Helsinki Institute for Information Technology HIIT

Annual Report 2007

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HELSINKI
INSTITUTE FOR
INFORMATION
TECHNOLOGY

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Yliopistopaino, Helsinki 2008

Cover photo: Kai Kuikkaniemi plays a video game (FUGA research project). Photo by Olli Pitkänen.
Lay-out: Visa Noronen

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Executive Summary

During its eight year of operation HIIT continued and expanded its work mainly organically. The total budget for 2007 was 7.5 million Euro with 200 researchers and staff members. During the year, HIIT researchers produced 184 publications and nine doctoral theses, setting a new record in both respects. The institute operates in three locations: Spektri Business Park (next to TKK campus), Otaniemi (TKK campus) and Kumpula (UH campus). Administratively, HIIT consists of the Advanced Research Unit (ARU) in TKK and the Basic Research Unit (BRU) in UH.

Year 2007 continued the transition period of 2006 - 2008 for implementing the new strategy and structure of HIIT as decided in 2005. During the year, the new administrative structure and processes were fully adopted. With this, the administrative division to units was in practise superseded with the more streamlined matrix structure of research programmes and research groups.

Major initiatives of 2007 included preparation of proposals for the EU's new 7th framework programme and participation in the preparation of the Strategic Centre of Excellence in Science, Technology and Innovation in ICT (in Finnish, ICT SHOK). Both initiatives will bear fruit in 2008.

HIIT's research was assessed in June 2007 as part of the national assessment of computer science research in Finland conduced by the Academy of Finland. The assessment report commented on the work of the institute generally favourably, and recommended further emphasis in international recruitment, clear processes for directing the growth and evolution of the institute, and linking the development to national research and industrial strategy.

Highlights of the research in HIIT during 2007 include the following:

- Ubiquitous Interaction group created CityWall, a multi-touch display featuring user-generated digital media arranged into themes and events. CityWall was installed in downtown Helsinki in April 2007 and has been in continued use since.
- Distributed Applications group developed a distributed platform for P2P web applications, the Fusion architecture, and demonstrated its utility in serverless Web applications
- For the task of data gathering in sensor networks, Geru project developed a local algorithm with best possible approximation guarantee. Local algorithms provide high scalability and fault tolerance in distributed systems.
- CoSCo group opened at aino.hiit.fi a prototype of a novel, content-based search engine for the Finnish web consisting of about 15 million documents. This effort also gave birth to an efficient web crawler, HooWWWer, available as open-source software at cosco.hiit.fi/search/hoowwwer/.

Martti Mäntylä
Professor, Research Director
Advanced Research Unit

Esko Ukkonen
Professor, Research Director
Basic Research Unit

HIIT is a joint research institution of Helsinki University of Technology (TKK) and the University of Helsinki (UH).

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1 HIIT in Brief

The Helsinki Institute for Information Technology HIIT conducts world-class research on future information technology. Its research ranges from fundamental methods and technologies to novel applications and their impact on people and society. HIIT's key competences are in Internet architecture and technologies, mobile and human-centric computing, user-created media, analysis of large sets of data, and probabilistic modeling of complex phenomena.

HIIT combines different styles of research: basic, strategic and innovation-oriented field research. HIIT is multidisciplinary, with scientists from computer, behavioural and social sciences, as well as humanities, design, and art. The projects are conducted with private companies, universities and research institutions.

HIIT is a joint research institution of the University of Helsinki (UH) and Helsinki University of Technology (TKK). It is located in three different sites in the Helsinki Metropolitan area. The institute is lead by Professor Martti Mäntylä and Professor Esko Ukkonen. They oversee the work of nearly 200 researchers.

HIIT partners with several international and Finnish companies as well as with universities and research institutions in Europe, North America and Asia. Through a long-term partnership with University of California, Berkeley, USA, HIIT maintains several visiting researchers in California.

HIIT research is funded by the Helsinki University of Technology (TKK), the University of Helsinki (UH), Tekes, the Academy of Finland and other foundations financing Finnish hi-tech research, the European Union (EU) and private companies.

2 Review of Year 2007

2007 was HIIT's eight year of operation.

The implementation of HIIT's strategy continued during the year on the basis of the decisions that HIIT Board reached in 2005. A major step in this was the move of the Ruoholahti Unit to its new premises in the Pilotti building in Spektri Business Park just next to the TKK campus in Otaniemi. It is expected that the resulting proximity to TKK's research groups will foster new visibility and co-operation.

The adoption of the new organisational model already launched in 2006 was fully realised during the year. With this, the operation, administration, and reporting of the HIIT are now organised according to the research programmes, and conduced through institute-wide internal administrative bodies.

A major activity of the first half of the year was the preparation of initiatives for the 7th Framework Programme of the European Union, the first Call of Proposals of which occurred in April 2007. HIIT prepared a total of seven proposals for the call; significantly, it acted as the coordinator of three of these. Several of the proposals were well received in the subsequent evaluations and negotiations. In particular, the strategically important Publish-Subscribe Internet Routing Paradigm project was accepted and was subsequently launched on 1.1.2008. Further success resulted from proposals submitted to the 2nd call in October 2007, resulting in two accepted projects launching later in 2008. With these developments, HIIT is now firmly integrated with European research activities. A new funder of HIIT, the U.S. National Institutes of Health, commenced funding a bioinformatics project.

Another major activity during the second half of 2007 was HIIT's participation in the initiative to establish a national Strategic Centre of Excellence in Science, Technology and Innovation (in Finnish the acronym is SHOK) for the ICT domain (ICT SHOK). The SHOKs are intended to form a new instrument for facilitating long-term research co-operation between academia and industry. When fully established, the volume of ICT SHOK is expected to be several hundred person-years per year.

The ICT SHOK preparation progressed along four technical domains: Future Internet, Flexible Services, Device Interoperability, and Co-operative Traffic. HIIT was the academic coordinator of the Future Internet programme, facilitating the preparation of the Strategic Research Agenda (SRA) of the programme and the build-up of the research consortium. Significantly, the SRA was submitted to the Euro-

pean Commission as the Finland's position to Future Internet research in EU programmes. HIIT participated also actively in the Flexible Services programme, coordinated by researchers from the University of Helsinki.

Early in 2007, HIIT researchers also submitted an initiative to establish a research programme on human-centered ubiquitous computing to the Academy of Finland. Somewhat fortuitously, the initiative led to rapid impact by being merged with another initiative already in progress at the Academy of Finland. As a result, the initiative was accepted and the programme will be launched in 2008.

HIIT's co-operation with the University of California at Berkeley reached another milestone in September 2007 with the formal launch of the new Finland-ICSI Center for Novel Internet Architectures (FICNIA). Hosted by HIIT and the International Computer Science Institute at Berkeley, the mission of the Center is to conduct fundamental research in novel Internet architectures, aiming at a significant contribution towards the future development of the Internet. It will operate through joint research activities, research visits, and events.

The Academy of Finland conducted a national review of computer science research in Finland during the summer of 2007. The review commented on the work of the institute quite favourably. It specifically recommended further emphasis in international recruitment of faculty and senior level researchers, clear processes for the mechanisms for the overall direction of growth and evolution of the institute, and linking the evolution to informing and/or being informed by national research and industrial strategy.

The publication record of HIIT researchers developed favourably during the year. We were especially pleased to see the growing impact of HIIT's work in the top conferences and publications. A total of nine HIIT researchers received their doctoral degrees during the year, a new record for the institute.

Total numbers	**2007**	**2006**	**change**
Funding M€	7.5	6.6	+14 %
Person-years	129	119	+8 %
Original publications	187	184	+2 %

3 Important Events

February

7 February
Lecture by Prof. Vladimir Mazalov, Russian Academy of Science: Nash Equilibrium in Networking Games
HIIT Ruoholahti, Helsinki

15 February
EcoPower Workshop
HIIT Ruoholahti, Helsinki

28 February
Final Seminar of the ProAct research programme of the Academy of Finland. The evaluation report of the programme praised the scientific impact of the programme, and made several recommendations to Academy based on the positive experience.
HIIT Kumpula, Helsinki

March

8 March
Prof. Pekka Himanen's report The Finnish Dream (Suomalainen unelma) was published. The report characterises innovation driven economy and society, and studies the underlying culture of creativity.

14-16 March
A joint research seminar by the HIIT's Network Society research programme and the department of Media Technology and Graphic Arts from the Royal Institute of Technology (KTH).
On a ferry between Helsinki and Stockholm

April

6 - 7 April
The HIIT personnel located previously at HTC Helsinki in Ruoholahti moved to the Pilotti building at Spektri Business Park next to TKK campus in Espoo.

May

13 May
IMUx workshop by the HIIT and Nokia Research Centre
Toronto, Canada

21 May
The City of Helsinki Science Award was conferred to Professor Esko Ukkonen in recognition of his work on methods for processing large and complex data sets.

25 May
The HIIT started to demonstrate in public the CityWall, a large multi-touch display.
Lasipalatsi, Helsinki

27 May – 2 June
Summer School on Algorithmic Data Analysis
Hotel Rantapuisto, Helsinki

28 May – 1 June
the 2nd Helsinki-Rutgers Ph.D. Student Workshop on Spontaneus Networking
HIIT Kumpula, Helsinki

June

1 June
The Finnish Information Processing Association gave its award for the best doctoral thesis in computer science for 2006 to Dr.

Risto Sarvas from HIIT for his dissertation Designing User-Centric Metadata for Digital Snapshot Photography.

19 June
Guest Lecture by Prof. Roderick Murray-Smith, Department of Computing Science, Glasgow University, Scotland & Hamilton Institute, NUI Maynooth, Co. Kildare, Ireland: Models of Continuous Uncertain Interaction
HIIT Otaniemi, Espoo

September

4 September
Guest Lecture by Dr. Nicholas Weaver, International Computer Science Institute Berkeley, USA: Intrusion Detection in the Multicore Institute
HIIT Spektri, Espoo

7 September
Future Internet seminar with Dr. Anthony J. Tether, Director, Dr. Robert Leheny, Deputy Director, Mr. Ronald Kurjanowicz, Chief of Staff, and Ms. Kimberly Garnett, assistant to the Director, Defense Advanced Projects Agency
HIIT Spektri, Espoo

12 September
Guest Lecture by Phokion G. Kolaitis, IBM Almaden Research Center, San Jose, USA: Schema mappings and data exchange
HIIT Kumpula, Helsinki

26 – 27 September
Opening Ceremony and Seminar of the Finland-ICSI Center for Future Internet Architecture
ICSI, Berkeley, USA

October

2 October
HIIT-NRC workshop
Nokia Research Center, Helsinki

9 October
NordicHIP Seminar
HIIT Spektri, Espoo

12 October
HIIT Seminar by Dr. Thore Husfeldt, Computer Science Department, Lund University: Inclusion-Exclusion in Combinatorial Optimisation

24 October
Workshop on legal issues in digital economy
In cooperation with ICRI and IBBT at K.U.Leuven, Leuven, Belgium

November

9 November
HIIT Seminar by Anna Pernestål, KTH School of Electrical Engineering, Automatic Control: Bayesian Fault Diagnosis - Utilizing Data and Prior Information

12 November
Guest Lecture by Dimitris Mavroeidis, Athens University of Economics and Business, Greece: Exploiting Semantic Thesauri in Text Classification and Information Retrieval using SVMs.
HIIT Kumpula, Helsinki

14 November
Guest Lecture by Dimitris Mavroeidis, Athens University of Economics and Business, Greece: Stability based Sparse LSI/PCA, with Extensions to K-Means and Spectral Clustering.
HIIT Kumpula, Helsinki

4 Research

4.1 Algorithmic Data Analysis (ADA)

The mission of the data analysis research programme in HIIT is to develop useful algorithmic data analysis methods for other sciences and for industry. The work involves both basic research in computer science and applied work on problems arising from applications.

Research Challenges

Example challenge 1:
Learning network structures. Network-like structures are numerous in various domains: mo lecular processes, social interactions, Internet etc. New computational methods are needed for finding the structure of such networks and for understanding their dynamic behaviour.

Example challenge 2:
The vocabulary, grammar and history of genomes. The genome codes information identifying the species and the individual. Computational techniques are needed for the description and analysis of variation. Segmentation methods using recurrent sources can be used to find components with similar underlying structure; latent variable techniques for sequences can also be used.

Example challenge 3:
Computational modelling of ecosystems. The environment can be measured in many ways on different scales ranging from remote-sensing based satellite images of landscapes to chemical compositions of nutrients in individual plants. The complex interactions in both the spatial and temporal domains across different scales are largely unknown, and their importance is growing.

Example challenge 4:
Sensor and context data management. To realise a vision of ubiquitous information processing, services and applications make use of a wide variety of context data, including sensor readings. The challenges we are working on are to efficiently gather sensor data, to perform context reasoning, and to take into consideration the resource constraints of the devices and the distributed nature of the environment.

Programme Management

Programme Director: Academy Professor Heikki Mannila

Programme Manager: Research Coordinator Greger Lindén

Programme Management Group:
- Academy Professor Heikki Mannila
- Senior Researcher Patrik Floréen
- Chief Research Scientist Jaakko Hollmén
- Professor Samuel Kaski
- Professor Hannu Toivonen
- Professor Esko Ukkonen

Research Groups

Adaptive Computing
- Senior Research Scientist Patrik Floréen

Combinatorial Pattern Matching
- Professor Esko Ukkonen

Data Mining: Theory and Applications
- Academy Professor Heikki Mannila

Discovery Group
- Professor Hannu Toivonen

Parsimonious Modelling
- Chief Research Scientist Jaakko Hollmén

Statistical Machine Learning and Bioinformatics
- Professor Samuel Kaski

4.1.1 Algorithmic and Probabilistic Methods in Data Mining

Project leader: Mannila, Heikki
Research group(s): Data Mining, Discovery Group, Parsimonious Modelling Data Analysis
Researchers: Toivonen, Hannu; Hollmén, Jaakko; Leino, Antti; Tatti, Nikolaj; Bingham, Ella; Schönauer, Stefan; Puolamäki, Kai; Heikinheimo, Hannes; Ukkonen, Antti; Haiminen, Niina; Junttila, Esa
Schedule: 2002-01-01- … (no ending date)
Co-operation units: -
Funding: Academy of Finland; graduate schools; HIIT Basic Research Unit basic funding
Keywords: -
Research programme: -
WWW page and publications: -

The project develops methods for the exploratory data analysis of large and high-dimensional data sets. One of the themes has been finding frequent patterns in large collections of data. The pattern classes include ordered and unordered patterns. Currently areas of interest include condensed representations and the combination of combinatorial and probabilistic techniques for approximating distributions. For sequential data, interests are in algorithms for sequence segmentation under various restrictions and in discovery of order from unordered data sets. Further, issues in subspace clustering and spectral methods have also been studied.

In 2006 there were several interesting developments. The methods on ordering seriation problems in paleontological and other applications advanced very considerably, and the publications were accepted to important forums. The work on finding partial orders from data also advanced. The novel problem setting of mining chains of relations has great promises, as well as the work on condensed representations and on spatial clustering.

4.1.2 Analysis of Dependencies in Environmental Time-series Data (AD/ED)

Project leader: Hollmén, Jaakko
Research group(s): Parsimonious Modelling
Researchers: Sulkava, Mika; Toivola, Mikko
Schedule: 2007-01-01 ... 2010-12-31
Co-operation units: Finnish Forest Research Institute (Metla), Finland; Department of Biology, University of Antwerp, Belgium
Funding: Academy of Finland
Keywords: -
Research programme: -
WWW page and publications: -

Data analysis aims at identifying general laws about phenomena under observation. In environmental informatics, the interest is in natural phenomena occurring in our environment based on an available data sets. The interesting phenomena are described by dynamic changes or responses to the changing conditions in the environment. Therefore, one of the central tools in describing changes in time are temporal models, or time-series models. Time series models are usually based on some form of assumptions about what the significant variables are and what kind of time scales are needed to capture the inherent dynamics of the system. In this research, we propose identifying these kind of dependencies across environmental time-series data, without accurate a priori knowledge of the underlying dependency structures. Methodwise, parsimonious or sparse representations for time-series models are sought in the high-dimensional model space. Data analysis algorithms for identifying time-series models with non-contiguous autoregressive variables will be developed. Other fundamental problems that will be investigated are algorithmic methods for identifying interaction between different measured variables in a multi-dimensional time-series and the interaction between time-series measured in spatially different places.

4.1.3 BioSapiens European Network of Excellence

Project leader: Ukkonen, Esko
Research group(s): Combinatorial Pattern Matching
Researchers: Kivioja, Teemu; Palin, Kimmo
Schedule: 2004-01-01 … 2008-12-31
Co-operation units: Several units
Funding: European Commission FP6 NoE
Keywords: Bioinformatics, data mining, genome annotation
Research programme: European Commission FP6 NoE
WWW page and publications:
www.biosapiens.info/page.php?page=home

BioSapiens is a Network of Excellence, funded by the European Union's 6th Framework Programme, and made up of bioinformatics researchers from 25 institutions based in 14 countries throughout Europe.

The objective of the BioSapiens Network of Excellence is to provide a large-scale, concerted effort to annotate genome data by laboratories distributed around Europe, using both informatics tools and input from experimentalists.

The Network will create a European Virtual Institute for Genome Annotation, bringing together many of the best laboratories in Europe. The institute will help to improve bioinformatics research in Europe, by providing a focus for annotation and by the organisation of European meetings and workshops to encourage cooperation, rather than duplication of effort.

An important aspect of the network activities is to try and achieve closer integration between experimentalists and bioinformaticians, through a directed programme of genome analysis, focused on specific biological problems. The annotations generated by the Institute will be available in the public domain and easily accessible on the web. This will be achieved initially through a distributed annotation system (DAS), which will evolve to take advantage of new developments in the GRID.

4.1.4 Computational Data Fusion of Multiple Biological Information Sources and Background Data (MULTIBIO)

Project leader: Kaski, Samuel
Research group(s): Statistical machine learning and bioinformatics
Researchers: Caldas, José; Lahti, Leo; Salojärvi, Jarkko
Schedule: 2007-10-01 … 2010-09-30
Co-operation units: Prof. Sakari Knuutila's group, Laboratory of Cytomolecular Genetics; Prof. Jaakko Kangasjärvi's Plant Stress group, Finnish Centre of Excellence in Plant Signal Researc; Dr. Alvis Brazma's Microarray group, European Bioinformatics Institute
Funding: Tekes
Keywords: machine learning, functional genomics, data integration, biomedical applications
Research programme: -
WWW page and publications:
www.cis.hut.fi/projects/mi/multibio/index.shtml

A current problem in biological and medical research is how to use existing biological knowledge and heterogeneous experimental data in making inferences on new data. We study new computational methods and theory for the fusion of multiple biological information sources with partially-relevant background data from existing and new databanks. We argue that using the available public or private background information from hundreds of different situations or conditions, it is potentially possible to both complement the existing scarce data and to focus the analysis on relevant variables.

The project complements the task-dependent bioinformatics methods, which are naturally required in all biological and medical research problems as well, with methods that address a key underlying statistical limitation in current studies using high-throughput measurement techniques: large p, small n. It is very hard to make trustworthy computational models or statistically significant diagnoses based on only few samples (small n) when the number of studied genes or metabolites (p) is large.

