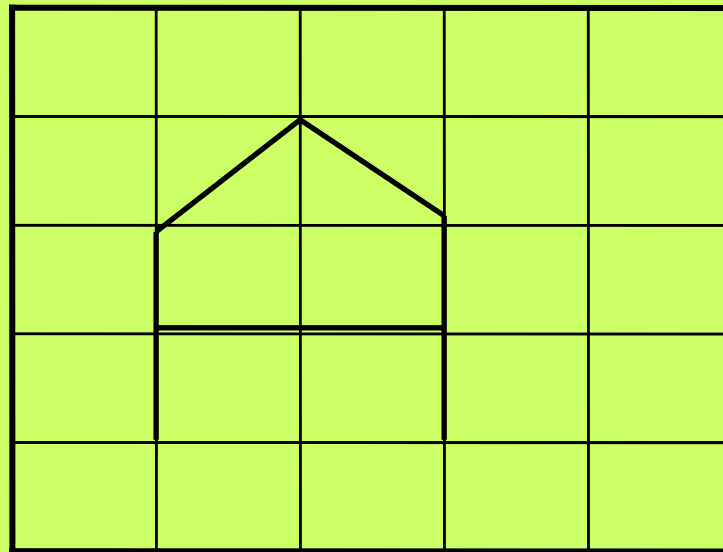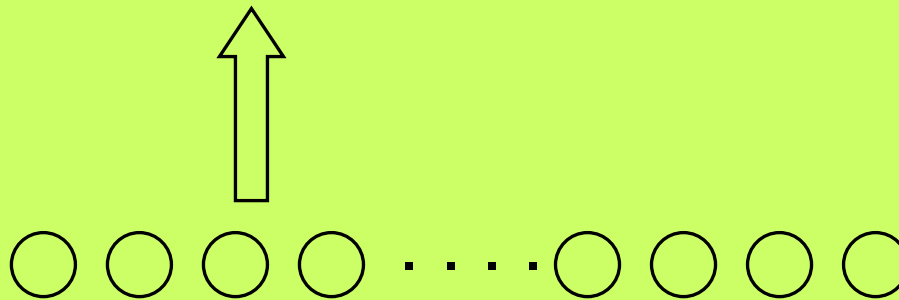Tune – Right Brain
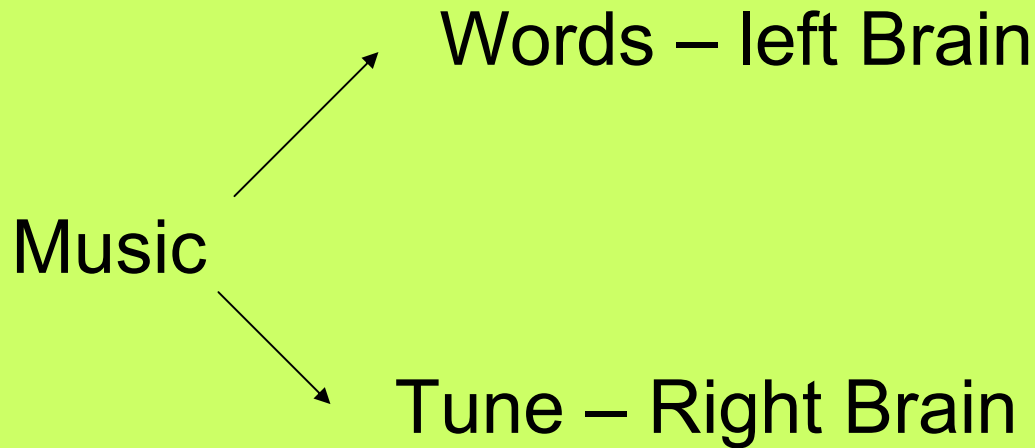
Maps in the brain. Limbs are mapped to brain

