

## Simulation Programs in C Language

Programs are downloadable

### Neocognitron

#### Neocognitron for Handwritten Digit Recognition

K. Fukushima: *Neurocomputing*, **51** (2003) 161–180

The *neocognitron*, which the author proposed previously, is a neural network model for robust visual pattern recognition.

To improve the recognition rate of the neocognitron, several modifications have been applied, such as:

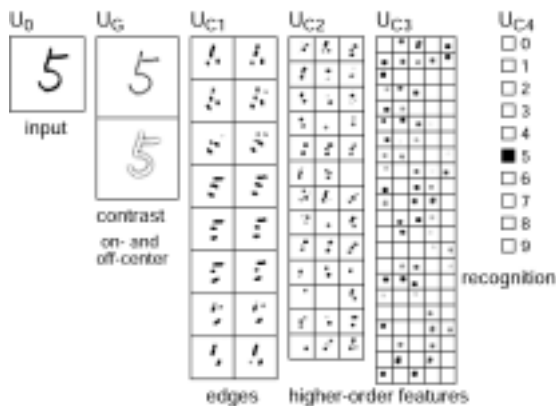
- 1) inhibitory surround in the connections from S- to C-cells,
- 2) supervised competitive learning at the highest stage.

These modifications brought an improved recognition rate as well as simplified architecture of the network.

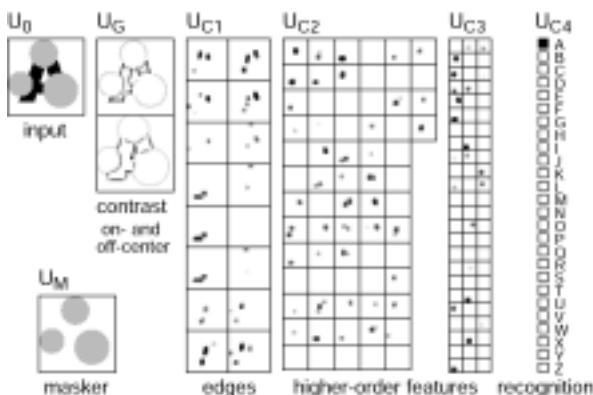
#### Experiments

Learning set: 3000 patterns (300 patterns for each digit)  
randomly sampled from ETL-1 database

Recognition rate: 98.6% for a blind test set (3000 patterns)  
100% for the Learning set



These responses are obtained in PostScript files by running the programs.

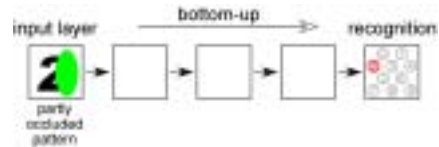


### Recognition of Partly Occluded Patterns

#### Recognition of Partly Occluded Patterns: A Neural Network Model

K. Fukushima: *Biological Cybernetics*, **84**[4] (2001) 251–259

#### Neural network model

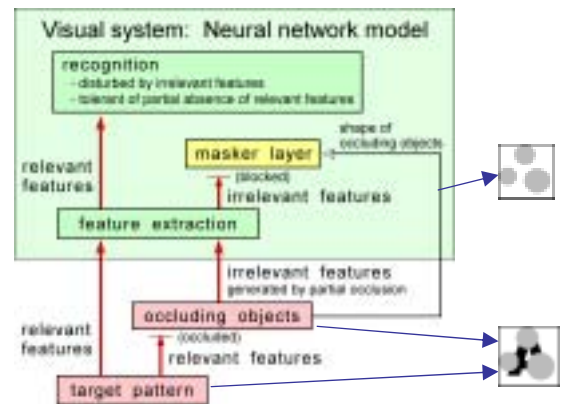


Partly occluded patterns

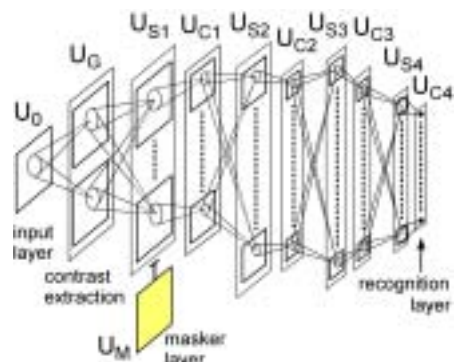
--- visible and invisible occluding objects ---



Why a pattern is easier to recognize when it is occluded by visible objects than by invisible opaque objects.



Irrelevant features generated by partial occlusion are blocked at an early stage of the network.  
(Ignore the contours owned by the occluding objects.)



Network architecture  
neocognitron + masker layer (UM)