4.1.5 Computational Methods for the Analysis of Palaentological Data

Project leader: Mannila, Heikki
Research group(s): Data Mining
Researchers: Mannila, Heikki; Heikinheimo, Hannes; Puolamäki, Kai; Bingham, Ella; Ukkonen, Antti
Schedule: 2005-01-01 ... 2008-12-31
Co-operation units: -
Funding: Academy of Finland, graduate schools
Keywords: -
Research programme: -
WWW page and publications: -

The project develops computational methods for the analysis of palaentological and other ecological data. The project has developed new dating methods based on spectral ordering and MCMC methods. A method using MCMC and the so-called Bernoulli model were used to discover errors in the data.

The hierarchical structure of modern mammal data was studied with the help of distance measurements based on distribution, and the automatic learning of the hierarchy was analysed. The project is a cooperation with the Department of Geology at the University of Helsinki.

The work lead to several important publications in 2006. The paper on seriation methods based on spectral techniques was published in Paleobiology, and a paper on MCMC tools for estimating the ordering of sites appeared in PLoS Computational Biology. The work was extended to the study of ecological datasets, where work on clustering methods showed interesting spatial coherence on mammalian species distributions.

4.1.6 Computational Methods for the Study of Variation in Language

Project leader: Mannila, Heikki
Research group(s): Data Mining
Researchers: -
Schedule: -
Co-operation units: Department of English, University of Helsinki
Funding: -
Keywords: -
Research programme: -
WWW page and publications: -

The project develops tools for the analysis of large datasets on linguistic change.

4.1.7 Computational Translation from Model Organisms to Humans (TRANSCENDO)

Project leader: Kaski, Samuel
Research group(s): Statistical Machine Learning and Bioinformatics
Researchers: Kaski, Samuel; Nikkilä, Janne; Huopaniemi, Ilkka; Ermolov, Andrey
Schedule: 2006-01-01 … 2008-12-31
Co-operation units: VTT Biotechnology (M. Oresic); VTT Information technology (A. Pesonen); University of Turku (E. Savontaus)
Funding: Tekes / MASI programme
Keywords: Bioinformatics, Diabetes, Human pathophysiology, Machine learning, Metabolomics
Research programme: -
WWW page and publications: sysbio.vtt.fi/transcendo/

The overall objective of the project is to build a comprehensive modelling and biosimulation framework for studying human pathophysiology in silico, with the initial focus area of Diabetes. We aim to combine a variety of mathematical modelling approaches for these tasks, including semantic and probabilistic modelling, and biosimulation. We will apply our methodology to practical problems of direct relevance to drug discovery. The results and deliverables of TRANSCENDO project are directly applicable to drug discovery, nutrition, healthcare, and bioinformatics domains. Given our approach uniquely combines several levels of modelling (semantic, probabilistic, and biosimulation), we expect our approach will result in novel solutions for modelling complex systems and phenomena.

4.1.8 Data Fusion in Bioinformatics (MudFun)

Project leader: Kaski, Samuel
Research group(s): Statistical machine learning and bioinformatics
Researchers: Klami, Arto; Lahti, Leo; Oja, Merja; Venna, Jarkko; Nikkilä, Janne; Peltonen, Jaakko
Schedule: 2004-01-01 … 2007-12-31
Co-operation units: Sakari Knuutila's research group, Laboratory of Cytomolecular Genetics, Haartman Institute; Eero Castrén's research group, Neuroscience Center, University of Helsinki
Funding: Academy of Finland, SYSBIO 2004-2007
Keywords: machine learning, functional genomics, data integration, biomedical applications
Research programme: -
WWW page and publications: www.cis.hut.fi/projects/mi/sysbio/

Combining multiple data sources in functional genomics for improving genome-wide inferences (MUDFUN) is a research consortium funded by the Academy of Finland as a part of a research program on Systems Biology and Bioinformatics (SYSBIO).

We address a fundamental data-analytic limitation of genome-wide microarray measurements. The number of genes that can be measured at a time is already huge but the number of samples (microarrays) is small and limited by the measurement cost and sample availability. Hence, the relative number of representative samples per gene is always very small, and the problem will persist; in new experimental settings there never exists representative data a priori. This makes accurate data analysis difficult and increases the chances of false discoveries when targeting a holistic view of the cell, based on the noisy high-dimensional data.

Our bioinformatics research problem is how to take advantage of existing, partially representative data sets of

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different types to support inferences in biological and medical questions. If this problem can be solved, data analysis methods could use the accumulating body of data, part of which may be publicly available, in supporting genome-wide inferences in new settings and research questions.

The developed methods will be applied in a representative set of research problems in two biomedical areas: cancer research and neuroscience.

4.1.9 Genetic Analysis of Schizophrenia Phenotype

Project leader: Mannila, Heikki
Research group(s): Data Mining
Researchers: Parviainen, Pekka; Koivisto, Mikko; Wessman, Jaana
Schedule: 2006-05-01... 2007-12-31
Co-operation units: -
Funding: Orion
Keywords: -
Research programme: -
WWW page and publications: -

The project developed computational tools for the analysis of large phenotypic databases related to schizophrenia.

During the year 2007, the tools developed were applied to real data, and the results were discussed with the collaborators at KTL and Orion.

4.1.10 Inductive Queries for Mining Patterns and Models (IQ)

Project leader: Mannila, Heikki
Research group(s): Data Mining
Researchers: Mannila, Heikki; Bingham, Ella
Schedule: 2006-08-31... 2008-08-31
Co-operation units: Universiteit Antwerpen, the Netherlands; Institut National des Sciences Appliquées de Lyon, France; Institute Josef Stefan, Slovenia
Funding: EU
Keywords: -
Research programme: -
WWW page and publications: iq.ijs.si

One of the main challenges of data mining is developing a common theoretical framework. Inductive databases, i.e. databases for data mining with a declarative approach to data analysis, offer a promising approach to this problem.

The IQ project studies the theoretical basis of inductive databases and develops inductive databases for various data analysis problems. They are being applied to biological problems.

4.1.11 Knowledge Discovery in Biological Databases (Biomine)

Project leader: Toivonen, Hannu
Research group(s): Discovery Group
Researchers: Eronen, Lauri; Hintsanen, Petteri; Kulovesi, Kimmo; Sevon, Petteri; Toivonen, Hannu; Yrjänäinen, Sampo
Schedule: 2005-03-01 … 2008-12-31
Co-operation units: Co-operation units: Jurilab Ltd; Biocomputing Platforms Ltd; GeneOS Ltd; Department of Medical Genetics, University of Helsinki; Karolinska Institutet, Stockholm; CSC; VTT Biotechnology
Funding: Tekes; companies; Basic Research Unit; University of Helsinki
Keywords: Bioinformatics, data mining, link analysis and discovery
Research programme: -
WWW page and publications: www.hiit.fi/ada/biomine

The project develops methods and tools for the analysis of public bio-databases (sequences, proteins, interactions, articles etc). With their help, bio-scientists can enhance their own data, discover previously unknown connections and analogies to public databases, and aim resources at the most promising objects of further study. The main application focus is on further analysis of candidate genes found in gene mapping. The project has studied the presentation of biological information as a graph, where the nodes represent different concepts (e.g. genes, proteins, tissue, phenotypes, cellular component) and the edges represent the relations between them (e.g. the connection between gene and biological process reported in a gene database). The project has developed methods for the analysis of such graphs and the automatic searching and visualisation of such relations between the concepts.

4.1.12 Methods for Combinatorial Construction, Classification, and Approximation (MOCCA)

Project leader: Kaski, Petteri
Research group(s): -
Researchers: -
Schedule: 2007-01-01 … 2009-12-31
Co-operation units: -
Funding: Academy of Finland
Keywords: -
Research programme: -
WWW page and publications: -

Project description and main developments in 2007: The objective of the project is to carry out fundamental research at the intersection of combinatorics and theoretical computer science. Among research topics to be considered are:

1. combinatorial and probabilistic methods in algorithmics and computational complexity theory, in particular, in the study of exact solvability and approximability combinatorial optimization problems;
2. computational methods for attacking existence, enumeration, and classification problems for finite combinatorial objects, in particular, codes, designs, and extremal graph problems;
3. topics in combinatorics stimulated by classification results.

In 2007 some of the more specific topics of study were:

- the "fast subset convolution" framework based on the fast zeta and Moebius transforms on the lattice of subsets of a finite set
- applications of fast subset convolution to exact algorithms for e.g. computing a minimum Steiner tree and the Tutte polynomial of a graph
- local approximability and inapproximability results for various fractional scheduling problems
- engineering an improved graph canonical labeling algorithm based on the individualization and refinement scheme
- classification of the biplanes with k=11 and the unitals with 28 points
- enumeration of the one-factorizations of the complete graph of order 14.

4.1.13 Molecular Markers for Asbestos-exposure Related Lung Cancer

Project leader: Hollmén, Jaakko
Research group(s): Parsimonious Modelling
Researchers: Toivola, Janne
Schedule: 2005-05-01 ... 2008-04-30
Co-operation units: Finnish Institute of Occupational Health (FIOH), Finland; HUSLAB, Finland
Funding: Tekes
Keywords: bioinformatics, data mining, data analysis, microarray, functional genomics
Research programme: -
WWW page and publications: -

The broader goal is to discover molecular markers for asbestos-exposure related lung cancer. To help in this endeavour, the aim of our research is to develop novel data-analysis methods, models and algorithms for the analysis of high-throughput measurements. Specifically, the interest lies in the analysis of microarray based gene expression and gene copy number change measurements. These measurements can be combined or additionally augmented by data sets from publically available databases. The search for the diagnostic variables can be considered as a problem of parsimonious modeling, in which a few informative variables are sought amongst a large number of available measurements. These informative variables can then be used in diagnostics of asbestos-exposure related lung cancer.

4.1.14 New Computational Techniques for Analysing the Structural and Functional Landscape of the Mammalian Genomes (CompGenome)

Project leader: Mannila, Heikki
Research group(s): Data Mining
Researchers: Gionis, Aristides; Haiminen, Niina; Koivisto, Mikko; Kollin, Jussi; Wessman, Jaana
Schedule: 2003-11-01 ... 2007-12-31
Co-operation units: National Public Health Institute (KTL), Finland; Finnish Genome Center, Finland; Karolinska Institute, Sweden; Department of Medical Genetics Research, University of Helsinki, Finland
Funding: Academy of Finland
Keywords: -
Research programme: -
WWW page and publications: www.cs.helsinki.fi/group/genetics

The project studies species-specific and inter-species genetic and functional varieties. The goal is to understand multifactorial diseases, among others. The biological themes include haplotype structures, large- scale genetic variations, phenotype clustering, and gene expression. The main computational themes are probabilistic modelling and MCMC methods, data mining and pattern discovery, and combinatorial algorithms. The project, a collaboration with the Finnish Genome Centre, the National Public Health Institute and Karolinska Institutet in Stockholm, belongs to the Academy of Finland's SYSBIO programme.

During the year 2007, the project continued segmenting genomes, detecting large-scale structural variation, and modelling multidimensional phenotypes. The results obtained are interesting especially from a modelling and computational point of view.

4.1.15 Optimising Data-gathering in Resource-constrained Networks (Geru)

Project leader: Floréen, Patrik
Research group(s): Adaptive Computing
Researchers: Suomela, Jukka; Musto, Topi; Kaski, Petteri
Schedule: 2007-01-01 … 2009-12-31
Co-operation units: -
Funding: Academy of Finland
Keywords: sensor networks, distributed algorithms, computational complexity
Research programme: -
WWW page and publications: www.hiit.fi/ada/geru

The Geru project carries out basic research on data gathering in sensor networks. A typical example of the kind of problems that we study is scheduling the activities of the nodes in a network. We may wish to prolong the lifetime of a battery-powered network by switching off the nodes according to a schedule, for example, or to satisfy some data transmission demands in a wireless network in the shortest possible time. Such problems are closely related to traditional combinatorial problems, such as partitioning and colouring graphs. Typically, these problems are computationally hard. Therefore, we focus on approximation algorithms, with which we are able to efficiently come up with a solution that is not necessarily optimal but provably near-optimal.

In 2007 we have studied, among others, local algorithms. These are distributed algorithms in which the operation of a network node depends solely on the input that was available at system startup in the immediate surroundings of the node. Through our work, we have gained new knowledge of the kinds of computational problems that can or cannot be solved by local algorithms.

4.1.16 Personalised Ubiservices in Public Spaces (PUPS)

Project leader: Floréen, Patrik
Research group(s): Adaptive Computing, Ubiquitous Interaction
Researchers: Nurmi, Petteri; Björkskog, Christoffer; Boström, Fredrik; Kukkonen, Joonas; Lagerspetz, Eemil; Vähäkangas, Taneli; Myllymäki, Petri; Laine, Tei; Liu, Tianyan; Jokipii, Matti; Kontkanen, Petri; Lahtinen, Jussi; Perkiö, Jukka; Silander, Tomi; Wettig, Hannes; Kurvinen, Esko; Hasu, Tero; Peltonen, Peter; Saarikko, Petri; Ailisto
Schedule: 2007-08-01 … 2009-07-31
Co-operation units: -
Funding: Tekes, companies
Keywords: context-awareness, personalisation, user research, user interface design
Research programme: Tekes Ubicom programme
WWW page and publications: www.hiit.fi/ada/pups

In the project we design, implement and field trial prototype ubicomp applications that combine context-awareness with personalisation in order to provide a better user experience in everyday tasks in public spaces. We undertake probabilistic modelling, make user experience research, develop services and prototypes, and design business models. Our target time to market for full-fledged applications is a few years ahead. The applications will run on the user's own mobile devices. The two-year project started in August 2007. The research partners are HIIT (ARU and BRU) and VTT. The company partners are Bitlips, Ekahau, Elisa, Idean Enterprises, K-Plus, Nokia, Ramblas Digital, Tuulia International, UpCode, as well as the Finnish Federation of the Visually Impaired.

The project has two application areas: shopping services for customers in Itäkeskus K-Citymarket (Massive) and an aggregate application for mobile context-aware and personalised digital media (Funnelry). We have shopping data to our disposal. We have made data analysis of the data and we build user models from it. Different available applications by project partners are integrated into our services to be developed.

This project is reported in the Annual Report twice, as parts of ADA and NS research programmes.

4.1.17 Probabilistic Prolog (ProbLog)

Project leader: Toivonen, Hannu
Research group(s): Discovery Group
Researchers: Toivonen, Hannu; Yrjänäinen, Sampo
Schedule: 2007-01-01 … 2008-05-31
Co-operation units: University of Leuven, Belgium
Funding: HIIT, University of Helsinki
Keywords: data mining, probabilistic logic programming, link analysis and discovery
Research programme: -
WWW page and publications: www.hiit.fi/discovery

We first introduced and now develop ProbLog, a probabilistic extension of Prolog. A ProbLog program defines a distribution over logic programs by specifying for each clause the probability that it belongs to a randomly sampled program. The semantics of ProbLog is then defined by the success probability of a query.

The key contributions so far are an effective solver for computing success probabilities, the formulation and a practical solution of the theory compression task for ProbLog, and an explanation-based learning setting using ProbLog.

Recent work integrates ProbLog with the probabilistic Biomine graph database of biological information.

4.1.18 Semantic Interpreter Widened Experience (Stepwise)

Project leader: Floréen, Patrik
Research group(s):
Researchers: Nurmi, Petteri; Boström, Fredrik; Liu, Tianyan; Oikarinen, Tiina-Kaisa
Schedule: 2006-09-01 … 2007-08-31
Co-operation units: Fishpool
Funding: Nokia Research Centre
Keywords: -
Research programme: -
WWW page and publications: www.hiit.fi/ada/stepwise

In this subcontracted project for Nokia Research Center, the aim was to prepare context-aware services with the use of statistical methods.

We developed an adaptive user interface “Capricorn” for mobile widgets. The web-based and platform-independent interface uses various adaptive web techniques to help the user manage her widgets. To name a few examples, we use collaborative filtering to recommend suitable widgets and we dim infrequently used widgets. The system is also able to provide context information to widgets, which can then adapt their contents on the basis of this. Examples of such services are-location-aware weather forecasts and location-aware news feed.

4.1.19 Spatial and Temporal Data Mining

Project leader: Salmenkivi, Marko
Research group(s): Data Analysis
Researchers: Leino, Antti; Hyvänen, Saara; Junttila, Esa
Schedule: -
Co-operation units: Research Institute for the Languages of Finland; Finnish Museum of Natural History, University of Helsinki
Funding: Graduate schools, HIIT Basic Research Unit basic funding
Keywords: -
Research programme: -
WWW page and publications: -

Study of place names, dialects, biodiversity, and climate, for example, results in data sets that have strong spatial and (possibly) temporal components. The research project looks at data mining methods that can be used to find spatial and temporal relationships in high-dimensional data.

Due to their computational cost, Bayesian methods have traditionally been utilized mainly in confirmatory data analysis.

During 2007 we have studied applicability of Bayesian Markov random field models, and Markov chain Monte Carlo methods in preprocessing the data, particularly in modelling the missing data. Our experiments show that the methods are efficient enough to be applied to the large dialect word data, and the preprocessing clearly improves the quality of the results of the subsequent data mining approaches.

4.2 Future Internet

The aim of the Future Internet research programme is to enhance the Internet infrastructure in order to enable efficient, secure and trusted always-on connectivity and services.

The objective is to develop concepts, technologies, and supporting theories and methodologies needed to design and implement future mobile and ubiquitous computing services and products for the Internet of the future.

Research Challenges

The future progress of the Internet is constricted by several bottlenecks: unwanted traffic, choking of the routing system, mobility and multi-homing, compensation and congestion, privacy and attribution, and trust and reputation. The current bottlenecks and deficiencies are limiting the potential utility of the Internet.

The core theme of the Future Internet programme is to find ways to remove these obstacles. These include the creation of new service concepts, context-sensitive services, enabling technologies for building adaptive and reconfigurable applications, personal digital asset management and mobile Internet middleware solutions that address the specific needs of mobile and ubiquitous computing.

Programme Management

Programme Director: pro tem Prof. Martti Mäntylä

Programme Manager: Dr. Kristiina Karvonen

Programme Management Group:
- Adj. Prof. Patrik Floréen
- Adj. Prof. Andrei Gurtov
- Prof. Heikki Hämmäinen
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- Prof. Raimo Kantola
- Dr. Arto Karila
- Dr. Kristiina Karvonen
- Univ. Lect. Markku Kojo
- Prof. Jukka Manner
- Dr. Pekka Nikander
- Prof. Jörg Ott
- Dr. Ken Rimey
- Prof. Sasu Tarkoma
- Prof. Antti Ylä-Jääski

Research Groups

Adaptive Computing
- Dr. Patrik Floréen

Distributed Applications
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Mobile Computing
- Prof. Kimmo Raatikainen, Dr. Ken Rimey, Prof. Sasu Tarkoma

Networking Research
- Dr. Andrei Gurtov, Dr. Pekka Nikander, Dr. Arto Karila, Dr. Kristiina Karvonen

Distributed Networking and Security
- Prof. Antti Ylä-Jääski, Prof. Sasu Tarkoma

4.2.1 Algorithms for Broadband Infrastructure (ABI)

Project leader: Manner, Jukka
Research group(s): Mobile Computing, Comnet
Researchers: Manner, Jukka; Virtamo, Jorma; Aalto, Samuli; Huovila, Teemu; Lassila, Pasi; Liuhto, Lauri; Raatikainen, Kimmo; Susitaival, Riikka
Schedule: 2006-01-01 … 2008-12-31
Cooperation units: VTT Technical Research Centre of Finland; Teletraffic Theory Group of the Networking Laboratory, Helsinki University of Technology; Computer Science Department, University of Helsinki
Funding: Tekes, BaseN, Ericsson, F-Secure, Nokia, TDC Song
Keywords: Wireless access (mesh) networks, Overlay networks, Traffic monitoring and analysis
Research programme: -
WWW page and publications: abi.vtt.fi
virtual.vtt.fi/virtual/abi/publications.htm

ABI (Algorithms for Broadband Infrastructure) is a 3 year project (May 2006 - May 2009). It is one of the strategic projects in the Tekes technology programme GIGA. The funding is mostly provided by Tekes with additional support from Nokia and Ericsson. Other industrial partners include TDC Song, F-Secure and BaseN Corporation. The project studies various kinds of algorithms used in broadband networking and network management. The emphasis is on performance aspects - development of provably effective techniques, and assessment of their performance. The main approach is modelling and analysis, but the project includes also prototype software development and simulation. The project has three focus areas: algorithms for wireless access networks, algorithms for overlay networking, and algorithms for traffic measurement and analysis.

