Editorial

Liebe Fachgruppenmitglieder,

Der Höhepunkt dieses Jahres, das EMISA-Fachgruppentreffen, findet vom 3. - 4. September 2015 in Innsbruck am Rande der *13th International Conference on Business Process Management (BPM 2015)* statt. Damit ist die EMISA, nach den Fachgruppentreffen in Wien (2012), St. Gallen (2013) und Luxemburg (2014), ein weiteres Mal zu Gast bei benachbarten Freunden. Den wissenschaftlichen Schwerpunkt wird in Innsbruck der *6th International Workshop on Enterprise Modeling and Information Systems Architectures* bilden. Den *Call for Participation* hierfür finden Sie in diesem Heft. Bitte denken Sie in jedem Fall daran, diesen Termin in Ihrem Kalender bereits heute zu blocken.

Uns freut es festzustellen, dass der von Michael Fellmann und Agnes Koschmider ins Leben gerufene Arbeitskreis „Semantische Technologien im Geschäftsprozessmanagement“ erfolgreich gestartet ist und in diesem Heft mit einem zweiten Fachbeitrag seiner Arbeit präsentiert. Der Titel lautet „Semantic Technology in Business Process Modeling and Analysis. Part 2: Domain Patterns and (Semantic) Process Model Elicitation .“

Wie immer freuen wir uns natürlich über Ihr Feedback und Ihre Anregungen jeglicher Art. Bitte senden Sie uns auch Informationen zu Ihren Veranstaltungen und Aktivitäten per E-Mail zu. Wir werden diese dann über die EMISA-Homepage (emisa.org) und den ebenfalls vor kurzem eingerichteten Twitter-Account (@EmisaFachgruppe) bewerben.

Auf ein baldiges Wiedersehen beim Fachgruppentreffen in Innsbruck!

Mit herzlichen Grüßen

Manfred Reichert
(EMISA-Sprecher)

Aus der EMISA-Fachgruppe:

- Call for Participation EMISA 2015 – 6th International Workshop on Enterprise Modelling and Information Systems Architectures (EMISA'15), 3. – 4. September 2015, Innsbruck
- Bericht von der Industrial & Systems Engineering Research Conference (ISERC)

EMISA 2015

Call for Participation

6th International Workshop on Enterprise Modelling and Information Systems Architectures

(co-located with BPM 2015)

September 3-4, 2015 – Innsbruck, Austria

https://ai.wu.ac.at/emisa2015/

The strategic importance of enterprise modelling has been recognized by an increasing number of companies and public agencies. Enterprise modelling delivers the 'blueprints' for co-designing and aligning business and enterprise information systems such that they complement each other in an optimal way. As example consider the support of business processes by process-aware information systems. Achieving such interplay requires a multi-perspective approach taking organizational, economic, and technical aspects into account. In a world of cloud, social and big data, additional challenges for enterprise modelling and the design of information systems architectures are introduced, e.g., in respect to the design of data-driven processes or processes enabling cross-enterprise collaboration. To deal with these challenges, a close cooperation of researchers from different disciplines such as information systems, business informatics, and computer science will be required.
EMISA 2015 is the sixth international workshop in a series that provides a key forum for researchers and practitioners in the fields of enterprise modeling and the design of information system architectures. The workshop series emphasizes a holistic view on these fields, fostering integrated approaches that address and relate business processes, business people and information technology. EMISA 2015 will provide an international forum to explore new avenues in enterprise modelling and the design of IS architectures by combining the contributions of different schools of information systems, business informatics, and computer science.

Programme EMISA 2015 Workshop

Thursday, 3rd September 2015

Time	Programme
14:00	Kolb, Leopold, Mendling: Welcome by the programme chairs
14:15	Keynote Agnes Koschmider: Quality of Process Element Labels – Where are we now, where should we go from here?
15:00	Storch, Laue, Gruhn: Flexible Evaluation of Textual Labels in Conceptual Models
15:30	Coffee Break

Session 1: Enterprise Modelling	
16:00	Koschmider, Caporale, Fellmann, Lehner, Oberweis: Business Process Modeling Support by Depictive and Descriptive Diagrams
16:30	Radloff, Schultz, Nüttgens: Extending different Business Process Modeling Languages with Domain Specific Concepts: The Case of Internal Controls in EPC and BPMN
17:00	Figl, Strembeck: Findings from an Experiment on Flow Direction of Business Process Models
General Meeting EMISA	
17:30	General Meeting EMISA
18:00	LG EMISA
19:30	Social dinner

Friday, 4th September 2015

Time	**Programme**
Session 2: Information Systems Architecture	
09:00	Kossak, Geist: An Enhanced Communication Concept for Business Processes
09:30	Rinderle-Ma, Ma, Madlmayr: Using Content Analysis for Privacy Requirement Extraction and Policy Formalization
10:00	Baumgrass, Cabanillas, Di Ciccio: A Conceptual Architecture for an Event-based Information Aggregation Engine in Smart Logistics
10:30	Coffee Break
Session 3: Process Model Matching Contest	
11:00	Leopold, Stuckenschmidt, Weidlich, Meilicke, Kuss: Results of the Process Model Matching Contest 2015
12:00	Kolb, Leopold, Mendling: Workshop Closing

Programme Co-Chairs

- Jens Kolb, Ulm University, Germany
- Henrik Leopold, VU University Amsterdam, The Netherlands
- Jan Mendling, Vienna University of Economics and Business, Austria

Process Matching Contest Organisators

- Henrik Leopold, VU University Amsterdam, The Netherlands
- Heiner Stuckenschmidt, University of Mannheim, Germany
- Matthias Weidlich, HU Berlin, Germany
- Christian Meilicke, University of Mannheim, Germany
- Elena Kuss, University of Mannheim, Germany

Organisation

The workshop is jointly organised by the University of Innsbruck and the *GI Special Interest Group on Design Methods for Information Systems* (GI-SIG EMISA).

Organising Committee

- Barbara Weber, University of Innsbruck, Austria
- Cornelia Haisjackl, University of Innsbruck, Austria
- Ilona Zaremba, University of Innsbruck, Austria

Location

EMISA 2015 will be co-located with the 13th International Conference on Business Process Management (BPM 2015). Both events will be hosted by the University of Innsbruck and BPM Research Cluster, and will take place in Innsbruck – also called "The Capital of the Alps". Innsbruck is rich in traditions and open to the world. The Tyrolean capital has always been a city of many faces: the imperial monuments and contemporary urban design, the Olympic records and opulent past splendour.

The EMISA workshop will take place at the **University of Innsbruck, School of Management, Universitätsstraße 15, 6020 Innsbruck, Austria**. The venue is easily accessible by a healthy walk within a maximum of 15 minutes walking time from all the recommended conference hotels in Innsbruck. Alternatively public transport can be used to reach the location.

Registration fees for EMISA and doctoral workshop

Regular registration:	300,00€
GI Members:	250,00€
Students (Bachelor or Master level):	100,00€

The registration fee includes the following:

- Attendance of workshop sessions (EMISA and doctoral workshops)
- Conference proceedings
- Refreshments during coffee breaks
- Evening event including dinner on Thursday (not included for students)

Please consult http://bpm2015.q-e.at/registration/ for details.

Additional information & Contact

For additional information, please access the workshop's website at:

https://ai.wu.ac.at/emisa2015/

Auch in diesem Jahr öffnete die Industrial & Systems Engineering Research Conference (ISERC) wieder ihre Pforten. Neben dem Standardprogramm wurden auch Doktoranden Kolloquien und Workshops angeboten. Die Konferenz startete am 30.05.2015 und endete am 02.06.2015. Innerhalb dieses Zeitraums wurden jeweils 8 stündige Sessions angeboten, in denen Forscher aus aller Welt ihre aktuellen Forschungsergebnisse im Plenum präsentieren und diskutieren konnten. Außerhalb der Sessions gab es zahlreiche weitere wissenschaftliche Aktivitäten, wie bspw. ein Besuch der Ausstellungsstraße, auf welcher Unternehmen und Forscher ihre Entwicklungen anhand von Postern vorstellen konnten. Darüber hinaus wurden interessante Key Notes aus dem Umfeld des Systems Engineering vorgetragen.