# Character Recognition:

A, **A**, *A*, ⊿ ⟁ ⅄

,

,

O/p grid

I/p neuron

Kohonen Net

- Self Organization or Kohonen network fires a group of neurons instead of a single one.
- The group "some how" produces a "picture" of the cluster.
- Fundamentally SOM is competitive learning.
- But weight changes are incorporated on a neighborhood.
- Find the winner neuron, apply weight change for the winner and its "neighbors".
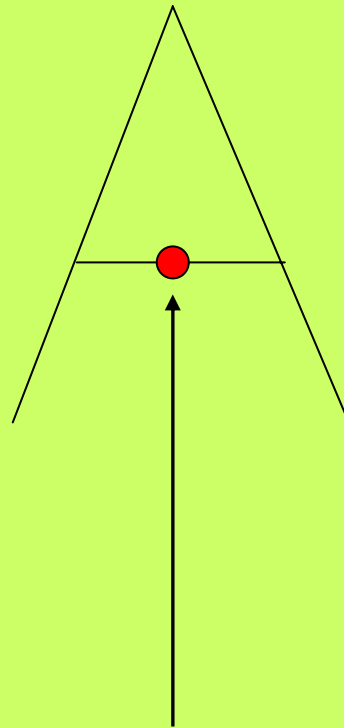
Winner

Neurons on the contour are the "neighborhood" neurons.

Weight change rule for SOM

$$W^{(n+1)}_{P+\delta(n)} = W^{(n)}_{P+\delta(n)} + \eta^{(n)} (I^{(n)} - W^{(n)}_{P+\delta(n)})$$
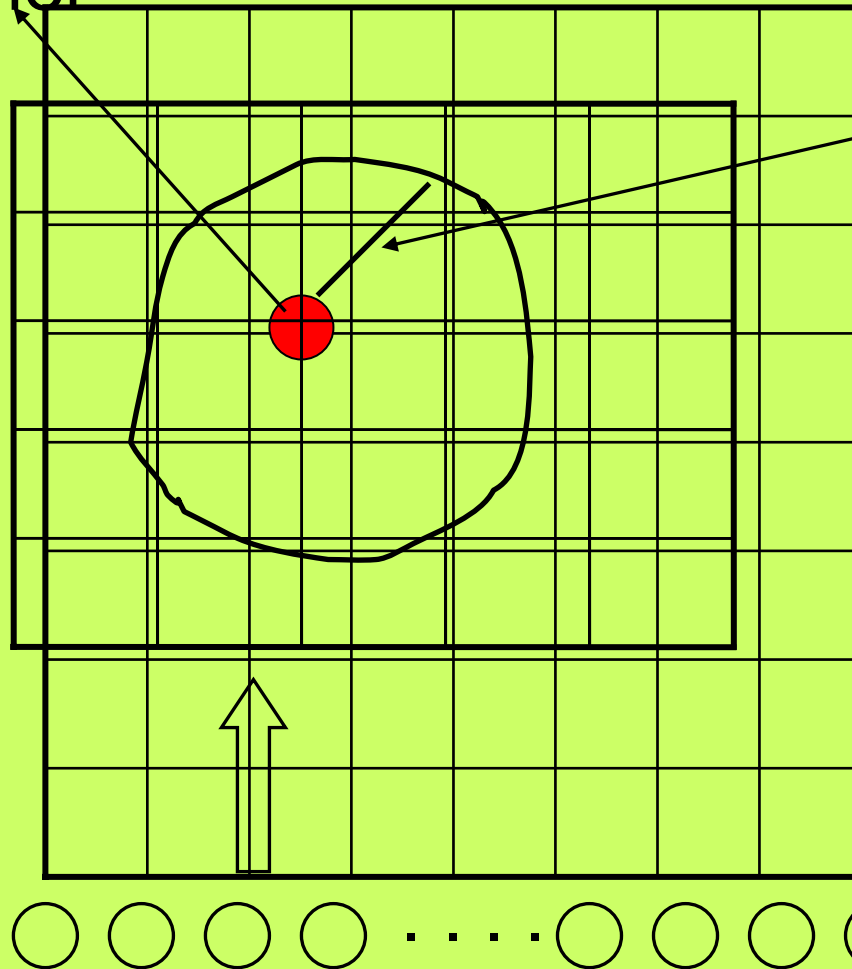
Neighborhood: function of n

