SDSU Systems Neuroscience 568/768

Professor:
Marty Sereno -- email: msereno@sdsu.edu
class time (2022): MWF 9:00-9:50 AM (opt.: F 8:00-8:50 AM)
Learning Glass lecture recording location: SSW 2667
office hours: Mon 10-11 or by appt.

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

Exams:
multiple question short-answer, each question with several subsections, test pdf link posted at 9 AM on exam day
day morning, email pics of filled-in exam pages by 11 AM
2 midterms, final (midterms: 24% each, final: 32%), and short final paper (20%)
old pdf answer keys from my similar UCSD Systems Neuroscience course 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 2022)
Week of Jan 17 (WF) -- Introduction [Mon: no class]
introduction to course membrane (Nernst) potential
Week of Jan 24 (MWF) -- Cellular Physiology
action potential, voltage-gated channels
post-synaptic potentials, ligand-gated channels
NMDA channels, synaptic-timing-dependent plasticity
Week of Jan 31 (MWF) -- Relation to Neural Models
dendritic propagation, equivalent circuits relation to simple Hebbian network models relation to simple attractor network models
Week of Feb 07 (MW) -- Neural Development
gastrulation, neural plate, neural tube, optic cup cylindrical coordinate system, temporal lobe formation the 'rule of Sereno'
Week of Feb 14 (MWF) -- Visual System I
retinal circuitry and streams dLGN (layers, non-lagged/lagged)
visual map structure (conformal maps)
Week of Feb 21 (MWF) -- Visual System II
general scheme for cortical layers edges, brightness, and primary motion in V1
1st midterm review
1st Midterm Exam -- Fri, Feb 25
Week of Feb 28 (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 07 (WF) -- Somatosensory System [Mon: no class]
somatosensory receptor types
arm diagram (length, force, alpha/gamma motoneurons) pathways (dorsal column, spinotrichalamic, spinocerebellar)
Week of Mar 14 (MWF) -- Auditory System I
somatosensory cortical areas
somatosensory cortical plasticity auditory transduction and hair cell receptors, cochlear transduction
Week of Mar 21 (MWF) -- Auditory System II
monaural cochlear nuclei responses auditory brainstem sound localization, construction of space map
Week of Mar 28 (MF) -- Finish Auditory, Motor System I
echolocation and speech sound processing auditory cortical areas [Wed: no class] gaze stabilization (VOR, OKN, pursuit)
Week of Apr 04 (MWF) -- Motor System I
superior colliculus retinal and motor maps sensorimotor coord transforms (double-step memory saccade)
multisensory map interactions -- sup. collic visual/auditory multisensory map interactions -- VLP somatosensory/visual
Week of Apr 11 (MWF) -- Motor System II
motor system overview
cortical and spinal pattern generators motor cortex
2nd midterm review
2nd Midterm Exam -- Fri, Apr 15
Week of Apr 18 (MWF) -- Motor System III
cerebellum anatomy, physiology
cerebellum and learning/conditioning connectional overview connectional/functional overview striatum striatum and hierarchical sequencing
Week of Apr 25 (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 02 (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 09 -- Final Exam 8-10 AM
Graduate students: final paper due May 13