Der Beitrag unseres Hochschulforschungsteams „Implementation of IT-accessibility with the IT-CMF Framework“ (D. Vaziri, A. Gadatsch) wurde sehr positiv aufgenommen und in der Runde mit Forschern diskutiert, so dass wir neue Ideen und Ansätze für unsere Forschung mit nach Deutschland nehmen konnten. Im Vergleich zu den anderen Vorträgen in unserer Session sowie in anderen Sessions lässt sich feststellen, dass unser Forschungsniveau den internationalen Anforderungen mehr als gerecht wird.

Abschließend kann der Besuch der ISERC Konferenz 2015 als Erfolg für das Forschungsteam und die Hochschule als Forschungseinrichtung angesehen werden. Weitere Informationen zur Konferenz sowie die Möglichkeit zum Herunterladen der jeweiligen wissenschaftlichen Artikel sind unter https://www.xcdsystem.com/iie2015/program/index.cfm?pgid=190 zu finden.

Semantic Technology in Business Process Modeling and Analysis. Part 2: Domain Patterns and (Semantic) Process Model Elicitation

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Abstract: Conceptual modeling in Business Process Management (BPM) is one of the core research areas of Information Systems (IS). A variety of different strategies for modeling support and model analysis exists such as syntax-based auto-completion features, recommendation techniques, correctness and compliance checking, abstraction and matching, semantic and domain patterns, or AI-based planning approaches. These mechanisms increasingly gain attention in the BPM and conceptual modeling community. Due to the great variety of techniques and use cases of modeling support systems, research is scattered amongst different sub-communities of the large BPM and conceptual modeling communities and a common ground for discussion and research is not yet established. In order to bring together researchers working on different aspects of modeling support systems, the new working group *Semantic Technologies in Business Process Management* (SEMTECHBPM) has been established, which is associated with the EMISA, a sub-group of the GERMAN INFORMATICS SOCIETY (GI).

The article at hand presents the second part of our overview article presenting first results of the SEMTECHBPM working group in outlining different existing research streams engaged with semantic technologies in business process modeling and -analysis. Although we discussed all aspects in the working group and also invited non-members to contribute their knowledge prior to writing this article, we make no claim that the overview provided with this article is well-balanced or exhaustive. Rather, it should serve as a starting point to foster the collaboration between researchers engaged with semantic technologies in BPM and to promote their results. We are open to comments and welcome researchers who want to participate in the SEMTECHBPM working group.

In the second part of the article, we focus on the extraction and usage of domain patterns and (semantic) process model elicitation techniques.

1 State of the Art of Semantic Technology (Part 2)

1.1 Semantic and Domain Patterns

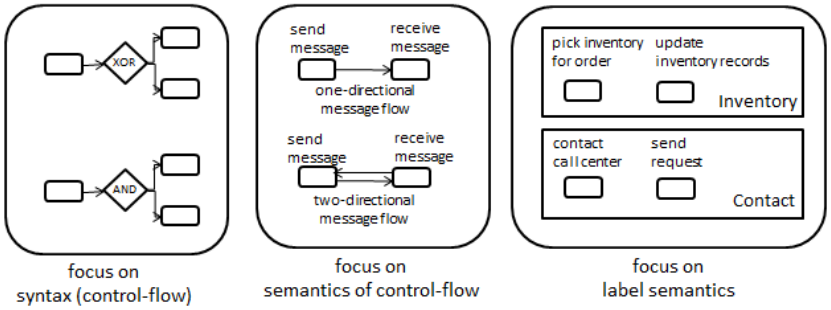
Patterns may serve as a basis for semantic modeling support and analysis. Whereas semantic patterns, for example, consist of a combination of control flow constructs to implement a specific behavior, domain patterns may specify the procedures or resources typically used in processes of a particular domain. This section provides the essential background on (business process) patterns and presents approaches that identify related patterns. Some of the approaches explicitly use semantic technologies to help identify the patterns, while others use other techniques to accomplish a semantic processing of the pattern-relevant data.

In general, patterns have long proven to be effective concerning their ability to preserve existing knowledge, to abstract from concrete problems, and to foster communication between participants [KR15]. The use of patterns is very common in fields such as Software Engineering (patterns in this field are grounded by (software) design patterns). In the field of Business Process Management patterns constitute a rather unstructured research area due to a missing consistent definition of the term business process pattern (BPP). Due to this lack, also a systematic comparison of patterns is hampered (e.g., see the findings in [BK14]).

A variety of patterns can be found in literature. Particularly, patterns investigating the recurring syntactic structure or behavior of process models have attracted high attention. A popular representative of this category are workflow control flow patterns [VDATHKB03], which describe syntactic relationships between process activities. For instance, the *Parallel Split* pattern describes the divergence of a branch into two or more parallel branches each of which executed concurrently (see left hand side of Figure 1 for an example).

In the following, we are particularly interested in patterns being useful for semantic technologies and patterns, which can be identified using semantic technologies. This are patterns that deal with process element labels or patterns facilitating to identify a recurring behavior of process model semantics (i.e., patterns that help to ensure compliance in busi-

Figure 1: Focus of Different Types of Workflow Patterns



Approach	Authors
Semantics of process activities	
Investigation of the repetition of business functions when designing a process model	Thom, Reichert and Iochpe [TRI09a]
Enforcing quality requirements through the application of process quality patterns	Foerster, Engels and Schattkowsky [FES05]
Identification of a question answering-pattern enabling automatically responding to questions	Hao et al. [HHWZ08]
Methodology for analysis of weaknesses in semantically analyzable business process models	Becker et al. [BBR+10]
Semantics of process activity labels	
Description of pattern to model the recurring behavior in inventories	Fern [Fer00]
Proposal of patterns for health services management projects	Stephenson and Bandara [SB07]
Description of recurring element labels of particular application domains	Koschmider and Reijers [KR15]

Table 1: Overview Process Model Design Patterns Focusing on the Process Model Semantics

ness process modeling). While the latter category has been widely discussed in Part 1 [FDK+15] of this article (see Chapter 2.3), this section is dedicated to the description of the first category of patterns. This category has been only rarely addressed in the literature (compared to compliance patterns or workflow patterns).

The right hand side and the middle part of Figure 1 illustrate patterns investigating process element labels using semantic technologies. Patterns, which address the semantics of labels (see right hand side of this figure) use semantic technologies in order to identify the content of process element labels without considering the control-flow. This means that a process model that has syntactical bottlenecks (e.g., a faulty usage of element constructs) might be appropriate with respect to patterns considering the label semantics. Exemplary, the Inventory pattern subsumes all process element labels that are involved in inventory management e.g., activities for managing reserves on the inventory, for managing adjustments to the inventory, and for managing the expected inventory. Process patterns, which identify the business functions that frequently occur in a process model such as decision making are described by a further type of patterns. For instance, the two-directional message flow pattern describes the business function of message exchange between activities that are bi-directionally connected.

Table 1.1 summarizes approaches, which are either related to patterns identifying the business function of process activities or the content of process element labels.

1.1.1 Pattern Elicitation

Only few approaches can be found, which (semi-)automatically identify business process patterns. Usually, this task is creative and manual work.

Compliance patterns can systematically be obtained by studying legal documents or internal guidelines. From these documents, it is possible to define anti-patterns (i.e. patterns that should *not* occur in a model) [DH14, DH15]. Less common are approaches such as

[SGE+13] where patterns define what *should* happen in a compliant process.

Systematic approaches for finding patterns need to process the element labels of activity nodes. SMIRNOV et al. [SWMW12] describe an algorithm where relations between actions in a process model are learned. These relations – called action patterns by SMIRNOV et al. – refer to co-occurrence and ordering relations between model elements.

