http://mri.sdsu.edu/sereno/SystNeuro

SDSU Systems Neuroscience 568/768

Professor:
Marty Sereno -- email: msereno@sdsu.edu
class time (2020): MWF 9:00-9:50 AM (grad: F 8:00-8:50 AM)
location (lectures and exams): SSW 2667
office hours: Mon 10-11 or by appt.
expect to take notes, exam mostly based on lecture content

Readings:
readings, lecture videos (links, top of homepage)
background reading (neuroscience reference texts):
Squire, Berg et al., eds. (2008/2013) *Fundamental Neuroscience*, 3rd/4th ed.
Kandel, Jessell, Schwartz, eds. (2008/2012) *Principles of Neural Science*, 5th/6th ed.
Nieuwenhuys, Voogd, van Huijzen (2008) *The Human Central Nervous System*, 4th ed.
background reading (undergrad neuroscience textbooks):
Nicholls et al. (2012) *From Neuron to Brain*, 5th ed.
Bear, Connors, and Paradiso (2006/2015) *Neuroscience: Exploring the Brain*, 3rd/4th ed.

Exams:
multiple question short-answer, each question with a few subsections, examples given in lecture
undergraduate: 2 midterms, final -- short-answer (midterms: 30% each, final: 40%)
graduate: 2 midterms, final (midterms: 24% each, final: 32%), and short final paper (20%)
old pdf answer keys from my similar UCSD Systems Neuroscience course (2007) here and here

Learning Objectives:
Students will be able to do the following:
(1) describe neuronal electrochemistry, development, and relation to simple dendritic, Hebbian, and attractor models
(2) diagram neuroanatomical structures/connections from low to high levels in visual, somatosensory, auditory sensory systems
(3) diagram structures/connections involving superior colliculus, cerebellum, striatum, motor cortex, and limbic systems
(4) analyze sequential processing stages in visual, somatosens., and auditory systems from signals and systems perspective
(5) describe neural models of eye movement planning, hierarchical motor control, and body position and orientation
N.B.: consult with me if a disability hinders your performance so we can use University resources to maximize learning

Lecture Topics: (Spring 2020)

Week of Jan 20 (W) -- Introduction
introduction to course
membrane (Nernst) potential

Week of Jan 27 (MWF) -- Cellular Physiology
action potential, voltage-gated channels
post-synaptic potentials, ligand-gated channels
NMDA channels, synaptic-timing-dependent plasticity

Week of Feb 03 (MWF) -- Relation to Neural Models
dendritic propagation, equivalent circuits
relation to simple Hebbian network models
relation to simple attractor network models

Week of Feb 10 (MWF) -- Neural Development
gastrulation, neural plate, neural tube, optic cup
cylindrical coordinate system, temporal lobe formation
the 'rule of Sereno'

Week of Feb 17 (MWF) -- Visual System I
retinal circuitry and streams
dLGN (layers, non-lagged/lagged)
visual map structure (conformal maps)

Week of Feb 24 (MWF) -- Visual System II
general scheme for cortical layers
edges, brightness, and primary motion in V1
1st midterm review
1st Midterm Exam -- Fri, Feb 28

Week of Mar 02 (MWF) -- Visual System III
aperture problems in general (color intro)
aperture problems for vis. pattern translation, optical flow
visual attention
visual object recognition

Week of Mar 09 (MWF) -- Somatosensory System
somatosensory receptor types
arm diagram (length, force, alpha/gamma motoneurons)
pathways (dorsal column, spinothalamic, spinocerebellar)
somatosensory cortical areas
somatosensory cortical plasticity

Week of Mar 16 (MWF) -- Auditory System I
auditory transduction and hair cell receptors
monaural cochlear nuclei responses

Week of Mar 23 (MWF) -- Auditory System II
auditory brainstem sound localization
echolocation and speech sound processing
auditory cortical areas

Week of Mar 30 -- SPRING BREAK

Week of Apr 06 (MWF) -- Motor System I
gaze stabilization (VOR, OKN, pursuit)
superior colliculus retinal and motor maps
sensorimotor coord transforms (double-step memory saccade)
multisensory map interactions -- sup. collic visual/auditory
multisensory map interactions -- VIP somatosensory/visual

Week of Apr 13 (MWF) -- Motor System II
motor system overview
cortical and spinal pattern generators
motor cortex
2nd midterm review
2nd Midterm Exam -- Fri, Apr 17

Week of Apr 20 (MWF) -- Motor System III
cerebellum anatomy, physiology
cerebellum and learning/conditioning connectional overview
connectional/functional overview striatum
striatum and hierarchical sequencing

Week of Apr 27 (MWF)-- Limbic System
connectional overview limbic system
H.M. and intermediate term memory vs. inertial guidance
place cells
head direction cells
grid cells
models: theta rhythms, attractor networks

Week of May 04 (MW) -- Neuroimaging EEG/MEG
hardware, spin vs. precession, Bloch equation
spin echo and gradient echo
phase-sensitive detection, intro to complex numbers,
frequency-encoding -- incorrect and correct intuitions
signal-to-noise
neural source of EEG/MEG signals
current source density, linear forward solution
course review

May 11 -- Final Exam 8-10 AM
Graduate students: final paper due May 14