Vision, Resources, and Opportunities for Next Generation of Data Mining and Cyber-Enabled Discovery and Innovation

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Jeannette Wing, Assistant Director

National Science Foundation (NSF)
Arden Bement, Director

National Science Foundation
WHERE DISCOVERIES BEGIN

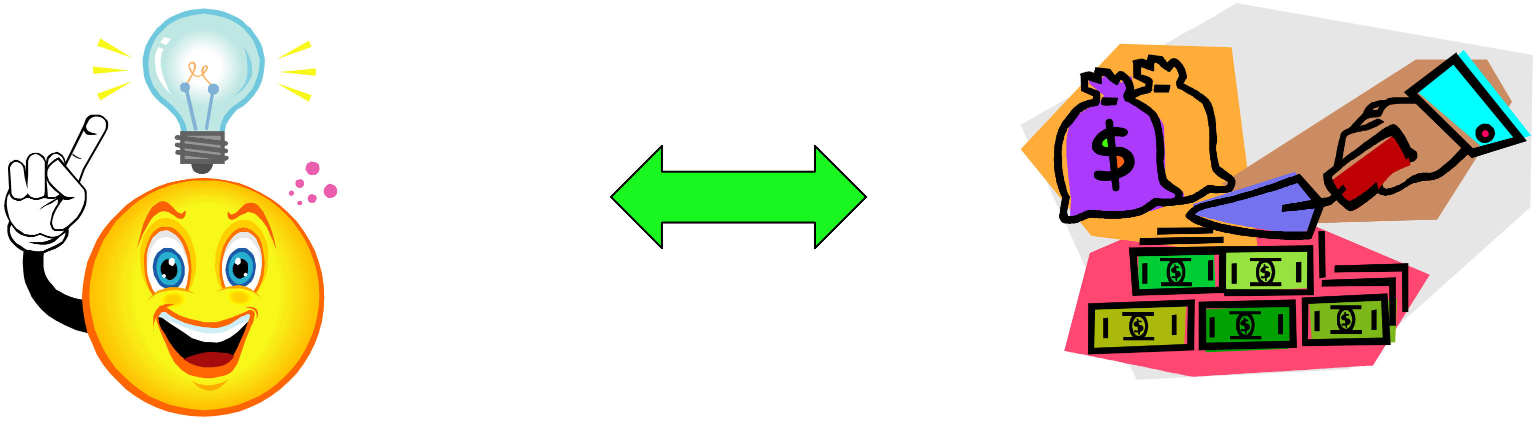
“We”

You: researchers

Academia
Industry
Government labs
International

Us: supporters

NSF, NASA, NIH, DOE,…
Industry
Private funders
International



What “us” need from you

- Research challenges
- Infrastructure needs
- Recommendations for partnerships
- Innovative proposals
  - Research
  - Workshops
  - Educational activities
- Dedication to education, outreach
- Taking broader impacts seriously
- Participation in review process
- Examples of successful research
- Come to NSF as program director, division director,…

Examples of Successful Research

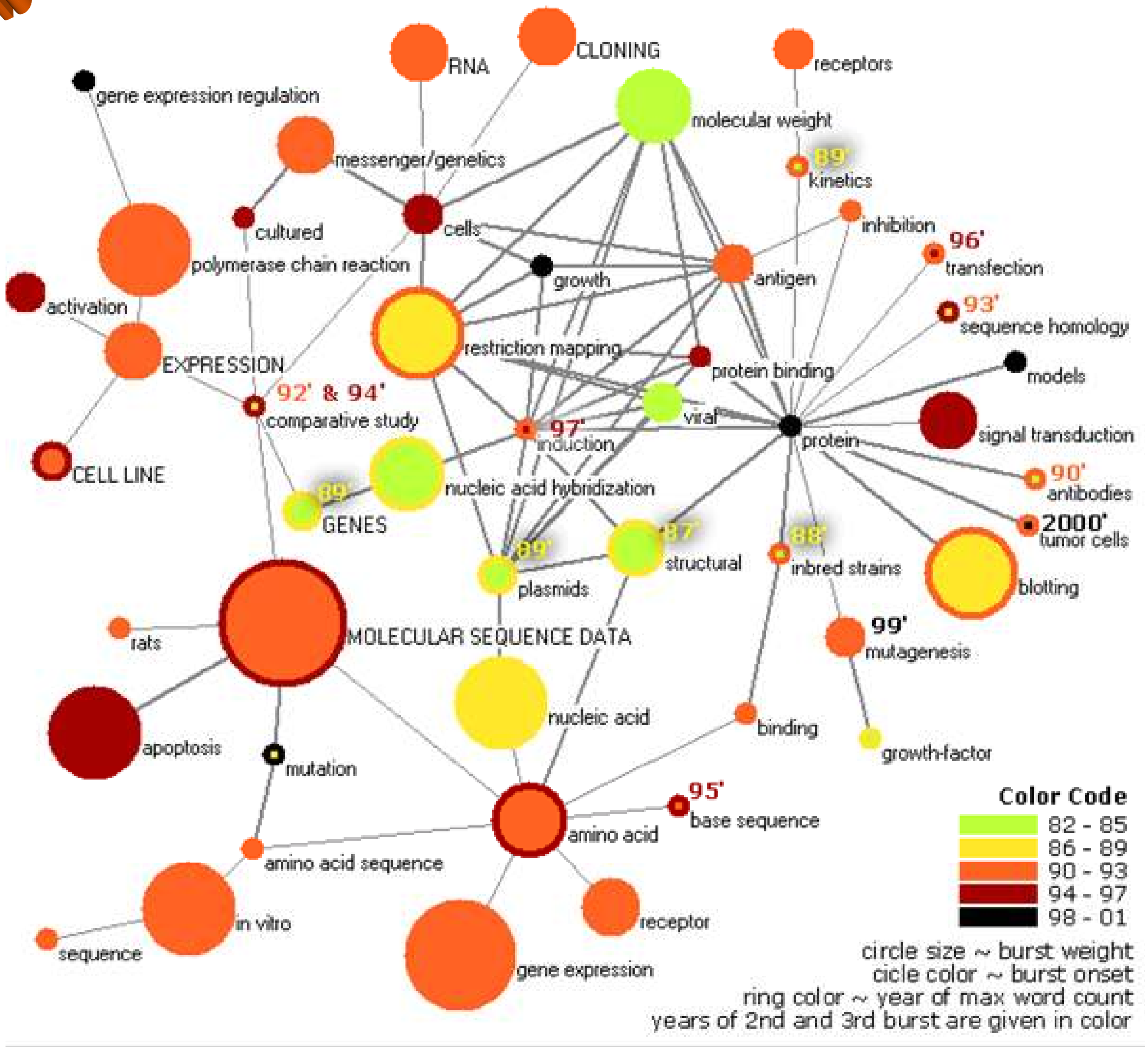
- Inform the public
- Justify funds spent
- Request more funding

Mapping

Topic Bursts

Visualization of keywords appearing in PNAS 1982 -- 2001.

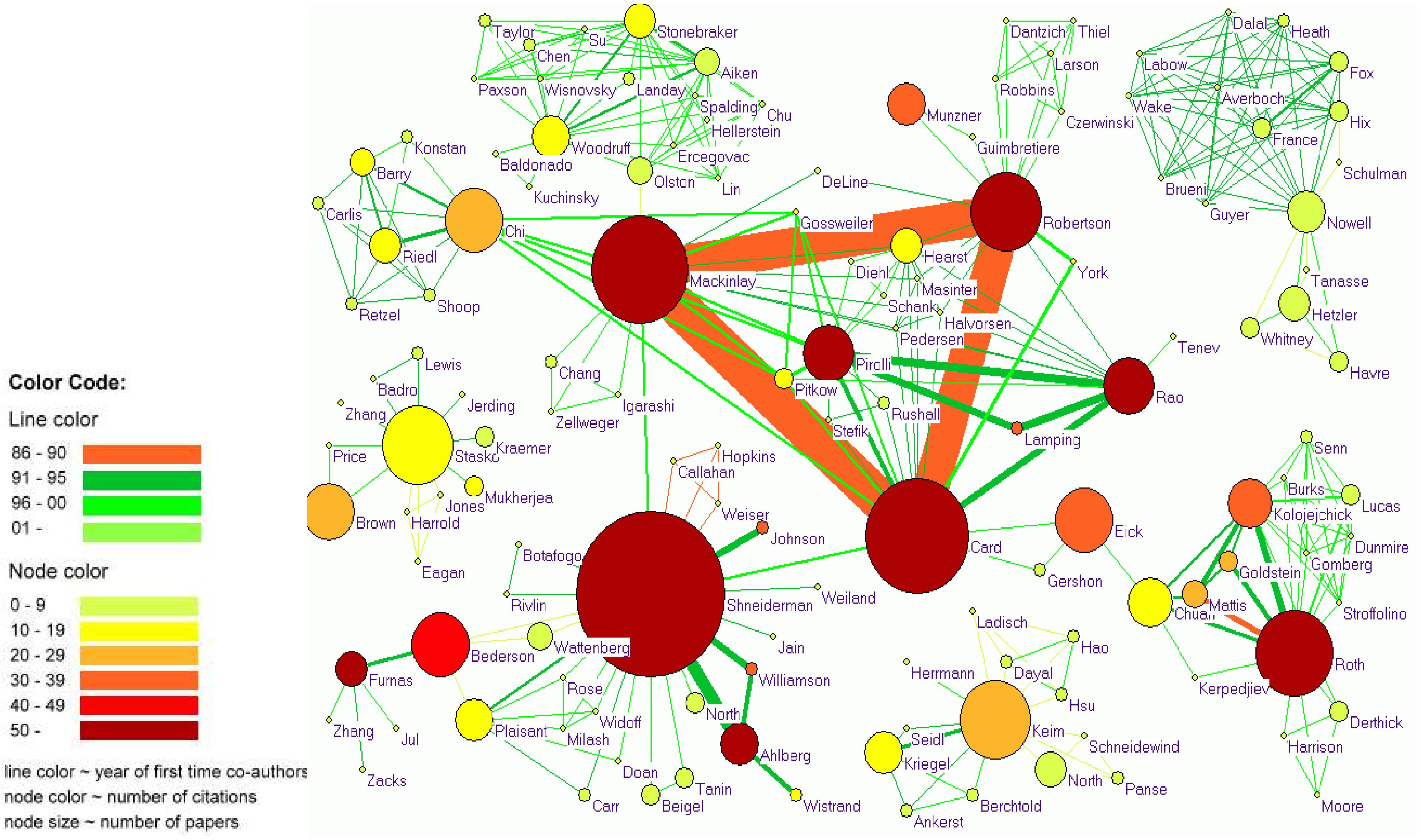
The top 10% of highly cited PNAS papers were analyzed to reveal keywords listed with high frequency or rapid initial appearance (Topic burst).



