

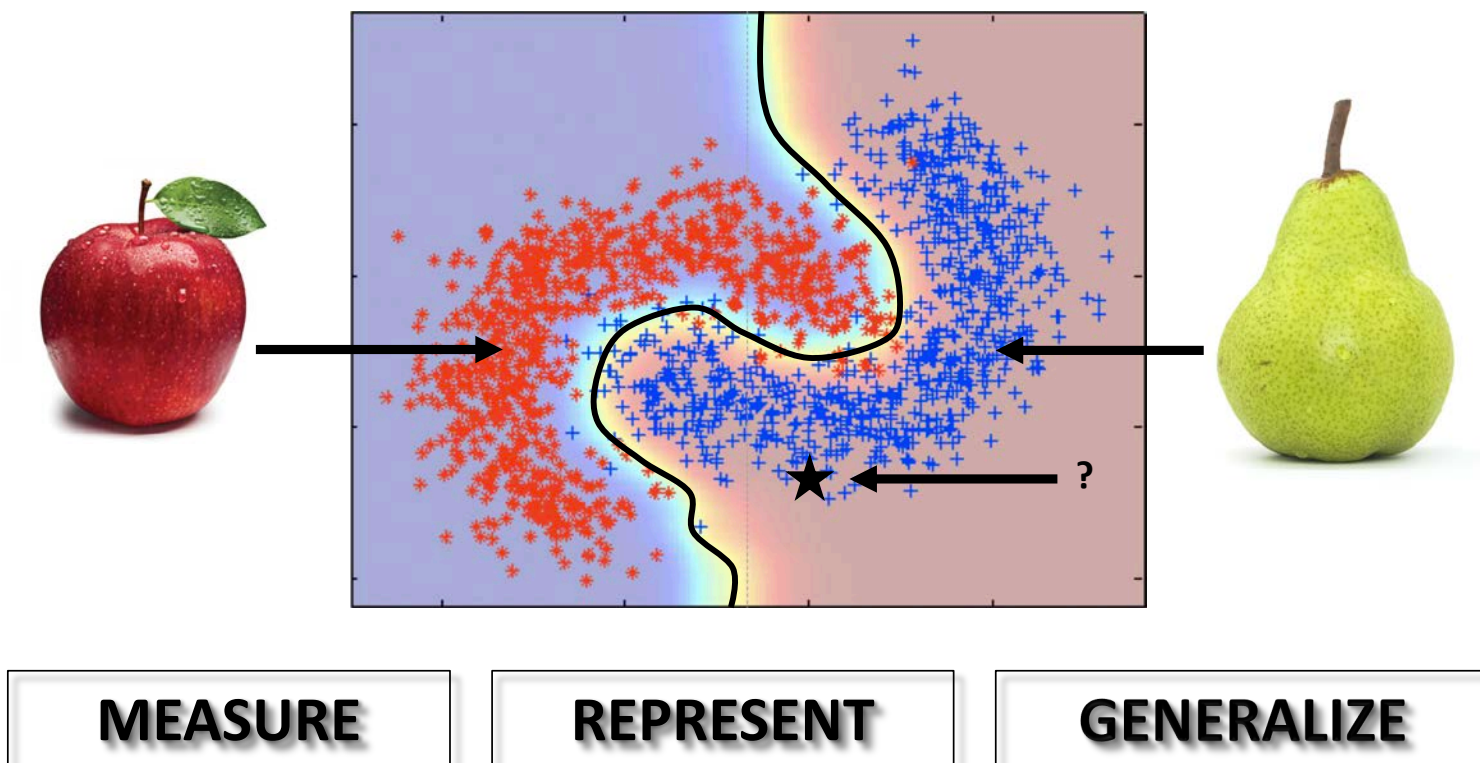
Pattern Recognition and Bioinformatics

Marcel Reinders

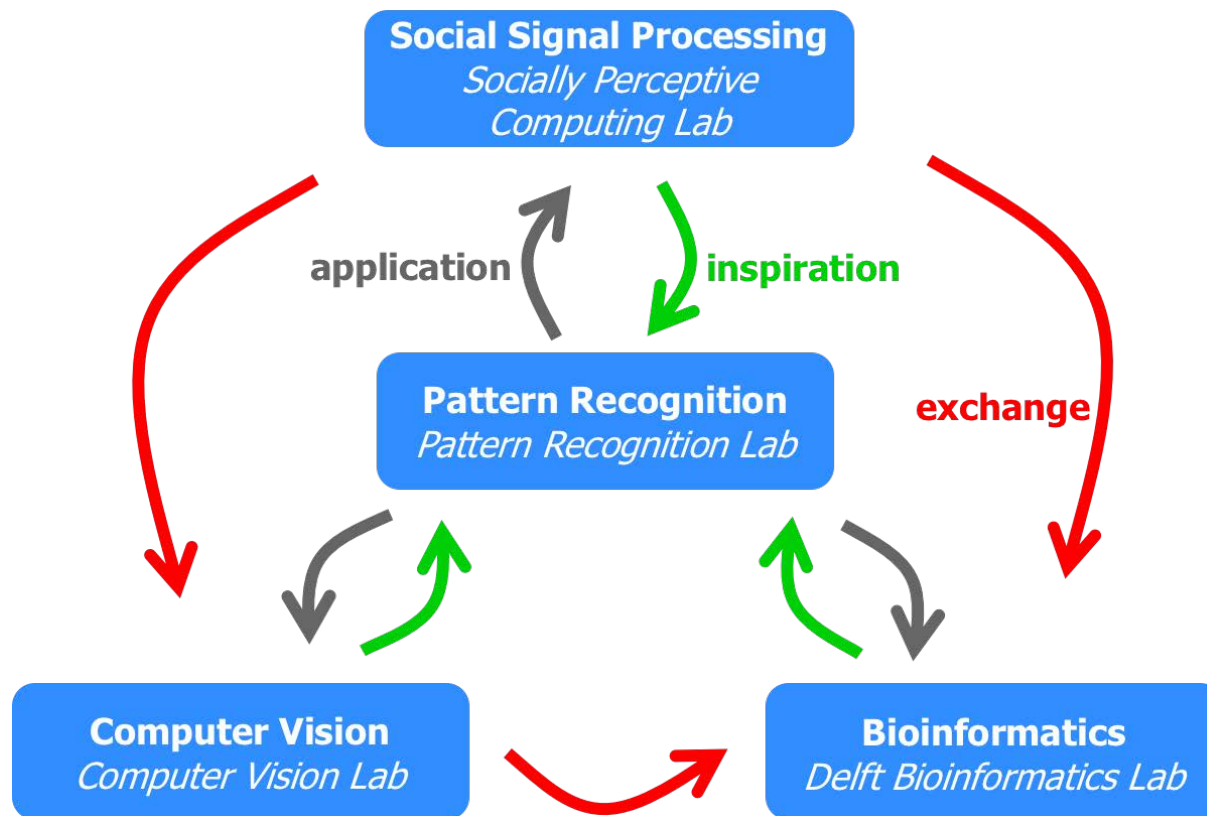
Modelling ... Learning from examples



Pattern Recognition core discipline



Pattern recognition & Bioinformatics *Four labs*





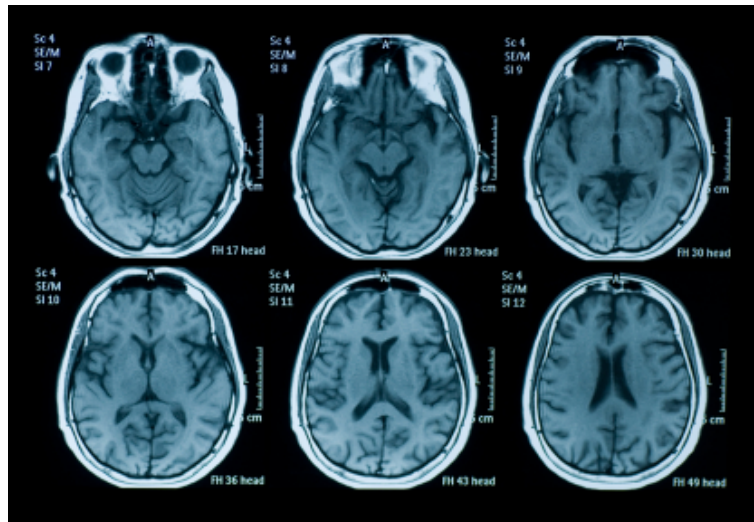
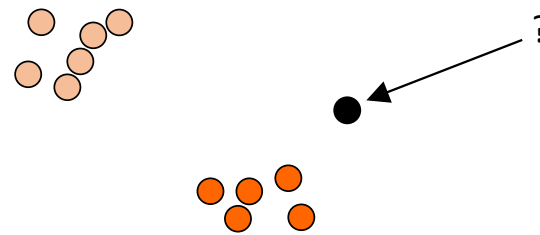
Pattern Recognition Lab