KOSCHMIDER and REIJERS [KR15] use natural language processing techniques for extracting high-level patterns for generic activities (such as "inventory" or "invoicing") from business process models.

While both [SWMW12] and [KR15] concentrate on the action verbs and the objects in a business process model, BÖGL et al. [BSPW08] aim to detect a variety of semantic roles (such as a role "source" and "direction") from an activity label. This is achieved by regarding semantic text patterns.

By analyzing a number of models, it is possible to identify stereotyped sequences of actions that are common for a family of processes. It has to be noted that this idea is not specific for the analysis of business process models. Representing typical courses of action as scripts is well researched in the area of text understanding. For the purpose of business process modeling, the theory of scripts has been exploited by LEIGH and RETHANS [LR84] who generated stereotypes of common purchasing processes by interviewing experts. PEYLO [Pey08] also follows the idea of scripts. He suggests an ontology-based approach to document a typical course of action. Those approaches perfectly fit our notion of a process model pattern, even if no graph-based business process models are involved.

In addition to the already mentioned approaches for identifying business process patterns manually or by using an algorithm, RODRÍGUEZ et al. [RDC14] describe a crowd-based process for finding patterns.

1.1.2 Using Patterns

Semantic business process patterns can be used in various ways. At first, the pattern names provide a common vocabulary which enables business process analysts to discuss the processes on a higher level of abstraction. Second, the patterns are helpful for education and training. Business process modelers can profit from experiences of others who have documented well-working solutions to common modeling problems.

As already discussed in the first part of our article, patterns and anti-patterns can be applied for checking the compliance of a model [STK+10, DH15] and – more generally – for improving the quality of the models [SGE+13].

Reuse of previously defined patterns (i.e. model fragments) does not only help to build better models, it can also be helpful for creating models faster. For this purpose, THOM et al. [TLIM07, TRI09b] extended a modeling tool such that certain patterns can be directly inserted into a model. While in their approach the patterns are included in the modeling tool, more advanced scenarios allow for storing commonly occurring process fragments in a repository [SKLS11]. Using such a repository, can allow indexing patterns, linking between patterns, searching for patterns and social collaboration such as adding comments

to documented patterns [Bir10].

All these techniques allow to suggest model fragments to be included into a model. However, patterns can also be used for recommendations of single activities (see for example [KR15]) and for auto-completion of process models [WFK11]. A detailed discussion of such recommender techniques can be found in [FZMK15].

1.2 Semantic Process Model Elicitation

The scope of this section are approaches that use semantic technologies to discover models from various input sources as well as to automatically construct, abstract, maintain, improve, enrich and translate models.

Semantic Process Mining denotes the extension of process mining techniques using semantic technology. In this area, DE MEDEIROS et al. [dMVdAP08] propose to shift the analysis of log files from the syntactic level (considering labels in the log files) to the semantic level using ontologies in order to accomplish a more accurate and robust analysis. The authors present core building blocks of such a technique and demonstrate the feasibility using the ProM framework. The practical application of Semantic Process Mining in an industrial application is demonstrated by INGVALDSEN and GULLA [IG12]. The authors discuss the industrial benefits and challenges of their Semantic Process Mining approach. They also describe how to make use of ontologies and annotated log files in conjunction with data mining technologies to enable a more flexible generation of process model views. This can be used to present the discovered models in business terms at various level of detail. The approach has been implemented in the process mining tool EVS (Enterprise Visualisation Suite) and applied to ERP systems such as SAP. Finally, BAIER and MENDLING develop an approach to bridge abstraction layers in Process Mining [BM13]. The authors tackle the problem of automatically associating the events from a log with the activities from a process model. One of the core challenges in this context is that events from logs are typically more fine-granular than activities. To solve this problem, they use domain knowledge extracted from existing process documentation.

Another form of process model discovery is *process discovery from text*. Early works in this area addressed the extraction of models from requirement specifications. For example, KOP et al. [KVH+05] developed a tool to support the extraction of behavior models from requirements texts. The approach makes use of various techniques for Natural Language Processing such as word tagging and sentence analysis. Further approaches also focus on process mining from specific sorts of text. For example, GONCALVES, SANTORO and BAIAO [GSB09] extract workflow models from group stories using text mining and natural language interpretation. Also, discovering process models by parsing business policies has been proposed and demonstrated by WANG, ZHAO and ZHANG [WZZ09]. In contrast to the approaches introduced so far, there are approaches to model discovery that are more versatile regarding the form of input. For example, GHOSE, KOLIADIS and CHUENG [GKC07] develop a framework and prototype for rapid process discovery called R-BPD. In a mixed-imitative setting, the tool can be used to extract process models from

Approach	Authors
Semantic Process Mining	
Core building blocks of semantic process mining tools	de Medeiros et al. [dMVdAP08]
Industrial application of semantic process mining	Ingvaldsen and Gulla [IG12]
Bridging abstraction layers in process mining	Baier and Mendling [BM13]
Process discovery from text	
Tool supported extraction of behavior models	Kop et al. [KVH+05]
Process discovery from model and text artefacts	Ghose, Koliadis and Chueng [GKC07]
Business process mining from group stories	Goncalves, Santoro and Baiao [GSB09]
Discovering process models from business policies	Wang, Zhao and Zhang [WZZ09]
Process model generation from natural language text	Friedrich, Mendling and Puhlmann [FMP11]
Extraction and reconstruction of enterprise models	Sanchez, Reyes and Villalobos [SRV14]
Planning-based process model construction	
Automated model construction: A logic based approach	Krishnan [Kri89]
SEMPA – an approach for business process model planning	Heinrich et al. [HBH+08]
Automated planning of context-aware process models	Heinrich and Schoen [HS15]
Process model abstraction	
A semantic approach for process model abstraction	Smirnov, Reijers and Weske [SRW11]
Techniques for generating model names	Leopold et al. [LMRLR14]
Value-chain discovery from business process models	Boubaker et al. [BCLM14]
Process maintenance and improvement	
Resolution of compliance violation using planning	Awad, Smirnov and Weske [ASW09]
Business processes contextualisation via context analysis	de la Vara et al. [DLVAD+10]
Continuous planning for business process adaptivity	Marrella and Mecella [MM11]
Revising process models through inductive learning	Maggi et al. [MCR+11]
Process optimization using formalized patterns	Niedermann, Radeschuetz and Mitschang [NRM11]
Process model enrichment	
Towards the Automated annotation of process models	Leopold et al. [LMF+15]
Automatic service derivation from model repositories	Leopold, Pittke and Mendling [LPM15]
Process model translation	
Transformation of use cases into activity diagrams	Yue, Briand and Labiche [YBL10]
Use cases to process specifications in BPMN	Sinha and Paradkar [SP10]
Automatic business process model translation with BPMT	Batoulis et al. [BESL+13]

Table 2: Range of Semantic Process Model Elicitation Approaches

diverse sources such as text, web-content or other models such as sequence diagrams. In order to resolve naming and abstraction conflicts, an enterprise ontology is used. The extracted models serve as a basis for further refinement by the human expert. Similarly, SANCHEZ, REYES and VILLALOBOS [SRV14] focus on the extraction and reconstruction of (existing) enterprise models using information from multiple sources such as information systems, databases and previously existing models. Although semantic technologies are not explicitly addressed, the approach makes use of a domain metamodel serving as a knowledge representation backbone which helps querying and analyzing the contents. Finally, research focuses on generating complete process models out of natural language descriptions. For example, FRIEDRICH, MENDLING and PUHLMANN [FMP11] automatically generate BPMN models from natural language text. The authors combine existing tools from Natural Language Processing and extend them with an anaphora resolution mechanism.

Departing form the discovery of models where semantic technology is used somewhere

behind the scenes, the field of *planning-based process model construction* uses semantic technologies and knowledge representation at its very core. An early work in this area is the automated model construction using a logic-based approach as proposed by KRISHNAN [Kri89]. More recent approaches combine logic, knowledge representation, planning and graph processing techniques to provide sophisticated tools and techniques. With SEMPA, an algorithm for the automated planning of process models has been devised by HEINRICH et al. [HBH+08]. Making the planning context-aware has subsequently been investigated by HEINRICH and SCHOEN [HS15].

