

I-Know '06

The 6th International Conference on Knowledge Management

PALADIN: A Pattern Based Approach to Knowledge Discovery in Digital Social Networks

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Agenda

- Social Networks & Knowledge Sharing in the Web 2.0
- Disturbances in Digital Media Usage
- Agency in Digital Social Networks
- PALADIN
 - Actor Network Theory
 - Model of Digital Social Networks
 - Pattern Language, Definition & Discovery
 - Evaluation Results
 - Visualization of Disturbances in Digital Social Networks
- Conclusions & Outlook

Social Networks in the Web 2.0

- Web 2.0 technologies to facilitate social structures
- New means of knowledge sharing such as
 - Blogs (trackbacks)
 - Wikis (collaborative editing)
 - flickr (folksonomy style tagging)
 - Feeds (syndication)
 - etc.
- However, will Web 2.0 technologies
 - really lead to more efficient collaboration?
 - make knowledge sharing even more complex?
 - be affected by the same disturbances as real world networks are?

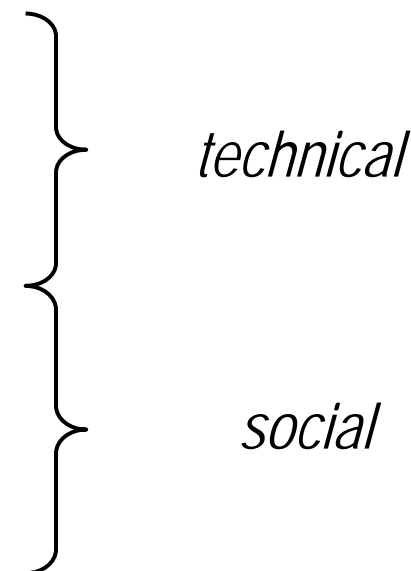
Disturbances in Digital Media Usage

- What is a disturbance?

"A disturbance is an emergence phenomenon based on collective, distributed decisions undertaken by agents, having positive or negative effects on digital social networks."

- Disturbances occur on different levels

- Physical
- Communication
- Network
- Egocentric
- Subgroup
- Community



Disturbances by Example

- Spammers – persons who abuse electronic messaging systems to send unsolicited, undesired bulk messages
 - Trolls – persons who post only in threads, started by themselves
 - Structural holes – person identified as a „social gap“ between two groups
 - ...
 - Result of disturbances in digital social networks
 - Communication slows down/speeds up
 - User contributions increase/decrease drastically
 - Users/Communities appear/disappear
- ⇒ How to detect disturbances in large digital social networks?
- ⇒ What learning process(es) to initiate?

Agency in Digital Social Networks

Agency: "Empowering users to take decisions on activity or inactivity in case of disturbances"

- Abstraction: **Pattern** as a general repeatable solution to a common recurring problem [Alexander 1978]
- Basis: **Pattern language** overcomes the difficulties for discovering and describing disturbances
- Computation: **Machine-readable** description of the patterns - XML-based pattern language for multidimensional disturbances
- Discovery: **Automatic Analysis** of digital social networks for disturbances with the pattern language