Marco Loog

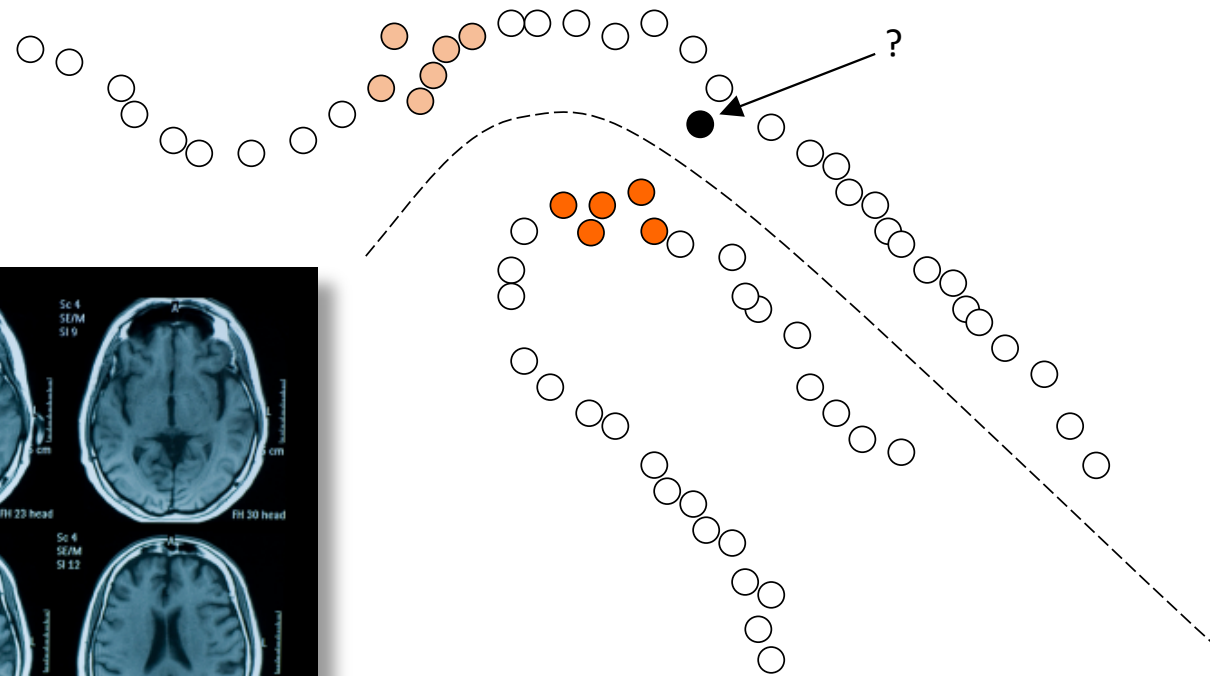
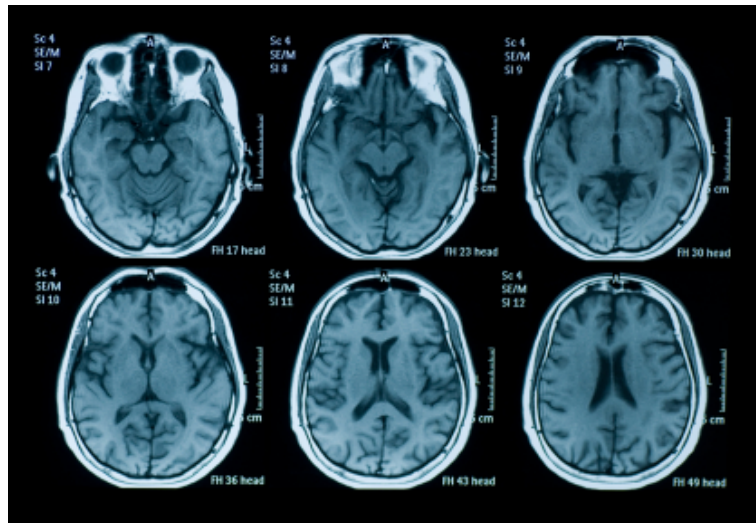
David Tax

Jesse Krijthe

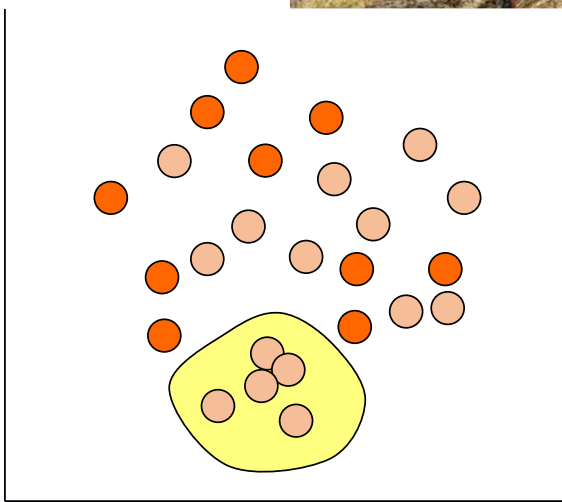
PR: Semi supervised learning



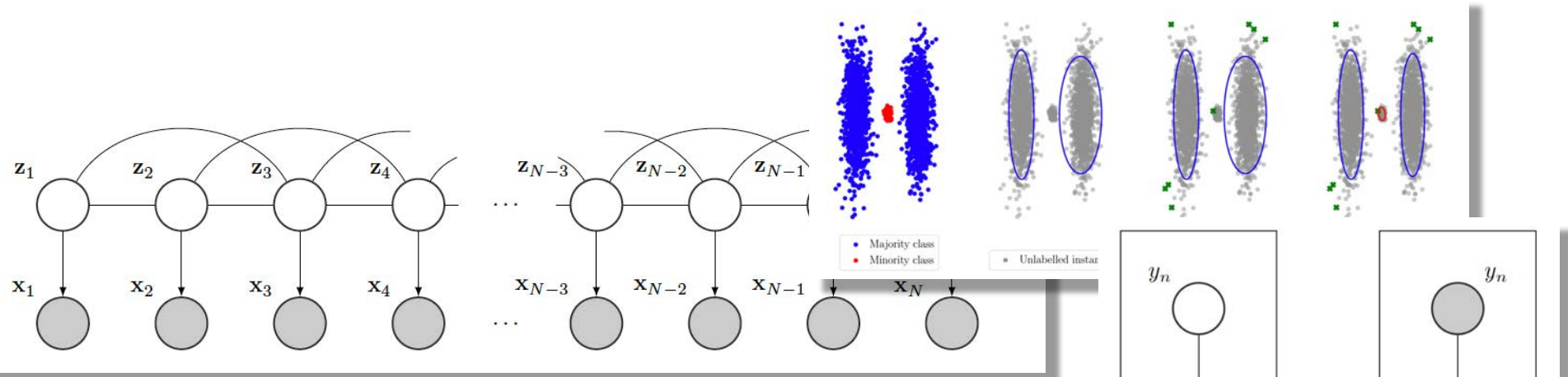
PR: Semi supervised learning



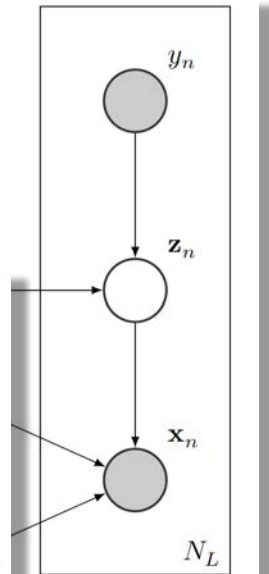
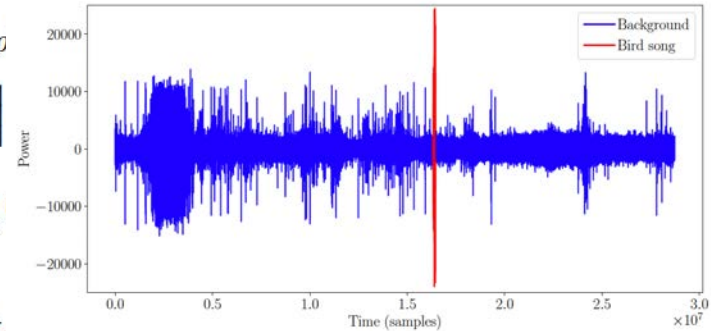
PR: Multiple instance learning



