Obsession with World University Ranking: clustering and Visualization

Tommy W. S. Chow

THE WORLD'S TOP 200 UNIVERSITIES

			Country	Peer review score	Employer review score	Staff/student score	Citations/staff score	International staff score	International students score	Overall score
1	1	Harvard University	US	100	100	100	96	93	91	100.0
2=	2	University of Cambridge	UK	100	100	99	83	98	91	97.6
2=	3	University of Oxford	UK	100	100	100	82	97	96	97.6
2=	4=	Yale University	US	100	98	100	91	84	75	97.6
5	9	Imperial College London	UK	99	99	100	81	98	100	97.5
6	10	Princeton University	US	100	94	95	97	83	75	97.2
7=	7	California Institute of Technology	US	100	55	100	100	100	91	96.5
7=	11	University of Chicago	US	100	97	100	86	71	90	96.5
9	25	University College London	UK	96	97	100	82	91	98	95.3
10	4=	Massachusetts Institute of Technology	US	100	99	85	98	34	94	94.6
11	12	Columbia University	US	100	96	94	91	34	89	94.5
12	21	McGill University	Canada	100	97	99	72	73	96	93.9
13	13	Duke University	US	98	97	100	92	16	74	93.4
14	26	University of Pennsylvania	US	97	96	88	92	83	65	93.3
15	23	Johns Hopkins University	US	99	77	98	96	35	69	92.9
16	16	Australian National University	Australia	100	91	100	66	68	91	91.6
17	19=	University of Tokyo	Japan	100	92	96	88	25	44	91.1
18	33=	University of Hong Kong	Hong Kong	95	90	85	79	100	89	90.7
19	6	Stanford University	US	100	99	66	100	25	94	90.6
20=	35=	Carnegie Mellon University	US	96	94	76	87	67	96	90.0
20=	15	Cornell University	US	100	98	74	93	36	69	90.0
22	8	University of California, Berkeley	US	100	98	59	92	73	88	89.7
23	33=	University of Edinburgh	UK	96	98	82	76	71	80	88.8
24	46=	King's College London	UK	90	95	91	70	93	84	88.2
25	29=	Kyoto University	Japan	99	89	83	90	29	24	87.2
26	18	Ecole Normale Supérieure, Paris	France	91	60	83	98	61	81	87.1
27	22	University of Melbourne	Australia	100	99	64	70	64	95	85.9
28	37	Ecole Polytechnique	France	76	94	100	78	70	94	85.1
29	42	Northwestern University	US	88	97	77	91	35	68	85.0
30	40	University of Manchester	UK	88	99	77	70	84	85	84.7
31	35=	University of Sydney	Australia	99	95	51	71	100	95	84.6
32	54=	Brown University	US	90	77	74	89	75	58	84.5
33=	50=	University of British Columbia	Canada	100	91	70	74	35	63	84.3
33=	45	University of Queensland	Australia	95	94	70	68	79	76	84.3
33=	19=	National University of Singapore	Singapore	100	93	34	84	100	100	84.3
36	14	Peking University	China	100	98	98	53	32	26	84.2
37	64=	University of Bristol	UK	81	98	85	77	88	72	84.1
38=	50=	Chinese University of Hong Kong	Hong Kong	83	79	80	80	100	85	83.8
38=	29=	University of Michigan	US	99	96	53	89	41	52	83.8
40	28	Tsinghua University	China	95	92	100	59	20	36	83.3
41	31	University of California, Los Angeles	US	100	92	56	91	20	36	82.8
42	24	ETH Zurich	Switzerland	92	75	61	74	100	92	82.5
43	38	Monash University	Australia	98	97	53	57	99	99	82.1
44	41	University of New South Wales	Australia	97	98	39	76	89	91	81.8
45	27	University of Toronto	Canada	100	96	21	93	86	50	80.6
46	70=	Osaka University	Japan	83	75	86	91	17	29	80.0
47	66	Boston University	US	91	89	49	88	29	88	79.7
48	69	University of Amsterdam	Netherlands	84	81	81	70	76	32	78.6
49	43	New York University	US	95	93	48	77	29	49	77.8
50	46=	University of Auckland	New Zealand	95	83	38	61	100	99	77.5
51=	63	Seoul National University	South Korea	92	54	80	79	16	24	77.1
51=	32	University of Texas at Austin	US	95	94	22	92	66	47	77.1
53=	58=	Hong Kong University of Science & Technology	Hong Kong	84	82	28	92	100	96	76.9
53=	78	Trinity College Dublin	Ireland	80	92	70	58	99	77	76.9
55=	84	University of Washington	US	84	50	73	92	44	33	76.7
55=	79=	University of Wisconsin-Madison	US	94	81	31	95	50	44	76.7
57	73	University of Warwick	UK	80	98	62	58	89	96	76.4
58	44	University of California, San Diego	US	98	39	51	95	23	30	76.3
59	17	London School of Economics	UK	89	100	65	29	100	100	75.7
60	58=	Heidelberg University	Germany	84	63	61	78	42	87	75.5
61	96	Katholieke Universiteit Leuven	Belgium	88	83	39	84	51	55	75.0
62	105=	University of Adelaide	Australia	75	86	66	65	77	96	74.7
63	86	Delft University of Technology	Netherlands	75	80	66	72	83	67	74.4

