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Meaningful metrics

VOSviewer and CitNetExplorer Tutorial

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Centre for Science and Technology Studies (CWTS), Leiden University

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Istanbul, Turkey, June 29, 2015

Universiteit Leiden

Centre for Science and Technology Studies (CWTS)

- Research center of Leiden University in quantitative studies of science (bibliometrics and scientometrics)

- Bibliometric contract research
  - Monitoring & evaluation
  - Advanced analytics
  - Training & education

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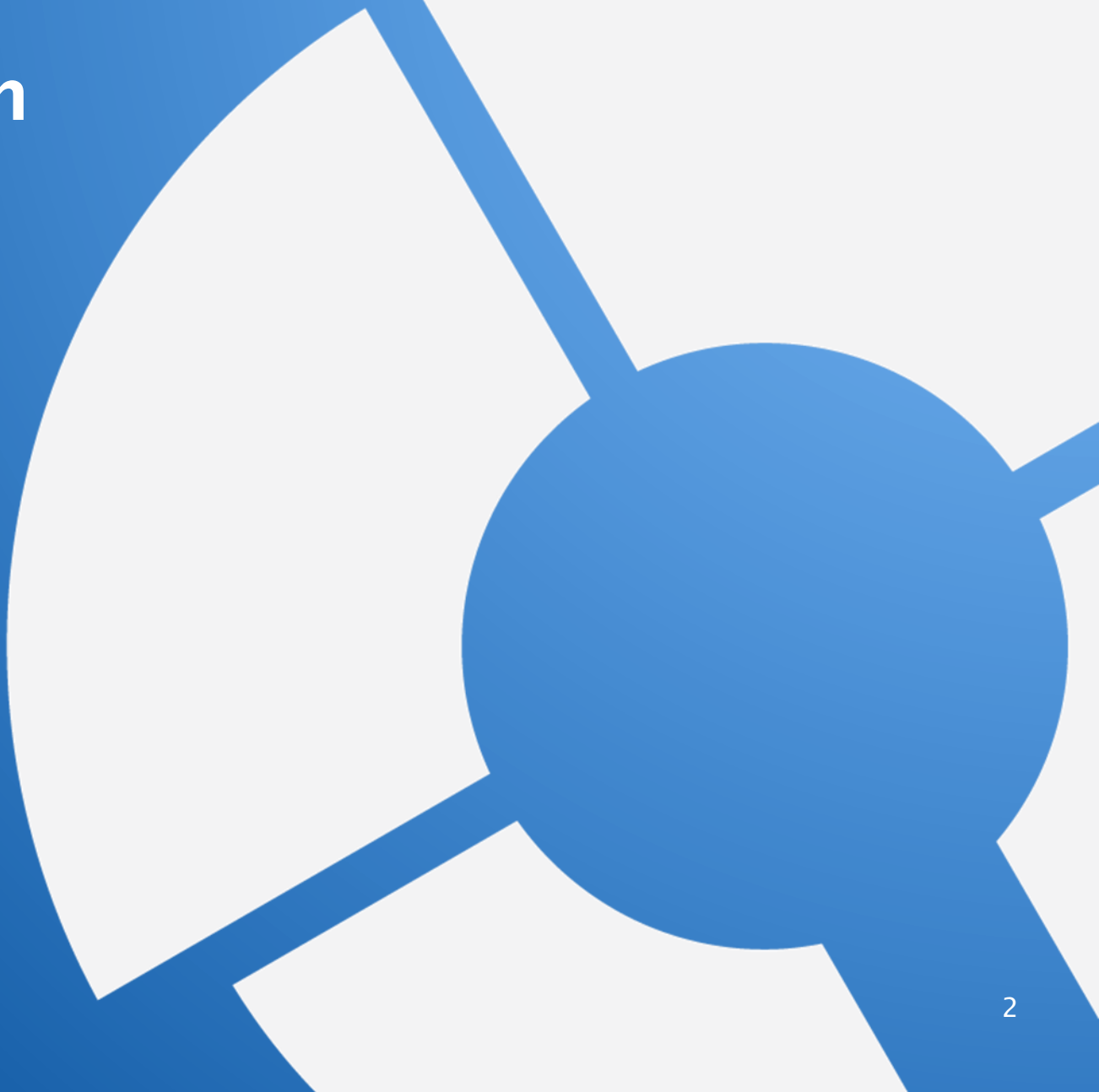
Introduction



Bibliometric mapping of science

- **Bibliometrics** is the scientific field that quantitatively studies all kinds of bibliographic data

- **Bibliometric mapping of science** is about quantitative methods for visually representing scientific literature based on bibliographic data

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Aim of bibliometric maps

- To provide an overview of the structure of the scientific literature in a certain domain or on a certain topic
- Applications:
  - To identify the main research areas within a scientific field
  - To get insight into the size of the different areas
  - To see how the areas relate to each other

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Types of bibliometric maps

- Co-authorship maps of
  - authors / organizations
- Co-citation maps of
  - publications / journals / authors
- Bibliographic coupling maps
  - publications / journals / authors / organizations
- Co-occurrence maps of
  - keywords / terms extracted from titles and abstracts of articles

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Bibliographic databases

- Contain metadata about publications and their citing publications
  - Authors
  - Affiliations
  - Source
  - Volume
  - Issue
  - Pages
  - Publications year
  - DOI
  - Title
  - Abstract
  - Keywords
  - Document type
  - Cited references
- Examples:
  - Thomson Reuters' Web of Science
  - Elsevier's Scopus
  - MEDLINE

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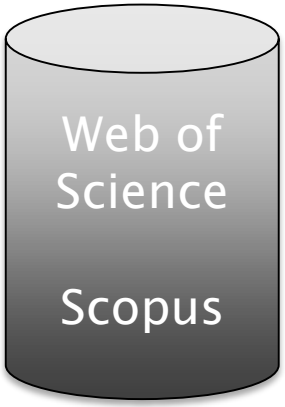
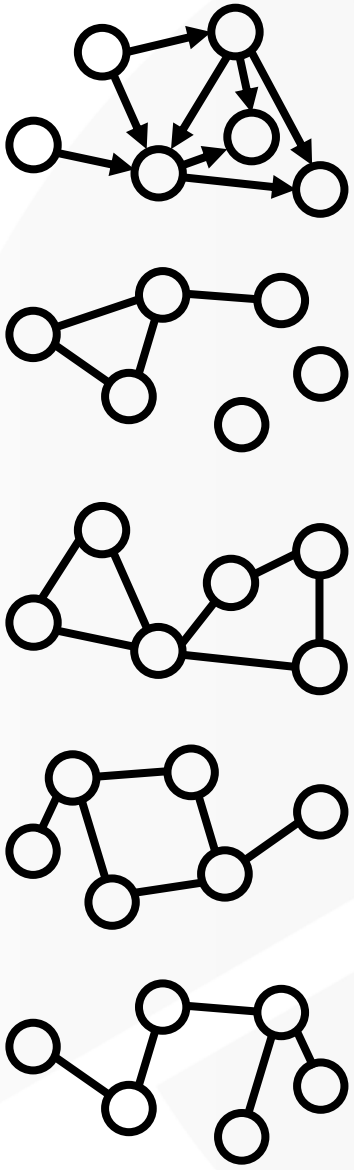
Bibliometric networks

Bibliographic database





Citation network of publications

Co-authorship network of authors / organizations

Co-citation network of pubs / authors / journals

Bibliographic coupling network of pubs / authors / journals

Co-occurrence network of terms

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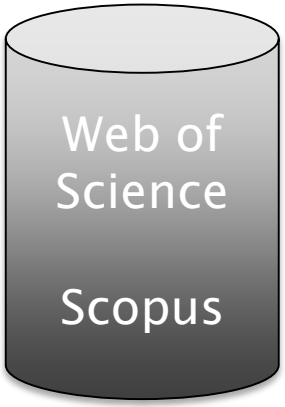
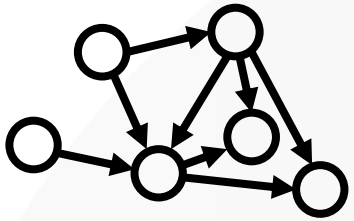
Software tools

