

# Data-Centric Engineering: Computer Vision and Pattern Recognition

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(CVPRL)**

Department of Computational Engineering  
School of Engineering Science

**Finnish CoE in Inverse Modeling and Imaging**

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<http://www2.it.lut.fi/cvprl/>



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SOUTH-EAST FINLAND - RUSSIA

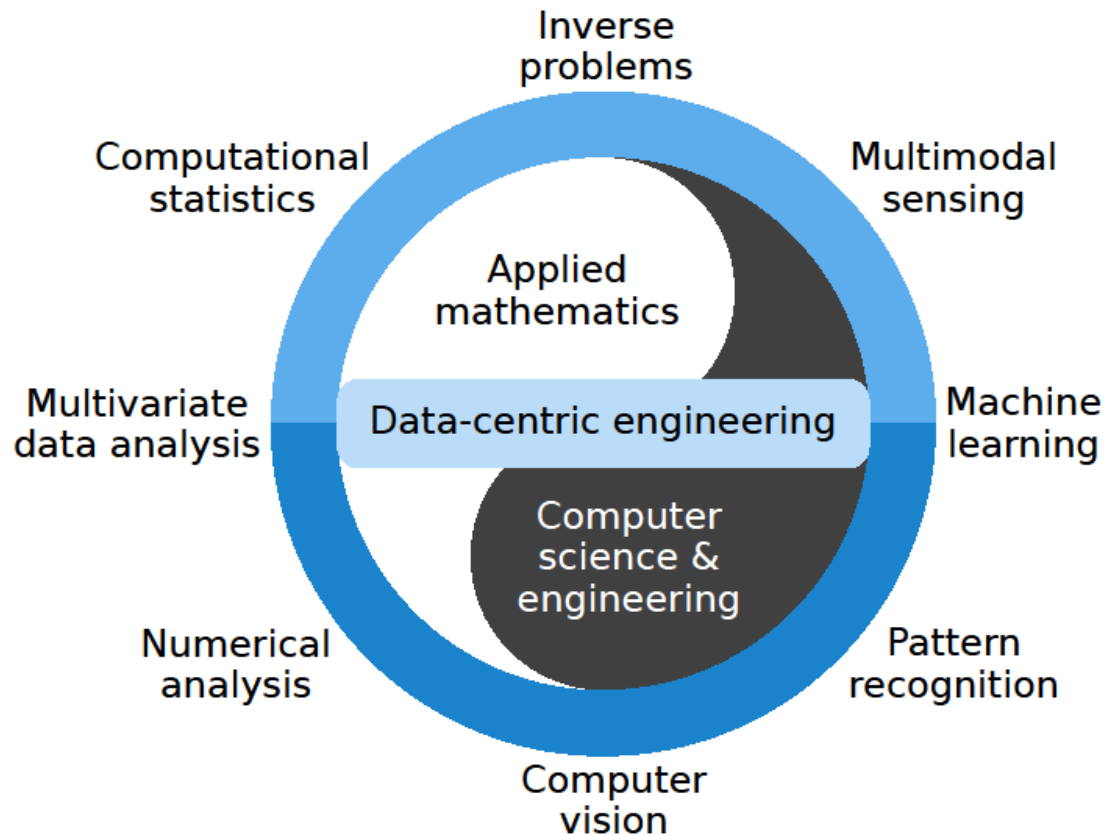
# Where is LUT and Lappeenranta?



Information: <https://www.lut.fi/>



# Computational Engineering: Data-Centric Engineering



<https://www.lut.fi/web/en/admissions/apply-to-lut/double-degree-studies/masters-programmes>

<https://www.lut.fi/web/en/admissions/masters-studies/msc-in-technology/computational-engineering/data-centric-engineering>

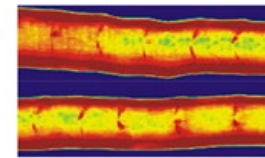
# CVPRL: research projects at LUT

## Computer Vision and Pattern Recognition Laboratory:

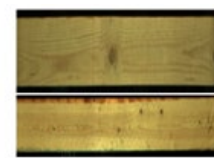
Applications of Computer Vision,  
Digital Image Processing and Analysis,  
Data Analytics.



