SDSU Systems Neuroscience

Professor:
Marty Sereno -- email: msereno@sdsu.edu

class time (2017): Mon 9:00-9:50 AM
location1: 1st class, exams only: LSS 356
location2: lectures: SSW 2667 (overflow: SSW 2649)
expect to take copious notes
exam mostly based on lecture content

Readings:
readings, lecture videos (links, top of homepage)
background reading (neuroscience reference texts):
background reading (undergrad neuroscience textbooks):

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 and explain neuronal chemistry, electronics, development, and evolution
(2) describe and diagram neuroanatomical structures and their connections in visual, somatosensory, auditory, motor, limbic systems
(3) describe and analyze sequential processing stages in visual, somatosensory, auditory, motor, limbic systems from a signals and systems perspective
N.B.: consult with me if a disability hinders your performance so we can use University resources to maximize learning

Lecture Topics: (Spring 2017)

Week of Jan 16 (WF) -- Introduction
introduction to course
membrane (Nernst) potential

Week of Jan 23 (MWF) -- Cellular Physiology
action potential, voltage-gated channels
post-synaptic potentials, ligand-gated channels
dendritic propagation, equivalent circuits

Week of Jan 30 (MWF) -- Relation to Neural Models
NMDA channels, synaptic plasticity
spike-timing-dependent plasticity
[no class: Wed Feb 01]
relation to simple Hebbian and attractor network models

Week of Feb 06 (MWF) -- Neural Development
gastrulation, neural plate, neural tube, optic cup
cylindrical coordinate system, temporal lobe formation
the 'rule of Sereno'

Week of Feb 13 (MWF) -- Visual System I
retinal circuitry and streams
dlGN (layers, non-lagged/lagged)
general scheme for cortical layers
visual map structure (conformal maps)
edges, brightness, and primary motion in V1
Gabor filter energy model

Week of Feb 20 (MWF) -- Visual System II
aperture problems in general (color intro)
aperture problems for vis. pattern translation, optical flow
visual attention
visual object recognition
1st Midterm Exam

Week of Feb 27 (MWF) -- Somatosensory System I
somatosensory receptors types
arm diagram (length, force, alpha/gamma motoneurons)
pathways (dorsal column, spinothalamic, spinocerebellar)

Week of Mar 06 (MWF) -- Somatosensory System II
somatosensory cortical areas
somatosensory cortical plasticity

Week of Mar 13 (MWF) -- Auditory System I
auditory transduction and hair cell receptors
monaural cochlear nuclei responses

Week of Mar 20 (MWF) -- Auditory System II
auditory brainstem sound localization
echolocation and speech sound processing
auditory cortical areas

Week of Mar 27 -- SPRING BREAK

Week of Apr 03 (MWF) -- Motor System I
gaze stabilization (VOR, OKN, pursuit)
superior colliculus retinal and motor maps
sensorimotor coord transforms (double-step memory saccade)

Week of Apr 10 (MWF) -- Motor System II
cerebellum anatomy, physiology
cerebellum and learning/conditioning
cortical and spinal pattern generators
connectional-functional overview striatum
2nd Midterm Exam

Week of Apr 17 (MWF) -- Limbic System
collection overview limbic system
H.M. and intermediate term memory
place cells
head direction cells
grid cells
models theta rhythms, attractor networks

Week of Apr 24 (MWF) -- Neuroimaging MRI
hardware, spin vs. precession
Bloch equation
spin echo and gradient echo
phase-sensitive detection
frequency-encoding -- incorrect and correct intuitions
spin phase in image space
intro to complex numbers, e to the i*phi, Fourier transform
slice selection and phase encoding
FLASH and EPI
signal-to-noise

Week of May 01 (MWF) -- Neuroimaging EEG/MEG
neural source of signals
current source density
linear forward solution
linear inverse vs. dipole fitting
course review

May 05-11 -- Final Exams
Graduate students: final paper due May 11