4.2.2 Context-Aware Adaptation of Trustworthy Systems (Trust4All)

Project leader: Floréen, Patrik
Research group(s): -
Researchers: Przybilski, Michael; Vähäkangas, Taneli
Schedule: 2005-10-01 … 2007-12-31
Cooperation units: Nokia Research Center, VTT, TKK, Philips, Eindhoven University of Technology, Leiden University, Océ, Telematica Institute, Centrum voor Wiskunde en Informatika, Solidtech, Robotiker, Fagor, Ikerlan, Visual Tools, Esi, Csem, Saia-Burgess
Funding: Nokia Research Centre
Keywords: component-based software, middleware, security
Research programme: EUREKA ITEA
WWW page and publications: www.hiit.fi/fi/trust4all

The EUREKA/ITEA project Trust4All studied the concept of trust in software architectures. The focus was on context-aware systems, and especially the trust and safety features of such systems. The research was based on the middleware for embedded systems that was developed in the Robocop project and extended in the Space4U project. The project was a joint effort of several European universities and companies. The research project at HIIT/BRU was subcontracted by Nokia Research Center.

In 2007 we continued working on approaches for secure access requirements and integrated them into the Trust4All middleware. We evaluated our models and concepts in the form of demonstrators. In the final phase of the project the concepts and technologies were transferred to Nokia.

4.2.3 Finland-ICSI Center for Novel Internet Architecture (FICNIA)

Project leader: Mäntylä, Martti
Research group(s): Networking Research, Distributed Networking and Security, Mobile Computing
Researchers: Karila, Arto; Karvonen, Kristiina; Koponen, Teemu; Koskela, Joakim; Raatikainen, Kimmo
Schedule: 2007-05-01 ... 2010-04-30
Cooperation units: International Computer Science Institute (ICSI), University of California Berkeley, USA
Funding: Tekes; L M Ericsson
Keywords: Internet architecture, international collaboration, new paradigms, security, trust, privacy
Research programme: -
WWW page and publications: -

The Finland-ICSI Center for Novel Internet Architectures is devoted to exploring ways to improve the current Internet structure to become more secure, reliable and flexible via enhancing the collaboration of Finnish and ICSI researchers in the area of Networking research. The mission of the Center is to conduct fundamental research in novel Internet architectures, aiming at a significant contribution towards the future development of the Internet that addresses its present problems.

During 2007, the operation of the Center was launched in a joint seminar organised in ICSI on Sept. 27, with six presentations from HIIT and four from ICSI. The main technical line of work consisted of HIIT's co-operation with ICSI's Data-oriented Network Architecture (DONA) project. Other work at HIIT focused on trusted overlay networks.

4.2.4 Fuego Core: Future Mobility Middleware (Fuego Core 2007)

Project leader: Raatikainen, Kimmo
Research group(s): Mobile Computing
Researchers: Tarkoma, Sasu; Kangasharju, Jaakko; Sri Kalyanaraman Ramya; Lindholm, Tancred; Lagerspetz, Eemil
Schedule: 2005-01-01 ... 2007-12-31
Cooperation units: Department of Computer Science, University of Helsinki; UC Berkeley, USA
Funding: Tekes; Nokia; TeliaSonera Finland
Keywords: middleware, mobile internet, data communications
Research programme: -
WWW page and publications: www.hiit.fi/fi/fc

Fuego Core was the core project of the Future Internet research program at HIIT. The project was a continuation of the work on future mobility middleware began in 2002. The project focused on five areas in fundamental mobility middleware: XML processing and messaging, mobile distributed event system, XML synchronization and data access, software configuration management, and desktop search. The project contributed to related international standardization, in particular the Mobile Web Initiative and the Efficient XML Interchange Working Group at the World Wide Web Consortium. The project disseminated its research results in international scientific publications and by releasing the produced middleware platform.

4.2.5 Infrastructure for HIP (InfraHIP)

Project leader: Mäntylä, Martti
Research group(s): Networking
Researchers: Gurtov, Andrei; Kousa, Mika; Komu, Miika; Koponen, Teemu; Vehmersalo, Essi; Lindqvist, Janne; Karlsson, Niklas; Korzun, Dmitry; Zhou, Wengpeng; Beltrami, Diego; Abhinav, Pathak; Partanen, Antti; Bagri, Abhijt; Louko, Antti
Schedule: 2004-08-01 ... 2007-03-31
Cooperation units: Laboratory of Telecommunications Software and Multimedia, Helsinki University of Technology (TKK)
Funding: Tekes; Ericsson; Nokia; Finnish Defence Forces; Elisa; TeliaSonera
Keywords: Internet, architecture, security, mobility, communication protocols
Research programme: -
WWW page and publications: infrahip.hiit.fi

The Host Identity Protocol (HIP) and the related architecture form a proposal to change the TCP/IP stack to better support mobility and multi-homing. Additionally, they provide for enhanced security and privacy and advanced network concepts, such as moving networks and mobile ad hoc networks. The InfraHIP project studies application related aspects of HIP, including APIs, rendezvous service, operating system security, multiple end-points within a single host, process migration, and issues related to enterprise-level solutions. Through this, the project maintains HIIT (and thereby Finland) as one of the leading research centres doing HIP related work. “Infra” in the project name stands for Infrastructure. As the basic HIP protocol is almost ready, the project focuses on developing the missing infrastructure pieces such as DNS, NAT, and firewall support to enable a widespread deployment of HIP.

The project has developed an open source implementation of the Host Identity Protocol (HIP). Related code was contributed to the official Linux kernel, with the result that all Linuxes are now “HIP-compliant”. The implementation supports most standardized features and has interoperated with Ericsson HIP and OpenHIP implementations. Furthermore, InfraHIP studied combining network overlays with HIP to provide better resilience against DoS attacks and for securing process migration systems.

4.2.6 Infrastructure for HIP II (InfraHIP II)

Project leader: Gurtov, Andrei
Research group(s): Networking
Researchers: Jylhäkoski, Juha; Khurri, Andrei; Komu, Miika; Koskela, Joakim; Mukhametzhanova, Assel; Silvennoinen, Lauri; Tapio, Juha-Matti; Varjonen, Samu; Finez, Moral
Schedule: 2007-04-01 ... 2009-09-30
Cooperation units: Laboratory of Telecommunications Software and Multimedia, Helsinki University of Technology (TKK); RWTH Aachen, Germany
Funding: Tekes; Elisa; Nokia; Finnish Defence Forces; Birdstep Technology; TeliaSonera Finland
Keywords: identity, protocol, mobility management, security, linux
Research programme: -
WWW page and publications: infrahip.hiit.fi

The current Internet architecture neither protects the communications between hosts against abusers nor supports seamless (delay-tolerant) communications with mobile devices, which is an obvious necessity e.g. in the world of portable terminal devices, such as smart phones. End-to-end connectivity is broken due to the introduction of private address spaces and Network Address Translators (NATs). Among the other major shortcoming of the current Internet architecture are its lack of support for multi homing and the difficulty of the transition from IPv4 to IPv6.

The Host Identity Protocol (HIP) addresses all of the issues mentioned above, supporting mobile and secure network connectivity for all existing applications through multiple network inter¬faces. It provides a new location-independent namespace for hosts, allows the host to move between networks without breaking the network connectivity. The new namespace is cryptographic by its nature which allows secure authentication of hosts, e.g., in firewalls and makes host identity theft infeasible. With the help of some infrastructure, HIP can also restore end-to-end connectivity to hosts behind NAT boxes because of the new address space. HIP also eases the transition towards IPv6 because it provides IP version independent addressing.

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The potential impact of HIP to the Internet is tremendous as it enhances the architecture in so many aspects. However, it may also introduce some additional problems that must be found and solved before the Internet community is convinced and deploys the protocol to its networks. For this reason, the InfraHIP II project is going to concentrate on experimentation and deployment of HIP, which seems to be the only way to resolve this uncertainty in expectations. InfraHIP II researchers are going to pioneer HIP by installing the related infrastructure and software in as many hosts as possible. The research team experiments with HIP on different systems and applications to find the possible problem areas. The InfraHIP II project builds on the software and knowledge gathered in InfraHIP project and takes the HIP architecture from the research laboratory to the real world.

4.2.7 Interconnected Broadband Home Networks (InHoNets)

Project leader: Ylä-Jääski, Antti
Research group(s): Distributed Networking and Security
Researchers: Manner, Jukka; Karvonen, Kristiina; Koivikko, Ursula; Kiravuo, Timo; Chowdhury, Rafiqul; Lembo, Sergio; Gurnani, Dinesh; Batra, Vikram
Schedule: 2006-01-01…2007-12-31
Cooperation units: Laboratory of Telecommunications Software and Multimedia, Helsinki University of Technology; Laboratory of Theoretical Computer Science, Helsinki University of Technology; Networking Laboratory, Helsinki University of Technology; Department of Communications Engineering, Tampere University of Technology
Funding: Tekes, Nokia, Ericsson, Elisa, Digita, Finnish Broadcasting Corporation YLE
Keywords: Home networks, broadband access networks, business value systems, end-to-end connectivity, internetworking, security
Research programme: -
WWW page and publications:
www.tml.tkk.fi/Research/inhonets/Main
www.tml.tkk.fi/Research/inhonets/Publications

This project focused on wireless broadband home networks, interconnectivity to infrastructure networks and seamless internetworking between several home networks through broadband access networks. This research aimed at ensuring reliable and secure broadband end-to-end connectivity between peer devices within one home; the peer devices can also be in multiple sites in several wireless home networks. This was a challenging environment since the target recipient was a consumer without ICT expertise. In addition to developing system architectures and internetworking solutions, business value systems were also analyzed.

4.2.8 Location Privacy and Authentication in Massively Distributed Systems (LPAMDS)

Project leader: Gurtov, Andrei
Research group(s): Networking
Researchers: Komu, Miika; Korzun, Dmitry
Schedule: 2006-01-16 ... 2007-12-31
Cooperation units: RWTH Aachen, Germany
Funding: Academy of Finland
Keywords: HIP, Internet indirection infrastructure, onion routing
Research programme: -
WWW page and publications: ds.informatik.rwth-aachen.de

The Internet has rapidly evolved during the last decade. Today, more and more mobile devices are capable of mobile communication and use the internet on the road. Most protocols that are used today have been developed in the 1970s. Therefore, they do not support host mobility, anonymity, host authentication, multicast, anycast and quality of service. There are many reasons why these services are still not available. The most important reason is that many of the Internet core components must be modified or replaced in order to enable these services.

The InfraHIP project team in Finland works on solutions to overcome the limitations of existing Internet Protocol IP. The Host Identity Protocol (HIP) uses public key cryptography to authenticate communication partners and to secure the connection between them. Although HIP does not require core components to be altered, some additional infrastructure is still re-

quired. The project InfraHIP uses the i3 technology to create a scalable and reliable infrastructure for HIP.

The research group in RWTH Aachen has already developed a proxy application which enables SAMBA support over i3. Cooperation between both teams would definitely have synergistic effects on both projects. Although HIP enables anonymity on the HIP layer, the data traffic on the network layer can still be monitored and traced back to certain IP addresses. The Project SARA, which was developed in Aachen, enables anonymity on the network layer.

A combination of both techniques offers a vast variety of possible uses. The idea of combining HIP authentication and SARAs anonymity offers the possibility to use anonymous identities. With these identities, it is possible to provide a trusted service without being exposed to third parties like military regimes.

Besides the main project, we lay one of our emphases on the promotion of young scientists. The exchange between Germany and Finland intends to help young scientists to gain experience in working in an international environment. Several PhD students from Finland and two PhD students from Germany will work on this project. Diploma students working on the project could be supervised directly while working abroad.

4.2.9 Multiaccess Experimentations in Real Converging Networks (MERCoNe)

Project leader: Gurtov, Andrei
Research group(s): Networking
Researchers: Khurri, Andrey; Vorobyeva, Ekaterina
Schedule: 2006-01-01 ... 2007-12-31
Cooperation units: Laboratory of Computer and Information Science, Helsinki University of Technology
Funding: Tekes; L M Ericsson; Nethawk; Nokia; Secgo; TeliaSonera Finland; VTT
Keywords: IPv6, measurement, HIP, N770, mobile router
Research programme: Tekes / GIGA - Converging Networks 2005-2010
WWW page and publications: www2.cs.hut.fi/~pmrg/index.cgi?id=256

MERCoNe (Multiaccess Experimentations in Real Converging Networks) solves new issues related to multiaccess in this heterogeneous multi-operator environment: seamless multi-operator and multi-domain mobility. It aims to integrate the capabilities of different networks to an end-to-end, seamless, efficient and secure solution for the user. Multi-domain implies that there are multiple providers of access and network connectivity. Multiple access technologies may be used, that mobility takes place across multiple trust domains. Multiple IP addressing realms may be used across various domains, e.g. IPv6 as well as public and private IPv4 addressing spaces. MERCoNe will also develop support for network mobility that can also be multi-homed either with a single mobile router that has multiple attachments to the Internet, or by using multiple mobile routers that attach the mobile network to the fixed network. MERCoNe creates a cross-layer and cross-domain handover triggering architecture that is used for optimizingmultiaccess and multi-operator environment management. The architecture provides means to gather cross-layer information, to process the information and to provide it, e.g., for mobility mechanisms, inter-operator roaming, end-to-end signaling, TCP/IP stack protocol optimization, media adaptation and other purposes defined by the project.

4.2.10 NordicHIP

Project leader: Gurtov, Andrei
Research group(s): Networking
Researchers: Yaqub, Kamran; Ponomarev, Oleg
Schedule: 2006-06-01 ... 2010-06-30
Cooperation units: Laboratory of Telecommunications Software and Multimedia, Helsinki University of Technology; Computer and Network Architectures Lab, Swedish Institute of Computer Science (SICS)
Funding: NORDUnet
Keywords: Name resolution, IPv6, privacy
Research programme: NORDUnet3 Programme
WWW page and publications: www.nordforsk.org/text.cfm?id=434

The NordicHIP project is funded by the NORDUnet3 programme. It involves issues in both areas of Security and Internet communication services. The public identities provided by HIP are essential to support trust and authentication between hosts. Furthermore, HIP allows for scalable security architectures as the requirement to the support infrastructure are modest; most communication occurs directly between HIP peers. Secure host and network mobility are the main assets built into the basic HIP protocol. On the communication side, HIP offers good possibilities for co-existence of IPv4 and IPv6 networks by supporting handovers between different IP versions. In this project, we will further investigate discovery of v4/v6 gateways and performance issues of cross-version IP mobility. We believe HIP can be a base of future Mobile Internet by addressing security and performance shortcoming found in the earlier proposals for mobility protocols.

4.2.11 Services for All (E!2023 ITEA S4ALL)

Project leader: Rimey, Kenneth
Research group(s): Distributed Applications
Researchers: Lindholm, Tancred; Mäntysaari, Ville; Silander, Tea; Kanerva, Pekka; Piispanen, Tuomas; Hasu, Tero
Schedule: 2005-01-19 ... 2007-09-30
Cooperation units: Alcatel CIT, France; BULL, France; Capricode, Finland; Fraunhoffer Fokus, Germany; INRIA, France; Institut National des Télécommunications, France; mCentric, Spain; Nokia, Finland; Schneider Electric, France; Thales, France; Université Joseph Fourier (LSR - IMAG), France; Universidad Politécnica de Madrid, Spain; University of Kassel, Germany; Vodafone, Germany; Odonata, France
Funding: Tekes
Keywords: Web services, Service-oriented architecture, Middleware, Orchestration, Service creation
Research programme: Information Technology for European Advancement (E!2023 ITEA)
WWW page and publications: www.hiit.fi/fi/s4all

The ITEA Services for All (S4ALL) project set out to make possible a world of user-centric services that are easy to create, share, and use. HIIT's contribution focused on developing the Interactive Service Composer for S60, and demonstrating the usefulness of this in the device management domain in collaboration with Capricode Oy. We also developed a number of useful open source libraries and tools for rapid service development on mobile phones using scripting language technologies. Much of our work was done with the Python programming language on S60 phones.

S4ALL was a European project labeled by ITEA and led by Alcatel, with partners in France, Finland, Germany, and Spain. The Finnish partners were HIIT, Capricode Oy, and Nokia. This

summary addresses only HIIT's contribution.

S4ALL envisioned providing end users with an interactive application enabling them to compose useful applications by combining component web services. HIIT created a working prototype of this Service Composer for the mobile phone. We then proceeded to develop this as a flexible controller for the SyncShield device management server from Capricode.

We also developed a number of enhancements to the scripting tool set, such as a wrapper generator to facilitate access from scripts to the phone's various native application database APIs, and a compatibility library enabling running of many scripts on the desktop for testing purposes.

4.2.12 Trustworthy Internet: Overlay Infrastructure for Trusted Computing and Communications (TrustInet)

Project leader: Mäntylä, Martti
Research group(s): Networking
Researchers: Gurtov, Andrei; Karila, Arto; Koponen, Teemu; Ponomarev, Oleg; Sääksvuori, Lauri; Tarkoma, Sasu; Varjonen, Samu; Korzun, Dmitry; Nikander, Pekka
Schedule: 2006-01-01 ... 2008-12-31
Cooperation units: Laboratory of Telecommunications Software and Multimedia, Helsinki University of Technology
Funding: Tekes
Keywords: DoS, SPAM, PGP, trust chain, overlay
Research programme: Tekes / GIGA - Converging Networks 2005-2010
WWW page and publications: trustinet.hiit.fi

Trust is the fundamental enabler for information ecosystems where services are consumed and produced. In today's information economy, trust is the necessary foundation for secure interoperability, and central to the successful realization of what's possible on the Web. Unfortunately, the present Internet falls short of this objective in several respects as evidenced by viruses and worms, denial-of-service (DoS) attacks, and junk mail that plague end users. Another set of threats is created by the increasing data collection practices, compromising users' privacy. These problems appear to become even more acute if functionalities such as terminal mobility are introduced in the existing Internet infrastructure.

Trustworthy Internet (TrustInet) research project will study how the trustworthiness of the Internet can be heightened by adding a slim overlay infrastructure on the top of the existing IP networks. The light overlay in-

frastructure builds a new kind of a network layer platform for the services above Thus, in our vision, our research will enable trustworthy Internet service platforms that connect the service consumers and providers with each other to enable services and service delivery mechanisms. To achieve the vision, the project will carry out original research in co-operation with an extensive international partner network; create prototype technologies, platforms, and solutions; perform experiments; influence the standardization of the field; and contribute to researcher education. Its main objective is to raise and maintain the level of competence of the participating groups at world class level.

