Informatik 5
Information Systems

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Overview

Today, the field of Information Systems does not only include structured databases, but at least equally important the semi-structured and unstructured data from the web and Internet of Thing sensors. The Chair of Information Systems and Databases addresses both domains, with metadata in the kernel of its research interest. Current major themes include mobile web services and metadata management, but also application themes such as personal electromobility, life science data integration and analytics, and lifelong technology-enhanced learning.

The Chair was founded in early 1991 by Prof. Matthias Jarke with two research assistants. Currently, it is co-led by Prof. Jarke with Prof. Stefan Decker and has grown to six professors, eight postdocs, seventeen doctoral candidates, five technical and administrative staff, and close to 40 student researchers. It is closely linked by shared leadership to the Fraunhofer Institute for Applied Information Technology FIT, and the Bonn-Aachen International Center for Information Technology (b-it). In June 2016, we celebrated our 25th Anniversary with almost 140 alumni, current colleagues, and a few long-term collaboration partners, in a symposium followed by a festive dinner in nearby Vaalsbroek Castle in wonderful weather.

Again, we were quite active in conference organization. In Aachen itself, the biggest event was the GI National Conference “Mensch and Computer 2016” which drew about 750 participants from research, industry, and administration, making it the second largest computer science conference in Germany this year. MuC 2016 was co-organized by professors Jarke and Prinz together with b-it Endowed Professor Jan Borchers and our psychology colleague professor Martina Ziefle. In addition, Informatik 5 researchers co-chaired the WEBIST Conference 2016 (K.-H. Krempels) and several workshops at conferences such as EC-TEL/JTEL (R. Klamma, M. Kravcik), ESWC (S. Decker), I-KNOW (R. Klamma) and VLDB (R. Hai, C. Quix).

We were also very happy about an unusual number of research awards to Informatik 5 researchers: best paper awards at CAiSE 2016 (Nicolaescu et al.), IFAC 2016 (Sun&Rose), ICWE 2016 (Koren&Klamma) and MuC 2016 (Franken et al.) and a Fraunhofer ICT Dissertation Award for our 2015 doctoral alumna Katja Niemann.

In the academic year 2015-2016, four doctoral theses were successfully defended at Informatik 5, by Manuel Allhoff (biomedical informatics), Sebastian Franken (CSCW), Zinayida Kensche (web-based learning communities), and Dominik Renzel (mobile requirements monitoring). Two further doctoral theses have been submitted towards the end of the academic year and are currently under review, with defenses planned still in 2016. Dr. Christoph Quix was appointed temporary professor of Data Management and Exploration after our professorial colleague Thomas Seidl left for Munich. The team of Prof. Decker was strengthened by hiring three postdocs: we welcome Oya Beyan, Michael Cochez, Benjamin Heitmann to Informatik 5, as well as new doctoral candidates Peter de Lange, Fabian Ohler and Andreas Pfeiffer who joined the teams of Drs. Klamma and Krempels, respectively.

Current strategic activities include a strengthening of our interdisciplinary ties to different engineering groups at RWTH Aachen University, both in the context of preparing for the upcoming next round of the German Excellence Initiative, and of strengthening the presence of Fraunhofer FIT in Aachen, aiming at a joint Center for Manageable Digitalization focused on applications in energy management, urban mobility, and smart textiles.
Aim of the BMWi-funded project MobilityBroker, successfully completed in June 2016, was the first-time combination of all mobility services in a German region on a single virtual marketplace. Instead of having to use, e.g. different applications for different services, the system functions as a single point of contact for regional travels offering intermodal travel. By combining different mobility services (Bus, Train, Carsharing, Bikesharing, Cab etc), users are able to easily select the best route based on his personal preference, e.g. best price or fastest travel. The routing incorporates real-time schedule and vehicle availability data. As a user interface to this marketplace, both a mobile and a web platform were developed.

Informatik 5 designed the overall system architecture and developed two key components. One is responsible for the information exchange among participating mobility providers, and the other one for the integration of sharing systems into the routing. Informatik 5 also supports the project partners with requirements engineering, e.g., of the mobile application.

In August 2015, the mobility station at RWTH University Campus Hörn was opened. Demonstrating one focal point of the project, the mobility station locally combines electronic sharing services and public transportation. As part of an initial test phase, users are able to query, book and utilize heterogeneous modes of transportation with the help of a comprehensive travel information system.
UFO: Urban Future Outline

HumTec Program with Excellence Concept “RWTH 2020”

K.-H. Krempels, M.C. Beutel, M. Jarke,
M. Ziefle (Communication Science), C. Schröder (Linguistics)

http://dbis.rwth-aachen.de/cms/projects/ufo

UFO was an interdisciplinary research project on quality of life in city quarters in the context of mobility, city structure and Energiewende. It consists of three subprojects: FuMob (Future Mobility), FuEco (Future Ecosystem) and FuEne (Future Energy). Informatik 5 participates in FuMob and FuEne. FuMob addresses requirements, capabilities and limitations of public communication and information when planning and implementing new mobility concepts. New approaches for planning and realizing infrastructure decision-making were developed with systematic stakeholder involvement (citizens, decision makers, experts, etc.) in a sustained manner. The tasks of Informatik 5 comprise requirements engineering, analysis of perspectives with relation to mobility chain and design space, selection of prototypical mobility scenarios and a user-centered, adequate communication and information concept.

FuENE focused on roadmapping sustainable and environmentally suitable energy turnaround. A comprehensive model and methodology for the realization of sustainable resilient energy systems systematically integrates social factors (customer perception of energy systems) into the technical, economical and informational process of energy scenarios. Informatik 5 developed parameters, strategies and solution spaces along with analysis and modeling of future scenarios. Project Urban Future Outline ended successfully in September 2016.

Projects on Technology Enhanced Learning

SAGE: Serious Games Pathway within the Undergraduate IT Programs

EU Tempus IV Joint Project

M. Jarke, R. Klamma, M. Kravcik

http://sage.ps

SAGE aims to enhance the capacity of the four partner universities in Tunisia and Palestine by enabling them to develop a sustainable curriculum in Serious Games and integrate this curriculum into their existing Computer Science programs. The chair leads two work packages in SAGE: the WP on Teaching Material for Serious Games and Gamification Courses and the WP on Quality Control and Monitoring. In addition, we contribute expertise and coordination activities in the other content production WPs, in the setup of the SG lab, in conceiving cross-course case studies, as well as in staff and student exchange. We will deliver tutor training, teach pilot courses at the partner universities, and host students of partner universities for study visits. On April 28-29 we hosted a consortium meeting at RWTH in
Aachen, where partners reviewed the project progress and planned the next events at Birzeit and Al-Quds Universities in Palestine (October 2016) as well as in Tunisia (April 2017).

**VIRTUS: Virtual Vocational Education and Training**

EU Erasmus+ Project

*M. Jarke, R. Klamma, M. Kravcik, D. Renzel, K. Neulinger*

http://virtus-project.eu

VIRTUS aims to develop an innovative, fully functional virtual vocational education and training (VET) center, which will provide appropriately designed modular certified courses in Modular Employable Skills (MES), corresponding to a wide range of circumstances such as regional growth potential and/or company restructuring and aiming at increasing the participation rate of adult learners in vocational education and training. In particular, the **VIRTUS virtual VET center (V3C)** will provide two modular courses on tourism and hospitality services and social entrepreneurship, certifiable by the European Credit System for Vocational Education and Training (ECVET) and the European Qualifications Framework (EQF). The consortium consists of seven partners from training industry, certification authorities, and academic institutions in Greece, Spain, Italy, Austria, and Germany. Our contributions will include the design and development for a virtual VET center technical platform for hosting the modular courses and to leverage social media to facilitate a VIRTUS community around the project and its central offerings. In its first year, our contributions consist in an early specification of the V3C platform, which will be implemented and evaluated in the second project year.

**Learning Layers: Scaling up Technologies for Informal Learning in SME Clusters**

EU FP7 Integrated Project


http://learning-layers.eu

Learning Layers develops a set of modular and flexible technological layers for supporting workplace practices that unlock peer production and scaffold learning in networks of SMEs, thereby bridging the gap between scaling and adaptation to personal needs. Building on mobile learning research, we situate learning into physical work places and practices to support situated, faster, and more meaningful learning. Learning Layers provide a shared conceptual foundation independent of the tools people use and the context they are in. Learning Layers are based on a common lightweight, distributed infrastructure that allows for fast and flexible deployment in highly distributed and dynamic settings. We apply these
technologies in two sectors that have been particularly hesitant to take up learning technologies, i.e. health care and building and construction.

Informatik 5 leads the work package “Architecture and Integration” with the overall objective being to co-ordinate all technology development tasks across the project. Technically the main objective is to conceive, develop and maintain a distributed, federated Layers architecture for fast and flexible deployment of network communication infrastructure and storage/editing of user-generated multimedia content in testbed environments.

Final Layers Infrastructure: The Layers Box

The Layers infrastructure is the technical backend for the Learning Layers project and enables the development and deployment of services and tools in a secure and private way. It consists of the Layers Box, a state-of-the-art Docker-based container system that can be deployed on any machine ranging from Mac Mini sized computers over server racks up to any cloud provider. It comes with an industrial-strength user management based on OpenID Connect and LDAP, a technology employed by Google and Microsoft.

