Group Formation in eLearning-enabled Online Social Networks

Steffen Brauer

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Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

Outline

Motivation

Classic eLearning environments

- Intra-group communication in predefined classrooms
- Managed by instructor
  - Creates groups
  - Analyses course results
  - Tracks learning progress

Online social networks (OSN)

- Socialize with friends
- Groups are user-triggered
- Ubiquitous use

How to provide a platform for self-paced learning on topics of personal interest?

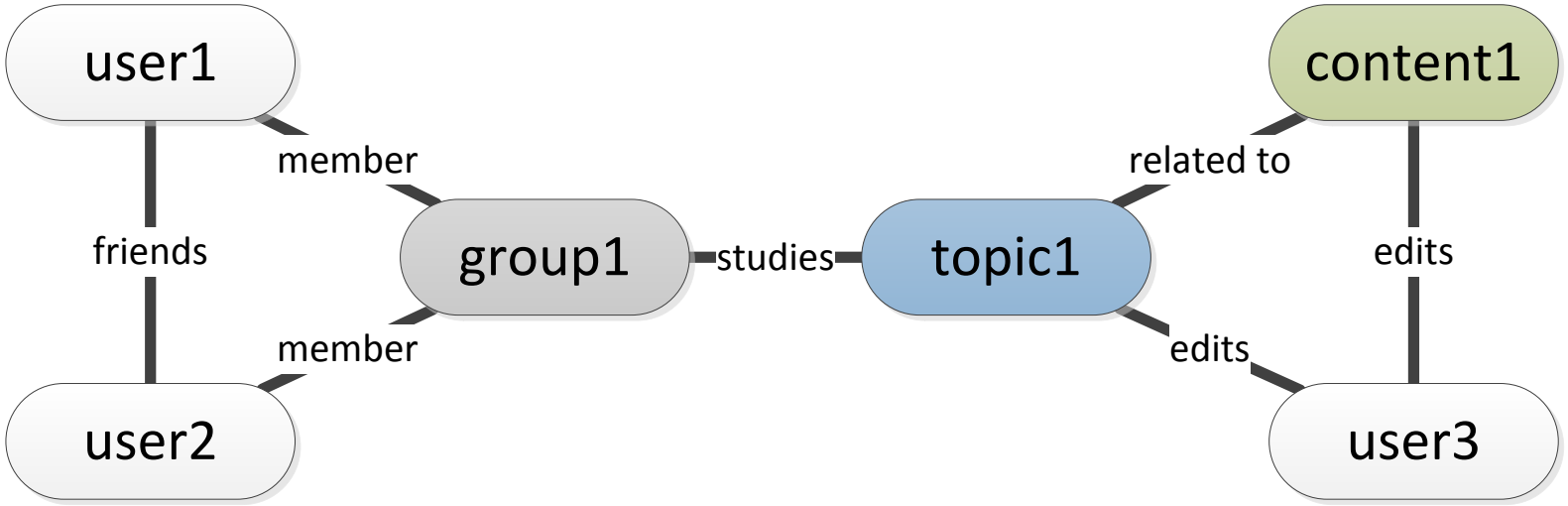
Motivation

Objectives & Challenges

- Our work focuses on integrating an OSN and an eLearning environment by removing the instructor
- Removal of instructor leads to challenges
  1. **How to stimulate a team building process that is effective for learners?**
  2. How to provide access to the relevant content for a learning group?
  3. How to facilitate a consistent learning progress, include feedback and corrective actions?
- Detailed description in [1, 2]

Network

- Open source online social network Diaspora [1] will be extended with eLearning related features
- Multi-entity network using unified approach
- Semantic web meets social web



[1] https://www.joindiaspora.com/

User Representation

Learning Style

- There is a lack of theoretical coherence and a common framework [3]
- Use of learning style in eLearning application for selecting a certain content representation can improve the learning experience [4, 5, 6]
- Learning style (Felder & Silverman Theory [7])
  - Active or Reflective (Processing)
  - Visual or Verbal (Input)
  - Sensing or Intuitive (Perception)
  - Sequential or Global (Understanding)

