A multidimensional approach to visualising and analysing patent portfolios

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Global TechMining Conference, Leiden, 2 September 2014

Rathenau Instituut

Many uses of patent analysis

- information on volume and specialisation of academic patenting
- measuring the globalisation of R&D of Dutch multinationals
- identifying emerging technologies for human materials transplants
- quality of academic patents

Feiten & Cijfers

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Patentaanvragen door kennis-instellingen

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Het wetenschaps- en innovatiebeleid vraagt van kennisinstellingen dat zij zich sterker profileren en dat zij hun onderzoek afstemmen op de behoeften van industrie en maatschappij. Patenten van kennisinstellingen zijn een belangrijke indicator voor die bijdrage. Er is echter een gebrek aan informatie over de patenten van kennisinstellingen. Deze publicatie draagt bij aan het opvullen van deze lacune.

Voornaamste conclusies

1. Sinds 1980 is het aantal patentaanvragen door kennisinstellingen met meer dan een factor 14 gegroeid. Hun aandeel in het totaal van Nederlandse patent-aanvragen is gegroeid van 1,1 procent in 1980/84 naar 4,7 procent in 2005/09. In 2005/09 droegen onderzoekers werkzaam bij kennisinstellingen direct (als aanvrager) of indirect (als uitvinder) bij aan één op de veertien patentaanvragen.
2. Het specialisatiepatroon van de kennisinstellingen is geleidelijk verbreed. De kennisinstellingen zijn vooral gespecialiseerd in chemie (onder andere biotechnologie, farmaceutica, voedselchemie) en instrumenten (onder andere medische techniek). We vinden een duidelijke overeenkomst tussen de specialisatiepatronen van bedrijven en kennisinstellingen.
3. In de topsectoren zijn kennisinstellingen vooral actief op het gebied van High tech, Life sciences en Chemie. Kennisinstellingen hebben een groeiend aandeel in de patentaanvragen die relevant zijn voor de topsectoren. Alleen bij Tuinbouw en uitgangsmaterialen doet deze ontwikkeling zich niet voor.

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Inhoud

Het Rathenau Instituut stimuleert de publieke en politieke meningsvorming over wetenschap en technologie. Daartoe doet het instituut onderzoek naar de organisatie en ontwikkeling van het wetenschapssysteem, publiceert het over maatschappelijke effecten van nieuwe technologieën, en organiseert het debatten over vraagstukken en dilemma's op het gebied van wetenschap en technologie.

The problem

- Custom queries for every analysis but they are essentially the same
- Indicators in local datasets but indicators need to be normalised globally
- Repeated calculations of the same indicators for the same patents take a lot of time
- How to analyse and visualise properties of a dataset in five different dimensions: time, citation, topics, diversity, and quality

Building a data infrastructure

- **Query set 1: Creates an aggregated version of PATSTAT**
  - information for applications, INPADOC families, and single priority families
  - basic properties of applications and families including citation relations and technical classification
  - pre-calculation of quality indicators including information for normalisation

- **Query set 2: Extract all information related to a specific dataset**
  - basic properties, geography, inventors and applicants
  - calculate quality in a global context
  - identify topics
  - produce output for statistical analysis and visualisation

Six dimensions for analysis

Dimension	Examples
Time	date of application date of publications distance in time between application, publication, citation, and granting
Citation	forward and backward to patents and non-patent literature references
Topics	clusters of highly similar patents as measured, for example, by cooccurrence of IPC codes or words
Diversity	variety of topics distribution of applications among topics
Quality	economic value technical impact nature of the invention
Geography	patent authorities country codes of inventors and applicants

Indicators for patent quality

Indicator	Interpretation	Reference
size	larger families are more valuable	Lerner (1994)
scope	broad patents are more valuable	Lanjouw et al. (1998)
backward citations	patents with more backward citations have higher value and are more incremental	Trajtenberg M. (1990) Lanjouw and Schankerman, (2001)
forward citations (within 5 years)	technological importance and economic value of inventions	Trajtenberg M. (1990)
number and share of NPLRs	distance to science, technical quality	Callaert et al. (2006) Branstetter (2005)
claims and adjusted claims	number of claims reflects expected patent value and technological breadth	Tong and Davidson (1994) Squicciarini et al. (2013)
grant lag	shorter lag indicates higher value	Czarnitzki, Hussinger & Schneider (2009)
generality	range of later generations of inventions that have benefitted from a patent	Trajtenberg, Henderson & Jaffe (1997)
originality	indicates diversity of knowledge sources	Trajtenberg, Henderson & Jaffe (1997)
radicalness	radical versus incremental	Shane (2001)
technology cycle time	pace of technological progress	Kayal & Waters (1999)

Identifying and describing topics

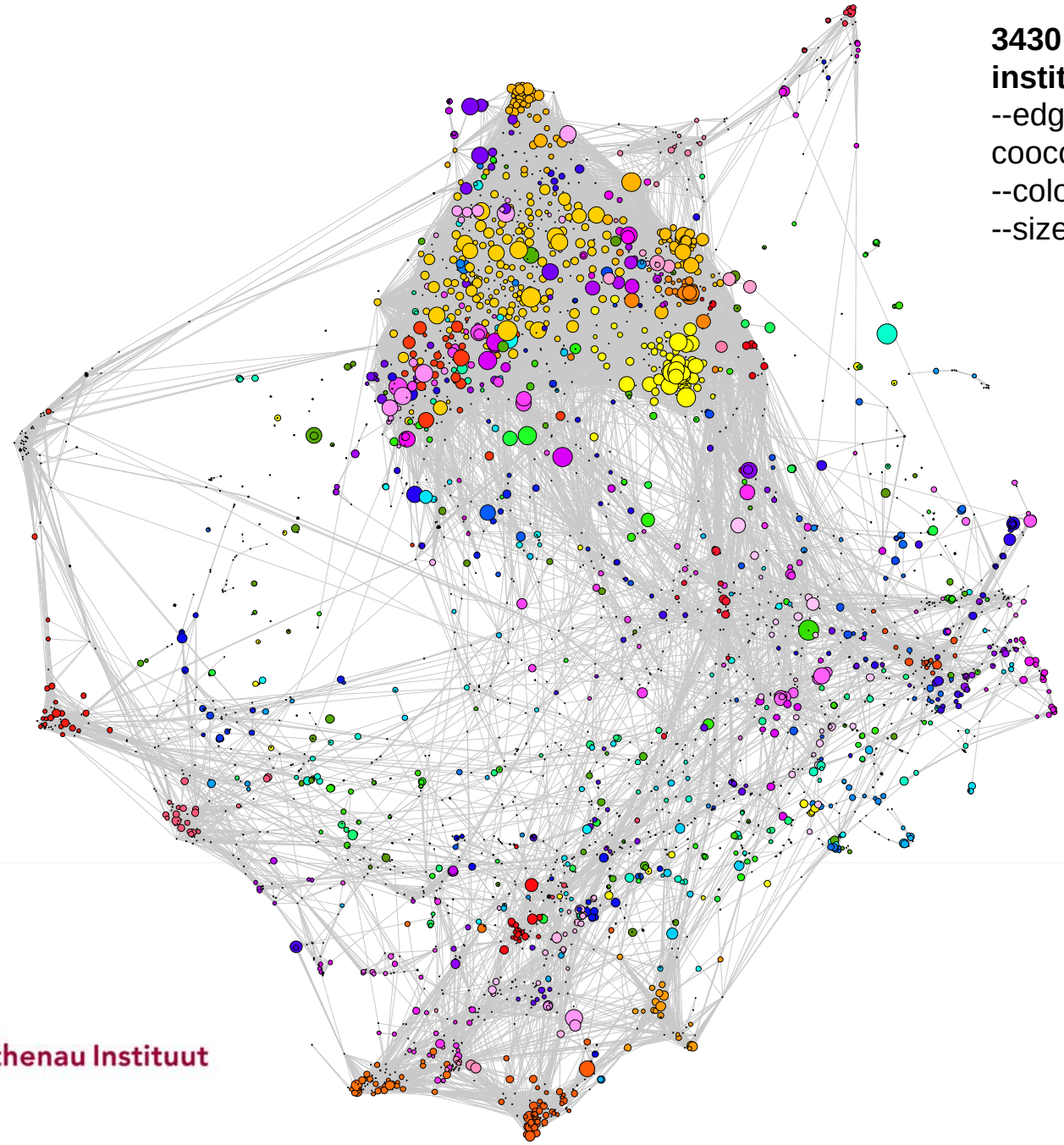
- Calculate similarity between patents in a dataset
  - IPC code co-occurrence at 4-digit, 7-digit or full level
  - combination of title words and IPC codes
  - user-defined measures

