BIMLOQ
Business Models Optimization for Quality

Antoni Ligęza, Grzegorz J. Nalepa,
Krzysztof Kluza, Krzysztof Kaczor, Szymon Bobek,
Weronika T. Adrian, Łukasz Łysik

Department of Automatics
AGH University of Science and Technology, POLAND

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http://www.geist.agh.edu.pl

Outline

BIMLOQ

2010 → 2012

MNiSW Grant N516 422338 *Business Models Optimization for Quality*

GEIST

Group for Engineering of Intelligent Systems and Technologies

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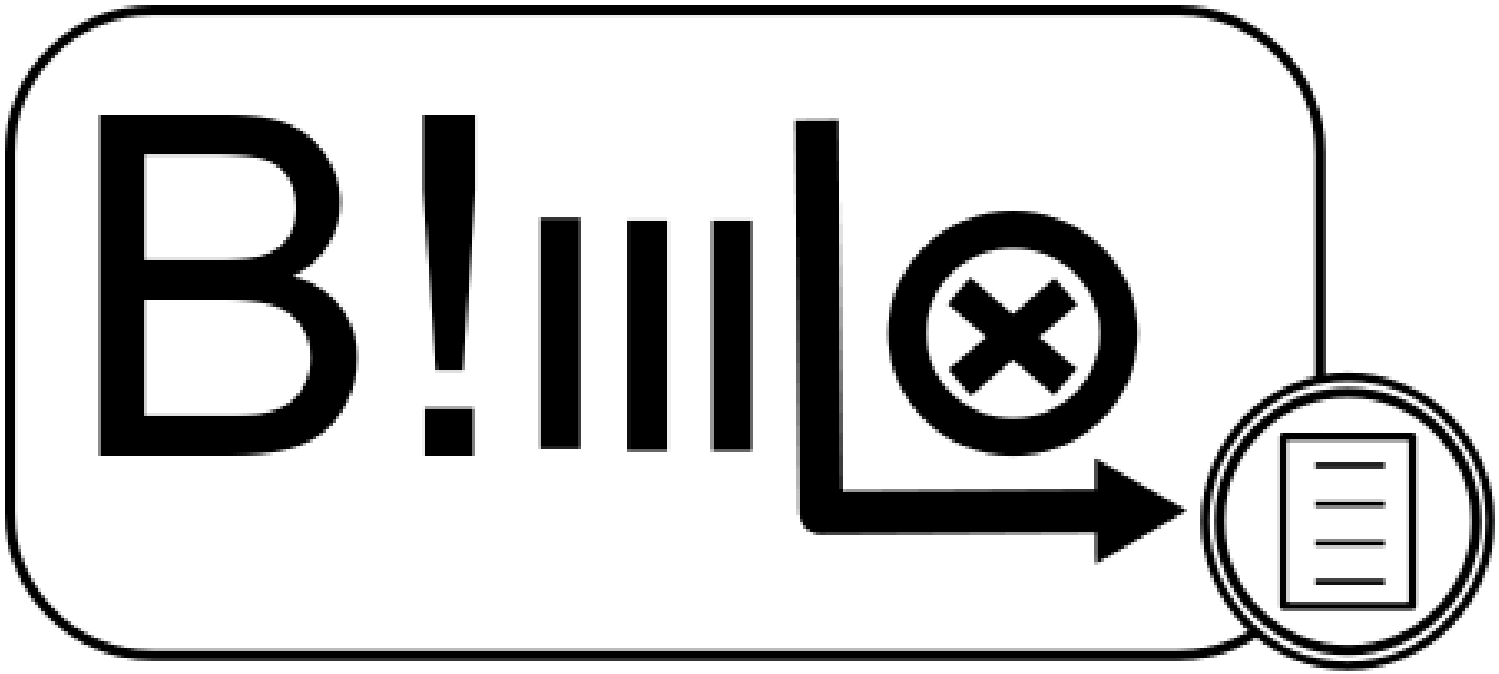
Outline

BIMLOQ



Business Models Optimization for Quality

Integration scope

Motivation

Aspects of the visual/logical gap in Business Process Management

- **Semantic**:
  - lack of a common ontology
  - lack of unified semantics
  - difficult unambiguous logical representation
  - lack of clear declarative model specification suitable for logical analysis
- **Functional**:
  goals and tasks in the Business Logic layer cannot be mapped to logical quality assessment methods
- **Technical**:
  technologies used in the visual design layer are incompatible with the declarative logical representation

BIMLOQ Overview

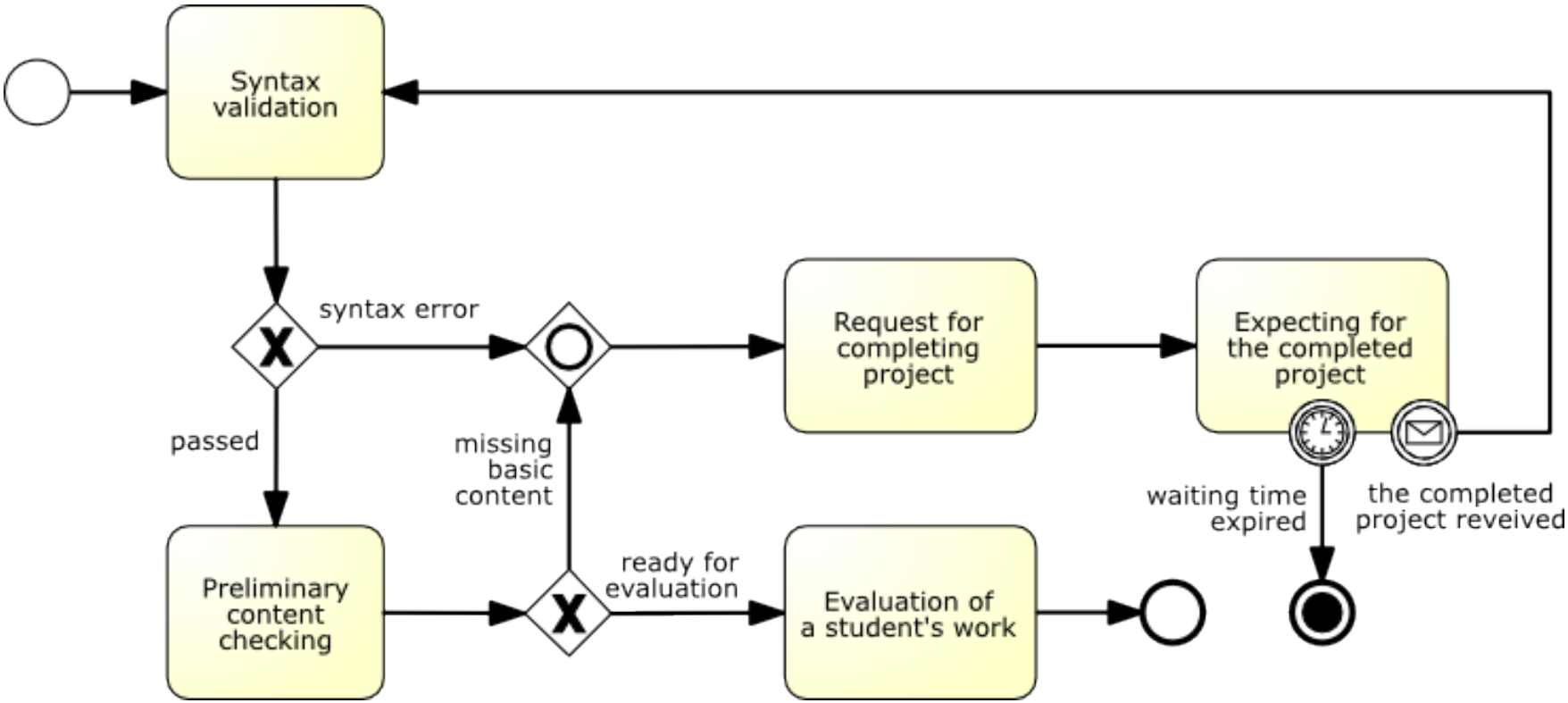
Objectives

- Development of a declarative logical model for Business Processes
- Integration of Business Processes with Business Rules
- Quality characteristics for Business Processes
- Analysis and optimization of Business Processes for safety, reliability and quality assurance

