- Introduction
  - What, how , and why?
- Basics of Signal Processing
  - Several approaches to signal processing of cognitive signals
  - Harmonic signals
  - Principle of Fourier analysis
  - Getting coefficients of Fourier series
  - Magnitude and phase spectrum
  - Sampling theorem
  - Discrete Fourier transform
  - Digital-to-analog conversion
  - Quantization
  - Fourier integral
  - Modifying spectrum
  - Principle of filtering
  - Frequency response
  - Linear and nonlinear systems
  - Spectrum of pulses
  - Impulse response
  - Spectrum of finite length signals
  - Effect of time windows
  - Time-frequency compromise
  - Principle of short-term Fourier transform
  - Spectrogram
  - Short-term Fourier transform as a bank of band-pass filters
- Physiology of hearing
  - Outer, middle, and inner ear
  - Cochlea as a frequency analyzer
  - Nerve firing
  - Acoustic inputs and firing rates on auditory nerve
  - Enhancement of temporal changes
  - Two-tone suppression
  - Neural tuning curves
  - Place theory of hearing
  - Effect of sound intensity on tuning curves
  - Synchrony of firing in auditory nerve
  - Neural responses in higher stages (nucleus, cortex)
  - Principle of reverse correlation technique
  - Time-frequency receptive fields
- Physiology of vision
  - Pinhole vision, compound eyes, human eye
  - Lateral inhibition in vision
  - Visual receptive fields
  - Human retina
  - Rods and cones
  - Physiology of color vision
  - Receptive fields in visual cortex
- Introduction to psychophysics
  - Detection and discrimination,
    - Receiver operating curve

- Just noticeable difference
- Weber's law
- Information
  - Prior and posterior probability
  - Measuring the information
  - Information rates
- Recognition
  - Effect of number of categories to be recognized
  - Capacity of human channel (magic number)
- Scaling
  - Power law of human perception

Psychophysics of hearing

- Threshold of hearing
- Signal integration at the threshold of hearing,
  - critical interval and critical bandwidth
- Frequency masking
  - psychophysical tuning curves
  - masking by bandlimited noise
  - masking by modulated noise
- Masking in time (temporal masking)
- Perception of loudness
  - JND in loudness (Weber's law)
  - Loudness and duration
  - Equal loudness curves
  - Loudness of complex sounds (more than one tone)
- Perception of frequency
  - JND in frequency (Weber's law)
  - JND in frequency and stimulus length
- Temporal resolution of hearing
  - Clicks
  - Temporal order
  - Perception of gaps in noise and in tones
- Perception of modulations
  - Modulation spectrum of speech
  - Perception of rhythm in speech

Some concepts from psychophysics of vision and similarities of vision with hearing

- Perception of contrast (Weber's law in vision)
- Brightness
- Adaptation in vision
- Sensitivity to various wavelengths of light
- Threshold of visual perception (temporal and spatial integration of stimuli)
- Relative brightnes
- Sensitivity to spatial frequencies
- Sensitivity to temporal modulations
- Color matching
- Afterimages

Applications (extracurricular – do not have to know)