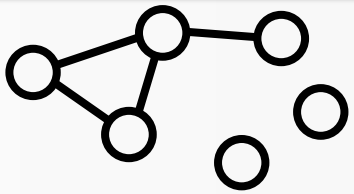
Bibliometric networks in VOSviewer

Bibliographic database

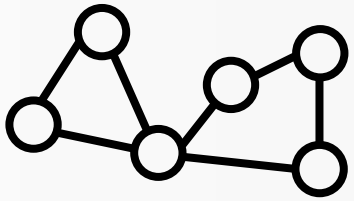




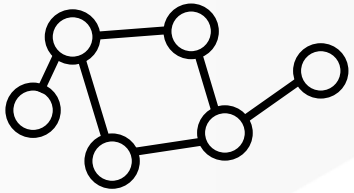
Citation network of publications



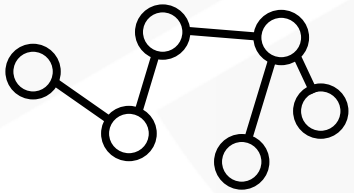
Co-authorship network of authors / organizations



Co-citation network of pubs / authors / journals



Bibliographic coupling network of pubs / authors / journals



Co-occurrence network of terms

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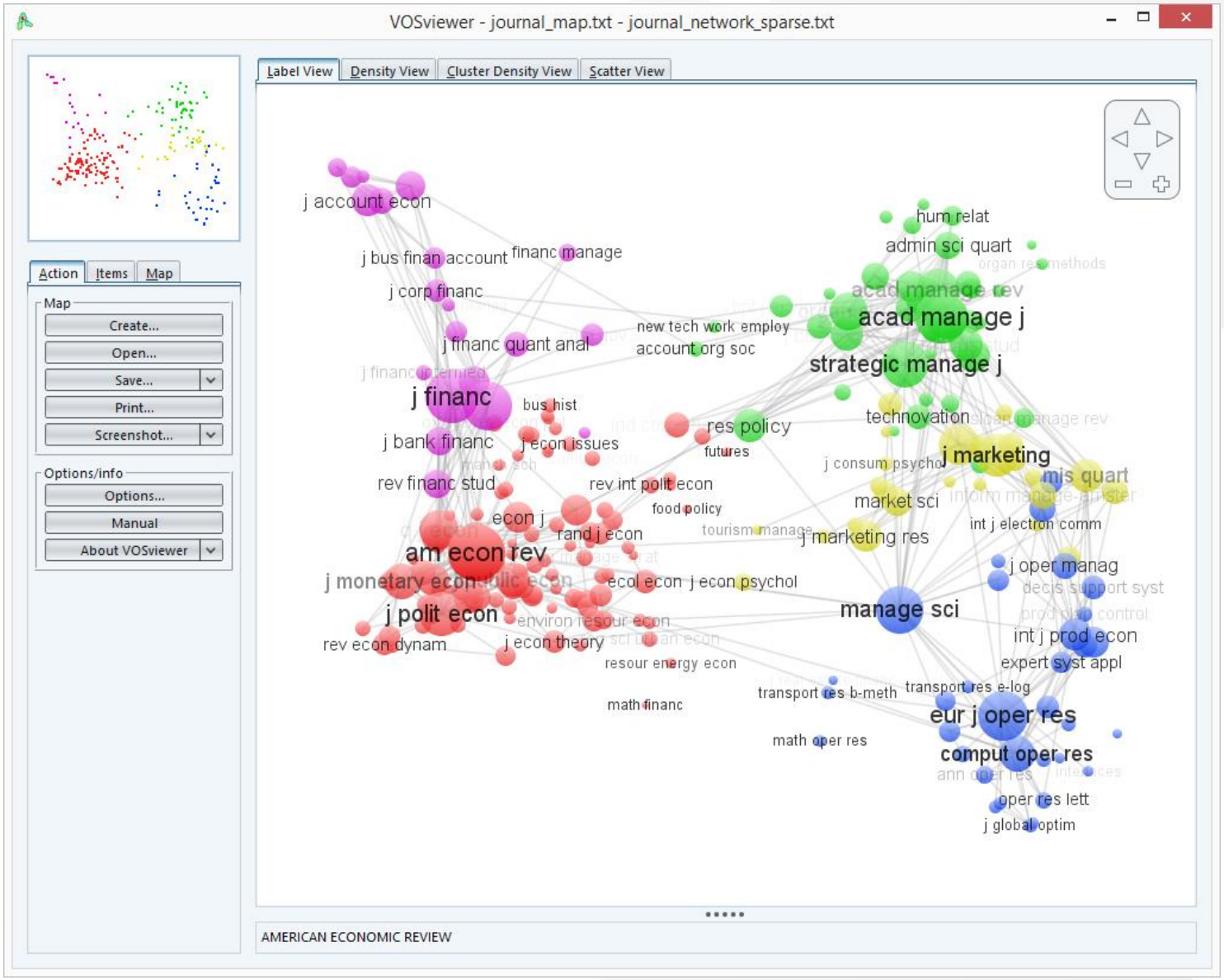
VOSviewer


VOSviewer - journal_map.txt - journal_network_sparse.txt
Label View
Density View
Cluster Density View
Scatter View
Action
Items
Map
Map
Create...
Open...
Save...
Print...
Screenshot...
Options/info
Options...
Manual
About VOSviewer
j account econ
j bus finan account
financ manage
j corp financ
j financ quant anal
new tech work employ
account org soc
j financ
bus hist
j bank financ
j econ issues
rev financ stud
res policy
futures
rev int polit econ
food policy
econ j
rand j econ
tourism manage
am econ rev
j monetary econ
ecol econ
j econ psychol
j polit econ
environ resour econ
rev econ dynam
j econ theory
resour energy econ
math financ
hum relat
admin sci quart
acad manage rev
acad manage j
strategic manage j
technovation
j consum psychol
j marketing
mis quart
market sci
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int j prod econ
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transport res b-meth
transport res e-log
eur j oper res
math oper res
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AMERICAN ECONOMIC REVIEW

VOSviewer: Overview

- Web of Science, Scopus, and PubMed support
- Text mining techniques
- Advanced mapping and clustering techniques
- Advanced visualizations:
  - Smart labeling algorithm
  - Overlay visualizations
  - Density visualizations
- Over 100 scientific publications using VOSviewer have been published

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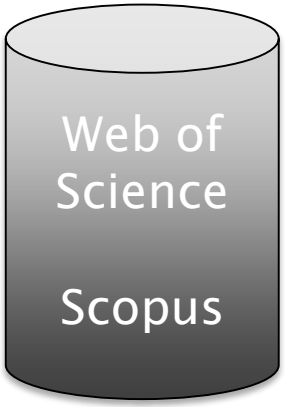
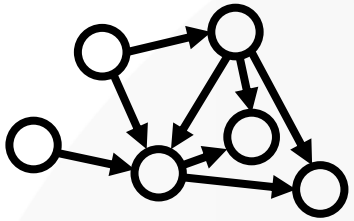
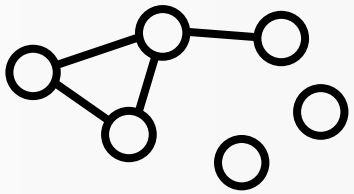
Bibliometric networks in CitNetExplorer

Bibliographic database

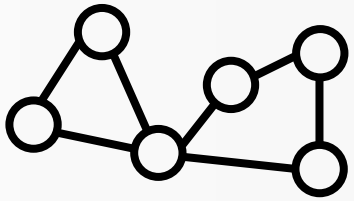




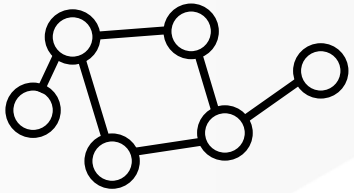
Citation network of publications



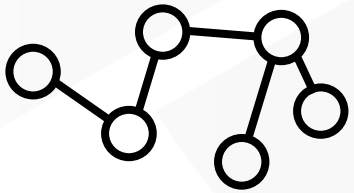
Co-authorship network of authors / organizations