Ke, Visvanath & Börner

Mapping the Evolution of Co-Authorship Networks

(Won 1st price at the IEEE InfoVis Contest, 2004)



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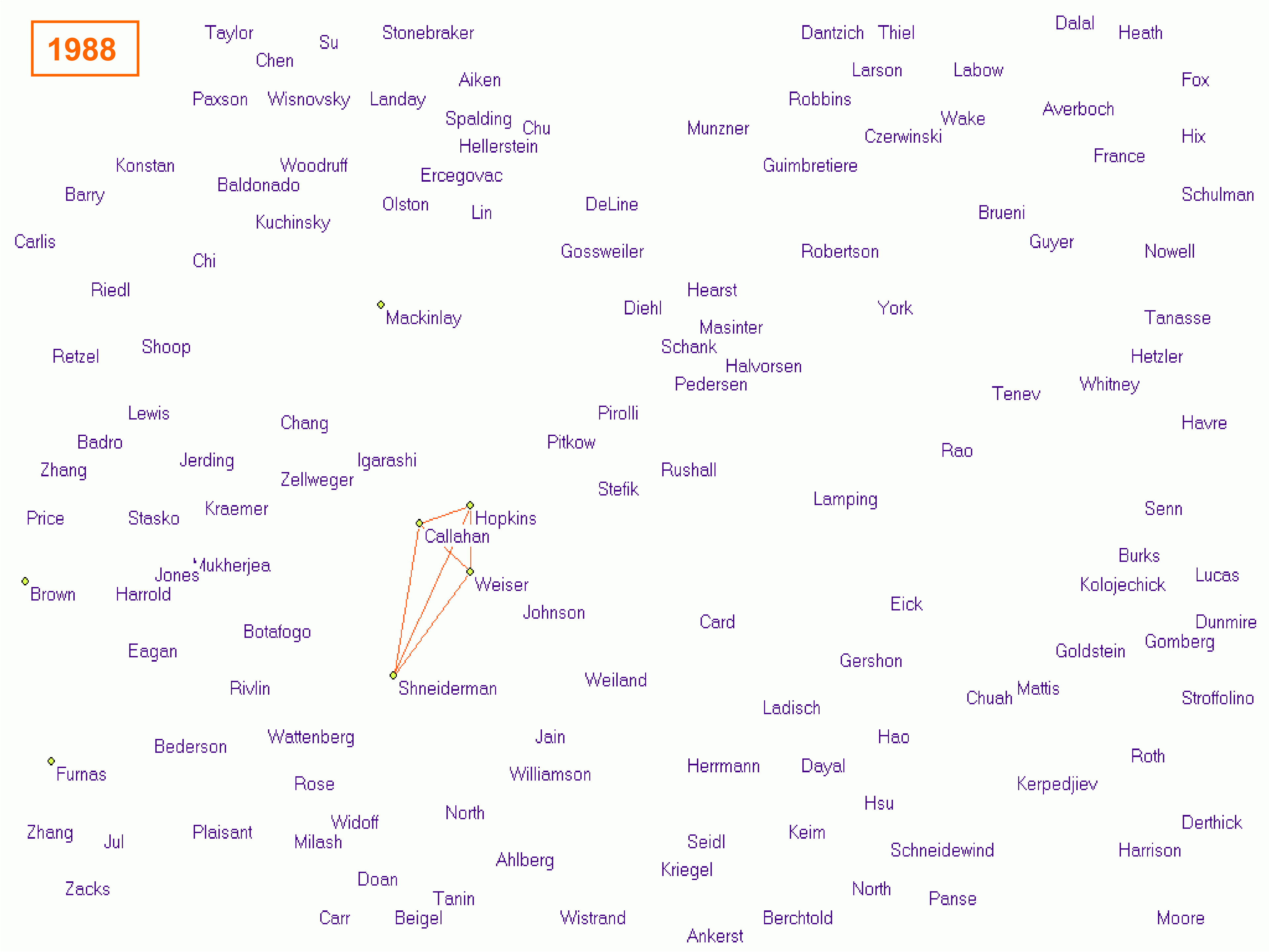
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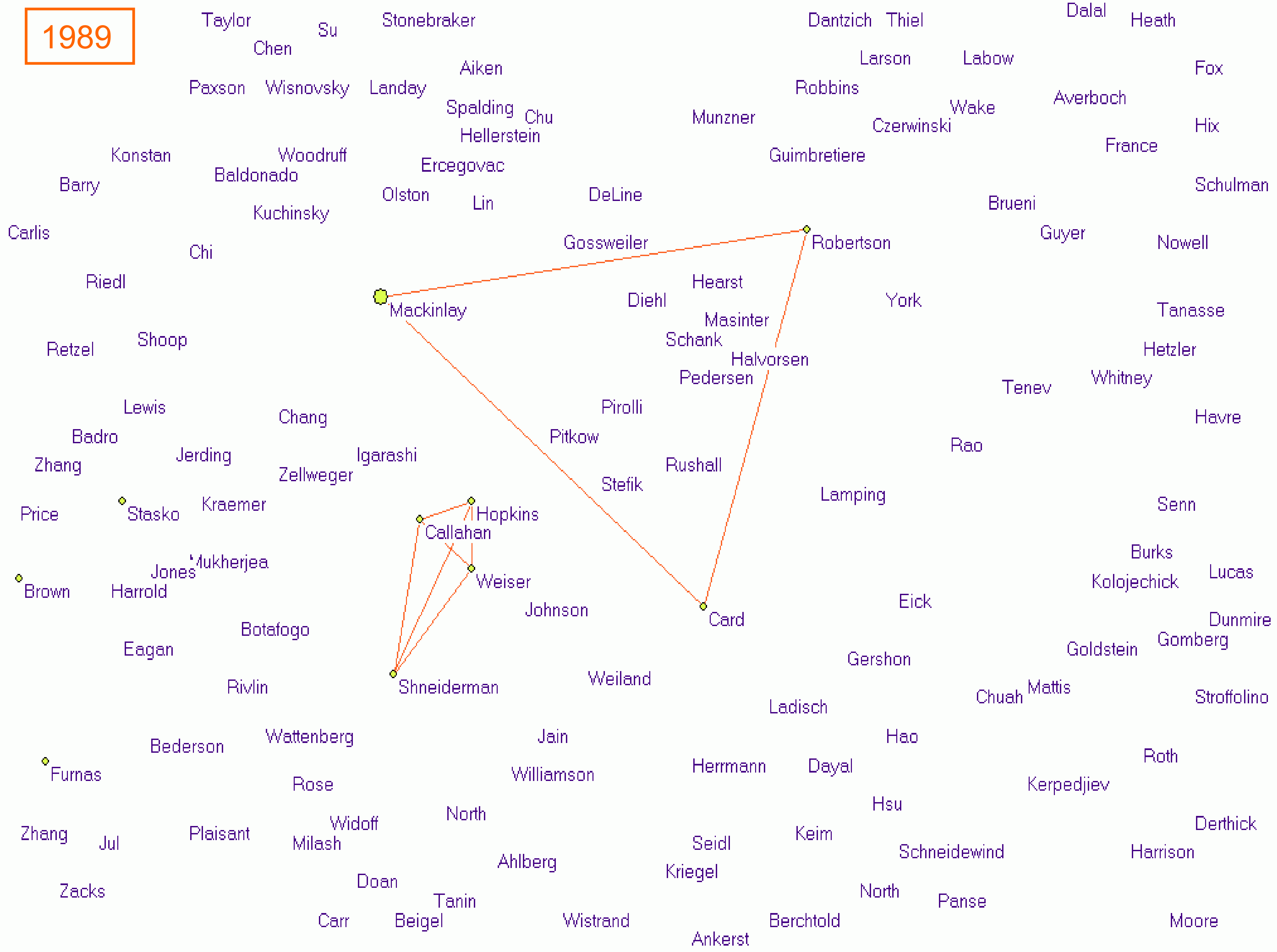
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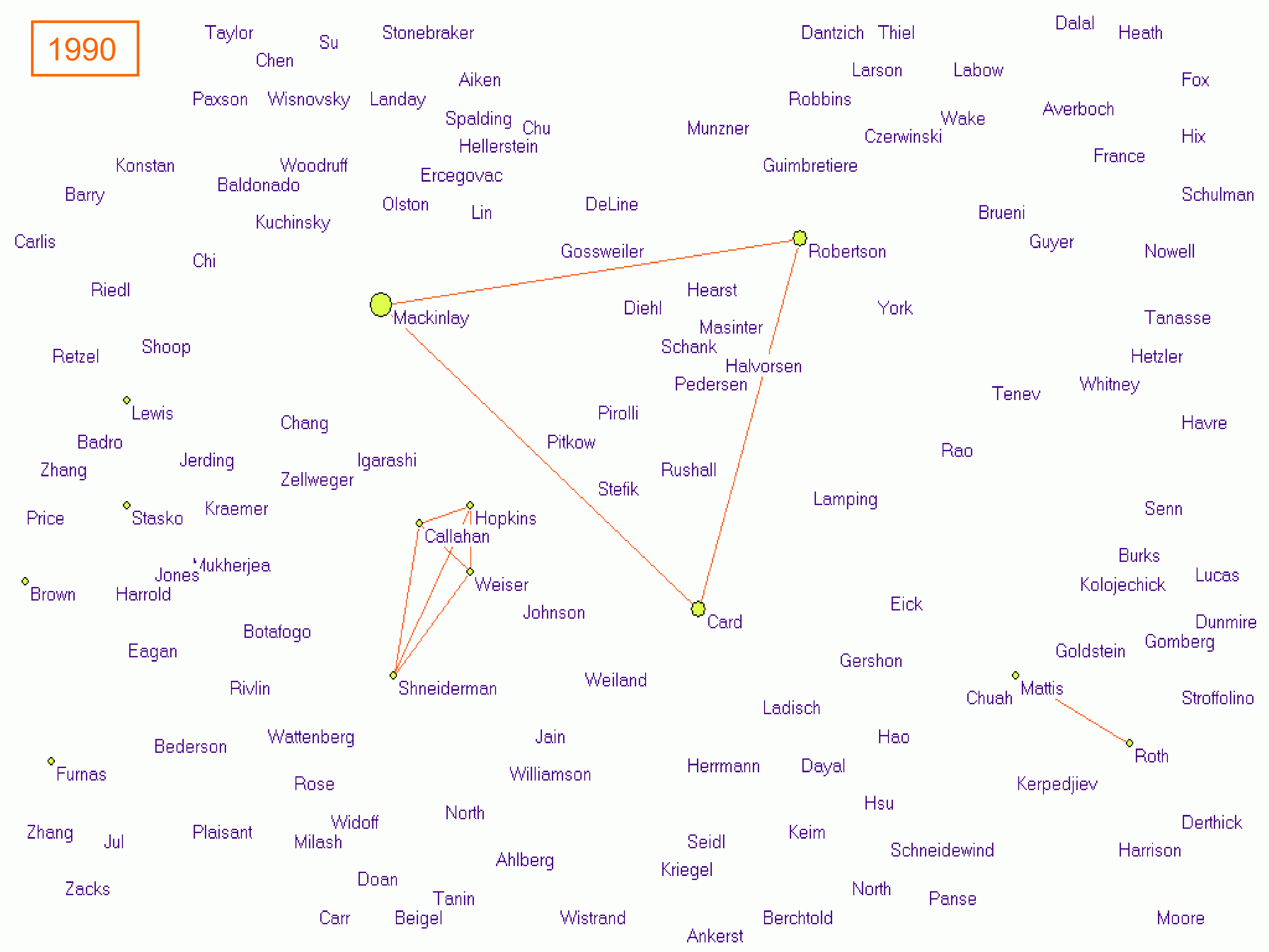