Based on business needs, a customized set of required services can be easily deployed. The big advantage over cloud providers such as Microsoft, Google or Amazon is not only that full control of the data is ensured but also that the Layers Infrastructure is open-source and free. It comes prepackaged with the Social Semantic Server and the las2peer service network. The Social Semantic Server is a service-based framework tailored towards informal learning applications, for example recommender services. las2peer is a peer-to-peer-based microservice environment that focuses on privacy and data ownership with services like code generation, community success, social requirements engineering and cloud video transcoding.
The dissertation project by Zinayida Kensche, successfully completed in 2016, defined learning community needs and let community stakeholders gain an insight into community issues. Its interdisciplinary research considers modeling of communities including requirements of learning theories for information systems design.

The proposed framework consists of a loop with four distinguished phases: modeling, refinement, monitoring and analysis. Learning communities are linked to one of archetypical learning community models to provide a first insight for community stakeholders. Monitoring digital traces of learners and comprehensive analysis of learners’ behaviors characterize communities, their learners and networks at whole. The information serves as an input for goal-oriented agent-based community learning models which make stakeholders aware about roles of learners, dependencies between them on goals, tasks and resources. This was tested on three cases: informal learning communities in language learning forums, life-long learning communities at workspace and communities at the crowdsourcing platform Wikipedia.
Project BOOST integrated outcomes of the previous projects BeCome and ROLE and into one platform, based on the ROLE technology for personal learning environments. These improvements and innovations were disseminated in five EU countries, as well as at various international events. In a piloting phase, various small enterprises in all five BOOST countries evaluated the BOOST platform in their settings. This solution enabled the Managers in these companies to specify their Business Critical Needs (Goals), assign to them Learning Indicators (Competences), and recommend relevant Learning Resources for Employees, who could use them in their learning process.

Then employees received a graphical overview of their assignments and learning progress, while managers could monitor the competence development process in the whole company and react accordingly. In the BOOST piloting and evaluation, this approach was well received by Managers, Employees, and VET providers. It also revealed a potential for further improvements collected in the Requirements Bazaar, providing future development opportunities.
WEKIT: Wearable Experience for Knowledge Intensive Training
EU Horizon 2020
M. Jarke, R. Klamma, M. Kravcik, I. Koren, P. de Lange, M. Hug, A. Sema

http://weit.eu

WEKIT is an ambitious European research and innovation project supported under Horizon 2020 to develop and test within three years a novel way of industrial training enabled by smart Wearable Technology (WT). 13 WEKIT partners representing academia and industry from six countries in Europe will build a ground-breaking industrial-strength learning technology platform and unique methodology to capture expert experience and share it with trainees in the process of enabling immersive, in-situ, and intuitive learning. In this way, WEKIT will bring learning content and technical documentation to life via task-sensitive Augmented Reality (AR), making industrial training more efficient, affordable and engaging.

Our main responsibility in WEKIT is to establish and maintain a community of stakeholders. Its members are involved in the process of developing the technology platform and Augmented Reality learning standards through community events and open project meetings. We organized Augmented Reality Standards Hackathon in Aachen in April, 2016 with broad support by hardware manufacturers in terms of AR devices shipped from all over the world. The objectives of the event included reaching to important stakeholders, attracting young developers into the WEKIT community, and exploring creative AR solutions. Over 20 participants in five teams entered the competition; the ideas selected by the teams for implementation covered a broad range of applications in both entertainment (gaming, arts, sports) and non-leisure contexts (learning and social communication).

Another major WEKIT community event “Requirements Bazaar Kick-off: Shape the Future of Augmented Reality Training” was held in the Industry track of the European Conference on Technology Enhanced Learning (EC-TEL), Lyon, France, September 13-16, 2016.

Projects on Near Real-Time Social Computing

Yjs: Near Real-time Collaboration on Arbitrary Data Types
R. Klamma, P. Nicolaescu, M. Derntl, K. Jahns
supported by Learning Layers and METIS

http://y-js.org/

Near real-time shared editing of shared artifacts in the Web browser has become popular for many applications like text writing, drawing, sketching and others. These applications require protocols for exchanging messages among user agents and for resolving editing conflicts. The available frameworks often expose drawbacks like failing to scale, restriction to linear data structures and client-server architectures.
In order to support a straightforward and easy way to add near real-time collaboration in Web applications, directly on the client-side, we have continued to support and develop Yjs, a lightweight open-source JavaScript framework that can be used for collaborative editing of arbitrary data types in P2P settings. The framework enables a fast and efficient way to add NRT collaboration and shared editing features to Web applications. It is based on a conflict-free replicated data type algorithm and supports communication protocols like WebSockets, XMPP and WebRTC. Yjs is currently available as a collection of open-source JavaScript libraries on GitHub. After receiving the Best Demo and Best Poster Awards at the 2015 International Conference on Web Engineering (ICWE 2015) in Rotterdam, Netherlands and being presented in a lightning talk at the European open source conference in Brussels (FOSDEM'15), a paper on the core algorithm of Yjs was accepted at the GROUP 2016, an important conference in the Computer Supported Cooperative Work (CSCW) domain. Moreover, Yjs continued to be included in OSS projects and research by various academic and industry environments. After several major releases, OSS developers continued to contribute to Y-richtext, a code and a Latex editor were implemented, and several examples were added to the main page. Yjs was adopted in several projects: SyncMeta, a framework for collaborative (meta)modeling; Simple Web-based Visual Analytics (SWeVA), an extensible Web-based visual analytics platform; Anatomy 2.0, an educational platform for the collaborative annotation and visualization of 3D objects on the Web; DireWolf, a framework for rich Web applications with Distributed User Interfaces (DUIs) for synchronizing the state between IoT devices; Liquid.js, a framework for migrating and cloning stateful Web Components across multiple devices and others. Since August 2014, the project gathered more than 13,500 page views from more than 5,100 individual viewers.

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**SyncMeta**

*M. Jarke, R. Klamma, M. Derntl, P. Nicolaescu, M. Rosenstengel*

supported by Learning Layers and METIS

[http://dbis.rwth-aachen.de/cms/research/ACIS/SyncMeta](http://dbis.rwth-aachen.de/cms/research/ACIS/SyncMeta)

SyncMeta is a framework for near real-time collaborative (meta)modeling. The framework enables the definition of the conceptual and visual aspects of a modeling language and allows generating model editors for these metamodels. The diagram editors used for modeling and metamodeling support synchronous, real-time collaborative creation of models.

SyncMeta was built fully based on open source libraries and open widely implemented protocols like XMPP and HTTP, and open, well-supported formats like JSON and SVG. The framework implementation is offered as a widget-based application, where each widget offers a certain functionality (like modeling canvas, palette, awareness of remote edits, property editor, export scripting, etc.). SyncMeta also features viewpoint definitions that enable users to specify views for certain parts or characteristics on the meta-model in a graphical near real-time collaborative manner. As an example, they can redefine entities - e.g., objects and relationships of the meta-model - and then apply the changes to the model. SyncMeta allows the user to flexibly generate and embed particular views of the model. Furthermore, users are supported during the collaborative modeling by an assistant which offers modelers

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^1 [https://github.com/y-js/y-richtext](https://github.com/y-js/y-richtext)
suggestions on actions they can perform during the modeling process. It considers the collaborative environment for the suggestions and steers user behavior accordingly.

During this academic year, SyncMeta was presented at the International Conference on Conceptual Modeling (ER2015). The extension for defining and applying arbitrary views during the collaborative modeling was presented and received the best paper award at the International Conference on Advanced Information Systems Engineering (CAiSE2016).

SyncMeta was used in the development of the Community Application Editor, a model-based tool which enables a cyclic software development process for creating community applications (cf. las2peer Working Group) and for generating and creating a storytelling tool around 3D objects (cf. Anatomy2.0). Finally, in the past months SyncMeta received a continuous refactoring and development process, which resulted into the adoption of our award winning Yjs library for the near real-time collaboration and communication features supported by the (meta)modeling framework.

las2peer Working Group

R. Klamma, D. Renzel, P. de Lange, P. Nicolaescu
M. Bender, T. Cujé, J. Koenning, J. Nalbach, A. Neumann, T. Winkler

supported by Learning Layers

https://las2peer.org

las2peer is the ACIS reference platform for Open Source Peer-to-Peer (P2P) community information systems (CIS). Each node in a las2peer P2P overlay network functions as a small-scale CIS, featuring secure end-to-end encrypted communication, distributed storage, federated service access for agents across the network, as well as a complete P2P community application development API. With this design, a CIS service ecosystem can evolve as a P2P network of interrelated CIS and be used in a much more flexible and scalable way than with standard cloud-based social software. Since 2013, the las2peer Working Group (WG) pursues its goal to establish las2peer as a full-fledged Open Source P2P-based CIS platform. After the successful integration of las2peer into our DevOpsUse methodology in the previous year, this year’s focus was put on improving both the usability as well as the visibility of the platform to internal and external developers. Our efforts resulted in fine-grained release management, with frequent releases and detailed changelogs, with an improved and increased usage of the Requirements Bazaar for requirement elicitation and JIRA for issue and version management.

Our new Web domain https://las2peer.org increases the project’s visibility and aims at attracting external developers to our project. It features frequent updates of new las2peer features, high-level documentation of las2peer core concepts and provides links to further las2peer resources, such as our GitHub Wiki project, that provides detailed example source code and explanations of various las2peer features.

On the conceptual side, this year we integrated the two related concepts, namely the Community Application Editor (CAE) and the MobSOS monitoring concept, into a combined las2peer approach. We described the results both in a technical paper as well as in a poster. Both aim at being a first-read for students working with las2peer. In the next year, the las2peer working groups will continue its mission. Apart from continued core and service
development and scientific publications, las2peer will serve as major contribution to the Layers project in form of a highly scalable and secure federation infrastructure reasonably combining P2P and cloud computing paradigms.