Learning rate: function of n

δ(n) is a decreasing function of n
η(n) learning rate is also a decreasing function of n
0 < η(n) < η(n –1) <=1

Pictorially

Winner
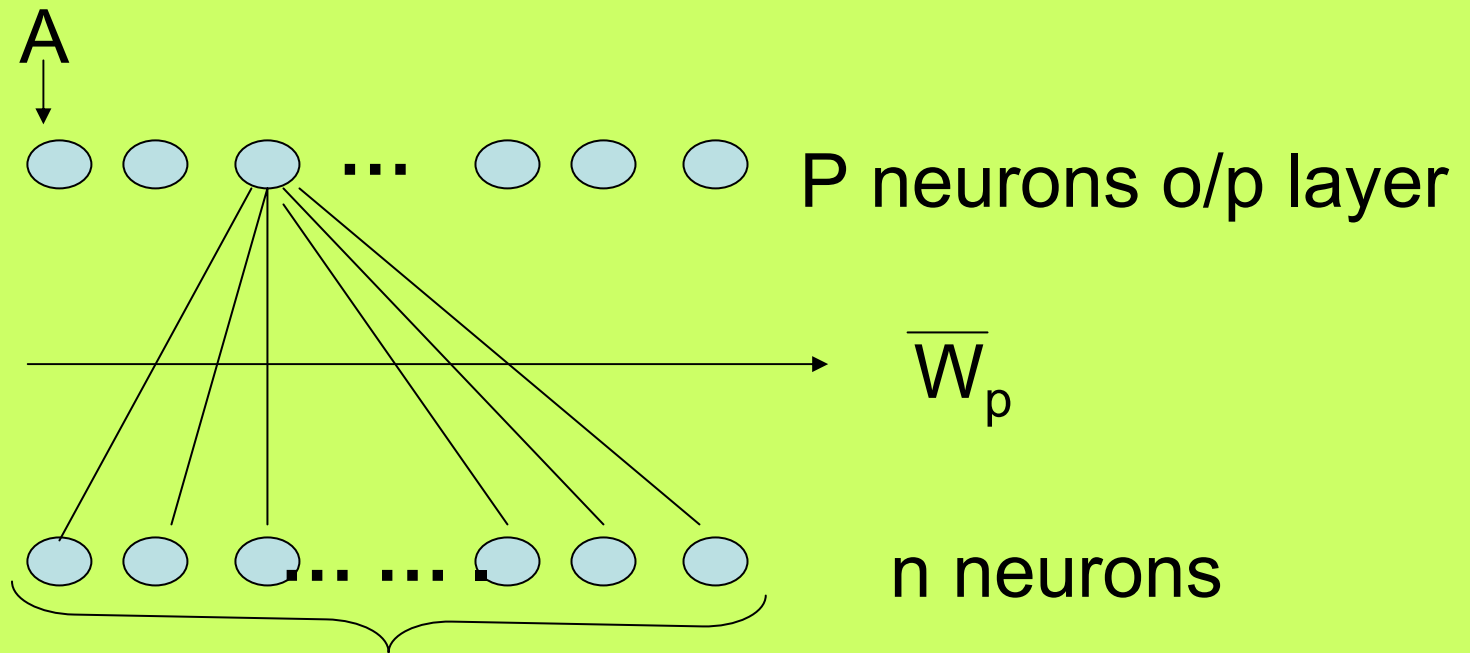
δ(n)