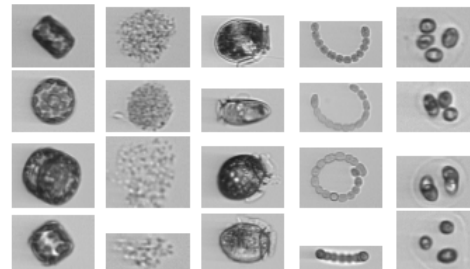
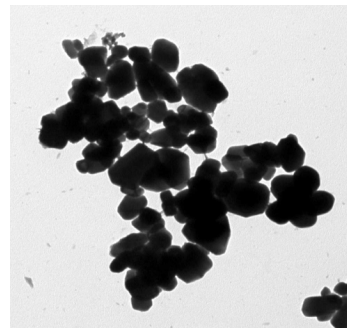
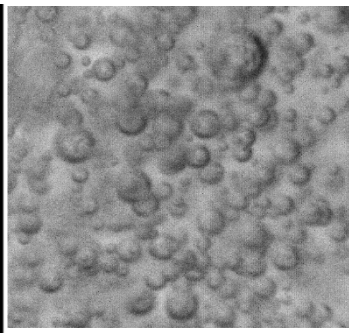
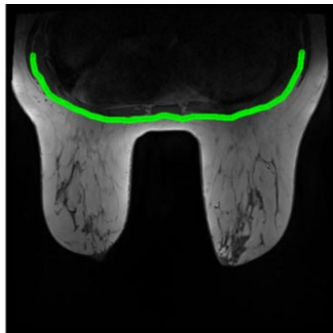
Laser scan (log surface)



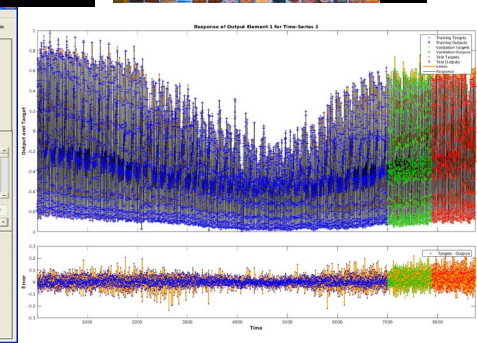
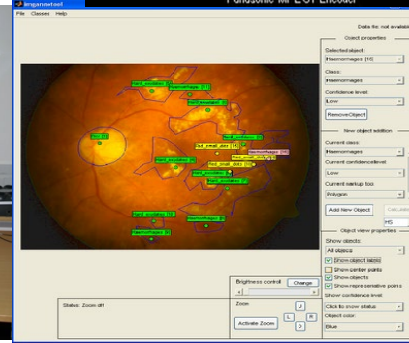
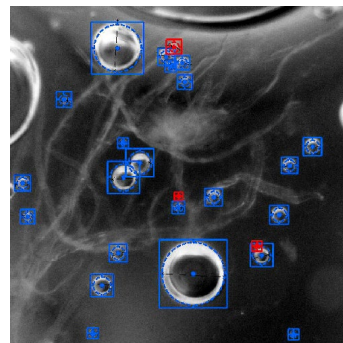
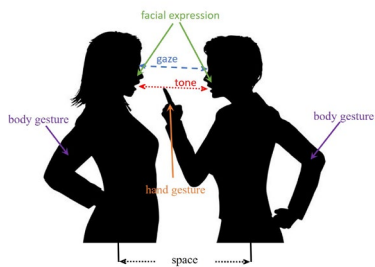
X-ray images (log)



RGB image (sawn timber)



Panasonic MPEG1 Encoder



# Medical Image Analysis: Diagnosis of Diabetic Retinopathy

Prof. Lasse Lensu et al.