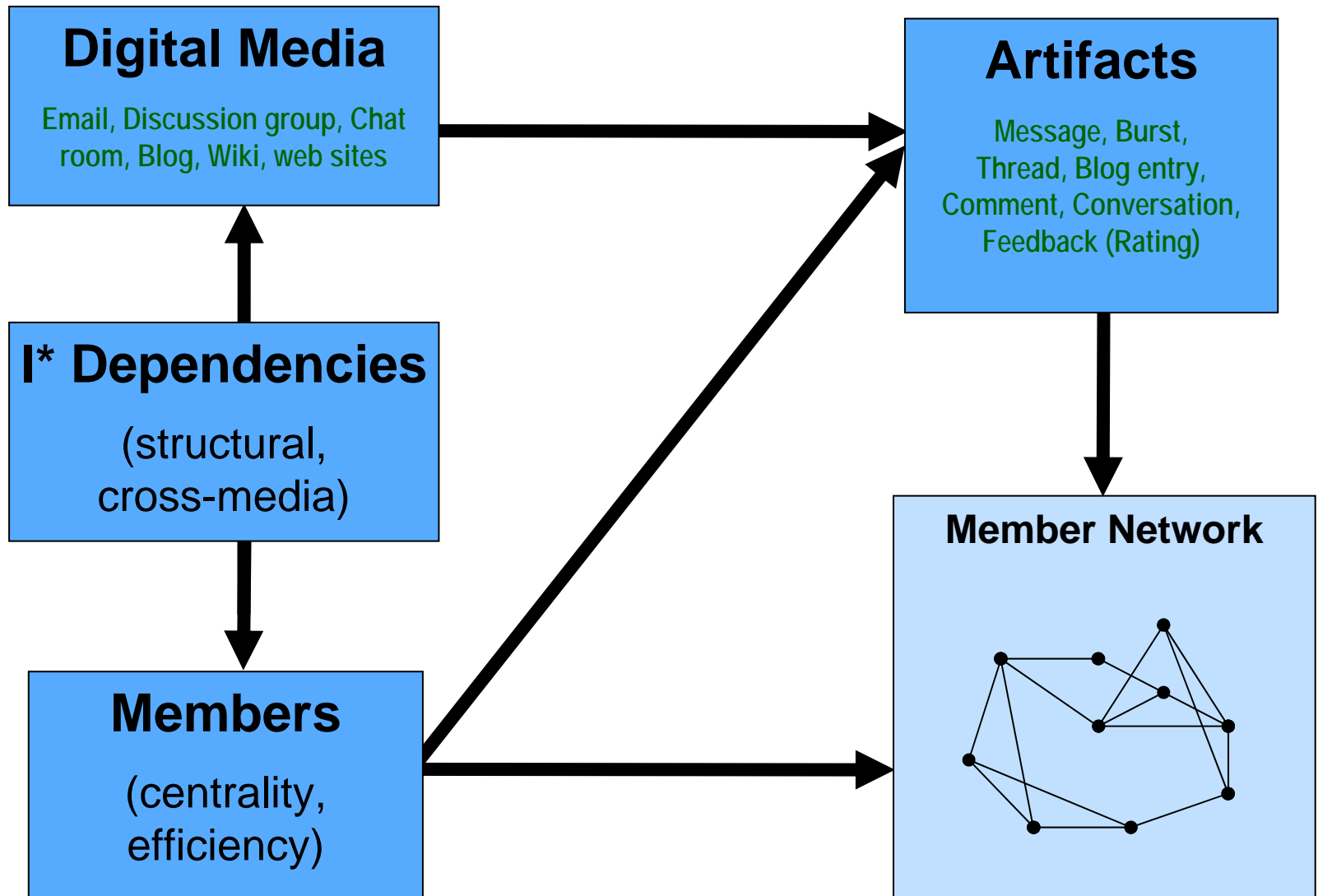
PALADIN

- Pattern based approach to automatically detect specific disturbances and to initiate appropriate learning process(es)
- **Digital social network model** based on
 - Actor-Network Theory
 - Graph Representation & Analysis
 - I* Framework
- **Multidimensionality** of digital social networks reflecting
 - Computer Science
 - Sociology
 - Media Theory
 - Graph Theory
 - Social Capital Theory