In 2007, the main result of the project was the development of a HIP-enabled peer-to-peer Session Initiation Protocol (P2PSIP) architecture. Integrating research in P2P and DHT security, the P2PSIP video and chat communication system will be piloted within HIIT in 2008.

4.2.13 UbiLife Foundations (UbiLife)

Project leader: Tarkoma, Sasu
Research group(s): Mobile Computing
Researchers: Xiao, Yu; Xi, Xiao
Schedule: 2007-06-01 ... 2009-10-31
Cooperation units: University of Oulu; University of Lapland; University of Art and Design in Helsinki
Funding: Tekes; Nokia; TeliaSonera; Sensinode; IBM; SysOpenDigia; City of Oulu
Keywords: ubiquitous computing, applications
Research programme: Tekes / Ubicom - Embedded ICT 2007-2013
WWW page and publications: www.ubilife.fi

In the UbiLife project, technologies will be developed to ease mobile users' context recognition, the assembly of easy-to-use applications and the resource management of smart environments. The developed technologies will be integrated into a software platform, which will support the creation of novel and innovative applications for mobile users.

In these applications, the wireless terminal functions as a user interface to the user's smart environment. The resources of the environment, such as sensor networks, displays and printers, are taken into use flexibly: applications suitable for the situation are assembled for the user on-the-fly. These applications also utilize wearable sensors, such as accelerometers, and physical user interfaces based on RFID technology. The visual appearance of this user interface communicates to the user which parts of the user's immediate surroundings work as a physical user interface and what functionalities they offer.

The Living Lab research segment of the UbiLife project conducts the UBI program's empirical research in real-life settings and with real end users. The challenge of the project is the concrete creation and testing of the ubiquitous society of the future with domain-specific proof of concept pilots. The middleware technology produced by the basic research is utilized in the technical implementation of the pilots. The functionality of the pilots is, in turn, evaluated with different kinds of field tests. These field tests produce valuable information of the pilots' technical functionality, usability and added value for the end user. The pilots also produce new information on the domain's special requirements. Furthermore, the added value of ubiquitous technology for the pilot, the service process and the value networks of its domain is studied.

4.2.14 Web Services in Ad Hoc and Mobile Infrastructure (WeSAHMI)

Project leader: Raatikainen, Kimmo; Manner, Jukka; Ylä-Jääski, Antti
Research group(s): Distributed Networking and Security, Mobile Computing
Researchers: Tarkoma, Sasu; Heikkinen, Jani
Schedule: 2006-01-01 … 2007-12-31
Cooperation units: Tampere University of Technology; University of Helsinki
Funding: Tekes; companies
Keywords: Ad-hoc networking, mobility, web services
Research programme: -
WWW page and publications: www.tml.tkk.fi/Research/wesahmi

The goal of the WeSAHMI project was to define and implement an experimental infrastructure for interactive wireless applications that can operate in an ad-hoc networking environment. In addition to the infrastructure, a demo application suite for an airport environment was implemented. Some of the features of the infrastructure included identification of mobile users and tracking of their presence, delivery of content, notifications, and status updates to mobile users in a server-initiated fashion, and managing and updating the state of both clients and servers in real time. The developed infrastructure extends the classical web architecture by catering for highly interactive applications, mobile clients, and targeted asynchronous information delivery, while retaining full server-side control over business logic.

4.2.15 Widgets Sharing (WiSh)

Project leader: Karvonen, Kristiina
Research group(s): -
Researchers: Ruohomaa, Sini (UH); Nurmi, Petteri (UH); Hassinen, Marja (UH)
Schedule: 2007-09-01 … 2008-01-31
Cooperation units: Department of Computer Science, University of Helsinki
Funding: Nokia Research Center
Keywords: Trust, recommendation systems, widgets, reputation model, user interface design
Research programme: -
WWW page and publications: -

In this subcontracted project for Nokia Research Center, the focus was on finding and evaluating a suitable trust model for realising a reputation management system for sharing widgets provided by an open community. The qualitative objective of the reputation system to be created was to encourage users to install and use new widgets by providing a sense of trust. A conceptual model for the reputation management system, along with a draft user interface for the system, were the outcomes of the project.

4.3 Network Society

The objective of the Network Society is to pioneer and develop human-centric, multidisciplinary, ubiquitous information and communication technology based on comprehensive understanding of needs and practices in the everyday life and social relations of a network society.

Research Domains

1. Mobile and ubiquitous interaction
2. Open media creation, management and distribution
3. Tools and methodology for service innovation
4. Development of a sustainable network society

Programme Management

Programme Director: Prof. Marko Turpeinen

Programme Manager: M. Sc. Kai Huotari

Programme Management Group:
- Prof. Pekka Himanen
- Dr. Giulio Jacucci
- Prof. Martti Mäntylä
- Dr. Antti Oulasvirta
- Dr. Olli Pitkänen
- Dr. Ken Rimey
- Dr. Risto Sarvas

Research Groups

The Network Society programme continues with new structure and focus the research of two older research programmes, the Digital Economy and the Media Convergence programmes.

Three partially overlapping research groups collaborate in the research:

Digital Content Communities
- Dr. Marko Turpeinen, Dr. Timo Saari

Digital Economy
- Prof. Jukka Kemppinen, Dr. Olli Pitkänen

Ubiquitous Interaction
- Dr. Antti Oulasvirta, Dr. Giulio Jacucci, Dr. Tommi Ilmonen, Dr. Esko Kurvinen, Prof. Martti Mäntylä

4.3.1 Advanced Virtual Economy Applications (AVEA)

Project leader: Mäntylä, Martti
Research group(s): Digital Content Communities
Researchers: Lehdonvirta, Vili; Lehtiniemi, Tuukka; Seppälä, Lassi
Schedule: 2007-10-01 ... 2010-03-31
Cooperation units: Waseda University, Tokyo, Japan; Turku School of Economics, Turku, Finland, Kungliga Tekniska Högskolan, Stockholm, Sweden
Funding: Tekes; Nokia; Playdo; CCP; Swelcom; Veikkaus
Keywords: electronic commerce, virtual economy, virtual consumption, online community
Research programme: Tekes: Verso - Vertical Software Solutions 2006-2010
WWW page and publications: virtual-economy.org

Advanced Virtual Economy Applications (AVEA) develops new approaches to so-called “virtual property”, artificially scarce digital objects that have rapidly become a viable business model for software products and online services, especially gaining prominence in so-called massively multiplayer online games. We focus on virtual property related revenue models, ways of measuring virtual economic activity, consumer behaviour in virtual economies, and extending the virtual property model to new platforms such as mobile and ubiquitous services.

4.3.2 Bay Area Perspective to Paper and Digital Media (Prodigy)

Project leader: Sarvas, Risto
Research group(s): -
Researchers: -
Schedule: 2007-04-03 … 2008-07-31
Cooperation units: -
Funding: -
Keywords: -
Research programme: -
WWW page and publications: -

Prodigy is a small-scale project that looks into media research in the San Francisco Bay Area and the Silicon Valley. The objective of the project is to chart the current top academic research in the area on media technology, mainly UC Berkley and Stanford University. The project is funded by paper research institute KCL and part of the study is to find out what is the role of paper in these media studies, and how is paper perceived as a future medium for communication and content production.

4.3.3 Community Media and Service-Oriented Architecture (COMSOA)

Project leader: Turpeinen, Marko
Research group(s): Digital Content Communities, User Experience
Researchers: Rantanen, Matti; Reti, Tommo; Lehdonvirta, Vili; Herrera, Fernando; Hietanen, Herkko; Johnson, Mikael; Kurvinen, Esko; Huotari, Kai; Koponen, Jarno; Savolainen, Petri; Järvinen, Miika
Schedule: 2005-10-01 ... 2007-09-30
Cooperation units: ISchool, University of California, Berkeley, USA; MIT Media Lab, Massachusetts Institute of Technology, USA; TU, Delft, the Netherlands
Funding: Tekes
Keywords: Social networks, community-centric design, service-oriented computing
Research programme: -
WWW page and publications: pong.hiit.fi

In COMSOA we focus on basic phenomena of community media, i.e., systems that enable and support social creativity, participatory media, and distributed problem solving. This work is grounded on a properly instrumented platform that facilitates the rapid creation of community services and experimentation with them. This basis is offered by service-oriented computing (SOC), a new emerging cross-disciplinary paradigm that has risen to offer solutions to various challenges in large-scale distributed computing. The service-oriented system architecture (SOA) changes the way software applications are designed, delivered, and consumed. Services are autonomous, platform-independent computational elements that can be described, published, and discovered using standard protocols and service metadata. They can be used to build networks of collaborating applications distributed within and across organizational boundaries, or closer to consumers.

SOA offers high availability and bandwidth through many users' wideband connections, and good scalability with no central servers as bottlenecks and one point of failure.

The COMSOA project studies the paradigm shift of service-oriented computing from a community-centric viewpoint. This is in contrast with the main body of research on service-oriented architectures, which mostly concentrates on potential benefits that can be achieved in technical adaptivity and replicability, business service flexibility, service life cycle management, and service discovery. This viewpoint typically pays little attention to the social behaviour of individuals and informal ad-hoc communities that are offering, subscribing and using the services on these new platforms. The term "peer-to-peer" has come to be applied to networks that expect end users to contribute their own files, computing time, or other resources to some shared project. Even more interesting than the systems' technical underpinnings are their socially disruptive potential: how in various ways they return content, choice, and control to other users.

We argue that dynamic social network analysis (SNA) and probabilistic community modelling coupled with systematic design methods, such as user-centric product concept design (UCPCD), are necessary building blocks of novel community-centric methodologies to design the architecture of future community services. This requires multi-disciplinary end-to-end research from technological platforms to various viewpoints on their implications in actual use in real world users and communities. COMSOA research will consist of

1. in-depth case studies of selected community media services,
2. development of new methods and tools for dynamic community analysis and modeling,
3. demonstration of the benefits of service-oriented computing by building extensions to service platforms being developed at HIIT, most notably to Digital Content Distribution Management System DiMaS, and
4. development of novel community-centric methodology for product and service concept design.

4.3.4 Context Cues: Context Data Derived Situation Cues to Support Meaningful Interactions

Project leader: Mäntylä, Martti
Research group(s): Ubiquitous Interaction
Researchers: Oulasvirta, Antti; Yanev, Kliment; Tiitta, Sauli; Lampinen, Airi; Tamminen, Sakari
Schedule: 2006-01-01 ... 2009-12-31
Cooperation units: Department of Computer Science, University of Helsinki; Massachusetts Institute of Technology (MIT), USA; Nokia Research Centre (NRC)
Funding: Academy of Finland
Keywords: Awareness information, human-computer interaction, user psychology, social cognition, field research
Research programme: -
WWW page and publications: www.hiit.fi/u/oulasvir

Awareness applications communicate, automatically or in a user controlled manner, cues of other people's or users' state or situation. A wide variety of novel awareness applications is soon enabled by modern ubiquitous sensor technologies, the envisioned domains ranging from communications to e-health and sports. Their key conceptual elements, situation cues, are automatically inferred attributes that describe user's state or situation to a remote user, e.g., one's location, work mode, activity, or interruptability. The project makes a new trans-disciplinary crossover, namely, we introduce the social psychological approach to the computer inference and design of situation cues in ubiquitous computing environments.

First, from the social psychological perspective, we ask: which situation cues and how can they be used to make meaningful inferences of others and what are the conditions for these inferences to provide a basis for socially meaningful, transparent

and accountable action that preserves privacy? We have been developing a social cognitive view to awareness cues, leveraging what is known about cognitive limitations in decision-making and problem-solving. The results have been published in a sociological method journal and in human-computer interaction.

Second, from the point of view of data mining, we ask: what cues can be reliably inferred from real sensor data? In 2007, we showed that a mobile user's attention can be predicted with an accuracy of about up to 75%, depending on available sensors in the mobile phone.

4.3.5 Conveying Affectiveness in Leading-edge Living Adaptive Systems (CALLAS)

Project leader: Jacucci, Giulio
Research group(s): Ubiquitous Interaction, Digital Content Communities
Researchers: Liikkanen, Lassi; Laitinen, Toni; Samperio, Rodolfo
Schedule: 2006-11-01 ... 2010-10-31
Cooperation units: VTT Electronics; BBC; Metaware; Studio Azzurro; XIM; Digital Video; Humanware; Nexture; University of Augsburg; ICCS/NTUA; University of Mons; University of Teeside; Helsinki University of Technology; Paris 8; Scuola Normale Superiore di Pisa; University of Reading; Fondazione Teatro Massimo; HITLaboratory New Zealand
Funding: European Commission FP6 IST
Keywords: multimodality, emotions, affective interfaces, art and entertainment, interactive drama
Research programme: European Commission FP6 IST
WWW page and publications: www.callas-newmedia.eu

CALLAS will investigate key aspects of Multimodal Affective Interfaces in the specific area of Art and Entertainment applications. As an integrated project CALLAS will address the following high-level objectives:

1. To advance the state-of-the-art in Multimodal Affective Interfaces by i) developing new emotional models that will be able to take into account a comprehensive user experience in Digital Arts and Entertainment applications and ii) new modality-processing techniques to capture (and elicit) these new emotional categories
2. To research, develop, and integrate advanced software components, tailored to the processing of individual modalities supportingthe semantic recognition of emotions, making them available through a “living” repository, called the CALLAS “shelf”
3. To develop a software methodology for the development and the engineering of Multimodal Interfaces that will make their development accessible to a larger community,

i.e. the assembly of a Multimodal interface from individual components will not require anymore a deep understanding of theories of Multimodality.

The effectiveness of the CALLAS approach in pursuing the aforementioned objectives will be validated by developing significant research prototypes (or Showcases) in three major fields of Digital Arts and Entertainment:

- Augmented Reality for Art, Entertainment, and Digital Theatre
- Interactive Installations for Public Spaces
- Next-Generation Interactive Television

CALLAS also aims to ensure the sustainability and the replicability of the technology results. This will be addressed mainly by supporting Technology Transfer, in particular towards SMEs operating in the new media sector, whether these SME are involved in Digital Arts and Entertainment or are innovative technology spin-offs.

The role of HIIT in the project is to direct the Subproject on User Experience and Showcases, this also includes leading a workpackage that develops a novel user experience evaluation approach for multimodal applications in art and entertainment. In addition HIIT leads one showcase implementing emotional and multimodal applications for public spaces. The first prototype evaluated with improvisational actors and puppeteers is presented at ACM Advanced Visual Interfaces 2008. The prototype is called Puppetwall (http://puppetwall.org) and allows to animate media using gestures and acoustic features of voice.

4.3.6 D-Choc: Technology Platform for Community Driven Mobile Games and Operator Collaboration

Project leader: Turpeinen, Marko
Research group(s): Digital Content Communities
Researchers: Kuikkaniemi, Kai; Rantanen, Matti; Lehdonvirta, Vili; Huotari, Kai
Schedule: 2006-11-01 ... 2007-12-31
Cooperation units: -
Funding: Digital Chocolate
Keywords: Mobile, Communities, Mobile operators, Mobile games
Research programme: -
WWW page and publications: -

Digital Chocolate is a developer of games and applications for mobile phones located in San Mateo, CA, USA and Helsinki. The project develops a commercial community platform for multi-player games and other social services. The project started late 2006.

In 2007, HIIT's role was to aid in the development and evaluation of the platform and of the game concept, especially from the community point of view. Future studies will concern word-of-mouth communication within digital services and consumer behaviour in virtual context.

4.3.7 DRAMA: Scenario Methods for User Centered Product Concept Design

Project leader: Mäntylä, Martti
Research group(s): User Experience
Researchers: Tiitta, Sauli; Kankainen, Tomi; Kantola, Vesa; Mehto, Kati; Sädekallio,
Schedule: 2004-01-01 ... 2007-12-31
Cooperation units: Helsinki Polytechnic Stadia; University of Art and Design Helsinki
Funding: Academy of Finland
Keywords: User-centric product concept design, Devised theatre, Forum theatre, Narrative theatre, Scenario-based design
Research programme: Academy of Finland / Industrial Design Programme
WWW page and publications: www.hiit.fi/fi/drama

DRAMA - Scenario Methods for User-Centered Product Concept Design (UCPCD) was a multidisciplinary research project, in which UCPCD's scenario-based working methodology and process were reinforced with methods of devised theatre. The ultimate goal was to make the human voice loud and clear in the new product development to create humane products. This was achieved by improving current working methods, tools, and processes.

In DRAMA, we studied possibilities to use devised theatre methods with UCPCD to create a new, rich and more profound approach to user centricity and to create dramatic scenarios, a new form of scenarios. In DRAMA, this was done by comparing several devised theatre and UCPCD methods and defining the relevant application areas for each one.

The following methodological areas of UCPCD were studied.

1. User research: user research methods, collecting user narratives and other dramatic compositions, and notation of user narratives.
2. Analysis of user data: methods for analyzing user narratives and interpreting user needs.
3. Product or service concept design: techniques for utilizing user narratives as a basis for design, writing the manuscript for a scenario on the basis of user narratives, the

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form and output of scenarios.
4. Concept evaluation: evaluation of concepts with users using devised theatre and dramatic scenarios.

The project was launched on January 1, 2004. As the first step, we defined the research contexts and user groups together with the National Consumer Research Centre. Taking a wide view of relevant societal issues, we decided to focus holistically on professional people of the age 55±5 years, a period of life where people often begin to be concerned with the nearing retirement age.

During the rest of 2004 the project performed two rounds of experimental drama production (narrative theatre and forum theatre) aimed at specific user groups (nurses' teachers; church workers; policemen) and also studied the same groups with traditional methods of user research. Through this, we collected an extensive set of qualitative user data that allowed us to compare qualitatively the data obtainable by these two parallel methods. During 2005 and 2006, the data were carefully analyzed and various methods of dramatic scenario generation explored.

During 2007, the work focused on the documentation and dissemination of the results. A "DRAMA book" was prepared and submitted for publication in early 2008. Several spin-off research ideas and projects were prepared; some of these are likely to bear fruit in 2008 and later.

4.3.8 Fun of Gaming: Measuring the Human Experience of Media Enjoyment (FUGA)

Project leader: Turpeinen, Marko
Research group(s): Digital Content Communities
Researchers: Huotari, Kai; Kontiainen, Mikko; Kosunen, Ilkka; Kuikkaniemi, Kai; Saari, Timo, Laitinen, Toni
Schedule: 2006-05-01 ... 2009-04-30
Cooperation units: Helsinki School of Economics, Finland; Högskolan på Gotland, Sweden; Hanover University of Music and Drama, Germany; University of Technology (RWTH) Aachen for the Faculty of Medicine represented by University Hospital Aachen, Germany; Technische Universiteit Eindhoven, the Netherlands
Funding: European Commission FP6 NEST
Keywords: Digital games, User experience, Measurements
Research programme: European Commission FP6 NEST
WWW page and publications: project.hkkk.fi/fuga

The main objective of FUGA is to create novel methods and improve existing measures in order to examine how the different dimensions of Computer Game Experience can be assessed comprehensively with high temporal resolution. FUGA will employ a broad variety of innovative techniques based on

- laboratory and mobile psychophysiological recordings (i.e., facial EMG, EEG, ECG, EDA, and respiration),
- functional magnetic resonance imagining (fMRI),
- eye movement recordings,
- the so-called (online) implicit association test, and
- tracking of behavioral indicators of emotion and motivation.