Technologies

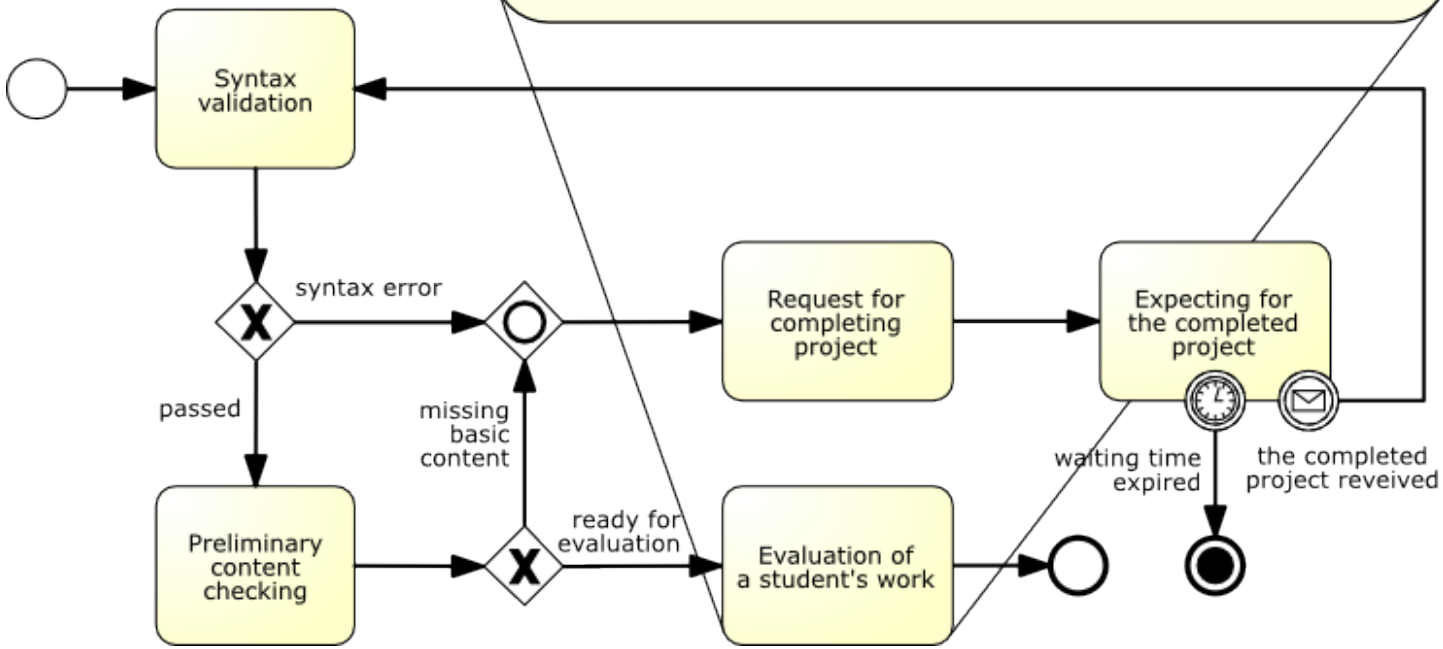
- **Modeling**: BPMN modeling tools
- **Analysis**: Verification tools, such as ProM, YAWL, Petri nets, etc.
- **Runtime**: HeaRT (HeKatE Runtime Environment)

An example of a BPMN model



An example of a BPMN model with rules

implemented functionality	quality	grade
any	low	satisfactory (D)
basic	high	good (C)
advanced	fair	very good (B)
	high	excelent (A)



3 approaches to Business Processes

Modeling

Integration of the HeKatE tools with a selected BPMN tools

Analysis

2 levels are considered

- local verification (for BPMN elements as well as rule tables in BPMN tasks)
- global verification (for BPMN models)

Runtime

Application of the HeaRT rule engine for executing selected BPMN models

BIMLOQ Output

Expected Benefits

- Instant Business Process quality assessment during development
- Maintainability assurance
- Formal analysis of Business Processes
- High adaptability in dynamic environments

Intended Results

- **Conceptual**: declarative model specification for logical Business Process representation and analysis
- **Practical**: new tools for analysis and optimization of specification quality, integration of visual BPMN tools and logical knowledge processing
- **Evaluative**: modeling and analysis of real-life application use cases

Business Process modeling notations

Business Process Notations

- BPMN (Business Process Modeling Notation) – `http://www.bpmn.org/`
- EPC (Event-Driven Process Chain)
- UML (Unified Modeling Language) – `http://www.uml.org`
- IDEF0 – `http://www.idef.com/`
- Petri Nets – `http://www.informatik.uni-hamburg.de/TGI/PetriNets/`

Business Process execution languages

Executable languages

- BPEL (Business Process Execution Language) – `http://bpel.xml.org/specifications`
- XPDL (XML Process Definition Language) – `http://www.wfmc.org/xpdl.html`
- BPDM (Business Process Definition Metamodel) – `http://www.omg.org/spec/BPDM/`
- YAWL (Yet Another Workflow Language) – `http://www.yawlfoundation.org/`
- jPDL (jBPM Process Definition Language) – `http://docs.jboss.org/jbpm/v3/userguide/jpdl.html`

Business Process engines

Workflow Engines

- ProM (Process mining toolkit) – http://prom.win.tue.nl/tools/prom
- Apache ODE (Orchestration Director Engine) – http://ode.apache.org/
- YAWL (Yet Another Workflow Language) – http://www.yawlfoundation.org/
- Documentum – http://www.emc.com/domains/documentum
- Bonita Open Solution – http://www.bonitasoft.com/
- Java Workflow Tooling – http://www.eclipse.org/jwt/
- Flow Mind – http://www.flowmind.org/
- jBPM – http://www.jboss.org/jbpm
- IBM Filenet P8 – http://www-01.ibm.com/software/data/content-management/filenet-p8-platform/

HeKatE software resources

Tools developed under the HeKatE research project:

Modeling

- HQEd (HeKatE Qt Editor) for XTT2

Analysis

- HeaRT (HeKatE RunTime)
- HalVA (HeKatE Verification and Analysis)

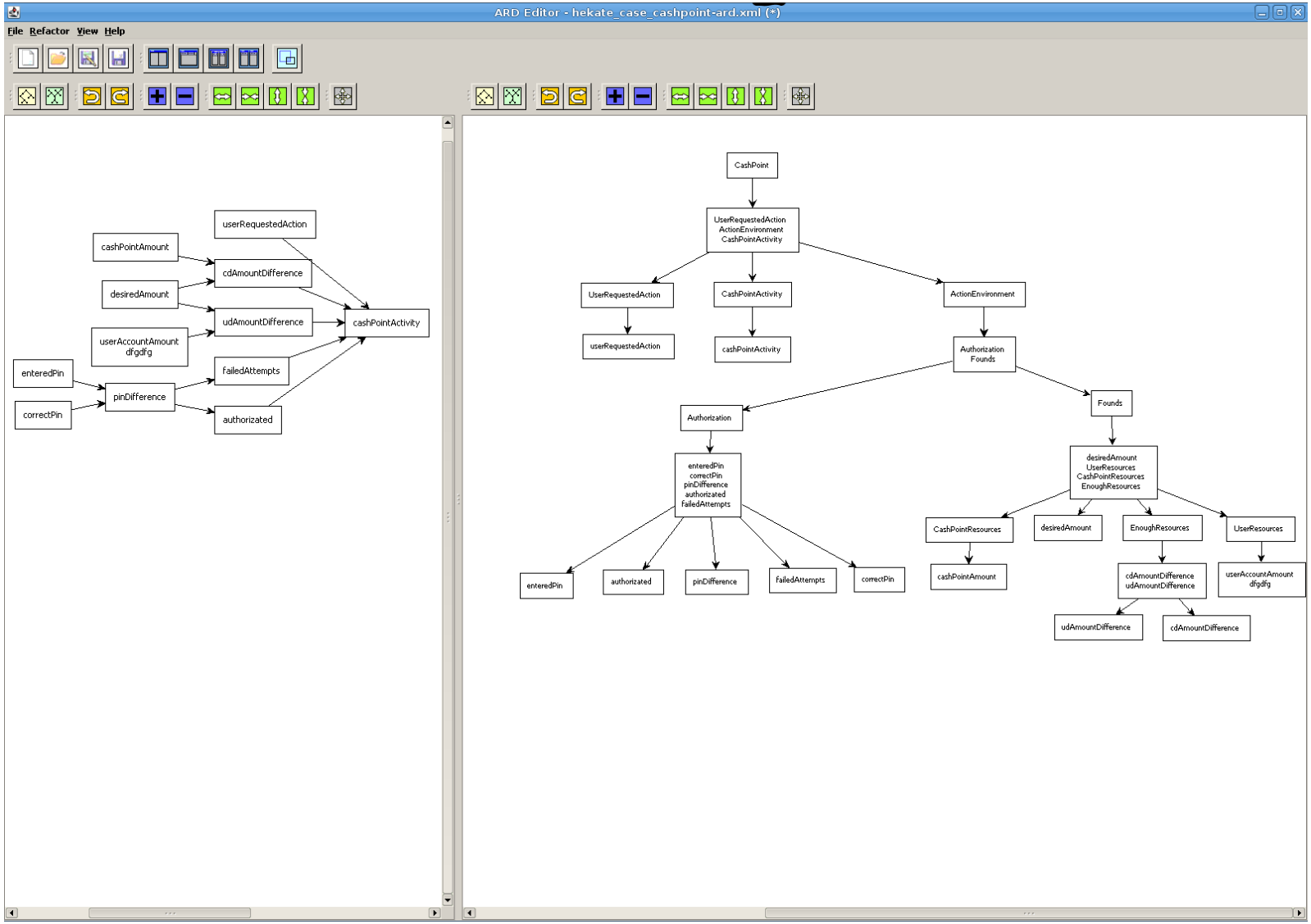
Runtime

- HeaRT (HeKatE RunTime)
- DEPfH (Drools Export Plugin for HQEd)

