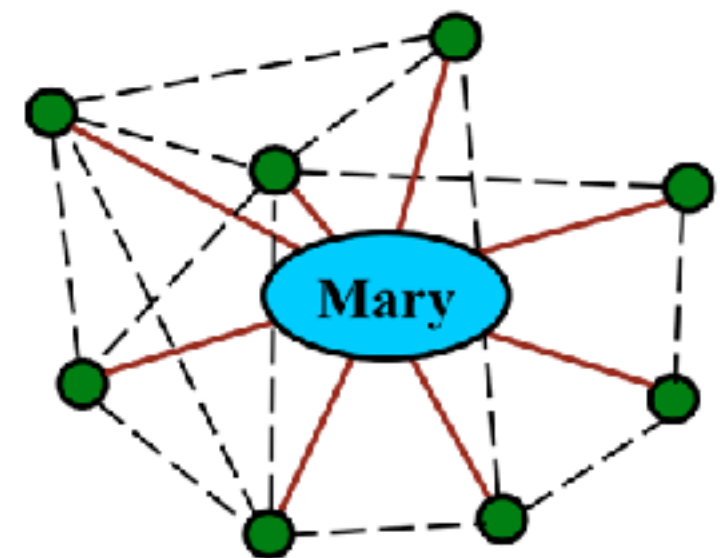# Visual Analysis of Ego-network Evolution

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2015.2.12

Introduction

- Ego-network(aka personal network, first-order zone)

  - Ego

  - Alters

  - Ties among the alters

Introduction

- Ego-network analysis is an important part of social network analysis

- An effective and intuitive way to investigate the ego-network evolution and the relation strength changes will help decision making in business intelligence, information security and social management

- It is challenging since the dynamic nature of a person's ego-network.The neighbours of a person, the relation strength with neighbours and the relations among neighbours may change over time.

Introduction

- It is an old problem

  - Long history in social network analysis field, research interests involving statistics distribution difference, link prediction, and community detection

  - Current dynamic graph visualization mainly focus on the topology changes between timestamps (Coming/Removing nodes, position changes, etc.)

  - Ego-network should focus on the changes of alters, the relation strength evolution between the ego and alters, and the community evolution of alters. Current visualization methods only focus on the first requirement

  - Lack of a analytic system that use the power of human visual recognition to explore, track, and compare the ego-network evolution patterns.

Contributions

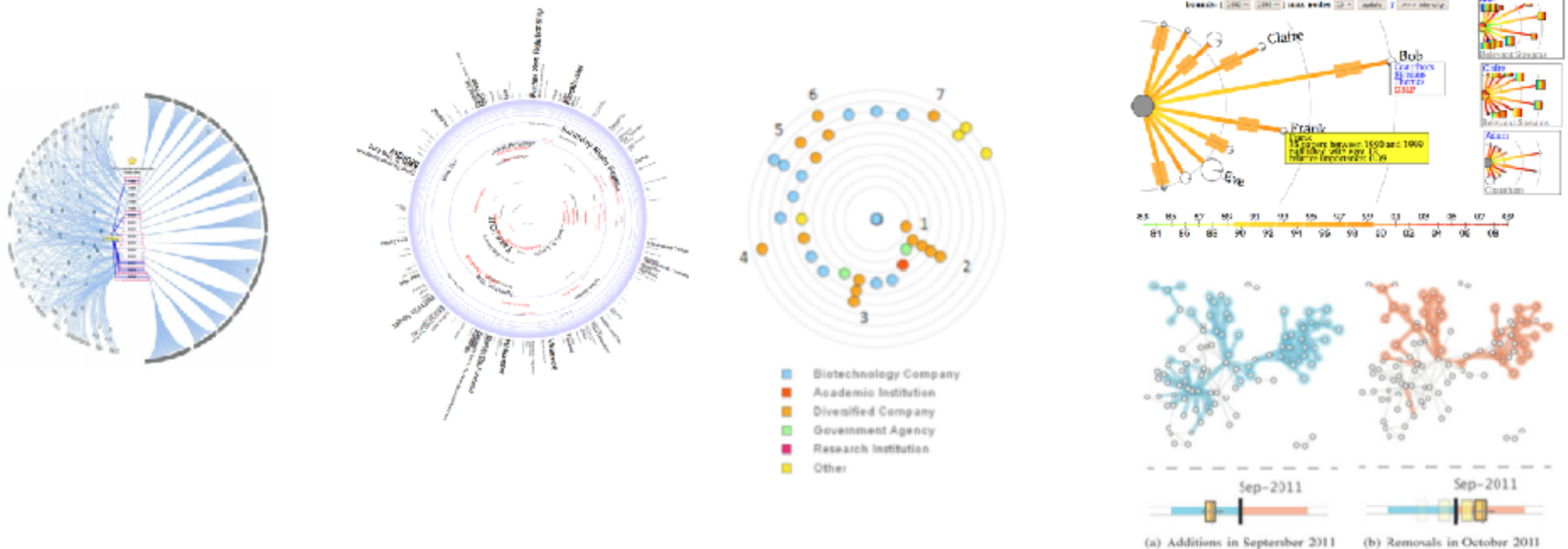- An interactive visualization system to enable users explore and compare ego-network evolution trends and patterns