Co-citation network of pubs / authors / journals



Bibliographic coupling network of pubs / authors / journals



Co-occurrence network of terms

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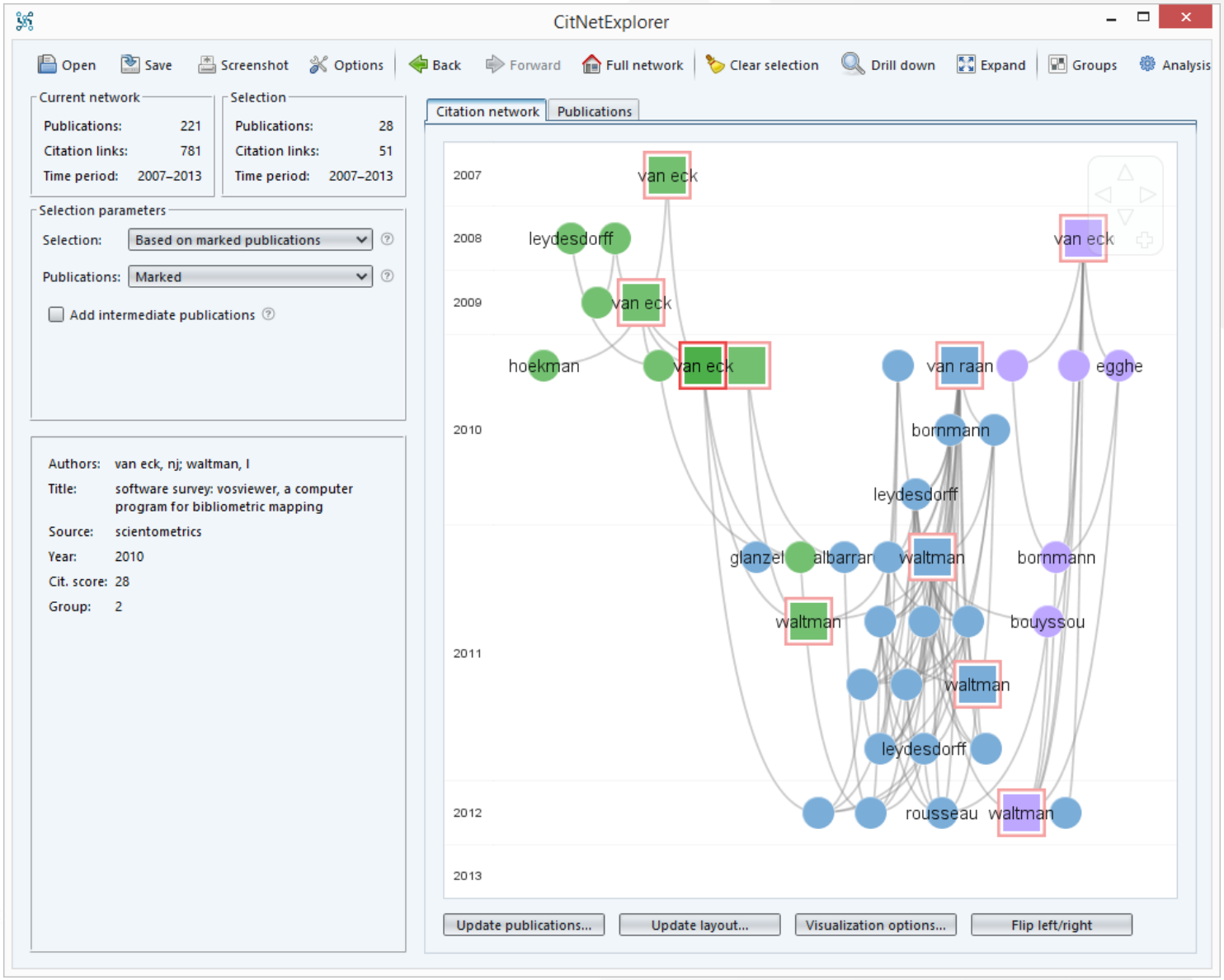
CitNetExplorer



CitNetExplorer: Overview

- Citation networks can be constructed directly based on data downloaded from Web of Science
- Very large citation networks can be handled, with millions of publications and tens of millions of citation relations
- Interactive functionality for drilling down into a citation network
- Various analysis techniques are available, including clustering of publications based on citation relations

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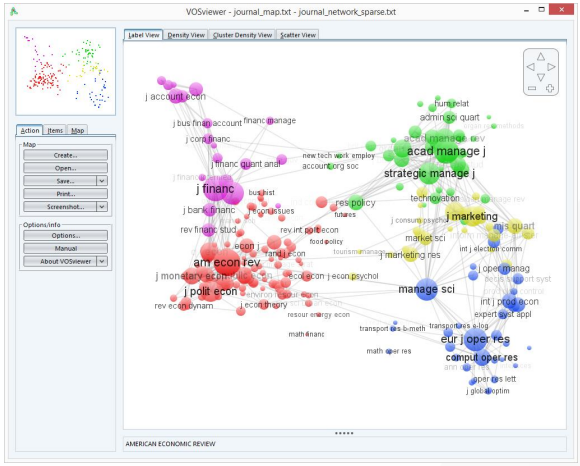
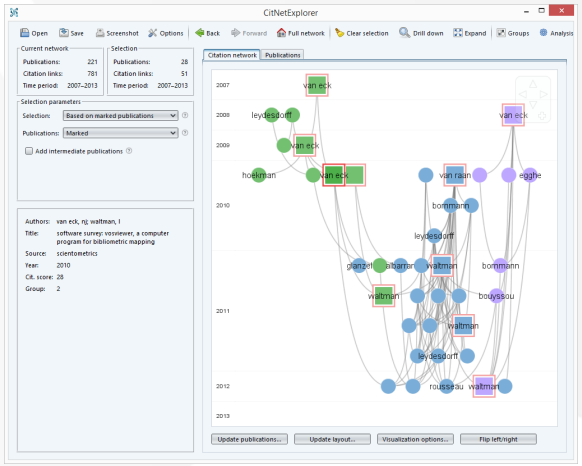
VOSviewer



- Any type of bibliometric network
- Co-citation and bibliographic coupling of publications
- Time dimension is ignored
- At most about 10,000 publications are supported

CitNetExplorer



- Only citation networks of publications
- Direct citations between publications
- Time dimension is explicitly considered
- Millions of publications are supported

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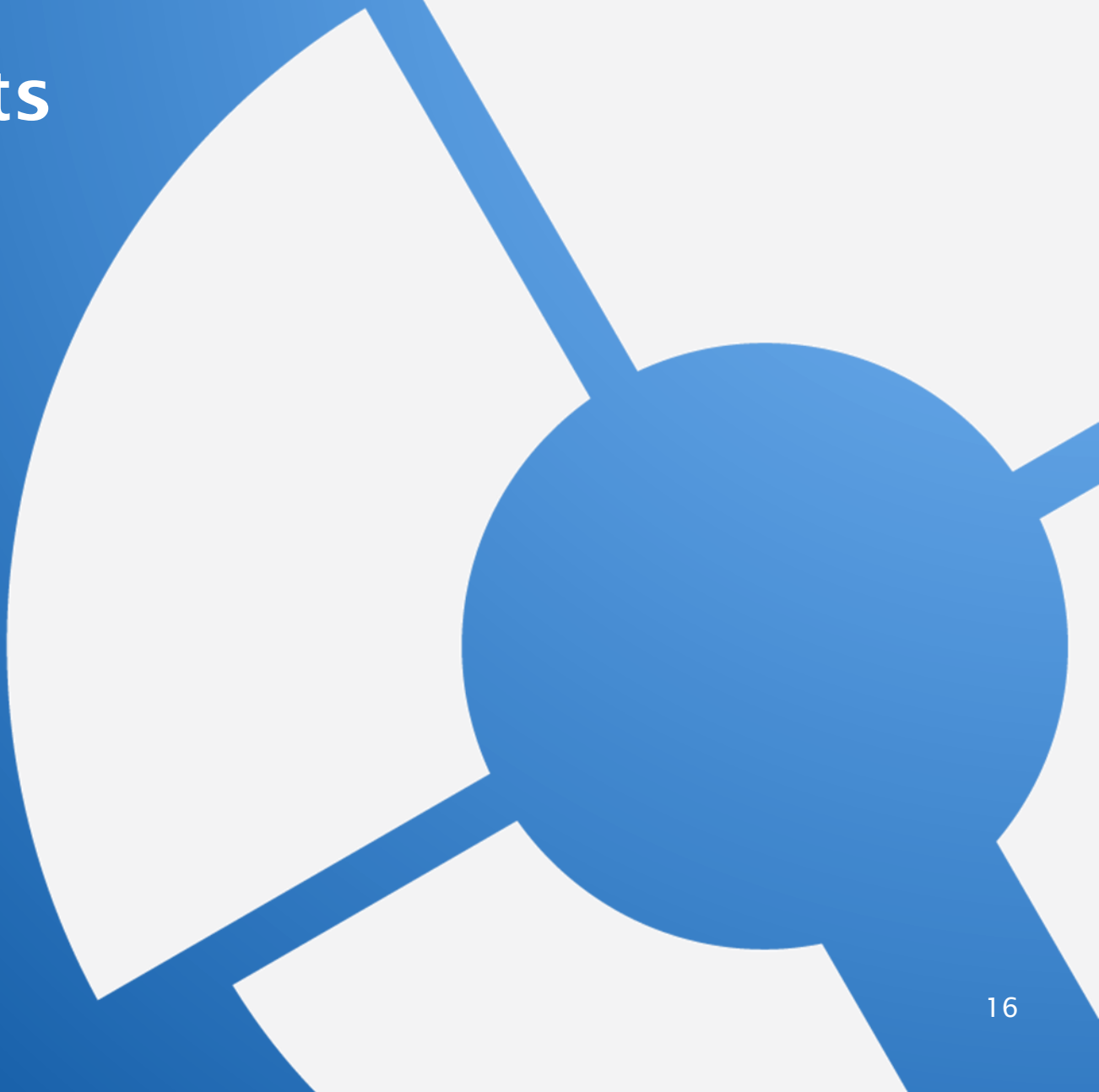
Assignments