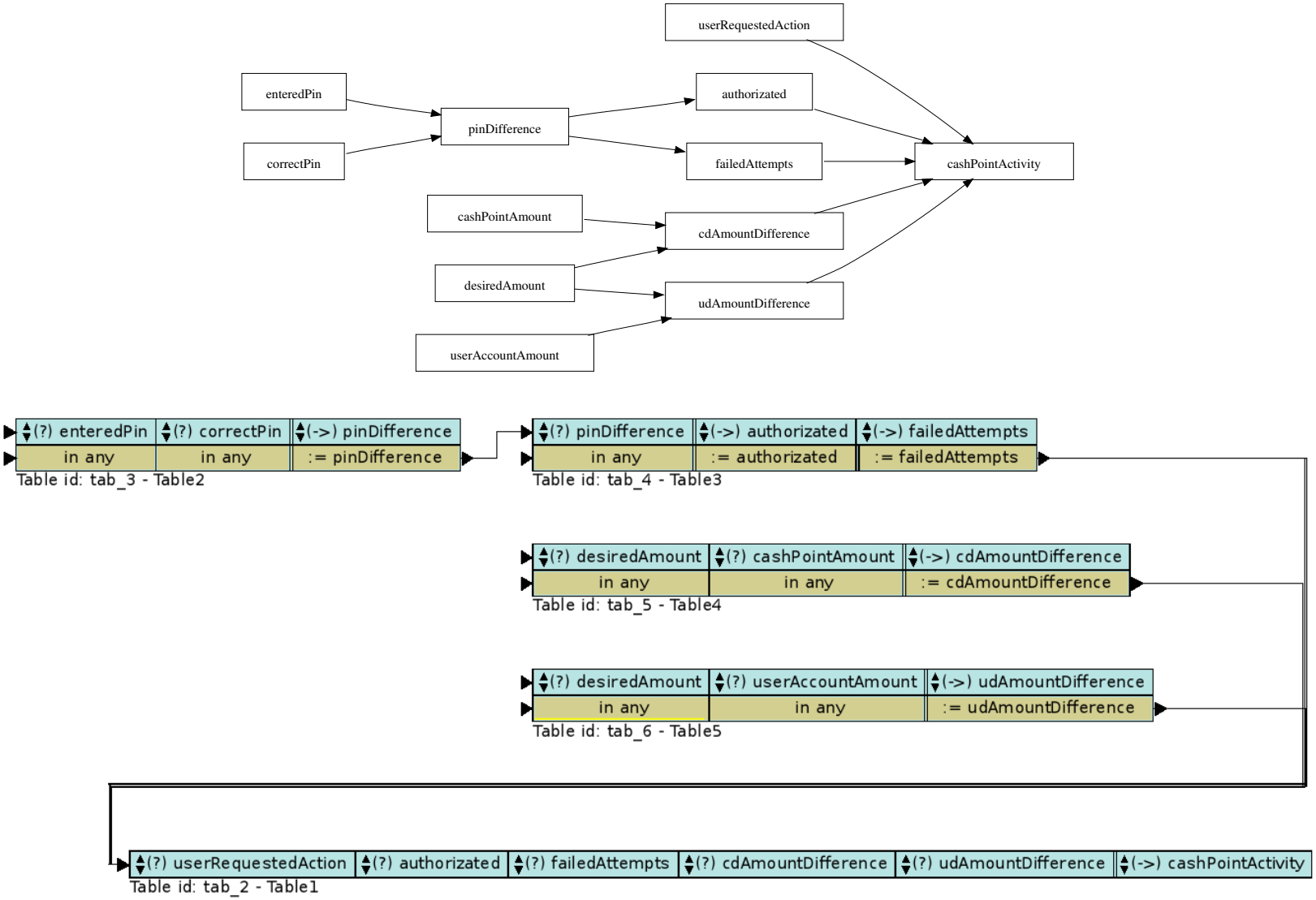
See: `hekate.ia.agh.edu.pl`

Outline

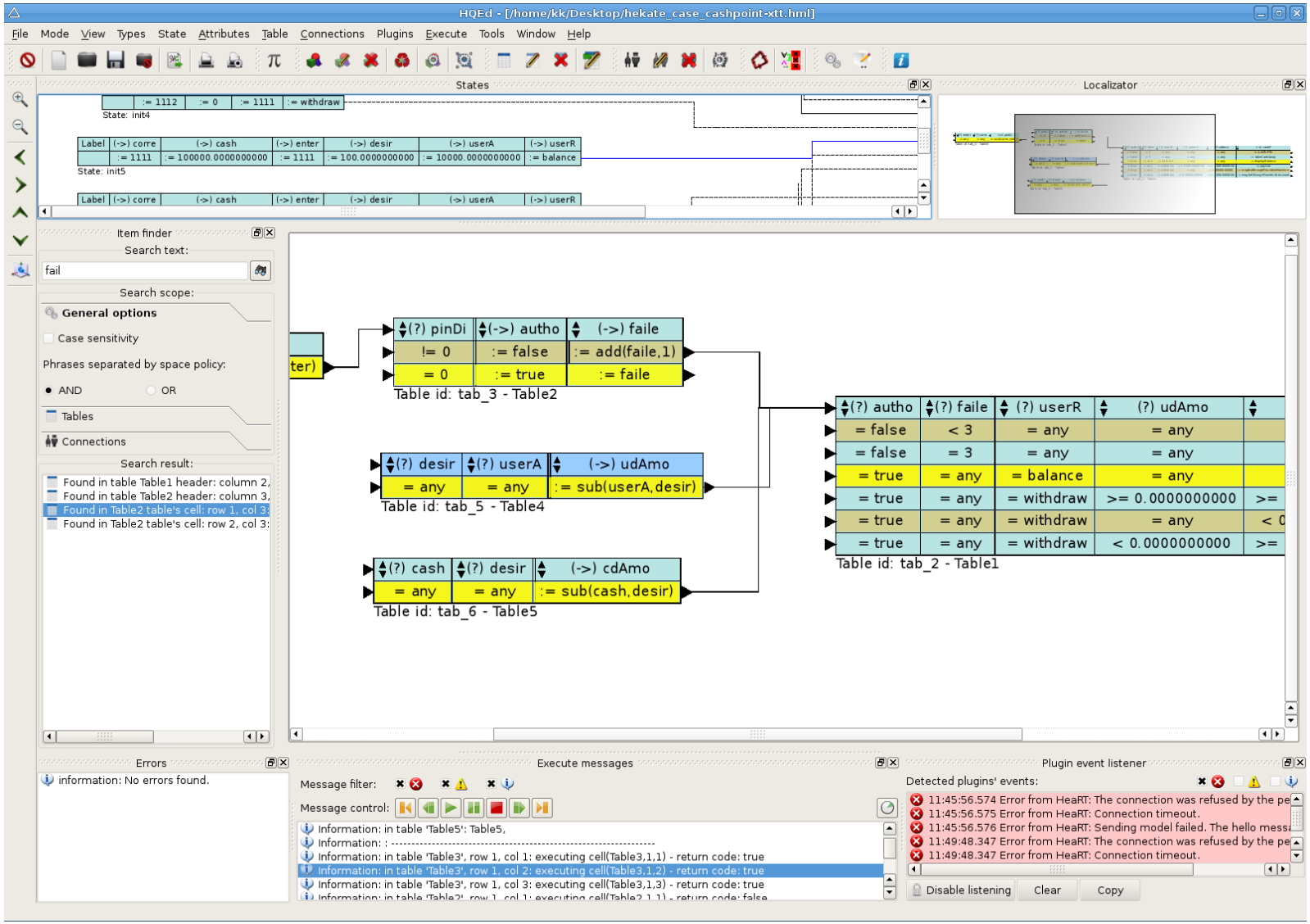
HJEd


ARD Editor - hekate_case_cashpoint-ard.xml (*)
File Refactor View Help
userRequestedAction
cashPointAmount
cdAmountDifference
desiredAmount
udAmountDifference
cashPointActivity
userAccountAmount
dfgdfg
failedAttempts
enteredPin
pinDifference
correctPin
authorizated
CashPoint
UserRequestedAction
ActionEnvironment
CashPointActivity
UserRequestedAction
CashPointActivity
ActionEnvironment
userRequestedAction
cashPointActivity
Authorization
Founds
Authorization
Founds
enteredPin
correctPin
pinDifference
authorizated
failedAttempts
desiredAmount
UserResources
CashPointResources
EnoughResources
CashPointResources
desiredAmount
EnoughResources
UserResources
enteredPin
authorizated
pinDifference
failedAttempts
correctPin
cashPointAmount
cdAmountDifference
udAmountDifference
userAccountAmount
dfgdfg
udAmountDifference
cdAmountDifference