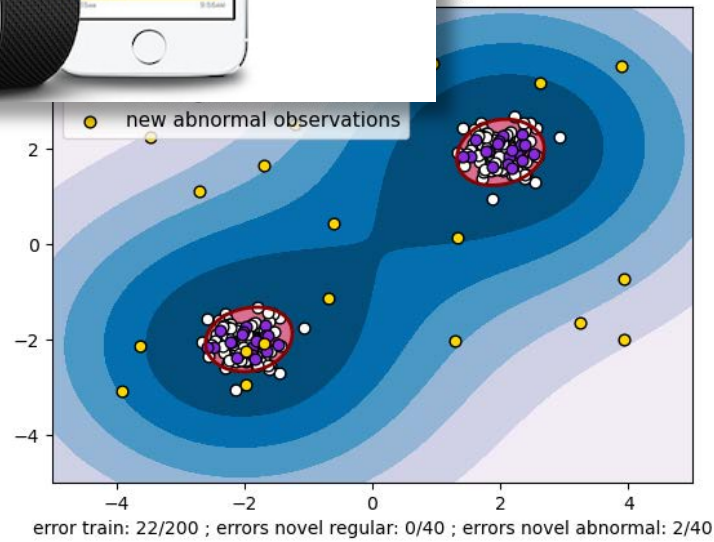
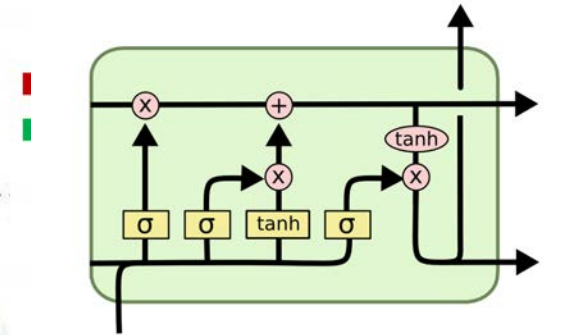
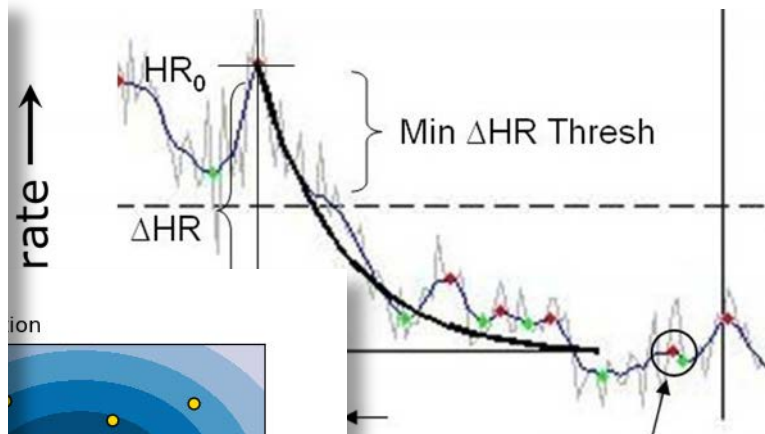
Rare category detection for temporal data



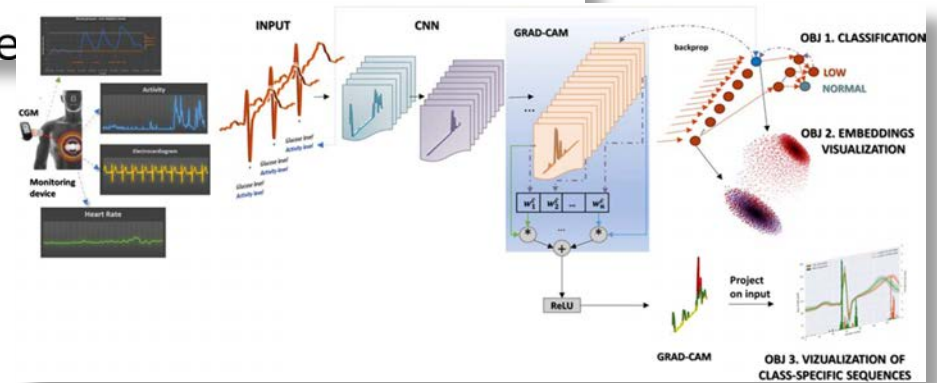
$$\begin{aligned}
 Q(\Theta, \Theta^{(t)}) &= \mathbb{E}_{\mathbf{Z}} \left[\log L_C(\Theta) \mid \mathbf{X}, \hat{\mathbf{Z}}, \Theta^{(t)} \right] \\
 &= \mathbb{E}_{\mathbf{Z}} \left[\log p(\mathbf{Z}) + \log p \right] \\
 &= \mathbb{E}_{\mathbf{Z}} \left[\log p(\mathbf{X} | \mathbf{Z}, \Theta) \right] \\
 &= \sum_{n=1}^N \sum_{k=1}^K \mathbb{E}[z_{nk} | \mathbf{X}, \hat{\mathbf{Z}}, \Theta] \\
 &= \sum_{n=1}^N \sum_{k=1}^K p(z_{nk} = 1 | \mathbf{X}_n)
 \end{aligned}$$



PR: (Heart rate) Event detection



Event end detection



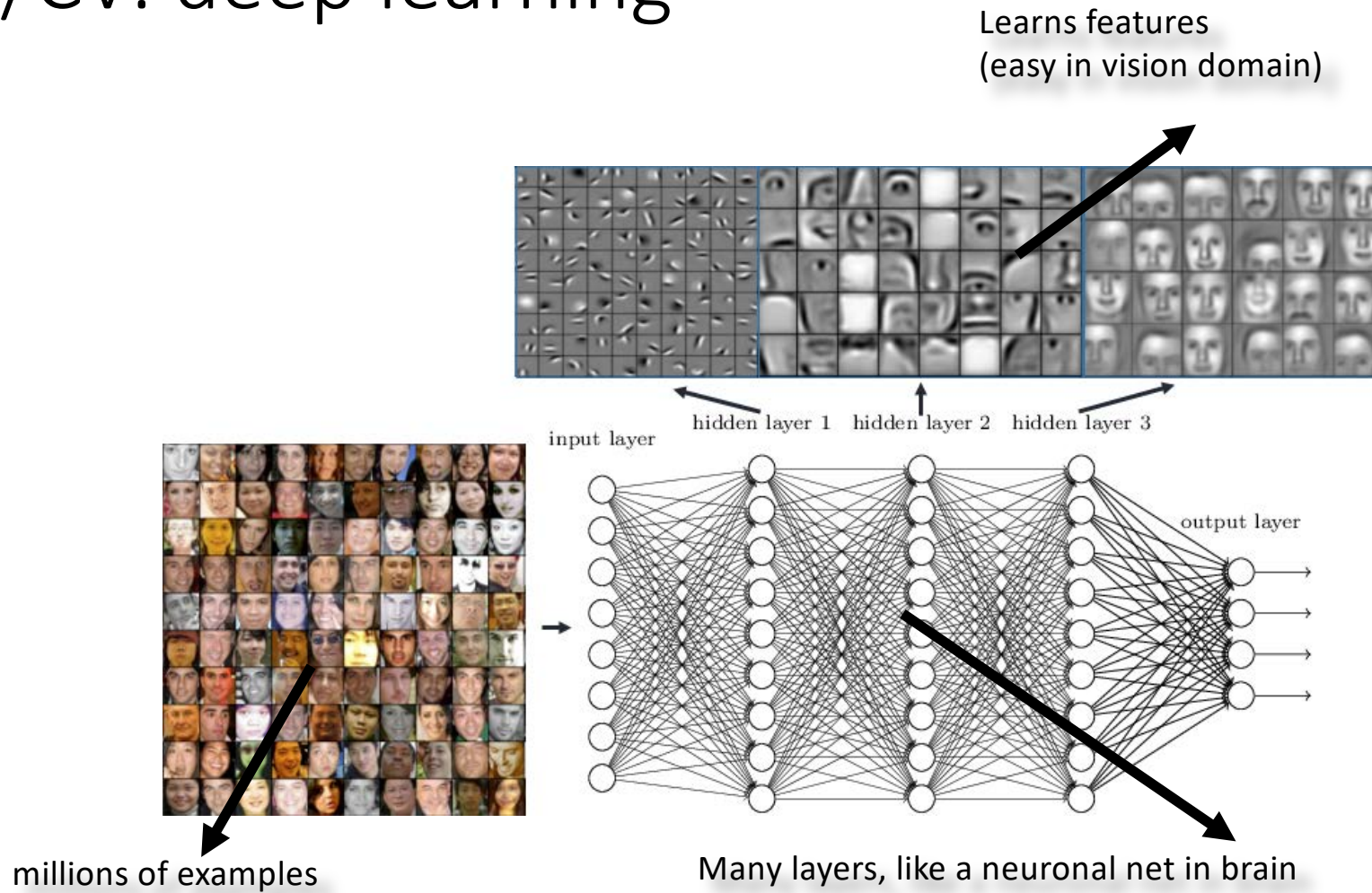


Computer Vision Lab

Jan van Gemert

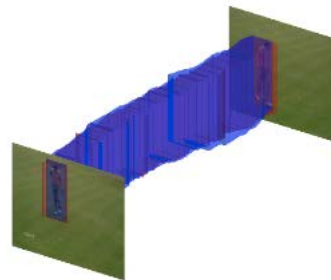
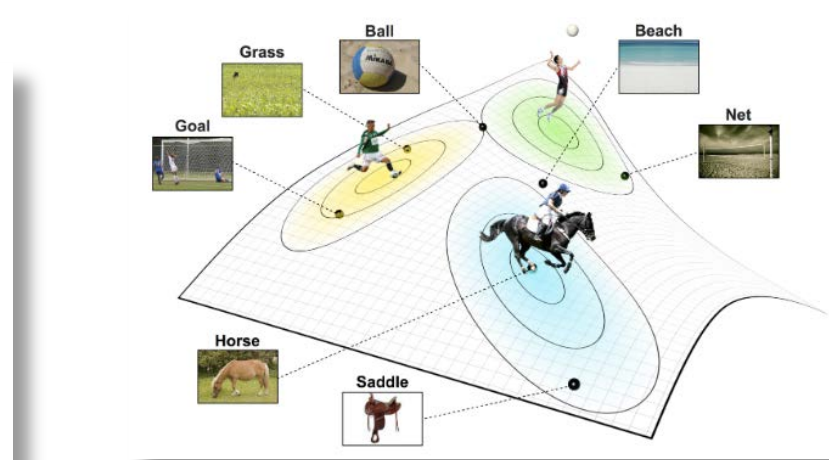
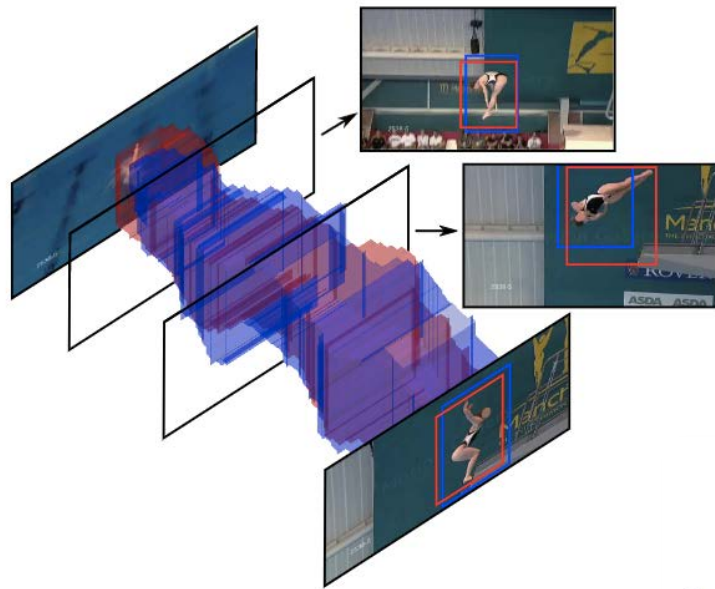
Silvia Pintae