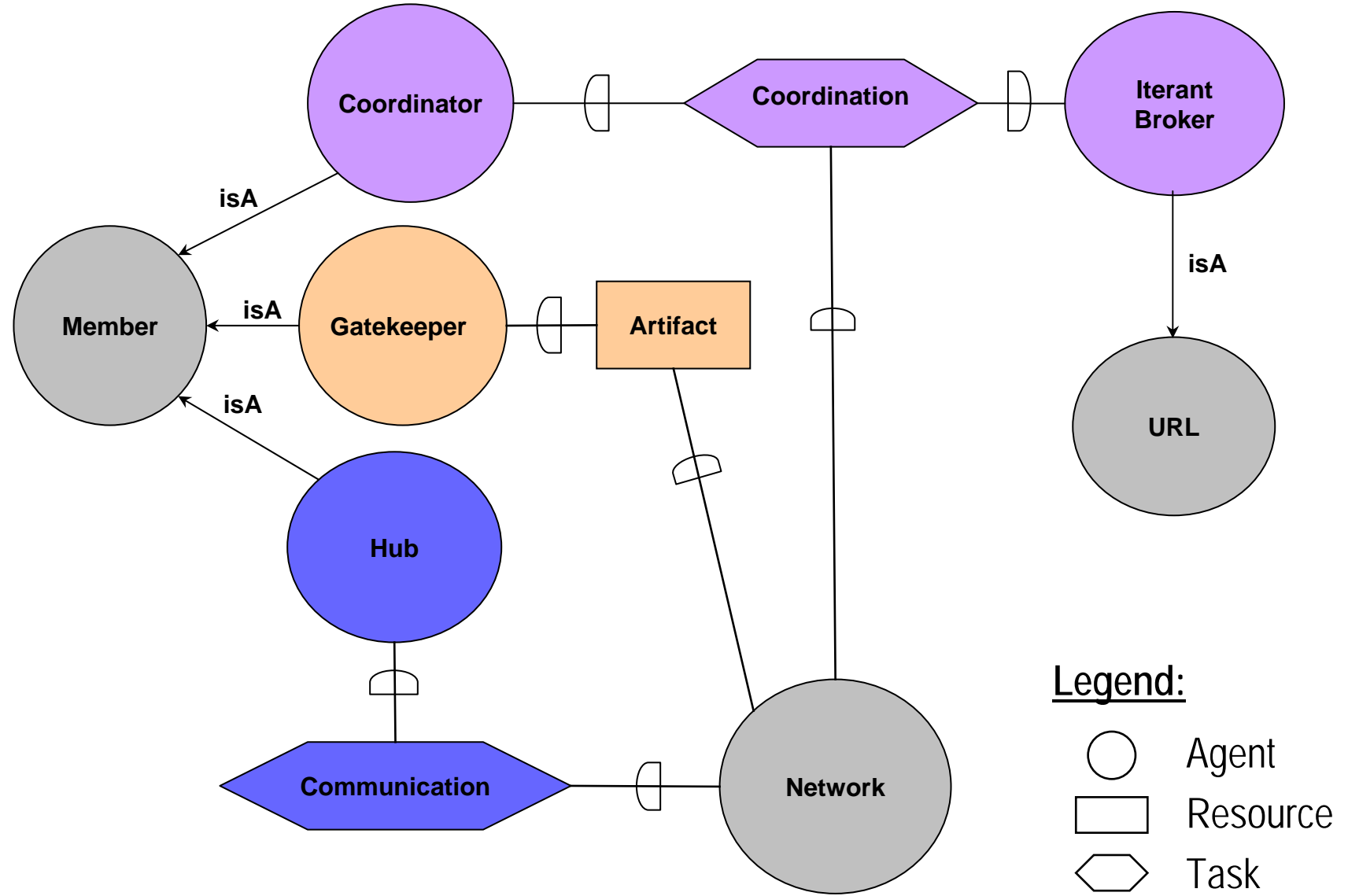
Actor-Network Theory [Latour 1997]

- **Actor** - the basic unit of the model, no difference between technical and social actors
- Semantics, given to the actors from the interpretation in the context of digital social networks:
 - **Member** – any person or group, part of the digital social network
 - **Medium** – an actor which enables the members to exchange information
 - **Artifact** – objects created by the members using some medium
- **Relation** – a relation between two actors
- **Network** – set of actors along with their relations

Model of Digital Social Networks



I* Dependency Model



Pattern Language

- **Variables**
 - simple variables (*troll*, *thread*)
 - properties (*thread.author*)
- **Operations**
 - Arithmetic (*+*, *-*, ***, */*)
 - Aggregate (*SUM*, *COUNT*, *AVERAGE*)
 - Logical (*&*, *|*, *~*, *FORALL* and *EXISTS*)
 - Comparison (*=*, *!=*, *>*, *<*).
- **Rules** for variable **binding**
 - Simple variables – pattern parameters, actors
 - Properties – actor properties or relations
- Interpreted by a **finite state automaton**

Pattern by Example: Troll

Troll Pattern: This pattern tries to discover the cases when a troll exists in a digital social network. A troll in the network is considered a disturbance.

Disturbance:

```
(EXISTS [medium | medium.affordance = threadArtefact]) &
(EXISTS [troll |(EXISTS [thread | (thread.author = troll) &
(COUNT [message | (message.author = troll) &
(message.posted = thread)]) > minPosts]) &
(~EXISTS[ thread1, message1| (thread1.author1 != troll) &
(message1.author = troll & message1.posted = thread1 ])))]))
```