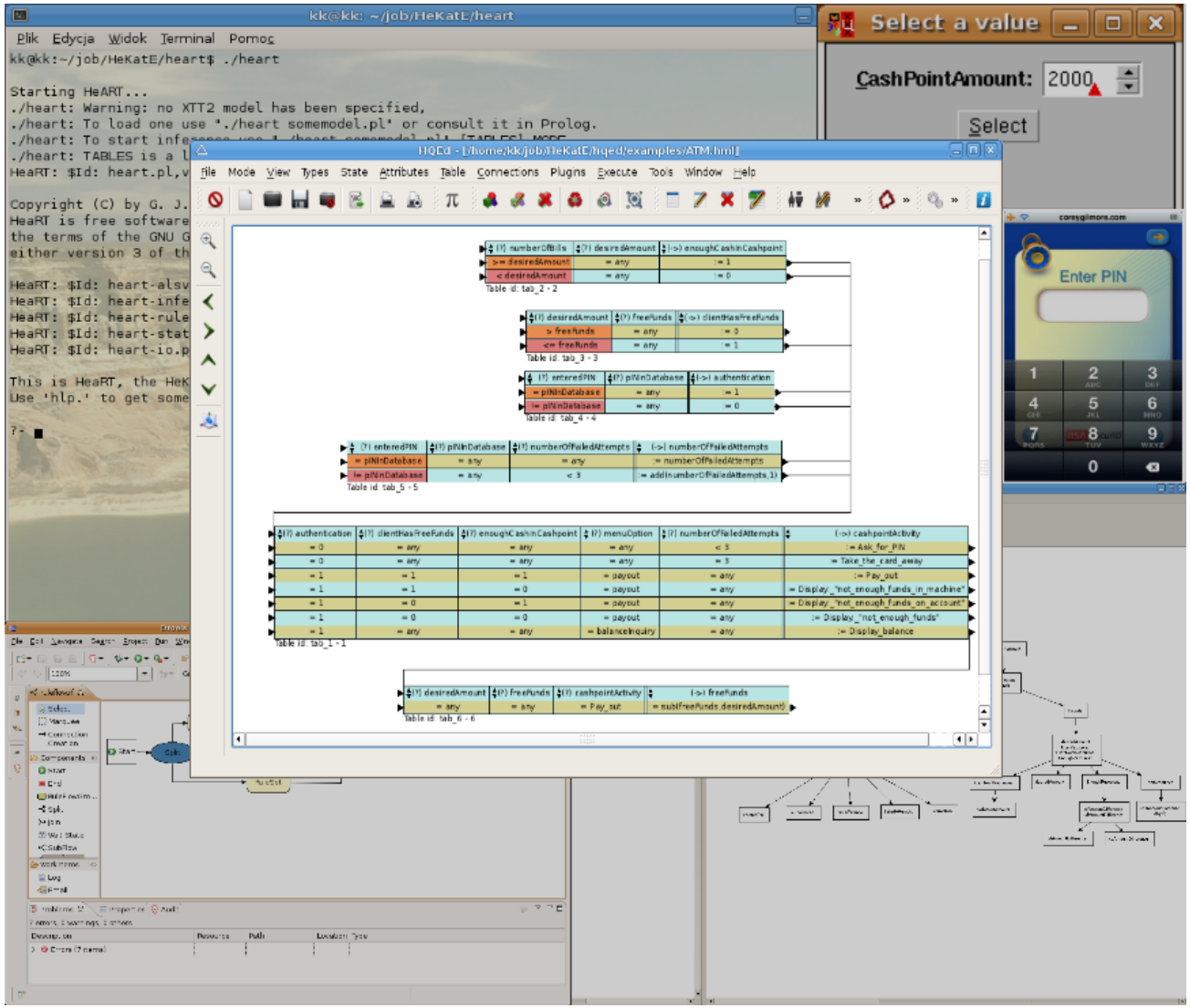
ARD+ ⟶ XTT2


userRequestedAction
enteredPin
correctPin
pinDifference
authorized
failedAttempts
cashPointActivity
cashPointAmount
cdAmountDifference
desiredAmount
udAmountDifference
userAccountAmount
(?) enteredPin
(?) correctPin
(->) pinDifference
in any
in any
:= pinDifference
Table id: tab_3 - Table2
(?) pinDifference
(->) authorized
(->) failedAttempts
in any
:= authorized
:= failedAttempts
Table id: tab_4 - Table3
(?) desiredAmount
(?) cashPointAmount
(->) cdAmountDifference
in any
in any
:= cdAmountDifference
Table id: tab_5 - Table4
(?) desiredAmount
(?) userAccountAmount
(->) udAmountDifference
in any
in any
:= udAmountDifference
Table id: tab_6 - Table5
(?) userRequestedAction
(?) authorized
(?) failedAttempts
(?) cdAmountDifference
(?) udAmountDifference
(->) cashPointActivity
Table id: tab_2 - Table1

HQEd


HQEd - [/home/kk/Desktop/hekate_case_cashpoint-xtt.hml]
File Mode View Types State Attributes Table Connections Plugins Execute Tools Window Help
States
Localizator
Item finder
Search text:
fail
Search scope:
General options
Case sensitivity
Phrases separated by space policy:
AND OR
Tables
Connections
Search result:
Found in table Table1 header: column 2,
Found in table Table2 header: column 3,
Found in Table2 table's cell: row 1, col 3:
Found in Table2 table's cell: row 2, col 3:
(?) pinDi (->) autho (->) faile
!= 0 := false := add(faile,1)
= 0 := true := faile
Table id: tab_3 - Table2
(?) desir (?) userA (->) udAmo
= any = any := sub(userA,desir)
Table id: tab_5 - Table4
(?) cash (?) desir (->) cdAmo
= any = any := sub(cash,desir)
Table id: tab_6 - Table5
(?) autho (?) faile (?) userR (?) udAmo
= false < 3 = any = any
= false = 3 = any = any
= true = any = balance = any
= true = any = withdraw >= 0.0000000000
= true = any = withdraw = any
= true = any = withdraw < 0.0000000000
Table id: tab_2 - Table1
Errors
information: No errors found.
Execute messages
Message filter:
Message control:
Information: in table 'Table5': Table5,
Information: : ----------
Information: in table 'Table3', row 1, col 1: executing cell(Table3,1,1) - return code: true
Information: in table 'Table3', row 1, col 2: executing cell(Table3,1,2) - return code: true
Information: in table 'Table3', row 1, col 3: executing cell(Table3,1,3) - return code: true
Plugin event listener
Detected plugins' events:
11:45:56.574 Error from HeaRT: The connection was refused by the pe
11:45:56.575 Error from HeaRT: Connection timeout.
11:45:56.576 Error from HeaRT: Sending model failed. The hello mess
11:49:48.347 Error from HeaRT: The connection was refused by the pe
11:49:48.347 Error from HeaRT: Connection timeout.
Disable listening
Clear
Copy