On the technical side, the las2peer WG focused mostly on stability of core concepts, like the distributed storage, group and user management and agent-to-agent peer-to-peer messaging. We also developed a set of core community services that can be utilized by all developers for their service development, like a distributed file storage service, an address book that handles las2peer contacts of a user and a calendar service that enables groups to manage their appointments collaboratively via the las2peer network. Both the CAE as well as MobSOS have received considerable updates in this year. The CAE now allows for a cyclic process of collaborative modeling for the design of applications (frontends, services and their mashup) and live code editing for code refinements, followed by the code generation and automatic deployment steps. The las2peer services for MobSOS have also received updates that enable distributed service monitoring for a complete network as well as the definition of custom service success models by developers, which can now be uploaded via a Web interface and are stored in las2peer’s distributed storage.

All our efforts are also depicted in our las2peer seed network that is maintained and updated frequently by our working group. It features all previously managed assets of las2peer. An overview can be found on our website, with links to frontends of our community services and customized monitoring statistics. It is open to the public, allowing students and external developers to connect to it and utilize its features. The CAE’s capabilities of automatic one-click deployment are used to generate and start las2peer nodes that directly connect to the seed network.
Anatomy 2.0 - Development of an online pool for digital 3D study objects in anatomy education

G. Toubekis, R. Klamma, P. Nicolaescu, A. Herrler, P. de Lange
S. Behrens, A. Brunmeier, T. Paffen, J. Benscheid

funded by ETS

http://www.e-anatomy.de/

The RWTH Aachen Exploratory Teaching Space (ETS) promotes creative ideas of blended learning and teaching. Anatomy2.0 enables ubiquitous access to 3D digital replicas of a selection of real anatomical study objects used in several medicine undergraduate course modules. It is the continuation of the ongoing efforts to make high quality digital 3D artefacts available to specialized user communities integrating learning technologies developed at the i5 Chair (see Nefertiti case study 2014). Within the project, a high-resolution scan (Breuckmann Smart Scan duo system) of various objects was realized and professional high-quality images were created for later texturing of optimized digital models. The digital objects are accessible with contemporary Internet browsers without any additional third-party plug-in based on current HTML5 specification for declarative 3D content with the Java-Script library X3DOM. The system allows interactive 3D navigation at runtime and individual and group annotation on the 3D object itself. The various models are selected to explore different degrees of complexity: surface structure, perspective depth, different colors, effect of shadows, material texture, all for training the awareness for physical properties of unique originals among the user groups.

Widget based course room for 3D digital objects with ROLE SDK
The system has been evaluated with good results by the target community at RWTH Aachen Medical University Anatomy course. The transferability to other faculties with similar use cases has been explored and tested (e.g. Engineering, Architecture and Cultural Heritage) with good results.

During the last year, we created the new e-anatomy.de domain. The system was augmented with near real-time collaboration features based on our Yjs library, such that users can collaboratively explore the 3D models and annotate them upon need. The system was presented at the International Conference on Web-based Learning (ICWL2015).

Moreover, a digital storytelling environment was created for using the 3D models at our disposal in formal and informal learning, targeting the Medical University Anatomy course as well as communities of practice in general that make use of digital artifacts in their practice. The environment builds on SyncMeta for enabling a collaborative storytelling editor and enables the creation of stories around specific 3D models from the e-anatomy project.

**Other Research Projects**

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<td><em>R. Klamma, M. Shahriari</em></td>
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Social Network Analysis (SNA) is a well-established method in sociology. With the advent of the World Wide Web and growing computational power interests grow in analyzing large sets of network data over time. We apply graph algorithms, dynamic network analysis methodologies and advanced approaches in Web Science to analyze dynamic patterns of human interaction expressed by traces left large scale information systems. Our annual lecture "Web Science" and seminar course "Web Science" contribute to a sound theoretical basis for student and research work.

In 2016, some overlapping community detection algorithms were extended to predict the evolution of overlapping communities over time. We applied the proposed OCD algorithm together with other baselines on dynamic networks. The properties of some of these algorithms are contrasted against each other in terms of number and size of communities and frequencies of overlapping members. Results indicate that size of communities is a distinctive indicator to predict the fate of communities.

Furthermore, we improved the overlapping community detection algorithms via shifting the research line toward devising context-aware algorithms. In other words, context of communities generated by users are combined with structural information of the network to devise better algorithms. In this regard, two contextualized algorithms working based on Term Frequency and Inverse Document Frequency (TF-IDF) of posts are devised. In the first algorithm, posts related to each user are extracted and converted to TF-IDF vectors. Afterwards, by defining an optimization problem together with K-means clustering algorithm, communities are detected; it is named Cost Function Optimization Clustering Algorithm (CFOCA). The second algorithm works by considering each term as a cluster and merging of
features based on an overlapping threshold; this algorithm is called Term Community Merging Algorithm (TCMA). To evaluate these algorithms, they are compared and contrasted regarding number of overlapping nodes, modularity and average community sizes.

In addition, we considered networks with both positive and negative connections. Positive edges are sign of trust and negative links indicate distrust. To pursue OCD algorithms in signed graphs, we extended DMID to the case of trust networks; we named it SDMID. In this case computation of disassortative matrix are extended to consider negative connections. Moreover, an extended information diffusion process is considered by considering negative links. To identify significance of overlapping nodes, we considered a prediction model using logistic regression and several other classifiers in order to identify importance of overlapping members. Moreover, we compared SDMID with two other OCD algorithms. Modularity, running time, Normalized Mutual Information, number of overlapping nodes, number and size of communities are computed and compared for these algorithms. Results indicate better performance of SDMID in case of trust networks.

SunSITE Central Europe
R. Klamma, R. Linde

http://sunsite.informatik.rwth-aachen.de/

Since 1995, Informatik 5 is active in the field of internet-based community support, both in terms of research on community and web service tools and in terms of providing infrastructures for scientific communities worldwide. For example, Informatik 5 hosted the first website for the city of Aachen in 1995 and, since the same year, manages one of the most successful public-domain Internet servers in the German science net, SunSITE Central Europe. Supported by Sun Microsystems with powerful hardware and base software, SunSITE Central Europe focuses on scientific community support, including mirrors of some of the most important research literature indexes, workspaces for Internet cooperation, and about 8 TB of open source software. Typically, the SunSITE enjoys around 35 million accesses per month. As additional scientific publication services, the SunSITE hosts the Central Europe (CEUR) Workshop Proceedings (CEUR-WS.org) with now over 1700 volumes and acts as a mirror for the Dagstuhl Research Online Publication Server. 700 of these volumes appeared in the last year, thus highlighting the popularity of CEUR as fair solution for open access publication.

i* Wiki
M. Jarke, G. Lakemeyer, R. Klamma, D. Renzel

http://istar.rwth-aachen.de/

Since September 2005, Informatik 5 is hosting the i* Wiki, a platform for researchers and users to foster investigation, collaboration, and evaluation in the context of the i* modeling language. In 2011, the wiki has been moved to the SunSITE server for better services to the
scientific community. Until today, the i* Wiki serves as central repository for researchers and industry representatives interested in i* specifications, tools, research, and case studies.

Cultural Heritage Management Assistance in Afghanistan
Auswärtiges Amt der Bundesrepublik Deutschland
G. Toubekis, M. Jansen, M. Jarke

RWTH Aachen University with financial support from the Culture Section of the Foreign Office of Germany and UNESCO supports since more than a decade the Afghan authorities in conservation and management of selected cultural heritage sites in the country. Recent activities included a project for the beautification of the of surroundings of the Old City wall in Ghazni as well as continued assistance in implementing a management system for the World Heritage site Cultural Landscape and Archaeological Remains of the Bamiyan Valley. Based on a detailed analysis of the natural and historical setting of the valley RWTH Aachen University developed a Cultural Master Plan of Bamiyan, which has served as the foundation for balancing preservation and development efforts in the future. To ensure the availability of the related map materials, the deployment of an OGC based web map service as basis for a heritage management information system is underway displaying the various heritage protection zones as well as giving details to individual heritage assets.

Big Data & Model Management

M. Jarke, C. Quix, S. Geisler, R. Hai, A. Chakrabarti (FIT), C. Zhou, A. Zaman, B. Bakiu (FIT), A. Dalevskaya (FIT),

Joint work with Fraunhofer Institute for Applied Information Technology

Big data is a buzzword that summarizes various aspects of handling large amounts of heterogeneous data. The goals are (among others) to perform efficient analytics and to derive new information from the base data. The heterogeneity of data is an important issue in big data: data is not only large in volume and produced at a high speed (velocity), it has also a high variety. Therefore, it is also necessary to address the challenges in terms modelling and integration of big data.

The research group has a long experience in developing systems and applications for handling complex, heterogeneous data. The model management system GeRoMeSuite has been developed as a platform for generic model management. This means that the heterogeneous modeling languages (e.g., XML Schema, the Relational Data Model, OWL) are represented in a generic metamodel (GeRoMe) in order to enable the integration and mapping of models represented in different modeling languages.
In general, model management aims at developing technologies and mechanisms to support the integration, merging, evolution, and matching of complex data models. This support is required for the management of complex, integrated, distributed, heterogeneous information systems. Basic concepts in model management are models, mappings and operators. Models describe the structure of data. Mappings represent relationships between elements from different models. Operators are operations on models and mappings (e.g., merging & matching of models, composition of mapping).

