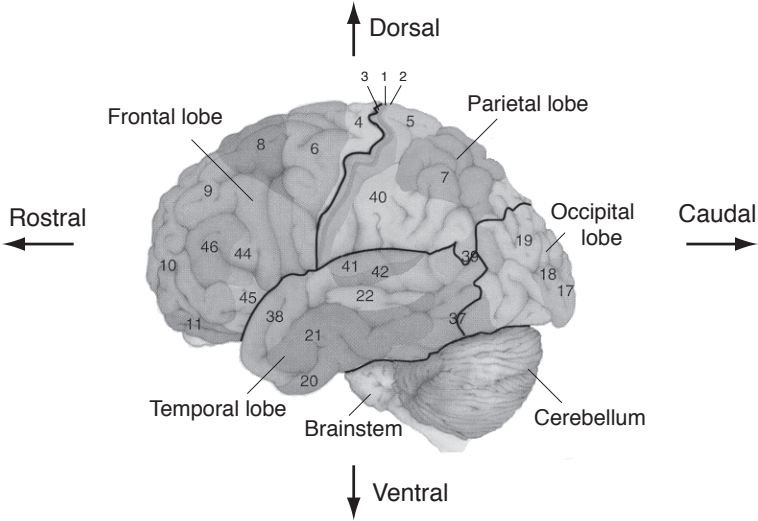


# Fundamentals of Computational Neuroscience 2e

December 27, 2009

Chapter 5: Cortical organizations and simple networks

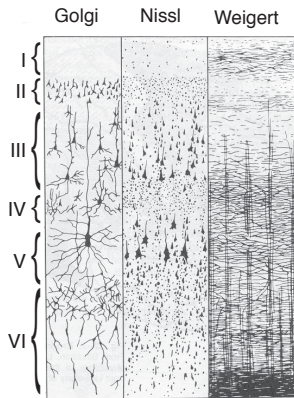
# Brain areas



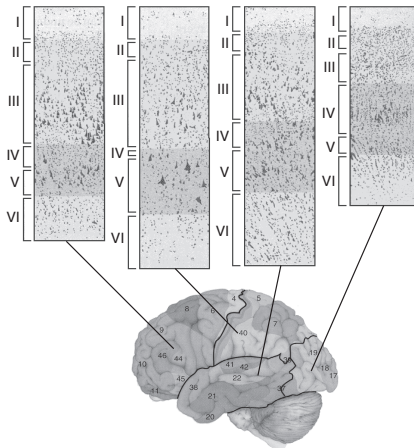


# Layered cortex

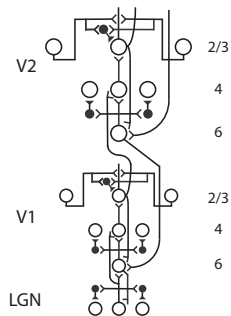
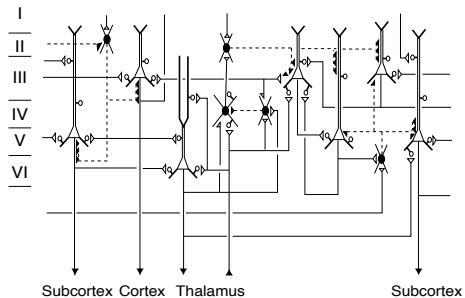
## A. Different staining techniques



## B. Variation in cortex

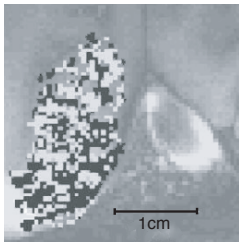


# Layered cortical architecture

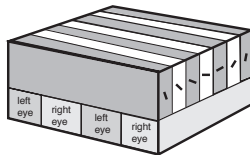


# Cortical maps

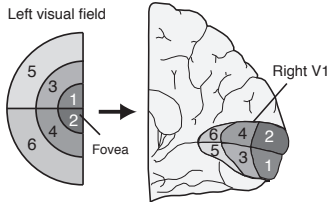
A. Ocular dominance columns



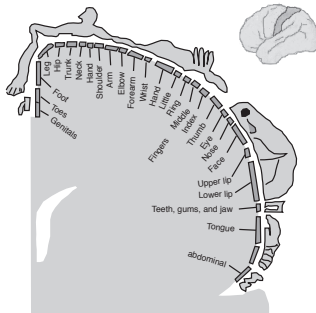
B. Relation between ocular dominance and orientation columns



