Digital Signal Processing Applications

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Days (2 Lec.)	**Contents**	Application
1	Application domains of Digital Signal Processing	
2	Basics of pattern recognition	- Basic pattern recognition system - Simple OCR and Speech recognition systems (assignment)
3-4	Speech, image, and video signals and raw file formats Sample-by-sample processing (image: brightening, darkening – inversion - log transformation – image addition, subtraction – histogram) Time-spatial processing (audio: filtering with standard low pass and high pass filters, image: smoothing and edge detection filters)	(MATLAB/octave) Reading a *.wav file – parts of the file fields – raw speech signal – amplification of the signal – reading a *.bmp file- checking the values of the matrix – conversion from RGB to gray level and BW- increasing brightness and darkness of an image – video as a sequence of images – fast forward through frames removal Audio: filtering using standard low and high pass filters Image: filtering using smoothing filters, sharpening filters, edge detection, noise filtering)
5-6	Pattern recognition basics, Clustering	-Multi-dimensional Gaussian distribution and its use in Pattern Recognition. - Principal Component Analysis, example, Face recognition - Dynamic Time Warping - Clustering techniques - Course Project description
7	2D Spectrum Discrete Cosine Transform	(MATLAB) 2D spectrum – an image with a tone in a certain direction – Basis functions in 2D Basics of 1D-DCT, why it is suitable for compression – DCT basis functions – DCT from DFT

		(MATLAB) 2D DCT – 2D basis functions
8	Lossless compression (Huffman coding, run length coding, concept of entropy) - MFCC filter banks	Assignment on lossless compression
9	Image, video compression	Image Compression: JPEG Video Compression: H.261 and MPEG
10	Speech coding (if time permits)- waveform based coders, LPCs, LPC-10	

Tools to be used: MATLAB/octave, Audacity, GIMP