The management of metadata is of particular importance for information integration, model management, and big data applications. Data lakes have been proposed as a solution to deal with the heterogeneity of big data, as they should provide a storage system for any kind of raw data. Metadata is of particular importance in such a system to have information about the structure and semantics of the data. The group has been working on the data lake system “Constance”, which has been demonstrated at the SIGMOD conference this year. This system is applied in other research projects, e.g., mi-Mappa and HUMIT, as basic platform for data integration. Future work will address the problem of incrementally defining schemas and mappings in a data lake system, and to enable query rewriting over a heterogeneous collection of data.
Complex innovations in medical engineering are not possible without collaborative co-operations today. However, the assembly of suitable experts is usually left to the initiating innovators themselves or fortuity. To tackle this problem a new integrative competence model of medical engineering based on data mining algorithms has been conceptualized by the institute of Applied Medical Engineering (AME). It identifies suitable actors based on published texts for a given project by matching experts from medical, technological and product-related fields to the project. Specifically, the product-related dimension of the approach faces the problem of the correct assignment of patents (and the corresponding inventors) to designated competence fields in medical engineering. In the mi-Mappa project we try to tackle this challenge by two different but complementary ways: on the one hand a relationship between information from medical products and patents is searched for, because medical products are easily assignable to competence fields and hence, the related patents are assignable to competence fields. On the other hand, we try to find publications of the patent innovators related to the project topics which are more easily assignable to competence fields than the patents themselves.

Informatik 5 implements especially solutions for the second way using patent analysis techniques, text mining, ontology design, and ontology matching. Part of this is the design and implementation of the data lake system “Constance”, in which data about patents and publications is integrated from multiple data sources. The system was demonstrated at the SIGMOD Conference this year. In addition, a system for the identification of authors of patents and publications, respectively, was developed.

ConceptBase is a multi-user deductive object manager mainly intended for conceptual modelling, metadata management and model management. The system implements the knowledge representation language Telos which amalgamates properties of deductive and object-oriented languages. ConceptBase is available as an open-source system under FreeBSD license on SourceForge. In 2016, DeepTelos, an extension of Telos for multi-level modeling, has been developed. A paper about DeepTelos will be presented at the 35th International Conference on Conceptual Modeling (ER 2016).
Data analysis in biomedical high throughput screening requires the integration of large and heterogeneous data sources (e.g., experiments archives, biomedical databases). Existing tools for data integration and analysis for biomedical data do not provide the required flexibility and expressive power, as the research questions and sources are continuously evolving and the provided information has to be semantically interpreted and adapted by the user.

The goal of the HUMIT project is the development of a big data approach that enables researchers to do cross-domain analysis of high throughput screening data. This will have a significant positive effect for the life science research, because the value of the data is increased as well as the potential to detect causes of diseases and new forms of treatment.

The main idea of the proposed approach is an incremental definition of data models and mappings, and a separation of the storage systems for raw data and analytical data. The user interaction is a key element in the data integration process.

The group at i5 develops basic methods for data integration, schema and mapping evolution and implements them in the data lake system “Constance” that forms the basis for the data integration platform of HUMIT.

Information systems in production and quality management are used to collect quality-relevant data that enable the traceability of the product during the production process. Furthermore, the data can be used to analyze the quality of the production and identify problems in the production process. However, the collection of machine- and process-oriented data is still not a standard in production systems today, as the interoperability between the different systems (e.g., Enterprise Resource Planning, Manufacturing Execution, or Computer Aided Quality systems) is still limited and requires application-specific customizations of the employed systems. The customization is very labor-intensive and therefore expensive; thus, especially SMEs (small and medium enterprises) are not able to analyze their data efficiently.

The goal of the charMant project is the development of a data management system, which facilitates the integration and analysis of product-oriented process data. The major challenge
is the acquisition and storage of heterogeneous data, collected from multiple data streams in
the production process. The key feature of the approach is the self-describing data structure
which uses a metadata-based approach to extract, store, and query data. This data structure is
managed within a data lake system from which application-specific data marts can be derived
to provide data for some analytics application.

The project started in June 2016 and is funded for two years. The Big Data & Model
Management group at i5 contributes with the development of basic methods for the
integration and analysis in data stream-based applications.

**INCENTIVE: INvestigation of online Communities Employing Network analysis,
natural language processIng, Visualizations and dEep learning**

*M.Jarke, Z. Kensche (née Petrushyna)*

This internal project aims to explore behavior in online communities using various emerging
techniques with several purposes: predicting of political mobilization and social unrest online
and offline, depicting funding prioritization according to geographical proximity and finding a
meaning of sentiments and emotions on development of political opinions and crowdfunding
projects.

Within this project we have started the collaboration with Network Science Institute at
Northeastern University, Massachussetts, with intention to perform a number of experiments
investigating human behavior online exploring their digital traces and estimating their
behavior offline employing experimental approaches of social science. Other collaborators
devoted to the project include Prof. C. Hopp and J. Kaminski from the Technology
Entrepreneurship team, RWTH Aachen. Together with them, we aim to predict and visualize
success of crowdfunding projects examining their profiles, investors and social opinion.
Other Activities

Service

- Stefan Decker’s major service activities in 2015-2016 included
  - Director, Fraunhofer FIT, Birlinghoven
  - Treasurer and Board Member, Informatics Europe
- Matthias Jarke’s major service activities in 2015-2016 included
  - Executive Director, Fraunhofer FIT, Birlinghoven
  - Hon. Adjunct Professor Computer Science, GUtech German University of Technology in Oman
  - Chairman, Fraunhofer ICT group, and Member Presidential Board, Fraunhofer Society (until 12.2015)
  - Chairman, Institute Leader Board, Fraunhofer Institute Center Birlinghoven Castle (until 12.2015)
  - Deputy Speaker, Fraunhofer Alliance Big Data
  - Member, Fraunhofer internal project selection board (since 01.2016)
  - Founding Director, Bonn-Aachen Intl. Center for Information Technology (B-IT)
  - Member of Management Board (Hauptvorstand), BITKOM
  - Member, IT Summit Platform “Innovative Digitalization of Business”, BMWi
  - Member, CONNECT Advisory Forum (CAF) on the HORIZON 2020 Program of the European Commission
  - Member, Strategy Expert Council, Austrian Ministry of Traffic, Innovation and Technology (bmvit), Vienna
  - Deputy Chairman, Hochschulrat, FH Köln
  - Chairman, Evaluation Committee Business Informatics, University of Mannheim
  - Member, Program Board, LOEWE Excellence Initiative Hessia
  - Member, CeBIT-Messeausschuss
  - Member, Expert Commission Digitalization Center Bavaria (EZ.B)
  - Chairman, ICT Program Evaluation Board, Vienna Science and Transfer Fund
  - Member, Engineering Faculty Advisory Board, University of Duisburg-Essen
- Ralf Klamma is WP leader in the EU FP7 IP Learning Layers, the H2020 project WEKIT, the ERASMUS+ project VIRTUS and the EU TEMPUS project SAGE. He is founding member of the European Association on Technology Enhanced Learning (EATEL) and SIG co-chair of SIG on Wearable-Enhanced Learning (SIG WELL). He is head of the steering committee of the European Conference on Technology Enhanced Learning (SIG EC-TEL) and steering committee member of the International Conference on Web-based Learning (ICWL). He is member of the advisory board of the CEUR-WS open access proceedings series. In 2016 he joined the advisory board of the EU project DEVELOP, coordinated by Trinity College Dublin.
Milos Kravcik was senior researcher in the international projects Learning Layers, SAGE, WEKIT and VIRTUS. He is serving as manager of the JTEL Summer School web site (http://jtelsummerschool.eu) as well as editor of WEKIT Community Portal (https://wekit-community.org/) and related social media. He served as external reviewer of PhD thesis at Trinity College in Dublin.

Wolfgang Prinz: Member of the Advisory Board of the Cologne Game Lab, TH Köln

Dominik Renzel continued to be manager of the i* Wiki (http://istar.rwth-aachen.de).

Thomas Rose acted as reviewer for several EU funded projects on “ICT for Energy and Water Efficiency” and “ICT for Low Carbon Economy and Smart Mobility” for the European Commission after serving as evaluation expert for EU Project Proposals on "ICT for Energy and Water Efficiency in Public Housing" in 2010/11.

Georgios Toubekis is member of the International Council of Monuments and Sites (ICOMOS) and the Bamiyan Expert Working Group by UNESCO. He serves as Jury member to the Europa Nostra Award in the research category and is advisor to UNESCO and ICOMOS in the nomination and monitoring process for World Heritage sites.

**Editorial Boards and Journal Reviews**


Markus C. Beutel served as a reviewer for the Journal of Business & Information Systems Engineering (BISE 2016).


Zinayida Kensche serves as a reviewer for the Social Network Analysis and Mining Journal.

Ralf Klamma serves as associate editor for Springer Journal on Social Network Analysis and Mining (SNAM) and on the Editorial & Scientific Board of IxD&A. He is section editor for the 2nd edition of the Springer Encyclopedia of Social Network Analysis and Mining (ESNAM) and editor for the IEEE Special Technical Committee on Social Networks (STCSN). He is editor-in-chief for the SunSITE CEUR and several community information systems. He also served as reviewer for Social Network Analysis and Mining (SNAM), IEEE Transactions on Learning Technologies (TLT), Multimedia Tools and Applications (MTAP), Journal of Networks and Applications (JNCA), Wirtschaftsinformatik (BISE), Journal of Computers in Higher Education (JCHE), Transactions on Data and Knowledge Engineering (TKDE), Transactions on the Web (TWEB) and Journal of Universal Computer Science (JUCS).