**IMAGERET/REVISION:**  
Kuomed, Mawell, Perimetria, Santen  
Tekes, Academy of Finland,  
LUT, UEF, Tampere U,  
Birmingham U, Bristol U,  
Czech TU, UC at Berkeley

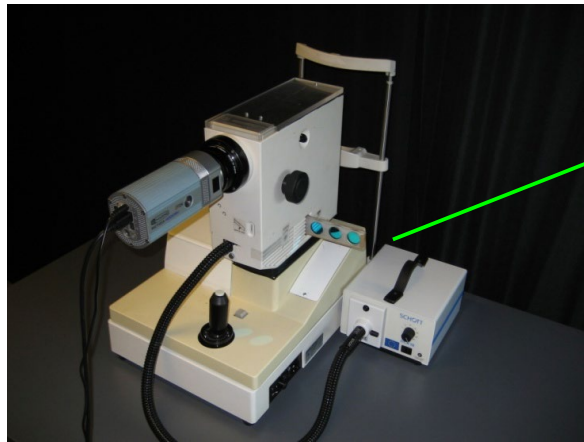
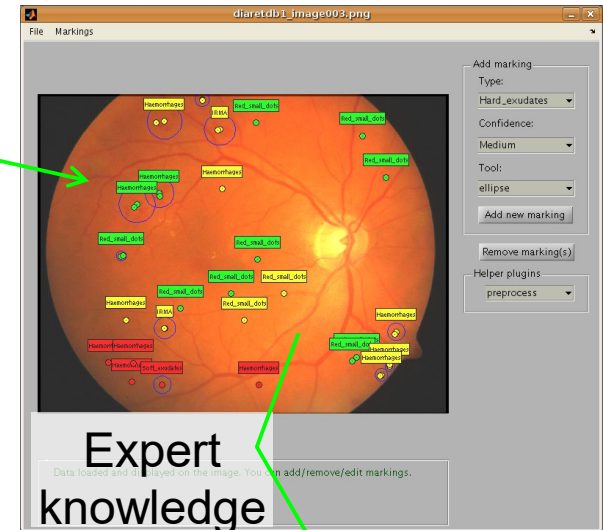
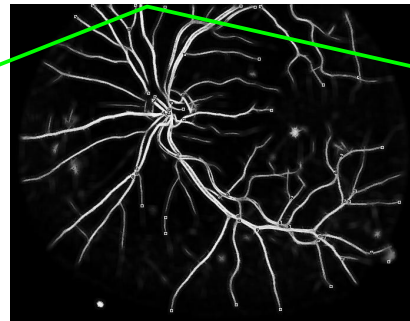
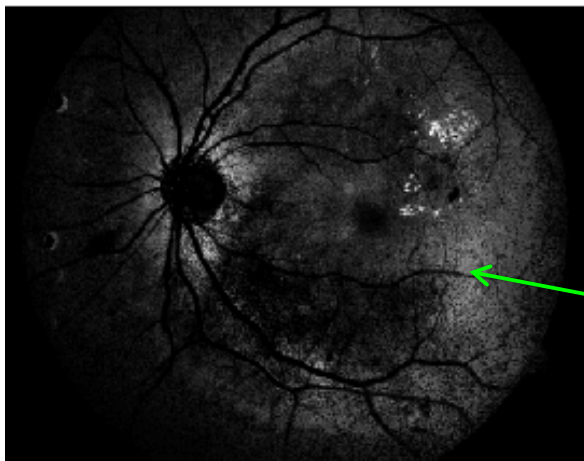