- Use the SAINT Toolkit (Somers et al., 2009)
  - Wordsplitter: to split titles into words (original and stemmed, excluding stop words)
  - Network tools: to identify clusters in the similarity matrix and in the citation network (algorithms of Blondel et al. (2008) and Rosvall and Bergstrom (2007)

- Queries to extract descriptives on topical clusters (e.g. main title words, most frequent IPC codes, main applicants)

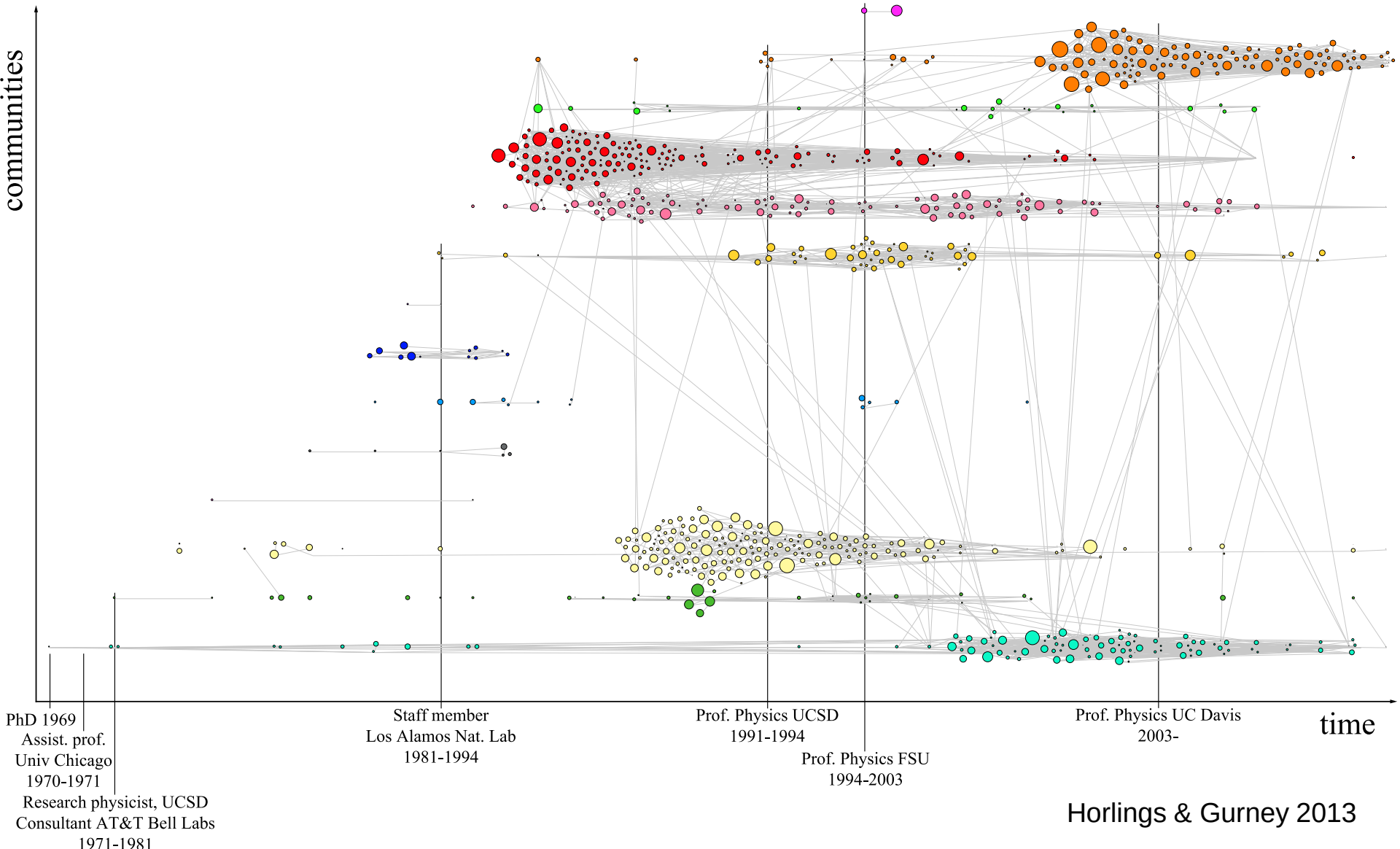
Visualising patent portfolios

- Queries produce nodes and edges files for Gephi
- Future: also output for Pajek
- How to show as many dimensions as possible in one figure?