User Representation

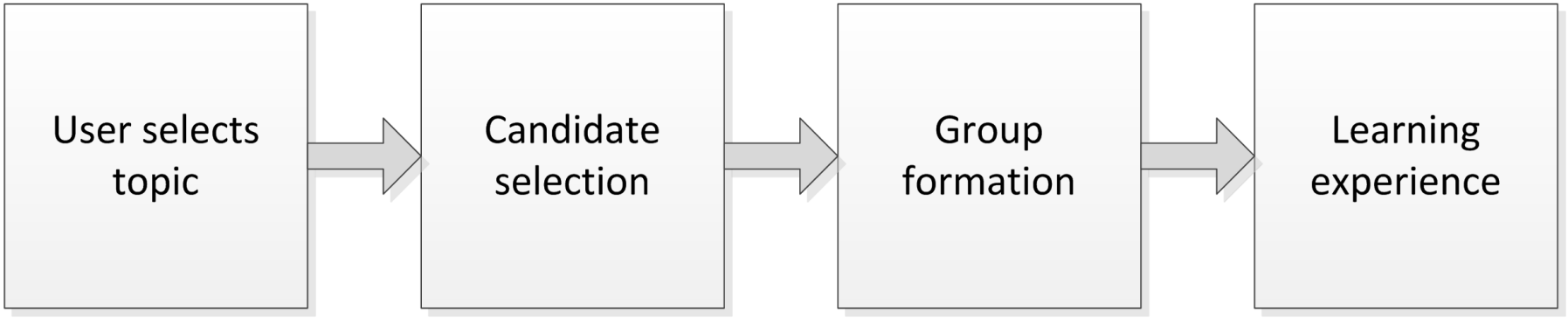
Knowledge

- Represented by tags
- Can describe besides content the competence of a user or the context and style of a content object [8]
- Each topic defines required tags with weights
- Users also hold tags with an activity index
- Knowledge Rank is calculated by product of weights and activity index

Availability

- Flag assigned by user or system

Approach



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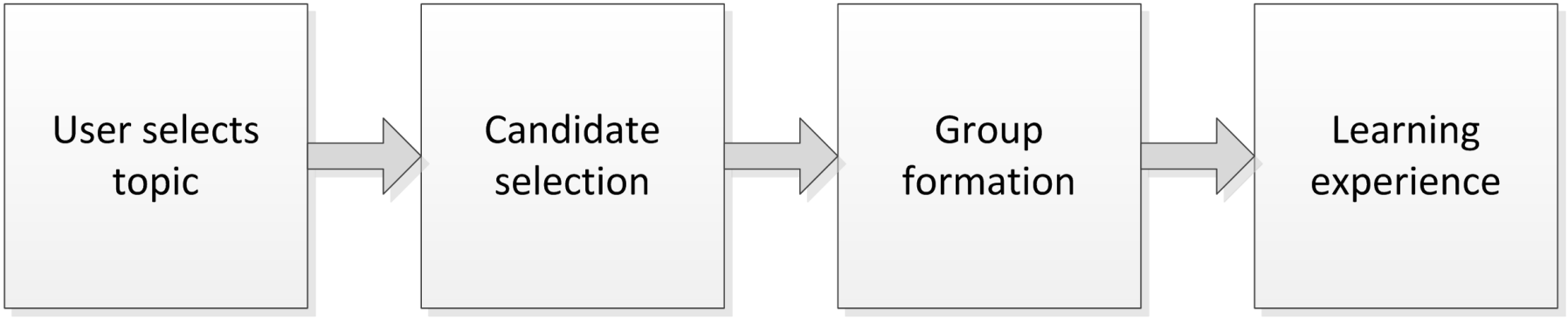

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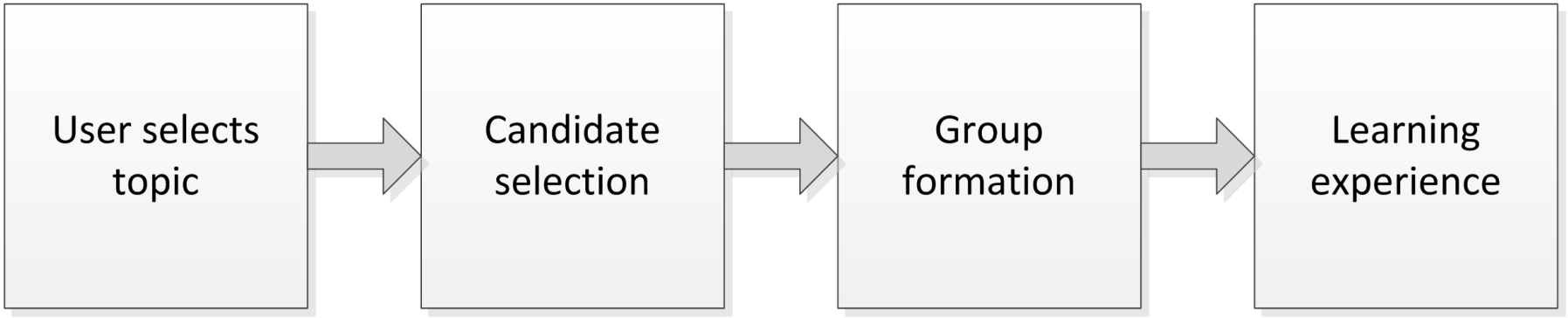