- A bump chart design combined with the sankey diagram and specialized glyphs to illustrate the changes of relation strength with neighbours and to track an ego-network community evolution process.

- Two case studies of real DBLP dataset to demonstrate the usefulness of our visualization system

- An improved graph similarity calculation algorithm targeting at ego-network data

Related Works

- Ego-network analysis

  - Papers from conferences like WWW, KDD, journals like Social Networks

- Graph matching

  - Several graph matching / similarity surveys based on the graph edit distance, artificial intelligence

  - Dynamic time warping or co-integration for time-series data?

- Network visualization (dynamic network, ego-network)

  - Eurovis'14 dynamic graph survey: node-link based, matrix based, animation, etc.

  - Ego-network visualization: From Shi, Reitz, Farrugia, and Brandes

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Biotechnology Company
Academic Institution
Diversified Company
Government Agency
Research Institution
Other

(a) Additions in September 2011   (b) Removals in October 2011

Design Tasks

- T1: Illustrate the clusters of similar ego-network distribution and their linking trends over time

- T2: Select and investigate a group of people with similar evolution patterns

- T3: Examine the details of one dynamic ego network

- T4: Side by side comparison of the evolution of two ego networks

Design Tasks

- T3

  - T3.1 How relation strengths evolve over time?

  - T3.2 How new relations come into being?

  - T3.3 How the alter communities evolve over time?

 - T3.4 How alters connected at one timestamp?

Visual Design

- Overview: Illustrate ego-network clusters & trends over time (T1, T2)

- LOD view: Explore a person's ego-network evolution including the relation strength changes between the ego and alters, community evolution flows of alters, and the relations among alters (T3, T4)

Overview Design

- Overview:

  - TableList + Density map + FlowMap / LineSet / Curves

  - Density map: based on graph similarity + MDS
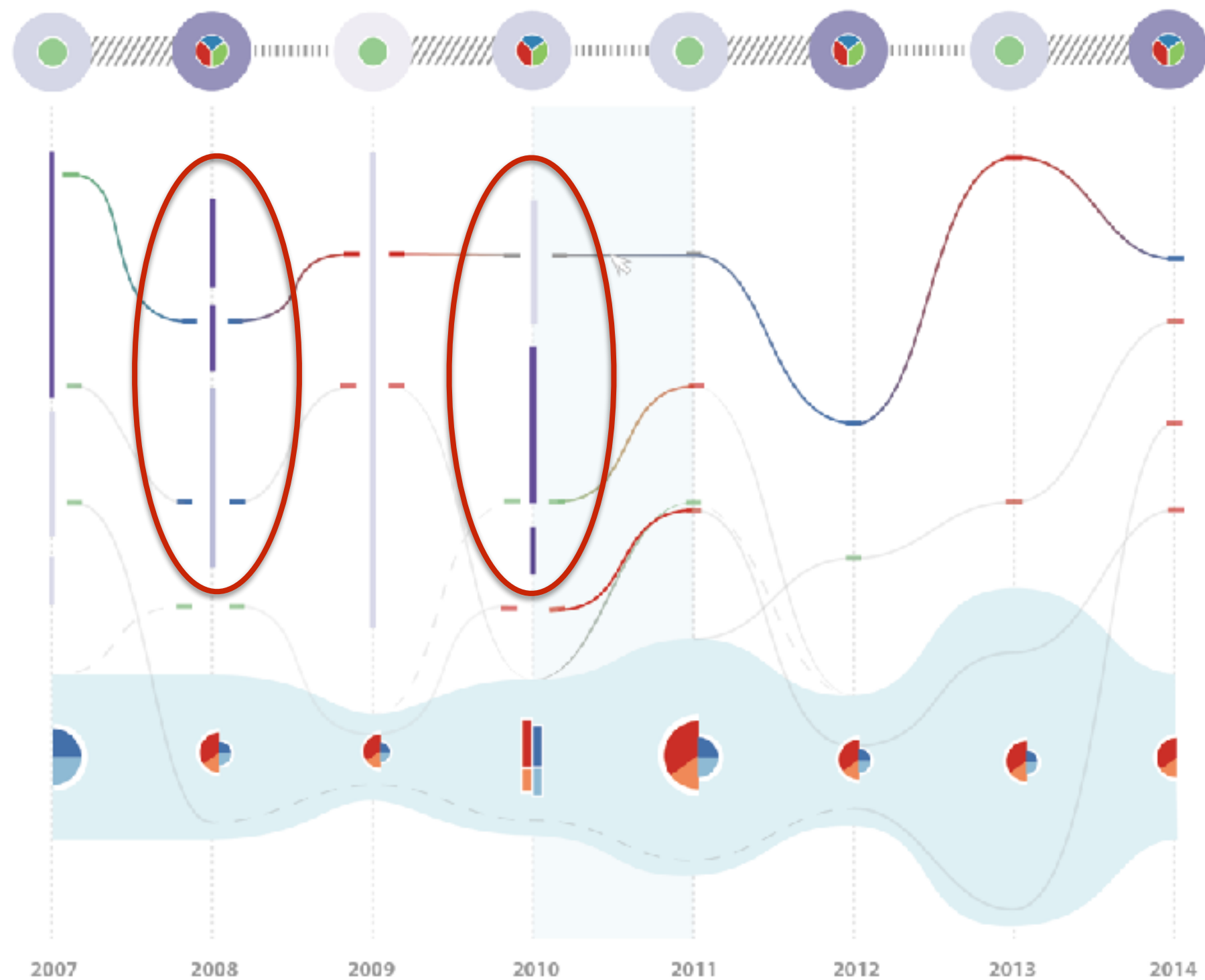
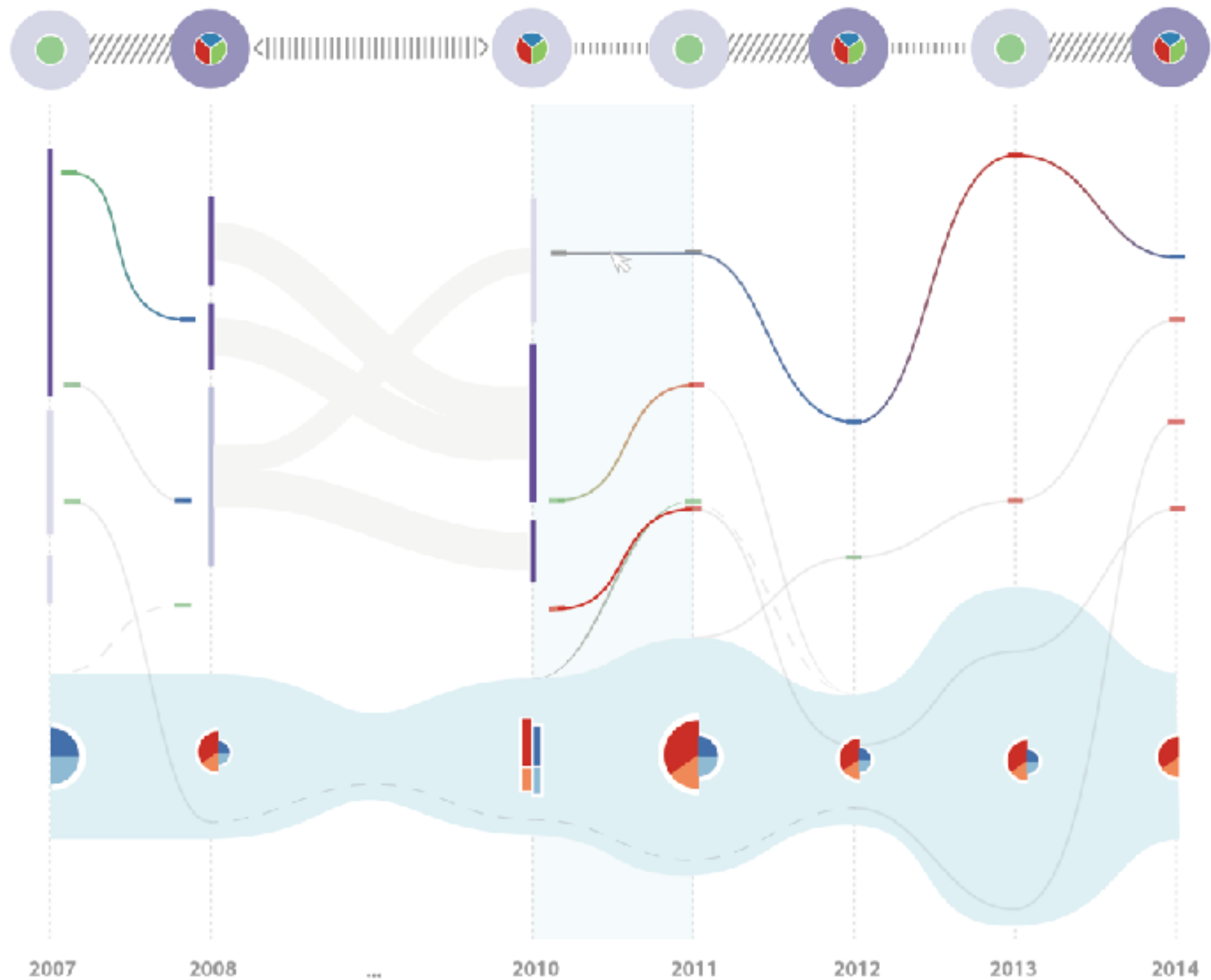# Overview Design