3430 priority patents of knowledge institutes in the Netherlands
--edges are similarities: cooccurrence of full IPC codes
--colours indicate topical clusters
--size indicates number of NPLRs

A scientist's lifetime publication output



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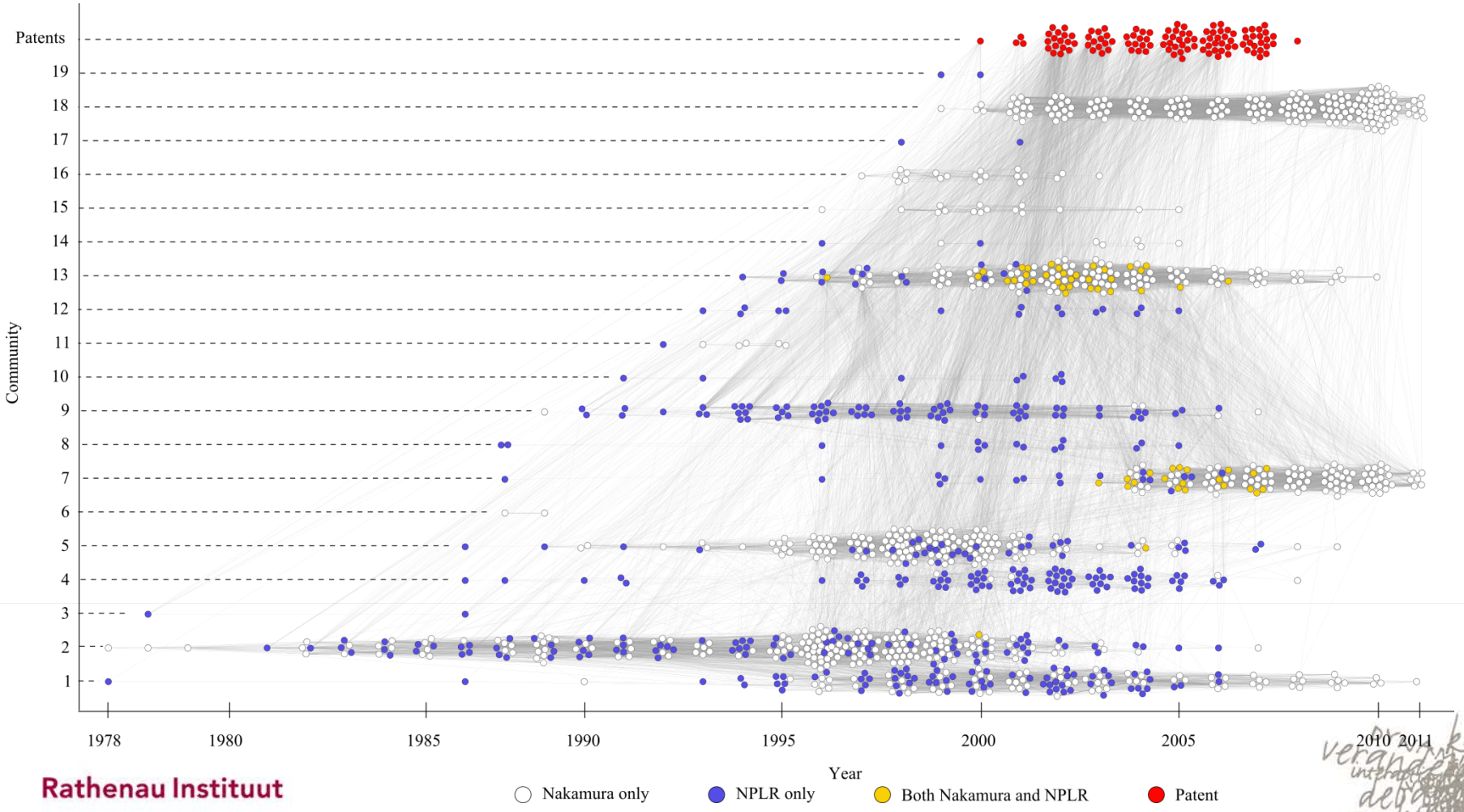
Linking patents to publications