Mathematics, Science and Technology Education (EJMSTE), and IEEE Transactions on Learning Technologies (TLT).

- Wolfgang Prinz serves on the editorial boards of the journals: Computer Supported Cooperative Work, Springer; and i-com: Journal of Interactive Media, De Gruyter
- Dominik Renzel continued to serve as reviewer for the International Journal on Multimedia Tools and Applications (MTAP).

Conference Organization
- Stefan Decker co-organised the Privacy Online Workshop at the ESWC Conference. He also served on the ESWC Program Committee.
- Benjamin Heitmann was member of the program committee of the Extended Semantic Web Conference (ESWC) 2016 (http://2016.eswc-conferences.org/) and the SEMANTiCS 2016 (http://2016.semantics.cc/).
- Together with Jan Borchers, Wolfgang Prinz, and Martina Ziefle, Matthias Jarke was co-chair of the Mensch & Computer Conference 2016, held in Aachen, September 2016. He was also elected to the Steering Committees of the Entity-Relationship Conference the CAiSE Conference series. Program committee memberships included the 28th International Conference on Advanced Information Systems Engineering (CAiSE’16), Ljubljana, Slovenia; the 15th International Conference on Ontologies, DataBases, and Applications of Semantics (ODBASE) in Rhodes, Greece; and the 34th International Conference on Conceptual Modelling (ER 2016) in Gifu, Japan.
- Zinayida Kensche was a program committee member of the 11th European Conference on Technology Enhanced Learning (EC-TEL 2016). She continues to serve as a member of program committee of European Summer School on Technology Enhanced Learning and Doctoral Consortium at the European Conference for Technology Enhanced Learning.
- Ralf Klamma was co-chair of the International Workshop on Learning Analytics for Workplace and Professional Learning (LA for Work) at the LAK 2016, co-chair of the workshop on Human Computer Interaction Perspectives on Industry 4.0 (HCI@Industry 4.0) at the I-KNOW 2016 and the SIG WELL Maker workshop at the EC-TEL 2016. He co-chaired the doctoral consortium of Mensch & Computer 2016, was member of the doctoral consortia at EC-TEL 2016, ICWE 2016 & ICWL 2016 and co-organized workshops at the 11th Joint European Summer School on Technology Enhanced Learning (JTEL 2016, Tallinn, Estonia). He served as program committee member / reviewer for the following conferences: ACM Computer Human Interaction (CHI’17), ACM Conference on Learning Analytics and Knowledge (LAK’17), IEEE International Conference on Collaboration and Internet Computing (CIC’16), Mensch & Computer (MUC’16), ACM International Conference on Interactive Experiences for Television and Online Video (TVX’16), Immersive Learning Research Network Conference (iLRN’16), IEEE International Conference on Collaborative Computing: Networking, Applications and Worksharing (CollaborateCom’16), International Conference on Web-based Learning (ICWL’16), European Conference on Technology Enhanced Learning (EC-TEL’16), Games and Learning Alliance Conference (GALA’16), DELFI’16, CRIWG Conference on Collaboration and Technology (CRIWG’16), 9th Workshop on Social and Human Aspects of Business Process Management (BPMS2’16), 2nd International Workshop on Collaboration and Gaming (CoGames’16), UNESCO-UNIR ICT & Education Latam Congress 2016.
• Milos Kravcik was program co-chair and workshops co-organizer at 12th Joint European Summer School on Technology Enhanced Learning (JTEL), co-organized 6th Workshop Personalization Approaches in Learning Environments (PALE at UMAP), and 6th Workshop on Awareness and Reflection in Technology-Enhanced Learning (ARTEL at EC-TEL). He was program committee member of the 15th International Conference on Web-based Learning (ICWL), 11th European Conference on Technology Enhanced Learning (EC-TEL) and its Doctoral Consortium, 15th IEEE International Conference on Advanced Learning Technologies (ICALT), 4th Games and Learning Alliance Conference (GALA), 13th ACS/IEEE International Conference on Computer Systems and Applications (AICCSA), International Workshop on Learning Analytics for Workplace and Professional Learning (LA for Work), 9th International Workshop on Social and Personal Computing for Web-Supported Learning Communities, and 3rd International Workshop on Peer Review, Peer Assessment, and Self Assessment in Education.

• Karl-Heinz Krempels was conference co-chair of the 12th Conference on Web Information Systems and Technologies (WEBIST 2016).

• Andreas Pfeiffer was program committee member of the SmartGreens Conference (SmartGreens ’16) in Rome, Italy.

• Wolfgang Prinz: Conference Co-Chair: Mensch und Computer 2016, Aachen

• Christoph Quix and Rihan Hai were members of the organization committee of the 11th Intl. Workshop on Quality in DataBases, held in conjunction with VLDB 2016, Delhi, India (http://www.dbis.rwth-aachen.de/QDB2016). Arnab Chakrabarti and Sandra Geisler were the local and publicity chairs of the workshop. Christoph Quix was a member of the program committee of the 35th International Conference on Conceptual Modeling (ER 2016), 5th International Conference on Data Management Technologies and Applications (DATA 2016), 24th European Conference on Information Systems (ECIS 2016), and 28th International Conference on Advanced Information Systems Engineering (CAiSE’16).

• Thomas Rose has been Program Committee member of the workshop for "IT-Support for Emergency Management and Response", GI conference 2016, Klagenfurt

Software Demonstrations


“Anatomy 2.0 – Development of an Online Pool for Digital 3D Study Objects”, Demo at the Mensch und Computer 2016 (MuC’16) in Aachen, Germany, September 5, 2016.


“Connecting End Users and Developers with the Requirements Bazaar”, Demo at the Mensch und Computer 2016 (MuC’16) in Aachen, Germany, September 5, 2016.


Open Source Community Involvement

Since a few years, the Advanced Community Information Systems group at Informatik 5 commits to Open Source Software (OSS) development. We increasingly share code bases resulting from our own developments in OSS repositories at different locations, such as GitHub, GitLab, or SourceForge. The Learning Layers project maintains and shares its complete code base on GitHub. With over 120 repositories, the ACIS team page on GitHub (https://github.com/rwth-acis) aggregates different strands of its OSS development work in own as well as third-party projects. One of the flag-ships of ACIS OSS development is the group’s own Community Information System platform las2peer.

Members of our group engage with the wider Open Source Software community by visiting events and hackathons organized by OSS projects to stay in contact with developer communities. The fourth time in a row, we actively participated at FOSDEM in Brussels, by giving a talk on the Layers Box (c.f. project Learning Layers). We also continued to organize such events ourselves, e.g. the WEKIT Hackathon in April 2016. Over the years, our OSS development process has grown to an advanced DevOps-style methodology with strong end-user participation in design and development (Requirements Bazaar & CAE), including an integrated technical infrastructure, maintained at I5 and on the Web to achieve maximal visibility.

- S. Gökay, W. Kluth, C. Samsel, K.-H. Krempels: SteVe is an open platform to implement and evaluate novel ideas for electric mobility, like authentication protocols, reservation mechanisms for charge points, and business models for electric mobility. It supports the Open Charge Point Protocol (OCPP) and was operationally tested with charging stations by multiple manufacturers. Besides its primary use as test and development platform, it is also used to operate various smaller electric charging installations across Europe. SteVe is distributed under GPL and is free to use. https://github.com/RWTH-i5-IDSG/steve.

- W. Kluth, S. Gökay, S. Samsel und K.-H. Krempels: Bikeman is an open source solution for managing eBike-Sharing systems. It offers the administration and maintenance of bike stations, eBikes and customers, and an API for integration into Travel Information Systems. The development started in 2014 and was applied by a local eBike sharing provider, Velocity GmbH. With an extended version of IXSI, we used state-of-the-art technology to connect Bikeman with the MobilityBroker.


- Koren, Martin Hug, Albi Sema: Requirements Bazaar: https://requirements-bazaar.org
• D. Renzel, A. Neumann: MobSOS – Open Source Community Information Systems
  Success Awareness Framework: https://github.com/rwth-acis/mobsos
Talks and Publications

Talks


S. Decker: “Smart Agriculture@FIT”, Joint SFI-Fraunhofer Event, Brussels, February 2, 2016


S. Decker: “Towards the privacy singularity”, Invited Talk, Launching the Privacy and Sustainable Computing Lab @ WU Vienna, 30. September 2016

M. Jarke: Wearable information management at Fraunhofer. German-Korean Future Technology Conference on Smart Textiles (Textronics), Seoul, Korea, October 13, 2015

M. Jarke: Fraunhofer Institute Center Birlinghoven Castle, Chilean CEO Delegation, Sankt Augustin, October 26, 2015


M. Jarke: Wie das Internet der Dinge die treiberbasierte Planung erweitert. Thinking Forward Forum Cologne, April 13, 2016


M. Jarke, K.-U. Witt, S. Wrobel: b-it Weiterentwicklung und Positionierung, b-it Foundation Executive Committee, August 21, 2016

Z. Kensche: Asking an Expert or a Friend? Simulating Forum Communities of Learners Using Reciprocity and Preferential Attachment. At 2nd GESIS Computational Social Science Winter Symposium, Cologne, Germany, 1-3 December, 2015


R. Klamma: Work Package 6, Learning Layers Consortium Meeting, Innsbruck, Austria, February 3-5, 2016
R. Klamma: Opening & Closing Speech, Learning Layers Integration Meeting, Aachen, Germany, March 30 - April 1, 2016

