The final exam will focus on the material we’ve covered since the second midterm and the overarching class themes covered in the final lecture. There will be a few questions specific to material covered before the second midterm. The material I expect you to know are listed on this study guide. The exam will be a mixture of multiple choice, fill-in-the-blank, and short answer questions. You will not be able to use any external sources of information during the exam (e.g., books or notes). You will need to bring a Scantron Form Number: X-101864-PAR-L (the same scantron form we’ve used for all the exams) and a #2 pencil. The format will be very similar to the midterms but there will be more multiple choice questions. Some sample short answer questions are posted on the course calendar. A good way to study for the exam is to answer the Lecture Guide questions and the Test Yourself questions in the course textbook (e.g., pg 90).

The lists of important concepts, phenomena, and methods below should guide your studying:

**Attention, Audition, and the Cutaneous Senses**

You should be able to explain, to give examples of, and/or to apply the following:

**VISUAL ATTENTION**
- Saccade
- Fixation
- Covert attention
- Factors that affect fixation patterns (e.g., stimulus salience, task demands)
- Inattentional blindness
- Change blindness
- Change blindness blindness
- Evidence that perception is possible without attention
- The Posner paradigm for studying attention (i.e., precueing)
- Evidence from having people watch films in an MRI scanner as to the degree that bottom-up cues can greatly control our attention and experience.
- The binding problem
- Treisman’s feature integration theory
- Illusory conjunctions
- Conjunction search
- Balint’s syndrome & the role of parietal cortex in perceptual binding
- The possible role of neural synchrony in perceptual binding
- Effects of attention on perception (reaction time, perceived contrast)
- Effects of attention on neural activity (esp. at different levels of the cortical hierarchy)
**AUDITION: Physical and Mental Dimensions, Localization, & Speech Perception**

What the frequency spectrum of a sound wave is
The relationship between sound wave amplitude (physical intensity) and loudness (perceived intensity) and how this depends on the sound wave frequency
How to interpret decibels
The relationship between sound wave frequency and the perception of pitch.
Tone chroma
The relationship between perceived timbre and harmonics, sound wave attack and delay.
The spherical coordinate system used to characterize auditory localization (i.e., elevation, azimuth, & distance)
Why auditory localization is hard
Binaural auditory localization cues (ITD & ILD)
Monaural auditory localization cues (HRTFs)
Auditory localization plasticity
Why auditory scene analysis is hard
Auditory scene analysis heuristics (e.g., location, similarity of timbre and pitch)
Phonemes (what they are and how they are produced)
Spectrograms (what they are)
Formants, formant transitions, and how they correspond to difference phonemes
Why speech perception is hard (e.g., the segmentation problem, the variability problem)
Effects of phonemic, lexical, sentence, & discourse context on speech perception and/or production
Categorical perception (what it is and evidence that phonemes are perceived categorically)
Examples of vision affecting auditory perception
Examples of audition affecting visual perception
Note: you do NOT need to know the material in the section on “Hearing Inside Rooms” or “Cochlear Implants” (though both or most definitely worth reading about)

**AUDITION: Physiology**
Function of the outer ear
Function of the middle ear
Inner hair cell function
Outer hair cell function
Bekesy’s place theory of hearing (and evidence for it)
How sound wave frequency is encoded by the timing of action potentials in the auditory nerve
The pathway of auditory information from the auditory nerve to primary auditory cortex (cochlear nucleus, superior olivary nucleus, inferior colliculus, medial geniculate nucleus)
The function and organization of A1, Core, Belt, & Parabelt auditory cortical areas
Evidence that auditory cortical areas are quite sensitive to experience (i.e., plastic)
Evidence for auditory what and where pathways
Evidence for a “central pitch processor”
Motor theory of speech perception (and evidence supporting it)
Topographic maps of auditory space (where they are and aren’t)
Panoramic neurons

**CUTANEOUS SENSES:**
Different response properties and functions of the following cutaneous receptors
- Merkel (SA1) mechanoreceptors
- Meissner (RA1) mechanoreceptors
- Ruffini (SA2) mechanoreceptors
- Pacinian (RA2) mechanoreceptors

Touch pathway to cerebral cortex
Somatosensory cortical areas (S1, S2, and other parts of the parietal lobe)
Somatotopic organization & plasticity
Different types of receptive fields of somatosensory thalamic and cortical neurons
Effect of attention on cortical somatosensory neurons
The utility of haptic exploration
Why tactile acuity differs across the body

**Commonalities Across the Senses**
You should be able to explain, to give examples of, and/or to apply the following:

Specific examples of general reasons why perception is a hard problem: ambiguity, misleading superficial similarities/differences, and sensory noise
Specific examples of how the brain deals with these perceptual problems (e.g., Helmholtz’s theory of unconscious inference)
The difference between top down and bottom up perceptual factors
Examples of how perception is an interactive process between the body and the sensory world and why this is useful for perception.
The position of the thalamus in sensory pathways
What it means to say that cerebral cortical areas are hierarchically organized (e.g., differences in receptive field structures as you go up the hierarchy)
Examples of neural “maps” in different sensory systems.
An effect of attention on cortical neurons
Examples of neural adaptation and the utility of adaptation
Marr’s levels of analysis
Examples of how studying cognition at the functional level can help to inform our understanding of how cognition is implemented by the nervous system and vice versa
Examples of the following different types of neural codes: frequency (rate) code, temporal code, spatial code, distributed code, specificity code
How perception might involve “analysis by synthesis”
What the following measures of brain function actually measure and what their pros and cons are: PET, fMRI, EEG/ERP, single neuron recording, optical imaging
What the following methods for manipulation brain function are and what their pros and cons are: lesioning (ablation), microstimulation, transcranial magnetic stimulation
Material from the First Midterm

You should be able to explain, to give examples of, and/or to apply the following:
Weber’s law and Steven’s power law
Different types of receptive fields in the visual system
Gestalt perceptual grouping heuristics
Figure and ground in images
Lateral inhibition
Cross-modal plasticity
Critical period
Helmholtz’s theory of unconscious inference

Material from the Second Midterm

You should be able to explain, to give examples of, and/or to apply the following:
Continuous vs. categorical perception of lightness vs. color
Cortical area MT and evidence that is involved in motion perception
Cortical area MST and evidence that it is involved in optic flow perception
Movement aftereffects and how motion perception is a vector sum of a distributed neural code
Emmert’s law and evidence supporting it
How action can facilitate perception
Affordances