COGS 107B

TA: Alexander Johnson
abj009@ucsd.edu

Office Hours: Mondays 1-2pm CSB114
or by appointment
Week 6

Midterm 2 Material so far:
- Neuromodulatory systems
- Spatial navigation/Hippocampus system
- Cerebellum system
- Basal Ganglia system
- Sleep systems

Questions on new material thus far?

Midterm 2 is (2/21/2019, CENTER 115) (Thursday)

Review session Tuesday in lecture - go to this!

Slides will be on the website dnitz.com under the (teaching - 107b) resources tab.
Principles of Re-entry

Hippocampus principle cell  Pyramidal Cell - same as cortex
Cerebellum principle cell  Purkinje Cell
Basal Ganglia principle cell  Medium Spiny Neuron (MSN)
Principles of Re-entry

Each system uses cortical information

Each system ‘updates’ cortical information

What is the ‘lag’ between a strong input and an output for a neuron?

~25ms = 0.025s
Reentrance in Cerebellum

What are the 3 cerebellar nuclei?

Fastigial
Interpositus
Dentate (different from HPC)

You will want to know this for the midterm
How does the inferior olive (error detection) effect purkinje cells & parallel fibers?

“Update model” signal
Basal Ganglia

What are the 2 inputs to Caudate Nucleus & Putamen (Striatum)?

- Cortical input
- SNc DA

Which pathway do D2 neurons contribute to?

- Indirect
Reward Prediction Error

How does Reward Prediction Error involve neurons with the D1 and D2 receptors?

If I expect a reward but don’t get one, what pathway is more active?

How does this impact cortical activity?

Food for thought:
How is Adenylyl Cyclase Involved?

Indirect Pathway
Changes pattern
(similar to the ‘update model’ signal @ different scale)
Sleep

Hypotheses for why we sleep:

Homeostasis & S-Factor
Metabolism & ATP accumulation
Learning & Memory

Impairment of Memory Consolidation During Sleep
How do neuromodulators influence sleep?
<table>
<thead>
<tr>
<th></th>
<th>Waking</th>
<th>NREM</th>
<th>REM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortical EEG / LFP</td>
<td>Fast/low-amp/irregular</td>
<td>Slow-waves/spindles</td>
<td>Fast/low-amp/irregular</td>
</tr>
<tr>
<td>Trunk Muscle Tone</td>
<td>High</td>
<td>Minimal</td>
<td>Absent (paralysis)</td>
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<tr>
<td>Eye Movements</td>
<td>Frequent</td>
<td>None</td>
<td>Frequent</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>High/variable</td>
<td>Low/regular</td>
<td>High/variable</td>
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<tr>
<td>Breathing Rate</td>
<td>High/variable</td>
<td>Low/regular</td>
<td>High/variable</td>
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<tr>
<td>Mentation</td>
<td>Vivid</td>
<td>Minimal / transient</td>
<td>Vivid</td>
</tr>
<tr>
<td>Hippo. LFP</td>
<td>Theta rhythm</td>
<td>Slow-waves</td>
<td>Theta rhythm</td>
</tr>
<tr>
<td>Cortex/Thalamus</td>
<td>Fast/irregular</td>
<td>Slower/burst-pause</td>
<td>Fast/irregular</td>
</tr>
<tr>
<td>ACh Neurons</td>
<td>High Rate</td>
<td>Lowest Rate</td>
<td>Highest Rate</td>
</tr>
<tr>
<td>NE Neurons</td>
<td>High Rate</td>
<td>Very Low Rate</td>
<td>Inactive (REM-off)</td>
</tr>
<tr>
<td>5-HT Neurons</td>
<td>High Rate</td>
<td>Low Rate</td>
<td>Inactive (REM-off)</td>
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<tr>
<td>HA Neurons</td>
<td>High Rate</td>
<td>Very Low Rate</td>
<td>Inactive (REM-off)</td>
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<tr>
<td>DA Neurons</td>
<td>Moderate Rate</td>
<td>Moderate Rate</td>
<td>Moderate Rate</td>
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<tr>
<td>VLPO Neurons</td>
<td>Inactive</td>
<td>Highest Rates</td>
<td>Inactive</td>
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<tr>
<td>REM-on Neurons</td>
<td>Inactive</td>
<td>Inactive</td>
<td>High Rate</td>
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<tr>
<td>Orexin Neurons</td>
<td>High Rate</td>
<td>Low Rate</td>
<td>Low Rate</td>
</tr>
</tbody>
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Sleep and Oscillations

What population-level activity happens to make an ‘oscillation’ in the LFP?

How and why does the LFP change as we get deeper & deeper in sleep?

What change (biological & LFP) happens with REM sleep?
Oscillations we measure come from Thalamus

EEG - Synaptic input to Cortex
NRT - Reticular Formation Neuron Spiking
TC - Thalamic Neuron Spiking

Missing a day of sleep means you will have More/More-Intense sleep the next day?