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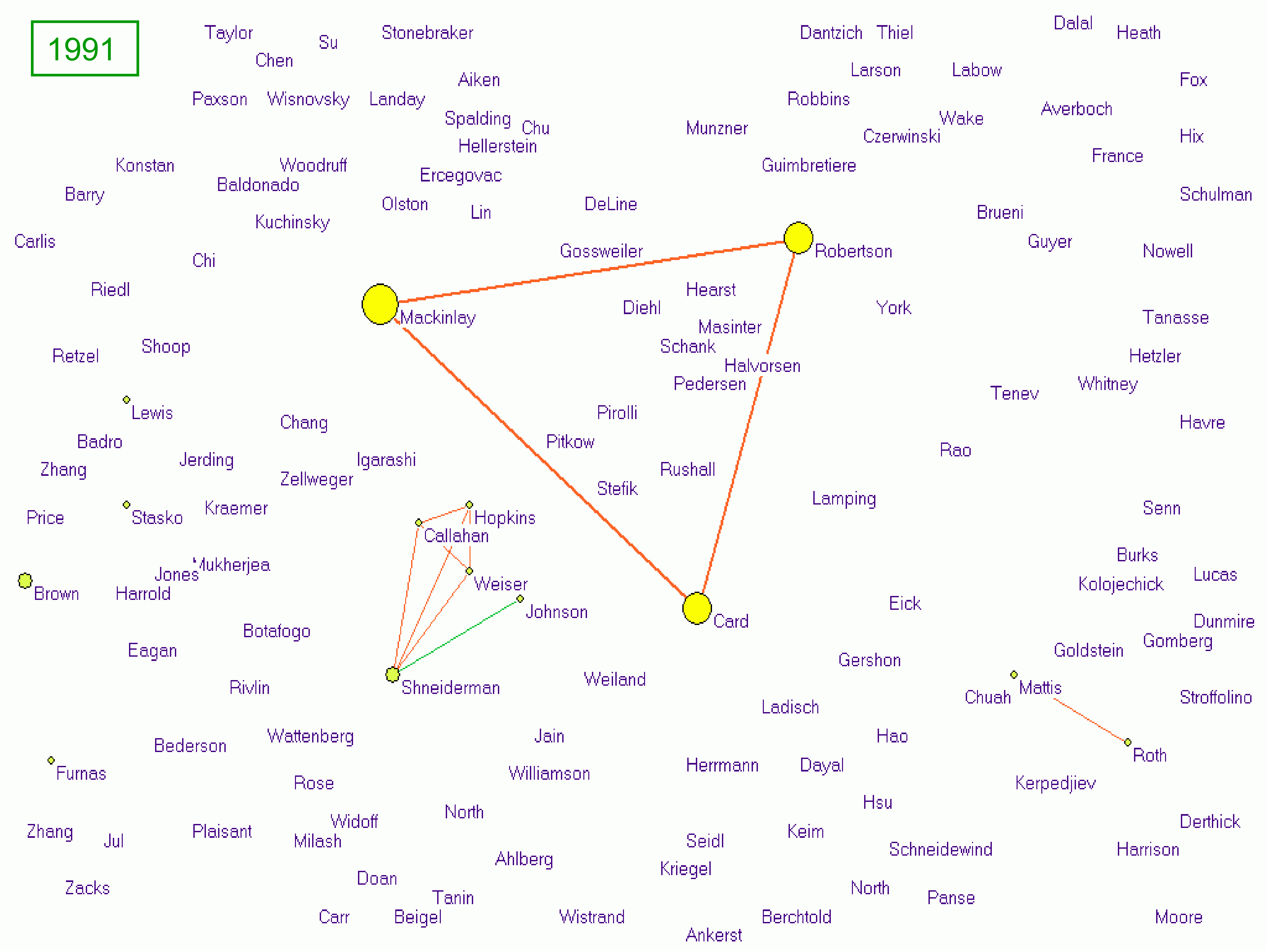
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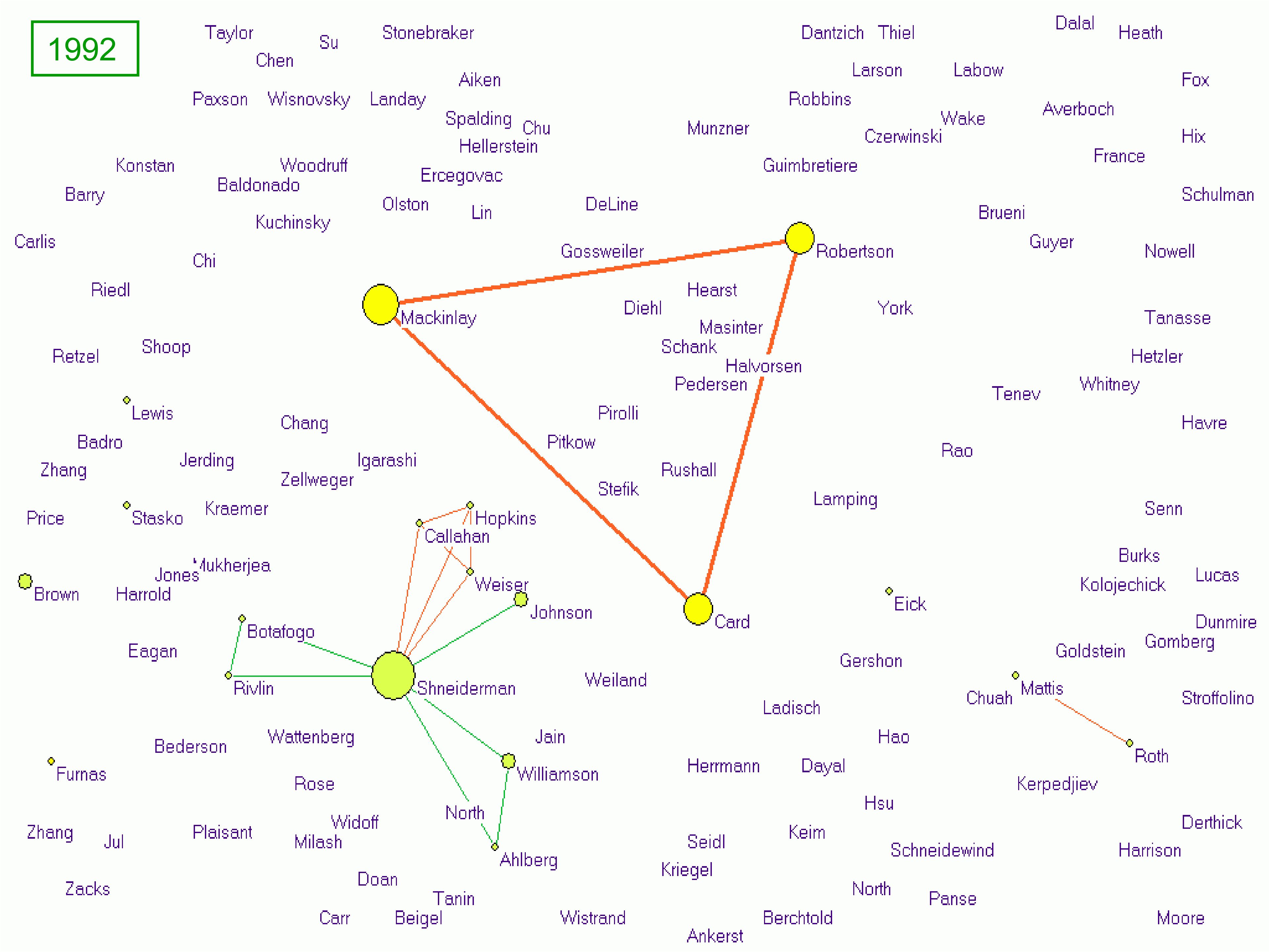
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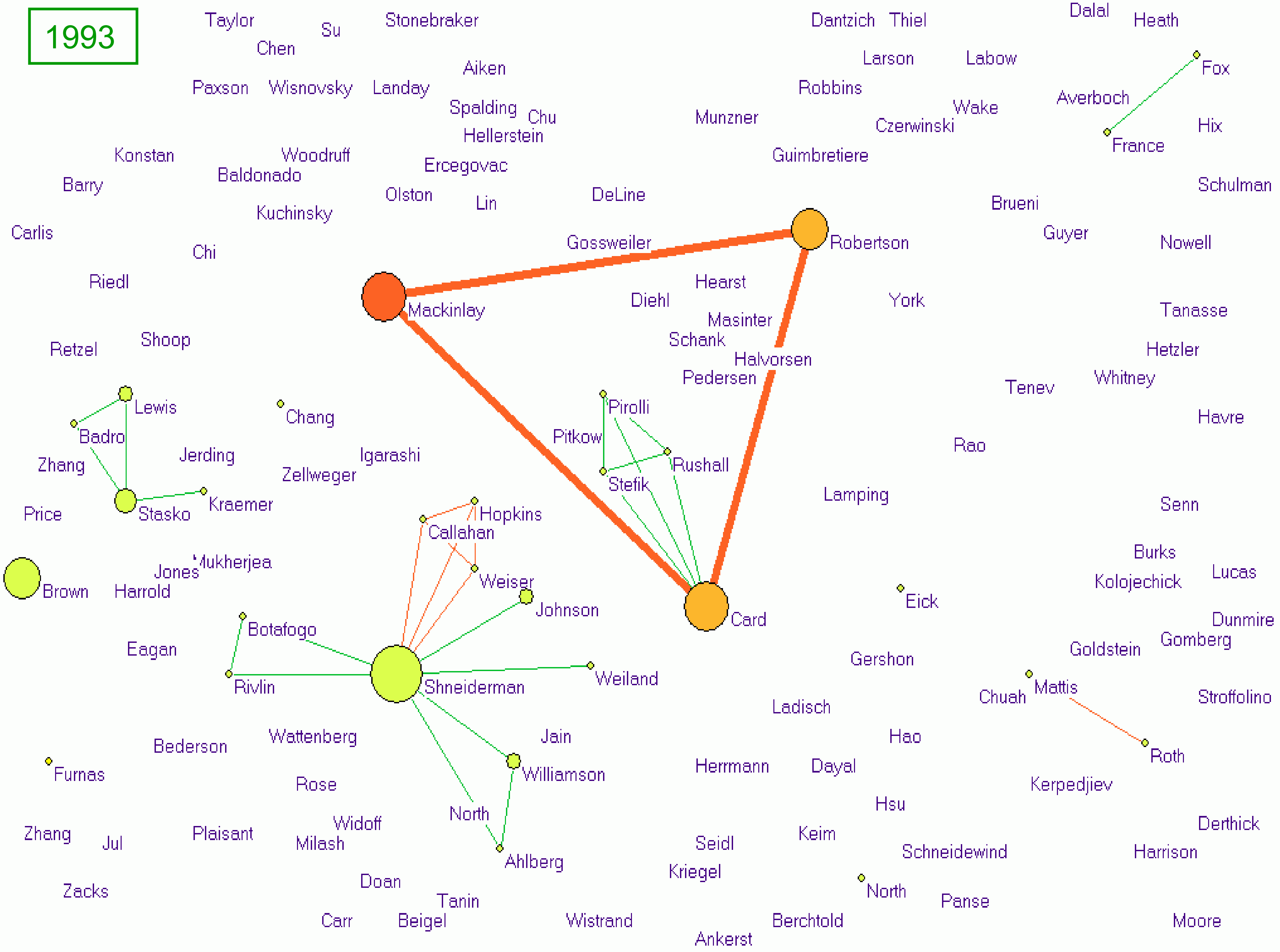
