

Contents

Preface	5
Personnel	7
Awards and activities	11
Doctoral dissertations	25
Theses	33
1 Introduction	37
<i>Algorithms and Methods</i>	
2 Bayesian learning of latent variable models	43
<i>Juha Karhunen, Tapani Raiko, Alexander Ilin, Antti Honkela, Jaakko Luttinen, KyungHyun Cho</i>	
2.1 Bayesian modeling and variational learning	44
2.2 Algorithmic improvements for variational inference	47
2.3 Extensions of probabilistic PCA	50
2.4 Gaussian process models of gene expression and gene regulation	52
2.5 Deep learning and Boltzmann machines	53
2.6 Oscillatory neural networks	56
2.7 Applications in climate science	57
2.8 Other Applications	58
3 Blind and semi-blind source separation	63
<i>Erkki Oja, Juha Karhunen, Alexander Ilin, Zhirong Yang, Jaakko Luttinen, He Zhang, Jarkko Ylipaavalniemi, Tele Hao</i>	
3.1 Introduction	64
3.2 Non-negative Low-Rank Learning	66
3.3 Finding dependent and independent sources from two related data sets	69
4 Multi-source machine learning	71
<i>Samuel Kaski, Mehmet Gönen, Arto Klami, Gayle Leen, Jaakko Peltonen, Ilkka Huopaniemi, Melih Kandemir, Suleiman A. Khan, Kristian Nybo, Juuso Parkkinen, Tommi Suvitaival, Jaakko Viinikanoja, Seppo Virtanen, Yusuf Yaslan</i>	
4.1 Introduction	72
4.2 Multi-view and multi-way learning	73
4.3 Multi-task learning	75

4.3.1 Asymmetric multi-task learning	75
4.3.2 Multi-task multiple kernel learning	76
4.4 Information visualization	78
<i>Bioinformatics and Neuroinformatics</i>	
5 Bioinformatics	83
<i>Samuel Kaski, Elisabeth Georgii, Arto Klami, José Caldas, Ali Faisal, Ilkka Huopaniemi, Suleiman Ali Khan, Leo Lahti, Juuso Parkkinen, Tommi Suvitaval</i>	
5.1 Introduction	84
5.2 Translational modeling for molecular medicine	85
5.3 Data-driven comparison and retrieval of gene expression experiments	88
5.4 Detection of dependencies between heterogeneous biological data types	91
6 Neuroinformatics	95
<i>Ricardo Vigário, Miguel Almeida, Nicolau Gonçalves, Nima Reyhani, Jarkko Ylipaavalniemi, Jayaprakash Rajasekharan, Jaakko Viinikanoja, Seppo Virtanen, Arto Klami, Mikko Kurimo, Samuel Kaski, Erkki Oja</i>	
6.1 Introduction	96
6.2 Natural stimuli and decoding	98
6.3 Phase synchrony	99
6.4 Document mining	101
<i>Multimodal interfaces</i>	
7 Content-based information retrieval and analysis	105
<i>Erkki Oja, Jorma Laaksonen, Markus Koskela, Ville Viitaniemi, Mats Sjöberg, Xi Chen, Satoru Ishikawa, Matti Karppa, Mikko Kurimo, Ville Turunen</i>	
7.1 Introduction	106
7.2 Semantic concept detection from images and videos	106
7.3 Content-based video analysis and annotation of Finnish Sign Language	107
7.4 Image based linking	107
8 Automatic speech recognition	111
<i>Mikko Kurimo, Kalle Palomäki, Janne Pylkkönen, Ville T. Turunen, Sami Virpioja, Ulpur Remes, Heikki Kallasjoki, Reima Karhila, Teemu Ruokolainen, Tanel Alumäe, Sami Keronen, André Mansikkaniemi, Peter Smit, Rama Sanand Doddipatla, Seppo Enarvi</i>	
8.1 Introduction	112
8.2 Training and adaptation of acoustic models	114
8.3 Noise robust speech recognition	118
8.4 Constraining and adapting language models	121
8.5 Speech retrieval and indexing	123
9 Proactive Interfaces	125
<i>Samuel Kaski, Erkki Oja, Jorma Laaksonen, Mikko Kurimo, Arto Klami, Markus Koskela, Mehmet Gönen, Antti Ajanki, He Zhang, Melih Kandemir, Teemu Ruokolainen, Andre Mansikkaniemi, Jing Wu, Chiwei Wang</i>	
9.1 Introduction	126

9.2 Inferring interest from implicit signals	126
9.3 Eye-movement enhanced image retrieval	127
9.4 Contextual information interfaces	127
10 Natural language processing	131
<i>Krista Lagus, Mikko Kurimo, Timo Honkela, Sami Virpioja, Oskar Kohonen, Mari-Sanna Paukkeri, Tiina Lindh-Knuutila, Ville T. Turunen, Ilkka Kivimäki, Laura Leppänen, Sini Pessala, Santosh Tirunagari</i>	
10.1 Introduction	132
10.2 Unsupervised and semi-supervised morphology induction	133
10.3 Keyphrase extraction	137
10.4 Vector space models of language	138
<i>Computational Cognitive Systems</i>	
11 Computational Cognitive Systems	143
<i>Timo Honkela, Krista Lagus, Marcus Dobrinkat, Oskar Kohonen, Mikaela Kumlander, Tiina Lindh-Knuutila, Ilari Nieminen, Mari-Sanna Paukkeri, Matti Pöllä, Juha Rautio, Sami Virpioja, Jaakko Väyrynen, Paul Wagner, Eric Malmi, Tero Tapiovaara, Tommi Vatanen, Ilkka Kivimäki, Laura Leppänen, Sini Pessala, Santosh Tirunagari</i>	
11.1 Introduction	144
11.2 Learning to translate	148
11.3 Socio-cognitive modeling	152
11.4 GICA: Grounded Intersubjective Concept Analysis	155
11.5 The GICA method	157
11.5.1 Obtaining subjectivity data	157
<i>Adaptive Informatics Applications</i>	
12 Intelligent data engineering	163
<i>Miki Sirola, Mika Sulkava, Jukka Parviainen, Jaakko Talonen, Eimuntas Augilius, David Ott, Kimmo Raivio, Antti Klapuri, Olli Simula</i>	
12.1 Data analysis in monitoring and decision making	164
13 Time series prediction	165
<i>Amaury Lendasse, Timo Honkela, Federico Pouzols, Antti Sorjamaa, Yoan Miche, Qi Yu, Eric Severin, Mark van Heeswijk, Erkki Oja, Francesco Corona, Elia Liitiäinen, Zhanxing Zhu, Laura Kainulainen, Emil Eirola, Olli Simula</i>	
13.1 Introduction	166
13.2 Environmental Modeling and Related Tools	167
13.3 Extreme Learning Machine	169
13.4 Process Informatics	170
13.5 Bankruptcy prediction	171
<i>Publications of the Adaptive Informatics Research Centre</i>	
	175