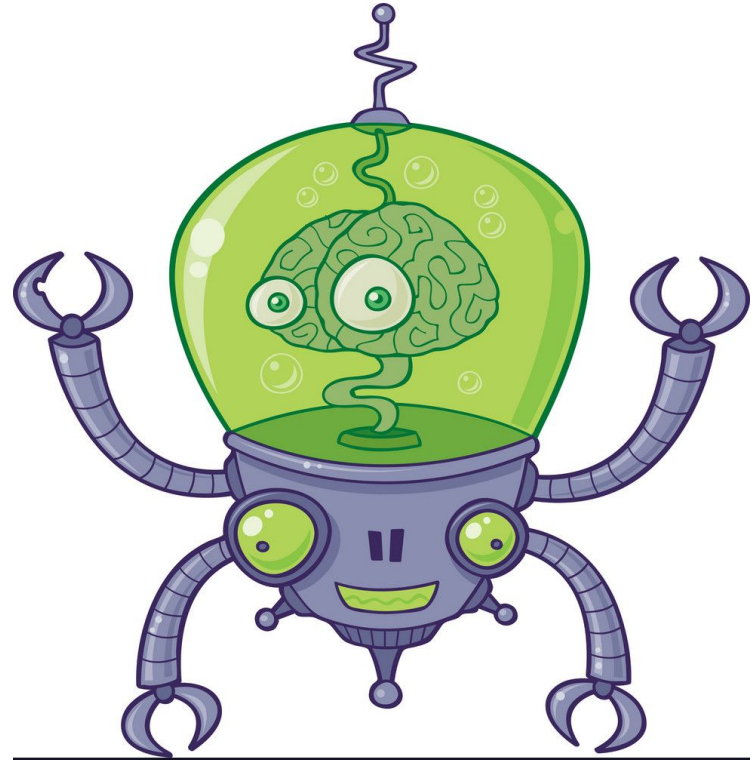

Neocognitron



Presentation by Jenish Maharjan

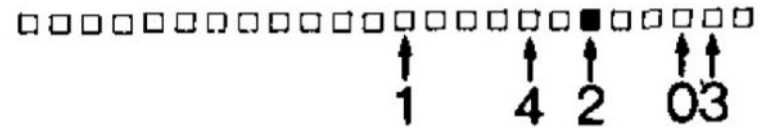
Introduction



- Neural Network Model introduced by Kuniyiko Fukushima (1980)
- Architecture inspired by the mammalian visual cortex
- Improvement over older Cognitron model
- Many improvements and modifications have been made since its inception