Forces: *medium; troll; network; member; thread; message; url*

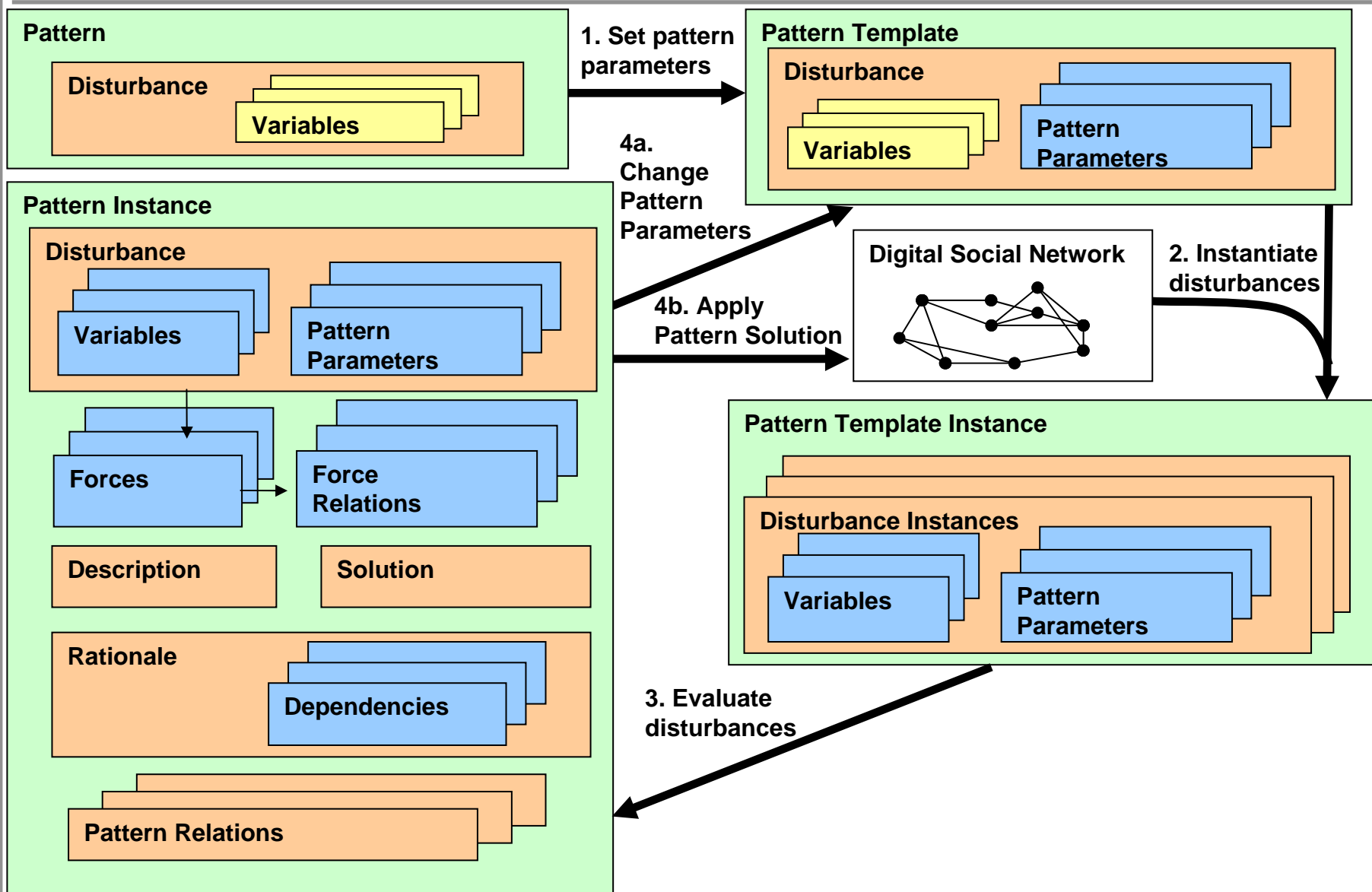
Force Relations: *neighbour(troll, member); own thread(troll, thread)*

Solution: No attention must be paid to the discussions started by the troll.

