



**Janne Toivola M.Sc.**

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## Introduction

After studying the use of *Hidden Markov Models* (HMM) and more general *Dynamic Bayesian Networks* (DBN) in time series data analysis, my research concentrates on various methods at the intersection of the fields of machine learning, pattern recognition, data mining, probabilistic reasoning, graphical models, parallel and distributed computing, and streaming time series data.

The department and the research group are involved in modeling data from multiple sources and their joint analysis. In addition to that, it is worthwhile to model also the dependency on temporal context. One example is distributed probabilistic reasoning to perform information fusion, knowledge discovery, change or novelty detection etc. processing in wireless sensor nodes, instead of the traditional way of collecting the raw data to a single computer to perform the analysis.

## Research topics

The topics for studies and research are: learning structure or causal relationships in probabilistic graphical models, inference with continuous variables, methods for approximate inference, real-time/online and fixed-lag reasoning, distributed and parallel computing, and hierarchical models. Currently, I'm applying the mentioned techniques in a research project (<http://mide.tkk.fi/ISMO>) by developing data analysis methods for structural health monitoring with wireless sensor networks.

Both the multidisciplinary research project at TKK and an international summer school on knowledge discovery for ubiquitous computing (KDUbiqu) have helped in gaining a deeper involvement with current and future research communities.

## Planned postgraduate studies

The major subject (T-module) of the studies is Computer and Information Science (Informaatiotekniikka, T101Z) and the minor subject (S-module) is Software Technology (Ohjelmistojärjestelmät, T014Z). The courses have already been completed. The initial topic of the thesis is "*Probabilistic reasoning in sensor networks*" and the initial goal is to graduate in four (4) years.

The work will be carried out in the Pattern Discovery group at the Department of Information and Computer Science. Academy Professor Heikki Mannila is the supervisor and chief research scientist Jaakko Hollmén (D.Sc.) is the instructor. Currently, most of the funding comes from the ISMO project.

Module Y courses (general subjects):

T-0.7050	Introduction to Postgraduate Studies in CS	2 cr	hyv
Mat-1.3011	Tieteen historia I	2 cr	hyv
Mat-1.3012	Tieteen historia II	3 cr	hyv
Mat-2.1197	Filosofia ja systeemiajattelu	3 cr	4

Module S courses (minor subject):

T-106.6200	Special course in software techniques: Advanced Data Structures	5 cr	5
T-106.6200	Special course in software techniques: Software Architectures	6 cr	3

Module T courses (major subject):

T-61.5060	Algorithmic methods of data mining	5 cr	5
T-61.5130	Machine Learning and Neural Networks	5 cr	5
T-61.5140	Machine learning: Advanced probabilistic methods	5 cr	5
T-61.6010	Special course in Computer and Informations Science I: High-dimensional data analysis: from optimal metrics to feature selection	6 cr	4
T-61.6020	Special course in Computer and Information Science II: Machine learning, basic principles	5 cr	hyv
T-61.6040	Special course in Computer and Informations Science IV: Information Networks	6 cr	4
T-61.6070	Special course in bioinformatics I: Modeling of biological networks	7 cr	5
T-61,Z	Postgraduate studies: The 2nd European summer school on knowledge discovery and ubiquitous computing	3 cr	hyv