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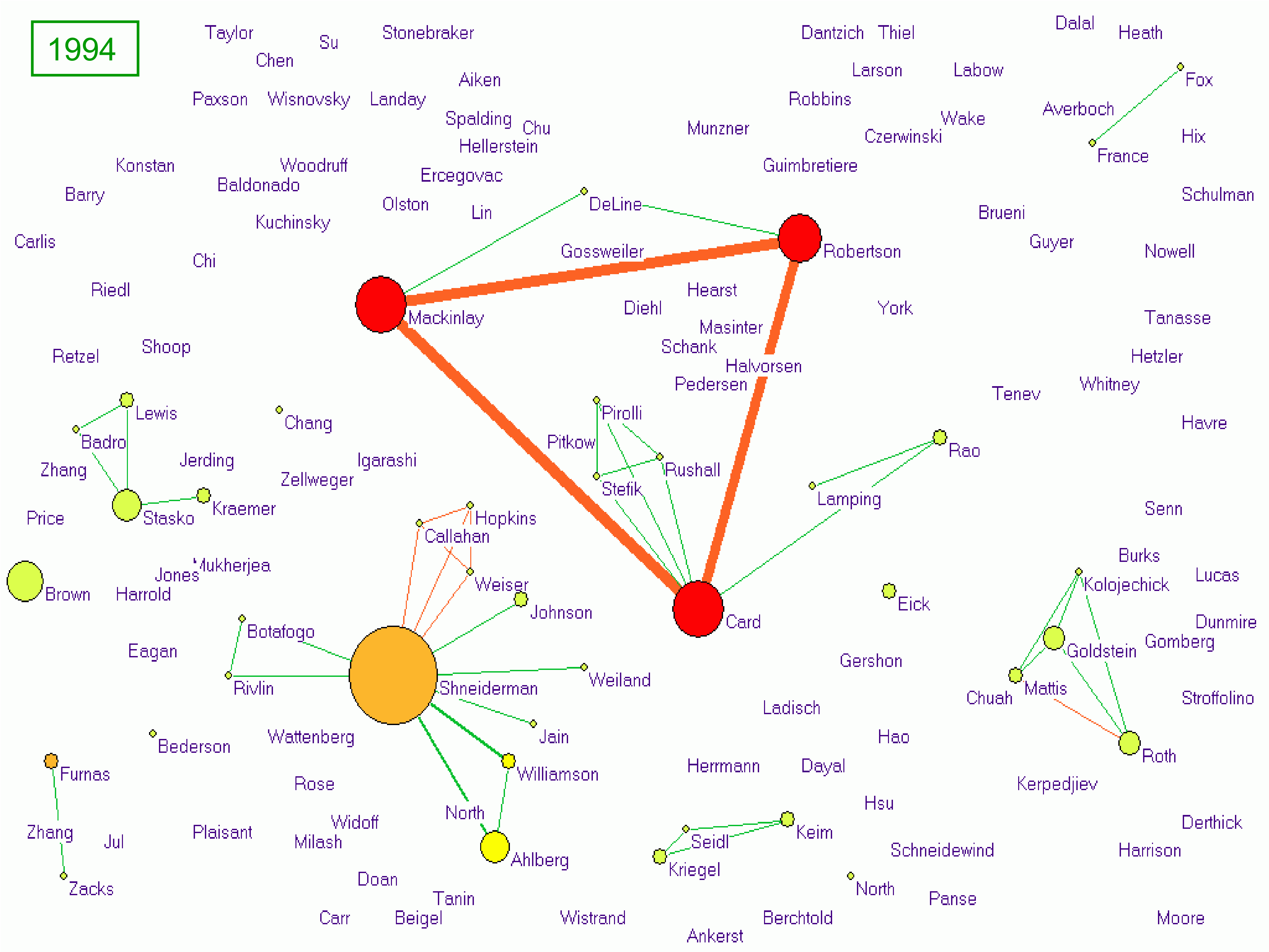
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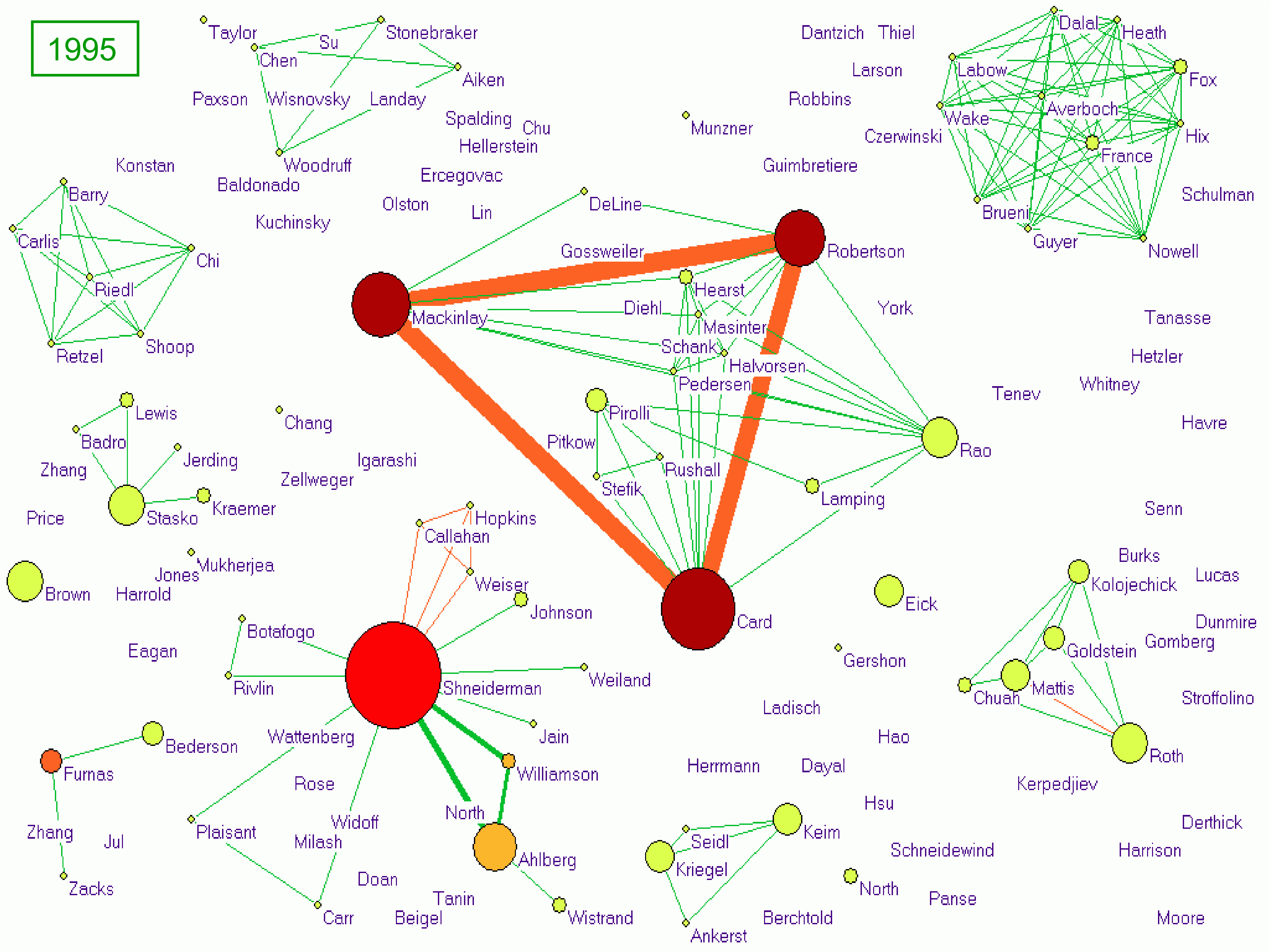
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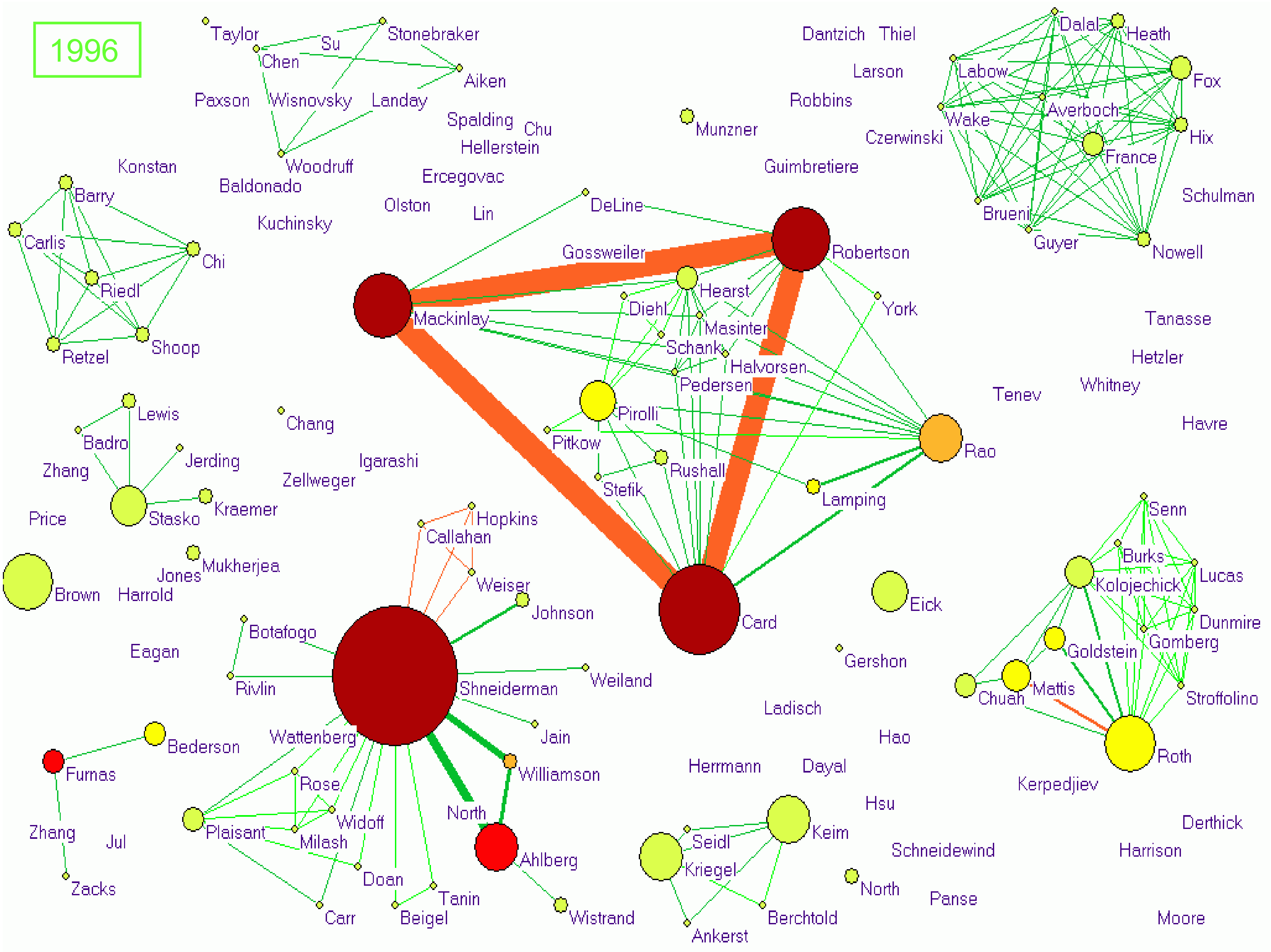
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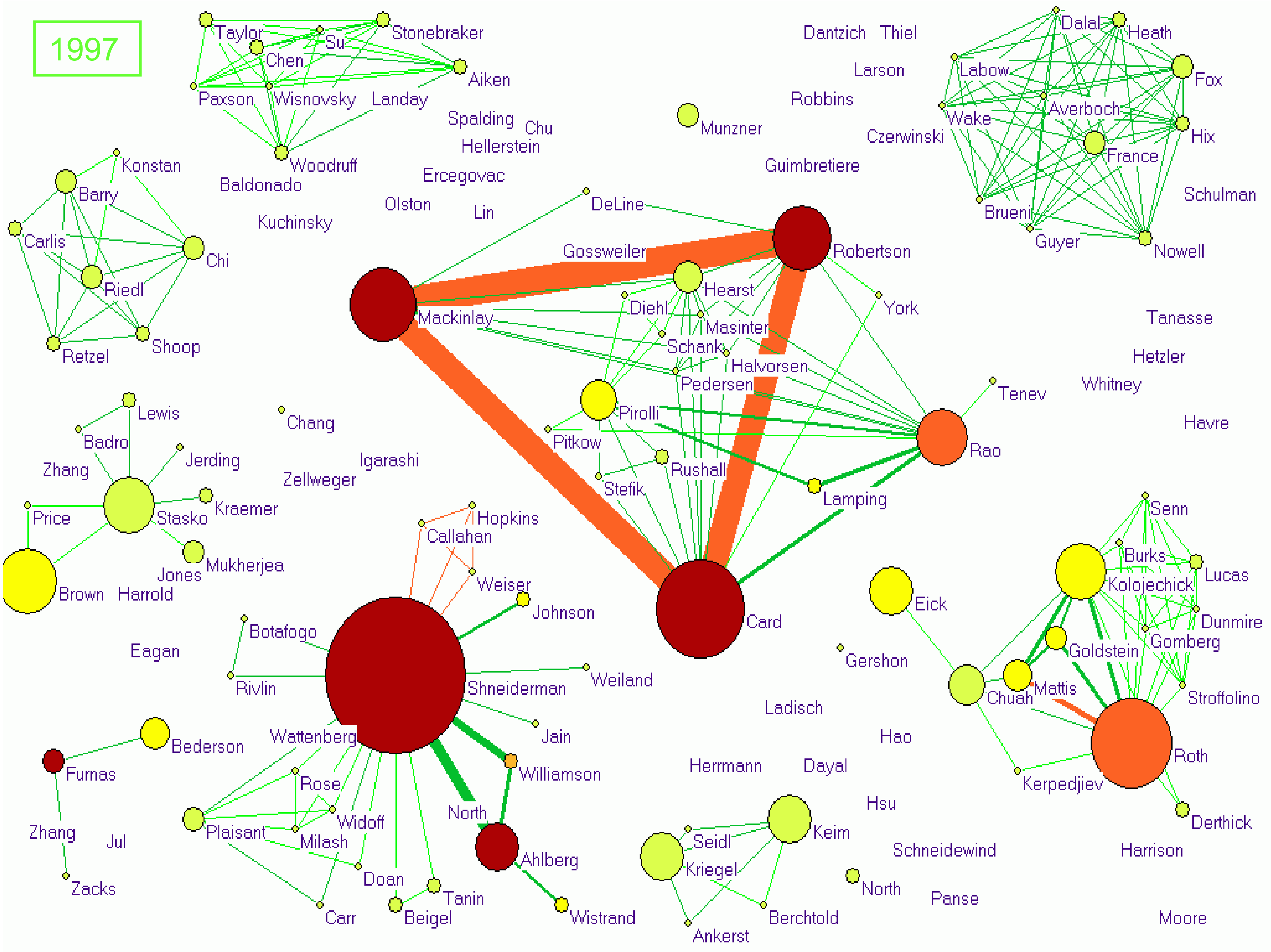