PR/CV: deep learning

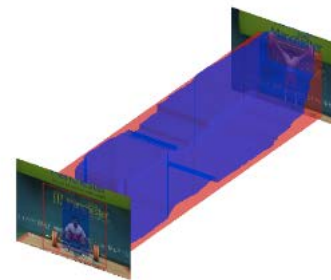


CV: Motion not (yet) solved in deep nets

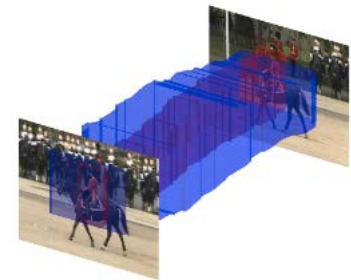
Action localization



(a) *Walking.*



(b) *Lifting.*



(c) *Riding horse.*

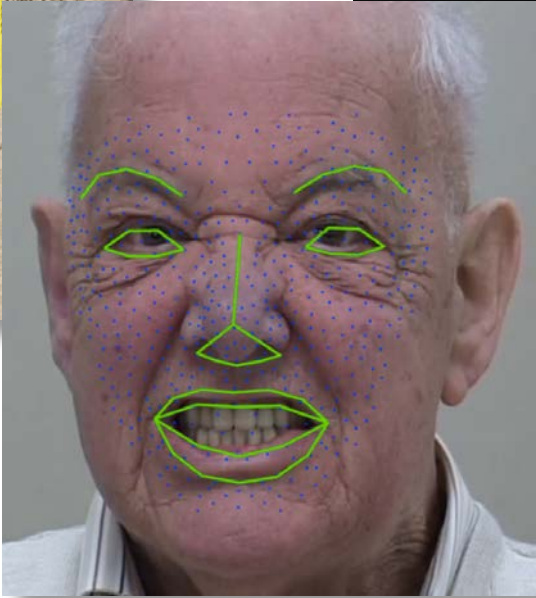
CV: Analyzing faces, expression



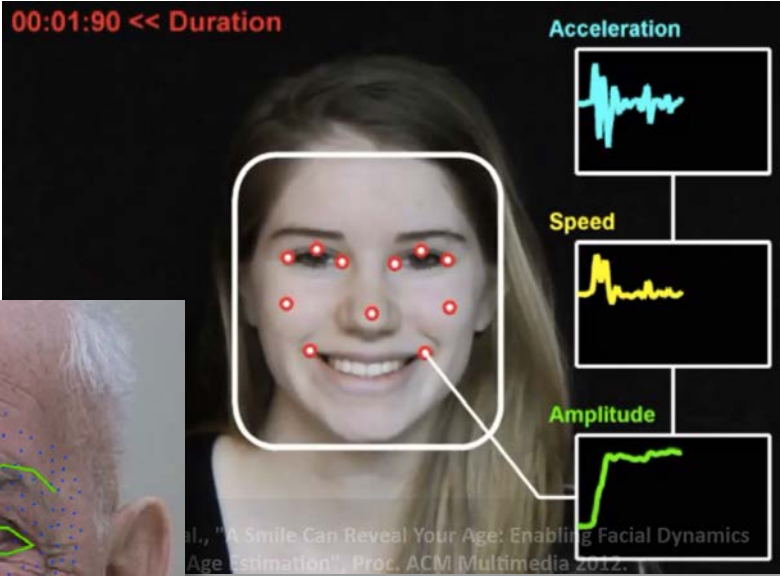
Angst Fear 65%

Verrassing Surprise 30%

Walging Disgust 5%



00:01:90 << Duration



Acceleration

Speed

Amplitude

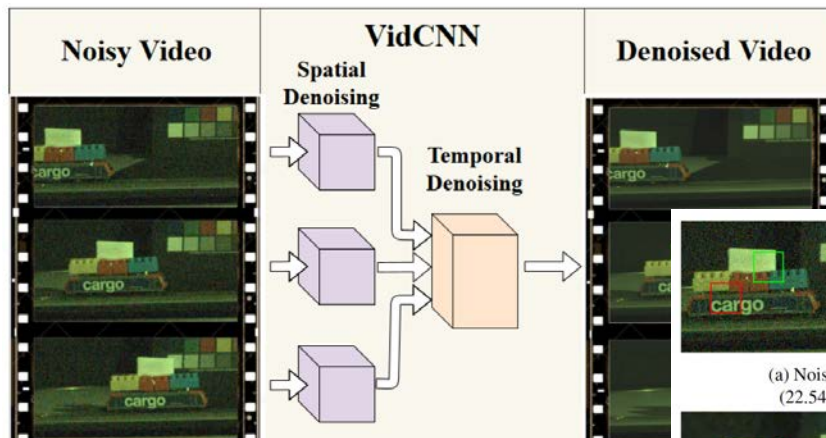
al., "A Smile Can Reveal Your Age: Enabling Facial Dynamics Age Estimation", Proc. ACM Multimedia 2012.

CV: magnifying motion, visualizing tremors, spying

The image is a collage illustrating computer vision applications. It features several key elements:

- Top Left:** A photograph of a woman's hands in a red patterned jacket.
- Top Center:** A diagram showing the processing of an 'Input frame' through a 'Complex Steerable Pyramid'. This pyramid is divided into 'Amplitude' and 'Input Phase' channels. The 'Amplitude' channel is further processed into 'Orientation Channels'. The final output is a 'Reconstruction' of the input frame.
- Top Right:** Two side-by-side close-up photographs of a man with glasses, showing subtle facial movements.
- Middle Left:** A photograph of a hand holding a small object, with a corresponding depth map visualization below it.
- Middle Center:** A diagram labeled 'The Visual Microphone: Pas' showing a sequence of depth maps or feature maps.
- Bottom Left:** A photograph of a hand with a white glove, and a small inset showing a heatmap of the hand's position.
- Bottom Center:** A 'High speed video' frame showing a window and a person's legs, with the text '(actual video playing here)' below it.

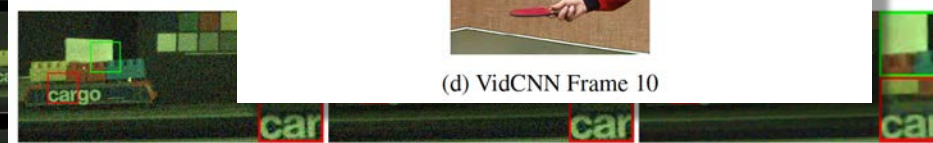
Learning video denoising



(a) Noisy Frame 9 (b) Noisy Frame 10 (c) Noisy Frame 11



(d) VidCNN Frame 10



(a) Noisy frame 2
(22.54/0.4402)

(b) DnCNN [14]
(24.30/0.5323)

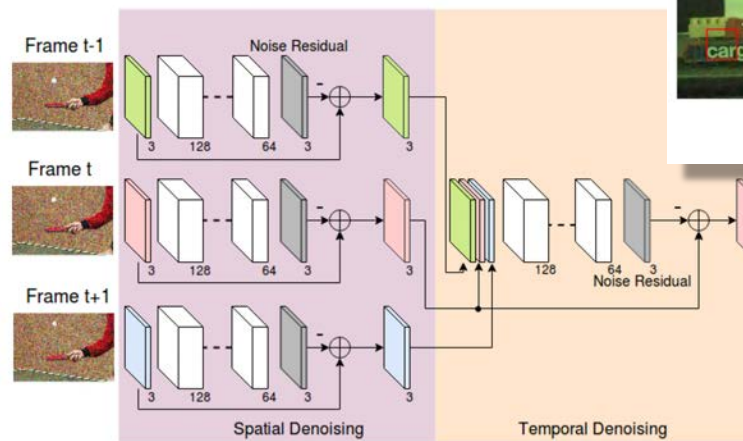
(c) VBM4D [10]
(29.08/0.7684)



(d) CBDNet [22]
(30.75/0.8710)