Once the process model is discovered or is constructed using semantics-enabled approaches, it may not be on the right level ob abstraction yet. Here, *process model abstraction* is applicable. When abstracting a process model, it is challenging to combine activities into high-level tasks in a way that approximates how a human would solve this problem. In this regard, SMIRNOV, REIJERS and WESKE [SRW11] developed an approach that exploits semantic information within a process model to decide on which activities belong to each other. Similarly challenging is to find a name for the newly created, more abstract model. To tackle this problem, LEOPOLD et al. [LMRLR14] developed a technique for generating model names. Another approach presented by BOUBAKER et al. [BCLM14] creates more abstract value-chains from business process models expressed using BPMN. The value-chains are represented using concepts of the REA-ontology. The transformation is implemented with the help of a Business Rules engine.

Following its creation, a process model is subject to *process maintenance and improvement*. Regarding maintenance, a major issue is to keep business processes compliant with regulations, especially if a huge number of such models exist. To ease the task of ensuring compliance, AWAD, SMIRNOV and WESKE [ASW09] develop a planning-based technique for resolving compliance violations in business process models. They address violations of execution ordering compliance rules using background knowledge in the form of violation patterns in conjunction with algorithms to detect and resolve them. Another form of background knowledge is used by DE LA VARA et al. [DLVAD+10] in the form of context analysis models. Originating from Requirements Engineering, such models are created to support the context-specific adaptation of business process models. Process model adaptation is also addressed by MARRELLA and MECELLA [MM11]. They propose a technique to automatically cope with unexpected changes preventing process execution. The technique is capable of modifying only those parts of the process that need to be changed or adapted and keeping other parts stable. It is based on continuous planning using the Planning Domain Definition Language as well as SmartPM, a formalism for declarative modeling.

Regarding improvements, it is challenging to include all relevant data sources and to detect improvement choices. To support this process, NIEDERMANN, RADESCHUETZ and MITSCHANG [NRM11] develop a deep Business Optimization Platform addressing these challenges by integrating data from various sources in a data warehouse and applying (amongst others) graph analysis and matching techniques to detect applicable patterns for process optimization. Another direction of research is to revise process models through inductive learning as proposed by MAGGI et al. [MCR+11]. The approach improves models by automatically revising them to be in line with practice throughout their lifetime

using a non-monotonic inductive learning system. In doing so, it aims to minimally revise business process models. The authors also argue that business process revision offers significant advantages over business process discovery.

Process model enrichment denotes performing operations on existing models aiming at an extension of the models content or the derivation of additional useful information e.g. to use, extend or implement the model. In this direction, LEOPOLD et al. [LMF+15] propose an approach for automatic process model annotation with elements of an activity taxonomy. The approach builds on the corpus-based method of second-order similarity, different similarity functions and a Markov Logic formalization of the annotation problem. The automated semantic annotations may be consumed by other tools and techniques e.g. to improve retrieval, content-analysis or matching of process models. An example of an approach deriving additional information from process models is the automatic service derivation from business process model repositories developed by LEOPOLD, PITTKE and MENDLING [LPM15]. The technique reduces the amount of manual work in the context of service derivation by automatically deriving service candidates from business process model repositories. The approach leverages semantic technology for deriving ranked lists of service candidates. It may be used for enabling business and IT managers alike to quickly spot reuse potential in their company, to improve Business/IT alignment or to prioritize IT support based on relative importance of a business operation.

Finally, *process model translation* deals with transforming a model from one (modeling) language to another. Regarding the translation from UML Use Cases to UML Activity Diagrams, YUE, BRIAND and LABICHE propose an automated approach [YBL10]. The implementation makes use of transformation rules as well as libraries for linguistic text processing. A similar but semi-automated approach that also aims at translating between Use Cases and Activity Diagram is developed by SINHA and PARADKAR [SP10]. The authors additionally put more emphasis on synchronizing between the two types of models and enforcing consistency. They also use natural language processing that is packaged by the authors in the form of a linguistic analysis engine for natural language use case description. Finally, in regard to the translation of the natural language labels contained in process models, BATOULIS et al. have developed an automated translation tool called BPMT [BESL+13]. It builds upon the machine translation system Moses and extends it with word and translation disambiguation considering the context of the domain. This is done to successfully process the compact and special language fragments typically found in business process models.

2 Conclusion

In the second part of the paper, we focused on approaches making use of semantic technologies in the area of domain patterns and (semantic) process model elicitation. What we again see in these areas is that a wide range of semantic technologies and techniques is in use.

However, regarding domain patterns, only a few approaches can be found being able to

(semi-)automatically identify business process patterns. Regarding the application of patterns, most of the tools we are aware of provide little flexibility regarding the granularity of reuse (e.g. parts from a pattern, complete pattern or combination of patterns integrated via a planning approach) and reuse strategy (e.g. recommending strategies). What is more, they are often tailored to specific pattern collections. Hence, approaches that more closely integrate (automatic) detection of patterns with pattern management and reuse in a single approach may be subject to future research.

Regarding (semantic) process model elicitation approaches, we see that semantic technologies in the area of Natural Language Processing are widely used. A recommendation for the research community would be to make the adaptations and adjustments to general purpose NLP tools reusable by packaging or providing them in a form that fosters reuse (e.g. via web services). In regard to other semantic technologies originating from the Artificial Intelligence community, such as planning approaches, no single tool or technique is dominating. Hence an opportunity for future research would be – in line with our observations from the first part of the article – to create a catalog of such tools and techniques describing their use, prospects and limitations in a BPM-related setting.

Finally, in regard to the knowledge representations used, we observe that the majority of approaches use non-standard representation languages and tools. Further, we notice that current approaches rarely use existing bodies of normative and (at least partially) formalized knowledge, such as the Process Classification Framework, the MIT Process Handbook, the Enterprise Ontology, or industry-related Frameworks, such as ITIL and SCOR. In addition, some knowledge representations such as pattern catalogs developed as part of research papers are either not accessible at all or not accessible in a machine processable form. Hence, it would be beneficial for further research and progress within the BPM field to update and curate standardized collections of knowledge and to make them easily available to the research community using standardized languages such as XML or OWL as well as lightweight interfaces for invocation such as web services.

References

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Für Sie gesurft – Neue (und alte) Tipps aus dem WWW

EMISA-Edition, Folge 32

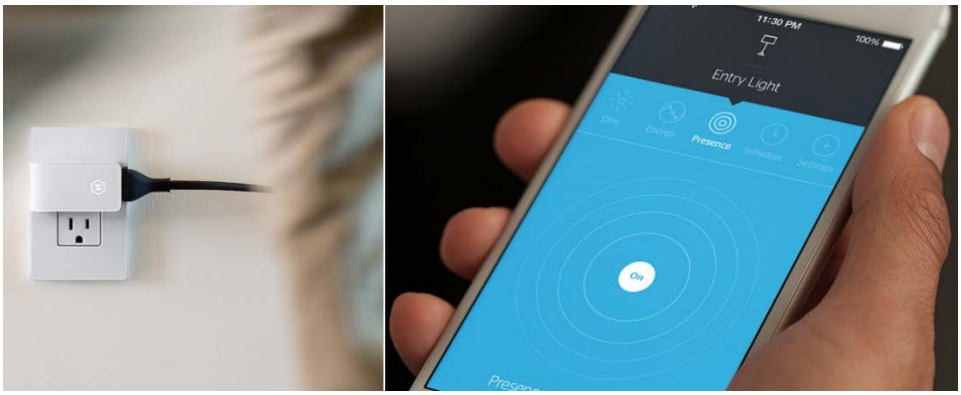
Gottfried Vossen, Universität Münster

Heute präsentiere ich Ihnen die 32. Folge dieser Kolumne. Wie immer stelle ich Ihnen Websites, Apps und Dienste vor, die mir (und anderen) in letzter Zeit aufgefallen sind. Einen ersten Schwerpunkt bildet diesmal das Thema Smart Homes. Dieses Thema nimmt ja inzwischen (wieder – nach mehrjähriger Pause) Fahrt auf, denn mittlerweile kann sich die Bedienung von Haustechnik weitgehend auf mobile Geräte wie Smartphones oder Tablets abstützen. Drahtlose Netze hoher Bandbreite sind auch in Privathäusern nahezu eine Selbstverständlichkeit, und die moderne Technik liefert gleich noch Alternativen wie Bluetooth Smart sowie Indoor-Navigation dazu. Damit wird es jetzt möglich und erschwinglich, die vielen bisher bereits angedachten Szenarien der Steuerung, Überwachung und Optimierung eines intelligenten Hauses zu realisieren. Ferner nimmt die Zahl innovativer Produkte für das intelligente Haus rapide zu; eines davon ist die Simplicam, die vor einigen Monaten in The Next Web vorgestellt wurde:

http://thenextweb.com/gadgets/2015/03/03/simplicams-home-monitoring-software-now-lets-you-customize-motion-and-face-detection-in-parts-of-the-room/

http://www.simplicam.com/

Ein anderes solches Produkt ist Smartplug von Zuli: „Zuli Smartplugs can make every room in your home feel just the way you like it. All the things that contribute to your idea of perfect comfort — lighting, temperature, and more — respond to your every move. Open the door to a personal oasis that follows you with every step." Und damit nicht genug: "When your home has Zuli Presence, any room with a Zuli Smartplug will know when you're there and instantly adapt to your personal lighting and temperature preferences — then everything turns off when you walk away."

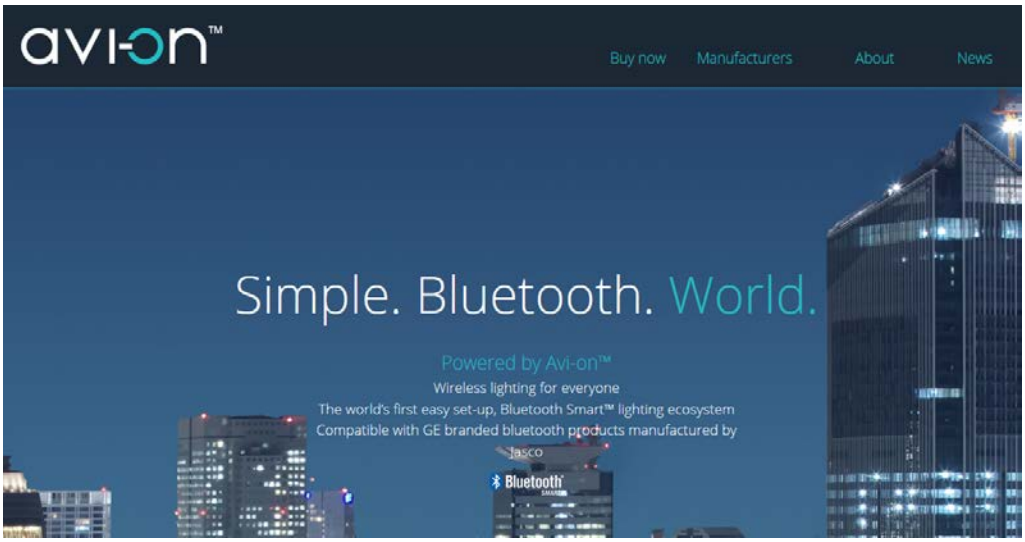


http://www.zuli.io/

Unternehmen wie Z-Wave liefern dazu die nötige Verbindungstechnik: „Z-Wave puts the power of home control and monitoring in the palm of your hand… literally. With your smart phone, tablet or PC you can control and access your Z-Wave devices at home. This means you get peace of mind knowing your home is secure — no matter where you are, more money in your pocket by saving energy easily — with no sacrifice, convenience like you've never known — one button to "shut down" your home when you leave, security knowing you'll receive an alert if there is any trouble at home — water, fire, alarm, door/window sensors. Z-Wave is a wireless technology that makes regular household products, like lights, door locks and thermostats "smart". Z-Wave products "talk" to each other wirelessly and securely and can be accessed and controlled on your phone, tablet or pc. By using a Z-Wave gateway you can connect to the things inside your house whether you're at home or while you're away. Currently there are nearly 1000 different Z-Wave products that all work together so you can choose the products that are right for your home.” Mehr dazu unter http://www.z-wave.com/.

Eine Alternative bietet Avi-On auf der Basis von Bluetooth Smart: „Avi-on’s Simple Bluetooth Home is the world’s first wireless lighting ecosystem for global markets. Through its own innovative products and partnerships with major brands, Avi on is changing the way the world wires and controls spaces.Avi-on’s proprietary app-cloud-firmware technology extends the functionality of Bluetooth Smart™ and CSR™mesh architecture, delivering wired performance without wires. Avi-on’s integrated platform enables major manufacturers to bring beautiful connected products to market in less than six months. The Avi-on platform is powering a complete line of GE branded Bluetooth Smart products, manufactured by Jasco Products, coming to market in Summer 2015.”

Es fehlt dann noch ein Sprachstandard, über den sich alle Geräte in einem Smart Home verständigen können, denn ohne einen solchen wird es höchstens ein Sprachenwirrwarr geben. Einer der aktuell diskutierten Standards ist Zigbee: „ZigBee is the only open, global wireless standard to provide the foundation for the Internet of Things by enabling simple and smart objects to work together, improving comfort and efficiency in everyday life. The ZigBee Alliance is an open, non-profit association of approximately 400 members driving development of innovative, reliable and easy-to-use ZigBee standards. The Alliance promotes worldwide adoption of ZigBee as the leading wirelessly networked, sensing and control standard for use in consumer, commercial and industrial areas.”



http://avi-on.com/

Der ZigBee-Standard hat bereits Version 3 erreicht, versteht sich selbst als eine Grundlage für das Internet der Dinge und wird derzeit von den der Allianz angeschlossenen Firmen getestet: “ZigBee 3.0 is the unification of the Alliance’s market-leading wireless standards into a single standard. This standard will provide seamless interoperability among the widest range of smart devices and give consumers and businesses access to innovative products and services that will work together seamlessly to enhance everyday life. ZigBee 3.0 is currently undergoing testing. Many Alliance members, including Atmel, Freescale, The Kroger Co., Legrand, NXP, Philips, Schneider Electric, Silicon Labs, Texas Instruments, Wincor Nixdorf, and V-Mark have been actively involved in the development and testing process. It is expected to be ratified in Q4 2015.”