HQEd plugins



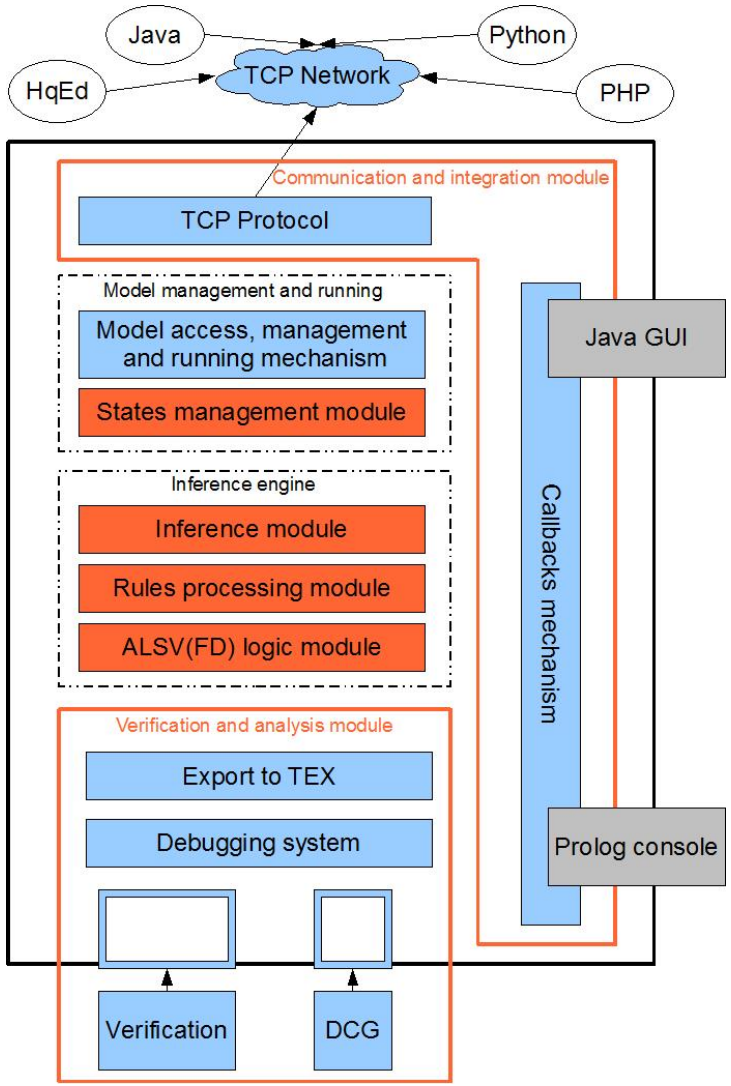
Drawbacks of ARD+

- Limited expressiveness
- Non extensible
- Compatibility problems
- Lack of tools

Advantages of XTT2

- Based on the expressive ALSV(FD) logic
- Formal rule language
- Visual design
- Structured rule base
- Advanced inference control
- Formal verification

HeaRT architecture



HMR rule representation

(?) diagn	(?) aller	(?) age	(->) medic
= AcuteSinusitils	= none	> 17	:= Amoxicillin
= AcuteSinusitils	= none	<= 17	:= Cefuroxime
= AcuteSinusitils	= penicillin	= any	:= Levofloxacin

Table id: tab_2 - Table1

```
xschm 'Table1': [diagnosis,allergic,age] ==> [medication].

xrule 'Table1'/1:
      [diagnosis eq 'AcuteSinusitils',
       allergic eq none,
       age gt 17]
    ==>
      [medication set 'Amoxicillin']
    :'Table2'.
xrule 'Table1'/2:
      [diagnosis eq 'AcuteSinusitils',
       allergic eq none,
       age lte 17]
    ==>
      [medication set 'Cefuroxime'].
xrule 'Table1'/3:
      [diagnosis eq 'AcuteSinusitils',
       allergic eq penicillin,
       age eq any]
    ==>
      [medication set 'Levofloxacin'].
```

Logical rule verification in HeaRT

```
Plik  Edycja  Widok  Terminal  Pomoc
DEBUG(2): Check: day symbolic mon
DEBUG(2): Check: day symbolic mon
DEBUG(2): Check: day symbolic mon
DEBUG(2): Check: day symbolic mon
DEBUG(2): Check: day symbolic fri
DEBUG(2): Check: day symbolic fri
DEBUG(2): Valid: day in [mon to fri]
DEBUG(1): Condition:  day in [mon to fri]  satisfied
DEBUG(2): Adding new fact:  today  set to  workday
DEBUG(2): Trans: today to workday
DEBUG(1): Go to: th/1
DEBUG(1): Firing rule:  dt/2
DEBUG(2): Check: day symbolic mon
DEBUG(2): Check: day symbolic mon
DEBUG(2): Check: day symbolic sat
DEBUG(2): Check: day symbolic sat
DEBUG(2): Check: day symbolic sun
DEBUG(2): Check: day symbolic sun
DEBUG(1): Condition:  day in [sat, sun]  NOT satisfied

DEBUG(1): Firing tabl:  ( ms ) [month] ==> [season]
DEBUG(1): Firing rule:  ms/1
Type value for attribute:  month
|:
```

Advantages of HeaRT

- Supports reasoning in modularized knowledge databases
- Implements four different inference strategies dedicated to take advantages of modularized knowledge bases
- Uses fast Prolog Unification algorithm instead of RETE
- Supports HMR language which is formal notation of rule-based systems based on XTT tables
- Allows for logical verification based on ALSV(FD)

HeKatE software resources

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See: `hekate.ia.agh.edu.pl`

Outline

Business Process Modeling Notation

BPMN

- readily understandable by all business users
- single specification for a Business Process Model
- currently provides several diagrams,
  mainly used: Business Process Diagram
- to define internal and external business procedure