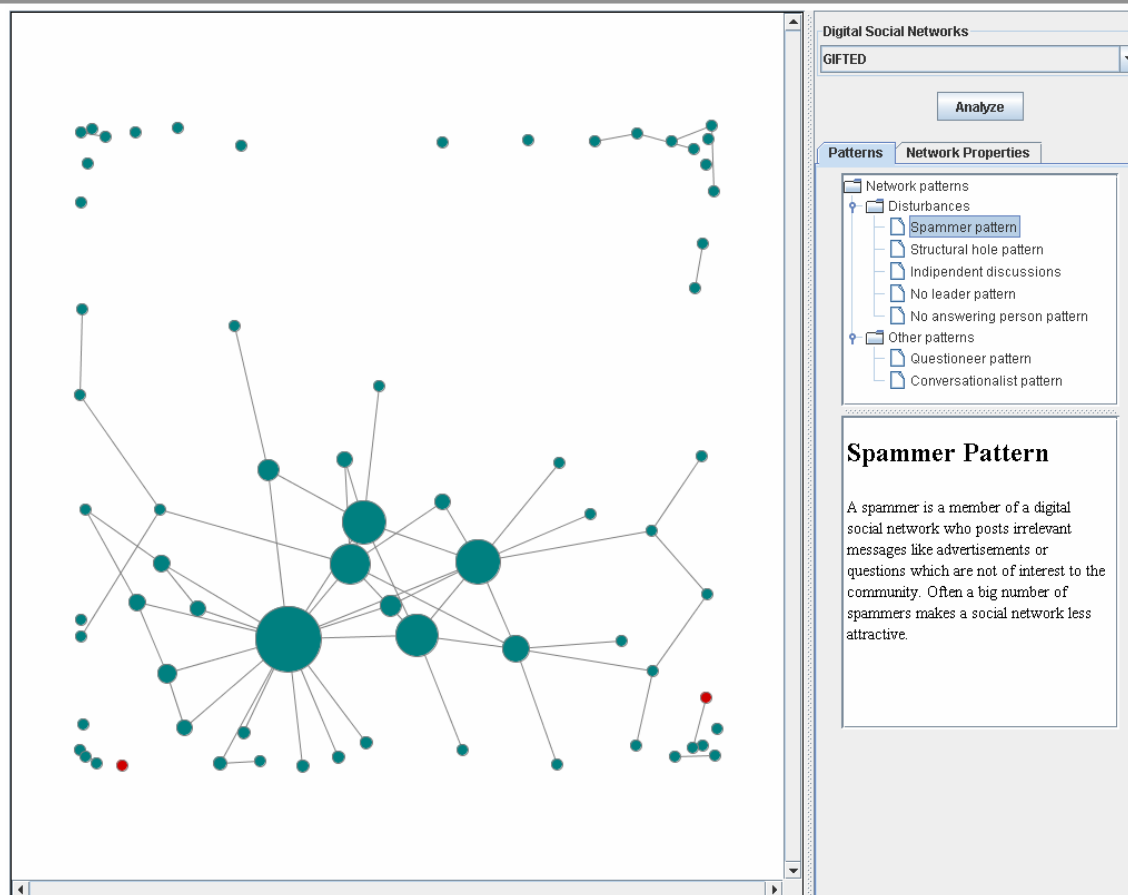
Rationale: The troll needs attention to continue its activities. If no attention is paid, he/she will stop participating in the discussions.

Pattern Relations: Associates Spammer pattern.