FlowMap:
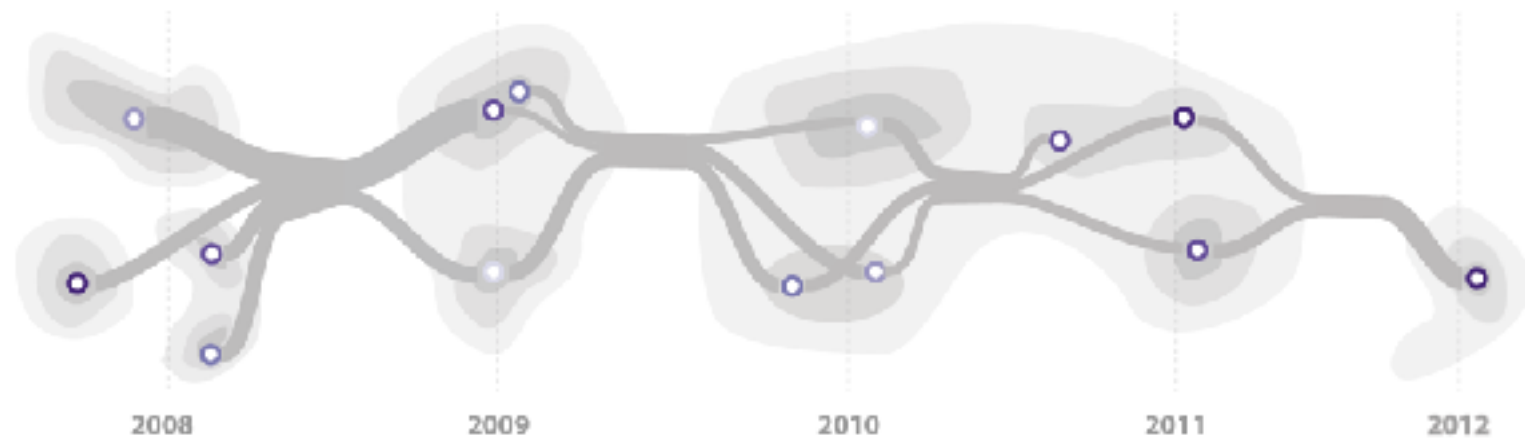
LineSet:

Curve:

LOD View Design

- LOD View:

    - Glyph view: Show ego-network's density and changes from last timestamp briefly

    - Evolution view: Show how many disconnected parts in each timestamp and the tie strength evolution between the ego and alters. Folding is allowed for users to explore the alters flow trend between multiple timestamps

    - Relation view: Show the relations of alters at one timestamp by clicking and expanding a timestamp axis
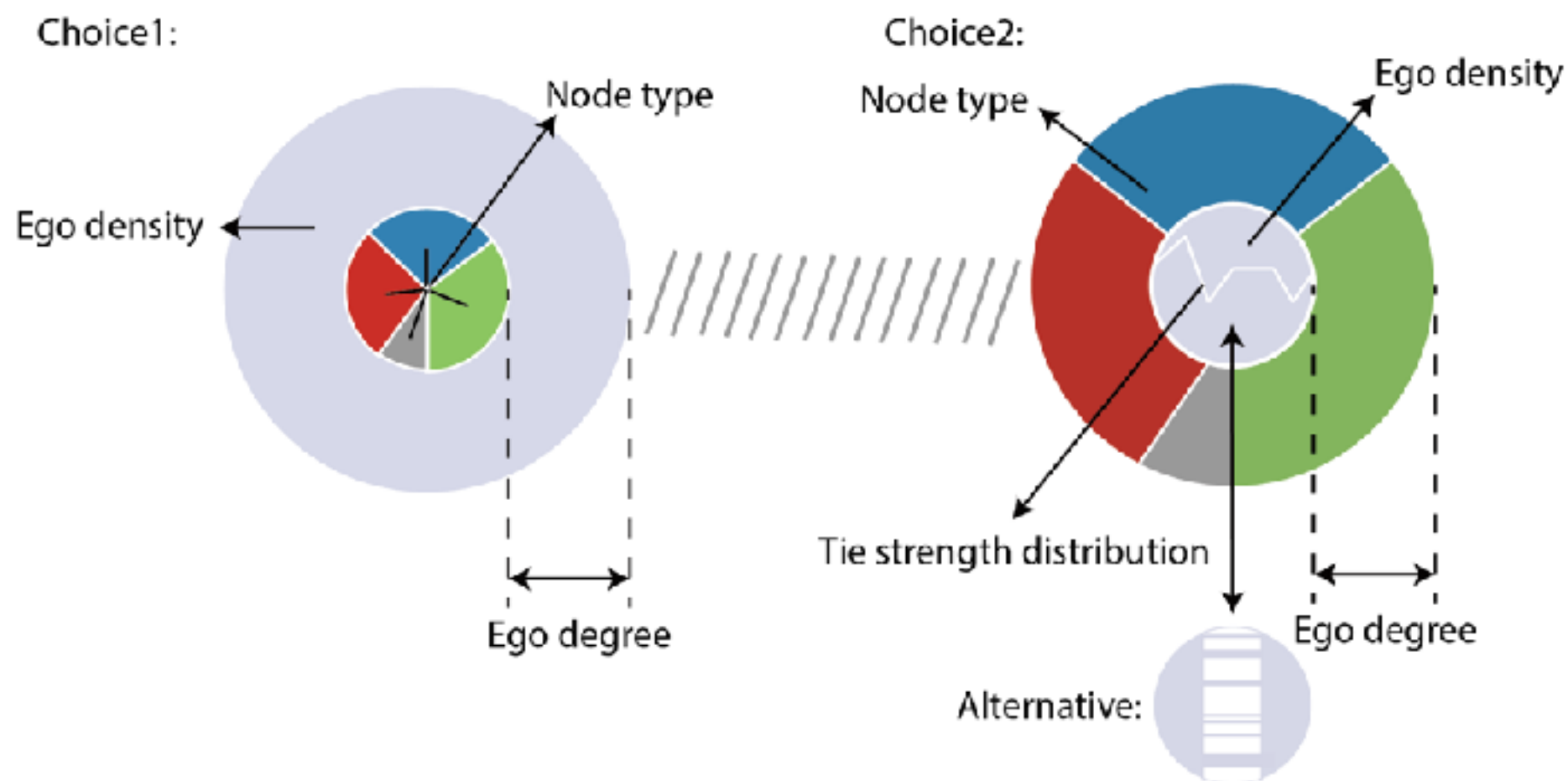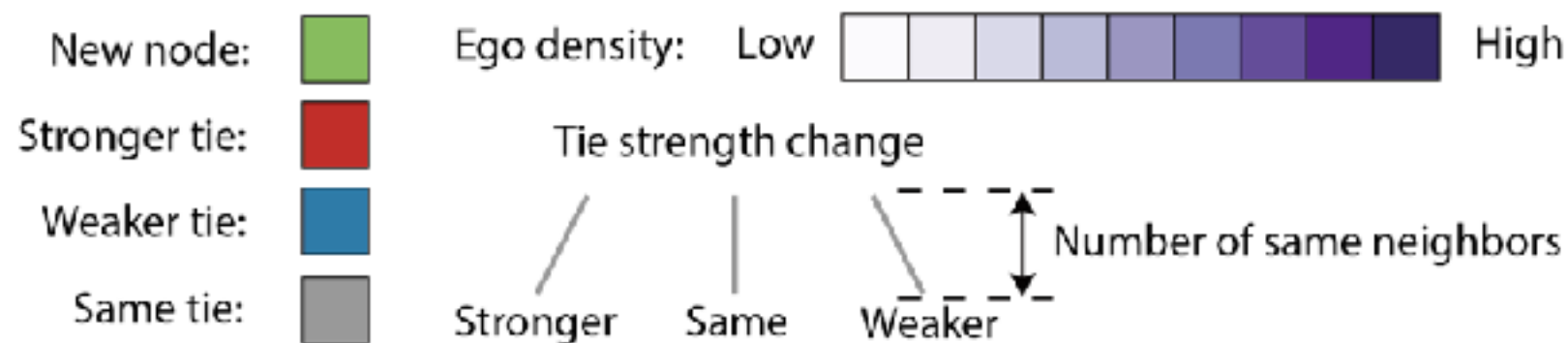
LOD View Design