Convergence for kohonen not proved except for uni-dimension

A

P neurons o/p layer

$\overline{W}_p$

n neurons

Clusters:
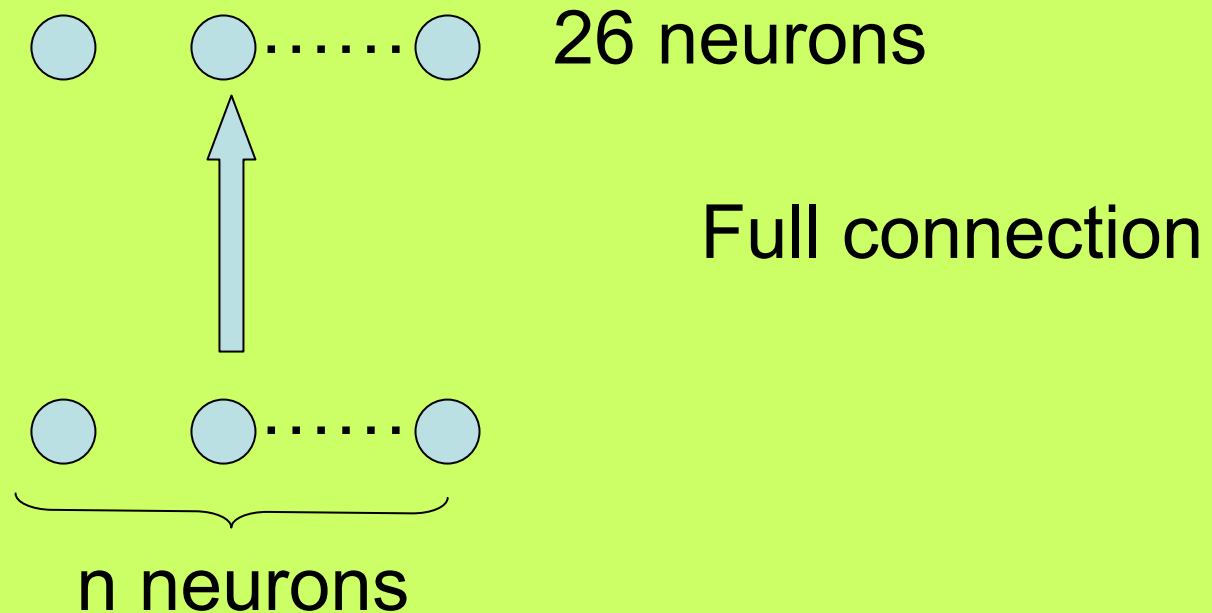
A : **A** ⊳ ⩗ ⩜

B :   :

C :   :

Clustering Algos

1. Competitive learning
2. K – means clustering
3. Counter Propagation

K – means clustering

K o/p neurons are required from the knowledge of *K* clusters being present.