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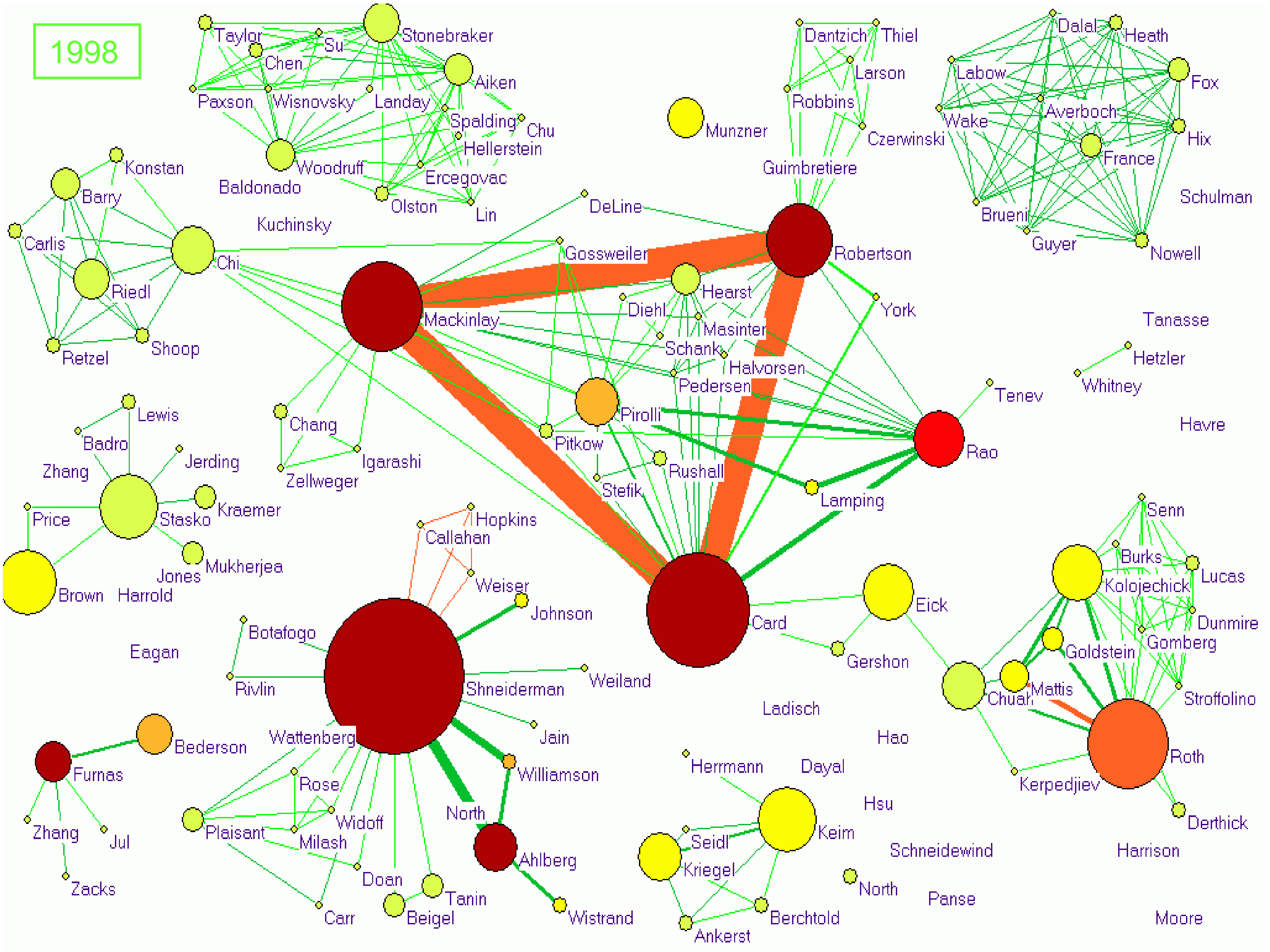
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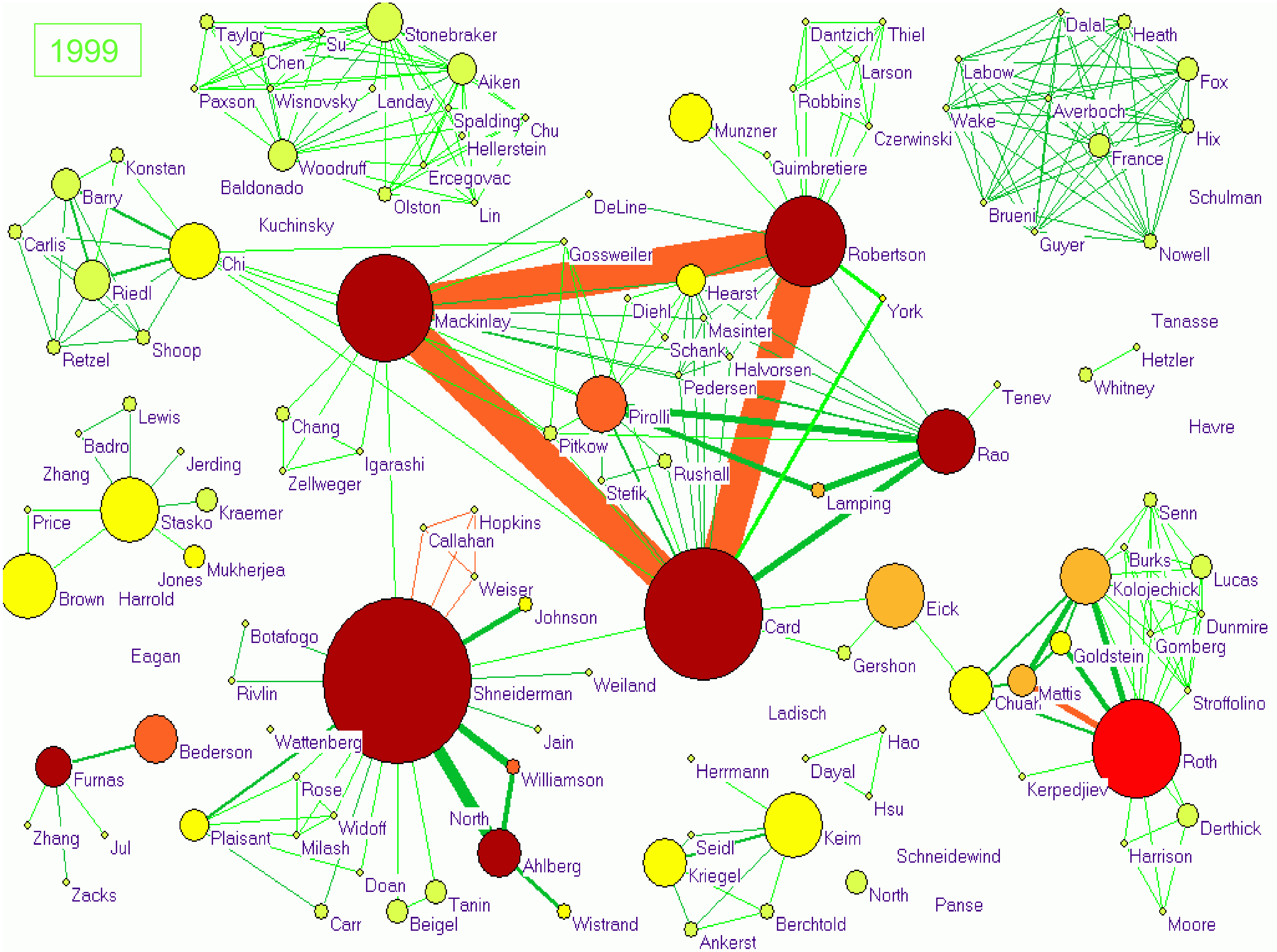
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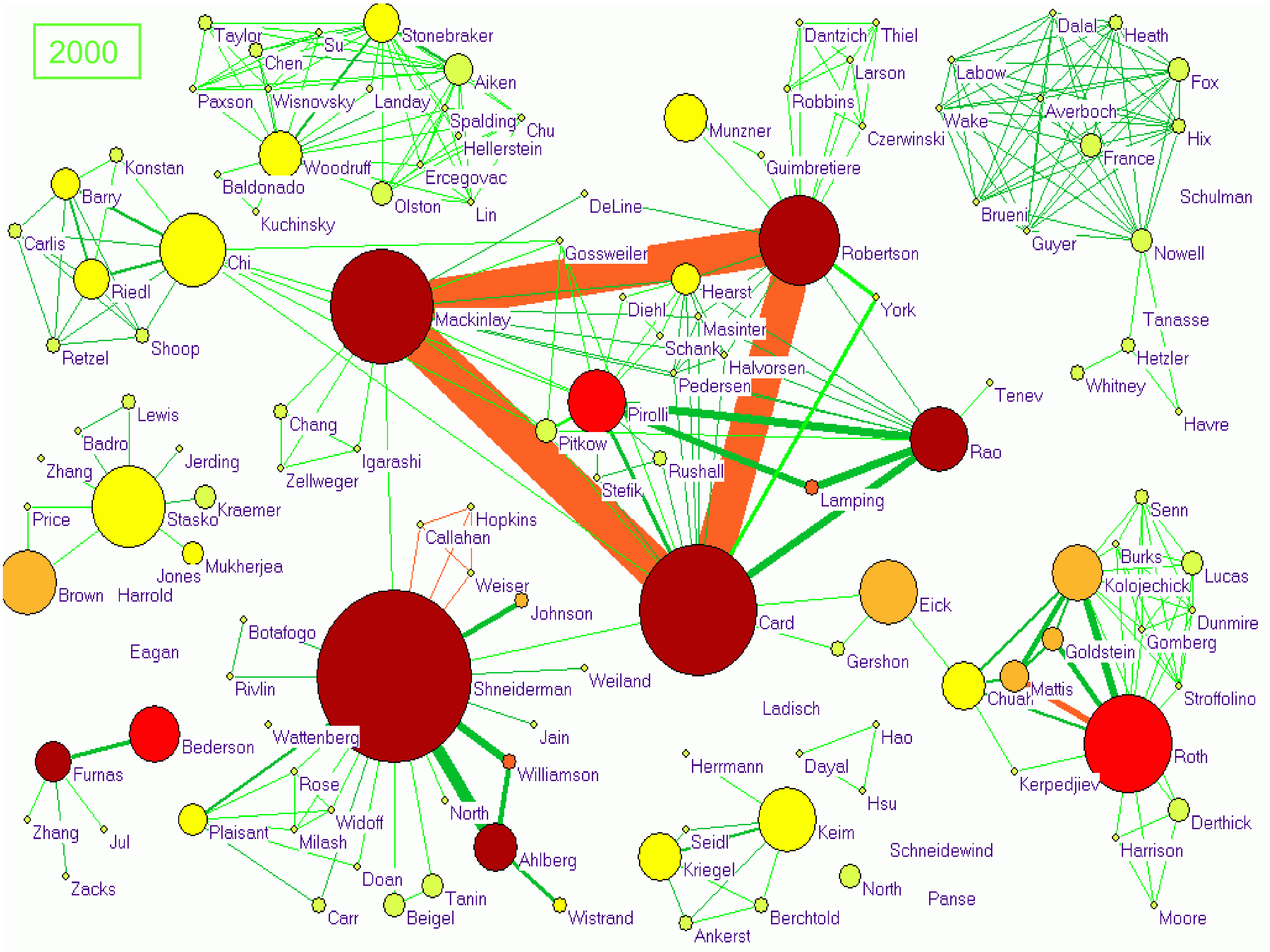
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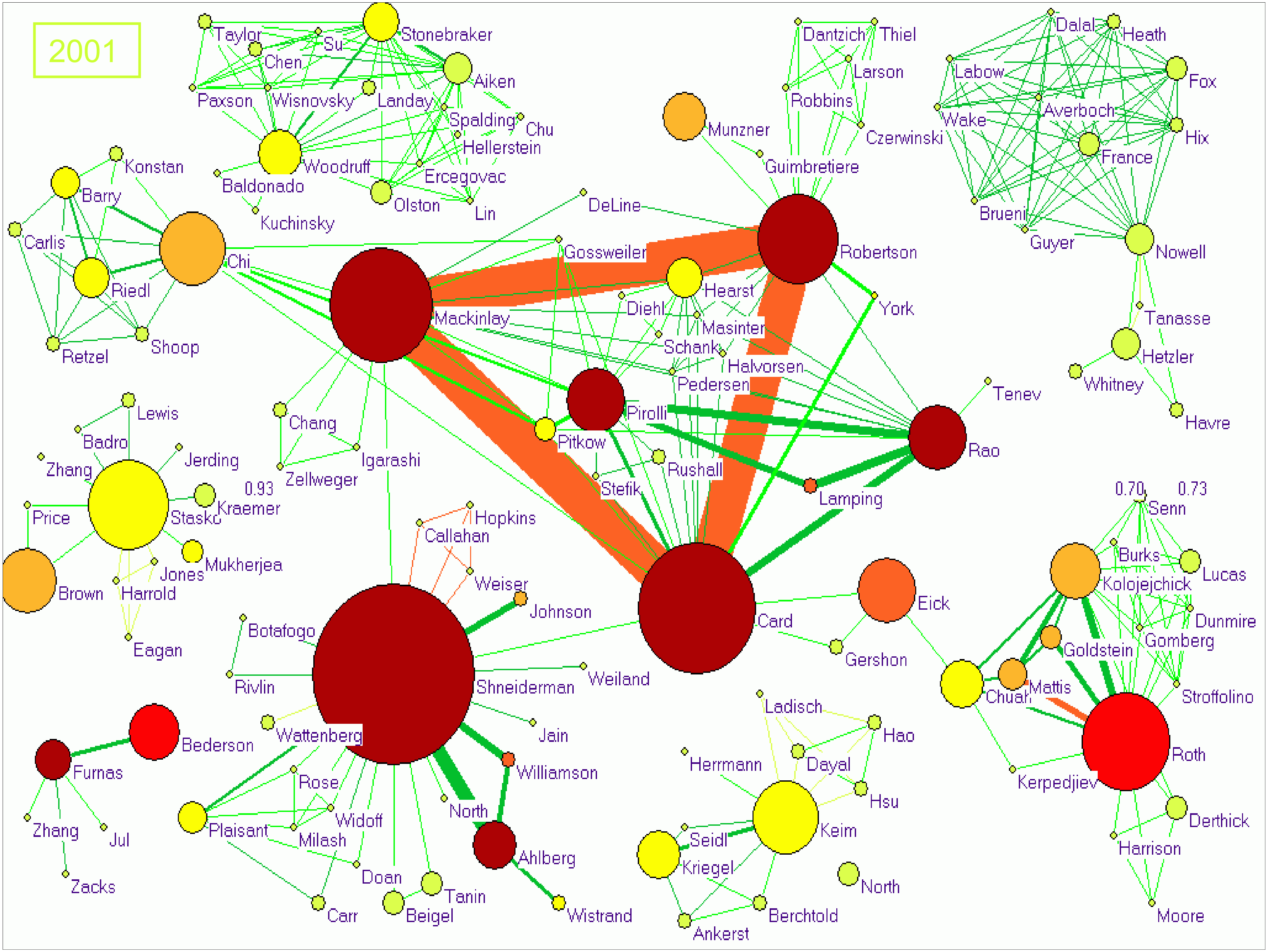