Assignments

1. Downloading data from Web of Science
2. Creating term maps using VOSviewer
3. Creating co-citation, bibliographic coupling, and co-authorship maps using VOSviewer
4. Analyzing citation networks of publications using CitNetExplorer

Data collection: Downloading Web of Science data

Downloading Web of Science data

Pay attention to the following:

- Use the **Web of Science Core Collection** database
- Use the **Full Record and Cited References** option
- Use a suitable file format:
  - VOSviewer supports both the plain text and the tab-delimited format
  - Tab-delimited files can be easily processed using spreadsheet software
- We use the tab-delimited format

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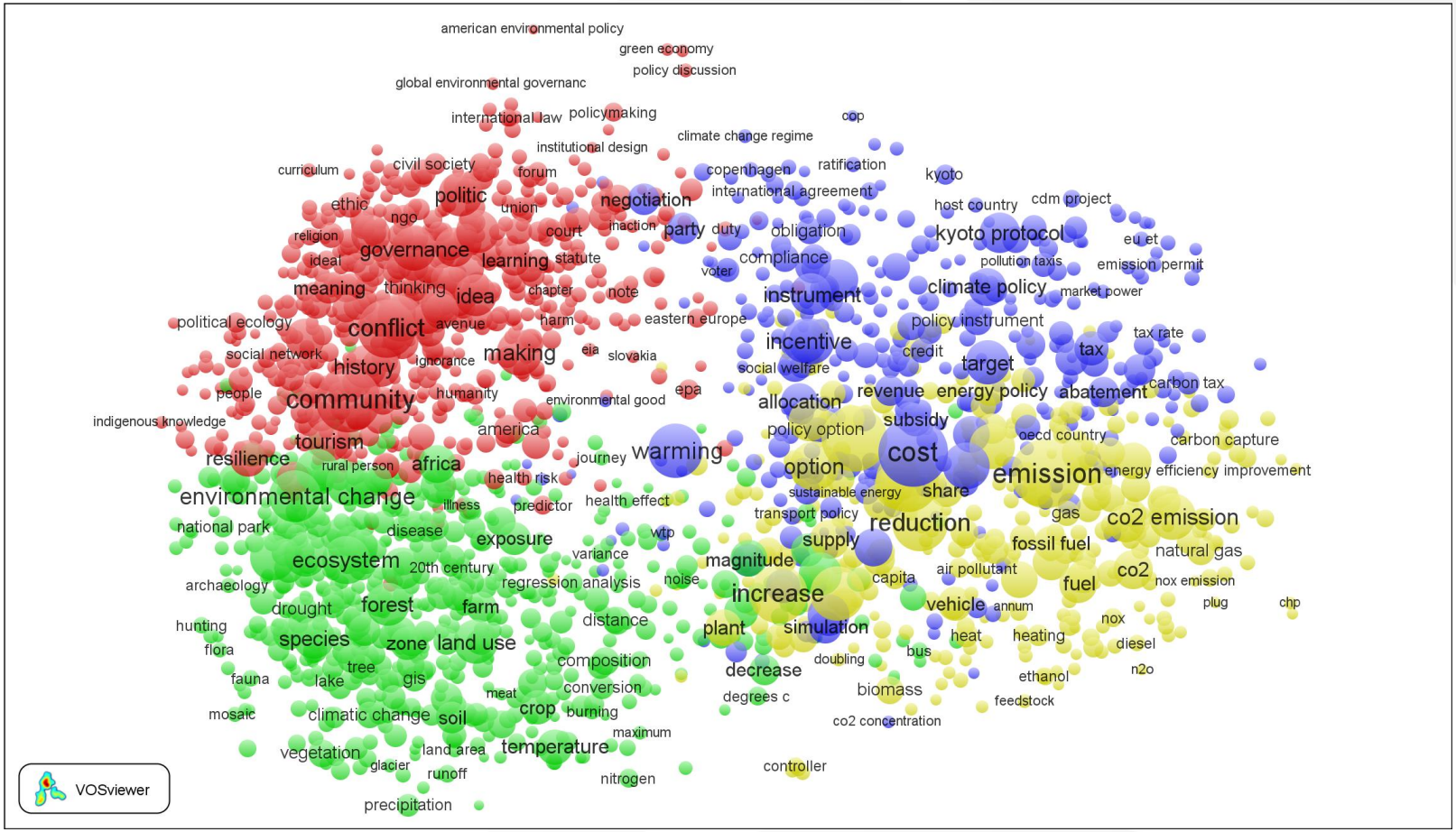
Demonstration + assignment 1

Term maps

Term map of social science research on global environmental change



Source: www.worldsocialscience.org/activities/world-social-science-report/the-2013-report/read-changing-global-environments/

Interpretation of a term map

- The larger a term, the higher the frequency of occurrence of the term
- In general, the smaller the distance between two terms, the higher the relatedness of the terms, as measured by co-occurrences
- The horizontal and vertical axes have no special meaning; maps can be freely rotated and flipped
- Colors indicate clusters of closely related terms

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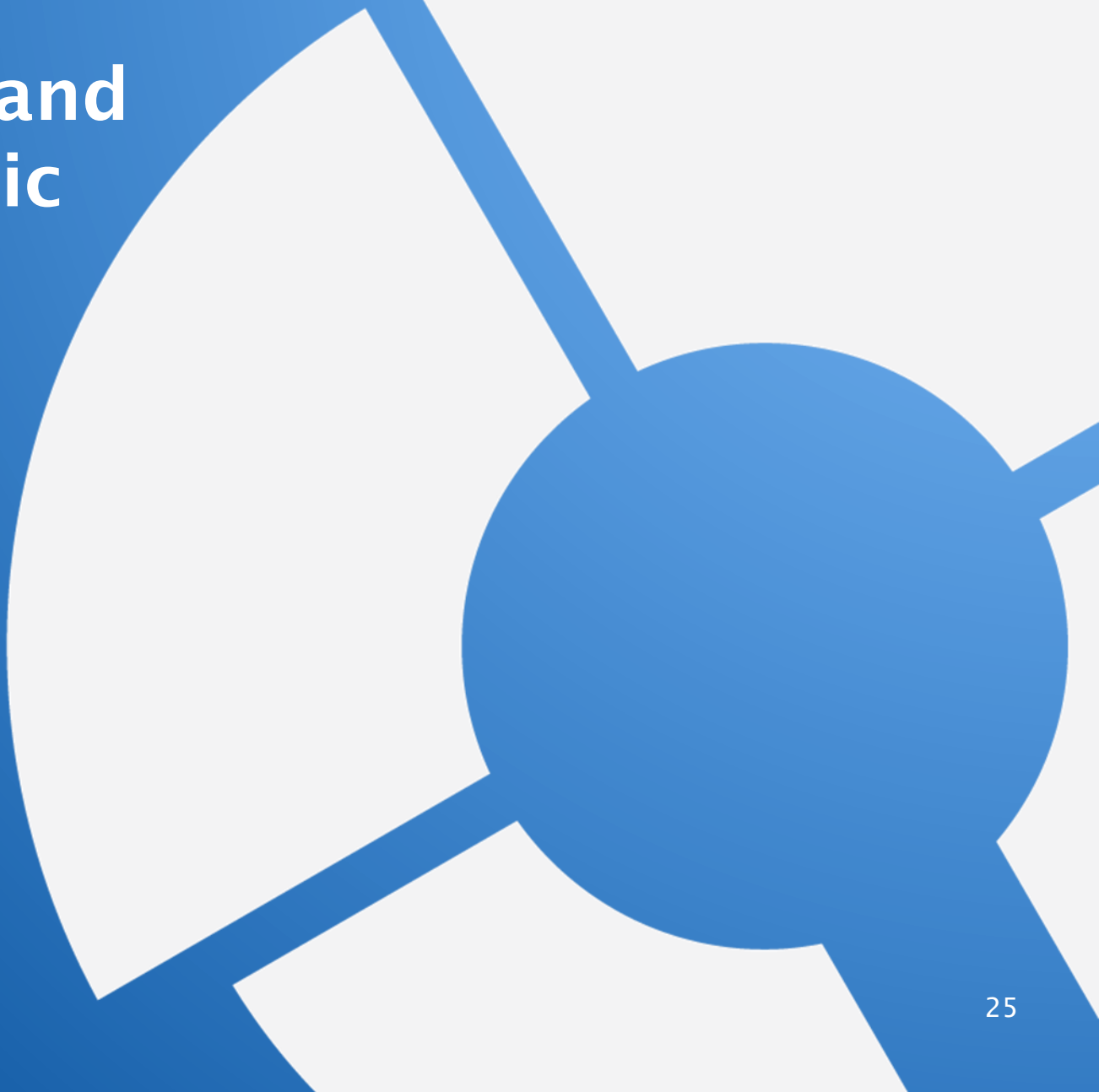
Demonstration + assignment 2