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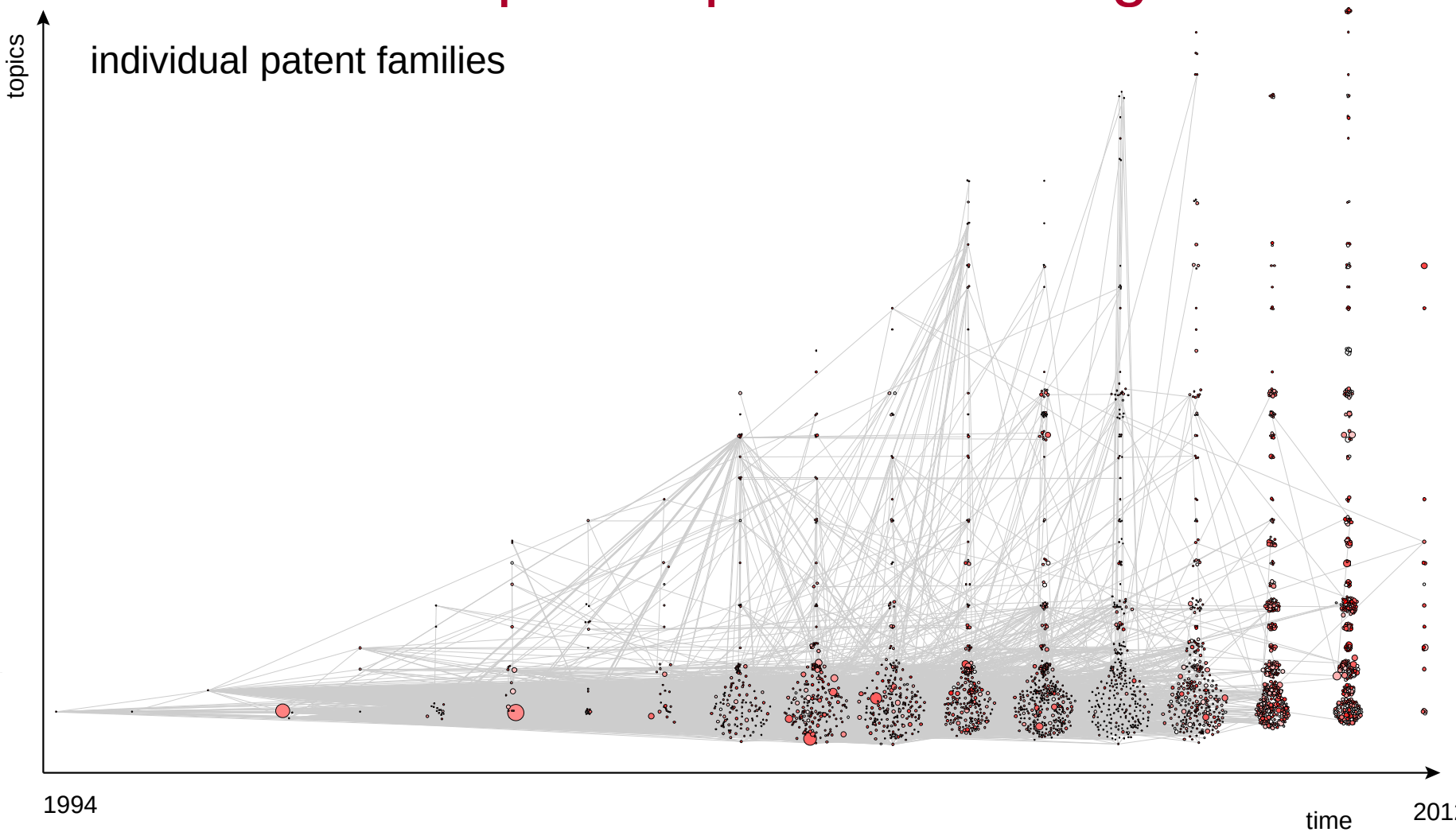
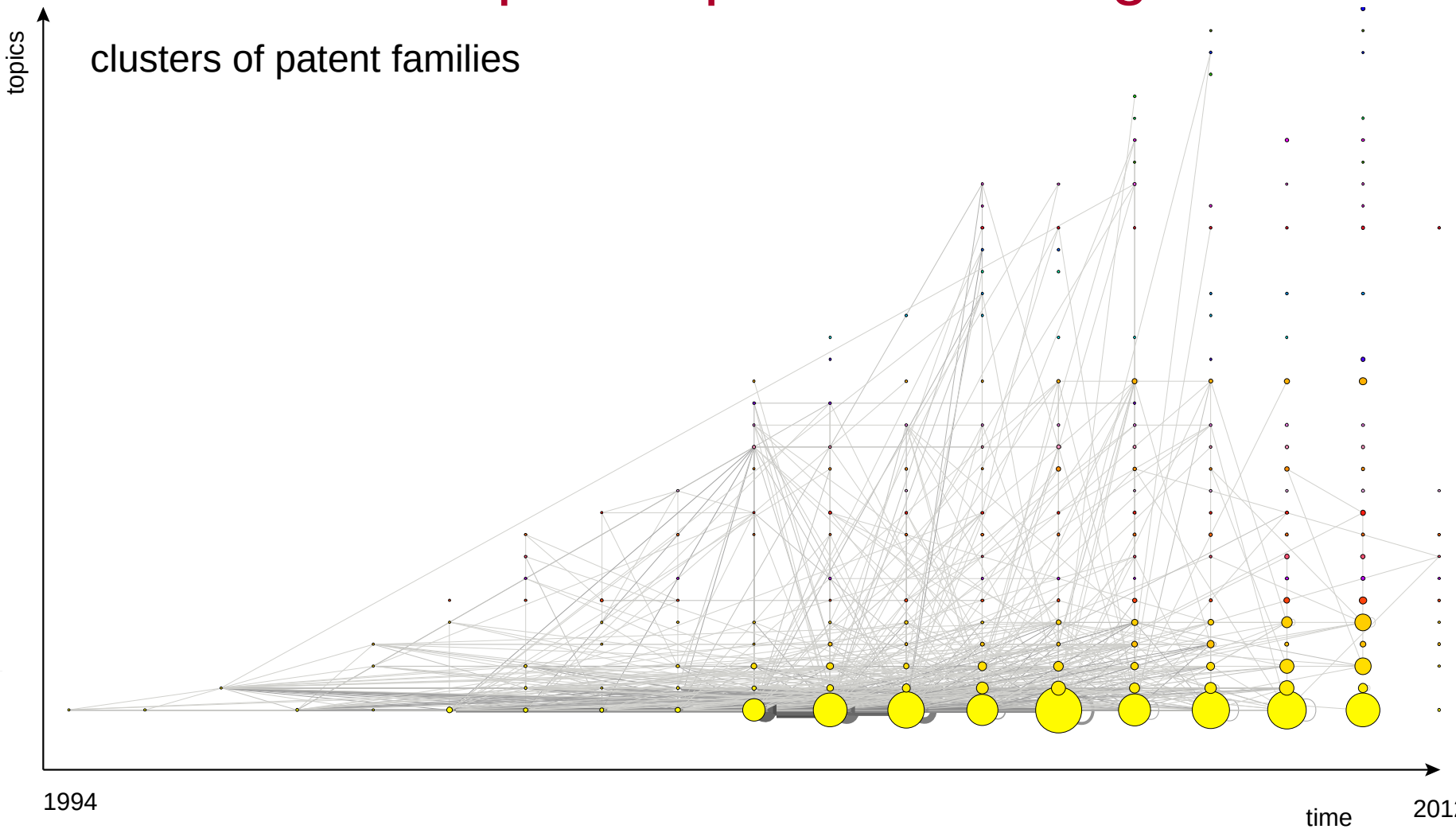
Gurney et al. 2013

A firm's lifetime patent portfolio: Google



A firm's lifetime patent portfolio: Google



No conclusion without statistical analysis

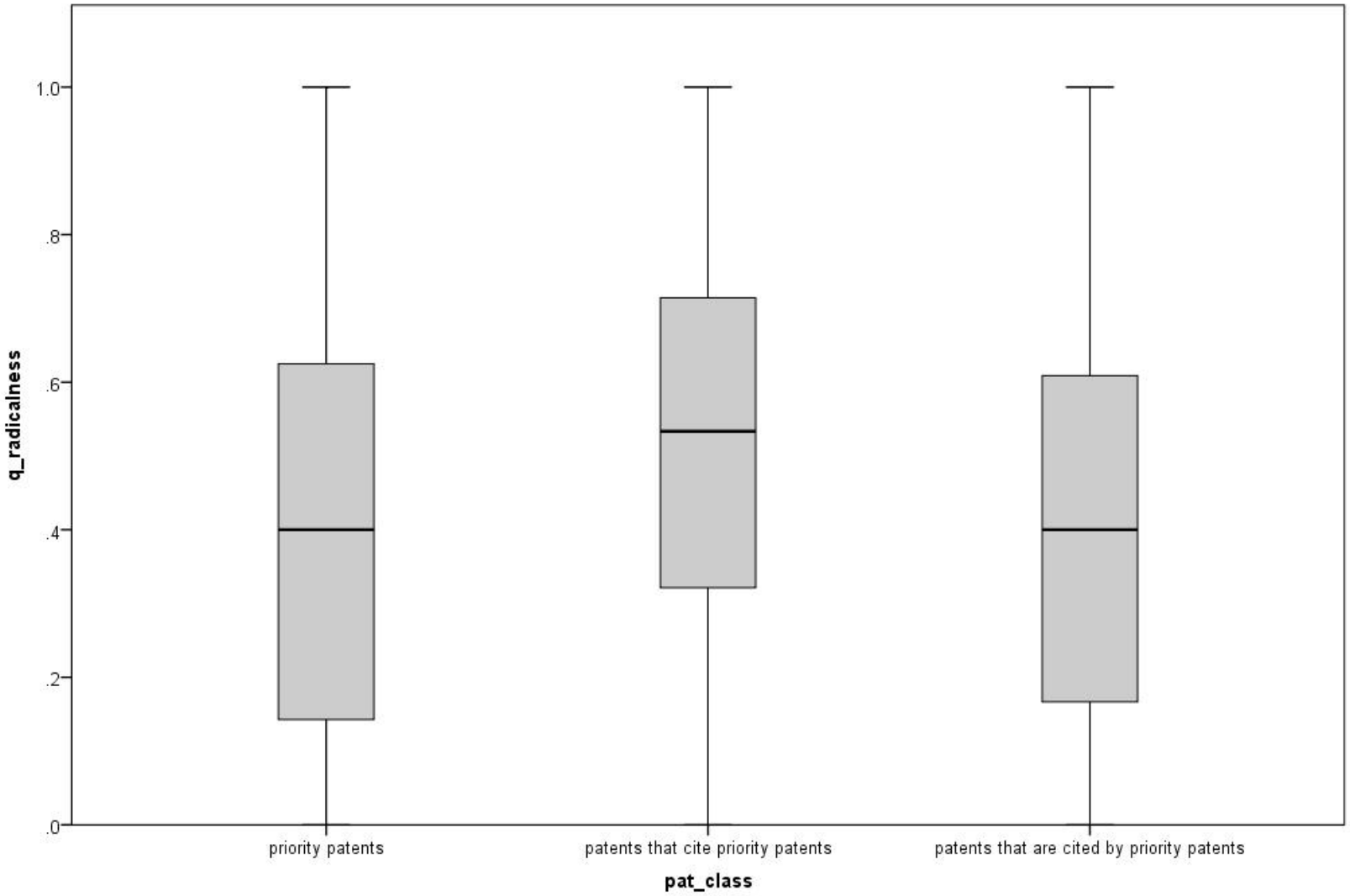
- A visualisation can be extremely informative...
- ....but be careful of the Rorschach effect!
- You must confirm what you think you see:
  - statistical analysis
  - interviews
  - other methods
- Queries produce
  - descriptive information on topical clusters
  - file with statistical information on all individual applications in the set