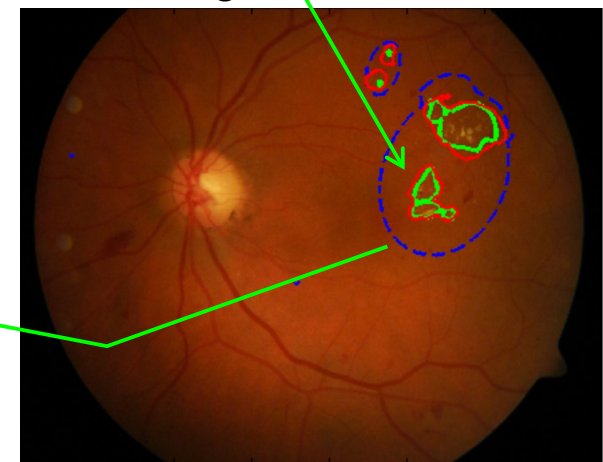
Image  
pre-processing



Expert  
knowledge

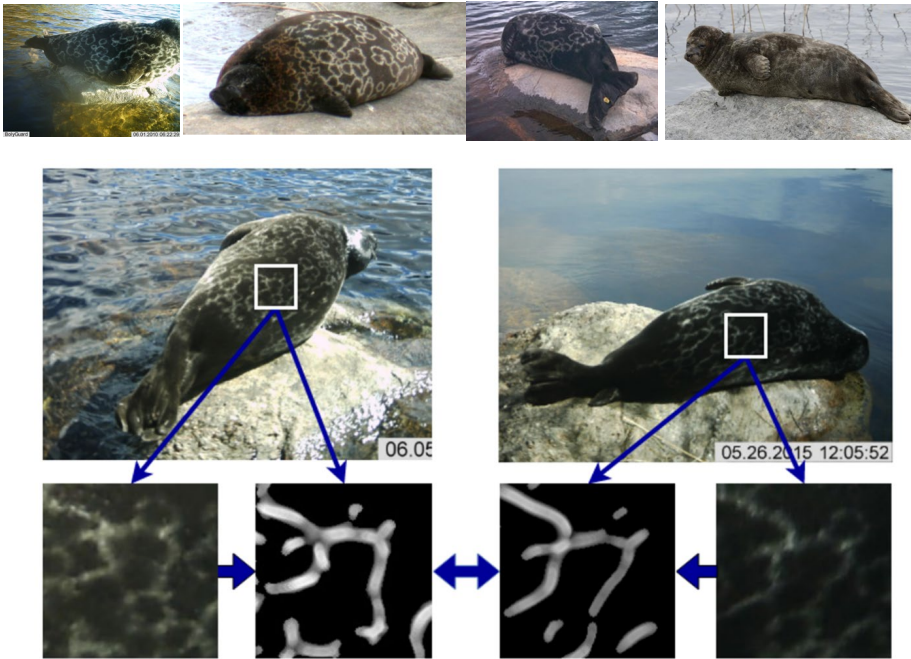


Statistical  
modeling of  
image  
information



# CoExist&SealVision: Could you help me by recognizing me?

Prof. Heikki Kälviäinen et al.



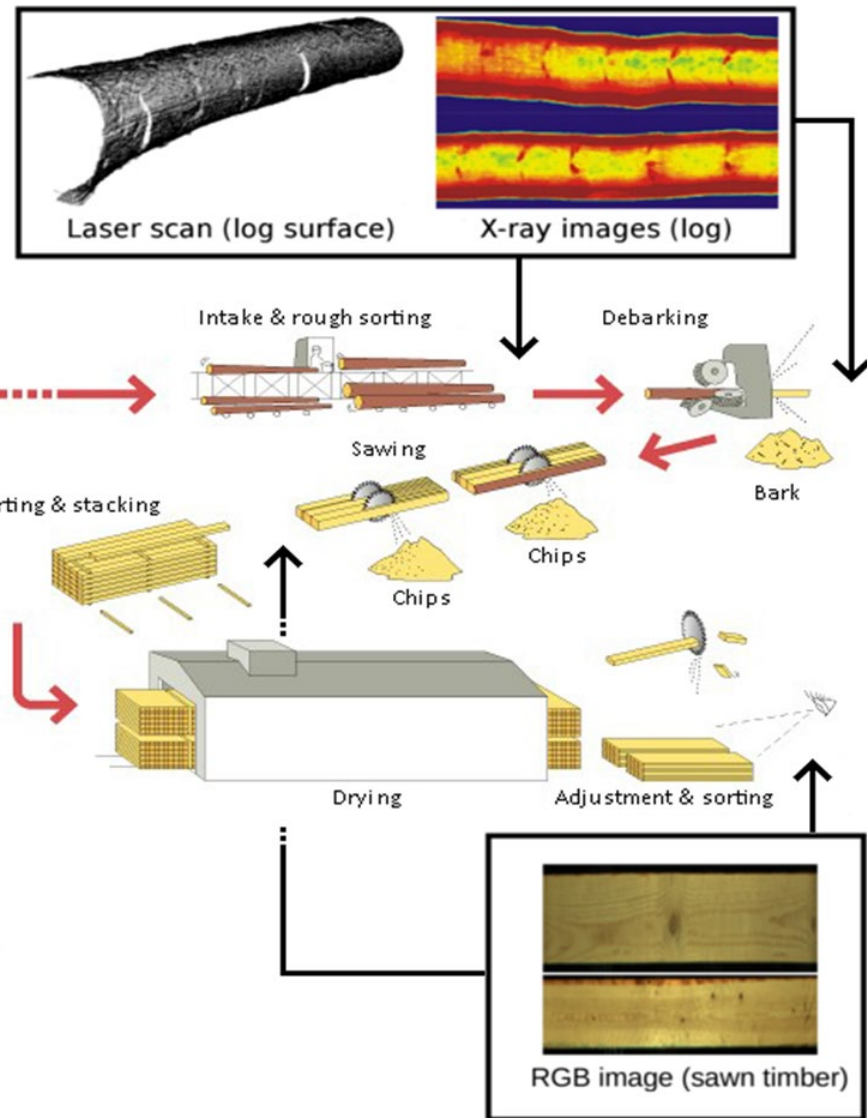
Nepovinnykh, E., Eerola, T., Kälviäinen, H., Siamese Network Based Pelage Pattern Matching for Ringed Seal Re-identification, *WACV, Workshop*, 2020.

