Workflow Management and Generalization Services

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Outline

• Introduction
• Workflow theory
  – Definition workflow (Petri nets)
  – Workflow patterns
• Requirements
• Realization
  – System Architecture
• Example
• Conclusions – Outlook
Introduction

- Application oriented research project (KTI)
- Industry partner – Axes Systems AG develops software for map production
- Aim of the project – integration of generalization services in a productive environment
Introduction

• Advantages of generalization services
  – Independence from platform and production line (map production system)
  – Hierarchical structuring – n-tier distribution; services can be used by higher level services (hls) and these (hls) can themselves use the functionality of others
  – Component architecture – components encapsulating a set of functionalities; interact with other components (emerges from object-oriented technology)

• Objective: process orchestration

  How to access, chain and control the generalization services?
Introduction

Requirements for process orchestration:

1. Incorporation of cartographers – Fully automated solutions not available for a production environment at the moment
2. Software tools needed for the chaining and orchestration of generalization services
3. Scalability for productive environments

Solution: Utilization of a workflow management system
Workflow Management Systems

• Mainly used in the context of *business* processes
  – assignment of tasks to persons
  – automation of processes is usually not supported
  – ensures the order of tasks to a given a flow

• Underlying theory of workflows origins from computer science

• Workflows are modeled by specific graph structures called Petri nets

• For our purpose a simplified model of Petri nets can be utilized
Theory

Definition Workflows

Workflow definition based on Petri nets

\[ W := (S, T, F) \]

\( W \) workflow

- \( S \) places
- \( T \) transitions
- \( F \) flow relations

\[ F \subseteq (S \times T) \cup (T \times S) \]
Theory
Definition Workflows

Workflow definition based on Petri nets

\[ W := (S, T, F) \]

\( W \) workflow

- \( S \) places \( \leftrightarrow \) data
- \( T \) transitions \( \leftrightarrow \) tasks (services) to execute
- \( F \) flow relations \( \leftrightarrow \) order of flow

\[ F \subseteq (S \times T) \cup (T \times S) \]
Theory
Workflow Patterns

exclusive choice
choose one flow path

multiple choice
choose several flow path

split
execute flows concurrently

simple merge
merge (one) alternative flows

synchronize merge
merge (many) alternative flows

synchronize
synchronize concurrent flows

loops: While- and For-Loop
(simple) merge – (exclusive) choice – *inner loop* – jump

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Requirements of a Workflow Management System

• Workflow construction (workflow editor)
  – graphical user interface to construct workflows
  – applicable for users without programming knowledge
• Data management
  – data flow (output of one service must fit to input of next service)
  – service interfaces
• Process management (workflow engine)
  – controlling executions of workflows
• Service management
  – application service providing
  – distribution of services
• User management
  – access rights and security
YAWL

Open source workflow management system
• Supports/offers:
  – patterns (loops can be constructed)
  – variables (assignment – XPath-Expressions)
  – call of web services via WSDL and SOAP

YAWL (Yet Another Workflow Language)
Queensland University of Technology, Australia
http://www.yawl-system.com/
YAWL

Open source workflow management system

- Supports/offers:
  - patterns (loops can be constructed)
  - variables (assignment – XPath-Expressions)
  - call of web services via WSDL and SOAP

- Workflow editor
  - allows graphical construction of workflows

- Workflow engine
  - allows (user interactive) execution of workflows
YAWL

- Workflow construction (workflow editor)
  - applicable for users without programming knowledge
  - graphical user interface to construct workflows
YAWL

- Workflow construction (workflow editor)
  - applicable for users without programming knowledge
  - graphical user interface to construct workflows – extension through a graphical data flow
YAWL

- Workflow construction (workflow editor)
  - applicable for users without programming knowledge
  - graphical user interface to construct workflows — extension through a graphical data flow
- Data management
  - data flow (output of one service must fit to input of next service)
  - primitive data types (integer, boolean, ...) — extension through generic data types (geo-features, constraints, ...)
  - service interfaces — adapted to call generalization web services
- Process management (workflow engine)
  - controlling executions of workflows
- Service management
- User management
Implementation
System Architecture

axpand

axpand-Core
offers
generalisation
functions

Generalisation Server

Workflow Engine

GUI

Workflow Editor

Registry Server
list of services &
workflows

(exTERNAL) Registry Server

external Application

external Generalisation Server

components of one workstation
– arbitrary instances per intranet

Registry Server and workflow storage
– one instance per intranet
# Comparison

<table>
<thead>
<tr>
<th>Workflow management system</th>
<th>Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aim</td>
<td>Interactive processing</td>
</tr>
<tr>
<td>Methodology</td>
<td>Service based</td>
</tr>
<tr>
<td>Consideration of hierarchies</td>
<td>Structures of workflows and sub-workflows</td>
</tr>
</tbody>
</table>

Workflow management systems can be used as a framework for generalization processing.
Building Generalization
Example

Trans-hydro-graph Building Partitioning while more partitions

pre-processing generalization loop

Process Building Partitions

Select a number of net elements to manipulate.
Example
Example
Example

Trans-hydro-graph Building Partitioning

while more partitions

Process Building Partitions

select building

Partition Building

Selection Road River Railway

Operation Graph

Select a number of net elements to manipulate.
Example

Building Generalisation

1. Trans-hydro-graph Building Partitioning
2. while more partitions
3. Process Building Partitions

Selection Road River Railway

1. select building
2. Operation Graph
3. Partition Building

Select a number of net elements to manipulate.
Example
Example
Example
Example
Example
Example

intr-resolution relations

inter-resolution relations
Example

Session H – Representation & Analysis
Tuesday 10:30 AM—NOON
Multi-Representation Databases with Explicitly Modelled Intra-Resolution, Inter-Resolution and Update Relations
Matthias Bobzien, Dirk Burghardt, Ingo Petzold, Moritz Neun, Robert Weibel

intra-resolution relations

inter-resolution relations
Conclusions – Outlook

• Workflow management systems are a suitable tool for orchestration and chaining of generalization services
• Ongoing implementation bases on YAWL an open source workflow management system
• Usage of workflow patterns allows complex modeling – more than simple sequences
• Example of building generalization illustrates the potential of workflows
• Further Research has to deal with the integration of relationships
Thanks for your attention!

Any Questions?

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