(e) CBM3D [34]
(31.11/0.8982)

(f) VidCNN
(34.14/0.9158)



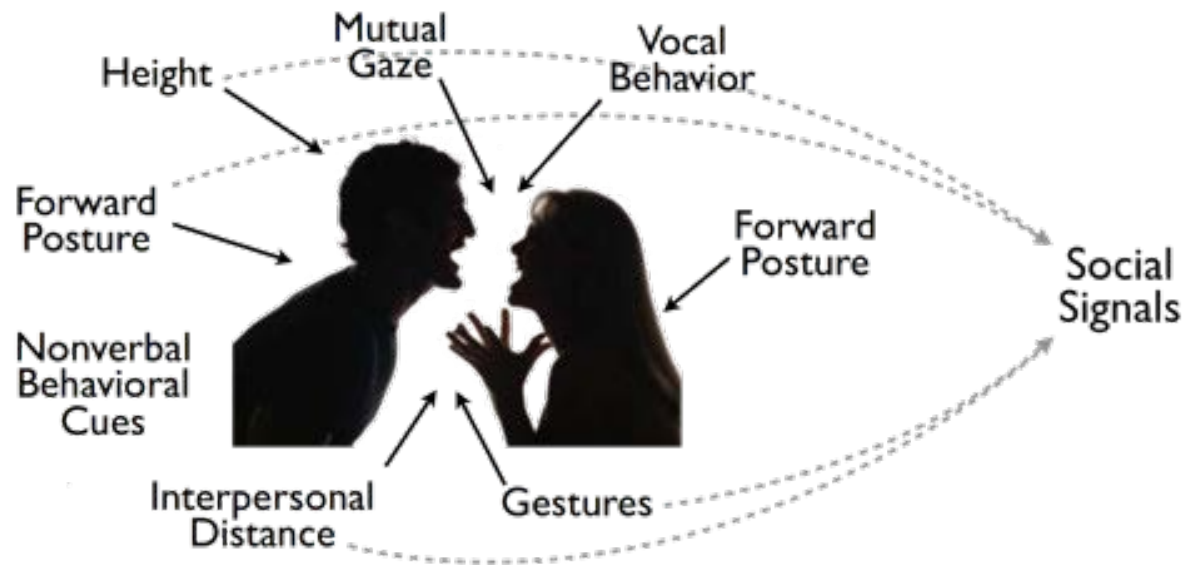
	Train		Mountains	Windmill		
Res./Frames	212×1091 / 4		1080×1920 / 4	1080×1920 / 3		
Light	50/255	55/255	[55,75]/255	44.6 lux	118 lux	212 lux
VidCNN	34.05	36.96	40.84	32.96	35.42	36.69
VBM4D[10]	29.10	33.48	37.34	26.62	30.69	32.92
CBDNet[22]	30.89	34.56	39.91	29.56	34.31	36.22
CBM3D[34]	31.27	34.06	40.20	29.81	34.06	35.74
DnCNN[14]	24.33	29.87	32.39	21.73	25.55	27.87



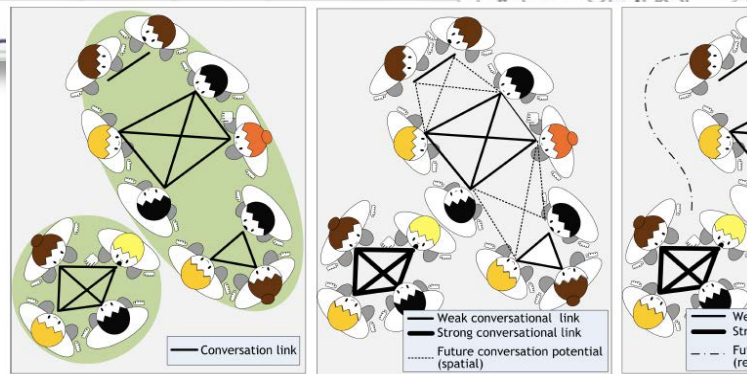
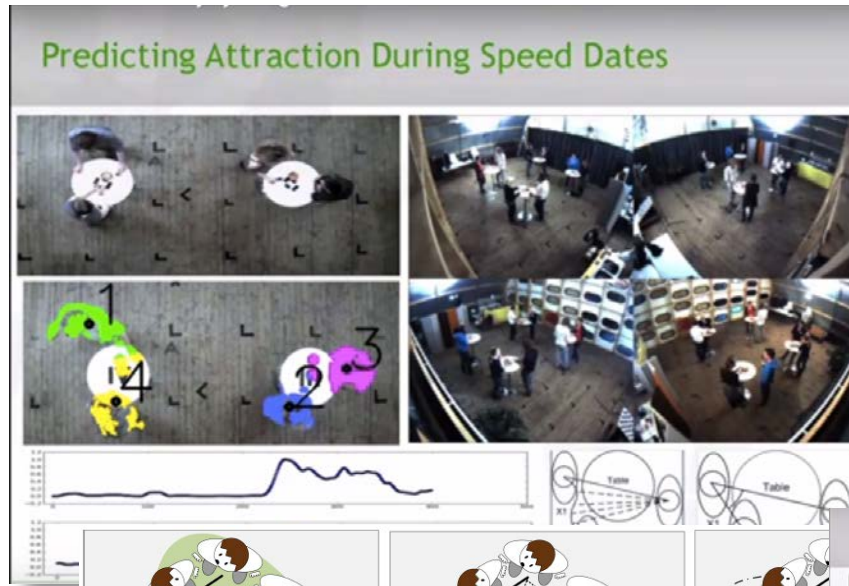
Socially Perceptive Computing Lab

Haley Hung

SPC: Social interaction



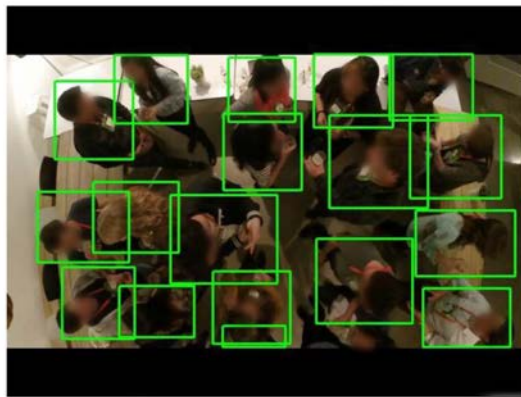
SPC: Analyzing group behavior



Measuring Social Context with Accelerometers



SPC: People detection

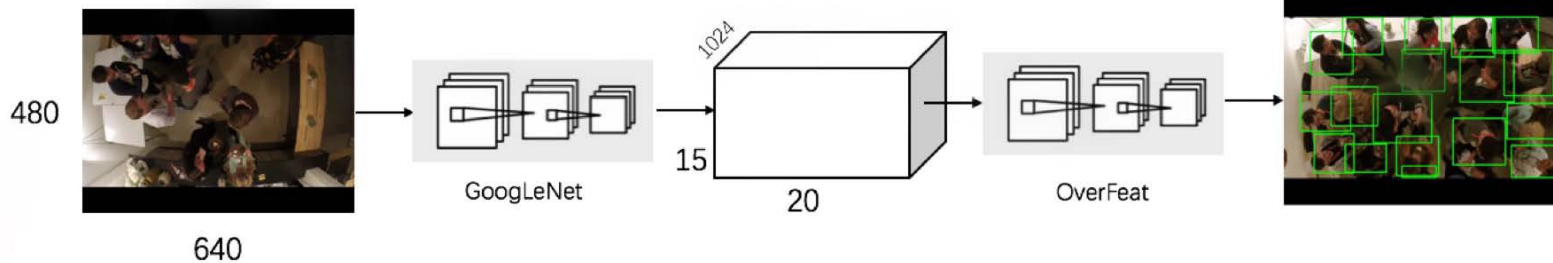
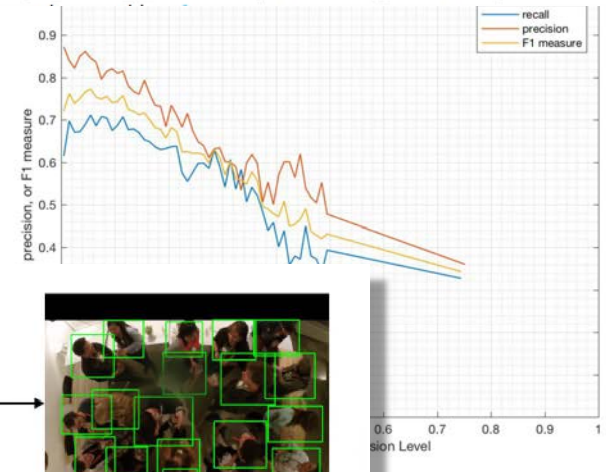