NOT for

- Organizational structures
- Functional breakdowns
- Data models

BPMN history

Aug 2001 Formation of Notation Working Group

Nov 2002 BPMN 0.9 Draft of specification

May 2004 BPMN 1.0 specification

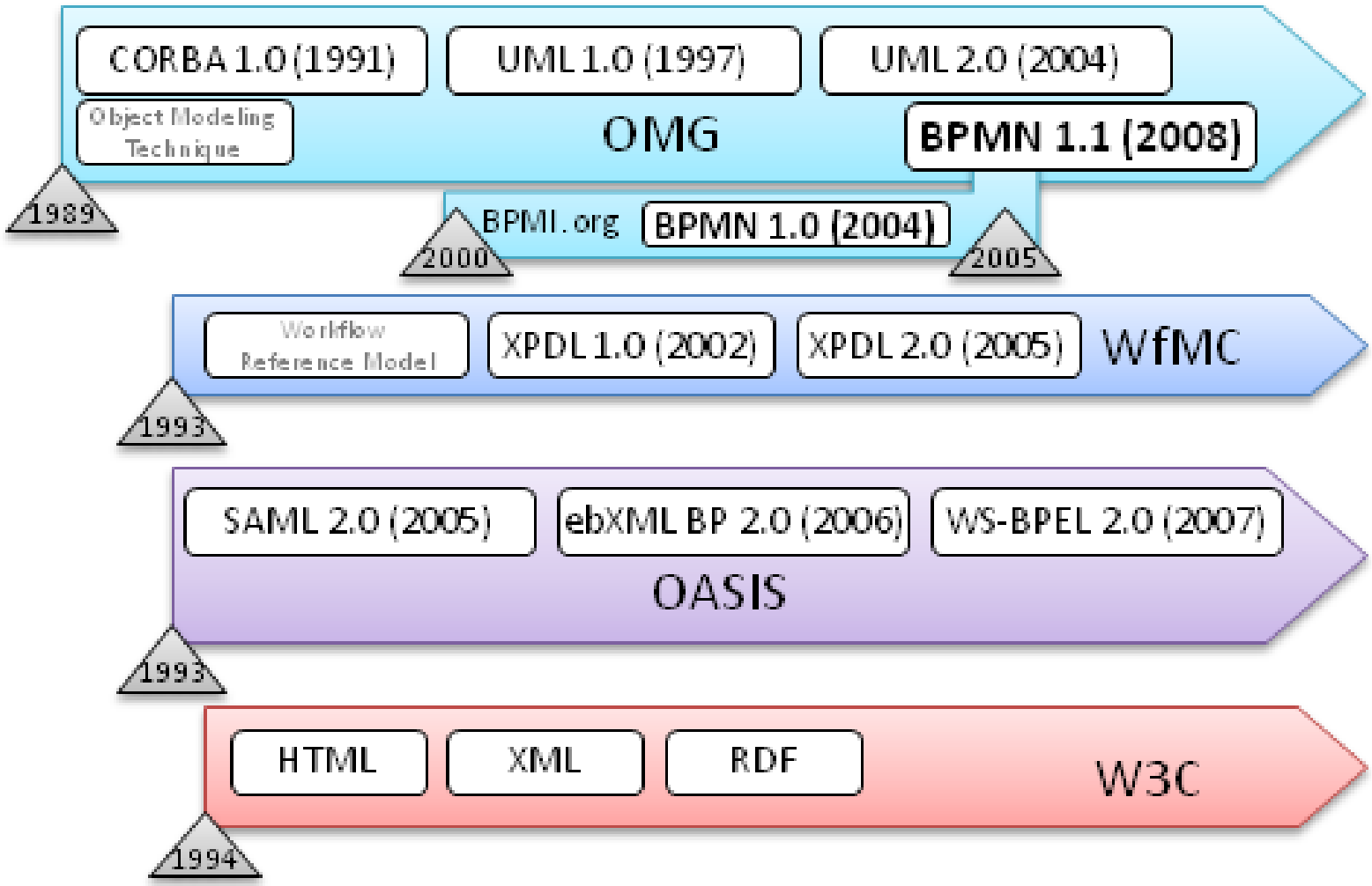
Jun 2005 Merger with OMG

Jan 2009 BPMN 1.2

Aug 2009 BPMN 2.0 Beta 1

Jan 2011 BPMN 2.0

BPMN history



Business Process

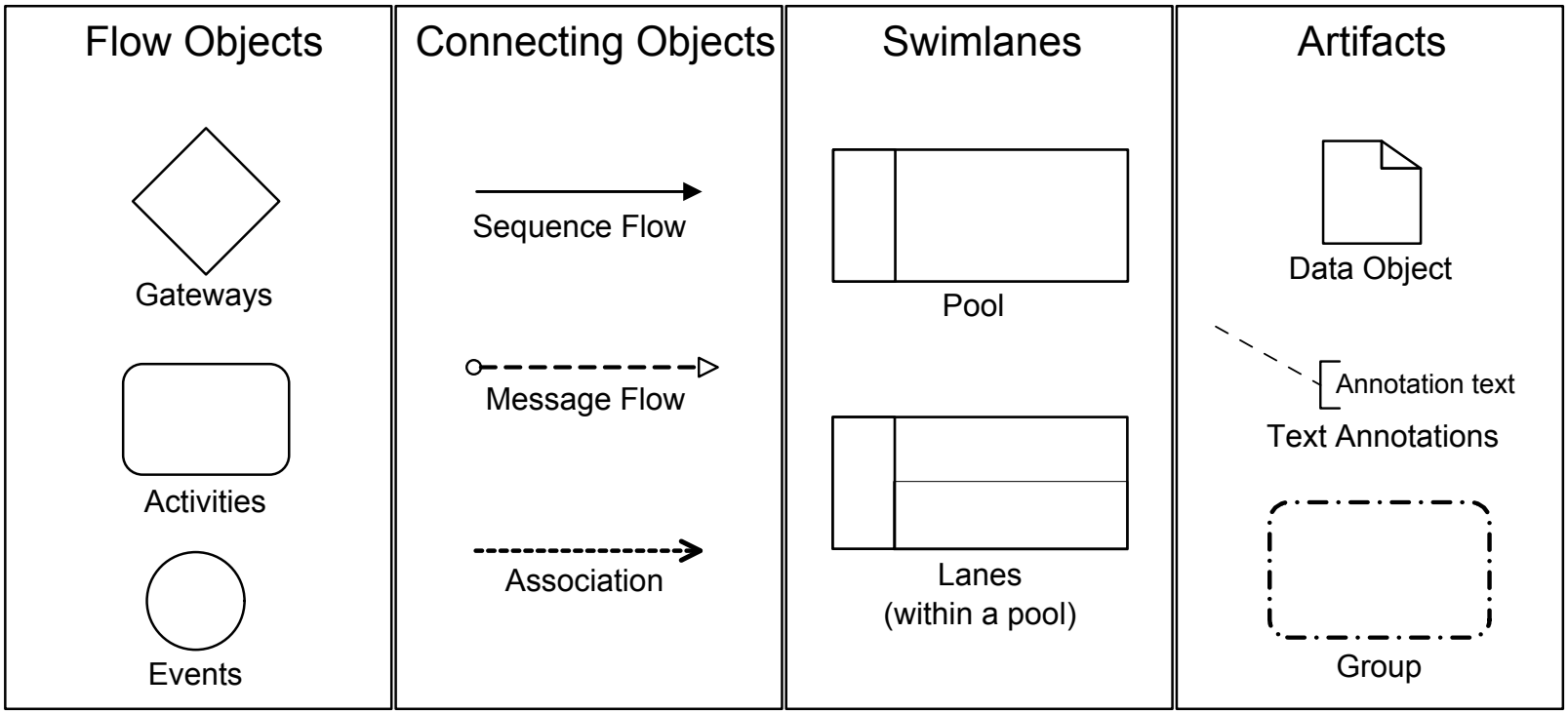
What is Business Processes (BP)?

A **collection** of related, structured **activities/tasks**
that **produce** a specific **service/product** (serve a particular goal)
for a particular customer.

Business Process Analysis

- Business Process Model defines the ways in which operations are carried out to accomplish the intended objectives of an organization
- Business Process can be decomposed into several sub-processes, which contribute to achieving the goal of the super-process
- Business Process Analysis typically includes the mapping of processes and sub-processes down to activity level

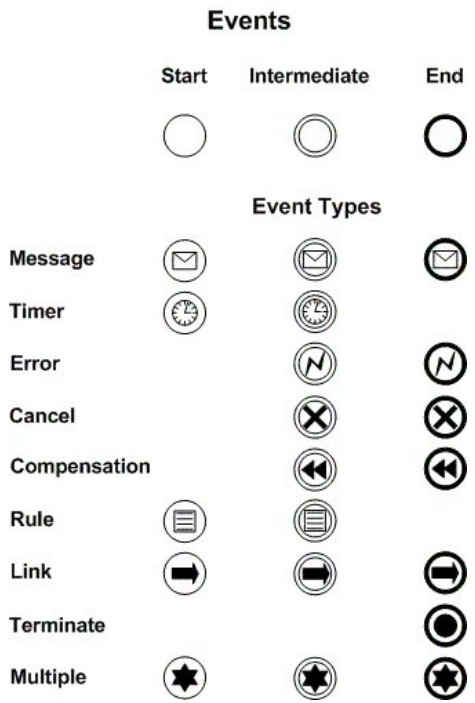
Core Set of Diagram Elements



Event elements

Events

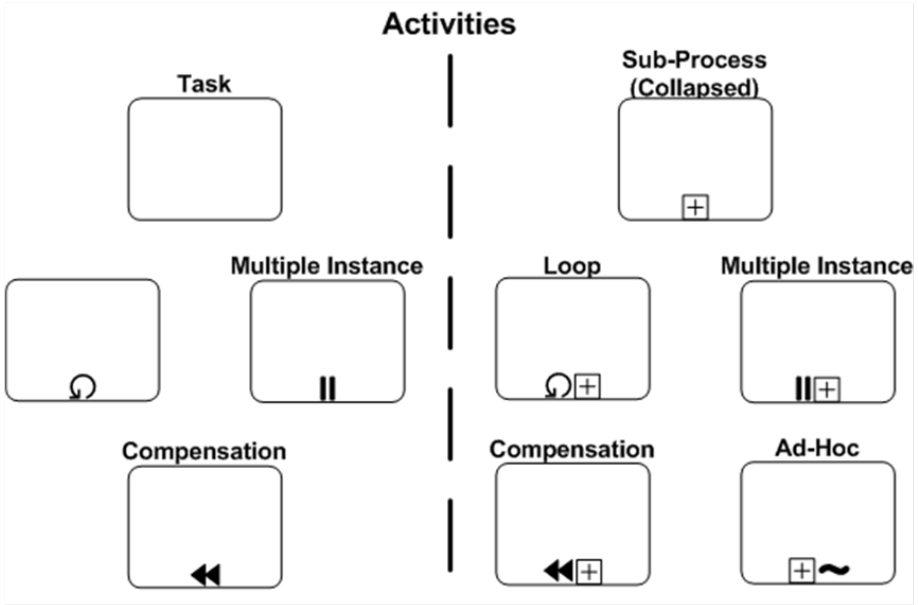
- happen during the course of a business process
- affect the process flow and usually have a trigger or a result
- can start, interrupt, or end the flow



Activity elements

Activities

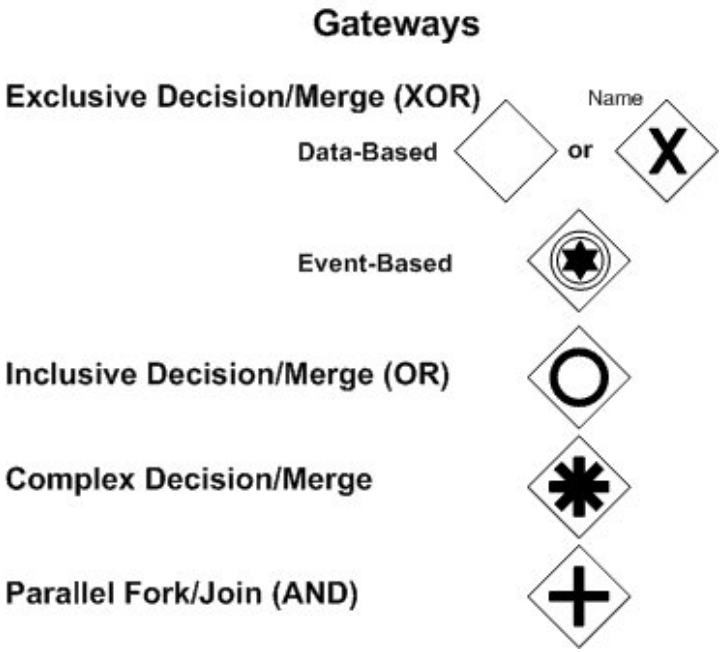
- work that is performed within a business process
- can be atomic or compound
- types: process, sub-process, and task



Gateway elements

Gateways

Gateways are used to control how sequence flows interact as they converge and diverge within a process.