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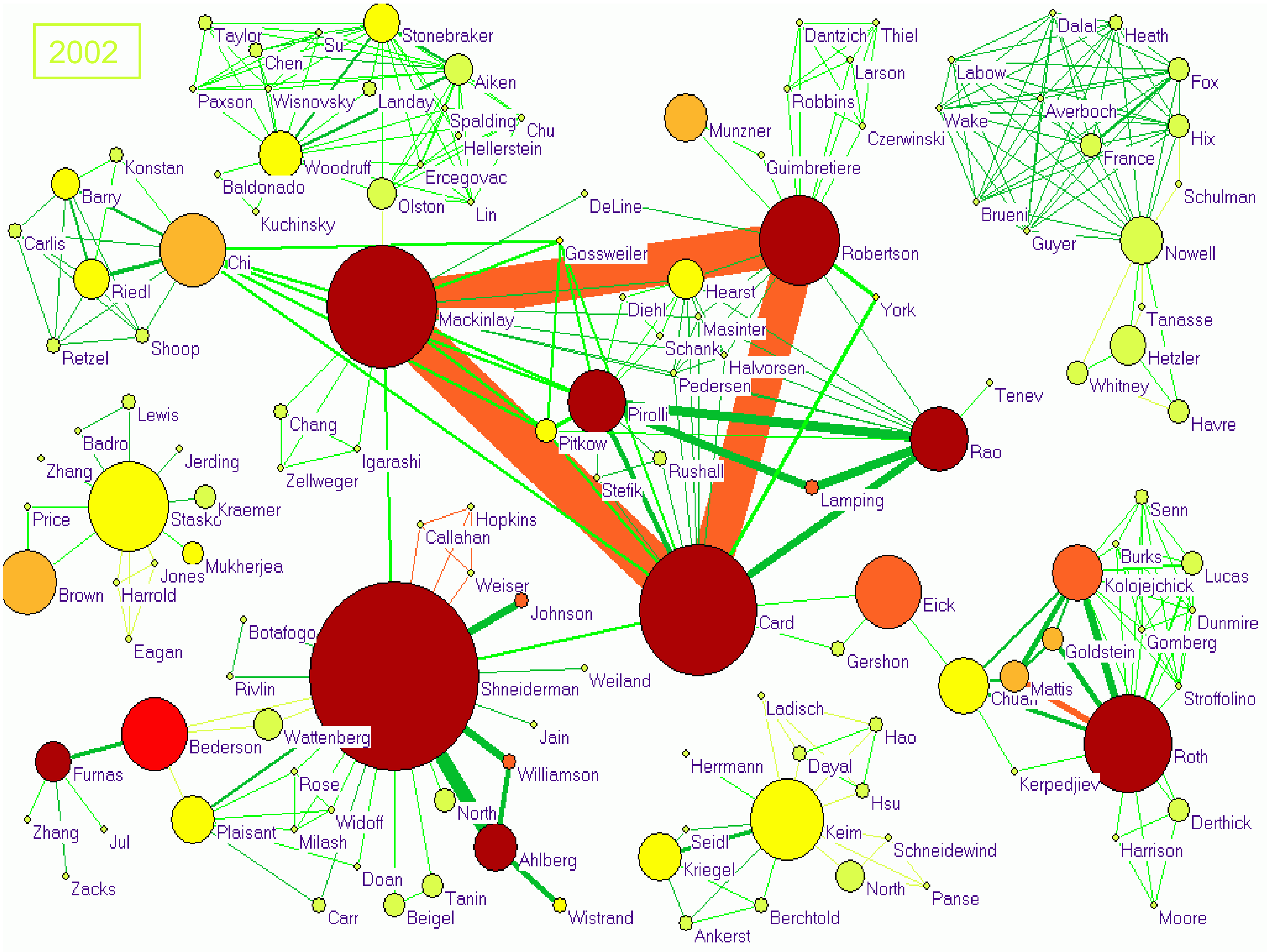
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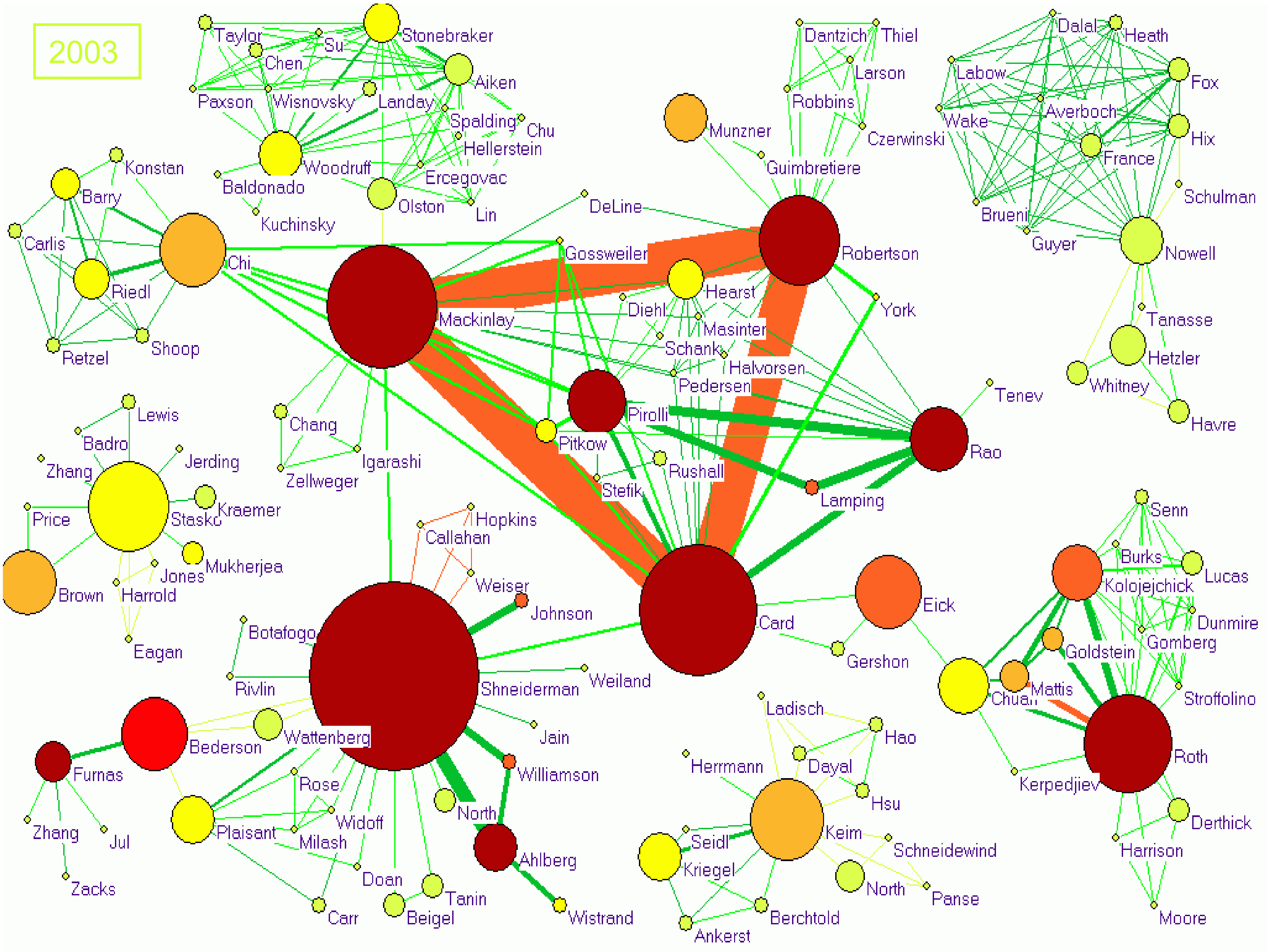
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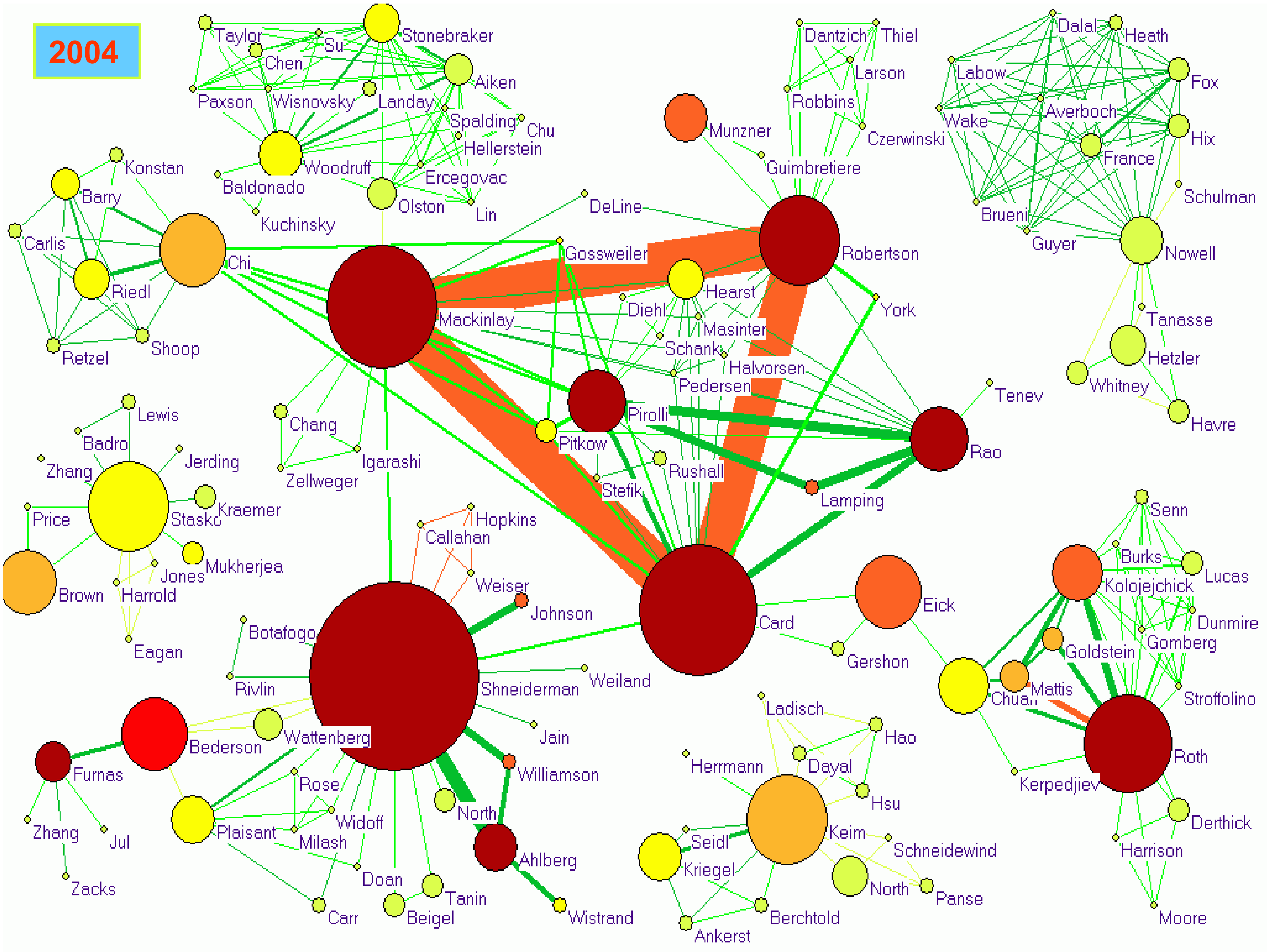
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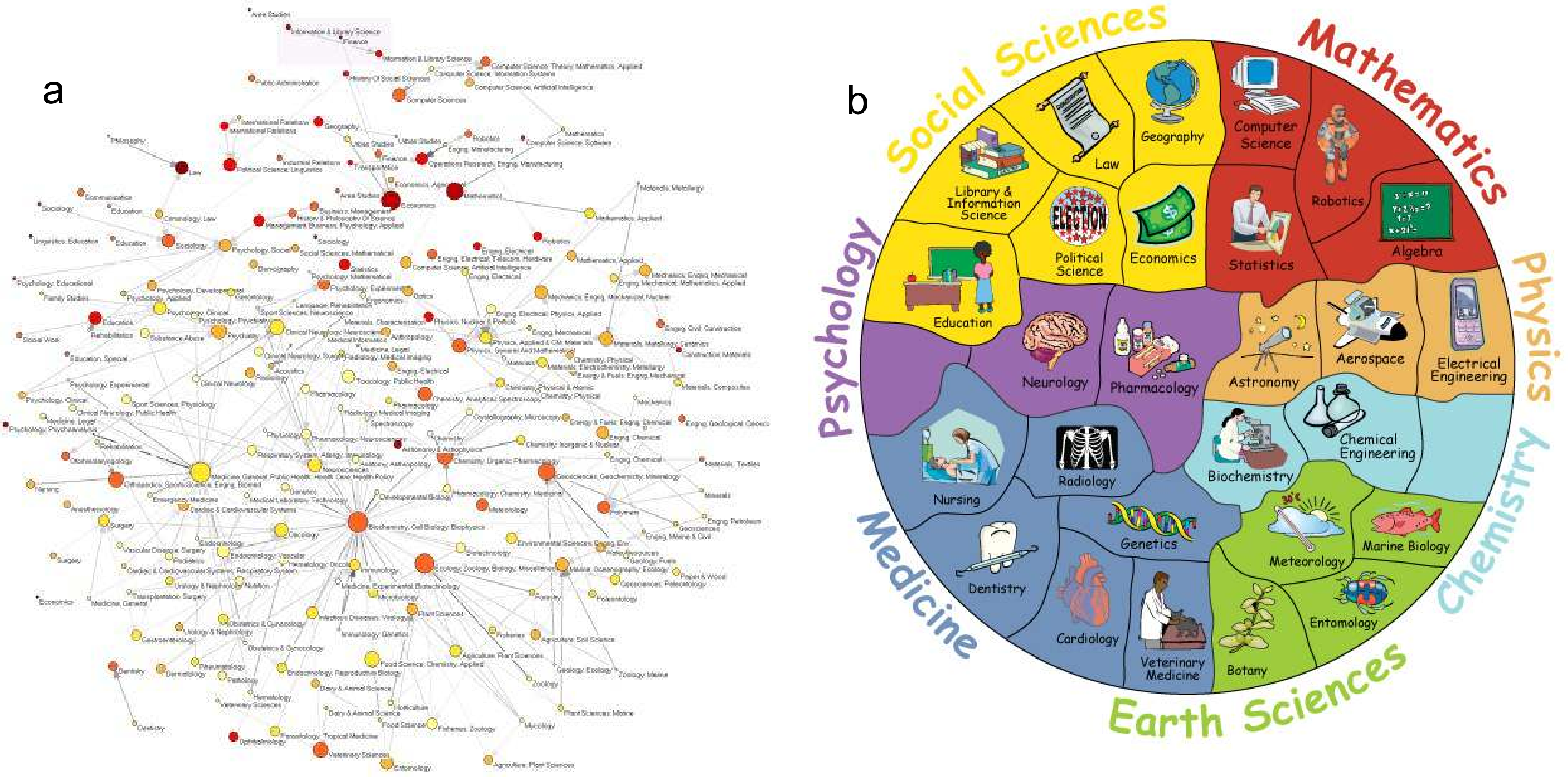