Only around 450 Saimaa ringed seals (“saimaannorppa” in Finnish) left in Lake Saimaa.

Detection and identification of **individual Saimaa ringed seals** based on the **fur pattern** using computer vision and machine learning for conservation of nature.

“Biometric passport” for seals (wild life photo ID).

Cooperation with biologists: UEF, Finland & BFNC, Russia (Lagoda ringed seals).



# DigiSaw: Leap of Digitalization for the Sawmill Industry

- Optimized sawing.
- Quality prediction of the end product from raw material.
- More efficient sorting of logs and sorting of the end products.

<http://www2.it.lut.fi/project/digisaw/>

FINNOS

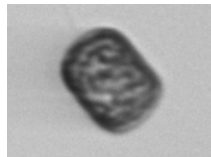
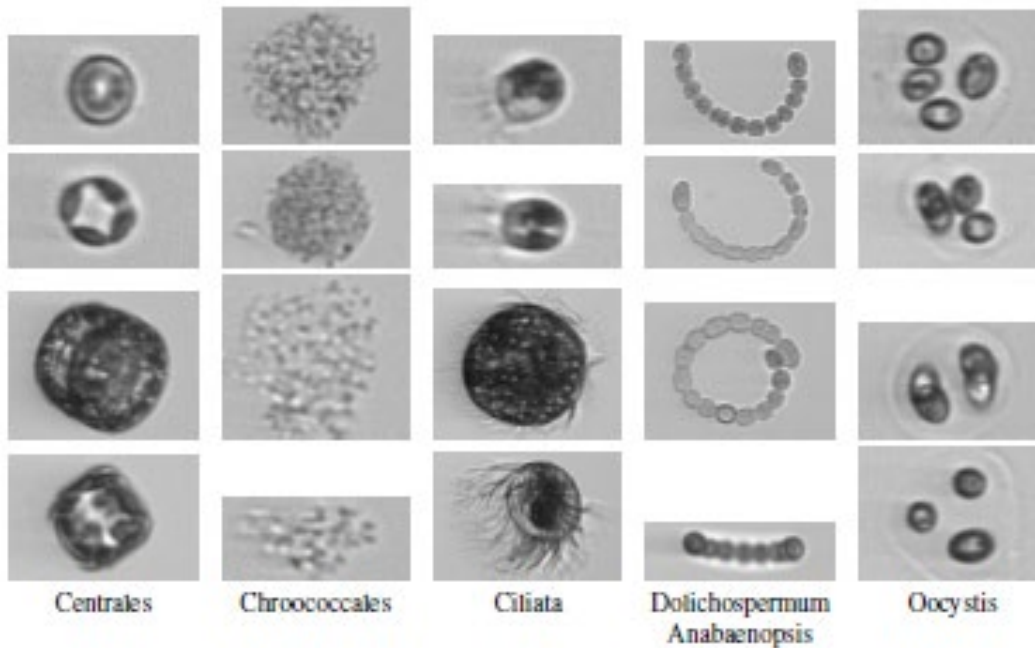
FinScan