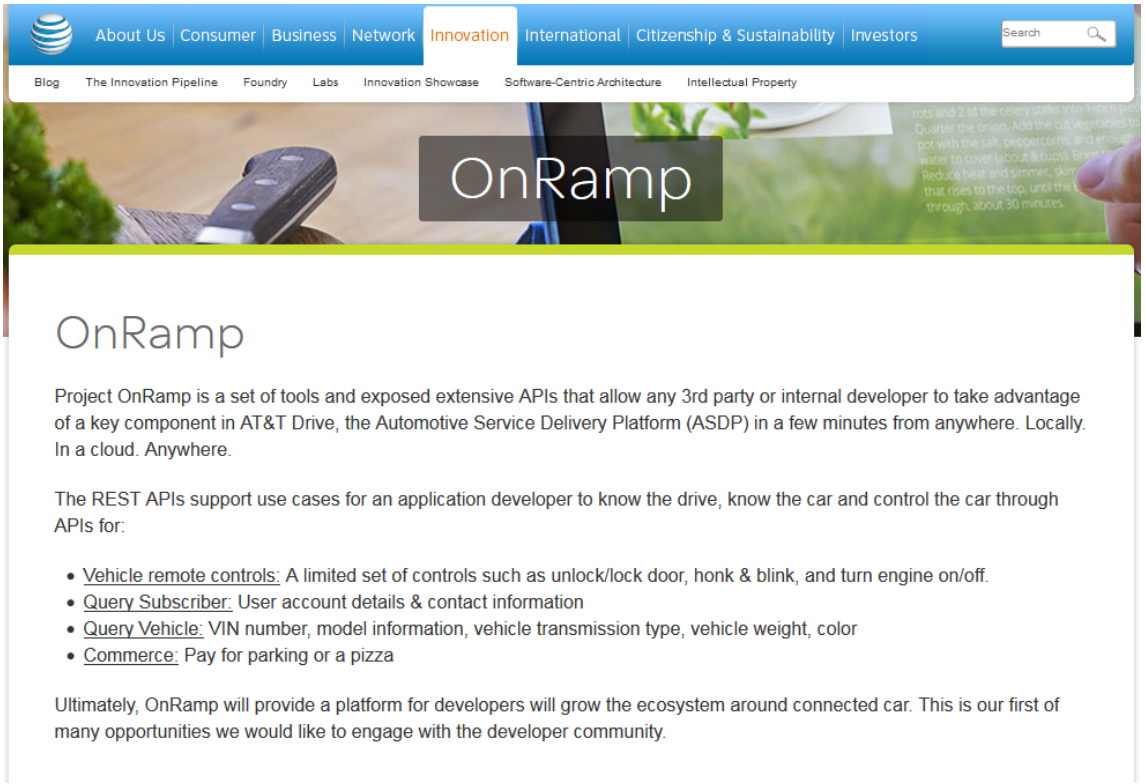
http://www.zigbee.org/

Immer mehr Entwicklungen beschäftigen sich mit dem Internet der Dinge; da verwundert es nicht, dass sich auch bereits Suchmaschinenhersteller mit diesem Thema befassen; eine solche ist Thingful: “Thingful is a search engine for the Internet of Things, providing a unique geographical index of connected objects around the world, including energy, radiation, weather, and air quality devices as well as seismographs, iBeacons, ships, aircraft and even animal trackers. Thingful’s powerful search capabilities enable people to find devices, datasets and realtime data sources by geolocation across many popular Internet of Things networks, and presents them using a proprietary patent-pending geospatial device data search ranking methodology, ThingRank. If you are concerned about asthma, find out about any air quality monitors in your neighborhood; somebody working with a Raspberry Pi can find others round the corner using the same computing platform; if you notice a ship moored nearby, discover more about it by tracking it on Thingful, or get notified of its movements; a citizen concerned about flooding in a new neighborhood can look up nearby flood monitors or find others that have been measuring radiation. You might even watch the weekly movements of a shark as it explores the oceans. … Thingful also enables people and companies to claim and verify ownership of their things using a provenance mechanism, thereby giving them a single web page that aggregates information from all their connected devices no matter what network they’re on, in categories that include health, environment, home, transport, energy and flora & fauna. Users can also add objects to a Watchlist in order to keep track of them, monitor their realtime status and get notifications when they change.
Some of the well-known Internet of Things services that Thingful currently indexes include Weather Underground, Smart Citizen, the UK Met Office Weather Observations Website, and Netatmo, as well as others like Thingspeak, Air Quality Egg, The International Soil Moisture Network and The Sea Turtle Conservancy.” Das nachfolgende Bild zeigt das Ergebnis (in diesem Fall Messstellen) meiner Suche nach “air quality Berlin”.

https://thingful.net

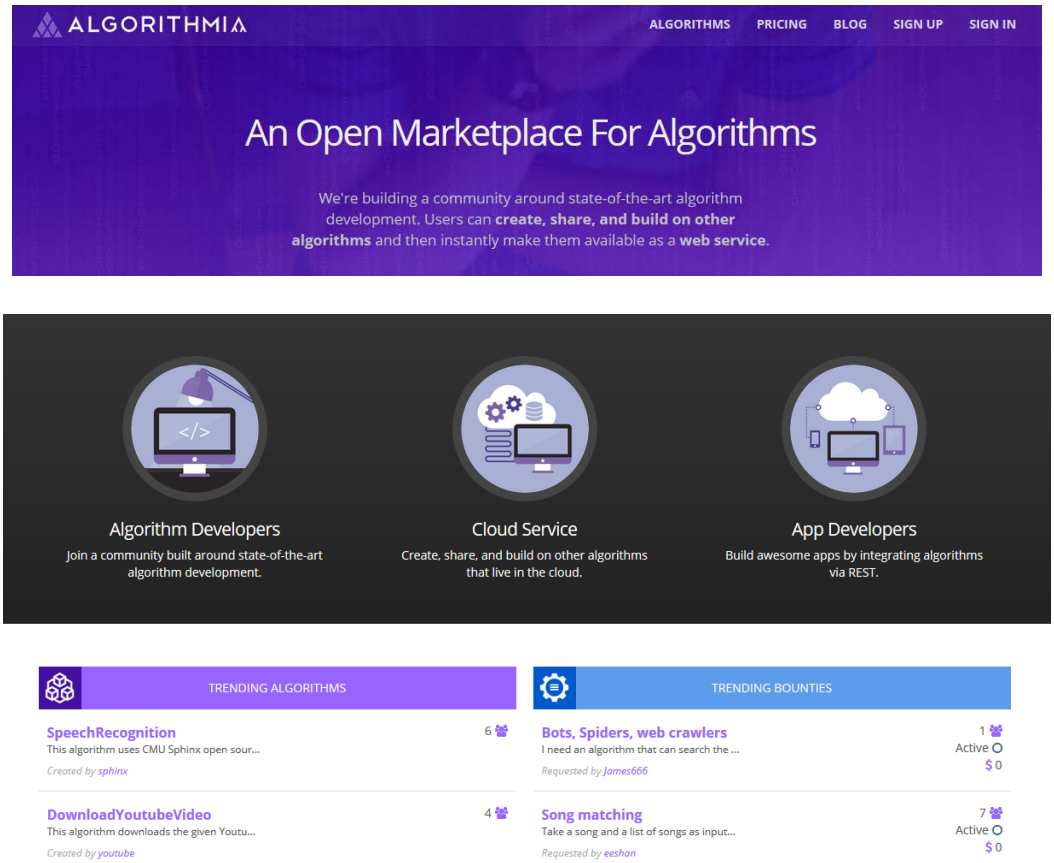
Wir bleiben noch einen Moment beim Internet der Dinge, in dem ja auch Autos vorkommen sollen. Hier hat AT&T eine interessante Entwicklung hervorgebracht: "With Project OnRamp,

users will be able to remotely control their cars. Project OnRamp includes developer tools and APIs for developers to tap AT&T Drive's Automotive Service Delivery Platform (ASDP). Developers could make it possible for users to remotely open car doors, blink lights or turn on the car. An AT&T representative provided an interesting, but scary, possibility of remotely applying the brakes on a car via a cloud-based command that controls an analog circuit in the braking system. But that won't happen anytime soon, as many security and hardware compatibility issues need to be accounted for."



http://about.att.com/innovation/showcase/onramp

Wer sich mit den Algorithmen beschäftigt, auf denen eine Suchmaschine wie Thingful basiert, oder wer andere Algorithmen entwickelt hat, die für Dritte interessant sein könnten, der kann sich jetzt an Algorithmia wenden, einen Marktplatz für Algorithmen. Im Techcrunch war dazu im März 2015 zu lesen: „Algorithmia, the startup that raised $2.4 million last August to connect academics building powerful algorithms and the app developers who could put them to use, just brought its marketplace out of private beta. More than 800 algorithms are available on the marketplace, providing the smarts needed to do various tasks in the fields of machine learning, audio and visual processing, and even computer vision. Algorithm developers can host their work on the site and charge a fee per-use to developers who integrate the algorithm into their own work. The platform encourages further additions to its library through a bounty system, which lets users request algorithms that researchers familiar with the field can contribute from their work or develop from scratch for a fee. To demonstrate the platform's algorithm hosting tools, the Algorithmia team built a simple app using seven user-contributed algorithms that visualizes what a crawler does as it works through links to build the structure of a site."