Connection

Flow/Connections

A Sequence Flow - shows the order in which activities are performed

A Message Flow - shows the flow of messages between two entities that are prepared to send and receive them

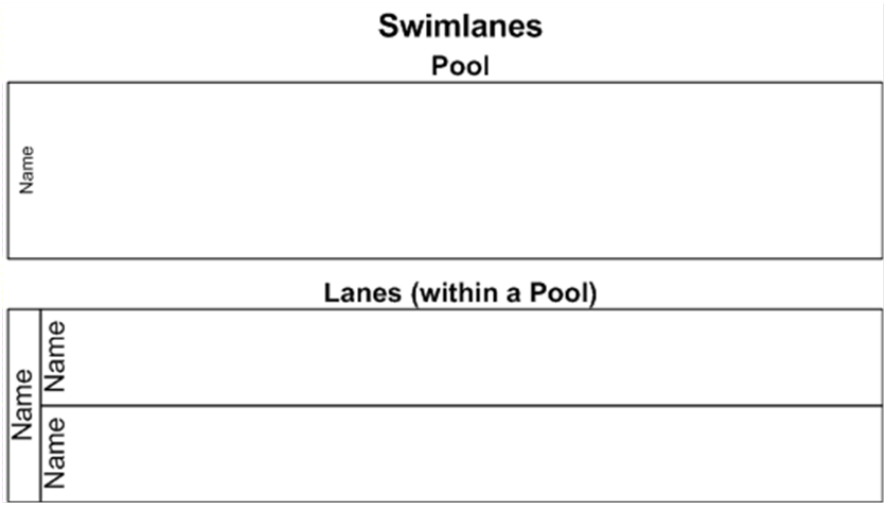
An Association - associates information and artifacts with flow objects

Swimlanes

Swimlanes

A Pool - a graphical container for partitioning a set of activities from other pools, usually in the context of B2B situations

A Lane - a sub-partition within **a pool**, extends the entire length of the pool, either vertically or horizontally



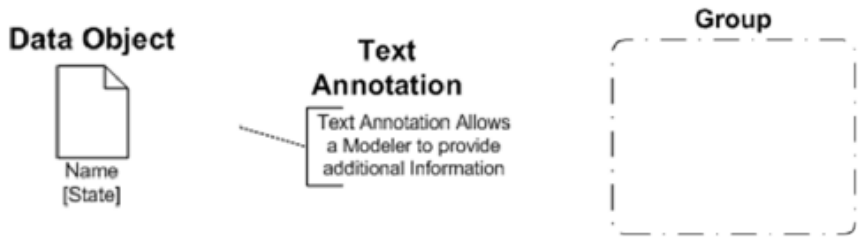
Artifacts

Artifacts

Data Objects - provides information about how documents, data, and other objects are used and updated within a process

Text Annotations - mechanism for a modeler to provide additional information for the reader of a BPMN diagram

Groups - provide a mechanism to visually organize activities



BPMN tools

According to OMG (updated March 1, 2011)