Co-citation and bibliographic coupling maps



Determining relatedness based on citation data

- How to determine the relatedness of publications, journals, authors, etc. based on citation data?
  - Co-citation relations
  - Bibliographic coupling relations
  - Direct citation relations (CitNetExplorer)

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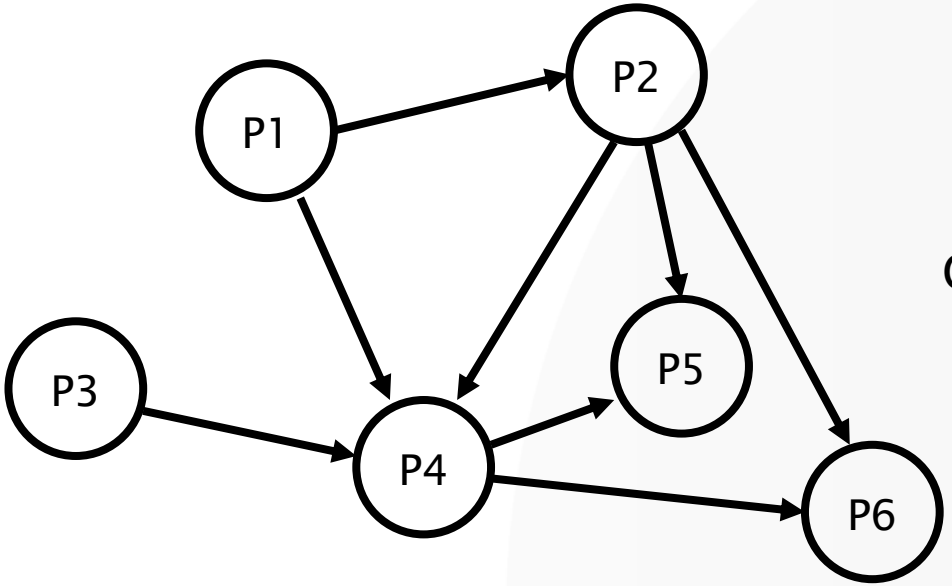
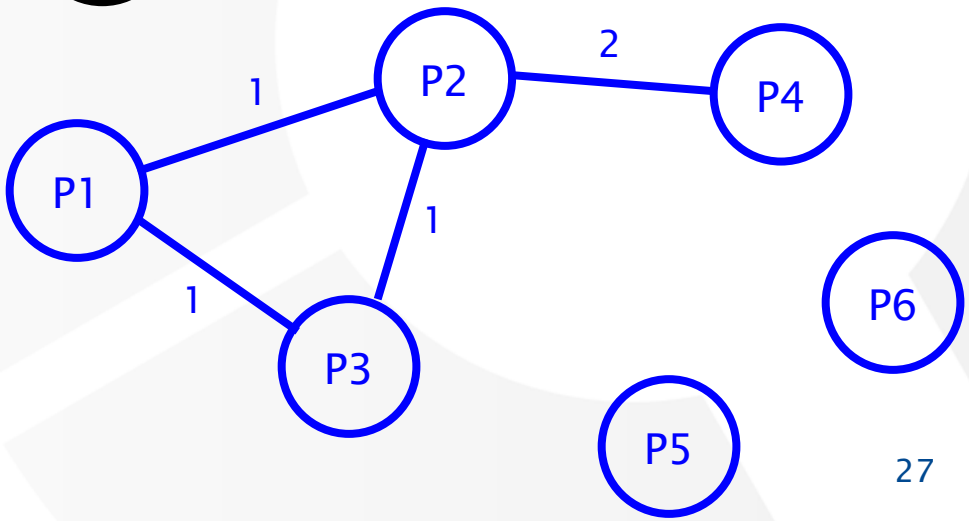
Bibliographic coupling network of publications