The quality of academic patents compared

	N (single priority families)	share of NPLRs = 0	mean share of NPLRs	standard deviation	median share of NPLRs
general universities	853	338 (39.6%)	.410	.392	.375
technical universities	606	365 (60.2%)	.193	.292	.000
non-university PROs	2,343	1309 (55.9%)	.215	.305	.000
top-100 firms	50,367	43389 (86.1%)	.042	.138	.000
other firms	29,891	24491 (81.9%)	.070	.198	.000

Estimates for 1990-2010. University-invented patents not yet included.

Technical university patents



Full paper

- First draft end of September
- Queries will be made publicly available
- Three use cases to illustrate possibilities
  - Visualising the portfolio of a firm
  - Identifying emerging topics in a technology area
  - Comparing the quality of patent clusters

Limitations

- There is no quick and dirty substitute for sound empirical analysis
- There are probably many ways to improve on my queries
- PATSTAT is incomplete and messy: a very precise analysis will always require detailed data cleaning

Thanks you for your attention

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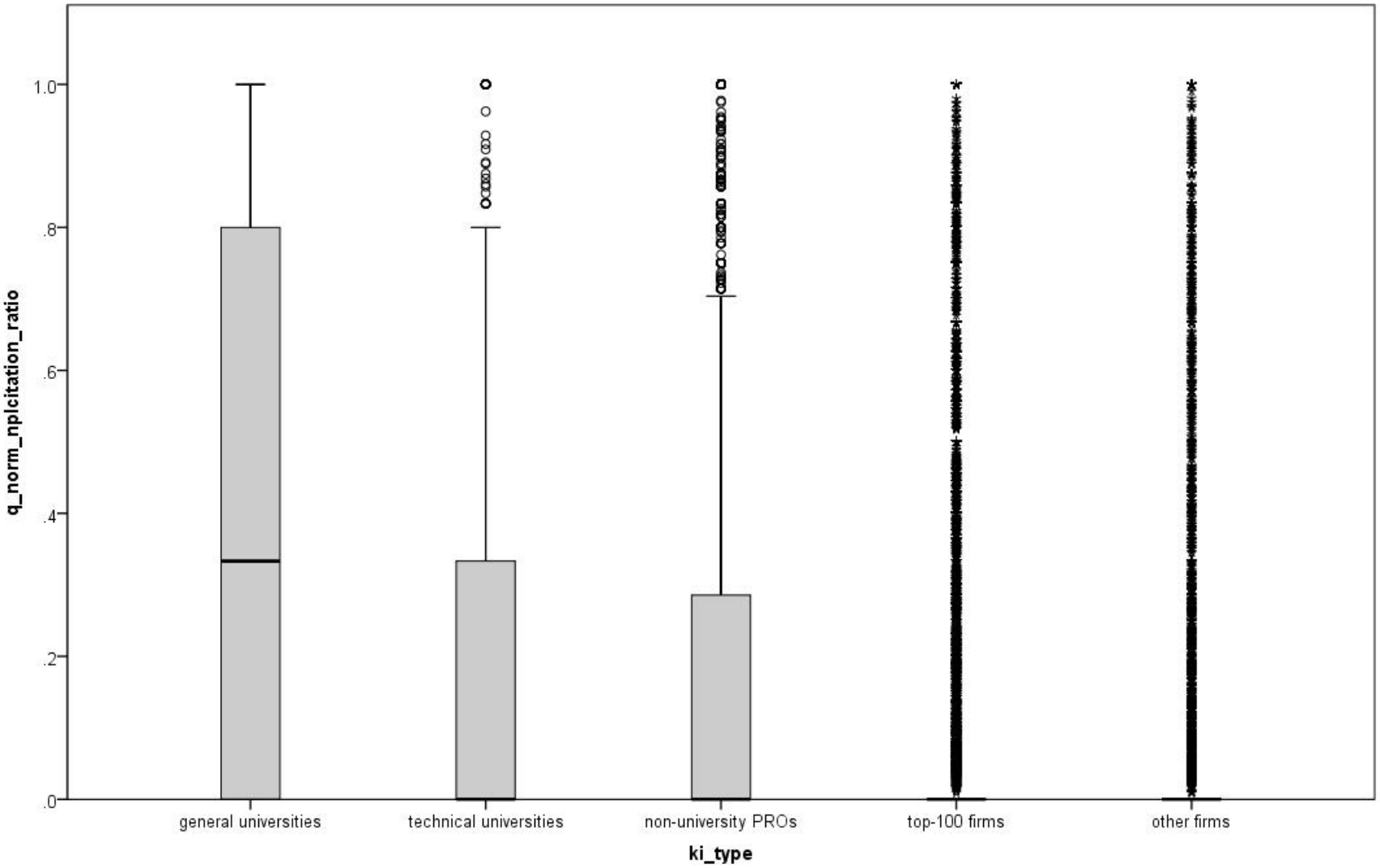
Ten steps in query set 2