R. Klamma: Introduction, WEKIT AR Hackathon, Aachen, Germany, April 15, 2016

R. Klamma: Work Package 2, SAGE Consortium Meeting, Aachen, Germany, April 28, 2016

R. Klamma: Barbarians at the Gates of Eden, 25th Anniversary of the Chair, Aachen, Germany, June 10, 2016


R. Klamma: Large-Scale Social Requirements Engineering, JMSE Summer School 2016, Koblenz, Germany, July 20, 2016

R. Klamma: Opening, MuC Doktorandenseminar, Aachen, Germany, September 4, 2016


I. Koren: Community-Driven Design and Evaluation of Web Information Infrastructures, Doktorandenseminar, Straelen, Germany, September 19, 2016

M. Kravcik: RWTH Aachen University in WEKIT, WEKIT Kick-off Meeting, Milano, Italy, January 11, 2016

M. Kravcik: RWTH Aachen University in VIRTUS, VIRTUS Kick-off Meeting, Athens, Greece, February 25, 2016
M. Kravcik: Data Analysis of Workplace Learning with BOOST, International Workshop on Learning Analytics Across Physical and Digital Spaces, Edinburgh, UK, April 25, 2016

M. Kravcik: Towards Adaptive Support of Self-Regulated and Workplace Learning (Keynote), 22nd International Workshop on Intelligent and Personalized Human-Computer Interaction (ABIS), Mensch und Computer, Aachen, Germany, September 4, 2016

M. Kravcik: WEKIT & VIRTUS Projects, Doktorandenseminar, Straelen, Germany, September 19, 2016

M. Kravcik: Data Analysis of Workplace Learning with BOOST & SWeVA, 2nd Workshop on Learning Analytics for Workplace & Professional Learning, Leeds, UK, September 23, 2016


P. Nicolaescu: A Microservice Approach for Near Real-Time Collaborative 3D Objects Annotation on the Web at ICWL 2015, Guangzhou, China, November 6, 2015


W. Prinz, Teilnahme an einer Podiumsdiskussion mit EU-Kommissar Günther Oettinger zum Thema „Industrie 4.0 – Verschlafen wir die digitale Revolution?“, Digital Talk 03, IHK Köln, Digital Cologne, 21.10.2015

W. Prinz, Trends, die den Arbeitsplatz der Zukunft beeinflussen“, Innovationstagung Bildung und Beschäftigung 4.0, TÜV Rheinland, Flora, Köln, 22.10.2015

W. Prinz, Sichere Nutzung von sozialen Medien im privaten und beruflichen Umfeld , Security Day Elberfeld, Bayer AG, Wuppertal, 23.10.2015

W. Prinz, Beacon Standardisierung, Hauptarbeitsgruppensitzung - Mobile Couponing & Beacons, GS1, Köln, 26.10.2015


W. Prinz, „Aspekte der Digitalisierung und deren Einfluss auf den Arbeitsplatz“, Digitalisierung – die Arbeitswelt von morgen, IHK Mittlerer Niederrhein, Neuss, 19.11.2015

W. Prinz, Wirtschaft 4.0 Seminar zur Digitalisierung, DIHK Bonn, 10.12.2015

W. Prinz, „Industrie 4.0“, Industrie 4.0 – Best Practice IHK Heilbronn, Elabo GmbH, Crailsheim, 15.12.2015


W. Prinz, Digitalisierung der Stadtverwaltung – Bauantragsverfahren, Stadt Köln, 25.4.2016


W. Prinz, Wie der Arbeitsplatz von Übermorgen aussieht – Fallbeispiele, BBH, Microsoft, Köln, 9.5.2016


C. Quix: Data Quality Management in Data Exchange Platforms – An Approach for the Industrial Data Space in Germany. 11th International Workshop on Quality in DataBases (QDB, co-located with VLDB 2016), New Delhi, India, September 2016.


D. Renzel: Information Systems Success Awareness for Professional Long Tail Communities of Practice. Doctoral Defense, RWTH Aachen University, Aachen, Germany, July 12, 2016.

M. Shahriari: Predictive Analysis of Temporal and Overlapping Community Structures in Social Media at WWW 2016, Montreal, Canada, April 12, 2016


Publications

Book and Edited Volumes


Journal Articles and Special Issues


Sandra Geisler, Christoph Quix, Sven Weber, Matthias Jarke: Ontology-based data quality management for data streams. ACM J. Data and Information Quality 7:4, Article 18, 2016.


István Koren and Ralf Klamma. 2016. Smart Ambient Learning with Physical Artifacts Using Wearable Technologies. EAI Endorsed Transactions on Future Intelligent Educational Environments 2, 6. DOI:10.4108/eai.27-6-2016.151526

Leif Oppermann and Wolfgang Prinz (eds.). Special Issue on Smart Glasses. i-com 15 (2), 2016.


**Conference Papers, Book Contributions, Patents**


Andreas Herrler, Simon Grubert, Marko Kajzer, Sadie Behrens, and Ralf Klamma. 2015. Development of Mobile Serious Game for Self-assessment as Base for a Game-Editor for Teachers. In Games and Learning Alliance. 4th International Conference, Revised Selected Papers. Springer International Publishing, Cham, Switzerland, 71–79. DOI:10.1007/978-3-319-40216-1_8


A. Pfeiffer; M. Jarke; Digital transformation within the eMobility market—Learnings and insights from early market development, Proc. SMARTER Europe 2016.


Mohsen Shahriari, Ying Li, and Ralf Klamma. 2016. The Significant Effect of Overlapping Community Structures in Signed Social Networks. Accepted at Post ASONAM Book.


Technical Reports


Ralf Klamma, Dominik Renzel, Peter de Lange, and Holger Janßen. 2016. las2peer - A Primer. ACIS Working Group Series (AWGS) 2016-020. Chair of Computer Science 5 - Databases & Information Systems, RWTH Aachen Univ. DOI:10.13140/RG.2.2.31456.48645
**Master Theses**

Tanya Agarwal: User-centered Design of Tools for Dynamic Tagging of Environment to Support Firefighters in Disaster Scenarios (Jarke, Prinz).

Bujar Bakiu: Layout-Aware Semantic Information Extraction from Semi-structured Documents (Jarke, Quix).

Sadik Bakiu: Semantic Schema Mapping Based on Graph Matching and Mapping Re-Use (Jarke, Quix). Praxispartner SAP.

Martin Barth: Applying Community Drift to Time-Aware Recommender Systems (Klamma, Trattner).

Lukas Boersma: Indoor-Standorterkennung für Tablet-PCs zur Bedienung von Laser-Sensoren (Prinz, Poprawe).

Kamilka Dutta: Business Procedure Modelling and Digitalization Toolbox (Prinz, Rose).

Abdullah Feroz: TrendNexus: Analysis and visualization of Twitter hashtags and their correlation (Prinz, Rose).

Adam Gavroniek: Human Agent Modelling and Simulation within Huge Logistics Centers (Jarke, Klamma), Praxispartner Zalando.

Stephen Gunashekar: A Framework for Predictive Analysis of Time Evolving and Overlapping Communities (Klamma, Jarke).

Mahnaz Hajibaba: WatchRing: Fast and eyes-free scrolling method for smart watches (Borchers, Prinz).

Manasi Jaypal: A Comparative Study of Data Transformation Technologies between Heterogenous Data Stores (Jarke, Quix).


Ridho Laksono: Usability, Modularity and Extensibility Improvement in CourseMapper (Schroeder, Prinz).

Sun Lei: Clustering of Patents for Inventor Identification (Jarke, Quix), Praxispartner ASEAG.

Sandra Möbus: Entwicklung eines Prognosemodells zur Hochrechnung von Besetzungszahlen in Bussen (Jarke, Rose).

Thomas Osterland: Context based user activity prediction for mobility planning (Jarke, Rose).

Robert Rogner: On-demand bus system with dynamic pick-up and drop-off points (Jarke, Rose).


Tobias Schürg: Development and evaluation of interaction concepts for mobile augmented and virtual reality applications considering external controllers (Prinz, Rumpe), Praxispartner Bitstar GmbH.
Dev Sharma: Holistic History User Interface in HCM Cloud Applications (Quix, Lakemeyer), Praxispartner SAP.

Zuhra Sofyan: Learning Analytics in CourseMapper (Schroeder, Prinz).

Manjinder Singh: Evaluation and Comparison of Different Platform-as-a-Service Application Development Patterns in the SAP Hana Cloud Platform (Jarke, Quix), Praxispartner IBM.

Arash Nasir Tafreshi: Collaborative and situation dependent management of public screen content (Prinz, Rose)

Petr Tarasenko: Enhancing L2P media library with interactive videos in blended learning context (Schroeder, Prinz).


Elmar Weber: Digitaler Assistent für die Reiseplanung (Jarke, Rose).

Maximilian Wiederhold: Optimized integration of vehicle sharing into internal-modal routing (Jarke, Rose).

Yi Xu: Travel Assistance handling Disruptions and Alternatives (Jarke, Rose).

**Bachelor Theses**

Philipp Bartels: WebTorrent-based Video Streaming on the Web (Klamma, Jarke).

Melvin Bender: Visual Web Analytics for the Internet of Things (Jarke, Klamma).

Jan Benscheid: 3D Object Annotation for Collaborative Storytelling (Klamma, Jarke).

Aymen Gannouni: A Comparative Study of Big Data Visualization Tools (Jarke, Quix).

Sabrina Häfele: Overlapping Community Detection Based on Content and Authority (Jarke, Klamma).