Little Background on Tertiary Education

- Australia Perspective:
- In 2005 alone, overseas students in Australia represented about 18% of all her higher education students.
- In Australia: international students (2004 to 2005) were valued at over Au$9 billion in export earnings.
- The third highest export for Australia: wool (Au$2.3 billion), wheat (Au$3.2 billion) and beef (Au$4.5 billion) in terms of value.

- US Figures:
- All degrees: 1959-60 476,704 phd 9,829
  2004-05 1.99 mil phd 44,600
- Graduates population larger than the national population of some countries

- The UK scenario?
- How about Hong Kong, and China?
- College Ranking has become an important issue.

Stanford

ATP/WTA world
Tennis ranking

HKU

The Glory and History

Nobel

Turing

MIT: The top world institutions for revolutionary science

- Use the last 20 years (1987 to 2006): The combined Nobel–Fields–Lasker–Turing (NFLT) metric
- Nobel, Fields medal, Lasker award (for Clinical Medical Research), and computing science (ACM. Turing award).

- The top world institutions for revolutionary science according to NFLT are
- MIT, Stanford and Princeton – all in the USA

- First: USA has 19 institutions with at least three prize-winners. Second: France, with three institutions having three or more winners;

- The UK and Norway have one each.

- Argument: (Alumni, faculty member, ex-faculty member,..)

- Revolutionary science is a term coined by Thomas Kuhn in his book, The structure of Scientific Revolutions (Chicago University Press, 1970)

Fields Medal (1982-2006)

1982: CONNES (Institut des Hautes Études Scientifiques), France
THURSTON (Princeton University), USA
Shing-Tung YAU (Institute for Advanced Study), USA

- 1986 DONALDSON (Oxford University), UK
FALTINGS (Princeton University), USA
FREEDMAN (University of California, San Diego), USA

- 1990 DRINFELD (Phys. Inst. Kharkov), Ukrainian
JONES (University of California, Berkeley), USA
MORI (University of Kyoto), Japan
WITTEN (Institute for Advanced Study, Princeton), USA

- 1994 BOURGAIN (Institute for Advanced Study, Princeton), USA
LIONS (Université de Paris-Dauphine), France
YOCCOZ (Université de Paris-Sud), France
ZELMANOV (University of Wisconsin), USA
- .
- 1998 BORCHERDS (Cambridge University), UK
GOWERS (Cambridge University), UK
KONTSEVIC (Institut des Hautes Études Scientifiques), France
McMULLEN (Harvard University), USA

- 2002 VOEVODSKY (Institute for Advanced Study, Princeton), USA

- 2006 Okounkov, Princeton University, USA
WERNER, Université Paris-Sud XI in Orsay, France
Terence Tao, UCLA , USA

- Summary : USA (12), France (5), UK (3), Ukrainian (1), Japan (1)

AMC Turing Award (Computing Science)

- Mostly USA
- Big share from US University: Berkely, Carnegie Mellon, and MIT
- Last UK recipient: 1991- Robin Milner (Cambridge)

- 2007 Carnegie Mellon University, UT Austin, USA
- 2006 IBM, USA
- 2005 Demark
- 2004 Corporation for National Research Initiatives, USA
- 2003 UCLA, USA
- 2002 USC, MIT, USA, Weizmann Institute (Israel)
- 2001 Norway, Norway
- 2000 Andy Yau, Princeton, USA
- 1999 University of North Carolina, USA
- 1998 Microsoft, USA
- 1997 Bootstrap Institute, USA
- 1996 Weizmann Institute, Israel,
- 1995 UC Berkely, USA
- 1994 Carnegie Mellon, Stanford, USA