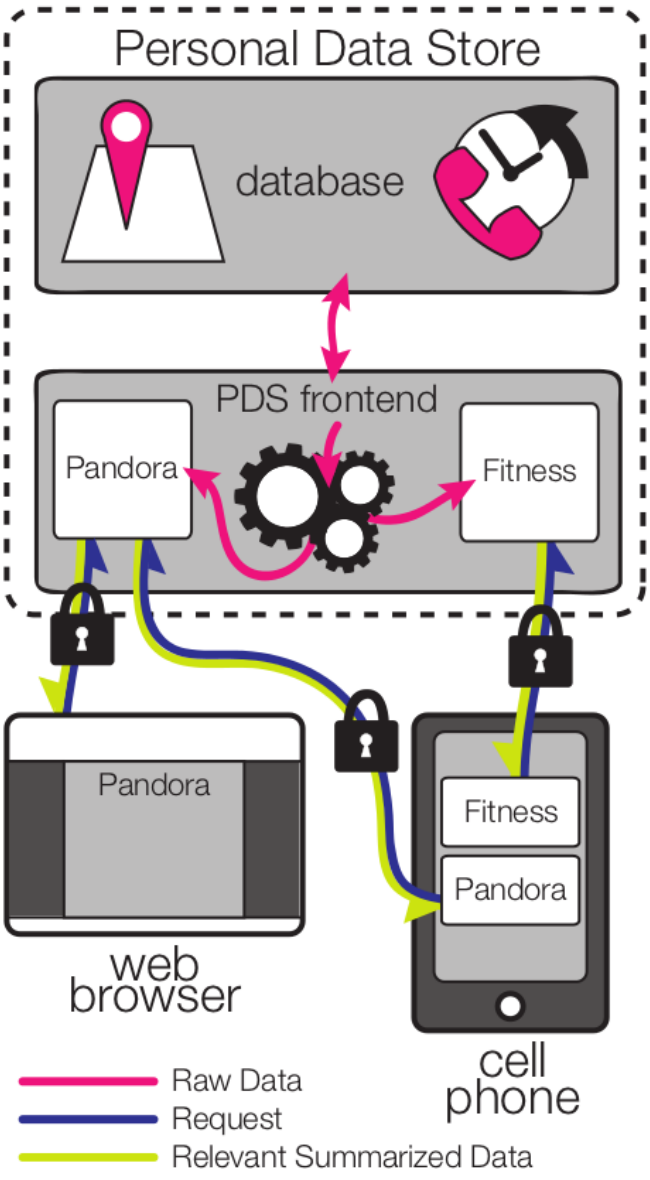


https://algorithmia.com/

Mein nächster Tipp richtet sich an diejenigen, die sich mit Big Data (oder Data Science in irgendeiner Form) auseinandersetzen müssen oder wollen. Leada ist ein Anbieter von Online-Kursen in diesem Bereich: „Leada's online courses teach you specific applicable skills in the following domains: Machine Learning, Statistical Analysis, Data Engineering. Our courses combine self-paced learning and instructor support when you get stuck. The course is structured so you have 2 weeks to complete the lesson content and 2 weeks to complete the project. For only $149, you receive lifetime access to the course and 4 weeks of instructor support.” Die Gründer der Plattform haben offensichtlich einschlägige Erfahrung, und sie arbeiten mit Externen zusammen, für die das ebenfalls gilt. Das Angebot könnte eine Marktlücke getroffen haben.

https://www.teamleada.com/

Vom MIT Media Lab stammt eine (weitere) Antwort auf die Frage, wie sich Privatheit von Daten bewerkstelligen lässt: „openPDS/SafeAnswers allows users to collect, store, and give fine-grained access to their data all while protecting their privacy. With the rise of smartphones and their built-in sensors as well as web-apps, an increasing amount of personal data is being silently collected. Personal data–digital information about users' location, calls, web-searches, and preferences–is undoubtedly the oil of the new economy. However, the lack of access to the data makes it very hard if not impossible for an individual to understand and manage the risks associated with the collected data. Therefore, advancements in using and mining this data have to evolve in parallel with considerations about ownership and privacy. Many of the initial and critical steps towards individuals data ownership are technological. Given the huge number of data sources that a user interacts with on a daily basis, interoperability is not enough. Rather, the user needs to actually own a secured space, a Personal Data Store (PDS) acting as a centralized location where his data live. Owning a PDS would allow the user to view and reason about the data collected. The user can then truly control the flow of data and manage fine-grained authorizations for accessing his data. … SafeAnswers uses two separate layers for aggregating the user's data: (1) sensitive data processing takes place within the user's PDS allowing the dimensionality of the data to be safely reduced on a per-need basis; (2) data can be anonymously aggregated across users without the need to share sensitive data with an intermediate entity through a privacy-preserving group computation method. With SafeAnswers generic computations on user data are performed in the safe environment of the PDS, under the control of the user: the user does not have to hand data over to receive a service. Only the answers, summarized data, necessary to the app leaves the boundaries of the user's PDS. Rather than exporting raw accelerometer or GPS data, it could be sufficient for an app to know if you're active or which general geographic zone you are currently in. Instead of sending raw accelerometers readings or GPS coordinates to the app owner's server to process, that computation can be done inside the user's PDS by the corresponding Q&A module." Weitere Details unter http://openpds.media.mit.edu/.

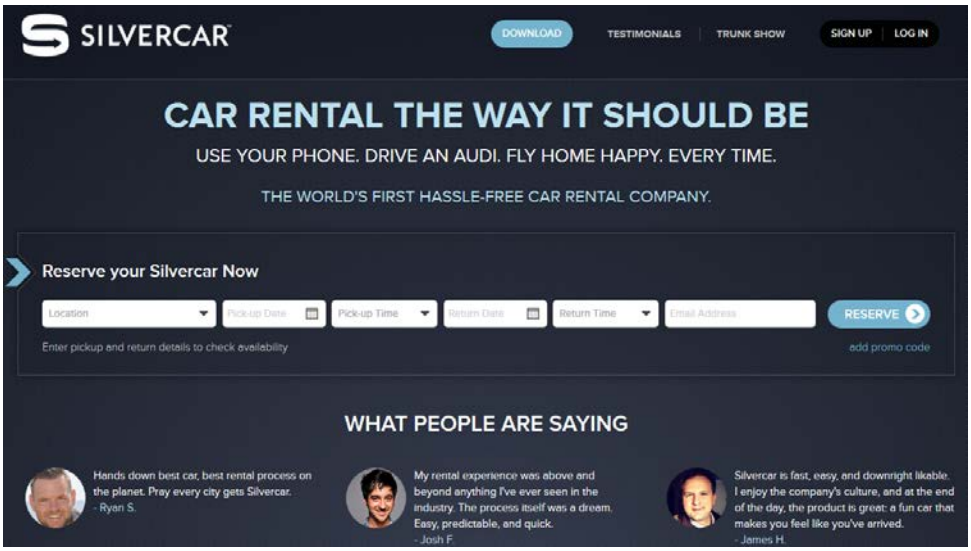


http://www.spliddit.org/

Wer hatte dieses Problem noch nicht: “One of you gets the biggest room. Another gets the view. But the unlucky one gets the tiny room that looks out into the stairwell. So how do you split the rent? Spliddit (with "carefully designed fair division methods"), is an algorithm that assigns rooms and then dictates a price for each room. You can also use it to split assets after a break-up, or share credit on a research paper.” Entwickelt an der Carnegie-Mellon University steht hier ein Algorithmus z. B. für das Aufteilen der Miete in WGs zur Verfügung, der alle Beteiligten zufrieden stellt und dessen Ergebnis nicht verbesserbar ist, ohne die zuvor genannte Eigenschaft zu verletzen. „We assume that the benefit a participant derives from getting a room she values at x for rent y is x minus y. We first match the participants to rooms in a way that maximizes the sum of values participants derive from their assigned rooms. We then compute prices for the rooms that minimize the maximum difference between the benefit derived by any two players (this is the objective function), subject to envy-freeness, by solving a linear program via CPLEX. Envy-free prices are guaranteed to exist, and, moreover, the overall allocation of rooms and rent is guaranteed to be optimal in terms of the above objective function among all envy-free allocations. Envy-freeness also implies efficiency and individual rationality.”