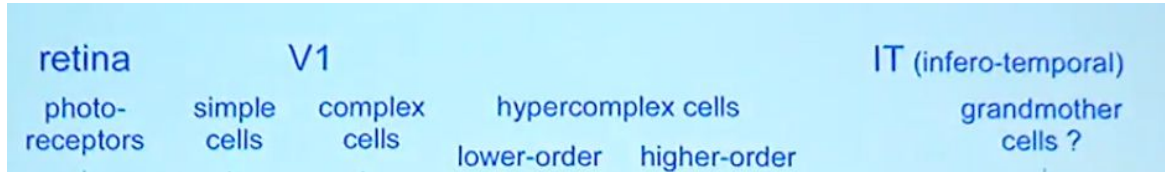
Task

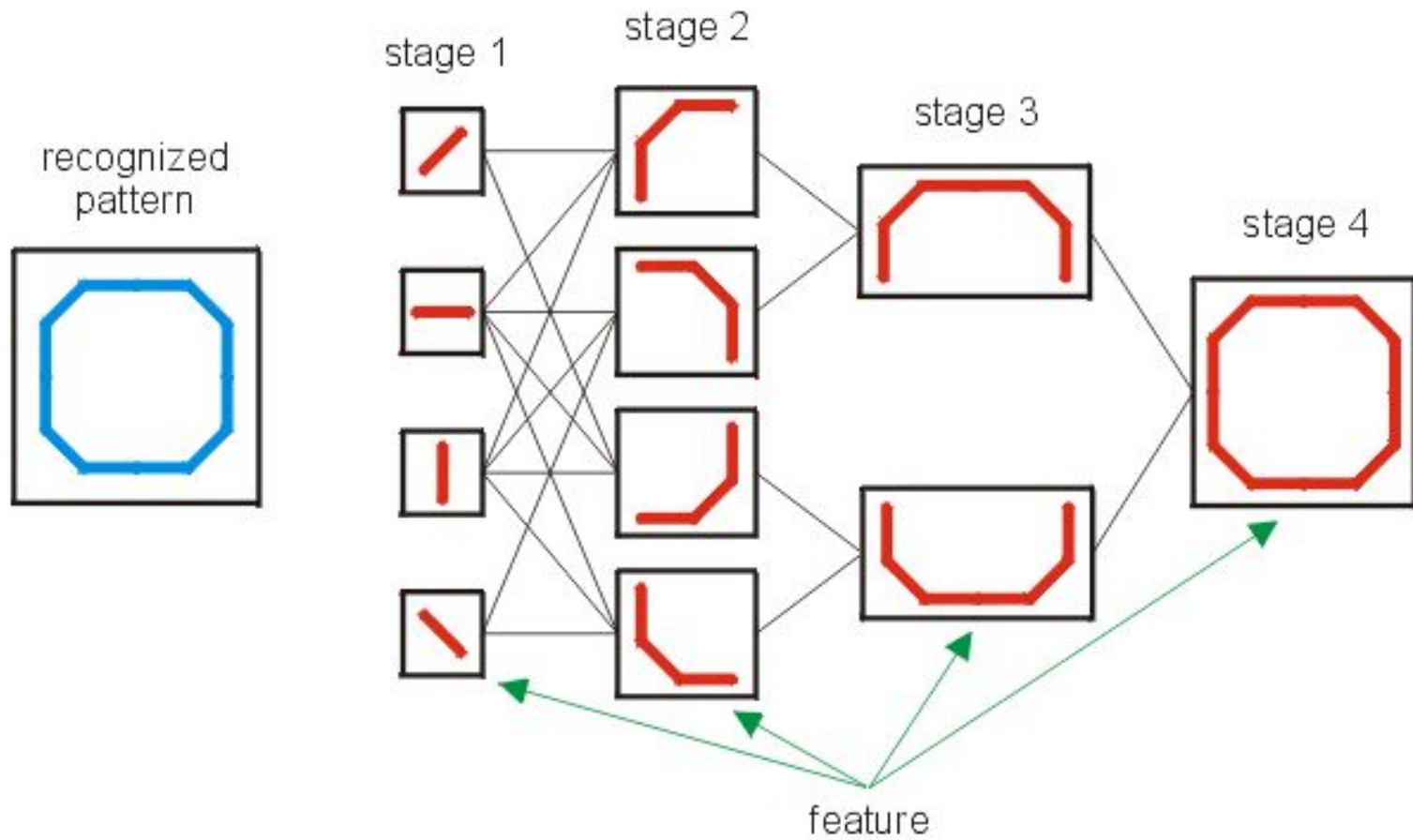
- Unsupervised handwritten character recognition
- Input - Unlabeled Images
- Output - Vector, with each bit encoding a distinct class of images



Inspiration

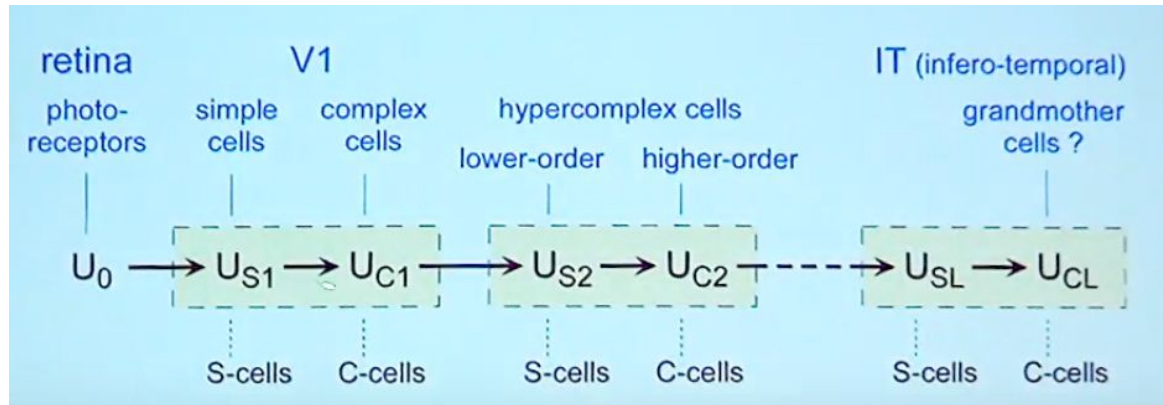
- Hubel and Wiesel - Cat's visual cortex
- A concrete functional architecture of simple cells and complex cells in the early visual cortex