BUSINESS  
FINLAND

# Plankton recognition from imaging flow cytometer data using convolutional neural networks

Prof. H. Kälviäinen, L. Lensu, T. Eerola, et al.



⇒ What plankton type?

A huge amount of data produced by a measuring device from Baltic Sea => how to recognize planktons automatically?

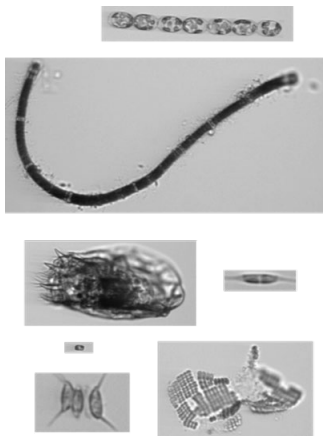
**Objective:** detect plankton types for analyzing the condition of the Baltic Sea and the climate change.

**Collaboration:** Finnish Environment Institute (SYKE), BUT, CTU, FastVision project.



# FastVision: LUT-BUT joint supervision

- Bureš, Jaroslav, **Classification of Varying-Size Plankton Images with Convolutional Neural Network**, MSc thesis, Brno University of Technology, 2020.
- Bureš, J., Eerola, T., Lensu, L., Kälviäinen, H., Zemčík, P. **Plankton Recognition in Images with Varying Size**, ICPR Workshops and Challenges, 2021.
  - Various modifications to the baseline convolutional neural networks are compared to address the extreme size variation in plankton image data.



Model combination	Test accuracy
InceptionV3 (299x299)	0.9228 ± 0.0019
InceptionV3 (299x299) + Jeffrey (128x128)	0.9259 ± 0.0012
InceptionV3 (299x299) + Barazanchi (224x224)	0.9271 ± 0.0018
InceptionV3 (299x299) + Barazanchi_2 (361x181)	0.9262 ± 0.0014
InceptionV3 (299x299) + Barazanchi_4 (448x112)	0.9284 ± 0.0014
InceptionV3 (299x299) + DeepWriter 2x(224x224)	0.9285 ± 0.0027
InceptionV3 (299x299) + Barazanchi_4 (448x112) + Deep-Writer 2x(224x224)	0.9303 ± 0.0017

# Brno University of Technology (CZ): LUT-BUT-DD master

## The content and structure of the Degree Programme

### LUT students

**TOTAL min 120 ECTS** 120

1. semester at LUT (select minimum 30 ECTS) 24

Course name	credits
Digital Imaging and Image Preprocessing	6
GPGPU Computing	6
Pattern Recognition	6
Advanced Data Analysis and Machine Learning	6

2. semester at BUT (select minimum 30 ECTS) 30

Course name	credits
Multimedia	5
Any voluntary course in 2nd or 3rd semester	
Speech Signal Processing	5
Data Communications, Computer Networks and Protocols	5
Physical Optics	5
Computational Geometry	5
Theoretical Computer Science	5

3. semester at BUT (select minimum 30 ECTS) 30

Course name	credits
Mathematical Structures in Computer Science	5
Computer Graphics	5
Term Project	5
Hardware/Software Codesign	5
Advanced Database Systems	5
Any voluntary course in 2nd or 3rd semester	5

4. semester at LUT 36

Course name	credits
Thesis work	30
Machine Vision and Digital Image Analysis *	6
Computer Vision *	6