Marius Laska: Real-time Trajectory Mining in the Internet of Things (Klamma, Blankenbach)

Marcel Lengen: Evaluierung und Vergleich von Werkzeugen zur Informationsextraktion aus PDF-Dokumenten (Quix, Berlage).

Ying Li: A RESTful Web Service for Overlapping Community Detection in Networks with both Positive and Negative Connections (Klamma, Jarke).

Thomas Nils Liepe: Entwicklung eines Best-Price-Finders (Jarke, Rose), Praxispartner AVV.

Marven von Domarus: Parallel Implementation of Overlapping Community Detection Algorithms (Klamma, Seidl).


Kai Schwarz: Online-Restrukturierung von Diskriminierungsnetzwerken (Jarke, Quix).

Tanja Schmelter: Evaluation and Design of Semantic Data Models for Competence Fields in Medical Engineering (Jarke, Schmitz-Rode).

Frederic Schneider: Detection of Manufacturing Defects during Mill Processes based on Machine Signals (Jarke, Brecher).

Johann Siebert: Tool Supported Recognition of HCI Patterns (Jarke, Rose).
Anton Widera: Serious Games for Public Health Interventions (Klamma, Herrler).

Thomas Winkler: A Live Collaborative Editing and Deployment Approach for Model-based Community Applications (Jarke, Klamma).

Awards

S. Franken, U. Norbisrath, W. Prinz: Runner-up Best Paper Award at the GI/UPA Conference “Mensch & Computer 2016”, Aachen, Germany, for their paper “The Impact of SearchTrails on the Quality of Collaborative Search”


P. Nicolaescu, M. Rosenstengel, M. Derntl, R. Klamma, M. Jarke: Best Paper Award at the 28th International Conference on Advanced Information Systems Engineering (CAiSE ‘16) for the paper “View-Based Near Real-Time Collaborative Modeling for Information Systems Engineering”


Can Sun, Thomas Rose: Young Researcher Award at the 8th IFAC Conference on Manufacturing Modelling, Management and Control (MIM 2016) in Troyes, France, for the paper “One Small Change Can Lead to Large Complexity: A First Glimpse at the Master Data Change and its Impact on the Semiconductor Supply Change”
**Dissertations at Informatik 5**

**Dissertation Manuel Allhoff**

Title: “Solving the Differential Peak Calling Problem in ChIP-seq Data”

Reporters: Thomas Berlage, Matthias Jarke, Martin Zenke

Date: June 7, 2016

Abstract: Gene expression is the process of selectively reading genetic information, and it describes a life-essential mechanism in all living organisms. Key players in the regulation of gene expression are proteins that interact with DNA. DNA-protein interaction sites are nowadays analyzed in a genome-wide manner with chromatin immunoprecipitation followed by sequencing (ChIP-seq). ChIP is a complex multistep protocol that provides millions of short DNA fragments covering the regions around these protein-DNA interaction sites. The subsequent sequencing step produces DNA strings (reads) of the beginning or end of these fragments but loses the information about their position which then have to be re-constructed by sophisticated string search algorithms.

In this thesis, we propose ODIN and THOR, algorithms to determine changes of protein-DNA complexes for distinct cellular conditions in ChIP-seq experiments with and without replicates. These methods address open challenges in previous ChIP-seq analyses such as the dependence of ChIP-seq peaks on the underlying protein of interest, artefacts arising due to the complexity of the protocol, and variations within clinical samples due to patients with different genetic backgrounds. We also propose two alternative approaches for the hitherto open problem how to evaluate such differential peak calling algorithms.
Dissertation Sebastian Andreas Franken

Title: “Supporting asynchronous, discontinuous, collaborative, complex search tasks by the visualization of search trails”

Reporters: Matthias Jarke, Michael Koch, Wolfgang Prinz

Date: June 22, 2016

Abstract: Complex search tasks have in common that their results are composed of individual partial results, which depend on the searcher’s personal preferences and skills. However, such complex search tasks lack in support when it comes to asynchronous and discontinuous search processes during collaborative search scenarios. In my thesis, I address the research question ‘Can search trails provide support for complex web search and how should tool support look like?’

To answer this question, I develop a novel solution for supporting asynchronous, discontinuous, collaborative, complex web search tasks. This is achieved by the web browser extension ‘SearchTrails’, which visualizes the user’s web search behavior as a force-directed graph, which can be stored and exchanged between collaborators. The generated search trails enable direct collaboration between searchers and provide an unfiltered insight where the searcher has searched before, and where results have been found. I show the effectivity and efficiency of my developed approach in two user studies. The first user study qualitatively shows the effectiveness of the developed approach, while the second user study quantitatively focuses on collaborative search scenarios. It shows the efficiency and the impact of the developed system on the quality of the search process and the search results. Based on the findings from the user studies, the main research question can be approved, which makes a scientific impact on the support of collaborative, complex search.
Dissertation Zinayida Kensche

Title: “Modeling Communities in Information Systems: Informal Learning Communities in Social Media”

Reporters: Matthias Jarke, Ralf Klamma, Markus Specht

Date: November 17, 2015

Abstract: Information modeling is required for creating a successful information system while modeling of communities is pivotal for maintaining community information systems (CIS). Online social media, a special case of CIS, have been intensively used but not usually adopted for learning community needs. Thus community stakeholders meet problems by supporting learning communities in social media. Under the prism of Community of Practice theory, such communities have three dimensions that are responsible for community sustainability: mutual engagement, joint enterprises and shared repertoire. Existing modeling solutions use either perspectives of learning theories, or analysis of learner or community data captured in social media but rarely combine both approaches. Therefore, current solutions produce community models that supply only a part of community stakeholders with information that can hardly describe community success and failure. We also claim that community models must be created based on community data analysis integrated with our learning community dimensions. Moreover, the models need to be adapted according to environmental changes.

This work provides a solution to continuous modeling of informal learning communities in social media. In particular, it makes the following contributions: 1. A metamodel of learning communities and its specific cases in social media. 2. A process of continuous community model creation that consists of four phases that model, refine, monitor and analyze learning communities. The phases and their realizations can be used to model any learning community with the purpose to support community evolution and to improve social media facilities to satisfy community needs. 3. Methods for community data analysis and storage have been exploited for retrieving learning community states to manage competences in a collaborative space and specifying culturally sensitive requirements of communities towards social media. 4. Our formal representation of a learning community has been used to model early requirements of learning communities and their evolution and to validate the effectiveness of possible community changes through multi-agent simulation.
Title: “Information Systems Success Awareness for Professional Long Tail Communities of Practice”

Examiners: Matthias Jarke, Ralf Klamma, Marc Spaniol

Date: July 12, 2016

Abstract: Facilitated by modern networked ICT, people around the world organize in self-sustaining communities of practice (CoP) across professional domains and organizational boundaries. Communities thereby pursue the main goal to learn how to do better. With today’s trend for mass individualization, we find a vast number and diversity of small professional niche communities in the long tail, apart from few large communities in the mainstream of the Web. As prerequisite for sustained success, communities must constantly stay aware of quality and impact of their community information systems (CIS). With fast-paced emergent technological and social progress, communities must develop agency to decide which tools best support them and why. While data-driven enterprises spend considerable technical and human resources in sophisticated business intelligence and analytics (BI&A) solutions for such decisions, communities face a real challenge, given their inherent resource scarcity. In meritocratic communities, a shared notion of CIS success must be negotiated from multiple specific, sometimes conflicting and idiosyncratic stakeholder perceptions of CIS success existing in a community. Standard positivist BI&A approaches with myopic focus on financial outcomes lack support for such inherently anti-positivist negotiation processes. Communities require respective support for CIS success awareness in terms of methodology, formalization, and technical infrastructure.

As solution to this problem, this dissertation presents MobSOS, a framework for CIS success awareness, tailored to the ontological properties of professional long tail CoP. From a methodological point of view, MobSOS extends a community-oriented design science research method by an explicit notion for CIS success modeling. CIS success models play the central role of fluid digital media operationalizing negotiation. Technically, MobSOS pursues an integrative approach to extend contemporary Web and P2P-based CIS platforms by CIS success awareness with the help of a CIS success modeling toolkit. Based on a comprehensive formalization framework, MobSOS supports operations such as monitoring, assessing, exploring, modeling, measuring, visualizing, validating, sharing, and negotiating different stakeholder notions of CIS success in a community-wide discourse.

In several national and international research projects, we successfully applied MobSOS in communities with varying scopes in domains such as health care, multimedia management, and technology-enhanced learning. Typical advanced CIS success models include few, yet highly relevant and effective success factors. They are well-balanced combinations of universal vs. community-tailored success factors and metrics. In particular, CIS success models with full coverage for both quality and impact and focused scope are more useful than models with myopic single-dimension focus and a vague scope. Awareness on CIS quality and impact brings communities agency in form of a better informed decision on CIS tool selection, use or active development. We could demonstrate that CIS success models contribute to determine ideal software configurations, to estimate development efforts, to identify and eliminate bottlenecks, to elicit hidden requirements, or to judge concrete impact on the community. MobSOS also proved to be an effective framework to identify learning patterns, to detect usage anomalies, or to measure learning progress. Our technical evaluations finally show that MobSOS is an effective, performant, and low-cost open-source framework for CIS success awareness.
Since January 2000, Fraunhofer FIT at Birlinghoven Castle, Sankt Augustin, is associated with RWTH Aachen University by joint appointment of Institute Director Professor Matthias Jarke, and since 2015 also Professor Stefan Decker, of Informatik 5. Three of the division leaders (Berlage, Prinz, Rose) have joint appointments as professors at RWTH Aachen. FIT is part of the Fraunhofer ICT Group, a consortium of 18 Fraunhofer Institutes with over 4000 researchers.