- Carnegie Mellon University: There are 10 Carnegie Mellon Turing award winners, including its first-ever recipient.
  http://www.cmu.edu/corporate/points_of_distinction/awards/turing.shtml

A Brief Table

- Number of Nobel–Fields–Lasker–Turing winners by nation 87–2006

Nation	Nobel	Other 3 awards	Total
USA	126	45	171
UK	9	10	19
France	5	7	12
Germany	9	0	9
Switzerland	7	0	7
Japan	3	1	4
Russia	2	1	3
Denmark	1	2	3
Norway	1	2	3

A minimum of 3 winners is required for inclusion.

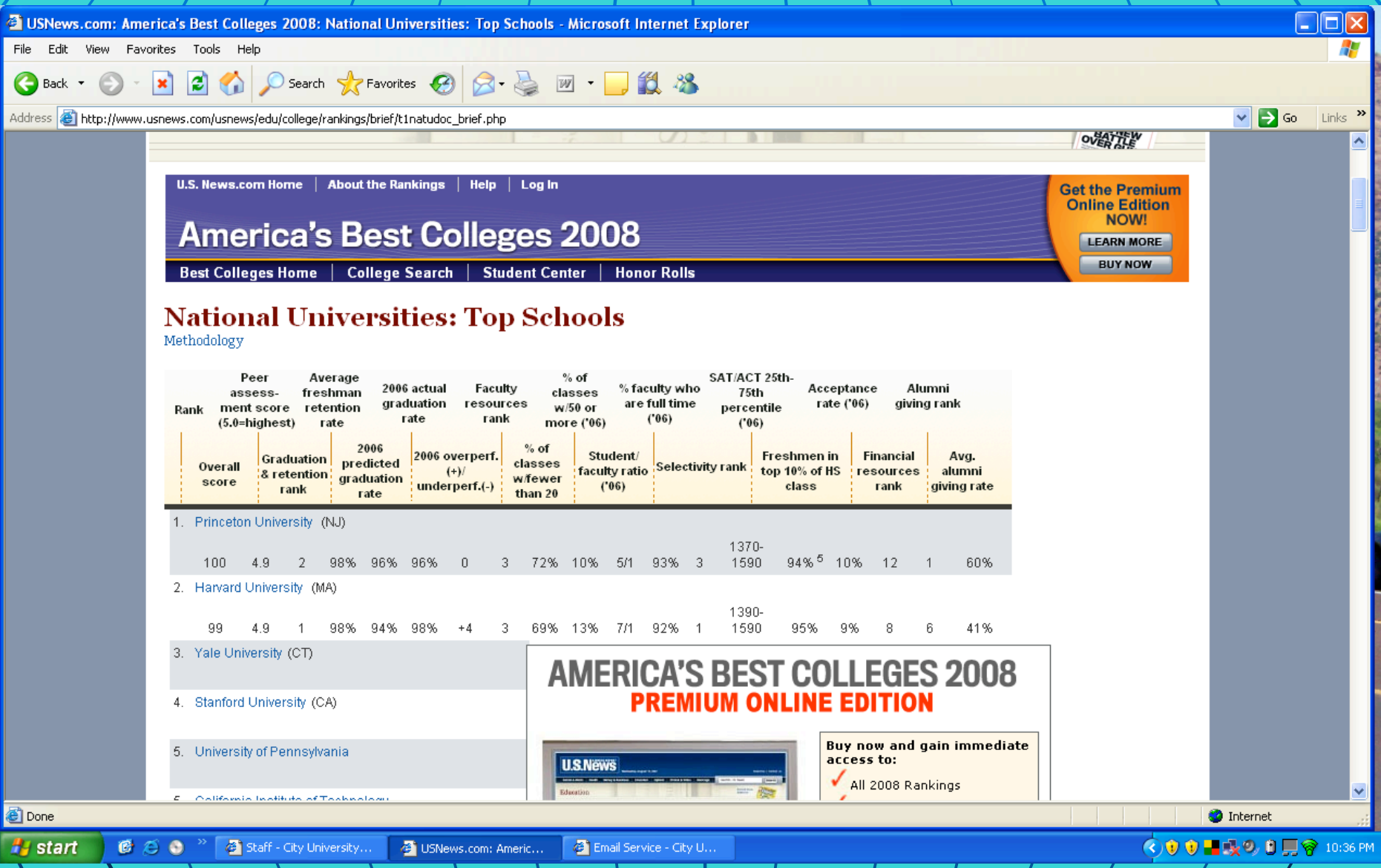
Does every student/parent look at these Glory?