Inspiration

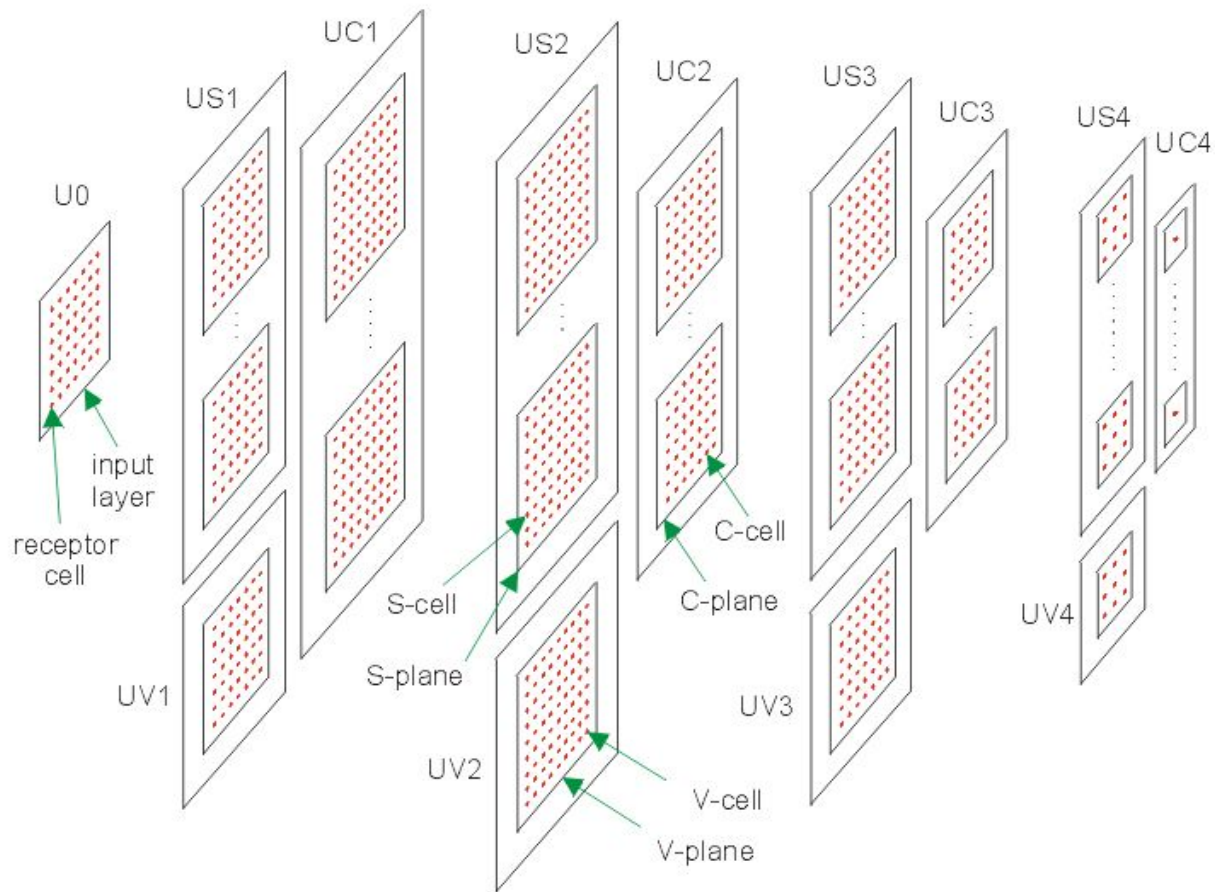
- Hubel and Wiesel - Cat's visual cortex
- A concrete functional architecture of simple cells and complex cells in the early visual cortex