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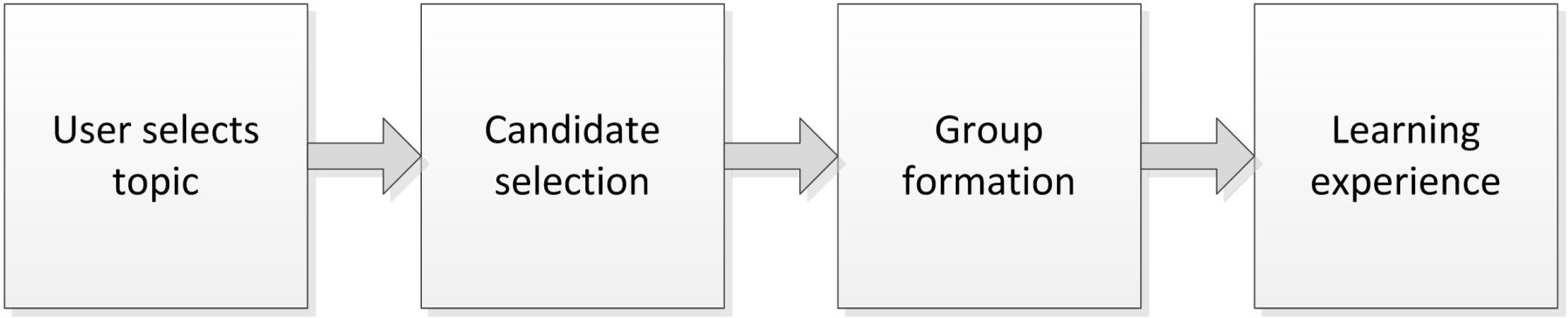

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2. Starting at the initiator, the social network is searched for candidates
3. If a number of candidates is found, the group formation tries to find the best constellation
4. Selected users are invited and learning experience starts

Approach
Candidate Selection

Candidate selection

- **Input**: social network, number of candidates, threshold
- Vertex is added to candidate set, if distance to initiator and topic is lower than threshold
- Distance formula includes learning style and knowledge rank (scale: 0 - 1)
- Implemented search algorithms:
  - Breath First Search(BFS)
  - Random Walk Search(RWS)
  - Best Connected Search(BCS)
- **Output**: candidate set

Approach
Group Formation

Group formation

- **Input**: candidate set
- Group fitness defined by:
  - Common learning style
  - High knowledge rank
  - Low distance in social network
- Implemented by genetic algorithms to reduce complexity
  - Group constellations are treated as chromosomes in a population
  - In each generation cross-over and mutation operations are performed
  - Only constellations with a high fitness are selected for next generation
- **Output**: best group constellations

Evaluation

Open Questions

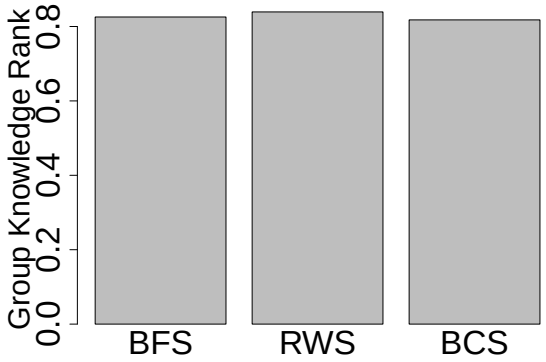
1. How are the user attributes distributed?
2. What is the impact of search algorithms?
3. Does the threshold influence the search complexity?
4. Does the candidate count influence the group fitness?