LOD View Design

Glyph Design

Expected Results

- Dataset:

  - DBLP, IMDb

- Tools:

  - Python, MongoDB, JavaScript

List of All Figures

- Expected figures (9 ~10):

  - Teaser: Introduce each part of the system

  - System overview: Show data processing pipeline

  - Overview design choices: Density map + Flow choice

  - LOD view curve layout algorithm

  - Glyph design choices

  - Neighbour relation design choices (Vertical bars, matrix, arc diagram, packing circles, etc.)

  - Case study 1 & 2 (2 ~ 3 figures)

  - User study results

Remaining Tasks

- Unsolved major problems:

  - Ego-network feature vectors & graph comparison algorithm effectiveness

  - Valuable patterns in dataset

  - Lack of experts and the target users (analysts or common users)

- Limitations

  - MDS calculation scalability

  - Scalability of LOD view

  - Community definition: cluster or disconnected part?

Remaining Tasks

- Workload:

  - Coding: Data processing | Graph comparison | Visual system | User study

  - Writing:

    ‣ Introduction + Related Works (2 pages)

    ‣ System Overview + Data Model + Graph Similarity (1 page)

    ‣ Design Rationale + Visual Design + Interaction (2.5 pages)

    ‣ 2 Case Studies + 1 User Study (2.5 pages)

    ‣ Discussion + Conclusion (0.5 page)

    ‣ References (1 page)

    ‣ Backup (0.5 page)

Remaining Tasks

- Milestones (deadlines):

  - March 2nd

    ‣ Writing: Introduction, Related Works

    ‣ Coding: Data processing, system prototype

  - March 16th:

    ‣ Writing: System overview, Design rationale, Visual design

    ‣ Coding: Got suitable graph matching algorithm, finish visualization system

- March 23rd

  ‣ Writing: 2 case studies

  ‣ Coding: Got suitable dataset and finish interactions

- March 30th:

  ‣ Writing: user study, discussion and conclusion

  ‣ Experiment: Finish user study statistics

- March 31st:

  ‣ Tune figures, proofread, make video

Thanks!