Network Structure

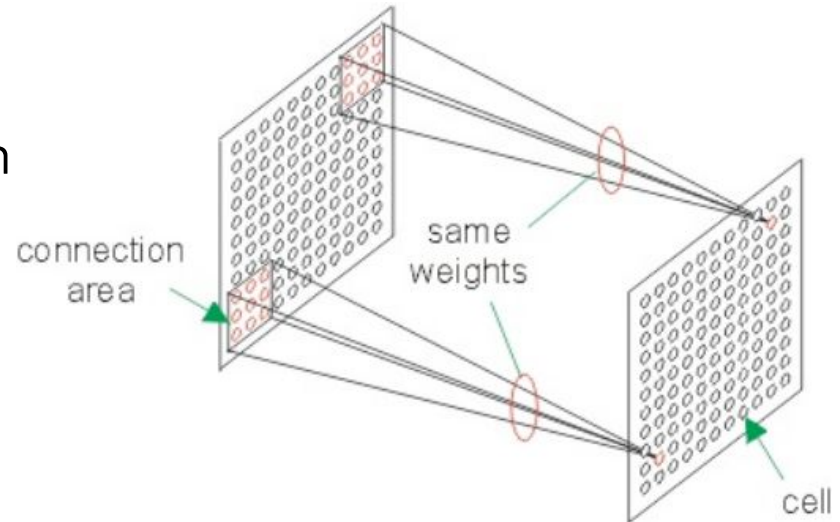


- Basic Form (1980)
 - ◆ Alternating S-layers and C-layers
 - ◆ 3 stages [More stages added in later versions]
 - ◆ Limited number of cell-planes in each layer



S-Layers

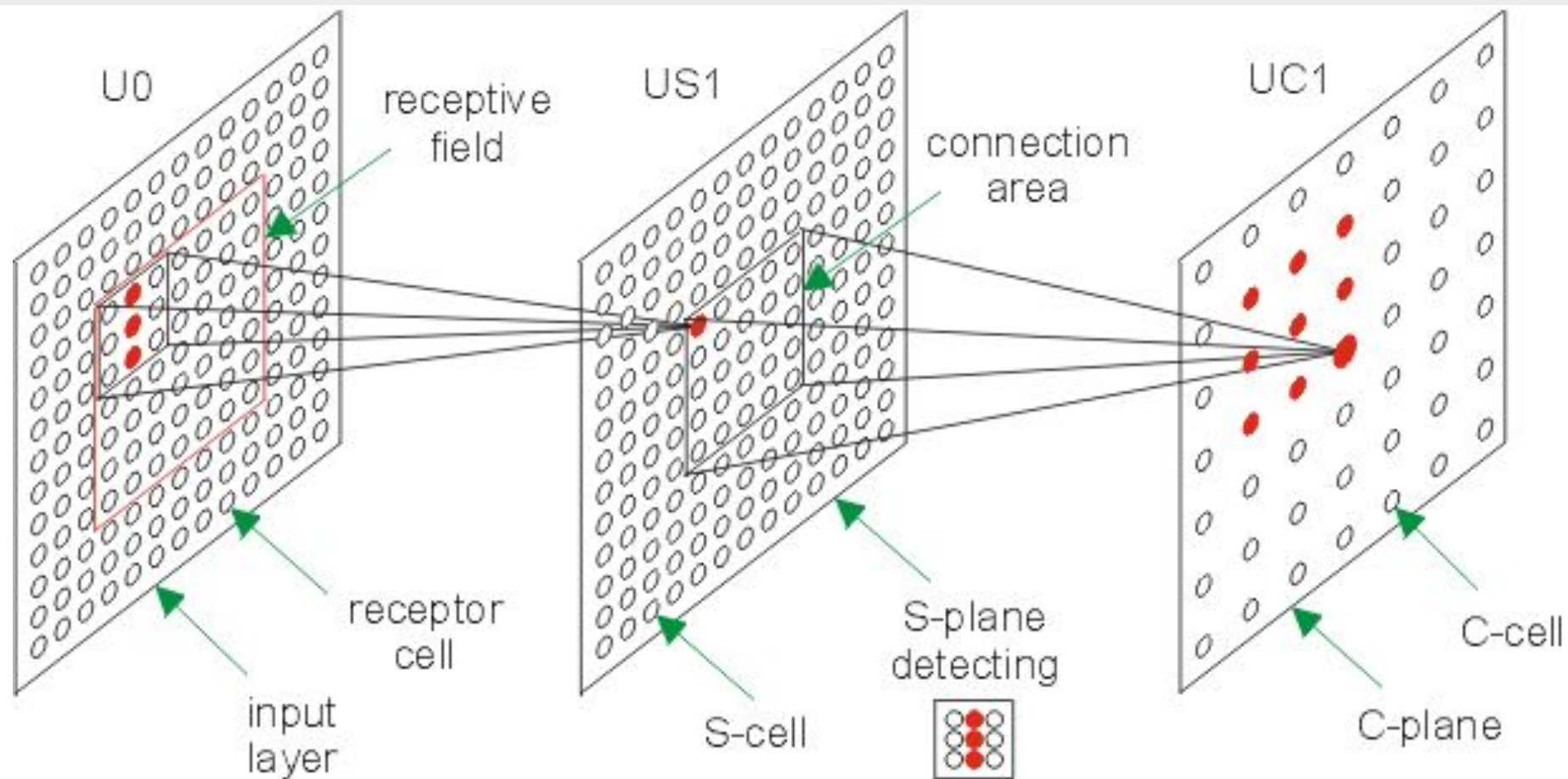
- Feature Detector
- Each cell in the layer detects the presence of a different feature in the layer's input data
- Adaptable Weights
- Each S-cell is accompanied by a V-cell