1. Delineating an entry dataset using search criteria
2. Producing a working data set
3. Collecting basic properties of patents
4. Extracting and calculating patent quality indicators
5. Calculating similarity of patent families in the working data set
6. Finding patent clusters by applying SAINT network tools
7. Constructing tables with nodes and edges data for Gephi
8. Constructing tables for statistical analysis
9. Extracting descriptives per patent cluster
10. Visualising the portfolio in Gephi

The quality of academic patents compared



Description of topical clusters

	A	B	C	D	E	F	G	H
1	**DESCRIPTIVES TOPICS IN PATENT PORTFOLIO**							
2	*Import from text: NAME_num_patents_topics.csv*							
3					9%			
4				530	46			
5	**cluster_ipc**	**m_inpadoc**	**first_year**	**last_year**	**description**	**English title word frequency**	**IPC codes**	**main assignees**
6	488	12	1979	2010	ABSORBABLE SURGICAL DEVICE WITH LAYERED COMPOSITE STRUCTURE; MATERIALS FOR OSTEOSYNTHESIS	surgical (10;83.3%), material (9;75%), device (5;41.7%), devices (5;41.7%), bone (4;33.3%), resorbable (4;33.3%), osteosynthesis (3;25%), made (3;25%), composite (3;25%), implant (3;25%), repair (2;16.7%), materials (2;16.7%), damaged (2;16.7%), absorbable (2;16.7%), fixation (2;16.7%), polymeric (1;8.3%), elements (1;8.3%), secure (1;8.3%), internal (1;8.3%), self (1;8.3%)	A61B17/00 (8;66.7%), A61B17/58 (8;66.7%), A61B17/68 (8;66.7%), A61F2/02 (8;66.7%), A61F2/30 (8;66.7%), A61L31/00 (8;66.7%), A61B17/80 (7;58.3%), A61B17/86 (7;58.3%), A61F2/00 (7;58.3%), A61L31/14 (7;58.3%), A61B17/72 (6;50%), A61L31/12 (5;41.7%), A61F2/28 (4;33.3%), A61L27/00 (4;33.3%), A61L31/06 (4;33.3%), A61L17/00 (3;25%), A61L26/00 (2;16.7%), A61L27/14 (2;16.7%), A61L31/02 (2;16.7%), A61L31/04 (2;16.7%)	BIOCON (4;33.3%), MATERIALS CONSULTANTS (4;33.3%), BIOCON OY, TAMPERE (2;16.7%), SYNTHES (2;16.7%), TORMALA, PERTTI (2;16.7%), AMARA BOUALI (1;8.3%), AMERICAN CYANAMID COMPANY (1;8.3%), BICON (1;8.3%), BIOKON OJ (1;8.3%), BLOEMER, ALOIS (1;8.3%), BLOEMER, ALOIS, PROF. DR.MED., 4390 GLADBECK (1;8.3%), BLOEMER,ALOIS,PROF.DR.MED. (1;8.3%), BUREEMAA ARCISU (1;8.3%), CAMBRIDGE SCIENTIFIC (1;8.3%), DEPUY MITEK (1;8.3%), DORENAATO KURAUSU (1;8.3%), DRAENERT, KLAUS (1;8.3%), DRAENERT, KLAUS, DR.MED. (1;8.3%), DRAENERT, KLAUS, DR.MED. DR.MED.HABIL., 8000 MUENCHEN (1;8.3%),
7	5	3498	1964	2012	ANTERIOR LUMBAR INTERBODY FUSION; INTERVERTEBRAL IMPLANTS; ARTIFICIAL INTERVERTEBRAL DISCS	implant (1318;37.7%), intervertebral (1108;31.7%), spinal (686;19.6%), disc (597;17.1%), device (507;14.5%), vertebral (433;12.4%), prosthesis (416;11.9%), fusion (399;11.4%), artificial (316;9%), cage (252;7.2%), interbody (234;6.7%), disk (206;5.9%), bone (191;5.5%), prosthetic (191;5.5%), system (188;5.4%), expandable (188;5.4%), vertebrae (184;5.3%), spacer (179;5.1%), body (176;5%), implants (171;4.9%)	A61F2/44 (321;91.8%), A61F2/30 (141;40.4%), A61F2/00 (129;37%), A61F2/46 (111;32%), A61F2/28 (71;20.3%), A61B17/70 (61;17.5%), A61B17/56 (37;10.6%), A61B17/58 (35;10.2%), A61F2/02 (31;9.1%), A61B17/88 (25;7.3%), A61B17/86 (20;5.8%), A61L27/00 (17;5%), A61B17/02 (15;4.3%), A61B17/00 (14;4.1%), A61B17/16 (12;3.5%), A61B19/00 (10;3.1%), A61F2/36 (9;2.7%), A61B17/17 (9;2.6%), A61B17/80 (7;2.2%), A61F2/38 (6;1.9%)	WARSAW ORTHOPEDIC (362;10.3%), SYNTHES (239;6.8%), SDGI HOLDINGS (192;5.5%), DEPUY SPINE (86;2.5%), AESCULAP & COMPANY (76;2.2%), ZIMMER SPINE (55;1.6%), TRIEU, HAI H. (38;1.1%), OSTEOTECH (36;1%), DEPUY ACROMED (35;1%), NUVASIVE (29;0.8%), ZIMMER (29;0.8%), LECHMANN, BEAT (26;0.7%), MATHYS MEDIZINALTECHNIK (25;0.7%), KYPHON (24;0.7%), STRYKER SPINE (24;0.7%), ABBOTT SPINE (22;0.6%), CERVITECH (22;0.6%), ULRICH & COMPANY