Map of Science derived from text mining of volumes of scientific literature.

(a) Visualization for researchers where 2D proximity represents similarity of research areas and size and color of research areas indicate activity level. Interactive map allows drilling to research articles.

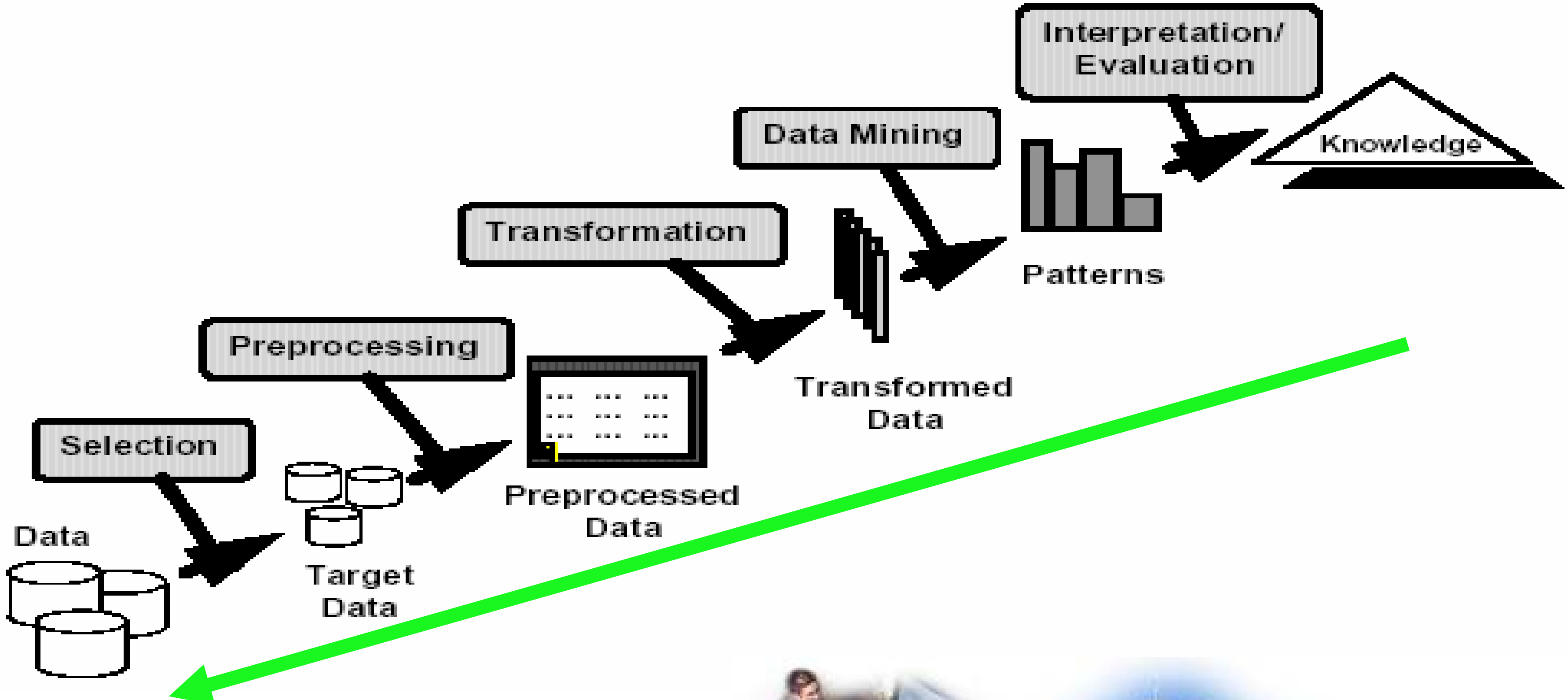
(b) Puzzle for elementary school students that represents similarity of research areas.