- Yes or no
- What do they care most?
- They care many other factors
  - Employment, strength of the college, reputation, student care, peers, campus, safety, etc
- Good students consider all aspects
- Less students consider other aspects

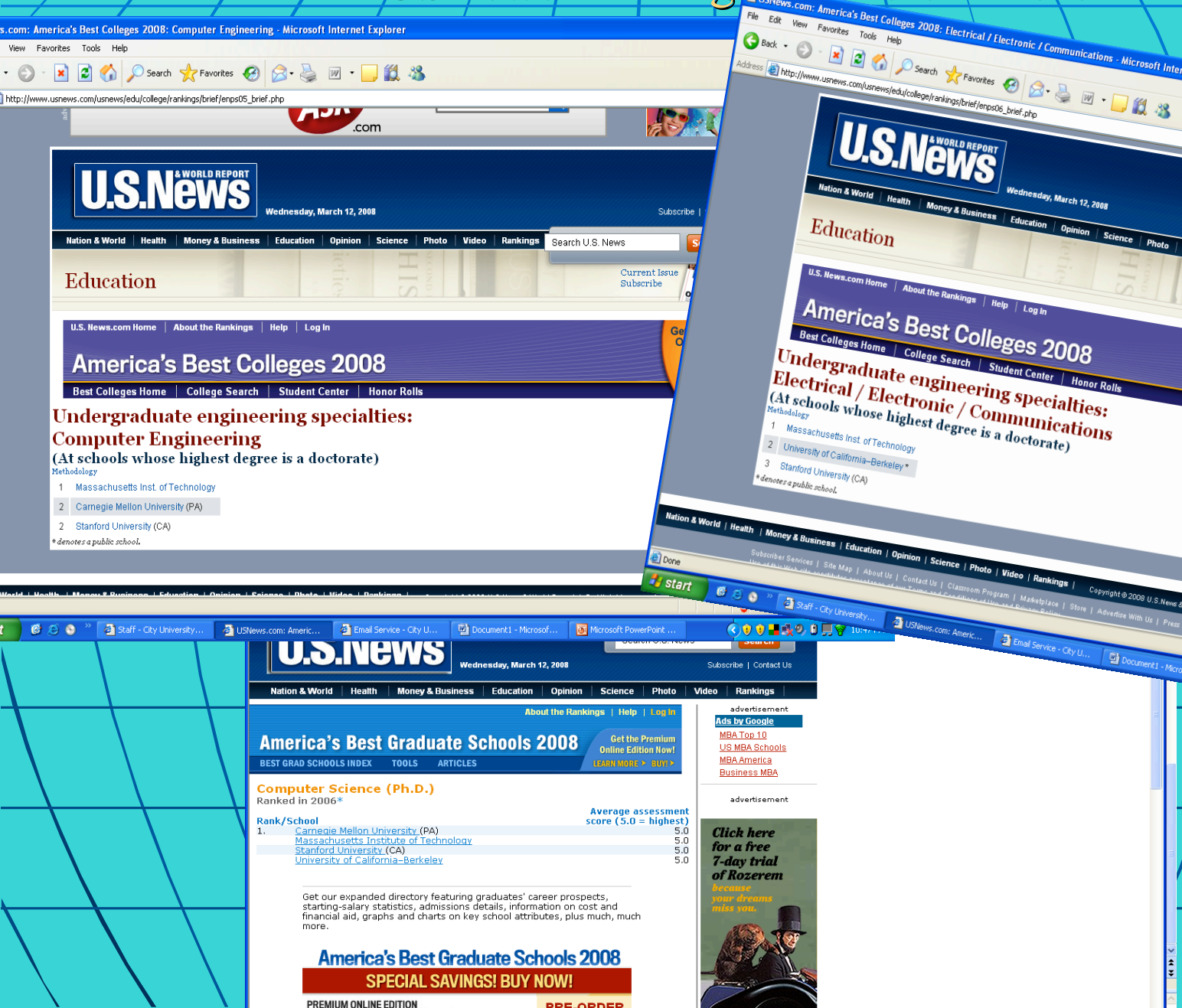
Parents and Students look for

- Harvard is not a revolutionary science college, but…
- Look for the best possible college of the discipline
- The Wharton Business/Finance School of U Penn
- The Life Science at Harvard and Johns Hopkins University
- The Business and Management at Michigan-Ann Arbor
- The School of Computer Science at MIT, Carnegie Mellon and Stanford
- The Department of Electronic Engineering of City University HK

Students/Parents Focus: The USNews Ranking



USNews Ranking in Different areas



The US experience

- Here is the actual UCLA 2007 Survey question and top 15 reasons that this conclusion was based on.