C-Layer



- Function: hiding the exact position of the detected feature
- Improves the network robustness to deformations of the pattern - scaling, shifting of the pattern's position, or noise

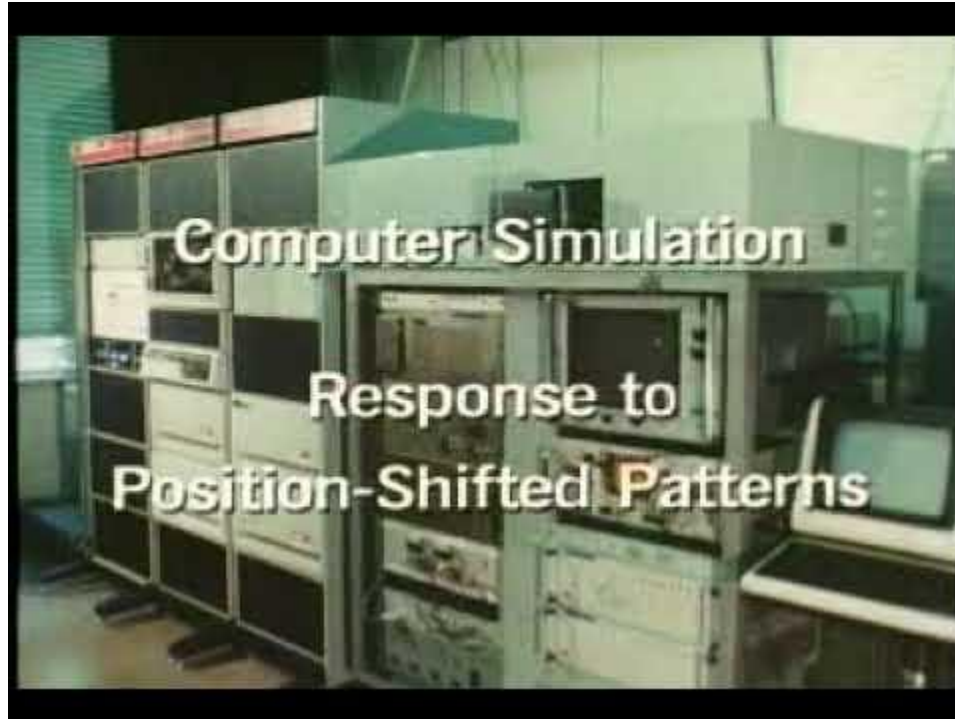


Learning



- Weights get initialized with small positive values
- For each training instance, if a cell is the most active in its region and in its plane, then its active weights get reinforced
- Show the same few training instances over and over again
- Math works out so that an S-cell's weights directly correspond to the feature it is recognizing and activation

Computer Simulation





Conclusion

References



Fukushima, K. "Neocognitron: A Self-organizing Neural Network Model for a Mechanism of Pattern Recognition Unaffected by Shift in Position." *Biol. Cybernetics* 36, 193-202 (1980)

Fukushima, K., and Miyake, S. "Neocognitron: A New Algorithm for Pattern Recognition Tolerant of Deformations and Shifts in Position." *Pattern Recognition* 15, no. 6 (1982): 455-469.

M. Kukačka. "Neocognitron: A Survey of a Classical Hybrid Neural Network Model." *WDS'11 Proceedings of Contributed Papers, Part I*, 112-118, 2011

Figures from: <http://www.kiv.zcu.cz/studies/predmety/uir/NS/Neocognitron/en/index.html>