A Temporal Representation of Point-Interval Relations

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The Problem

- Situation
  - A large telecommunication company
  - Faults → alarms generated by network resources
    e.g. devices are out of order or traffic bursts entail problems
  - System operator tries to identify underlying faults: problematic since the data stream of alarms is quite complex and dense
  - Furthermore: events are imprecise wrt. time (no access to precision)

The Problem

- Aim
  - automise identification of faults
  - Intermediate aim: cluster alarms → simplification for operator

    Supporting network operators in localising faults
    Reduction of information by generating high-level alarms
    Reduction of workload for the operator

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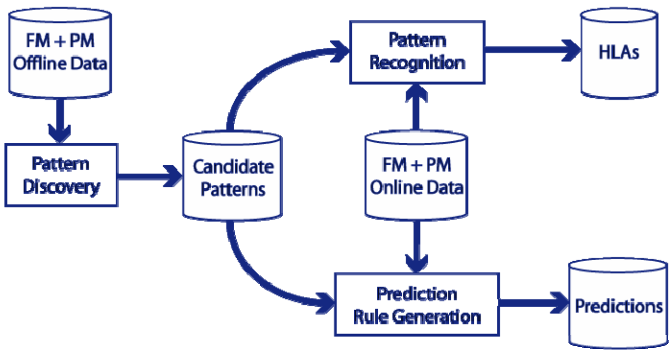
System Overview



- Focus on pattern representation

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Data

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A = alarm(?, “AdapterGGSN“, “GGN“, “Communication“, “GGSN lost contact
   with all RADIUS authentication servers associated with APN“)
B = alarm(?, “AdapterGGSN“, ?, “Communication“, “GGSN lost contact with
   all RADIUS accounting servers associated with APN“)
C = alarm(?, “AdapterGGSN“, ?, “SNMP AGENT“, “10.22.170.129“)

TemporalRelations:

A HEAD_TO_HEAD B
A OLDER_AND_CONTEMPORARY C
B OLDER_AND_CONTEMPORARY C
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Method

- Relational system as a mean for representing termporal information, mainly based on
  - Allen 1983, 1984
  - Vilain, Kautz 1986
  - Ladkin, Maddux 1994
  - Cohn, Hazarika 2001

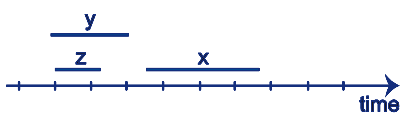
Method

- Coarse set of jointly exhaustive and pairwise disjoints relations between events (e.g. alarms)
- Relation algebra → CSP (e.g. for testing the consistency of pattern descriptions or to complete knowledge)

Name	Symbol	Converse	Relation
before	$<$	$>$	$\{P_i, I_k\} < \{P_j, I_l\}$
equal	$=$	$=$	$\{P_i\} = \{P_j\}$
during	d	c	$\{P_i\}$ d $\{I_k\}$
contains	c	d	$\{I_k\}$ c $\{P_i\}$
after	$>$	$<$	$\{P_i, I_k\} > \{P_j, I_l\}$

An example: composing relations

- Given three temporal entities: x, y, and z
- It holds: x > y and y c z

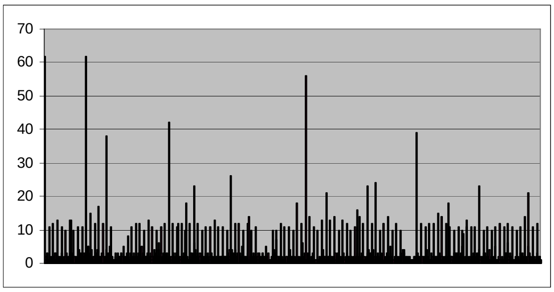


- The composition provides x > z

	<	c	=	d	>
<	<	<	<	< d	< d = c >
c	< c	c	c	d = c	c >
=	<	c	=	d	>
d	<	< d = c >	d	d	>
>	< d = c >	>	>	d >	>

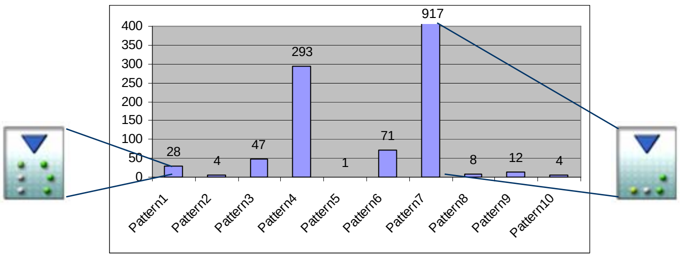
Experimental Analysis

- Structure of test data set
  - 5 different adapters, 2 hour time range, 5810 alarms
  - Peak: 62 alarms per second, Mean: 0.8 alarms per second



Experimental Analysis

Based on the representation



Summary

- Method
  - A temporal (i.e. 1-dimensional) representation of events has been proposed (including points and intervals in time)
  - It can be dealt with using CSP techniques
- Application
  - Thrown alarms in telecommunication networks: mining for frequent patterns (mining for important patterns → expert knowledge)
  - The generality of the approach allows the application in other domains in the future

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Misuse Detection System (MDS)

Sixth Framework Programme Priority 2 Information Society Technologies

Misuse Detection System

- Comarch, Poland
- Polska Telefonia Cyfrowa
- Tekever, Lisbon
- University of Bradford
- Bournemouth University
- Bremen University

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