An important objective of FUGA is to establish the construct validity, reliability, and predictive validity of the different Game Experience measures. A further objective is to develop a prototype of an emotionally adaptive game. The innovative measurement approach provided by FUGA can be applied when designing new digital games for different purposes (e.g., entertainment, education, therapy). In addition to its scientific impact, FUGA would be expected to contribute to the rise of the European computer games industry.

4.3.9 Global Network Society (GNS)

Project leader: Himanen, Pekka
Research group(s): Digital Economy
Researchers: -
Schedule: 2005-08-01 ... 2010-07-31
Cooperation units: University of Art and Design Helsinki, Finland; Oxford University, UK
Funding: The Centenary Fund of the Technology Industries of Finland
Keywords: global network society
Research programme: -
WWW page and publications: -

The aim of this research line is to analyse at macroscopic societal level the logic and global challenges of the network society. The baseline of the work is given by the studies of Professor Pekka Himanen with Professor Manual Castells, who have previously analyzed comparatively the Finnish/European, the Silicon Valley/USA, and Singapore/Chinese network society models. An interim goal of the work is to develop an integrated set of indicators, the Global Future Index, for describing the relations of network society development to innovation systems and social context. In 2007, a draft version of the index was prepared partly in cooperation with the World Economic Forum's future work and a monograph "Suomalainen unelma" was published.

4.3.10 Immortalidad: Future Social Use of Photography

Project leader: Sarvas, Risto
Research group(s): Digital Content Communities
Researchers: Näsänen, Jaana; Vihavainen, Sami; Turpeinen, Marko; Lehmuskallio, Asko
Schedule: 2005-08-15 ... 2007-02-15
Cooperation units: Futurice, Finland; Yliopistopaino, Finland; University of California, Berkeley, USA
Funding: Keskuslaboratorio KCL
Keywords: photography, digital media, communities, social software
Research programme: -
WWW page and publications: pong.hiit.fi/dcc

The Immortalidad project studied future social use of personal media. Grounding the work on literature and empirical data on domestic photography and memorabilia creation and sharing, we designed future concepts the aim of which was to blur the boundaries between personally, socially, and professionally created media. The concepts took also into account the perceptions and characteristics people assign to digital and paper as format for media. A photobook service prototype was implemented and evaluated as the flagship of the project. Other concepts included photo games, images to paper cups, and self-made recipe books. The project was 18 months and 7.5 person years in total from Fall 2005 to Winter 2007.

4.3.11 InnoGuard

Project leader: Soisalon-Soininen, Eljas
Research group(s): Digital Economy
Researchers: Kemppinen, Jukka; Virtanen, Perttu; Lee, Na Ri; Oksanen, Kenneth; Lilja, Timo
Schedule: 2006-11-01 ... 2009-11-30
Cooperation units: Lappeenranta University of Technology, Finland; University of Cambridge, UK
Funding: Tekes; Nokia; Finnish Defence Forces; Papula; Tatu Ylönen; Roschier
Keywords: IPR, patents, software, reverse-engineering
Research programme: -
WWW page and publications: innoguard.cs.hut.fi

The Innoguard-project consists of a technical and legal track. The research hypothesis of the techical track is that it is easier to recognize a given algorithm or a data structure in a program by searching signs of the algorithm's predicted behavior in the program's internal dynamic behavior rather than by trying to decompile or disassemble it. The latter approach is indeed known to suffer from both prohibitive practical costlyness as well as theoretical limitats.

The legal and business track studies legislative and business trends of patenting, especially in software. If the technical research turns out affirmative, it could have a significant impact on how patent, copyright and trade secrecy violations can be monitored, and also in finding prior art when considering the novelty of an innovation. Consequently, these two research tracks will be in constant interaction and essentially converge on the third year when the applicability and influence of the results of the technical track will be evaluated.

The technical track will be conducted at the Helsinki University of Technology (TKK) under the lead of professor Eljas Soisalon-Soininen. The legal and business track is lead conducted at the Department of Business Administration of Lappeenranta University of Technology (LUT) under the lead of professor and principal scientist Jukka Kemppinen. Both tracks will employ on average the equivalent of two full-time researchers.

4.3.12 IPCity: Integrated Project on Interaction and Presence in Urban Environments

Project leader: Jacucci, Giulio
Research group(s): Ubiquitous Interaction
Researchers: Peltonen, Peter; Samperio, Rodolfo; Kleimola, Jari
Schedule: 2006-01-01 ... 2010-01-01
Cooperation units: Fraunhofer FIT; Sony Netservices SNS; Aalborg University; Vienna University of Technology; Graz University of Technology; University of Oulu; University of Applied Arts Vienna; Université Marne la Vallée
Funding: European Commission FP6 IST
Keywords: Presence and interaction in mixed reality environments
Research programme: European Commission FP6 IST
WWW page and publications: www.ipcity.eu

The research aim of the IPCity project is to investigate analytical and technological approaches to presence in real life settings. Analytically, this includes extending the approaches to presence accounting for the participative and social constitution of presence, the multiplicity and distribution if events in time and space. Technologically, this translates into developing portable environments for on-site configuration, mobile and light-weight mixed reality interfaces with the ambition to weave them into “the fabric of everyday life”. Methodologically, this calls for moving “out of the lab” with field trials in real settings, applying a triangulation of disciplines and methods for evaluation. These range from interpretative-ethnographic to quasi-experimental approaches and include cognitive science, social-psychological, and cultural-anthropological disciplines. The vision of the IPCity project is to provide citizens, visitors, as well as professionals involved in city development or the organisation ofevents with a set of technologies that enable them to collaboratively envision, debate emerging developments, experience past and future views or happenings of their local urban environment, discovering new aspects of their city. This includes:

- Extending analytical frameworks for presence, including the participative constitution of presence, the role of (shared) memory and mutual understanding, temporal fluctuations and interruptions (design for non-disruptiveness).
- Developing an environment for MR

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interaction prototyping and a platform and toolkit for cross reality content authoring.

- A range of building blocks and components ranging from mobile and lightweight mixed reality for situated participation to semi-stationary outdoor mixed reality environments that exploit the features of the surrounding physical environment. The showcases include urban renewal projects, large scale events, and explorative edutainment and story telling applications.

Most of the recent work of HIIT focussed on developing The CityWall, a large public display, to which users can send their own media content using mobile phones. It has been created to support multi-touch interaction, thus enabling collaborative use of the display. The CityWall was set up in a city center with the goal of showing information of events happening in the city. The installation has been successfully running from the beginning of May 2007 in the city center of Helsinki, Finland, and it has been part of multiple large-scale events. Several field trials of its use have been conducted resulting in two long papers both honored with awards at ACM CHI2008 and ACM MUM2007 which received the conference's Best Paper Award.

The showcase succeeded in carrying out field trials in three different large-scale events in Helsinki (Eurovision May 2007, Samba Carnival June 2007, Helsinki Festival August 2007). The multitouch display was the object of demonstration in a B2B event of the advertising sector in August 2007 in Germany.

In addition the CityWall has been turned into a permanent installation coming in contact with several thousands citizens and visitors. In particular in the Helsinki Festival the CityWall was part of the official program of the night of the Arts and appeared in the National News paper Heslingin Sanmat as well as in the program of the event. The CityWall appeared in several media internationally, Design Week UK, Casamica Italy(magazine of Coriere della Sera), Italian National Television Rai Tre in the news , Italian radio the first channel interview. The Citywall was also object of interviews on national italian television and radio (Raidue and RadioUno).

The CityWall attracted a lot of attention also in the web. Our site http://citywall.org received more than 40 000 contacts. A video was posted in youtube, CityWall was referenced in a variety of important websites, including slash.com and several blogs. We received requests from all over the world to create similar installations.

This work also resulted in a start-up to commercialise the technology www.multitouch.fi . Three of the researchers that worked in WP7 have founded the company.

4.3.13 Macroeconomic Indicators in Eve Online (MEVE)

Project leader: Turpeinen, Marko
Research group(s): Digital Content Communities
Researchers: Lehtiniemi, Tuukka; Lehdonvirta, Vili
Schedule: 2007-08-20 … 2007-12-20
Cooperation units: -
Funding: CCP Games, Iceland
Keywords: virtual economy, MMO, macroeconomic indicators, econometrics
Research programme: -
WWW page and publications:
http://ccp.vo.llnwd.net/o2/pdf/QEN_Q4-2007.pdf (EVE Online Quarterly Economic Newsletter, 4th quarter 2007. February 2008, CCP hf.)

The network of transactions that emerges from economic interactions between users and program code in a massively multi-user online (MMO) service, such as a game, is called a virtual economy. In recent years, there have been attempts to use macroeconomic indicators such as GDP to measure the size, activity and growth of a virtual economy.
However, there are inherent problems in applying measures intended for national economies to virtual economies. The MEVE project focused on creating custom-built macroeconomic indicators for virtual economies using a unique economic data set from the "virtual world" EVE Online.

The project conducted pioneering work on the econometric analysis of very large virtual economy data sets.

4.3.14 Mobile City Moments (E!3187 CELTIC MCM)

Project leader: Mäntylä, Martti
Research group(s): Digital Content Communities, Ubiquitous Interaction
Researchers: Sarvas, Risto; Hasu, Tero; Jacucci, Giulio; Evans, John; Lehmuskallio, Asko; Näsänen, Jaana; Saarikko, Petri; Salovaara, Antti
Schedule: 2007-01-15 ... 2009-06-30
Cooperation units: Stockholm School of Economics; Appello Systems AB; CARSA; CBT Comunicacion & Multimedia; Fundació Barcelona Media Universitat Pompeu Fabra; IDEAN Research; Innovalia Association; Musiclink AB; Sendandsee; Telefonica I+D; TeliaSonera Finland; Radarspot; Umeå University
Funding: Tekes
Keywords: aging population, mobile services, traveling, seniors, tourism, mobile services, service design
Research programme: CELTIC (CELTIC)
WWW page and publications: www.mobilecitymoments.eu

MCM project studies the technological needs of the ageing population (55-65 yrs) in a traveling/tourism context. The goal of the project is to develop and evaluate a mobile phone service for senior tourists.

This goal is approached from three different angles:

- Business research, which looks for new opportunities in combining traveling business with mobile services.
- User research, which studies the values, attitudes, and needs of the ageing population in a traveling context.
- Third, the technological research looks into solutions that match the needs of the traveling business and the needs of the end-users.

The project has altogether 14 partners in Finland, Spain, and Sweden.

4.3.15 Mobile Life (MobiLife)

Project leader: Mäntylä, Martti
Research group(s): User Experience, Digital Economy
Researchers: Kurvinen, Esko; Kontiainen, Mikko; Pitkänen, Olli; Ylitalo, Katri; Salovaara, Antti; Mäntylä, Teemu; Lehmuskallio, Harri
Schedule: 2004-09-01 ... 2007-02-28
Cooperation units: Nokia; Alcatel-CIT; Ericsson; LM Ericsson; Hewlett-Packard Italiana; Motorola; NEC Europe; Siemes Mobile Communications; DoCoMo Communications Laboratories Europe; Elisa; Fraunhofer Gesellschaft zur Foerderung der angewandten Forschung; University of Helsinki; Universität Kassel, Fachgebiet Kommunikationstechnik; The University of Surrey; NEOS Engineering SRL; Stichting Telematica Instituut; UNIS; Suunto; BellStream; Telecom Italia
Funding: European Commission FP6 IST
Keywords: application, service, mobile, wireless, user-centricity
Research programme: European Commission FP6 IST
WWW page and publications: www.ist-mobilife.org

People are used to being able to contact anyone, anywhere, at anytime. However, the challenge of enabling mass-market-scale ubiquitous services and applications remains. The strategic goal of MobiLife was to bring advances in mobile applications and services within the reach of users in their everyday life by innovating and deploying new applications and services based on the evolving capabilities of 3G systems and beyond.
Future environments affected by the ICT convergence give new possibilities, but also new challenges due to increasing heterogeneity, user needs and expectations. The research challenge of MobiLife was to address problematics related to different end-user devices, available networks, interaction modes, applications and services.

MobiLife had both technological and societal global impact by addressing the technical viability and user-accept-
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ance of solutions that belong to three main Focus Areas:

- Self-awareness provides support for automatic configuration arrangement of devices, services, and local connectivity in the user s local environment. It also enables automatic and multi-modal interfaces that enhance the user experience and minimise the active user effort needed in man-aging the local environment.
- Group-awareness comprises context and presence support enabling individuals to relate to, share, and interact with each other and common artefacts. Also novel privacy and trust models are addressed, which are mandatory for users to be able to rely on and use these new services and applications.
- World-awareness offers automatic support for seamless access to and delivery of services across different domains that enable individuals to retain the accustomed use of their services, as they move between different environments and infrastructures.
- The MobiLife consortium consisted of application owners, manufacturers, operators, solution providers and academia. MobiLife was part of the Wireless World Initiative, which comprises several projects for IST.

The original end date of the project was extended until end of February 2007 to give more time for documenting and disseminating the results. The main line of work in 2007 was the preparation and submission of the Mobilife book, to which HIIT researchers contributed several chapters.

4.3.16 MoMUPE: Multi-User Publishing Environment

Project leader: Turpeinen, Marko
Research group(s): Digital Content Communities
Researchers: Vuorenmaa, Janne; Kuikkaniemi, Kai; Seppälä, Lassi
Schedule: 2005-09-01 ... 2007-12-31
Cooperation units: Tampere University of Technology; Lappeenranta University of Technology; VTT
Funding: Tekes; Nokia
Keywords: mobile media, multi-user applications, context-aware systems
Research programme: -
WWW page and publications: www.mupe.net

Mobile phones are advanced communication devices and they can be used to create context-aware applications. Although context-awareness has been a hot research topic for a long time, no widely used applications yet exist. This project aimed to create context-aware multi-user applications that can be run on any mobile phone. The applications were developed with the Multi-User Publishing Environment (MUPE), which is an open source application platform developed in Nokia Research Center (NRC). It has been used successfully in many NRC and university projects, and this project continued this work. The platform enables rapid development of mobile multi-user context-aware applications and games. This project aimed to research new and emerging technologies.

4.3.17 Open Innovation

Project leader: Martikainen, Petri
Research group(s): -
Researchers: -
Schedule: 2006-11-10 ... 2007-02-28
Cooperation units: Forum Virium Helsinki
Funding: City of Helsinki, Economic and Planning Centre
Keywords: open innovation
Research programme: -
WWW page and publications: -

The project prepared a report on open innovation based on interviews with industry, government and academia. The report gave recommendations for developing and piloting open innovation environments in close connection with public services.

4.3.18 P2P-Fusion

Project leader: Rimey, Kenneth
Research group(s): Digital Content Communities, Distributed Applications
Researchers: Reti, Tommo; Hietanen, Herkko; Huotari, Kai; Järvinen, Miika; Savolainen, Petri, Ruottu, Toni; Hämäläinen, Harri
Schedule: 2006-06-01 ... 2009-05-31
Cooperation units: University of Art and Design Helsinki, Finland; Technische Universiteit Delft, the Netherlands; Budapesti Muszaki Es Gazdasagtudomanyi Egyetem, Hungary; Stichting Nederland Kennisland, the Netherlands; Stichting Nederlands instituut voor Beeld en Geluid, the Netherlands; Neuman Janos Digitalis Konyvtar Es Multimedia Kozpont KHT, Hungary
Funding: European Commission FP6 IST
Keywords: Peer-to-peer network, distributed semantic database, licencing, social media
Research programme: European Commission FP6 IST
WWW page and publications: arki.uiah.fi/p2p-fusion

The P2P-Fusion project is developing a new software system, Fusion, that supports audiovisual creative activities and makes it easy for anyone to create, reuse, and share video productions over the Internet legally, without costly servers and complicated system management.

Fusion binds together a distributed metadata store, a peer-to-peer file sharing network, social enrichment features, audiovisual production and editing software, support for embedded licenses, and a social media application toolkit into an integrated easy-to-use solution.

HIIT's contributions revolve around intellectual property issues and the architecture of the distributed metadata store. The latter is evolving into a peer-to-peer social network based on replicated data and cryptographic signatures. Our vision is to enable people to publish information and maintain editorial control over it without associating it with a particular Internet host. Our prototype software integrates this serverless peer-to-peer space seamlessly with the world wide web.

4.3.19 Pamphlet: Hybrid Media Products and Services for Communities

Project leader: Sarvas, Risto
Research group(s): Digital Content Communities
Researchers: Johnson, Mikael; Lehmuskallio, Asko
Schedule: 2006-04-01 ... 2007-04-30
Cooperation units: Myllykosken Pallo; Dynamoid; National Consumer Research Centre, Finland
Funding: Keskuslaboratorio (KCL); Futurice; Tekniska Föreningen i Finland (TFiF)
Keywords: hybrid media, video photography, communities, community media, paper media
Research programme: -
WWW page and publications: -

Pamphlet studied digital media communities and how to design hybrid media product concepts for those communities.

One of the objectives of the designed concepts was that the community members themselves could customize or otherwise affect the product. The project created more understanding on the role of paper-based products in digital media communities. The designs were a community calendar for an alumni associaton, a hybrid media publishing platform for a football fan club, and several hybrid media concepts for the community service IRC-galleria. The project started in April 2006 and ended in October 2007. It was a co-operation project with KCL, Dynamoid, Futurice, TFIF, Myllykosken Pallo, TKK, and the National Consumer Research Center.

4.3.20 Personalised Ubiservices in Public Spaces (PUPS)

Project leader: Floréen, Patrik
Research group(s): Adaptive Computing, Ubiquitous Interaction
Researchers: Nurmi, Petteri; Björkskog, Christoffer; Boström, Fredrik; Kukkonen, Joonas; Lagerspetz, Eemil; Vähäkangas, Taneli; Myllymäki, Petri; Laine, Tei; Liu, Tianyan; Jokipii, Matti; Kontkanen, Petri; Lahtinen, Jussi; Perkiö, Jukka; Silander, Tomi; Wettig, Hannes; Kurvinen, Esko; Hasu, Tero; Peltonen, Peter; Saarikko, Petri
Schedule: 2007-08-01 … 2009-07-31
Cooperation units: -
Funding: Tekes, companies
Keywords: context-awareness, personalisation, user research, user interface design
Research programme: Tekes Ubicom programme
WWW page and publications: www.hiit.fi/ada/pups

In the project we design, implement and field trial prototype ubicomp applications that combine context-awareness with personalisation in order to provide a better user experience in everyday tasks in public spaces. We undertake probabilistic modelling, make user experience research, develop services and prototypes, and design business models. Our target time to market for full-fledged applications is a few years ahead. The applications will run on the user's own mobile devices. The two-year project started in August 2007. The research partners are HIIT (ARU and BRU) and VTT. The company partners are Bitlips, Ekahau, Elisa, Idean Enterprises, K-Plus, Nokia, Ramblas Digital, Tuulia International, UpCode, as well as the Finnish Federation of the Visually Impaired.

The project has two application areas: shopping services for customers in Itäkeskus K-Citymarket (Massive) and an aggregate application for mobile context-aware and personalised digital media (Funnelry). We have shopping data to our disposal. We have made data analysis of the data and we build user models from it. Different available applications by project partners are integrated into our services to be developed.

This project is reported in the Annual Report twice, as parts of ADA and NS research programmes.