Zum Schluss noch ein Hinweis für diejenigen von uns, die schon mal in den USA einen Mietwagen benötigen: „Car rental, at least at the airport, hasn’t really changed in a long time. Texas-based Silvercar is looking to change all that. The company just launched in Chicago, and to date has grown from two airports in Texas to nearly 10 in the past two years. The service uses a fleet of their own Audi A4 vehicles and an application platform to make sure that you always have a ride. See, Silvercar isn’t necessarily interested in reducing the cost of a car by all that much. Instead, the company focuses on ensuring a high-quality experience — users can specify in the app when they land and Silvercar valets pick them up

curbside — as well as a luxury car in the form of the A4. When you rent from a traditional car rental vendor, you usually have to choose to upgrade to a Nav system or a connected audio system, and the list goes on and on. All of Silvercar's A4s come pre-loaded with all the goodies, and are rented at a flat price. So while the Silvercar price isn't originally as low as the cheapest car on a regular rental lot, you're likely saving when you choose Silvercar over a comparable option at a traditional rental place, according to the Silvercar founders. The company is currently toying with the idea of opening up Silvercar beyond the airport use-case, offering a fleet of A4s at various pick-up locations, not unlike Zipcar. Silvercar is also working on integrating corporate accounts onto the platform, which is currently done manually on the back-end." (Quelle: http://techcrunch.com vom 12.6.2015)

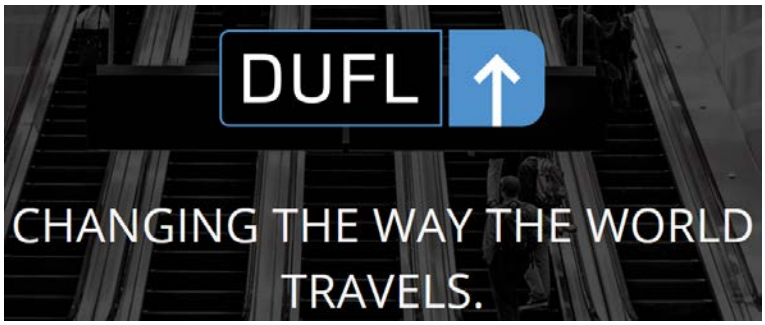


https://www.silvercar.com

Und wer noch mehr Komfort beim Reisen wünscht, dem kann ich Dufl empfehlen: „The absolute worst part of traveling, whether it's for business or for pleasure, is packing and unpacking a suitcase. The work it takes to pack a bag is negligible, but having a clean inventory of clothes each time you pack takes far more planning. Dufl is looking to change all that. The idea behind Dufl is that frequent travelers waste a lot of time trying to clean and prep their clothes for each trip, especially when those trips are pretty much back-to-back. With Dufl, the user never has to pack a bag or clean their travel clothes ever again.

Here's how it works: An interested user downloads the Dufl app and signs up. Soon after, a Dufl-branded suitcase will appear at that user's door, ready and waiting to be filled with the clothes that user most commonly travels in. Dufl then picks up the bag through its partner FedEx, takes inventory of all the clothes in your suitcase and takes professional photographs, and repacks the bag with the precision of a Four Seasons housekeeper. Now that the virtual closet is set up, users have the option to book a trip. They simply tell Dufl where they're going, which hotel they're staying at, and virtually pack through the app, choosing the clothes they'd like to have with them on this trip. Dufl ensures that the user's suitcase beats him or her to the hotel, and when the trip is over, Dufl has FedEx pick up the used luggage and take it back to Dufl's central storage location. Dufl washes or dry cleans the clothes, puts them back in your virtual closet, and you arrive home with no laundry to do or even a bag to drag along behind you. Storage in the virtual closet costs users $10/month,

and each trip costs a flat fee of $100, which includes shipping to and from your destination, as well as cleaning and folding the clothes. Dufl says that users can swap out clothes from their virtual closet at any time at no cost, and that Dufl can even overnight items you asked for the night before, thanks to that FedEx partnership. After all, you won't arrive home in the same outfit you wore on the plane, so the Dufl closet is always organically swapping in one outfit for the next."



http://www.dufl.com/

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Business Process Architectures: Concepts, Formalism, and Analysis (Extended Abstract)*

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Business Process Management has become an integral part of modern organizations in the private and public sector for improving their operations. In the course of Business Process Management efforts, companies and organizations assemble large process model repositories with many hundreds and thousands of business process models bearing a large amount of information. With the advent of large business process model collections, new challenges arise as structuring and managing a large amount of process models, their maintenance, and their quality assurance.

This is covered by business process architectures (BPAs) that have been introduced for organizing and structuring business process model collections. A variety of BPA approaches have been proposed that align business processes along aspects of interest, e.g., goals, functions, or objects. They provide a high level categorization of single processes ignoring their interdependencies, thus hiding valuable information. The production of goods or the delivery of services are often realized by a complex system of interdependent business processes. Hence, taking a holistic view at business processes interdependencies becomes a major necessity to organize, analyze, and assess the impact of their re-/design. Visualizing business processes interdependencies reveals hidden and implicit information from a process model collection.

In this thesis, we present a novel business process architecture approach for representing and analyzing business process interdependencies on an abstract level. We propose a formal definition of our business process architecture approach, design correctness criteria, and develop analysis techniques for assessing their quality. We describe a methodology for applying our BPA approach top-down and bottom-up. This includes techniques for BPA extraction from, and decomposition to process models while considering consistency issues between business process architecture and process model level. Using our extraction algorithm, we present a novel technique to identify and visualize data interdependencies in business process data architectures. Our business process architecture approach provides business process experts, managers, and other users of a process model collection with an overview that allows reasoning about a large set of process models, understanding, and analyzing their interdependencies in a facilitated way. In this regard, we evaluated our BPA approach in an experiment and provide implementations of selected techniques.

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Automatic Detection and Resolution of Lexical Ambiguity in Process Models (Extended Abstract)[1]

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Process models are often used to support the specification of requirements of information systems. In this context, it is essential that these models do not contain structural or terminological inconsistencies. To this end, several automatic analysis techniques have been proposed to support quality assurance. While formal properties of control flow can be checked in an automated fashion, there is a lack of techniques addressing textual quality. More specifically, there is currently no technique available for handling the issue of lexical ambiguity caused by homonyms and synonyms. The referenced article addresses this research gap by proposing techniques to detect and resolve lexical ambiguities in process models.

The detection technique uses semantic vectors that represent the possible meanings of a term in the context of a process model. Furthermore, the paper introduces necessary and sufficient conditions that facilitate the automatic identification of truly ambiguous homonyms and synonyms. The proposed resolution techniques employs different strategies based on semantic relations that suggest alternative terms for replacement. Both techniques use the lexical database BabelNet, which provides a rich knowledge base of possible word senses and semantic relations between them.

These techniques have been evaluated by using three process model collections from practice varying in size, domain, and degree of standardization. In particular, the performance of the detection technique was evaluated by conducting an extensive experiment. The experiment involved six native English speakers who provided their interpretation of a term in a given model. The performance of the resolution technique has been assessed by quantifying the degree of ambiguity and comparing it before and after applying the resolution strategies to the test collections. The evaluation with the English native speakers illustrates that the detection technique identifies a significant number of homonyms and synonyms within the test collections. Moreover, the introduced metrics highlighted the positive effect of the resolution approach, which has lead to a significant reduction of ambiguity.

[1] The original article is published as Fabian Pittke, Henrik Leopold, Jan Mendling: Automatic Detection and Resolution of Lexical Ambiguity in Process Models. IEEE Transactions on Software Engineering 41(6): 526–544 (2015).