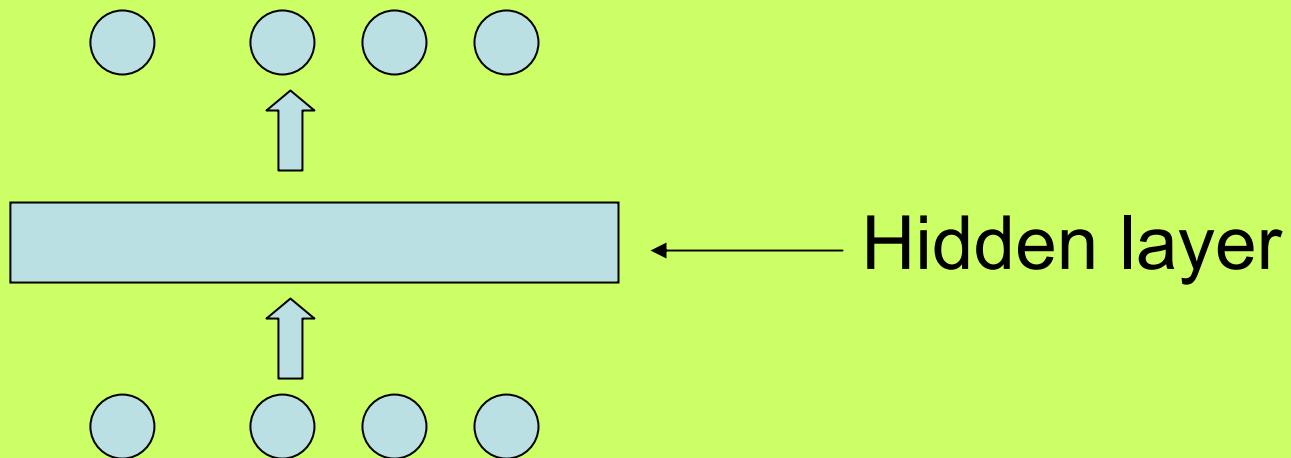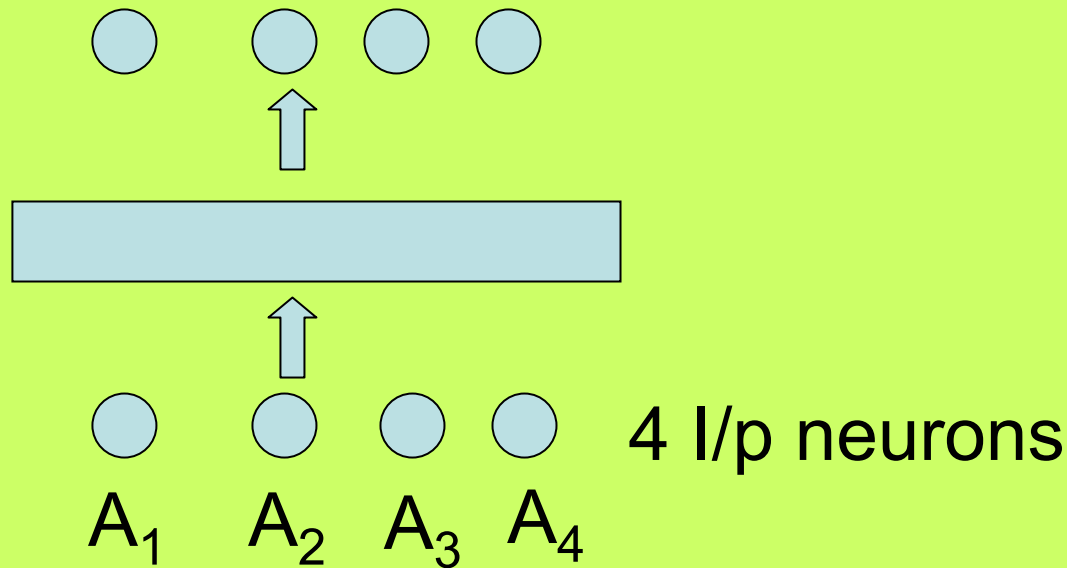26 neurons

Full connection

n neurons

Steps

1. Initialize the weights randomly.
2. I^k is the vector presented at k^{th} iteration.

3. Find W* such that