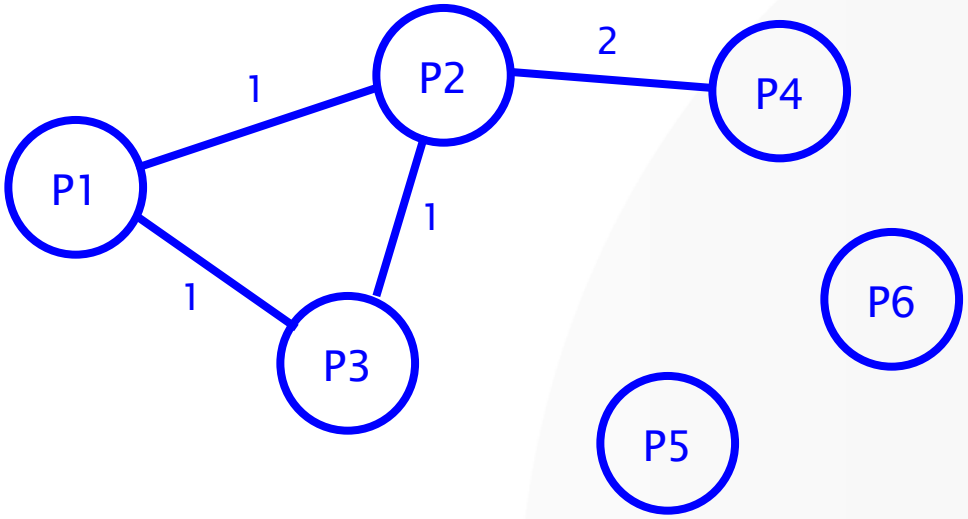


Citation network

Bibliographic coupling network



Matrix representation of bibliographic coupling network



	P1	P2	P3	P4	P5	P6
P1		1	1	0	0	0
P2	1		1	2	0	0
P3	1	1		0	0	0
P4	0	2	0		0	0
P5	0	0	0	0		0
P6	0	0	0	0	0	

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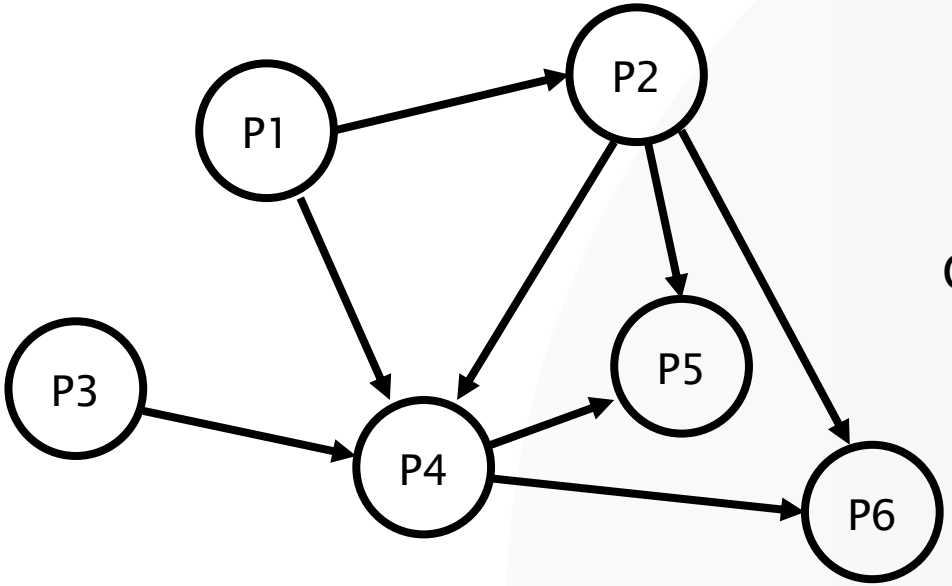
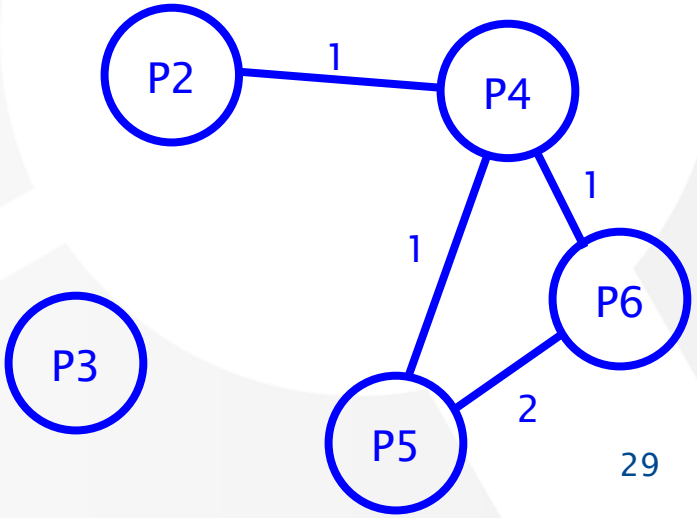
Co-citation network of publications



Citation network

Co-citation network



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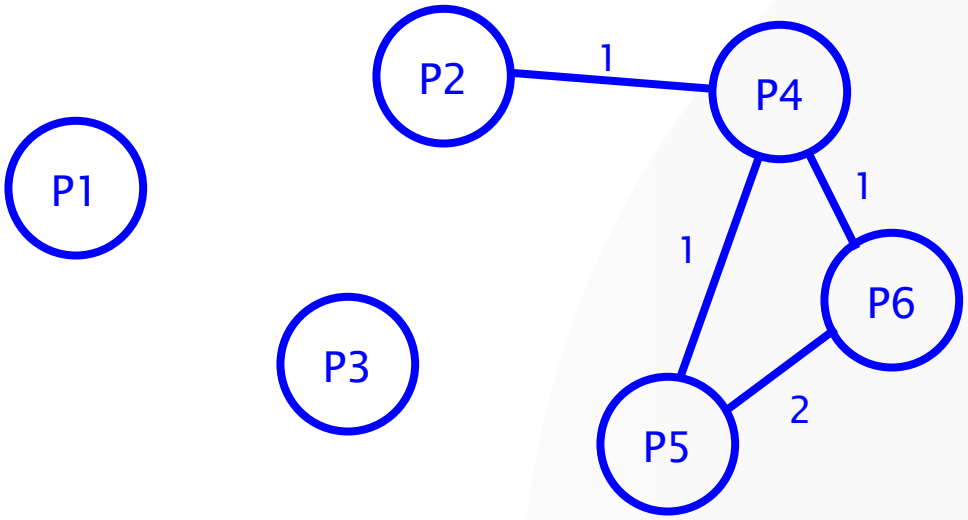
Matrix representation of co-citation network



