


CISC 3250 Systems Neuroscience

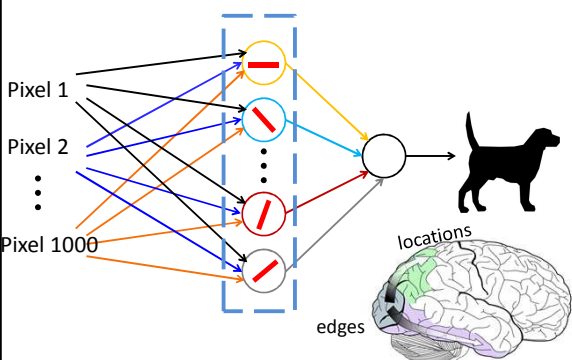
Representations
in the brain



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1

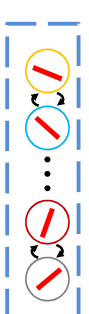
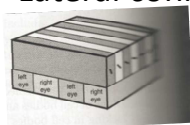
Feed-forward network



locations
edges
objects

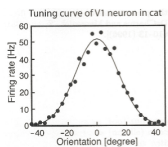
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http://en.wikipedia.org/wiki/File:Ventral-dorsal_streams.svg

Lateral connections

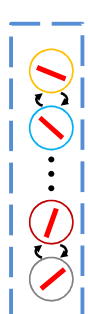
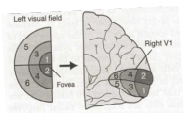
Nearby neurons respond to similar features

Neuron can respond slightly less to features slightly deviant from maximum preference



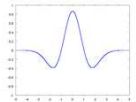

Tuning curve of V1 neuron in cat
Henry et al.,
J Neurophys 1974.

Lateral connections: surround suppression

Nearby neurons respond to similar features

Neuron can have suppressed response for features deviant from maximum preference

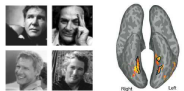



4

Classes of representation

Local representation

- Neural level: "grandmother" cell
- "Region" level: face region, place region

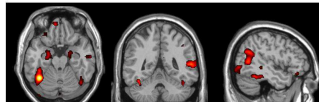


Fully distributed representation

- Every neuron/region plays a part

Sparsely-distributed representation

- Neural level: hyper-column for perceptual feature
- "Region" level: face network



Decoding mechanisms

Population coding for neural prostheses

- $\hat{s}_{dir} = \sum_i r_i s_i^{pref}$

r – spiking rate
s – encoded feature
- "Normalized" firing rate
- $\hat{r}_i = \frac{r_i - r_i^{min}}{r_i^{max}}$
- $\hat{s}_{pop} = \sum_i \frac{\hat{r}_i}{\sum_j \hat{r}_j} s_i^{pref}$