$$|w^* - I^k| < |w_j - I^k| \text{ for all } j$$
4. make $W^{*(new)} = W^{*\,(old)} + \eta(I^k - w^*)$.

5 K $\leftarrow$ K +1 ; if go to 3.

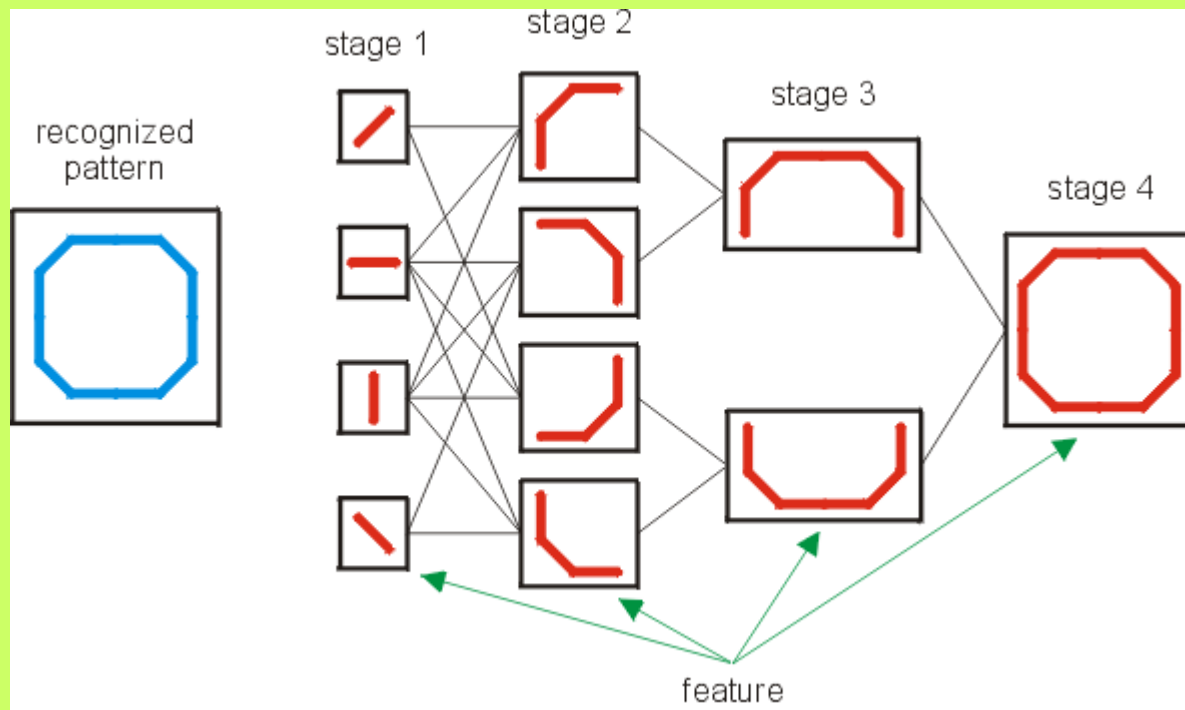6. Go to 2 until the error is below a threshold.

