This course provides a brief introduction to the principles of speech processing. We review the following basic elements: Information theory, ARMA systems, Hidden Markov models, Fourier analysis, energy, autocorrelation, linear predictive methods, source separation, and speech recognition. The course project assignments require programming in Matlab, C++, or Java.

**Information Theory**
- Nonparametric methods for entropy and mutual information estimation.
- Kernel Mutual Information, Kernel Generalized Variance, Kernel Canonical Correlation Analysis.

**Stochastic Process**
- AR, MA, ARMA systems.
- Linear dynamical systems.
- Expectation maximization. Maximum likelihood parameter estimation.
- System identification with subspace methods.

**Frequency domain**
- Fourier transformation.
- Wavelets.
- Discrete cosine transformation.
- Z transformation.
- Spectrogram, spectrum, cepstrum.
- Sampling theory.
- Denoising.

**Linear filters**
- Infinite impulse response filters.
- Finite impulse response filters.

**Source Separation**
- Principal component analysis.
- The cocktail party problem.
- Independent Component Analysis: FastICA, Jade, Radical algorithms.
- ICA extensions: post-nonlinear ICA, ICA on AR processes.
- Blind source deconvolution. Blind Subspace Deconvolution.
- One-microphone source separation.

**Speech Analysis**
- Linear predictive coding.
- Pitch detection.

**Speech Recognition**
- Hidden Markov models.
- Dynamic time warping.