IT-JIM
signal and image processing

It-Jim Summer Internship on Computer Vision 2020: Course Program

Classical Computer Vision			
Week 1: Image Processing and Understanding	**Lecture:** What is Image? Image Representations • Pixels and Intensities • Color spaces • Histogram, histqe, CLAHE Image Processing • Filtering (blur, bilateral) • Image gradients • Thresholding (global, adaptive, Otsu) • Morphological operations	**Workshop:** • OpenCV basics • python, libs • image/video input • channels separation • colorspaces • thresholding • filtering • morphology	**Homework:** • color figures segmentation
Week 2:	**Lecture:** Features: Part I • Corners and Edges	**Workshop:** • Contours • Template matching	**Homework:** • color figures detection and classification

Feature extraction and matching	• Contour detection • Template matching • Local keypoints: detection & description. Scale and rotation invariance. • SIFT, SURF • Toward real-time: FAST & ORB • Binary description: ORB, A-KAZE • Descriptors matching • Hist matching • 3D reconstruction example	• Histogram matching	• symbols detection on a plan

Week 3:
Detection and Tracking
	Lecture:
	• Homography and RANSAC
	• Intrinsic and Extrinsic
	• Camera calibration
	• Planar object detection and augmentation
	• Tracking:
	  ○ Optical Flow
	  ○ Template-based
		Workshop:
		• Image stitching
		• Sparse and dense optical flow
			Homework:
			• Tracking by detection
			• Tracking by OF

	○ Tracking-by-detection		
Week 4: Feature crafting for CV problems	**Lecture:** ● image retrieval ● BoW, clustering and local features ● HoG for pedestrian detection ● LBP, GLCM for texture recognition ● Haar for face detection ● histogram matching for human tracking ● d-Nets for image matching ● ER, MSER for text detection ● Bag-of-Words	**Workshop:** ● Feature extraction ● pattern detection ● FFT matcher	**Homework:** ● Image retrieval with feature extraction on a part of Mini-ImageNet
Machine Learning and Deep Learning in Computer Vision			
Week 5: Introduction to Machine Learning	**Lecture:** ● Machine learning: how does that work ● Types of ML	**Workshop:** ● Custom superpixels	**Homework:** ● Image classification using ML methods

	• Supervised learning(Regression, Classification) • Unsupervised learning (Clustering, Dimensionality reduction)	segmentation by clusterization • MNIST classification with a few ML algorithms	on a part of Mini-ImageNet

Week 6:
Introduction to neural networks
	Lecture:
	• Neural networks
	  ○ key concepts
	  ○ neuron model
	  ○ backpropagation and gradient descend
	• Convolutional NNs
	  ○ Appearance of CNNs
	  ○ Feature extraction explanation
		Workshop:
		• MNIST classification with NN and CNN
			Homework:
			• Image classification using NN and CNN on a part of Mini-ImageNet

Week 7: DL in CV: Part 1	**Lecture:** • Evolution of architectures ○ key architectural improvements since AlexNet • More types of convolutional layers	**Workshop:** • Implementation of main architectural blocks of popular modern CNNs	**Homework:** • transfer learning on rotated MNIST

	○ transposed, deformable, dilated, separable ● Overfitting problem ○ Data augmentation ○ Regularization techniques	● batch normalization ● augmentations.	
Week 8: DL in CV: Part 2	**Lecture:** Overview of architecture types based on tasks • Image classification • Object detection • Semantic segmentation • Object tracking • Autoencoders • Generative adversarial networks (GANs)	**Workshop:** ● Overview of Deeplab v3+ and YOLO v3 architectures	**Homework:** ● Ball detection on table football videos (segmentation CNN) ● Denoising autoencoder on MNIST