College has very good academic reputation	63.0%
This college's graduates get good jobs	51.9%
A visit to the campus	40.4%
I was offered financial assistance	39.4%
Wanted to go to a college this size	38.9%
College has a good reputation for social activities	37.1%
The cost of attending this college	36.8%
Grads get into good grad/professional schools	34.1%
Wanted to live near home	19.2%
Rankings in national magazines	**17.6%**
Information from a website	17.0%
Parents wanted me to go to this school	13.0%
Admitted early decision and/or early action	11.4%
Could not afford first choice	9.7%
High school counselor advised me	9.0%

University Ranking

Different Perspectives:

- Students
- Parents
- Teachers
- Professors
- University Presidents
- Government
- Community
- International

The Six Features used by the UK Times

2007 Case (Argument on the weightings)

- Peer review 40%
- Employer Reviewer 10%
- Research Citation 20% (medicine school**)
- Staff to Student ratio 20%
- International Staff 5%

- International Student 5% (US case undergrad/post-grad)

100%: NUS, LSE, IC, Cranfield, Geneva, Ecole Polytechnique (swiss), Ecole Normale Lyon (France);

99%: Monash, NTU, Auckland, Maastricht (Australia), KTH, Royal Institute of Tech (sweden), Wollongong (Australia), RMIT (Australia);

98% UCL

So it all come back to the feature selection issue

Example: to select the major features for being an attractive or non-attractive man

Self-Organizing Map (SOM)

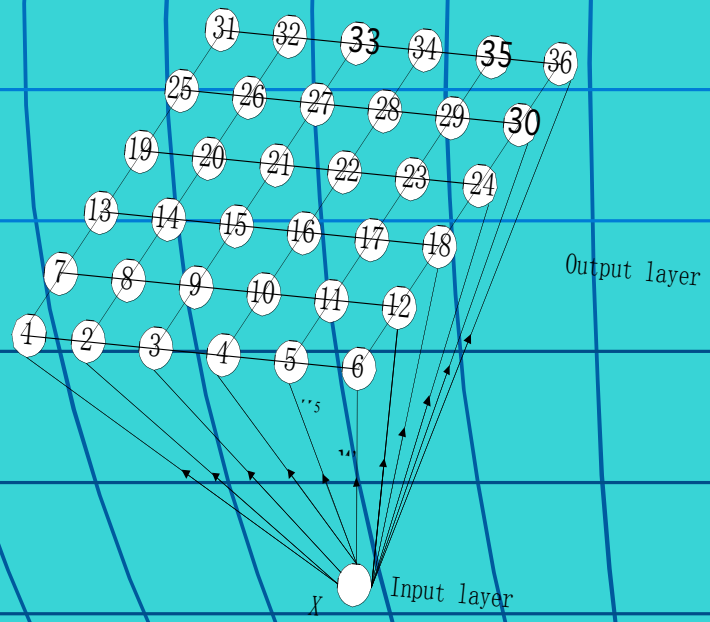
- Unsupervised learning algorithm
  - Based on competitive learning
    - Dimension reduction (Visualization)
      - Topological ordered map
      - Applications: Engineering, physical science, and finance analysis.