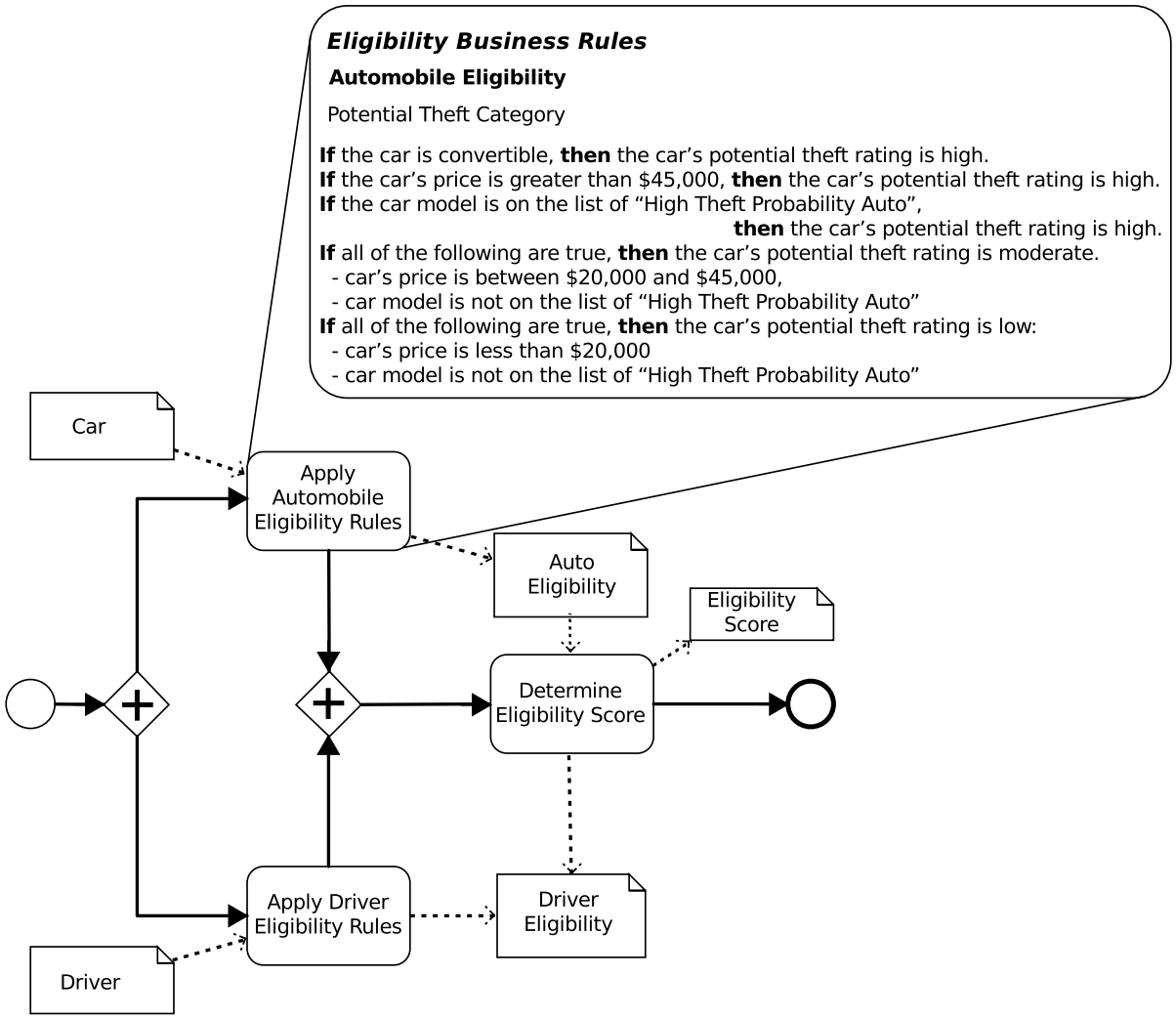
- 76 BPMN implementations
- 4 planned

Evaluation in progress

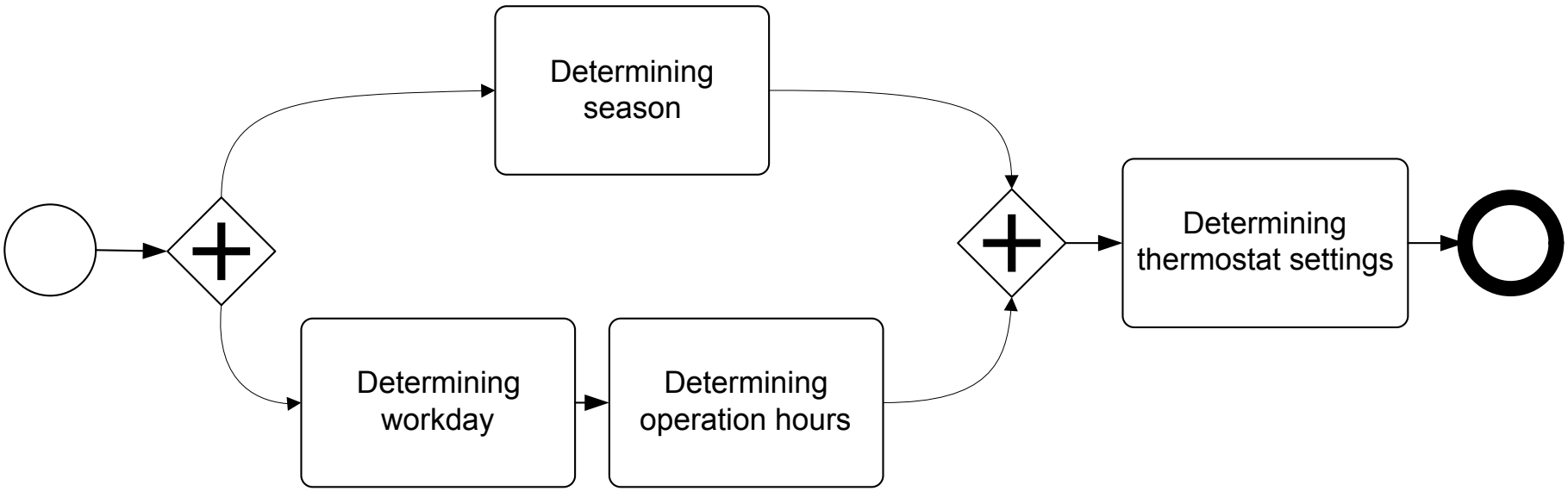
1. Oryx
2. IBM WebSphere Business Modeler Advanced
3. Business Process Visual ARCHITECT
4. Corel iGrafx
5. and many others

Outline

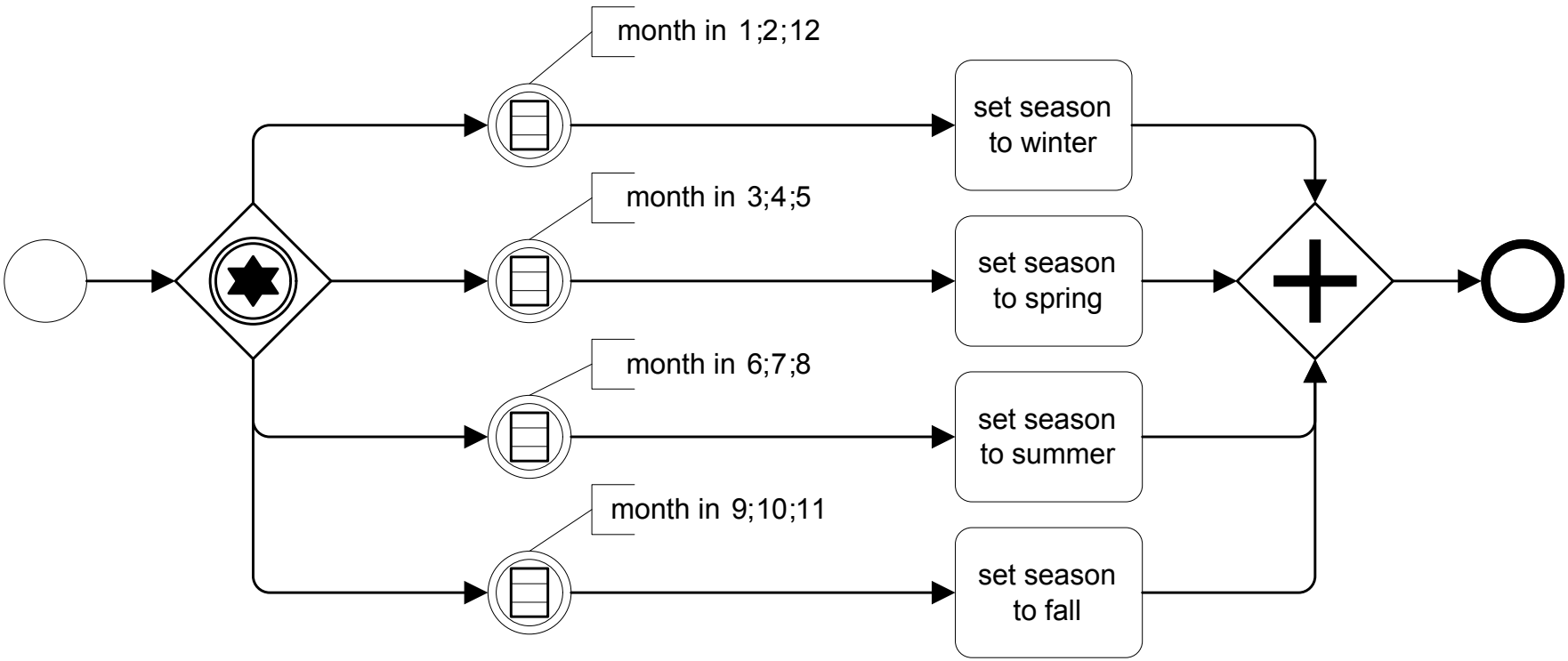
UServ Financial Services case study



Mapping BPMN workflow to the XTT2 inference control graph



Mapping BPMN taks to the XTT2 table



Mapping BPMN elements to XTT

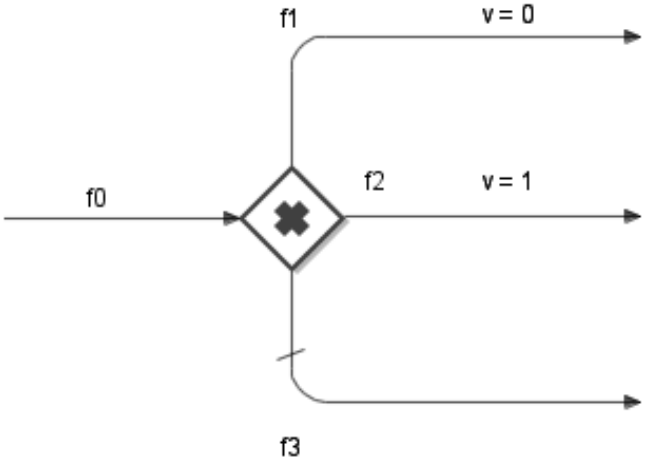
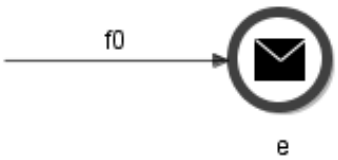
<table>
<tr><th>BPMN Element</th><th>XTT2 Table</th></tr>
<tr><td colspan="2">Exclusive split gateway $\mathcal{G}_s^{ex}$</td></tr>
<tr><td> 
</td><td>
<table>
<tr><th>f_0</th><th>v</th><th>f_1</th><th>f_2</th><th>f_3</th></tr>
<tr><td>$eq\ 1$</td><td>$eq\ 0$</td><td>$set\ 1$</td><td>$set\ 0$</td><td>$set\ 0$</td></tr>
<tr><td>$eq\ 1$</td><td>$eq\ 1$</td><td>$set\ 0$</td><td>$set\ 1$</td><td>$set\ 0$</td></tr>
<tr><td>$eq\ 1$</td><td>$notin\ [0,1]$</td><td>$set\ 0$</td><td>$set\ 0$</td><td>$set\ 1$</td></tr>
</table>
</td></tr>
<tr><td colspan="2">Throw event $e \in \mathcal{E}^{th}$</td></tr>
<tr><td> 
</td><td>
<table>
<tr><th>f_0</th><th>e</th></tr>
<tr><td>$eq\ 1$</td><td>$set\ 1$</td></tr>
</table>
</td></tr>
</table>

Table 1: BPMN to XTT2

Outline

Research threads

Current research threads

RSLG – Selecting subset of BPMN for modeling, verification and executing purposes

PRTR – Tools and methods of mapping BPMN to/from other notations

DSIP – Development of BPMN-based declarative specification of inference process

BRBP – Detailed specification of the integration of BP and BP

QCSL – Selection of important BP quality criteria

Secondary threads

SVBP – Specification of rules and processes in natural language (SBVR)

WKEV – Integration with Wiki as groupware platform

BIMLOQ Timeframe

Timeframe

- **Nov 2009**: End of the HeKatE project.
- **Apr 2010**: BIMLOQ starts.
- **End od 2010**: Evaluation and overview of existing solutions.
- **Currently**: RSLG, PRTR, QCSL.
- **End of 2011**: DSIP, SVBP, BRBP.
- **Spring 2012**: complete cases.
- **October 2012**: BIMLOQ ENDS.

The End

Thank you for your attention!
Any questions?

GEIST Web Page: `http://geist.agh.edu.pl`

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