4.3.21 Possu: Recognition of Rights in Digital Music Distribution

Project leader: Mäntylä, Martti
Research group(s): Digital Content Communities
Researchers: Hietanen, Herkko; Huttunen, Anniina
Schedule: 2007-01-01 … 2007-12-31
Cooperation units: Nokia Research Center
Funding: Nokia Research Center
Keywords: P2P, file sharing, voluntary payment, post payment system, copyright, law, attitudes, music, video, games
Research programme: -
WWW page and publications: -

The research studied the attitudes of P2P file sharing community.

The main method was a research survey conducted online (n=6000). The study was analysed and compared to other P2P surveys. The survey results suggest that P2P users are aware that they are breaking the law and about half of the users even consider the use of illegal file sharing sites as morally wrong. Even though survey participants knew what amounted to copyright infringement, they had difficulties in recognizing the legal uses of works that copyright law permits.

The biggest payoff for the illegal file sharers was the immediate access to large catalogue of works which were free of charge and DRM-free. Yet nearly half of the respondents would be willing to pay monthly for a service that enabled unlimited music and video file sharing and downloading.

Rights owners' actions and amendments in the legislation have not had any noticeable impact on file sharing. File-sharers are aware of the punishments but the risk of getting caught was considered miniscule.

4.3.22 Psychologically Augmented Social Interaction over Networks (PASION)

Project leader: Jacucci, Giulio
Research group(s): Ubiquitous Interaction
Researchers: Oulasvirta, Antti; Nyyssönen, Tuomo; Saari, Timo; Tiitta, Sauli
Schedule: 2006-01-01 ... 2009-12-31
Cooperation units: Telekom Italia, Italy; Institute Auxologico Italiano, Italy; Eindhoven University of Technology, the Netherlands; Goldsmiths College, UK; Helsinki School of Economics, Finland; ITI Center for Research and Technology, Germany; Mediascore, Germany; Siemens, Germany; University of Bielefeld, Germany; University of Cologne, Germany; Universidad Politecnica de Valencia, Spain; University of Lincoln, UK; Universite de la Mediterranee, France; Universita de Padova, Italy; Xiwrite s.a.s., Italy
Funding: European Commission FP6, Information Society Technologies
Keywords: Emotions, knowledge work, information networks, social interaction, mobile devices, awareness systems
Research programme: European Commission FP6, Information Society Technologies
WWW page and publications: www.psychnology.org/File/PNJ4%281%29/PSYCHNOLOGY_JOURNAL_4_1_BRUGNOLI.pdf

Ever more frequently, social and particularly group interactions, involve mediated communication. Yet we know very little about the factors determining the effectiveness of the interaction. How do participants in mediated communication substitute the implicit, and non verbal signals which play such an important role in traditional, face to face communication? What are the equivalent signals in a mediated environment? The mechanisms involved in traditional communication are well-known. By contrast, very little is known about the forms of mediated communication. For instance, we do not know the role of implicit and non-verbal communication when the communica-

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tion takes place in a mediated environment. PASION's working hypothesis is that in mediated environments these messages will take completely new forms and that these forms are due to group interactions in technology-mediated environments.

As current communication technologies are ineffective in conveying the social, non-verbal and contextual informationrequired for effective communication, PASION will deliver an innovative shared virtual environment where a pioneering mediated social communication will take place. During trials PASION will be used by "large community of mobile users" providing strategic support to the activity of the group (adapted to the needs of specific applications in collaborative work and social gaming) by implementing "specific feedback strategies" based on the interpretation of the state and dynamics of social communication within the group.

In the four years of the project, PASION will investigate the basic scientific and technological issues which need to be resolved to achieve this goal. Basic research will investigate the socio-psychological foundations of mediated social interaction. Wizard-of-Oz prototypes will be used to elicit user input on basic concepts. Ergonomic studies will investigate critical issues of usability and user acceptability. Using this input, the project will design and develop new techniques to capture information relevant to social communication, and new ways of representing this information to users within the SVE. Two trials (one for each specific application collaborative work, and social gaming) will investigate the effectiveness the concepts and technologies incorporated in the environment. A special effort will be dedicated to the investigation of the complicated ethical issues raised by this work, and to plans for business development.

Recent achievement in the project by HIIT include the development of a field equipment with multiple cameras for out-of-the-lab mobile quasi-experiments. Also HIIT contributed to evaluate and re-design application to augment communication in knowledge group work.

4.3.23 Täky: Creating Meanings and User Experiences with User-Created Metadata

Project leader: Sarvas, Risto
Research group(s): Digital Content Communities
Researchers: Vihavainen, Sami; Seppälä, Lassi; Tiitta, Sauli; Kurvinen, Esko; Turpeinen, Marko
Schedule: 2006-11-01 ... 2008-03-31
Cooperation units: Yahoo! Research Berkeley, USA
Funding: Tekes; VTT; Nokia; SanomaWSOY; Aina Group; Profium
Keywords: tagging, tags, mobile applications
Research programme: -
WWW page and publications:
www.vtt.fi/proj/taky/index.jsp?lang=en

User-created keywords, tags, have become an important tool in communicating, organizing, and searching user-generated content in the Internet. The new phenomenon in tagging with free keywords is that it is actively done as part of social networking and also outside any professional or organizational context. This pastime and social context and is the main difference between tagging and, for example, conventional indexing and keyword annotation.

One major question in designing systems that leverage tags is the users' motivation to do the tagging. Why would the user tag the content? The tagging must have a benefit for the user, and often the benefit has to be immediate. To solve the issue of motivating the user the tagging interaction has to be designed to bring clear and understandable benefits to the user relatively quickly. A consequence of this is that the mechanisms for motivating the user affect the tags themselves. In this project we tested this hypothesis by testing three tag related applications with three user groups in two countries. We found that motivations for tagging depended much on the social context in which the application was used. Also, the design of the applications significantly directed the tagging processes and the content of the tags.

4.3.24 Urban Space and Experience Design (USED)

Project leader: Kaipainen, Mauri
Research group(s): Ubiquitous Interaction
Researchers: Mäkelä, Tapio; Tikka, Heidi; Ånäs, Susanna; Paterson, Andrew
Schedule: 2005-01-01 ... 2007-12-31
Cooperation units: -
Funding: Academy of Finland
Keywords: -
Research programme: -
WWW page and publications: -

The objective of USED was to develop a critical approach for understanding and developing urban media experiences in art, design and planning. The context of research was provided by the new configurations of public space by wireless technologies, and the applied media arts projects realised within USED belonged to an emerging genre of new media: public and participatory authoring. The research process was an iteration between phases of basic research: critical conceptualisation, empirical work with user groups, development of methods; and the applied artistic and technical research in tools development, production, testing and documentation.

4.4. Probabilistic Adaptive Systems

Our goal is to automate intelligent behavior by building robust probabilistic models for a complex world. The work has a strong basic research component that intersects artificial intelligence, machine learning, computer science, information theory and mathematical statistics. The results of this methodological work are applied to both scientific and industrial applications.

Research Challenges

- Theoretical frameworks for probabilistic modeling. To develop computationally efficient, general-purpose methods for probabilistic modeling, focusing on issues related to model selection, parameter estimation and inference.
- Models for intelligent information access. In many modern information networks (like the Internet and various sensor networks), the data can not be found in a well structured format, and accessing the information may be a problem even if the information is in principle available. The goal is to apply probabilistic models to perform information retrieval tasks in these kinds of environments.
- Models for image analysis. To develop probabilistic methods for processing two- or three-dimensional measurement data, with applications in data visualization and de-noising, and in the analysis of brain imaging data.
- Models for information processing in the visual system of the brain. To develop probabilistic computational models that show how vision is possible in the brain, and to generalize these principles to different domains of computational neuroscience and computational intelligence.
- Models for probabilistic data fusion. To develop probabilistic methods for combining inputs originating from heterogeneous data sources.
- User modeling. To develop probabilistic modeling methods for personalization, profiling and segmentation.

Programme Management

Programme Director: Professor Petri Myllymäki

Programme Manager: Research Coordinator Tomi Silander

Programme Management Group:
- Prof. Petri Myllymäki
- Dr. Aapo Hyvärinen
- Prof. Samuel Kaski

Research Groups

Complex Systems Computation Group (CoSCo)
- Prof. Petri Myllymäki, Dr. Jorma Rissanen, Prof. Henry Tirri, Dr. Wray Buntine

Neuroinformatics
- Dr. Aapo Hyvärinen

Statistical Machine Learning and Bioinformatics
- Prof. Samuel Kaski

4.4.1 Cognitive-Level Annotation using Latent Statistical Structure (CLASS)

Project leader: Myllymäki, Petri
Research group(s): Complex System Computation (CoSCo)
Researchers: Tuominen Antti; Tuulos, Ville; Silander, Tomi; Laine, Tei; Urtela, Mika
Schedule: 2006-01-01…2008-12-31
Cooperation units: The LEAR team, INRIA, Grenoble, France; The Visual Geometry Group, Department of Engineering Science, University of Oxford, UK; The VISICS team, Katholieke Universiteit Leuven, Belgium; the ICRI-LIIR team, Katholieke Universiteit Leuven, Belgium; The Empirical Inference for Machine Learning and Perception department of the Max-Planck Institute for Biological Cybernetics, Tübingen, Germany; The AI team, CNRS, France; Laboratoire Jean Kuntzmann, Grenoble, France
Funding: EU
Keywords: -
Research programme: -
WWW page and publications: class.inrialpes.fr

Class develops a basic cognitive ability for use in intelligent content analysis: the automatic discovery of content categories and attributes from unstructured content streams. The demonstrators will focus on object recognition and scene analysis in images and video with accompanying text streams. Autonomous learning will make recognition more adaptive and allow more general classes and much larger and more varied data sets to be handled.

Technically, the work combines latent structure models and semi-supervised learning methods from machine learning with advanced visual descriptors from computer vision and state-of-the-art text analysis techniques. Three levels of abstraction will be studied: new individuals (specific people, objects, scenes, actions); new object classes and attributes; and hierarchical categories and relations between entities.

Class is an interdisciplinary project, combining six leading European research teams in visual recognition, text understanding & summarization, and machine learning.

4.4.2 Cognitively Inspired Visual Interfaces for Representing Multidimensional Information (CIVI)

Project leader: Myllymäki, Petri
Research group(s): Complex System Computation (CoSCo)
Researchers: Uronen, Pekka; Lahtinen, Jussi; Kontkanen, Petri
Schedule: 2005-01-01 … 2008-12-31
Cooperation units: Center for Knowledge and Innovation Research (CKIR), Helsinki School of Economics
Funding: Academy of Finland
Keywords: graphical interfaces, visualization, multidimensional scaling, information retrieval, human cognition, mental representations
Research programme: -
WWW page and publications: cosco.hiit.fi/projects.html

With the hundreds of millions of documents in the Internet and Intranets, lack of information is rarely a problem, but how to access the information we need. In this information retrieval setting we can distinguish two separate tasks: filtering out the relevant information from the vast data masses available, and representing the resulting multi-dimensional information in a useful format. In this project we focus on the second task and assume that the first task can be solved by using publicly available tools such as the open-source search software package developed in the Alvis and SIB projects. On one hand, the question is studied as a mathematical dimension reduction problem, on the other, as a challenge in perceptual psychology; a view studied in collaboration with Ilpo Kojo's group at CKIR.

4.4.3 Combining Multiple Data Sources in Functional Genomics for Improving Genome-wide Inferences

Project leader: Hollmén, Jaakko
Research group(s): -
Researchers: Ruosaari, Salla; Toivola, Janne; Tikka, Jarkko
Schedule: 2004-01-01 … 2007-12-31
Cooperation units: -
Funding: Academy of Finland
Keywords: bioinformatics, data mining, data analysis, microarray, functional genomics
Research programme: -
WWW page and publications: -

We address a fundamental data-analytic limitation of genome-wide microarray measurements. The number of genes that can be measured at a time is already huge but the number of samples (microarrays) is small and limited by the measurement cost and sample availability. Hence, the relative number of representative samples per gene is always very small, and the problem will persist; in new experimental settings there never exists representative data a priori. This makes accurate data analysis difficult and increases the chances of false discoveries when targeting a holistic view of the cell, based on the noisy high-dimensional data. Our bioinformatics research problem is how to take advantage of existing, partially representative data sets of different types to support inferences in biological and medical questions. If this problem can be solved, data analysis methods could use the accumulating body of data, part of which may be publicly available, in support-inggenome-wide inferences in new settings and research questions. The developed methods will be applied in a representative set of research problems in two biomedical areas: cancer research and neuroscience.

4.4.4 Learning Methods for Bioinformatics

Project leader: Kaski, Samuel
Research group(s): Statistical Machine Learning and Bioinformatics
Researchers: Tripathi, Abhishek; Peltonen, Jaakko; Ajanki, Antti; Oja, Merja
Schedule: 2006-01-01 … 2008-12-31
Cooperation units:
Funding: University of Helsinki research funds
Keywords: data fusion, regulatory networks, background information
Research programme: -
WWW page and publications: http://www.cis.hut.fi/projects/mi/

The project develops methods for combining biological measurements, and for using background information in analysis of new measurements. Typical microarray measurements provide tens of thousands of values for each sample, but in a single experiment it is usually not feasible to collect measurements for more than tens of samples. Analysing such data collection of few samples but many features without constraints would be. Earlier measurements and existing biological knowledge provide natural constraints.

We develop new computational methods both for using existing earlier measurements to help the analysis task, and to efficiently and automatically create background information for new measurements from large measurement collections.

4.4.5 MDL-Based Methods for Image Denoising (Kukot)

Project leader: Myllymäki, Petri
Research group(s): Complex System Computation (CoSCo)
Researchers: Rissanen, Jorma; Roos, Teemu; Kontkanen, Petri; Mononen, Tommi; Wettig, Hannes; Silander, Tomi
Schedule: 2006-01-01…2008-06-30
Cooperation units: Laboratory for Computational Engineering, Helsinki University of Technology
Funding: Tekes
Keywords: -
Research programme: -
WWW page and publications: www.mdl-research.org

We can consider digital bit streams processed in the ICT sector as consisting of two overlapping parts, where one part is useful information and the other is useless noise. There is noise in all digital media; it is generated by the faults in original information sources (such as bad image resolution) and errors in signal transmission (such as disruptions in wireless communications or faults in hard drives). Noise can be filtered if the features of the source are known (in some degree at least), but it is very difficult to build general methods for denoising since they have top be able to construct adaptive models of random noise sources. The main problem with such adaptive modelling is the regularization of models; too complex (over-adaptive) models will interpret noise as part of the information and thus be rendered useless.

MDL (Minimum Description Length) is an information-theoretical framework developed by the father of arithmetic encoding, Jorma Rissanen. It provides an elegant solution for this problem. Unfortunately, the methods based on the MDL theory are often very challenging computationally. Based on the latest results of the MDL theory, the project has collaborated with Jorma Rissanen and developed new, computationally efficient general denoising methods.

4.4.6 Methods for Fusing Eye Movements and Text Content for Information Retrieval

Project leader: Kaski, Samuel
Research group(s): Statistical Machine Learning and Bioinformatics
Researchers: Ajanki, Antti; Salojärvi, Jarkko; Savia, Eerika
Schedule: 2006-01-01 … 2007-12-31
Cooperation units: Intelligent Systems Group, University College London, United Kingdom
Funding: Pump Priming Programme, PASCAL Network of Excellence
Keywords: machine learning, information retrieval, eye tracking, implicit relevance feedback
Research programme: -
WWW page and publications: www.cis.hut.fi/projects/mi/pump06

This project develops new kinds of information retrieval systems, by fusing multimodal implicit relevance feedback data with text content using Bayesian and kernel-based machine learning methods.

A long term goal of information retrieval is to understand the “user’s intent”. We will study the feasibility of using eye tracking to directly measure the interests at the sentence level, and of coupling the results to other relevant sources to estimate user preferences. The concrete task is to predict relevance for new documents given judgments on old ones. Such predictions can be used in information retrieval, and the most relevant documents can even be proactively offered to the user.

4.4.7 Neuroinformatics

Project leader: Hyvärinen, Aapo
Research group(s): -
Researchers: Hoyer, Patrik; Hurri, Jarmo; Hyvärinen, Aapo; Kurki, Ilmari; Köster, Urs; Lindgren, Jussi; Perkiö, Jukka
Schedule: 2003-08-01 ... (no ending date)
Cooperation units: Department of Psychology, University of Helsinki, Finland; Low temperature laboratory, Helsinki University of Technology, Finland; Carnegie Mellon University, USA; Naples University, Italy; Maastricht University, the Netherlands; Institute for Statistical Mathematics, Japan
Funding: HIIT Basic Research Unit basic funding; Helsinki Graduate School of Computer Science and Engineering; Academy of Finland; University of Helsinki special post-doctoral funds; a German foundation
Keywords: -
Research programme: -
WWW page and publications: www.hiit.fi/neuroinf

Neuroinformatics is broadly defined as the intersection of Information technology and neuroscience. Our research goals are

1. to build mathematical models of brain function. In computational visual neuroscience, our approach is to consider how the brain performs a sophisticated statistical and probabilistic analysis of the environment. To this end we also need
2. to develop new multivariate statistical models. The mathematical methods we use are often closely related to independent component analysis (ICA). As a collaborative effort, we also
3. apply advanced statistical methods on neuroscientific data.

In 2007, we further developed our probabilistic model of continuous-valued data based on two linear layers and a

nonlinearity between them. When the model is estimated from natural images, we obtain a processing system which is quite similar to what is found in the primary visual cortex. Our method is the first to succesfully estimate both layers of such a model from natural images. The model is also promising for other kinds of data; in fact, it is a generalization of independent component analysis which has already been applied on many different fields.

The subproject on causal discovery continued succesfully. We developed several extensions of the basic method, including the cases of latent variables, latent classes, and temporal dependencies. These extend the applicability of the methods on the one hand, and enable them to use more information in the data on the other. A collaborative project on this theory was initiated with some of the leading researchers in the field: Spirtes, Glymour & Scheines at CMU. Applications of these method to various fields, including brain imaging, are under investigation.

A rather new research direction was unsupervised learning of features which are useful for action. In contrast to most other schemes for learning action-related representations, the idea here is to learn a representation without any kind of reinforcement, so that the representation simply learns the regularities of the consequences of actions. In addition, we considered unsupervised learning of regularities in the action sequences themselves.

A new project on analysis of brain imaging data was started in collaboration with Riitta Hari's world-renowned group at the Low temperature laboratory of the Helsinki University of Technology (TKK).

The purpose is to analyze electrical activity in the human brain in two non-classical paradigms: resting state and natural stimulation. In contrast to conventional paradigms, the analysis has to be done by unsupervised learning methods because there is no stimulation protocol which would enable supervised learning methods to be used.

4.4.8 Probabilistic Methods for Microarray Data Analysis (PMMA)

Project leader: Myllymäki, Petri
Research group(s): Complex System Computation (CoSCo)
Researchers: Rissanen, Jorma; Roos, Teemu; Kontkanen, Petri; Wettig, Hannes; Lahtinen, Jussi; Silander, Tomi
Schedule: 2004-01-01…2008-06-30
Cooperation units: Laboratory for Computational Engineering, Helsinki University of Technology; Institute of Biomedicine, University of Helsinki
Funding: Tekes
Keywords: -
Research programme: -
WWW page and publications:
cosco.hiit.fi/projects.html

The main objective of the research is to develop advanced methods for microarray data analysis. In particular the project focuses on the following research issues: denoising of microarray images, comprestimation (multiterminal estimation), gene clustering and classification, and estimation of the reliability of the results.