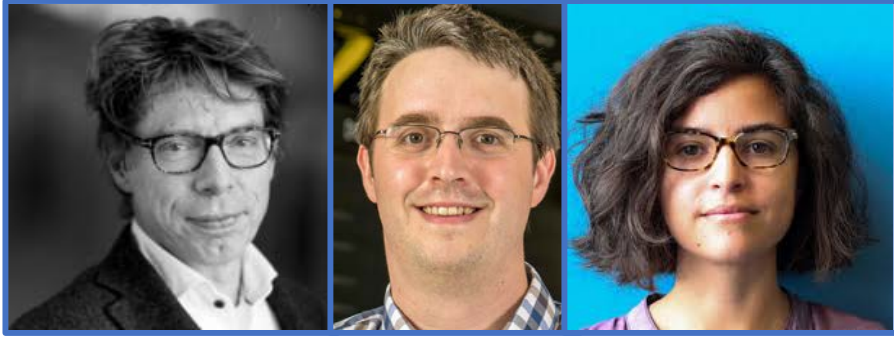
(a) Body Annotation



(b) Head Annotation

Training data	Test data	AP	Recall	EER	COUNT	F1 measure
Day1&2less	Day3	0.6843	0.7667	0.74	0.1203	0.7232
	Day2	0.5635	0.7221	0.68	0.2813	0.633
	Day1	0.6174	0.7378	0.69	0.195	0.6723
		0.6191 (+0.0155)*	0.7422 (+0.0155)*	0.7033 (0.0133)*	0.1989 (-0.0063)*	0.6762 (+0.0169)*
	Day3	0.6785	0.7632	0.72	0.1249	0.7183
	Day2	0.564	0.6894	0.66	0.2223	0.6205
	Day1	0.6497	0.7121	0.68	0.0961	0.6795
		0.6307 (+0.0271)*	0.7216 (-0.0146)*	0.6867 (-0.0033)*	0.1478 (-0.0574)*	0.6728 (+0.0202)*





Bioinformatics

Marcel Reinders

Thomas Abeel

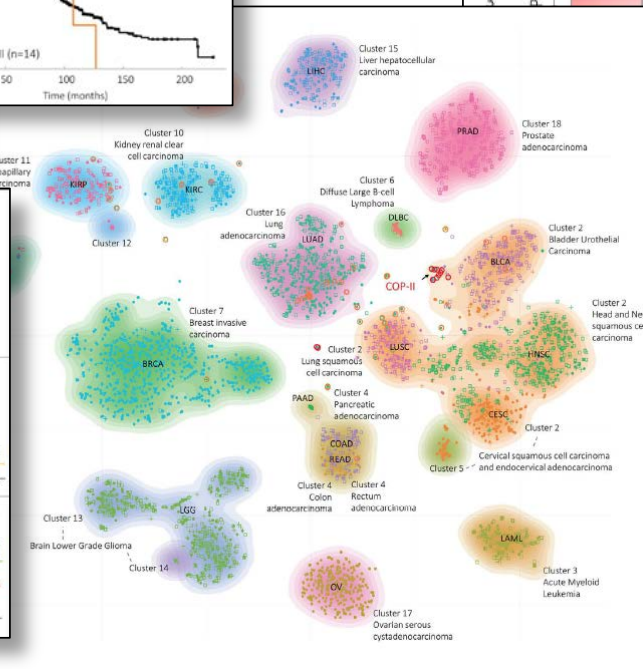
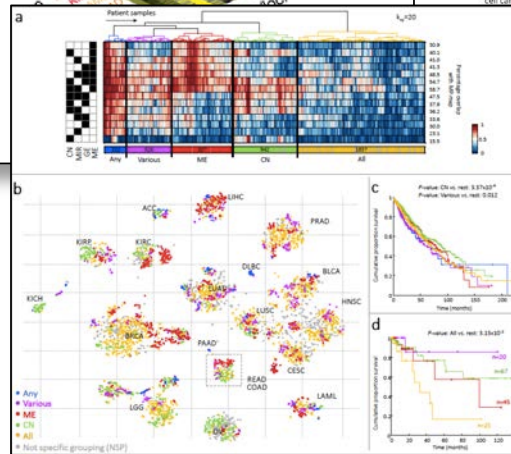
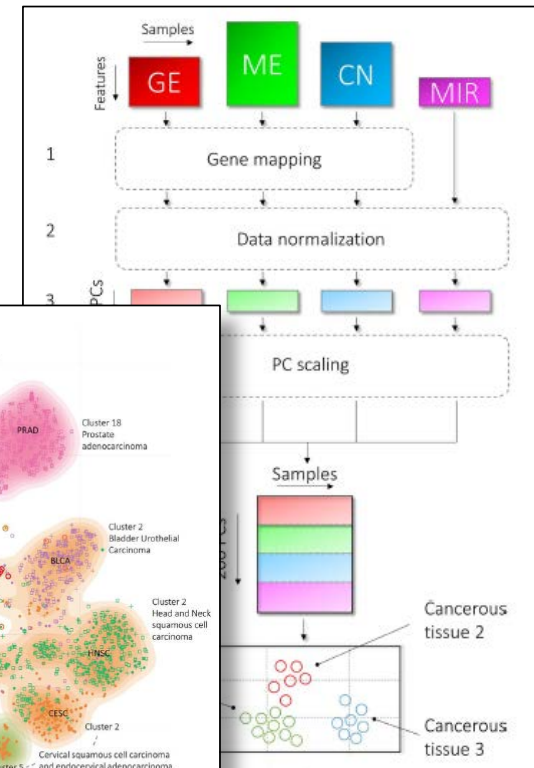
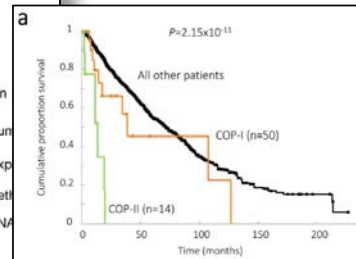
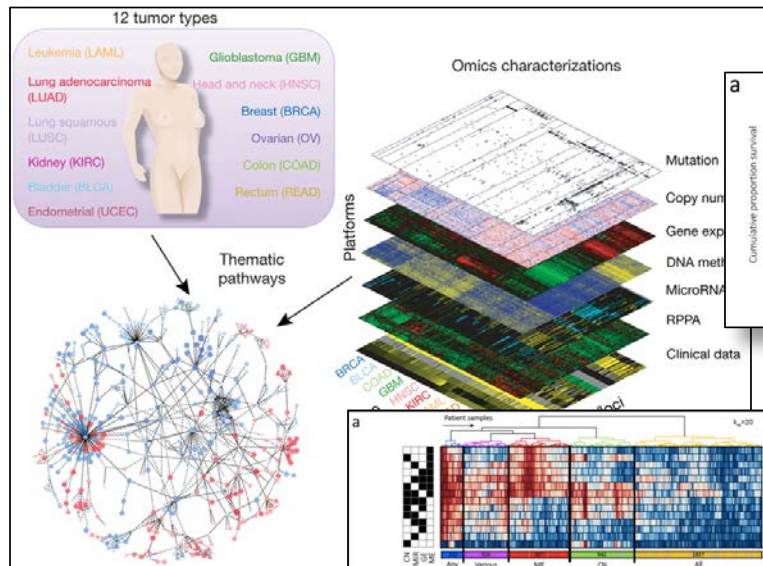
Joana Goncales

BI: Molecules in cell, DNA, lots of developments Fueled by *high throughput measurements*



**Bioinformatics
Specialization**

BI: Data integration



BI: Clinical Genetics (NIPT – test)

DOI: 10.1002/pd.4816

ORIGINAL ARTICLE

Calculating the fetal fraction for noninvasive on genome-wide nucleosome profiles

Nucleic Acids Research Advance Access published online first

Roy Straver^{1,2,*}, Erik A. Siermans², Henne Holstege¹

WISECONDOR: detection of fetal aneuploidy using shallow sequencing maternal plasma DNA with a within-sample comparison scheme