8	135	73	1975	2011	APPARATUS AND METHODS FOR BONE SURGERY	apparatus (63;86.3%), bone (26;35.6%), surgery (25;34.3%), knee (15;20.6%), femoral (12;16.4%), tibial (9;12.3%), resection (7;9.6%), performing (7;9.6%), femur (6;8.2%), forming (5;6.9%), tunnel (5;6.9%), operation (5;6.9%), tool (5;6.9%), wire (4;5.5%), osteotomy (4;5.5%), orthopaedic (4;5.5%), surgical (4;5.5%), invasive (4;5.5%), shaping (4;5.5%), device (4;5.5%)	A61B17/16 (52;71.2%), A61B17/17 (48;65.8%), A61B17/56 (46;63%), A61B19/00 (34;46.6%), A61B17/00 (23;31.5%), A61B17/15 (23;31.5%), A61B17/58 (15;20.6%), A61F2/46 (13;17.8%), A61B17/14 (9;12.3%), A61B17/88 (9;12.3%), A61F5/00 (9;12.3%), A61B17/92 (7;9.6%), A61B17/32 (6;8.2%), A61B17/90 (5;6.9%), A61F2/36 (5;6.9%), A61B17/60 (4;5.5%), A61B17/68 (4;5.5%), A61B17/02 (3;4.1%), A61B17/72 (3;4.1%), A61B18/18 (3;4.1%)	HOWMEDICA OSTEONICS CORPORATION (6;8.2%), DEPUY PRODUCTS (4;5.5%), SMITH & NEPHEW (4;5.5%), BIOMET MANUFACTURING CORPORATION (3;4.1%), DOW CORNING CORPORATION (3;4.1%), DOW CORNING WRIGHT CORPORATION (3;4.1%), MARTINS HAROLD M. (3;4.1%), MICHAEL EGAN (3;4.1%), SULLIVAN, JOAN M. (3;4.1%), WHITTAKER GREGORY R. (3;4.1%), TAYLOR, JR.) RONALD L. (2;2.7%), ARTHREX (2;2.7%), BIOMET SPORTS MEDICINE (2;2.7%), CARDO MEDICAL (2;2.7%), CLEM MICHAEL F. (2;2.7%), EGAN, MICHAEL (2;2.7%), ETHICON (2;2.7%), EUGENE SHERRY (2;2.7%), GUZMAN PAMELA C. (2;2.7%), HESS, CHRISTOPHER J. (2;2.7%)
9	588	9	1978	2006	ARTIFICIAL BONE	bone (9;100%), artificial (7;77.8%), calcium (5;55.6%), phosphate (4;44.4%), substitute (3;33.3%), based (3;33.3%), material (3;33.3%), process (2;22.2%), graft (2;22.2%), preparation (2;22.2%), manufacturing (2;22.2%), machinable (1;11.1%), powder (1;11.1%), skull (1;11.1%), ceramic (1;11.1%), neutral (1;11.1%), carrier (1;11.1%), mother (1;11.1%), forming (1;11.1%), model (1;11.1%)	A61F2/00 (9;100%), A61F2/28 (9;100%), A61L27/00 (7;77.8%), A61F2/46 (6;66.7%), A61L27/12 (6;66.7%), A61F2/02 (3;33.3%), A61F2/30 (3;33.3%), A61L24/02 (3;33.3%), A61L27/56 (3;33.3%), A61C8/00 (2;22.2%), A61K6/033 (2;22.2%), C04B35/447 (2;22.2%), A61B17/00 (1;11.1%), A61B17/56 (1;11.1%), A61B17/58 (1;11.1%), A61F2/82 (1;11.1%), A61K33/42 (1;11.1%), A61L24/00 (1;11.1%), A61L27/02 (1;11.1%), A61L27/10 (1;11.1%)	ANZAI MASAHIRO (1;11.1%), BATTELLE MEMORIAL INSTITUTE (1;11.1%), BATTELLE-INSTITUT E. V. (1;11.1%), BATTELLE-INSTITUT EV, 6000 FRANKFURT (1;11.1%), BERKELEY ADVANCED BIOMATERIALS (1;11.1%), CHAE, SOO KYUNG (1;11.1%), ETEX CORPORATION (1;11.1%), GENIN FRANCOIS Y. (1;11.1%), HONG, KUG SUN (1;11.1%), KIM, HONG YEOL (1;11.1%), KYUNG WON MEDICAL COMPANY (1;11.1%), LEE, HO YEON (1;11.1%), LUO PING (1;11.1%), NEW X-NATIONAL TECHNOLOGY (1;11.1%), OLYMPUS CORPORATION (1;11.1%), RHEE, CHANG HUN (1;11.1%), RIKEN CORPORATION (1;11.1%), SEO, KANG MOON (1;11.1%), SEOUL NATIONAL UNIVERSITY (1;11.1%), SHIMOSAWA
10	106	59	1994	2011	ARTIFICIAL FACET JOINT; FACET JOINT PROSTHESIS	facet (50;84.8%), joint (49;83.1%), replacement (17;28.8%), artificial (10;17%), fusion (9;15.3%), device (8;13.6%), prosthesis (7;11.9%), joints (7;11.9%), implant (7;11.9%), prostheses (6;10.2%), apparatus (6;10.2%), systems (6;10.2%), spinal (5;8.5%), spine (5;8.5%), vertebral (5;8.5%), system (4;6.8%), fixation (4;6.8%), devices (4;6.8%), posterior (4;6.8%), ligament (3;5.1%)	A61B17/70 (51;86.4%), A61F2/44 (41;69.5%), A61B17/59 (23;39%), A61B17/88 (22;37.3%), A61B17/56 (21;35.6%), A61F2/30 (20;33.9%), A61F2/00 (14;23.7%), A61B17/04 (9;15.3%), A61B17/86 (9;15.3%), A61B19/00 (7;11.9%), A61B17/16 (6;10.2%), A61B17/00 (5;8.5%), A61F2/46 (5;8.5%), A61F2/02 (4;6.8%), A61F5/00 (4;6.8%), A61F2/08 (3;5.1%), A61B17/08 (2;3.4%), A61B17/17 (2;3.4%), A61B17/34 (2;3.4%), A61B17/82 (2;3.4%)	GMEDELAWARE 2 (8;13.6%), DEPUY SPINE (7;11.9%), HAWKINS, JOHN, RILEY (6;10.2%), ARCHUS ORTHOPEDICS (5;8.5%), BORGSTROM, ANNE (5;8.5%), FACET SOLUTIONS (4;6.8%), KWAK, SEUNGKYU, DANIEL (4;6.8%), CHERWITZ, ALAN (3;5.1%), DUNBAR, WILLIAM (3;5.1%), HOY, ROBERT W. (3;5.1%), JONES, LAWRENCE (3;5.1%), REILEY, MARK (3;5.1%), SPINAL ELEMENTS (3;5.1%), STINSON, DAVID (3;5.1%), WARSAW ORTHOPEDIC (3;5.1%), YUAN, HANSEN (3;5.1%), ZYGA TECHNOLOGY (3;5.1%), ASSELL, ROBERT (2;3.4%), BLAIN, JASON (2;3.4%), BOEHM, FRANK, H., JR. (2;3.4%)