The project has developed algorithms for finding the globally optimal Bayes network for cases with 30 or less variables. The empirical testing of the results are still going on. In addition, the project studied methods for parallelizing Bayes network learning algorithms, and developed a novel, theoretically elaborate method for constructing variable-width bin histogram density estimators.

4.4.9 Search-in-a-Box (SIB)

Project leader: Myllymäki, Petri
Research group(s): Complex System Computation (CoSCo)
Researchers: Buntine, Wray; Tuominen, Antti; Tuulos, Ville; Löfström, Jaakko; Poroshin, Vladimir; Lahtinen, Jussi; Silander, Tomi; Perkiö, Jukka; Valtonen, Kimmo
Schedule: 2003-03-01 ... 2007-06-30
Cooperation units: Department of Computer Sciences, University of Tampere; Department of Health Policy and Management, University of Kuopio
Funding: Tekes; Nokia; Alma Media; M-Brain, Wisane, National Board of Patents and Registration of Finland
Keywords: intranet search, web search, text analysis
Research programme: Tekes / FENIX
WWW page and publications: cosco.hiit.fi/search/sib.html

The SIB project developed next-generation methods for semantic information retrieval based on automatic analysis of text documents. These methods have been integrated to a set of prototypes that are tested in different pilot environments, such as corporate information-management systems, topic-based search engines, analysis of email messages, and public intelligent search engines.

Our search engine for the freely available Wikipedia encyclopedia gives an example of our public demonstrators. The pilot can be found at http://wikipedia.hiit.fi, and it manifests some of the new features enabled by our semantic approach to document search. In the basic research line of work underlying this pilot, the MPCA suite for unsupervised topical analysis of documents was modified extensively so that it can be used much more automatically.

In the latter part of the project we decided to crystallize the main lessons learnt by building a public prototype

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of a large scale, full- fledged Internet search engine. The result, the Aino Search Engine (aino.hiit.fi), provides content-based search for the whole .FI domain, consisting of about 15 million documents. An effort of this scale requires strong emphasis on distribution of computational load, which was achieved by streamlining the needed components to small, independent modules. We took an opportunity to experiment with a novel content-based ranking scheme of ours, which should be especially robust in noisy environments like the Web. Together the new ranking scheme and the modular back-end form the basis for Aino. In addition this effort gave birth to an efficient web crawler, HooWWWer. Together Aino and HooWWWer power a publicly available, regularly updated, search engine for the Finnish Web.

4.4.10 SensorPlanet

Project leader: Myllymäki, Petri
Research group(s): Complex System Computation (CoSCo)
Researchers: Perkiö, Jukka; Silander, Tomi; Laine, Tei
Schedule: 2006-10-01 … 2007-06-30
Cooperation units: -
Funding: Nokia Research Center
Keywords: -
Research programme: -
WWW page and publications: www.sensorplanet.org

The SensorPlanet initiative, innovated and set up by the Nokia Research Center, aims at building an open global mobile device centric research platform for Wireless Sensor Network (WSN) research (akin to somewhat analogous platform for backbone network services called PlanetLabs). The distributed platform will provide the necessary infrastructure for world's top research labs to perform innovative research on wireless sensor networks, where the mobile devices can be seen both as gateways to the mesh sensor networks and also as sensor nodes themselves. This open innovation initiative will allow Nokia to collaborate with the best teams in the field around the world, and direct the academic Wireless Sensor Network research globally towards a mobile device centric innovation.

In addition to the generic SensorPlanet open initiative, Nokia ran a Tekes funded research project which supported local SensorPlanet-related research work in Finland, and the SensorPlanet project was part of Nokia's Tekes project work via subcontracting to the Cosco group.

4.4.11 Supervised Unsupervised Learning and Relevant Subtask Learning (SULRSL)

Project leader: Kaski, Samuel
Research group(s): Statistical Machine Learning and Bioinformatics research
Researchers: Peltonen, Jaakko
Schedule: 2005-08-01 … 2008-12-31
Cooperation units: -
Funding: Academy of Finland
Keywords: supervised unsupervised learning, semisupervised learning, relevant subtask learning, transfer learning, partially relevant data
Research programme: -
WWW page and publications: http://www.cis.hut.fi/projects/mi/sdm

We develop statistical machine learning methods to extract from high-dimensional data sets regularities that are relevant to the analyst. We infer relevance from auxiliary information that comes with the data, such as class labels coupled with input samples. In tasks like discriminative visualization, discriminative clustering or discriminative feature extraction, the labels guide unsupervised analysis of the features; we call such tasks supervised unsupervised learning.

In both standard supervised learning and in the new idea, supervised unsupervised learning, a common problem is having too little labeled training data. The problem is particularly hard for the high-dimensional data in genome-wide studies of modern bioinformatics, but appears also in image classification from few examples, finding of relevant texts, etc.

Thankfully, the world is full of potentially related ”background” data sets: for instance in bioinformatics there are databases full of data measured for different tasks, conditions or contexts; for texts there is the web. Our second research problem is, can we solve the small-data problem by using the partially relevant data sets to build a better class-discriminative model for the test data?

5 Research Training and Research Visits
5.1 Doctoral Degrees Earned by the HIIT Personnel

Karvonen, Kristiina:
Bridging the Gap between Human and Machine Trust: Applying Methods of User-Centred Design and Usability to Computer Security. Espoo: Helsinki University of Technology, 2007

Kurvinen, Esko:
Prototyping Social Action. Publication Series of the University of Art and Design Helsinki. A;75. Helsinki: University of Art and Design Helsinki, 2007

Leino, Antti:
On Toponymic Constructions as an Alternative to Naming Patterns in Describing Finnish Lake Names. PhD Thesis, Studia Fennica Linguistica 13. Helsinki: Finnish Literature Society, 2007.

Oja, Merja:
Methods for Exploring Genomic Data Sets: Application to Human Endogenous Retroviruses. PhD Thesis, Dissertations in Computer and Information Science, report D23, 2007. Espoo: Helsinki University of Technology, 2007.

Raento, Mika:
Exploring Privacy for Ubiquitous Computing: Tools, Methods and Experiments. Department of Computer Science, Series of publications A, Report A-2007-2. Helsinki: University of Helsinki, 2007

Riva, Oriana:
Middleware for Mobile Sensing Applications in Urban Environments. PhD Thesis, Department of Computer Science, Series of Publications A, Report A-2007-6, University of Helsinki, 2007.

Roos, Teemu:
Statistical and Information-Theoretic Methods for Data Analysis. PhD Thesis, Department of Computer Science, Series of Publications A, Report A-2007-4, Helsinki: University of Helsinki, 2007.

Soininen, Aura:
Patents in the Information and Communications Technology Sector: Development Trends, Problem Areas and Pressures for Change. Acta Universitatis Lappeenrantaensis; 262. Lappeenranta : Lappeenranta University of Technology, 2007

Venna, Jaakko:
Dimensionality Reduction for Visual Exploration of Similarity Structures. Dissertations in computer and information science. Report D; 20. Espoo: Helsinki University of Technology, 2007

5.2 Post-graduate Courses Arranged by HIIT

Spring 2007 courses

- Advanced Issues in Usable Security (Kristiina Karvonen)
- Biological Sequence Analysis (Esko Ukkonen)
- HCI and Personal and Ubiquitous Systems (Antti Oulasvirta)
- Kolme käsitettä: Todennäköisyys (Petri Myllymäki)
- Linear Algebra Methods for Data Mining (Saara Hyvönen)
- Modeling of Vision (Aapo Hyvärinen)
- Network Application Frameworks (Sasu Tarkoma)
- Protocol Software Engineering (Kimmo Raatikainen, Oriana Riva)
- Recent Advances in Trustworth Computing (N. Asokan)
- Seminar on Adaptive Computing Research (Patrik Floréen)
- Seminar on Intelligent Systems Research (Tei Laine)
- Seminar on Language Technology and Applications (Greger Lindén)
- Seminar on Self-Healing Information (Kimmo Raatikainen)
- Spatial Data Mining (Antti Leino)
- Special Course on Data Mining (Marko Salmenkivi)
- Three Concepts: Utility (Tei Laine)
- Tietojenkäsittelytieteen jatko-opiskelijaseminaari (Hannu Toivonen)

Autumn 2007 courses

- Energy Aware Ubiquitous Computing (N. Asokan, Jukka Manner, Antti Ylä-Jääski)
- Kolme käsitettä: Informaatio (Teemu Roos)
- Performance Issues in Mobile Computing and Communication (Kimmo Raatikainen)
- Practical Course on Biodatabases (Petteri Sevon)
- Seminaari: Tiedon louhiminen www:stä (Marko Salmenkivi)
- Seminar on Opportunistic Networks (Jussi Kangasharju)
- Seminar on User Modelling (Petteri Nurmi)
- Tekoäly (Tei Laine)

5.3 Research Visits

Visits to HIIT

Ardito, Carmelo
University of Bari, Italy
4 months

Brasma, Alvis
European Bioinformatics Institute EBI, Hinxton, UK
3 weeks

Egry-Nagy, Attila
Royal Society Wolfson BioComputation Research Lab, University of Hertfordshire, UK
1 week

Husfeldt, Thore
Lund University, Sweden
4 days

Jaakkola, Tommi
MIT, USA
1 month

Jain, Bijendra
Indian Institute of Technology, Delhi, India
4 days

Gallo, Arianna
University of Bristol, UK
6 weeks

Garriga, Gemma
Laboratory of Relational Algorithmics, Complexity and Learnability, Barcelona, Spain
1 week

Gionis, Aristides
Yahoo! Research, Barcelona, Spain
1 week

Goethals, Bart
Department of Math and Computer Science, University of Antwerp, Belgium
1 week

Grouchy, Paul
Queen's University, Ontario, Canada
3 months

Kiefer, Jürgen
Zentrum Mensch-Maschine-Systeme, TU Berlin
2 months

Le Page, Wim
Department of Math and Computer Science, University of Antwerp, Belgium
1 week

Madden, Michael
Department of Information Technology, National University of Ireland, Galway, Ireland
1 month

Mavroeidis, Dimitris
Athens University of Economics and Business, Greece
4 days

Nyberg, Mattias
Linköping University & Scania, Sweden
1 day

Pernestål, Anna
KTH School of Electrical Engineering, Stockholm, Sweden
1 week

Phokion, Kolaitis
IBM Almaden Research Center, San Jose, USA
1 week

Weaver, Nick
ICSI, USA
1 week

Woelki, Diana
TU Berlin, Germany
1 week

Yaslan, Yusuf
Istanbul Technical University, Istanbul, Turkey
6 months

Visits from HIIT

Caldas, José
European Bioinformatics Institute EBI, Hinxton, UK
months

Hoyer, Patrik
Carnegie Mellon University, Pittsburgh, USA
1 month

Kaski, Samuel
European Bioinformatics Institute EBI, Hinxton, UK
2 months

Koponen, Teemu
University of California, Berkeley, USA
8 months

Lehdonvirta, Vili
Waseda University, Japan
8 months

Nurmi, Petteri
National ICT Australia NICTA, Canberra, Australia
1 month – continues in 2008

Miettinen, Pauli
Dipartimento di Informatica e Sistemistica Antonio Ruberti, Università di Roma “La Sapienza”, Rome, Italy

Oulasvirta, Antti
University of California, Berkeley, USA
4 months

Ponomarev, Oleg
Rheinisch-Westfäliche Technishe Hochschule, Aachen, Germany
3 months

Przybilski, Michael
The Department of ISOM, The University of Auckland Business School, Auckland, New Zealand
6 months

Reti, Tommo
University of California, Berkeley, USA
12 months

Vihavainen, Sami
University of California, Berkeley, USA
8 months

Saari, Timo
Temple University, Philadelphia, USA
12 months

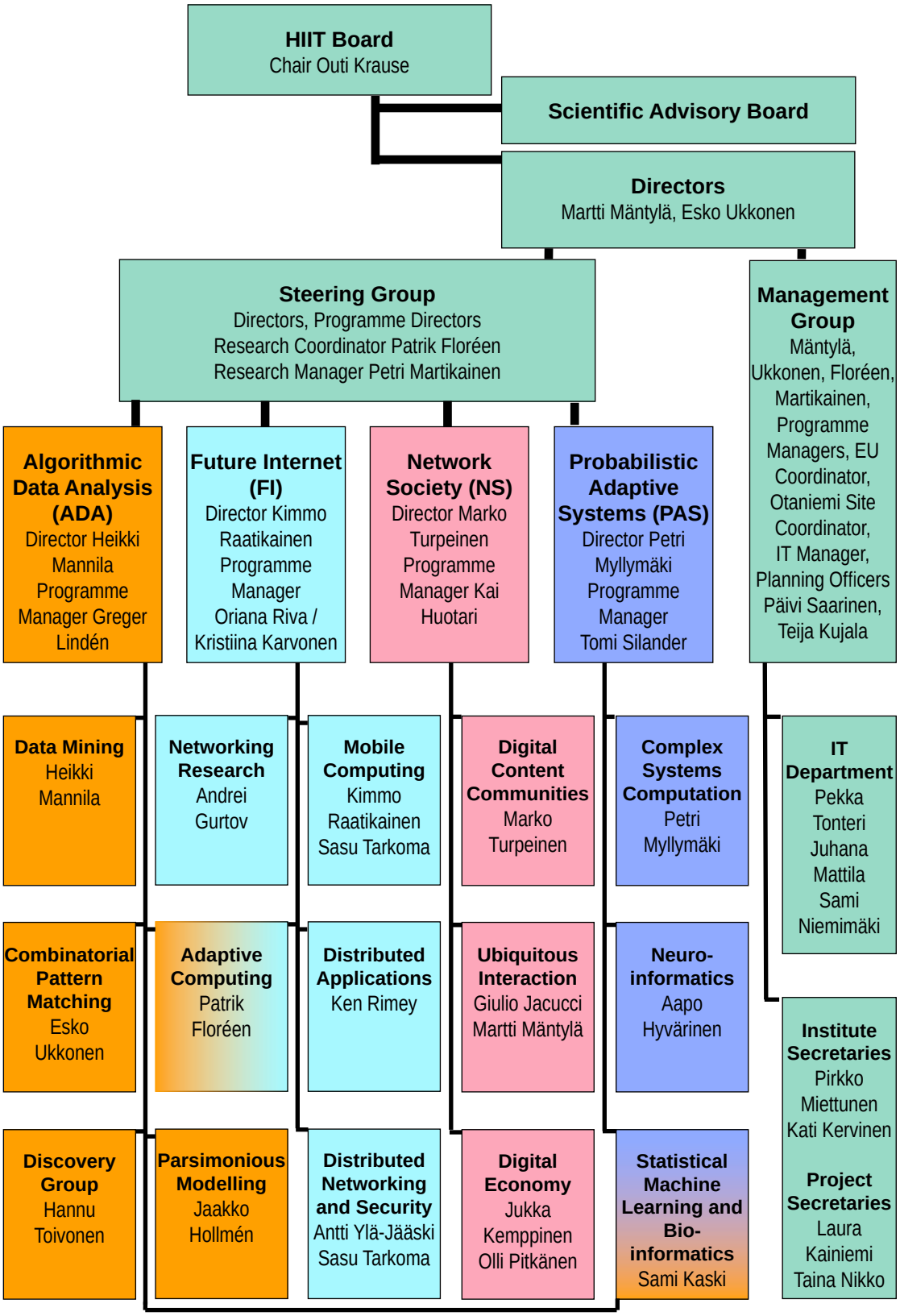
6 Administration
6.1 Overview

HIIT is a joint research centre of TKK and UH. The HIIT Board, nominated by the universities, decides on its overall research strategy and research programmes. The Scientific Advisory Board, nominated by the Board, provides scientific guidance and criticism for the Board. At present HIIT consists of two administrative units. Spektri Unit in Espoo is associated with TKK, and Kumpula Unit in Helsinki is associated with UH. Each unit has a Director nominated by the Board.

Research programmes are led by the Programme Directors. Together with the Directors, they constitute the Steering Group responsible for inter-programme coordination and planning. The Steering Group also accepts new research groups to HIIT. The Management Group is responsible for the coordination of the administrative processes such as planning, budgeting, and reporting; communications; and preparation of joint events.

Research programmes each have a Programme Management Group consisting of the senior researchers of the research groups contributing to the work. The Research Programme Manager facilitates the operation of the programme management group and coordinates the joint activities of the programme. A Programme Advisory Board (PAB), consisting of invited members from industry and academia, provides feedback on programme results and advises on their vision, mission, and key research lines. The programme-specific PABs replaced the earlier Industrial Advisory Board which was disbanded in 2006.

HIIT's administration team provides administrative services. The IT department is responsible for the IT infrastructure and key services of the institute.


HIIT Board
Chair Outi Krause
Scientific Advisory Board
Directors
Martti Mäntylä, Esko Ukkonen
Steering Group
Directors, Programme Directors
Research Coordinator Patrik Floréen
Research Manager Petri Martikainen
Management Group
Mäntylä, Ukkonen, Floréen, Martikainen, Programme Managers, EU Coordinator, Otaniemi Site Coordinator, IT Manager, Planning Officers Päivi Saarinen, Teija Kujala
Algorithmic Data Analysis (ADA)
Director Heikki Mannila
Programme Manager Greger Lindén
Future Internet (FI)
Director Kimmo Raatikainen
Programme Manager Oriana Riva / Kristiina Karvonen
Network Society (NS)
Director Marko Turpeinen
Programme Manager Kai Huotari
Probabilistic Adaptive Systems (PAS)
Director Petri Myllymäki
Programme Manager Tomi Silander
Data Mining
Heikki Mannila
Networking Research
Andrei Gurtov
Mobile Computing
Kimmo Raatikainen
Sasu Tarkoma
Digital Content Communities
Marko Turpeinen
Complex Systems Computation
Petri Myllymäki
IT Department
Pekka Tonteri
Juhana Mattila
Sami Niemimäki
Combinatorial Pattern Matching
Esko Ukkonen
Adaptive Computing
Patrik Floréen
Distributed Applications
Ken Rimey
Ubiquitous Interaction
Giulio Jacucci
Martti Mäntylä
Neuro-informatics
Aapo Hyvärinen
Institute Secretaries
Pirkko Miettunen
Kati Kervinen
Project Secretaries
Laura Kainiemi
Taina Nikko
Discovery Group
Hannu Toivonen
Parsimonious Modelling
Jaakko Hollmén
Distributed Networking and Security
Antti Ylä-Jääski
Sasu Tarkoma
Digital Economy
Jukka Kemppinen
Olli Pitkänen
Statistical Machine Learning and Bio-informatics
Sami Kaski

6.2 Board

The highest decision-making body of HIIT is the Board.

The Board consists of nine full members of whom eight are appointed by the parent universities and represent the academic community and the main industrial partners of HIIT. One member of the board represents and is elected by HIIT personnel. In addition, the Board invites members from industrial companies with whom HIIT co-operates to participate in the work of the Board.

The decision-making power is invested in the full members, whereas the invited members have the right to attend and to speak at the meetings.

In 2007 the Board convened four times. In addition, the members of the Board met, sans HIIT personnel, in November to discuss HIIT's future after the three year transition period ending this year.

Apart from dealing with the statutory tasks (i.e. approving the annual budgets and activity plans of both units, approving the HIIT annual report, following up the work of the units through regular activity updates given by the two Research Directors of HIIT, etc.), the major theme for the Board's work in 2007 was to discuss the future strategy of HIIT and its implementation after 2008.