Pattern Discovery Process



Spammer Visualization



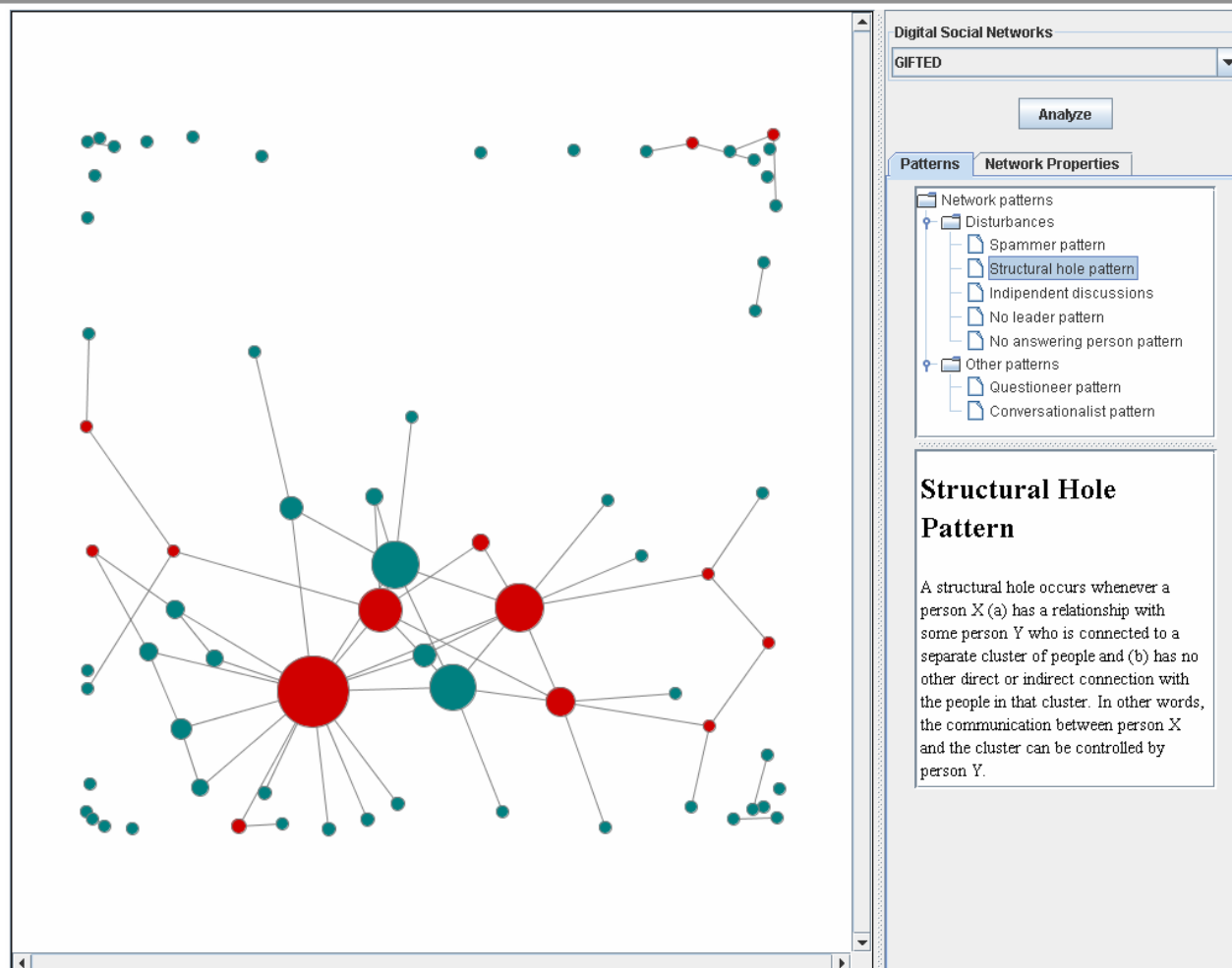
$$(\exists[\text{medium} \mid \text{medium.affordance} = \text{threadArtefact}]) \wedge$$

$$(\exists[\text{spammer} \mid (\text{COUNT}[\text{thread} \mid (\text{thread.author} = \text{spammer})] > \text{minThreadCount})) \wedge$$

$$((\neg \exists[\text{thread1} \mid (\text{thread1.author} = \text{spammer}) \wedge$$

$$(\text{COUNT}[\text{message} \mid (\text{message.posted} = \text{thread})] > \text{maxMessageCount})))$$

Structural Hole Visualization



$$(\exists [m] (1 - (2 / ((\text{COUNT}[n | n.\text{neighbour} = m]))^*)) (\text{COUNT}[p | (p \neq n) \wedge ((p.\text{neighbour} = n) \wedge (p.\text{neighbour} = m) \wedge (n.\text{neighbour} = m))])) > \text{efficiencyParameter}])$$

Evaluation results

10 patterns of disturbance over 119 social network instances,
17359 individuals, 215 345 mails

Pattern	Occurrences	Remarks
Burst	22	The pattern finds out topics which were very important for certain period of time. Scalability is necessary.
No Conversationalist	76	The existence implies little communication in the network.
No Questioner	67	The existence implies that the network is not popular.
No Answering Person	61	Occurs in small networks. The effects of the lack of an answering person must be further checked with content analysis.
Troll	2	Troll occurs very rarely in cultural communities. True negatives exist.
Spammer	86	Spammers can be found often in discussion groups. False positives exist.
Leader	37	The pattern occurs in the network centered around a member.
No Leader	40	Occurs in big networks where the members are distributed in different clusters.
Structural Hole	67	Occurs for members having neighbors with only one contact.
Independent Discussions	13	Occurs in large networks where disconnected subnetworks exist. Scalability is necessary.

Conclusions

- Web-based application suitable for knowledge discovery in arbitrary digital social networks based on abstract and reusable patterns
- Underlying interdisciplinary research methodology
- Enhanced agency in digital social network usage by
 - self-reflection on community activities
 - proposition of learning process(es) in case of disturbances
- Comprehensive case study performed over 119 network instances

Outlook

- Web-based interface to trigger (large) simulation runs of digital media usage in cultural sciences communities
 - Analysis of "Agency & Patienthood" phenomena:
 - Which discourses can be expected in the (near) future?
 - What influence do different media have on communities?
 - What are the impacts of my actions on the community?
 - Which event(s) should have taken place?
 - How will the community/ies evolve?
- ⇒ Local simulation of global digital social network activities

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