With approximately 140 researchers, Fraunhofer FIT investigates foundations of sustainable business IT under the three perspectives of human-centered design, high-tech process support, and financial, managerial, and technological risk management. In 2015, the institute operated with a record third-party funding of 10.8 m€, representing a growth of more than 10% over 2014 and over 80% of its overall budget. About 4.2 m€ came from direct contract research, the remainder from European and national funding agencies. The institute is organized in five research divisions:

- Cooperation Systems (Prof. Wolfgang Prinz) focuses on cooperation and innovation management using social media, continuing technology-enhanced learning technologies, and advanced visualization technologies such as augmented reality. There is a close cooperation with Informatik 5 in the area of social computing.
- User-Centered Computing (Dr. Markus Eisenhauer) investigates systems engineering by humans for humans, i.e. a user-centered and participative approach to the design of software-intensive Cyberphysical Systems. Our LinkSmart middleware has been highly successful in supporting energy-saving CPS e.g. in a production or smart city context; FIT’s Certified Usability Engineer courses are among the most successful of the Fraunhofer continuing education Academy, and the Accessibility and Web Compliance group closely cooperates with the SignGes Center on Sign Languages and Gesture Research to improve the education and job situations of deaf citizens.
Life Science Informatics (Prof. Thomas Berlage) develops innovative big data solutions for life science and healthcare. This includes obtaining data via different sensor technologies for human use and use in the lab. FIT is co-coordinating the Fraunhofer initiative Medical Data Space for ensuring digital sovereignty over medical data. At CeBit 2016, the department demonstrated a solution for the cooperative monitoring and coaching of diabetes patients via a telemedicine portal developed in collaboration with an industry partner with Medical Data Space support.

Risk Management and Decision Support (Prof. Thomas Rose) supports sustainability by evaluating, minimizing, and managing different kinds of risks. The micro-simulation group MIKMOD assists several German federal ministries in financial impact analyses of proposed law changes.

Since 2016, a fifth department, located in Augsburg and Bayreuth under the leadership of finance informatics professor Hans-Ulrich Buhl (University of Augsburg) pursues a financial value-based approach to different aspects of business management. In 2016, a big success of the group was the acquisition of the Kopernikus strategic BMBF project SynErgie which studies the impact of renewable energy sources on the control of industrial processes.

In addition, several renowned colleagues from other universities are linked to Fraunhofer FIT as department co-leaders or consultants, including social informatics specialist Volker Wulf (University of Siegen) with a group focusing on usability issues, and Thomas Hoeren (University of Münster), a well-known leader in the field of media and Internet law.
Since 2003, the B-IT has been pioneering the brain gain of much needed IT specialists from all over the world by offering top-level international master programs in applied informatics. In a unique cooperation between RWTH Aachen University, the University of Bonn, the Bonn-Rhein-Sieg University of Applied Sciences, and the Fraunhofer Center Birlinghoven Castle, these master programs address Media Informatics, Life Science Informatics, and Autonomous Systems, respectively. Currently, students from over 40 countries worldwide are studying in the beautiful B-IT Building on the Rhine River in Bonn-Bad Godesberg. The B-IT is directed by Professors Stefan Wrobel (Bonn), Matthias Jarke (RWTH Aachen and Fraunhofer FIT), and Kurt-Ullrich Witt. Eight endowed professorships are funded by the B-IT Endowment, including matching funds by NRW State.

In the academic year 2015-2016, an external evaluation confirmed the quality of the program, whose Media Informatics program under the responsibility of RWTH Aachen University has already produced alumni who not just completed a doctorate but also achieved professorship positions. Since 2010, the program is coordinated by Prof. Jan Borchers, one of the endowed professorship holders, and supported by study advisor Dr. Jürgen Rapp. In 2016, a new International Advisory Board has been appointed which includes top managers and entrepreneurs from the region as well as international researchers, including former ACM President Wendy Hall.

Placement tracking of the B-IT graduates show that the dual goal of strengthening German business and science by young promising international graduates, and of improving further the linkages to their home countries by returning well-educated graduates for their local commercial and scientific job markets, has been impressively reached. The quality of the program was confirmed in 2012 by re-accreditation of all B-IT Master programs, which covered not only the German ASIIN but also the new European accreditation label EurInf, which the B-IT programs were the first to achieve within all of Europe. Full details can be found in the B-IT Annual Report 2016 published at www.b-it-center.de.

Participants were greeted by Vice Rector Aloys Krieg of RWTH Aachen University, then Matthias Jarke and Stefan Decker gave an overview of historical accomplishments and future plans of Informatik 5. Keynote Speakers included John Mylopoulos (University of Trento, Dr. h.c. RWTH Aachen University) on requirements and Stefanie Kethers (Melbourne/Australia, Dr. rer.nat. from RWTH Aachen in 2000) on the international Research Data Alliance. Tung Bui (University of Hawaii, Ph.D. with Prof. Jarke at New York University 1984) presented fascinating research on IT in disaster management, whereas Ralf Klamma (leader of the ACIS research group at Informatik 5) discussed the opportunities and challenges of social network communities e.g. in lifelong learning. Finally, Alexander Ferrein (professor at FH Aachen, and Ph.D. graduate of Prof. Lakemeyer) and Wolfgang Prinz (deputy institute leader of Fraunhofer FIT and professor at Informatik 5) presented award-winning results from the Robotics/Knowledge-Based Systems Research Area and from the Fraunhofer FIT Institute. The presentations gave much food for thought and lively debates. After the symposium, participants enjoyed the sunny weather, beautiful environment, and excellent food at a festive dinner in Vaalsbroek Castle, following the tradition of the quintennial Informatik 5 alumni meetings.

In addition to numerous Informatik 5 alumni and departmental colleagues, the 140 attendants also included long-time Informatik 5 cooperation partners, such as professors Armin Cremers (co-founder of b-it institute), Gerhard Fischer (University of Colorado, FIT Curatory Board), Michael Jansen (GUtech Oman), Wolfgang Marquardt (Jülich Research Center), Joachim W. Schmidt (TU Harburg, master thesis advisor of Prof. Jarke), Yannis Vassiliou (NTUA Greece), as well as several colleagues from Stefan Decker’s former affiliation with the Digital Engineering Research Institute (DERI) in Galway/Ireland.

With 750 participants, the leading conference of the Special Interest Group Human-Computer-Interaction of the Gesellschaft für Informatik e.V. and the German UPA was again one of the largest HCI conferences in Europe. A large number of presentations, workshops, tutorials, exhibitions and demonstrations provided the background for intensive discussion about HCI research in theory and practice. Design and use of mobile systems, wearables and the application of Augmented Reality were important conference topics, also reflected by three keynotes: Martin Kaltenbrunner presented the basics of tangible user interfaces combined with a new paradigm for the design of electronic instruments. Tomer Sharon used demonstrated methods that help designers and developers to create products that users really enjoy. David Crellin provided insights of a project from the UK: the design and distribution of the micro:bit computer to all pupils of class 7-8. Three applications developed over night in an ad-hoc hackathon demonstrated the manifold application domains of this small device.

A special conference highlight was the conference dinner in the city hall including the presentation of awards, some to members and alumni of RWTH Aachen University:

- **Best interactive demo:** „Juniorakademie Hovercraft“, Matthias Ehlenz together with pupils who developed a Hovercraft-Model.
- **Best Short Paper:** „Integrierte Eingabegräte: Sind Links- oder Rechtshänder besser?“ by Michael Oehl, Julia Stein and Christine Sutter
- **Best Paper Award:** “More interactivity with IT support in advisory service encounters?” by Mateusz Dolata (Media Informatics Alumnus) und Gerhard Schwabe.
- **Honorable Mention Paper Award:** “The Impact of SearchTrails on the Quality of Collaborative Search” by Sebastian Franken, Ulrich Norbisrath and Wolfgang Prinz.

Conference papers are available in the digital library of the Special Interest Group Human-Computer-Interaction of the GI: [http://muc2016.mensch-und-computer.de/](http://muc2016.mensch-und-computer.de/)
On July 16, 2016, the computer science department conducted the 10th InfoCup, an indoor soccer tournament for the groups of the department. Informatik 5 organized the tournament, and as in the previous years, INFORM GmbH sponsored the event.

This year, seven teams participated:

- Mentoring Informatik
- COMSYS
- Visual Computing Institute
- Fachschaft
- Informatik 3
- Informatik 11
- Informatik 5

The tournament was organized in a qualifying phase as a round-robin tournament, and a knockout phase. In the first phase, it was easy to see that Informatik 11 is the favorite to win the tournament, as they won all their matches and had only one goal scored against them. The teams of Mentoring, Comsys and Informatik 5 were close in fighting for the second place.

Those teams made also the semi-final in which Informatik 11 won a close match against the Mentoring team. The second semi-final between Comsys and Informatik 5 was decided by penalty shoot-out, with Informatik 5 as the lucky winner. The final was a clear 3-0 win for Informatik 11, congratulations to their first win of the InfoCup tournament. The final results of the tournament are

1. Informatik 11
2. Informatik 5
3. Mentoring
4. Comsys
5. Visual Computing Institute
6. Fachschaft
7. Informatik 3

After the tournament, the teams celebrated the winner with a BBQ in the backyard of the computer science building. Thanks to the sponsoring INFORM GmbH, it was a nice social event with food and drinks.