Roy Straver^{1,2,*}, Erik A. Siermans², Henne Holstege¹

Maternal Bloodstream

Woensdag 16 november 2016 ... Het laatste nieuws het eerst op NU.nl

Voorpagina [NU.nl](#) > nipt-test

Net binnen

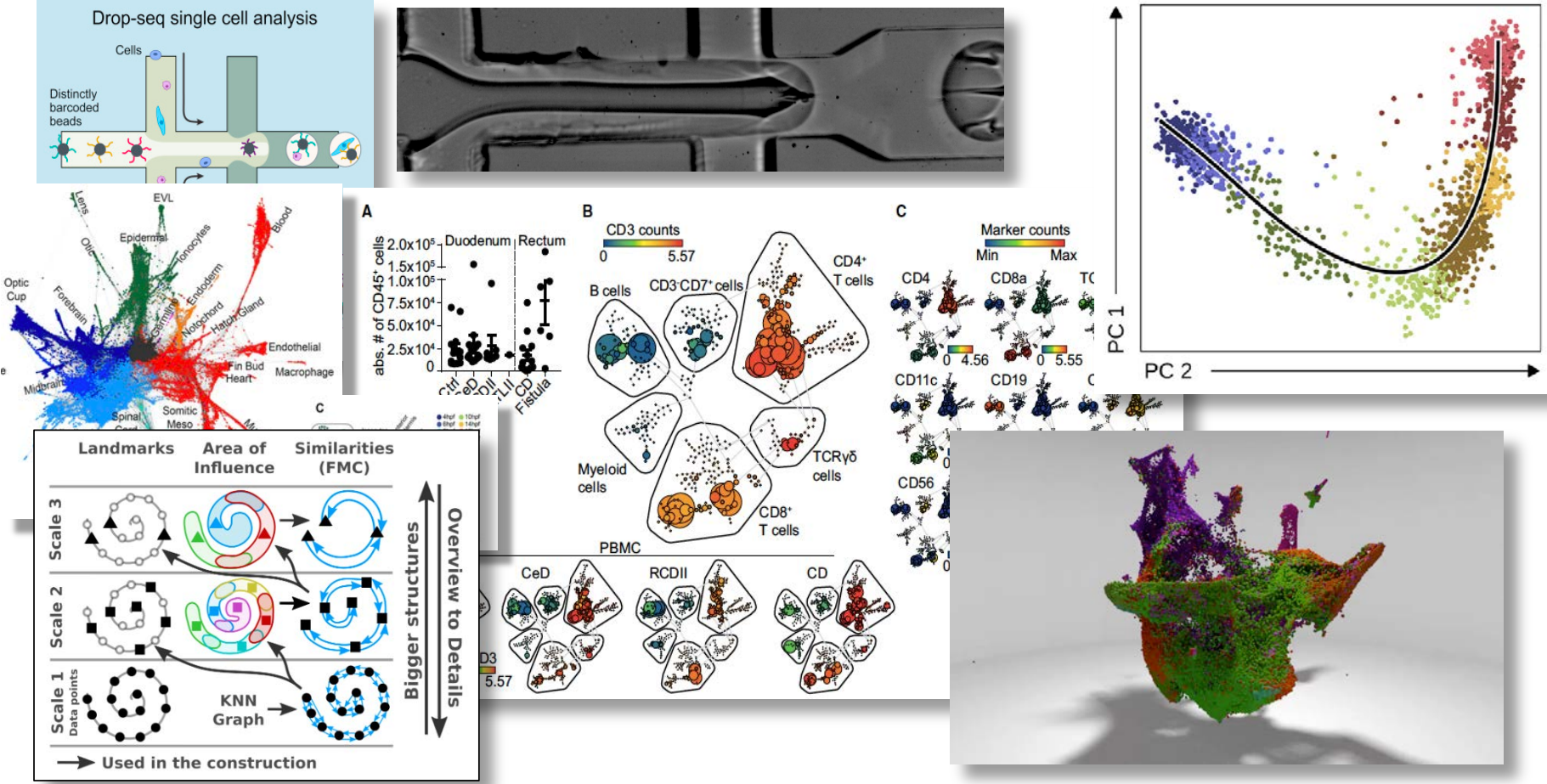
Algemeen

Economie

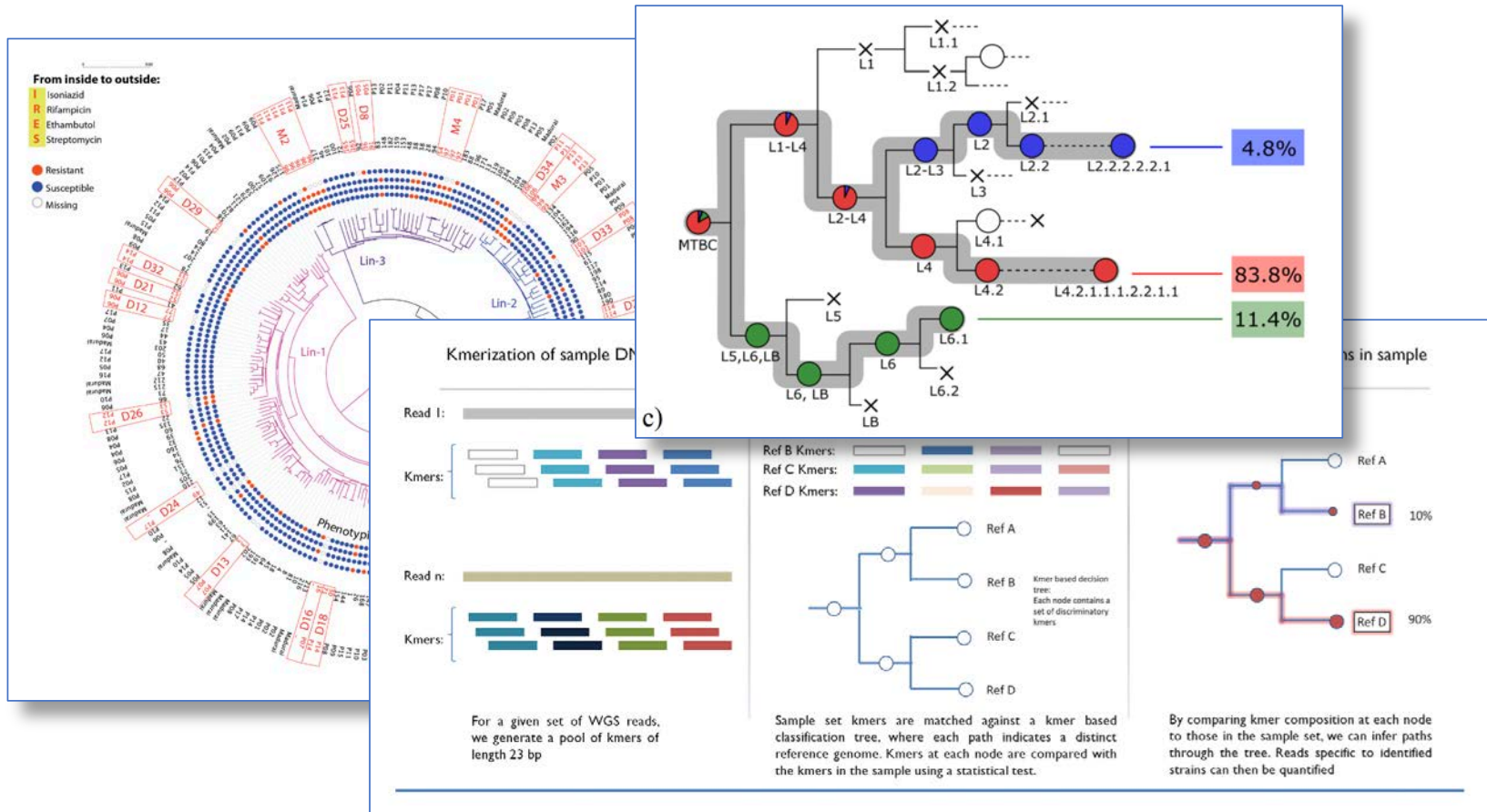
Zwangere vrouwen kunnen rechtstreeks kiezen voor NIPT-test

$$z_i = \frac{R_i^g - \mu_{ir}}{\sigma_{ir}}$$

BI: Visualizing/Clustering/pseudo-time ordering



BI: Antibiotic Resistance Mechanisms

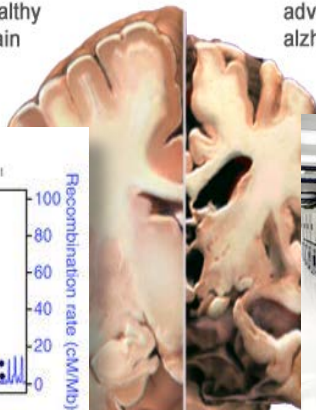


BI: Alzheimer disease



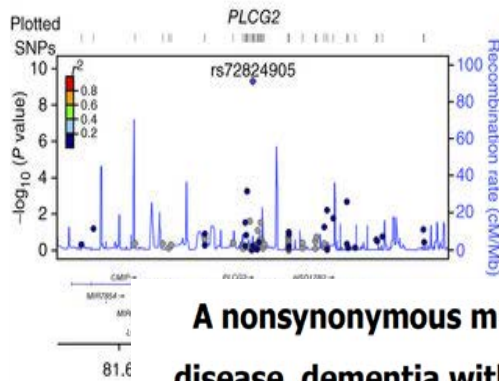
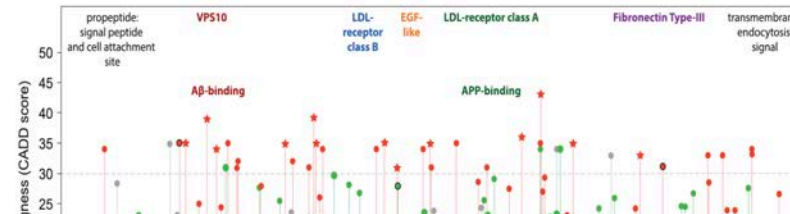
healthy brain

advanced Alzheimer's



ARTICLE

Characterization of pathogenic *SORL1* genetic variants for association with Alzheimer's disease: a clinical interpretation strategy