\* select one of the two courses or a compatible course

### BUT students

**TOTAL min 120 ECTS** 122

1. semester at BUT (select minimum 30 ECTS) 30

Course name	credits
Mathematical Structures in Computer Science	5
Computer Graphics	5
Theoretical Computer Science	5
Term Project	5
Hardware/Software Codesign	5
Advanced Database Systems	5

2. semester at BUT (select minimum 30 ECTS) 30

Course name	credits
Multimedia	5
Image Processing	5
Speech Signal Processing	5
Data Communications, Computer Networks and Protocols	5
Physical Optics	5
Computational Geometry	5

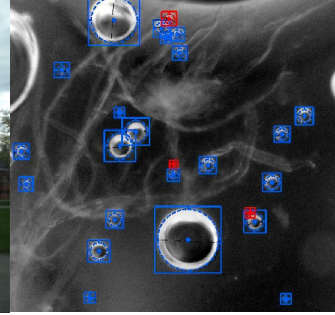
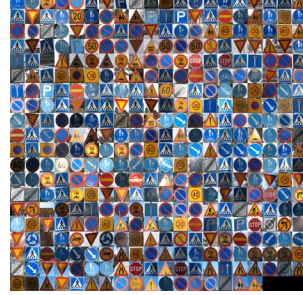
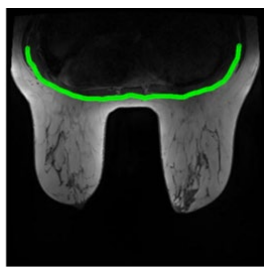
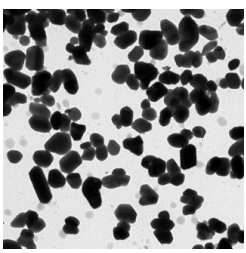
3. semester at LUT (select minimum 30 ECTS) 26

Course name	credits
GPGPU Computing	6
Pattern Recognition	6
Advanced Data Analysis and Machine Learning	6
Seminar in Intelligent Computing	4
Academic Writing in English	4

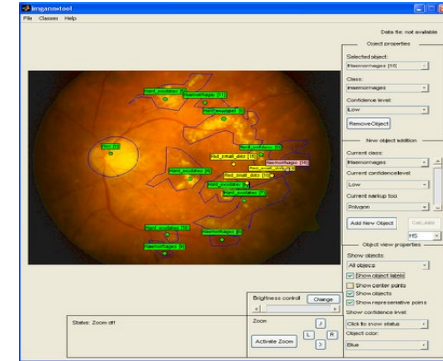
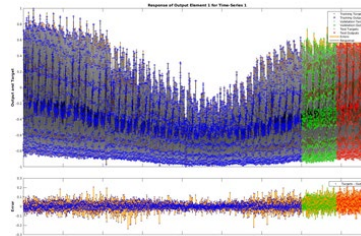
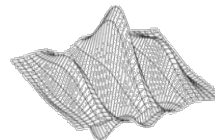
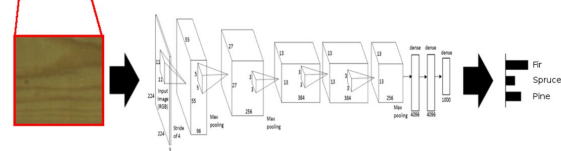
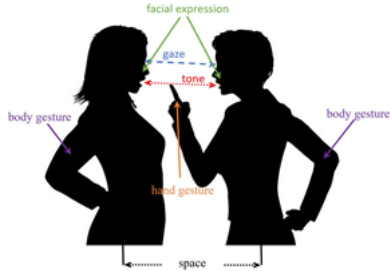
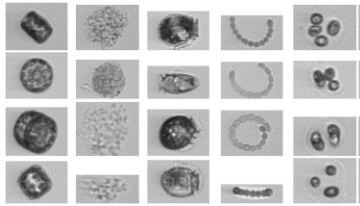
4. semester at LUT 36

Course name	credits
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Computer Vision *	6

\* select one of the two courses



# Computational Engineering by CVPRL: Data-Centric Engineering Computer Vision and Pattern Recognition



<http://www2.it.lut.fi/cvprl/>