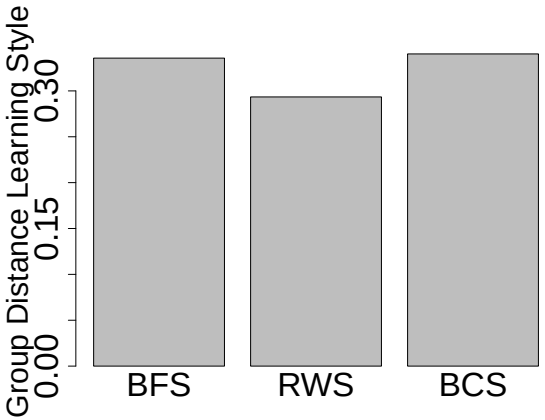
Challenges

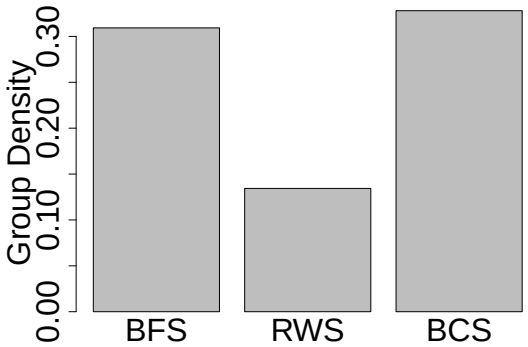
1. Evaluation on synthetic data
2. Simplification: Only user objects in the social network and all users are available
3. How to distribute the user attributes?
   - Learning style: empirical data from Felder & Spurlin [9]
   - Knowledge: 20 tags are power-law distributed over all vertices with random activity index