11	230	16	1997	2011	ARTIFICIAL JOINT REPLACEMENT SUPPORTING INSTRUMENT	joint (14;87.5%), artificial (13;81.3%), replacement (11;68.8%), knee (7;43.8%), operation (6;37.5%), arthroplasty (6;37.5%), system (6;37.5%), program (5;31.3%), assisting (5;31.3%), hip (5;31.3%), total (4;25%), plan (4;25%), preoperative (4;25%), planning (3;18.8%), apparatus (3;18.8%), jig (3;18.8%), positioning (3;18.8%), device (3;18.8%), tool (3;18.8%), computer (2;12.5%)	A61B19/00 (15;93.8%), A61B17/56 (13;81.3%), A61F2/46 (12;75%), A61B17/16 (4;25%), A61F2/38 (4;25%), A61B17/14 (3;18.8%), A61B17/15 (3;18.8%), A61B17/58 (3;18.8%), A61B5/107 (3;18.8%), G06T1/00 (3;18.8%), A61B17/00 (2;12.5%), A61B17/02 (2;12.5%), A61B17/60 (2;12.5%), A61B5/103 (2;12.5%), A61F2/32 (2;12.5%), G06K9/00 (2;12.5%), G06T17/40 (2;12.5%), A61B17/90 (1;6.3%), A61B18/20 (1;6.3%), A61F2/30 (1;6.3%)	LEXI (4;25%), KOGA YOSHIO (2;12.5%), SOFT CUBE COMPANY (2;12.5%), STRYKER LEIBINGER & COMPANY (2;12.5%), TATSUMI ICHIRO (2;12.5%), WRIGHT MEDICAL JAPAN (2;12.5%), XU DONGLIANG (2;12.5%), BURGER, THORSTEN (1;6.3%), DE LA BARRERA JOSE LUIS MOCTEZUMA (1;6.3%), DODDS, GORDON (1;6.3%), GUANGZHOU ZHONGDA MEDICAL EQUIPMENT COMPANY (1;6.3%), GUANGZHOU ZHONGDA MEDICAL INSTRUMENT COMPANY (1;6.3%), HANANOUCHI TAKEHITO (1;6.3%), HIRAKAWA KAZUO (1;6.3%), ITO TOMOYUKI (1;6.3%), ITOKAZU KAZUMASA (1;6.3%), KITAMURA, YUGO (1;6.3%), KOBAYASHI KOICHI (1;6.3%), MATSUMOTO,
12	22	857	1963	2012	ARTIFICIAL LIGAMENT, MUSCLE, AND TENDON; LIGAMENT RECONSTRUCTION	ligament (372;43.4%), device (162;18.9%), artificial (162;18.9%), tendon (136;15.9%), tissue (88;10.3%), fixation (84;9.8%), graft (80;9.3%), prosthesis (76;8.9%), implant (76;8.9%), cruciate (71;8.3%), bone (70;8.2%), knee (69;8.1%), apparatus (67;7.8%), reconstruction (65;7.6%), prosthetic (64;7.5%), repair (61;7.1%), surgical (55;6.4%), muscle (54;6.3%), ligaments (52;6.1%), system (52;6.1%)	A61F2/08 (852;99.4%), A61B17/56 (81;9.5%), A61B17/04 (79;9.2%), A61F2/00 (76;8.9%), A61F2/02 (65;7.6%), A61B17/17 (49;5.7%), A61L27/00 (46;5.4%), A61B17/58 (45;5.3%), A61F2/38 (44;5.1%), A61B19/00 (40;4.7%), A61B17/16 (26;3%), A61B17/88 (23;2.7%), A61B17/00 (22;2.6%), A61B17/68 (21;2.5%), A61F2/30 (21;2.5%), A61B17/86 (20;2.3%), A61F2/48 (20;2.3%), A61B17/06 (19;2.2%), A61L27/18 (18;2.1%), A61B17/11 (17;2%)	SMITH & NEPHEW (22;2.6%), ETHICON (17;2%), ARTHREX (16;1.9%), DEPUY MITEK (15;1.8%), GOBLE, E. MARLOWE (12;1.4%), LABOUREAU, JACQUES-PHILIPPE (11;1.3%), LINVATEC CORPORATION (9;1.1%), SULZER (9;1.1%), SOMERS W. KARL (7;0.8%), KARL STORZ & COMPANY (7;0.8%), LABOUREAU JACQUES (7;0.8%), SEEDHOM, BAHAA, BOTROS (7;0.8%), AESCULAP & COMPANY (6;0.7%), PROTEK (6;0.7%), UNIV NIHON (6;0.7%), ARTHROCARE CORPORATION (5;0.6%), ATLANTECH MEDICAL DEVICES (5;0.6%), BAXTER (5;0.6%), BIOMET SPORTS MEDICINE (5;0.6%), BRULEZ,
13	226	22	1989	2009	BIOLOGICAL REACTOR FOR ARTIFICIAL LIVER	artificial (17;77.3%), liver (15;68.2%), biological (8;36.4%), reactor (8;36.4%), bioreactor (6;27.3%), support (4;18.2%), system (3;13.6%), biologs (3;13.6%), cell (3;13.6%), bed (2;9.1%), perfusion (2;9.1%), fluidized (2;9.1%), bracket (2;9.1%), suspension (2;9.1%), hepatocyte (2;9.1%), filling (2;9.1%), microcapsule (2;9.1%), ventricular (2;9.1%), adapted (1;4.6%), active (1;4.6%)	A61B17/00 (22;100%), A61F2/00 (22;100%), A61M1/14 (15;68.2%), C12M3/00 (12;54.6%), A61M1/00 (4;18.2%), A61D1/00 (3;13.6%), A61M1/18 (3;13.6%), A61M1/10 (2;9.1%), C12M3/02 (2;9.1%), A61F2/24 (1;4.6%), A61J1/00 (1;4.6%), A61K35/12 (1;4.6%), A61M1/12 (1;4.6%), A61M1/36 (1;4.6%), A61M3/00 (1;4.6%), A61N1/362 (1;4.6%), A61N2/02 (1;4.6%), C12N3/00 (1;4.6%), C12N5/077 (1;4.6%)	ZHEJIANG UNIVERSITY (7;31.8%), THE AFFILIATED DRUM TOWER HOSPITAL, MEDICAL SCHOOL OF NANJING UNIVERSITY (2;9.1%), ANGEION CORPORATION (1;4.5%), BIOSYSTEM MEDICAL TECHNOLOGY (SHANGHAI) COMPANY (1;4.5%), BIOSYSTEM MEDICAL TECHNOOGY (SHANGHAI) COMPANY (1;4.5%), CONVERGE MEDICAL (1;4.5%), FLEISCHMAN, SIDNEY, D. (1;4.5%), GULOU HOSPITAL ATTACHED TO MEDICAL COLLEGE OF NANJING UNIV. (1;4.5%), HOUSER,RUSSELL A. (1;4.5%), INST. OF ELECTRICAL ENGINEERING, CAS (1;4.5%), NO.1 HOSPITAL ATTACHED TO NO.3 MILITARY MEDICAL UNIV., PLA (1;4.5%), NO.1 SUBSIDIARY HOSPITAL, NO.3 MILITARY MEDICAL UNIV. OF P.L.A. (1;4.5%), THE AFFILIATED DRUM TOWER HOSPITAL OF NANJING UNIVERSITY MEDICAL SCHOOL (1;4.5%), THE FIRST AFFILIATED HOSPITAL OF THIRD MILITARY MEDICAL UNIVERSITY OF PLA (1;4.5%), THE FIRST PEOPLE'S HOSPITAL OF FOSHAN (1;4.5%), TOLOMEO, DEBORAH