0308264

Vipin Kumar and Jaideep Srivastava, University of Minnesota

Data Mining for Rare Class Analysis

- A precursor to many attacks on networks is often a reconnaissance operation, more commonly referred to as a scan. These computers, once compromised, are used to send spam, serve pornography, or launch large scale attacks on the Internet.
- This project developed a new, effective method for scan detection by employing a data mining approach, which makes it possible to use automated techniques for knowledge discovery from massive data.
- Extensive experiments on real network traffic data have shown that the new methods have substantially better performance than the state of the art methods, in terms of coverage, false alarm rate and speed of detection.
- With millions of compromised computers constantly scanning the Internet, such improved scan detection techniques are critical to providing security analysts with the information they need to take preventive measures.


Interpretation/ Evaluation
Knowledge
Data Mining
Patterns
Transformation
Transformed Data
Preprocessing
Preprocessed Data
Selection
Target Data
Data

IIS-0414380

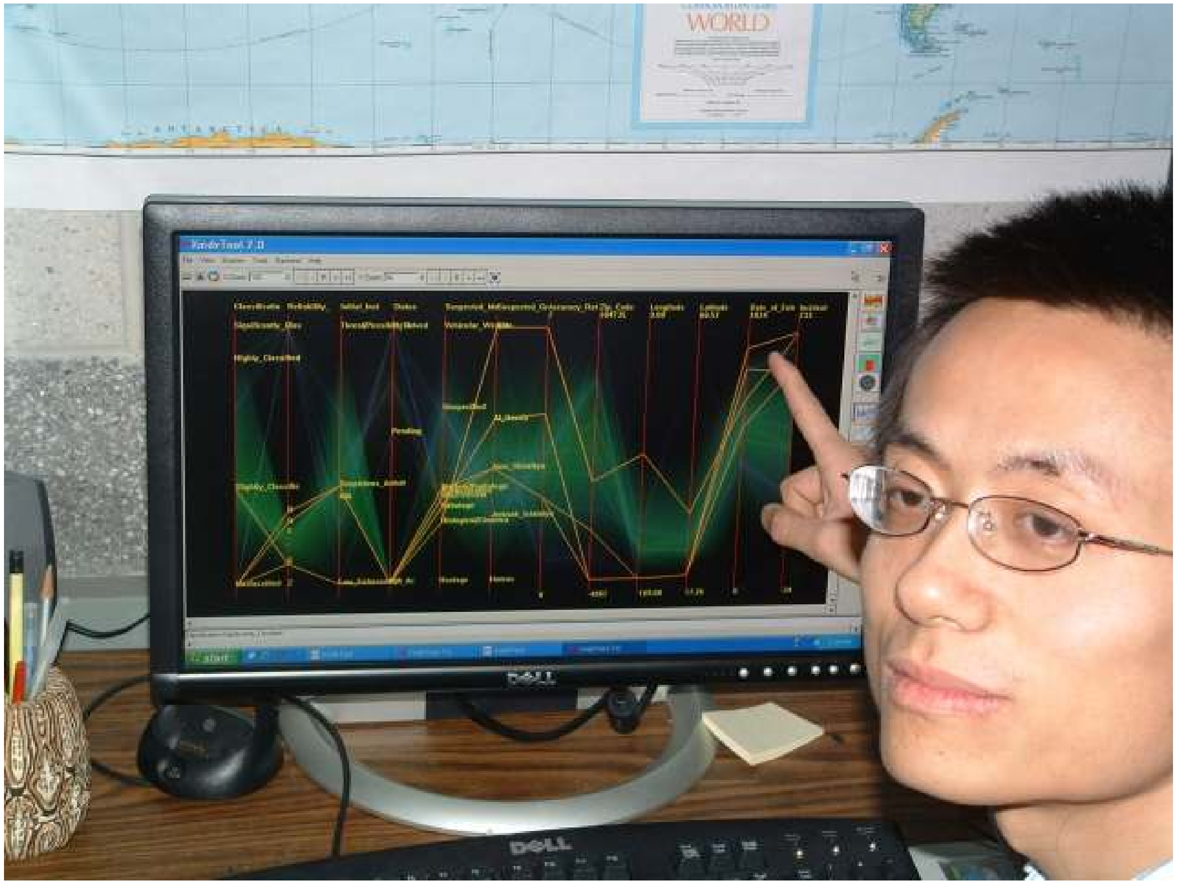
Matthew O. Ward and Elke A. Rundensteiner, WPI

Quality-Aware Visual Exploration Tools

In general, exploratory data analysis assumes data is of high quality and that data transformations, either computational (e.g., data mining) or visualization, do not cause loss of information and result in new knowledge of high quality.

In reality, data is rarely of uniformly high quality or certainty, and every transformation performed distorts or loses information. This disparity leads to results (new knowledge) that may be misleading or incorrect, with potentially serious consequences.

This project adds a new and important dimension to knowledge discovery – making the researcher aware of the quality of the data they are analyzing as well as the information loss resulting from filtering, sampling, clustering, visualizing, and all other transformations applied to the data, resulting in more accurate and reliable knowledge and decisions can be drawn from data.



A data analyst points out high confidence clusters in a simulated homeland security dataset. Lower quality information has been automatically deemphasized.

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  - Create your profile
  - Receive
    - Announcement on funding opportunities
      - **Explosives and Related Threats: Frontiers in Prediction and Detection (EXP)**
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  - Search by keywords, dates, directorates, …
  - Browse the NSF Web:
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      - Integrative Graduate Education and Research Traineeship Program (IGERT)
      - NSF Graduate Teaching Fellowship in K-12 Education (GK-12)
      - Grant Opportunities for Academic Liaison with Industry (GOALI)
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      - Partnerships for International Research and Education (PIRE)
- **Awards Search**
  - Search by keywords
    - Find researchers, relavant NSF programs, program directors, …
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    - Get an idea about the scope

CISE++ Opportunities: http://www.nsf.gov/dir/index.jsp?org=CISE

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Industry/University Cooperative Research Centers Program (I/UCRC)

CISE Pathways to Revitalized Undergraduate Computing Education (CPATH)

Research Experience for Undergraduates (REU) Sites & Supplements