Board Members 2007 and their personal deputies

Vice Rector Outi Krause	**TKK, Chairman of the Board**
(Vice Rector Kalevi Ekman)	TKK
Professor Olli Simula,	TKK
(Professor Heikki Saikkonen)	TKK
Vice Rector, Thomas Wilhelmsson	UH, Vice-Chairman of the Board
(Vice Rector, Professor Marja Makarow)	UH
Professor Jyrki Kivinen	UH
(Docent Lea Kutvonen)	UH
Raimo Vuopionperä,	Oy L M Ericsson Ab
(Björn Melén)	Oy L M Ericsson Ab
Aimo Maanavilja	Elisa Communications Oyj
(Pertti Hölttä)	Elisa Communications Oyj
Juha Aaltonen	TeliaSonera Finland Oyj
(Martin Mäklin)	TeliaSonera Finland Oyj
Henry Tirri	Nokia Oyj
(Petteri Alinikula)	Nokia Oyj
Patrik Floréen	HIIT
(Kai Huotari)	HIIT

Invited Members

Ari Hirvonen	TietoEnator Oyj
(Olli Lötjönen)	TietoEnator Oyj
Eskoensio Pipatti	Sanoma Oyj
Juha Vesaoja	Yleisradio Oy
Pekka Järvinen	Nordea
(Juha Toivari)	Nordea

The Research Directors of HIIT Martti Mäntylä and Esko Ukkonen are responsible for preparing and submitting propositions to the Board. In addition, the Research Manager Petri Martikainen has the right to attend meetings.

Board Secretary
Planning Officer Päivi Saarinen

After the HIIT board term of 2004-2006 ended, the new board for the term 2007-2008 was appointed on the 27th of February 2007.

6.3 Scientific Advisory Board (SAB)

The Scientific Advisory Board (SAB) of HIIT consists of internationally prominent scholars who are invited by the HIIT Board. The objective of the SAB is to provide critical guidance about HIIT's research activities and to advise the HIIT Board on strategic planning for future research directions of HIIT.

SAB Members 2007

Dr Ross Anderson	University of Cambridge
Professor Alberto Apostolico	Georgia Tech
Professor Richard Buxbaum	University of California at Berkeley
Professor Christos Faloutsos	Carnegie Mellon University
Professor Randy Katz	University of California at Berkeley
Professor Bengt Jonsson	Uppsala University
Professor Martin Kersten	University of Amsterdam and CWI*
Professor Kari-Jouko Räihä	University of Tampere
Professor Mart Saarma	University of Helsinki
Professor John Shawe-Taylor	University of Southampton
Professor Hal Varian	University of California at Berkeley
Dr Martin Vingron	Max Planck Institute for Molecular Genetics

* National Research Institute for Mathematics and Computer Science in the Netherlands

The SAB did not meet during 2007. The next meeting will take place 26-28 May 2008 to monitor the progress of HIIT's strategy.

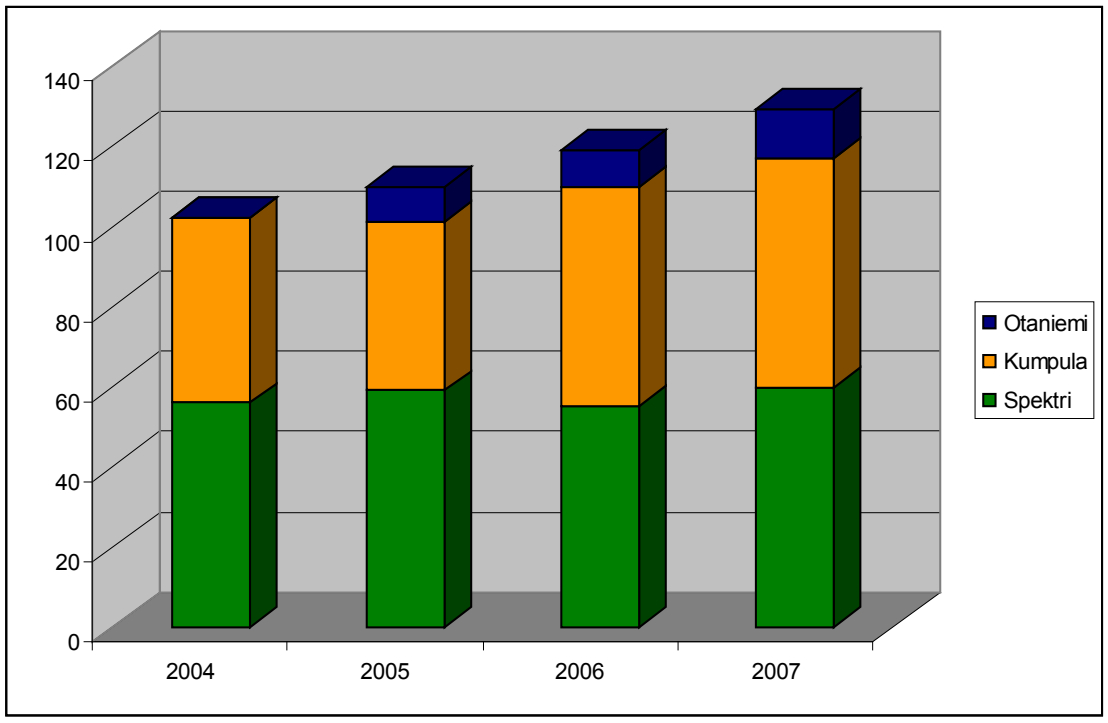
6.4 Personnel

The personnel directly employed by HIIT are formally employed by the two parent universities; the Spektri and Otaniemi personnel are employed by TKK and the Kumpula personnel by UH. In addition, there are a number of persons working in HIIT with some other form of funding, such as post-graduate students with funding from Helsinki Graduate School of Computer Science and Engineering (HeCSE) and researchers with academic positions. Many of HIIT's personnel have double or even triple affiliations. Most common is an affiliation with one or both of the parent universities, but there are also some who share their time between HIIT and some other organisation. The diversity of affiliations is characteristic of HIIT personnel.

Number of person-years and distribution by sites in 2003-2006

Staff (person-years)	2004	2005	2006	2007
Spektri	56	59	55	60
Kumpula	46	42	55	57
Otaniemi	*	9	9	12
Total	**102**	**110**	**119**	**129**

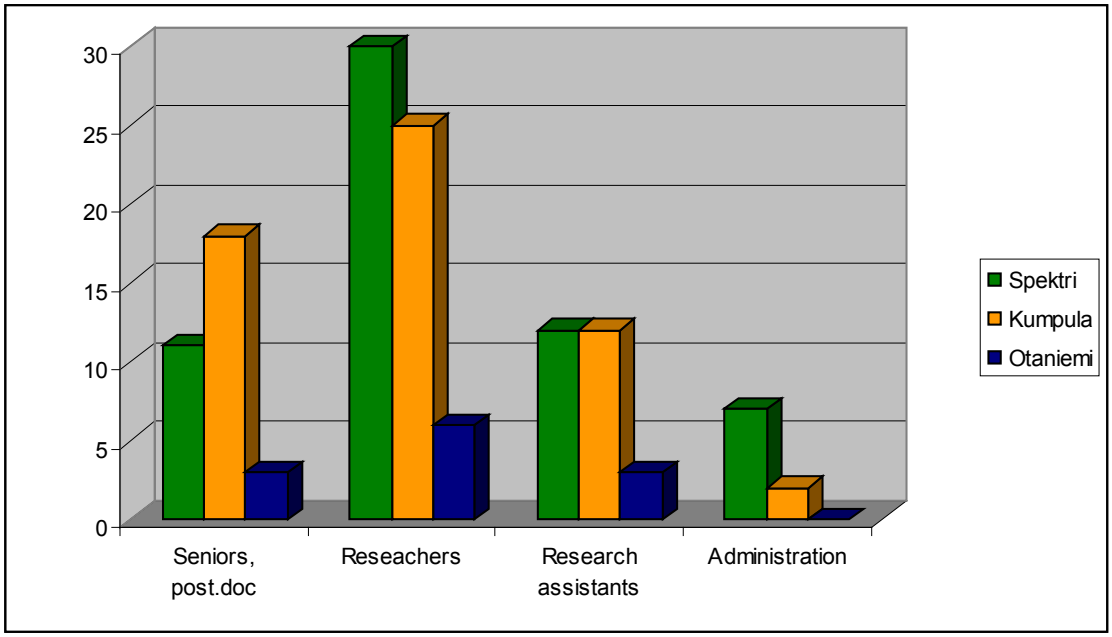
* Otaniemi personnel was included in Kumpula staff in 2004



In 2007 the total number of employees was 197; HIIT staff completed 129 person-years, ten more than the previous year. About 17 % of the personnel were foreigners coming e.g. from China, Germany, Greece, India, Italy, Pakistan, Russia, Spain, Kazakhstan, and El Salvador.

Number of person-years and distribution by personnel groups in 2007

Staff (person-years)	Spektri	Kumpula	Otaniemi	Total	Change from 2006
Seniors, post.doc	11	18	3	32	+ 1
Reseachers	30	25	6	61	+ 6
Research assistants	12	12	3	27	+ 2
Administration	7	2	-	9	+1
Total	**60**	**57**	**12**	**129**	**+ 10**



During 2007, the distribution of researchers, senior researchers, postdocs and students remained roughly the same when compared to the previous year. This was in line with HIIT policy, which favours research groups with a good balance of personnel at different levels of advancement.

7 Funding and Costs

Spektri Unit Finances

SPEKTRI (RUOHOLAHTI)	2005	2006	2007
Total funding	**3 680 175**	**3 958 172**	**4 132 540**
TKK funding	164 359	263 272	436 837
UH funding	168 200	168 200	168 200
Academy of Finland	586 531	140 698	83 875
Tekes, National Technology Agency	1 949 083	1 953 297	1 917 903
European Union (EU)	280 582	658 028	852 437
Industry	457 074	559 943	510 642
Ministries and other public funding	22 242	99 727	74 821
Other domestic funding	52 104	115 007	87 825
Total expences	**3 786 832**	**3 809 977**	**4 014 856**
Salaries	2 530 688	2 511 946	2 538 365
Other operational expences	732 690	725 940	958 624
Rents	374 023	407 331	354 006
Service charge to TKK	149 432	164 760	163 861

University funding, of total funding	**9 %**	**11 %**	**15 %**
External funding, of total funding	**91 %**	**89 %**	**85 %**
Academy funding, of total funding	16 %	4 %	2 %
Tekes funding, of total funding	53 %	49 %	46 %
Industry funding, of total funding	12 %	14 %	12 %
EU funding, of total funding	8 %	17 %	21 %
Other public funding, of total funding	2 %	5 %	4 %

Salaries, of total expences	67 %	66 %	63 %
Other expences, of total expences	23 %	23 %	28 %
Rents, of total expences	10 %	11 %	9 %

TKK funding for 2007 increased towards the goal of funding balance between TKK and UH by 2009. Funding from Academy of Finland decreased because of the end of the PROACT research programme; in 2008, this trend is expected to reverse. Funding from EU increased with the launch new projects awarded in late 2006. High operational expenses are partly explained by one-time costs related to the move of the unit to Spektri. The balance between internal and external funding was improved towards the long-term aim of 25%-75%.

Kumpula Unit Finances

KUMPULA	2005	2006	2007
Total funding	**1 861 421**	**2 179 499**	**2 737 000**
UH funding	731 000	891 744	877 000
Academy of Finland	650 580	490 570	485 000
Tekes, National Technology Agency	107 380	418 612	665 000
European Union (EU)	197 597	274 818	450 000
Industry	174 864	103 756	260 000
Total expences	**1 635 915**	**1 965 993**	**2 446 105**
Salaries	1 270 587	1 483 555	1 632 852
Other operational expences	222 111	242 647	408 628
Service charge to UH (rents included)	143 217	239 790	404 625

University funding, of total funding	**39 %**	**41 %**	**32 %**
External funding, of total funding	**61 %**	**59 %**	**68 %**
Academy funding, of total funding	35 %	22,5 %	18 %
Tekes funding, of total funding	6 %	19 %	24 %
Industry funding, of total funding	9 %	5 %	9 %
EU funding, of total funding	11 %	12,5 %	16 %

Salaries, of total expences	78 %	75 %	68 %
Other expences, of total expences	14 %	12 %	16 %
Rents, of total expences	9 %	12 %	16 %

Otaniemi Unit Finances

OTANIEMI	2005	2006	2007
Total funding	**406 741**	**436 790**	**663 917**
TKK funding	100 000	106 386	95 357
Center of Excellence funding from TKK	78 145	71 280	71 000
Academy of Finland	228 596	218 226	329 400
Tekes, National Technology Agency	0	40 898	168 160
European Union (EU)	0	0	0
Industry	0	0	0
Total expences	**382 258**	**395 107**	**581 208**
Salaries	335 073	344 875	479 800
Other operational expences	2 831	21 064	25 850
Service charge to TKK/UH (rents included)	44 354	29 168	75 558

University funding, of total funding	**25 %**	**24 %**	**25 %**
External funding, of total funding	**75 %**	**76 %**	**75 %**
Academy funding, of total funding	56 %	50 %	50 %
Tekes funding, of total funding	0 %	9 %	25 %
Industry funding, of total funding	0 %	0 %	0 %
EU funding, of total funding	0 %	0 %	0 %
CoE funding, of total funding	19 %	16 %	11 %

Salaries, of total expences	88 %	87 %	83 %
Other expences, of total expences	1 %	5 %	4 %
Rents, of total expences	12 %	7 %	13 %

HIIT Finances Summary

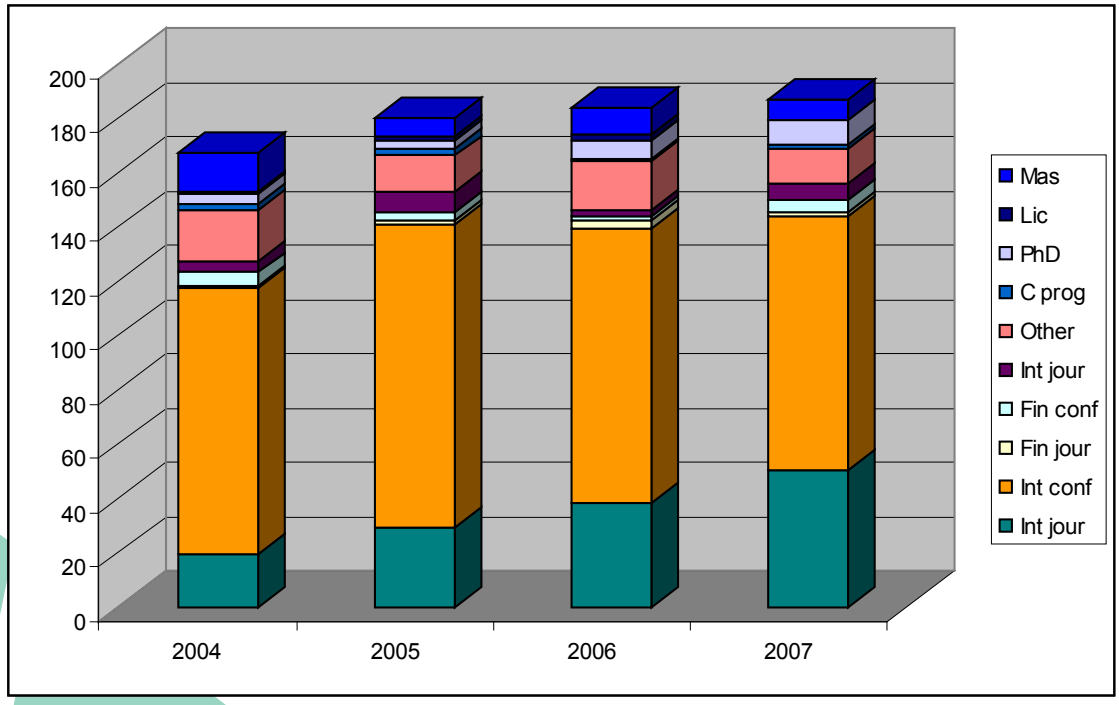
HIIT	2005	2006	2007
Total funding	**5 948 337**	**6 574 462**	**7 533 457**
Universities	1 241 704	1 500 882	1 648 394
Academy of Finland	1 465 707	849 494	898 275
Tekes, National Technology Agency	2 056 463	2 412 807	2 751 063
European Union (EU)	478 179	932 846	1 302 437
Industry	631 938	663 699	770 642
Ministries and other public funding	22 242	99 727	74 821
Other domestic funding	52 104	115 007	87 825
Total expences	**5 805 006**	**6 171 076**	**7 042 169**
Salaries	4 136 348	4 340 376	4 651 017
Other operational expences	957 632	989 651	1 393 102
Rents	374 023	407 331	354 006
Service charge to TKK/UH	337 003	433 718	644 044

University funding, of total funding	**21 %**	**23 %**	**22 %**
External funding, of total funding	**79 %**	**77 %**	**78 %**
Academy funding, of total funding	25 %	13 %	12 %
Tekes funding, of total funding	35 %	37 %	37 %
Industry funding, of total funding	11 %	10 %	10 %
EU funding, of total funding	8 %	14 %	17 %
Other funding, of total funding	1 %	3 %	2 %

Salaries, of total expences	71 %	70 %	66 %
Other expences, of total expences	22 %	23 %	29 %
Rents, of total expences	7 %	7 %	5 %

Appendices
A - Publications

Publications 2004 - 2007	2004	2005	2006	2007
Articles in international scientific journals with referee practice	19	29	38	50
Articles in international edited works and conference proceedings with referee practice	98	112	101	94
Articles in Finnish scientific journals with referee practice	1	1	3	1
Articles in Finnish edited works and conference proceedings with referee practice	5	3	2	5
Scientific monographs	4	8	2	6
Other publications	19	13	18	13
Computer programmes (and algorithms)	2	3	1	1
Degrees				
- PhD and DSc thesis	4	3	7	9
- Licenciate thesis	1	1	2	0
- Master's thesis	14	7	10	8
Total	**167**	**180**	**184**	**187**



Articles in International Scientific Journals with Referee Practice

Arkin, E.M.; Mitchell, J.S.B; Polishchuk, V.: Two new classes of Hamiltonian graphs (extended abstract). Electronic Notes in Discrete Mathematics: 29 (2007), pp. 565 - 569.

Balcázar, J. L.; Garriga, G. C.: Horn axiomatizations for sequential data. Theoretical Computer Science: 371(3): p. 247 - 264 (2007).

Bingham, E.; Kaban, A.; Fortelius, M.: Aspect Bernoulli model: Multiple causes of presences and absences. Pattern Analysis and Applications: 2007 (e-version, on paper 2008).

De Raedt, L; Kimmig, A; Toivonen, H.: Probabilistic Explanation Based Learning. Machine Learning 2007: pp. 176 - 187.

Gionis, A.; Mannila, H.; Tsaparas, P.: Clustering Aggregation (long version). ACM Transactions on Knowledge Discovery from Data: 1, 1 (2007).

Gionis, A.; Mannila, H.; Mielikainen, T.; Tsaparas, P.: Assessing Data Mining. Results via Swap Randomization. ACM Transactions on Knowledge Discovery from Data (TKDD): Volume 1, Issue 3 (December 2007) Article No. 14.

Gupta, R.; Ruosaari, S., Kulathinal, S.; Hollmén, J.; Auvinen, P.: Microarray image segmentation using additional dye - An experimental study. Molecular and Cellular Probes: nro 5-6, 2007. pp. 321 - 328.

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