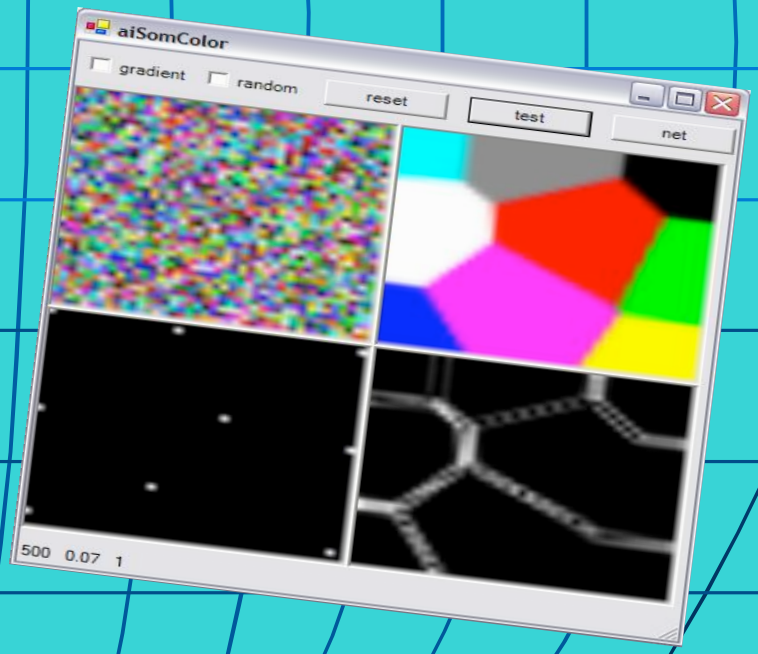
Background on SOM

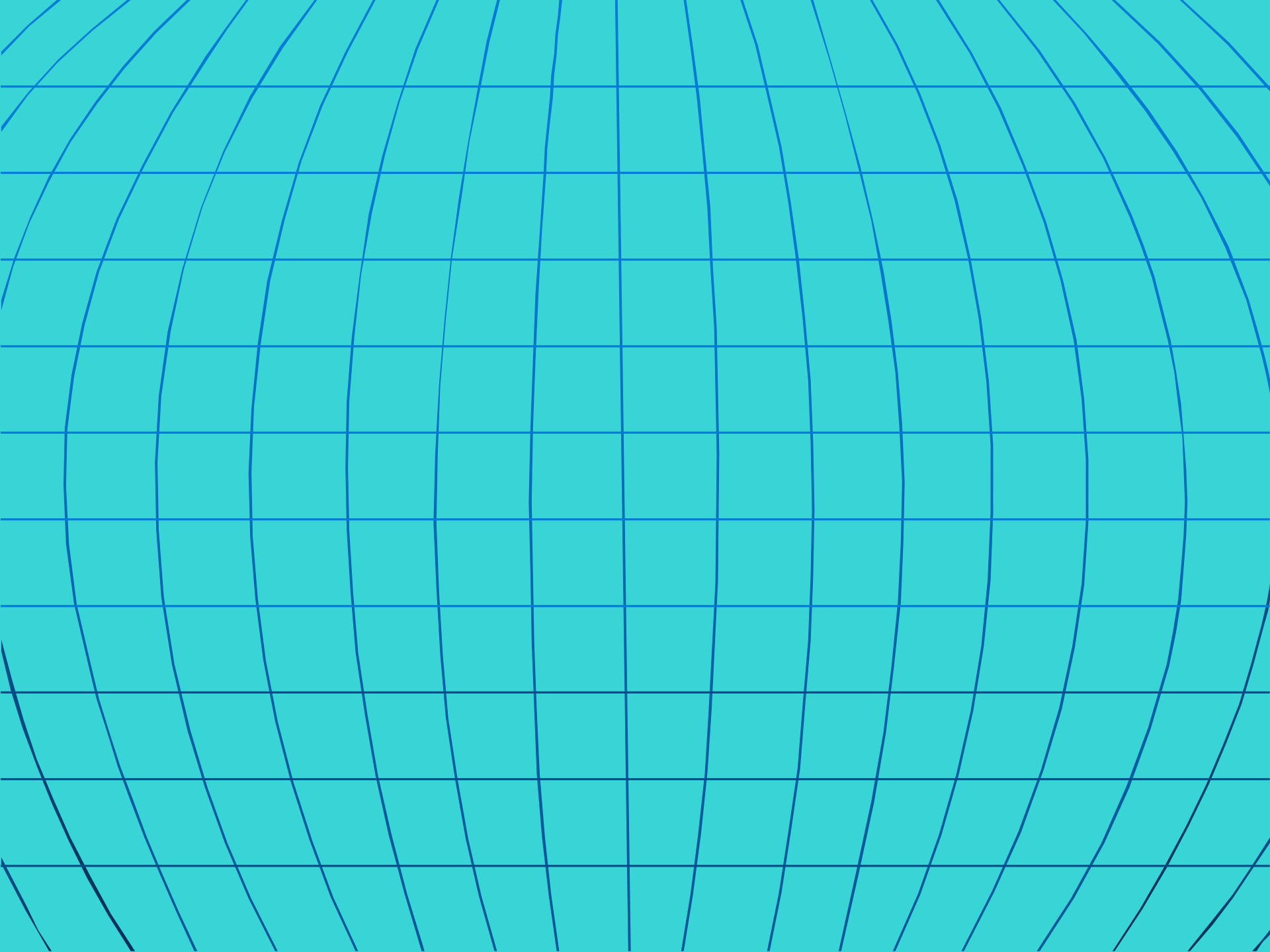
- Handling datasets using computational methods has become an integral part of business, science, engineering, and even education
- Problematic because the increase of data dimensions, and number of instances
  - Feature selection, data reduction, Clustering and visualization are important to Engineering and non-engineering problems
  - What is my view on University ranking from the above perspectives