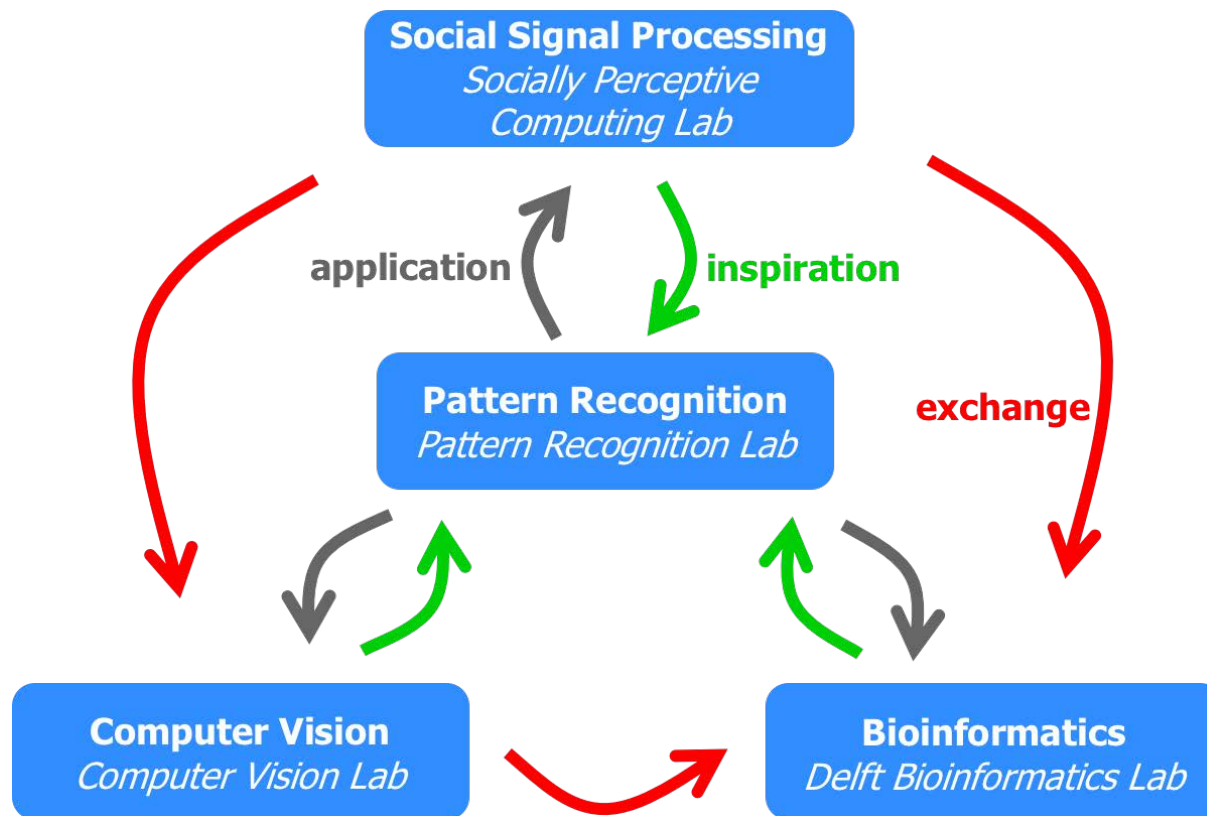


A nonsynonymous mutation in *PLCG2* reduces the risk of Alzheimer's disease, dementia with Lewy-bodies and frontotemporal dementia, and increases the likelihood of longevity.



25K exomes, 5K WGS

Pattern recognition & Bioinformatics *Four labs*



Pattern recognition & Bioinformatics *Courses*

CS4220 Machine Learning 1 (mandatory)

CS4230 Machine Learning 2

CS4240 Deep Learning

CS4245 Computer Vision by Deep Learning

CS4165 Seminar Social Signal Processing

CS4250 Selected Topics in Molecular Biology

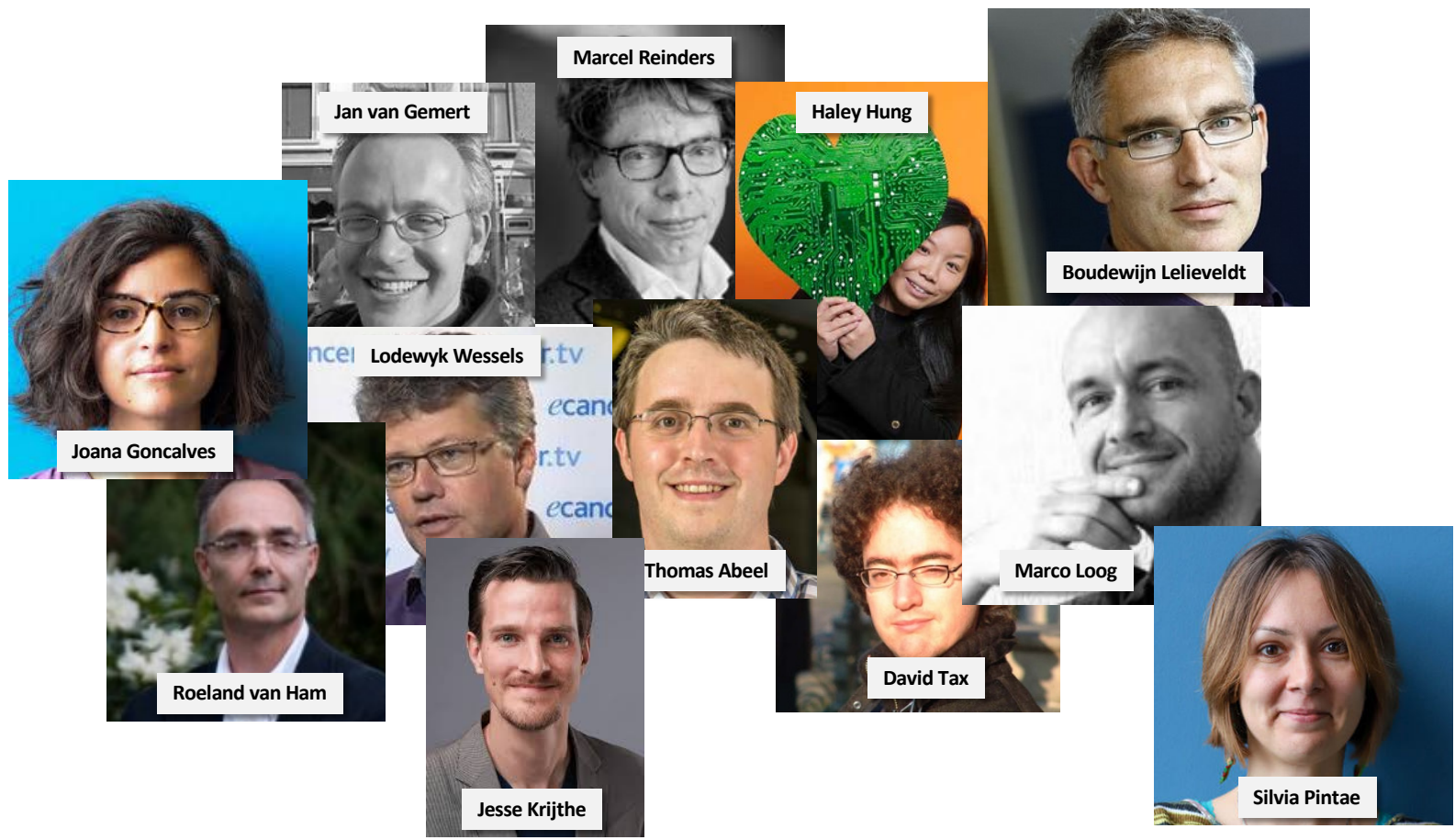
CS4255 Algorithms for sequence-based bioinformatics

CS4176 Algorithms for network-based Bioinformatics

CS4260 Machine Learning in Bioinformatics

CS4329 Recent Topics in bioinformatics

More info: PRB staf



Pattern recognition & Bioinformatics

Pattern Recognition Lab	Marco Loog
	David Tax
	Jesse Krijthe
Computer Vision Lab	Jan van Gemert
	Silvia Pintae
Socially Perceptive Computing Lab	Haley Hung
Bioinformatics Lab	Marcel Reinders
	Thomas Abeel
	Joana Goncalves

Leiden University Medical Center	Boudewijn Lelieveldt
Netherlands Cancer Institute	Lodewyk Wessels
Keygene	Roeland van Ham

PATTERN RECOGNITION & BIOINFORMATICS

ABSTRACT

Pattern recognition is concerned with processing raw measurement data by a computer to arrive at a prediction, which can then be used to formulate a decision or action to take. Problems to which pattern recognition are applied have in common that they are too complex to model explicitly, thus requiring algorithms to learn parameters in generic models from limited sets of examples.

HIGHLY RECOMMENDED



CS4220 Machine Learning 1	Q2	5EC	Core
CS4240 Deep Learning	Q3	5EC	Spec.

RECOMMENDED COURSES



CS4165 Seminar Social Signal Processing	Q1&2	5EC	Sem.
CS4250 Selected Topics in Molecular Biology	Q1	5EC	Spec.
CS4255 Algorithms for sequence-based bioinformatics	Q2	5EC	Spec.
CS4176 Algorithms for network-based Bioinformatics	Q3	5EC	Spec.
CS4260 Machine Learning in Bioinformatics	Q3	5EC	Spec.
CS4329 Recent Topics in bioinformatics	Q4	5EC	Spec.
CS4245 Computer Vision by Deep Learning	Q4	5EC	Sem
CS4230 Machine Learning 2	Q3&4	5EC	Spec.

RESEARCH THEMES



- Delft Bioinformatics Lab (e.g. genomics)
- Computer Vision Lab (e.g. deep learning)
- Pattern Recognition Lab
- Socially Perceptive Computing Lab

COURSES TO BROADEN YOUR HORIZON



IN4086 Data Visualization	Q2	5EC	Core
IN4325 Information Retrieval	Q3	5EC	Spec.

CONTACT

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T: +31 15 27 86052

W: www.prb.tudelft.nl

URL

<https://www.tudelft.nl/ewi/over-de-faculteit/afdelingen/intelligent-systems/pattern-recognition-bioinformatics/>