	P1	P2	P3	P4	P5	P6
P1		0	0	0	0	0
P2	0		0	1	0	0
P3	0	0		0	0	0
P4	0	1	0		1	1
P5	0	0	0	1		2
P6	0	0	0	1	2	

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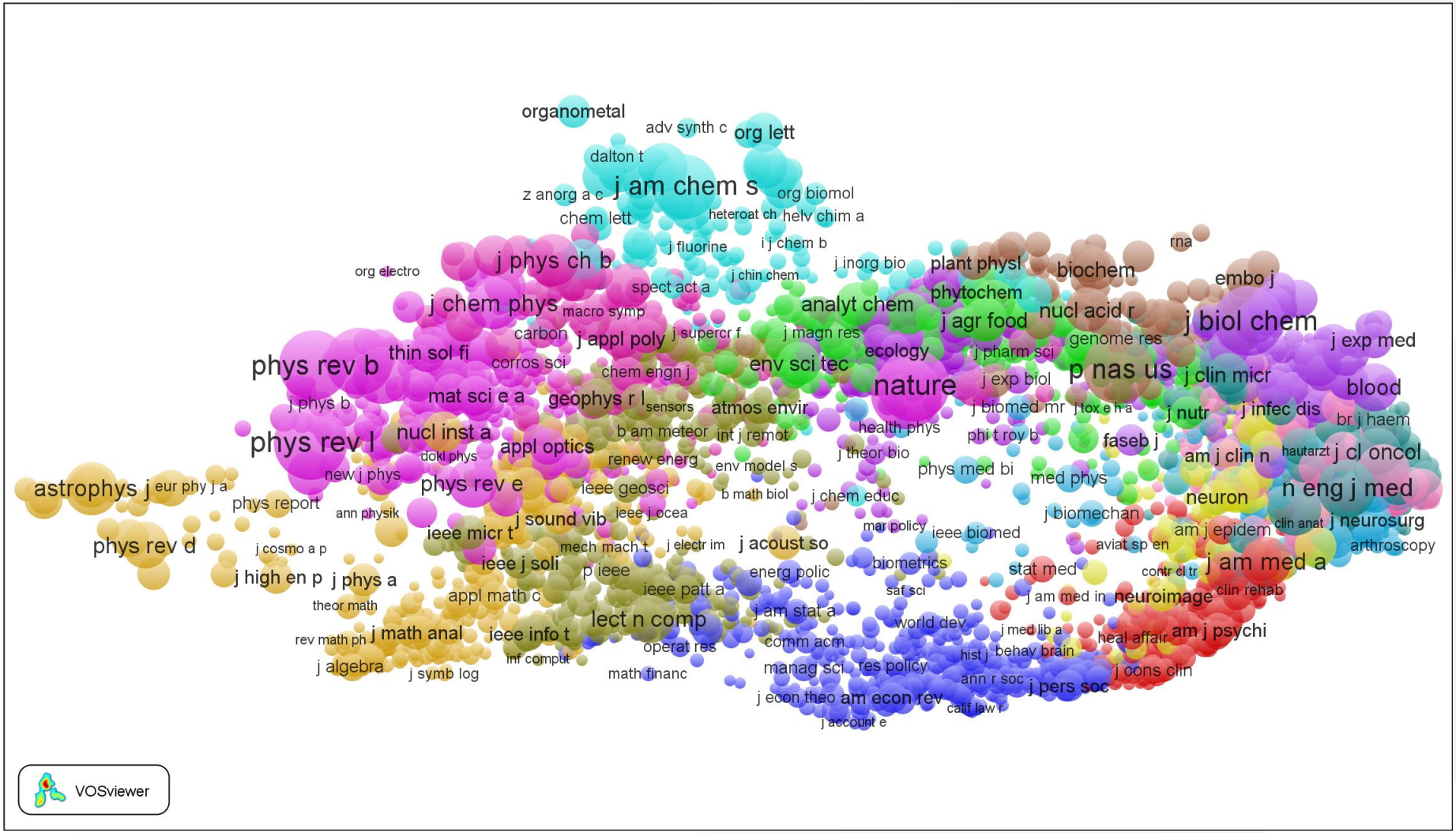
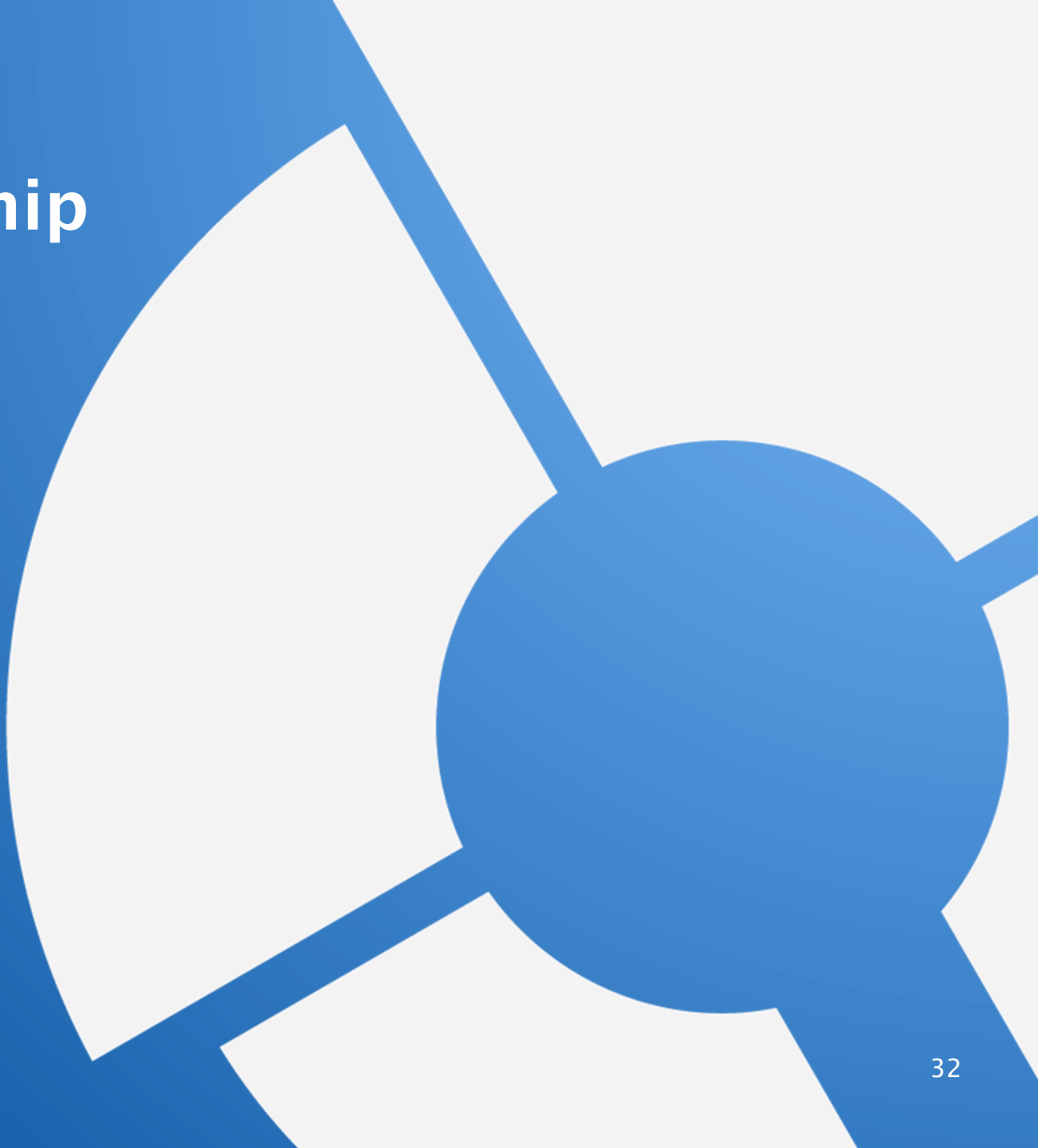
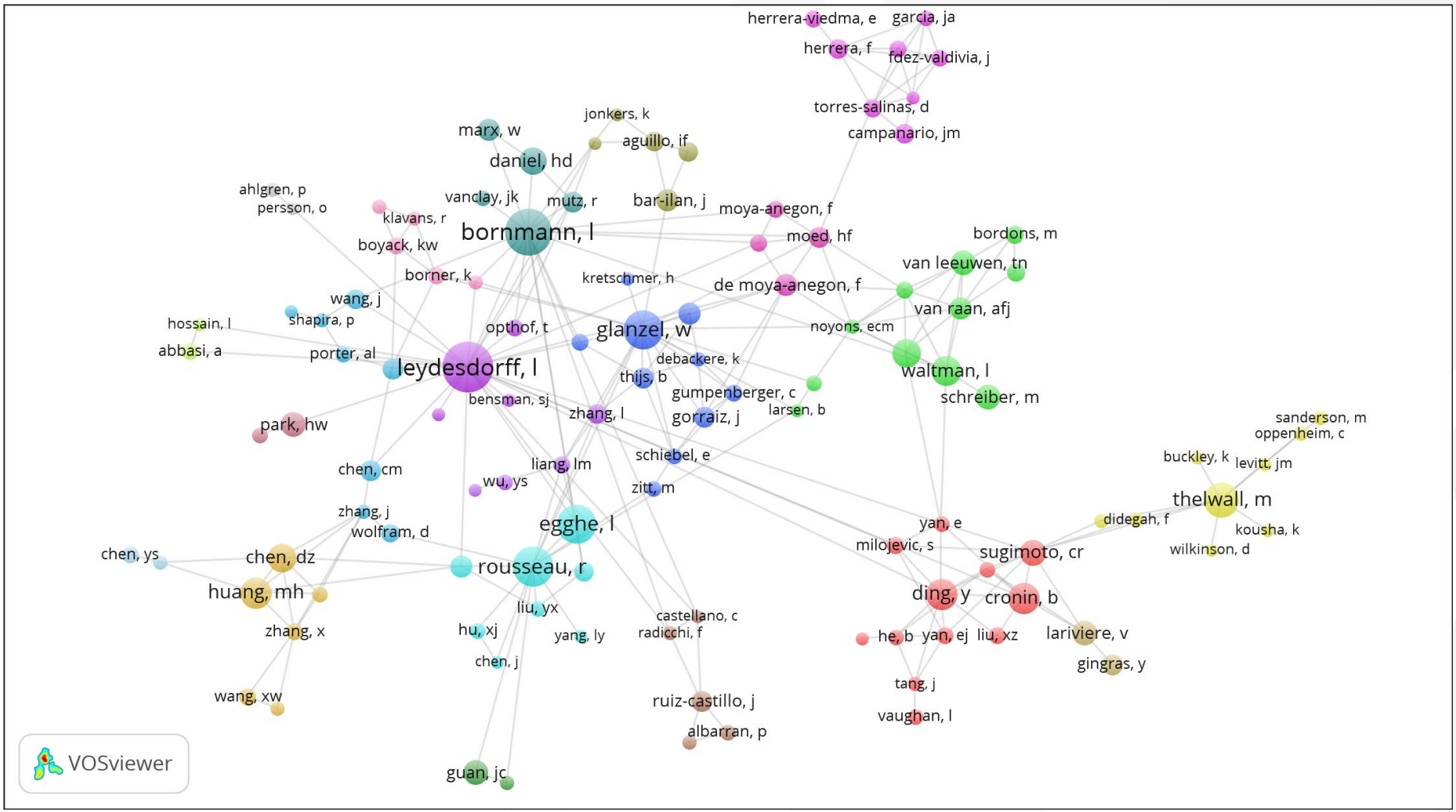
Co-citation map of journals