C. Topographic map of the visual field in primary visual cortex



D. Somatosensory map

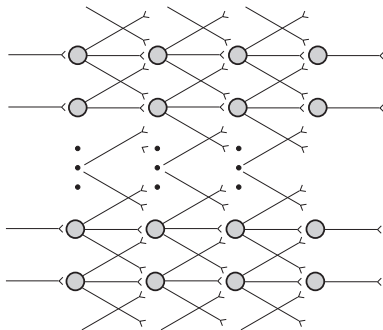


# Neuronal chains

A. Linear chain

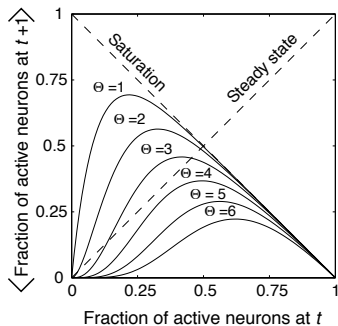


B. Diverging-converging chain

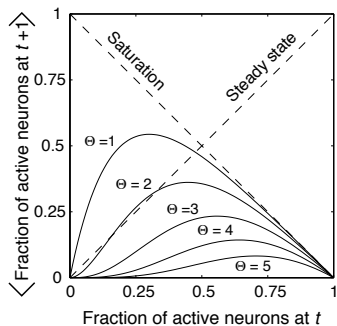


# Netlets

A. Without inhibitory neurons



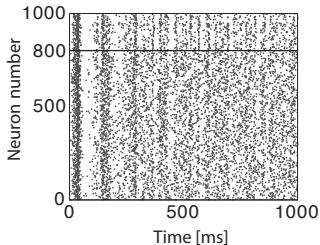
B. With inhibitory neurons



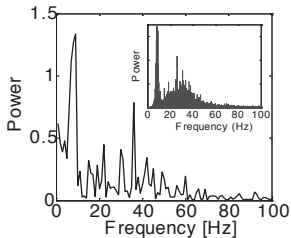


# Random networks with axonal delay

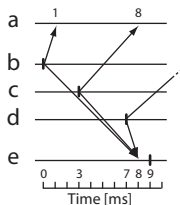
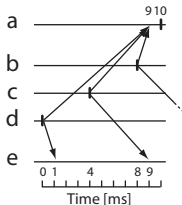
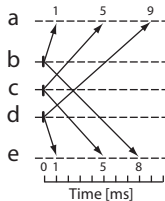
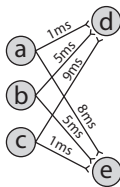
A. Spike trains in random network



B. Power spectrum in random network



C. Spike activation with axonal delay



```

1  % Created by Eugene M. Izhikevich, February 25, 2003
2  % Excitatory neurons      Inhibitory neurons
3  Ne=800;                   Ni=200;
4  re=rand(Ne,1);           ri=rand(Ni,1);
5  a=[0.02*ones(Ne,1);      0.02+0.08*ri];
6  b=[0.2*ones(Ne,1);       0.25-0.05*ri];
7  c=[-65+15*re.^2;         -65*ones(Ni,1)];
8  d=[8-6*re.^2;           2*ones(Ni,1)];
9  S=[0.5*rand(Ne+Ni,Ne), -rand(Ne+Ni,Ni)];
10
11 v=-65*ones(Ne+Ni,1);    % Initial values of v
12 u=b.*v;                  % Initial values of u
13 firings=[];              % spike timings
14
15 for t=1:1000              % simulation of 1000 ms
16     I=[5*randn(Ne,1);2*randn(Ni,1)]; % thalamic input
17     fired=find(v>=30); % indices of spikes
18     if ~isempty(fired)
19         firings=[firings; t+0*fired, fired];
20         v(fired)=c(fired);
21         u(fired)=u(fired)+d(fired);
22         I=I+sum(S(:,fired),2);
23     end;
24     v=v+0.5*(0.04*v.^2+5*v+140-u+I);
25     v=v+0.5*(0.04*v.^2+5*v+140-u+I);
26     u=u+a.*(b.*v-u);
27 end;
28 plot(firings(:,1),firings(:,2),'.');

```

## Further Readings

Edward L. White (1989) **Cortical circuits**, Birkhäuser

Moshe Abeles (1991) **Corticonics: Neural circuits of the cerebral cortex**, Cambridge University Press