Evaluation

Candidate Selection



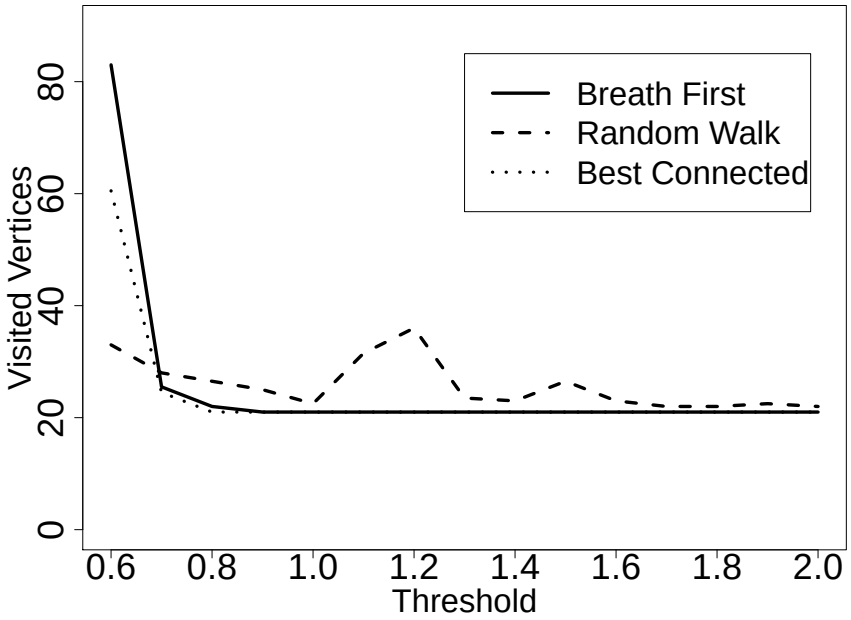


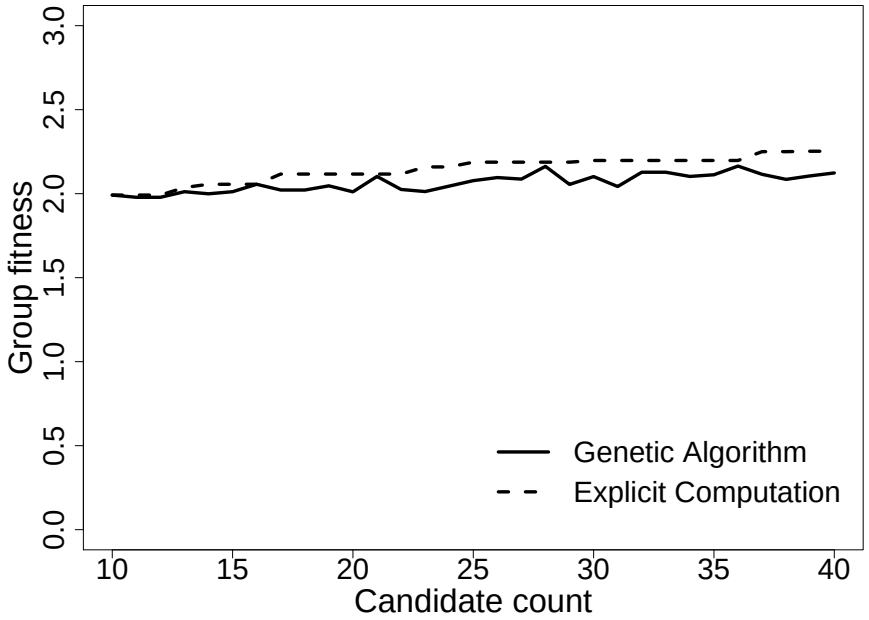


- No significant differences in distance of learning style and knowledge rank
- BFS and BCS produce nearly equal results
- RWS produce low group density

Evaluation

Group Formation



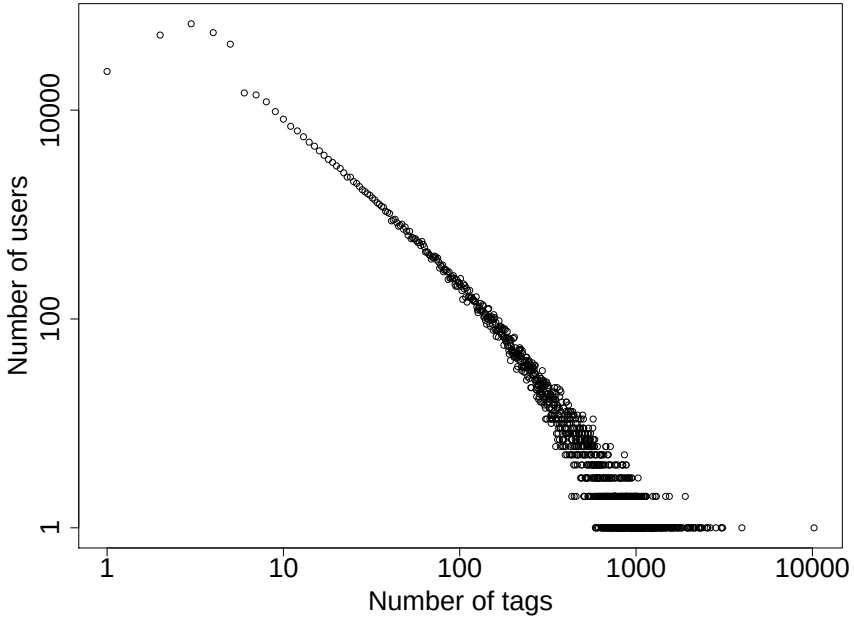


- RWS performs best if threshold < 0.7
- BFS and BCS convert at 0.9

- BFS was used to find candidates
- Threshold $= 0.8$
- No significant change in group fitness

Stack Overflow data

- Realistic Distribution of tags in test network
- Stack Overflow provides access of data via data.stackexchange.com
- Tags assigned to users via answers for tagged questions



- Users: 1.225.580
- Posts: 9.882.000
- Unique Tags: 34.408
- Assigned Tags: 9.692.515

Metric for Group Density

Current Realisation

- Length of shortest paths between all members
- Normalized by network diameter
- Does not take advantage of multi-entity network
- Diameter has to be up to date at any time

Goal

- Based on all connections between group members
- Can be calculated without any global metric
- Idea: edge disjoint paths

Facebook Study

- Source of appropriate test data
- Via Facebook App
- Evaluation of
  - Number of Friends
  - Learning style via questionnaire [2]
- Find participants via Amazon Mechanical Turk

[2] http://www.engr.ncsu.edu/learningstyles/ilsweb.html

Conclusion

Problem: How to simulate a team building process that is effective for learners?

- User model includes availability, learning style and knowledge
- Approach divided in two parts:
  - Candidate selection
  - Group formation
- Evaluation based on synthetic data

Future research

- Improve data base by empirical data
- Include tie strength to take full advantage of unified approach

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