Co-authorship maps

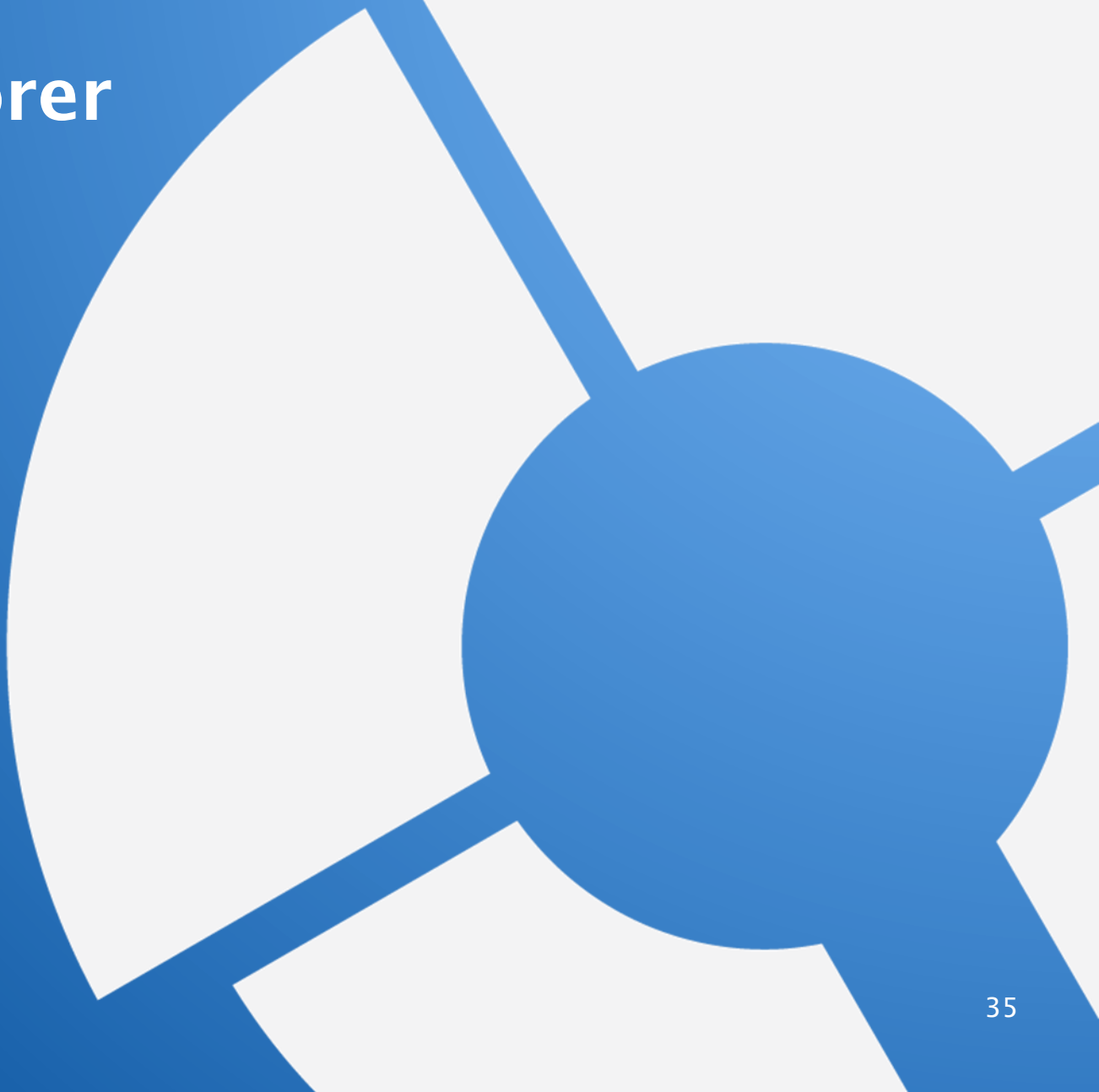


Co-authorship map of authors



Demonstration + assignment 3

CitNetExplorer



Why use CitNetExplorer?

- To analyze the structure and development of a research field
  - Example: Identifying the main topics in the field of scientometrics and tracing the developments within each topic
- To delineate a research area
  - Example: Delineating the literature on science mapping
- To study publication oeuvres
  - Example: Identifying the publications of a researcher and analyzing the influence of cited and citing publications
- To support literature reviewing
  - Example: Reviewing the literature on the *h*-index

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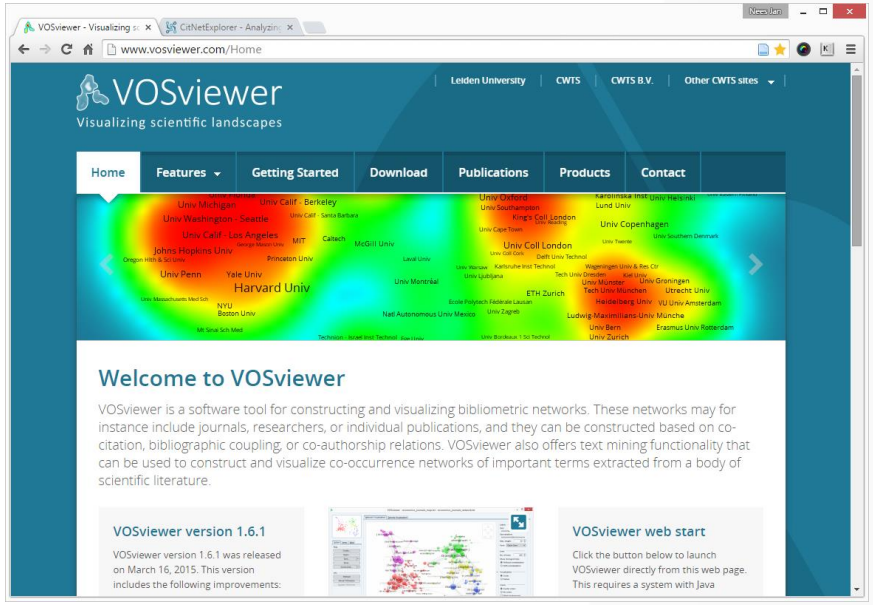
Demonstration + assignment 4

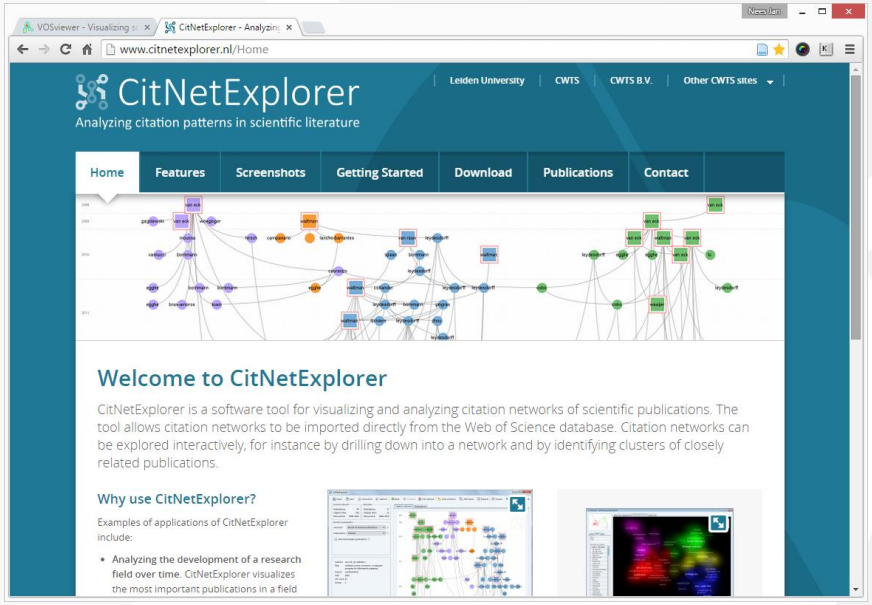
More information

Websites

www.vosviewer.com



www.citnetexplorer.nl



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Publications on VOSviewer

- Van Eck, N.J., & Waltman, L. (2014). Visualizing bibliometric networks. In Y. Ding, R. Rousseau, & D. Wolfram (Eds.), *Measuring scholarly impact: Methods and practice* (pp. 285-320). Springer. 10.1007/978-3-319-10377-8_13
- Van Eck, N.J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538. 10.1007/s11192-009-0146-3
- Waltman, L., Van Eck, N.J., & Noyons, E.C.M. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of Informetrics*, 4(4), 629-635. 10.1016/j.joi.2010.07.002
- Van Eck, N.J., Waltman, L., Dekker, R., & Van den Berg, J. (2010). A comparison of two techniques for bibliometric mapping: Multidimensional scaling and VOS. *JASIST*, 61(12), 2405-2416. 10.1002/asi.21421
- Waltman, L., & Van Eck, N.J. (2013). A smart local moving algorithm for large-scale modularity-based community detection. *European Physical Journal B*, 86(11), 471. 10.1140/epjb/e2013-40829-0

Publications on CitNetExplorer

- Van Eck, N.J., & Waltman, L. (2014). CitNetExplorer: A new software tool for analyzing and visualizing citation networks. *Journal of Informetrics*, 8(4), 802-823. 10.1016/j.joi.2014.07.006
- Van Eck, N.J., & Waltman, L. (2014). Systematic retrieval of scientific literature based on citation relations: Introducing the CitNetExplorer tool. In *Proceedings of the First Workshop on Bibliometric-enhanced Information Retrieval (BIR 2014)*, pages 13-20. ceur-ws.org/Vol-1143/paper2.pdf

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Course: Bibliometric Network Analysis and Science Mapping

- April 12-13, 2016
- Leiden University, The Netherlands
- Participants are introduced into the main techniques for bibliometric network analysis and science mapping
- Special attention is paid to applications in a research evaluation and science policy context
- www.cwts.nl

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