A simple way to visualize Self-Organizing Map (SOM)

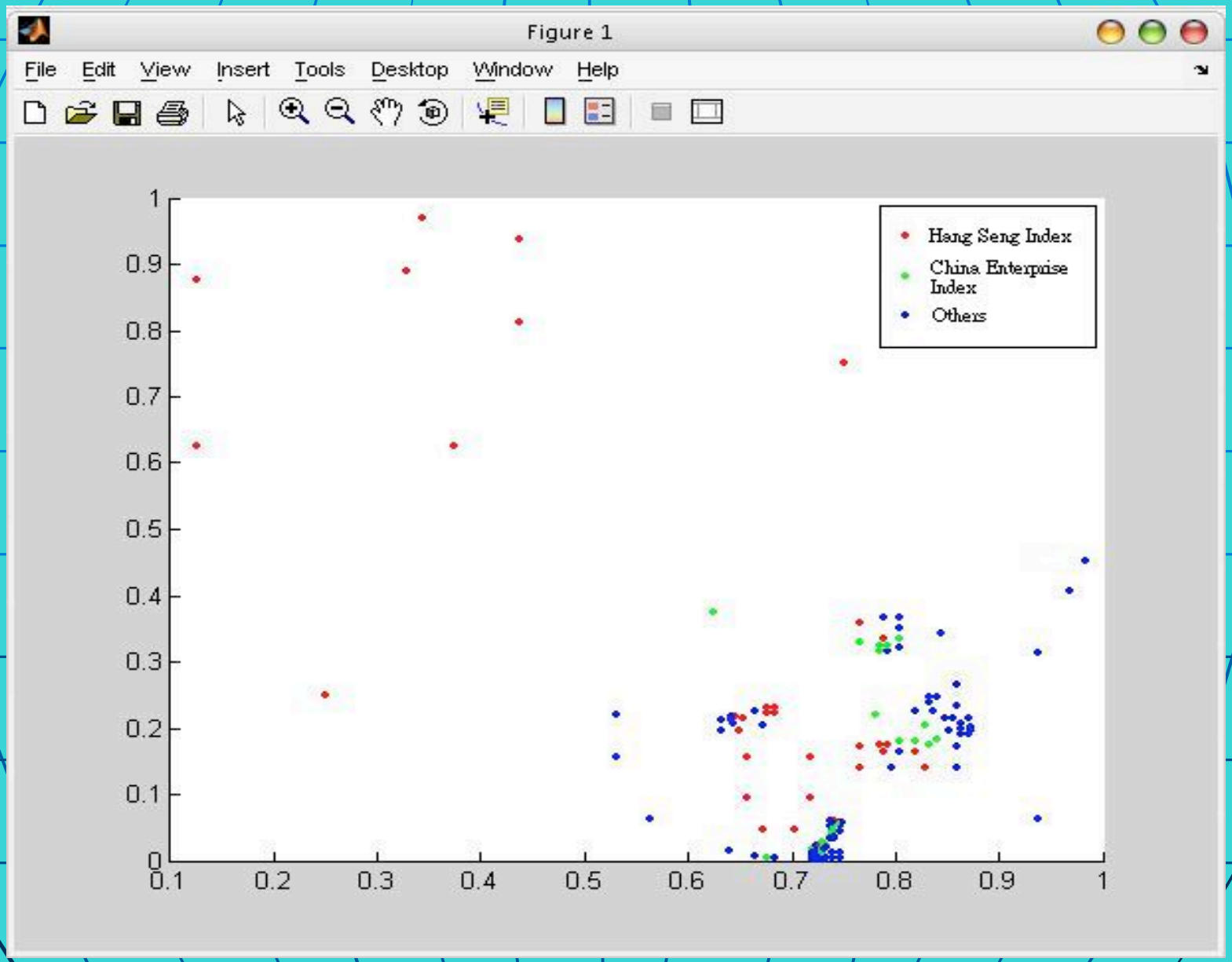
Input space: RGB inputs







SOM output map on Hong Kong Stocks



Our Work on Self-Organizing Map

- Developing New SOM models
- Different types of applications:
  Image, documents retrieval,
  Plagiarism detection,
  Business data analysis (Stocks)