Two part assignment

Cluster Discovery By SOM/Kohenen Net

4 I/p neurons

A_1 A_2 A_3 A_4

NeoCognitron
(Fukusima et. al.)

Hierarchical feature extraction based

Corresponding Netowork

stage 0 · stage 1 · stage 2 · stage 3 · stage 4

U0 · US1 · UC1 · US2 · UC2 · US3 · UC3 · US4 · UC4

input layer

S-layer

C-layer

V-layer

UV1 · UV2 · UV3 · UV4
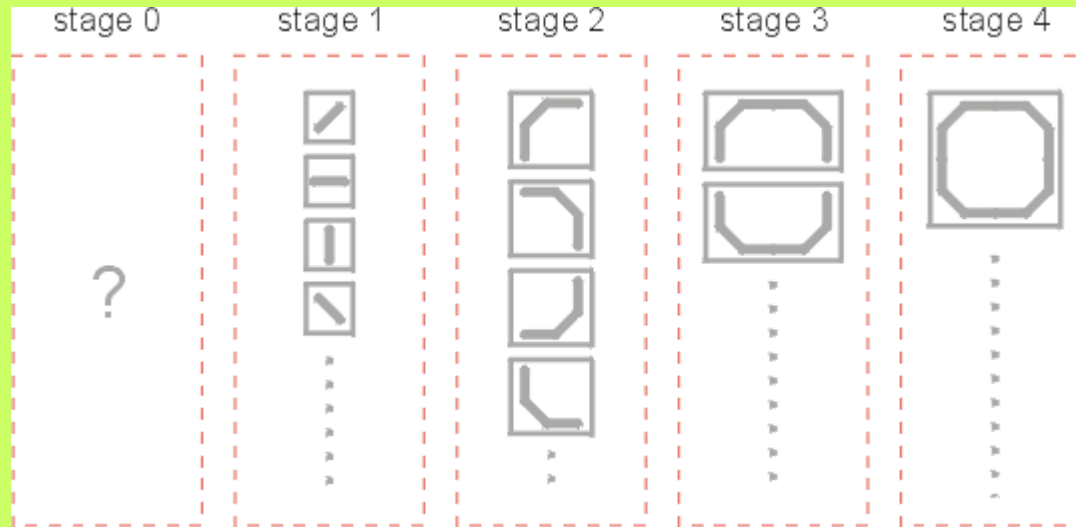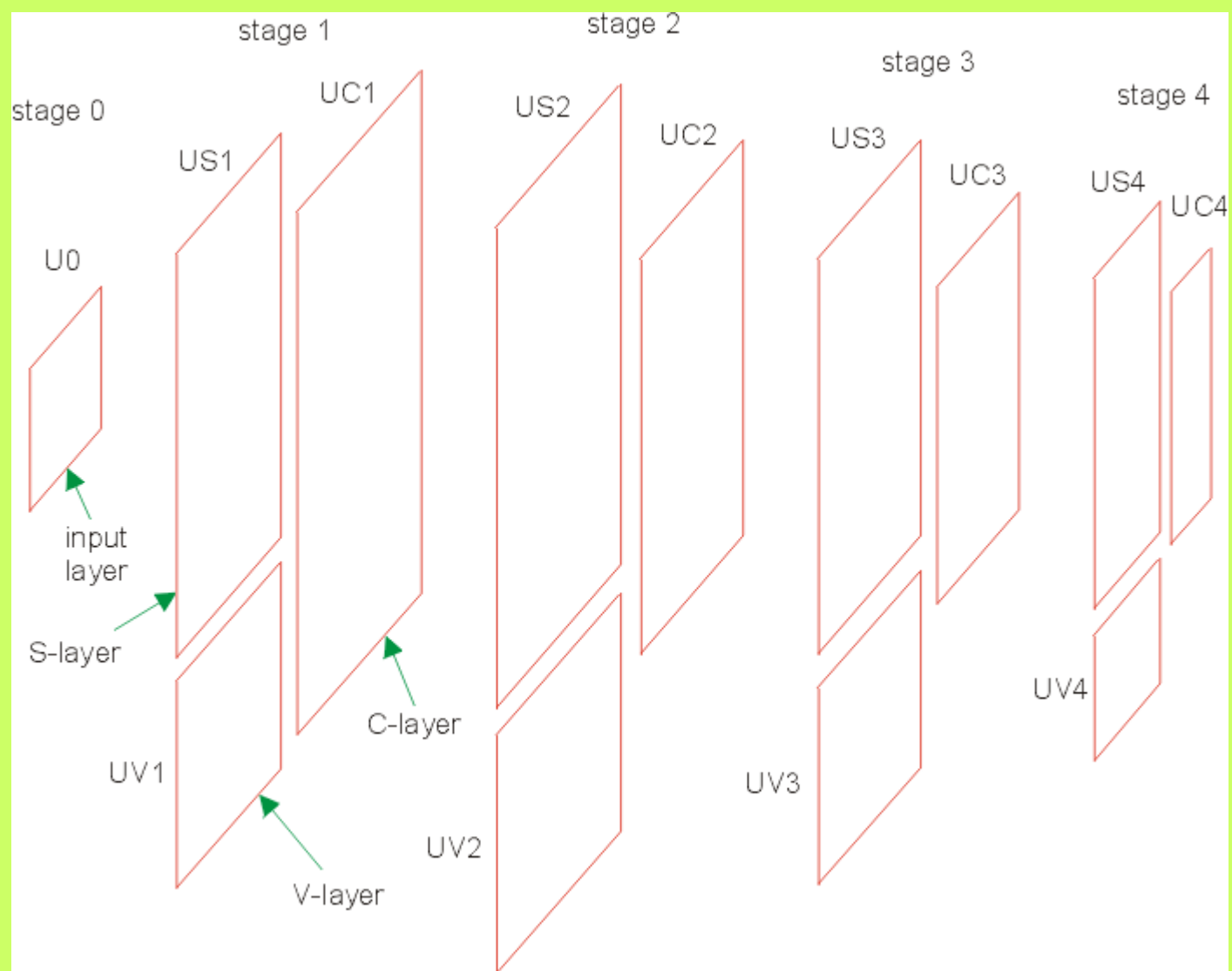
S-Layer

- Each **S-layer** in the neocognitron is intended for **extraction of features** from corresponding stage of hierarchy.

- Particular S-layers are formed by distinct number of S-planes. Number of these S-planes depends on the number of extracted features.

V-Layer

- Each **V-layer** in the neocognitron is intended for **obtaining of informations about average activity** in previous C-layer (or input layer).

- Particular V-layers are always formed by only one V-plane.

C-Layer

- Each **C-layer** in the neocognitron is intended for **ensuring of tolerance of shifts of features** extracted in previous S-layer.

- Particular C-layers are formed by distinct number of C-planes. Their number depends on the number of features extracted in the previous S-layer.