2006 Times World Top 2007 University ranking

THE TOP 200 WORLD UNIVERSITY RANKINGS

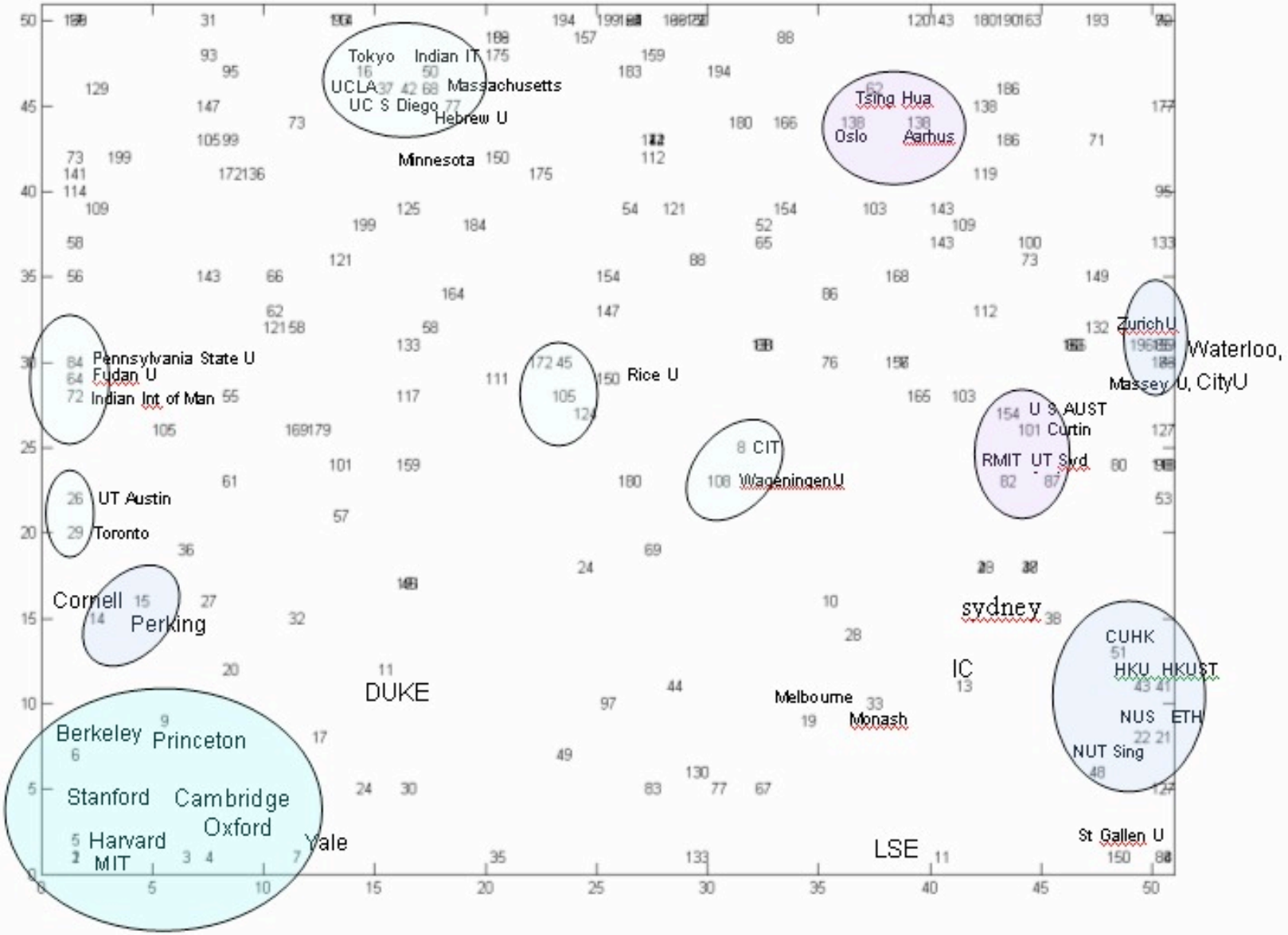
THE WORLD'S TOP 200 UNIVERSITIES

Source: QS

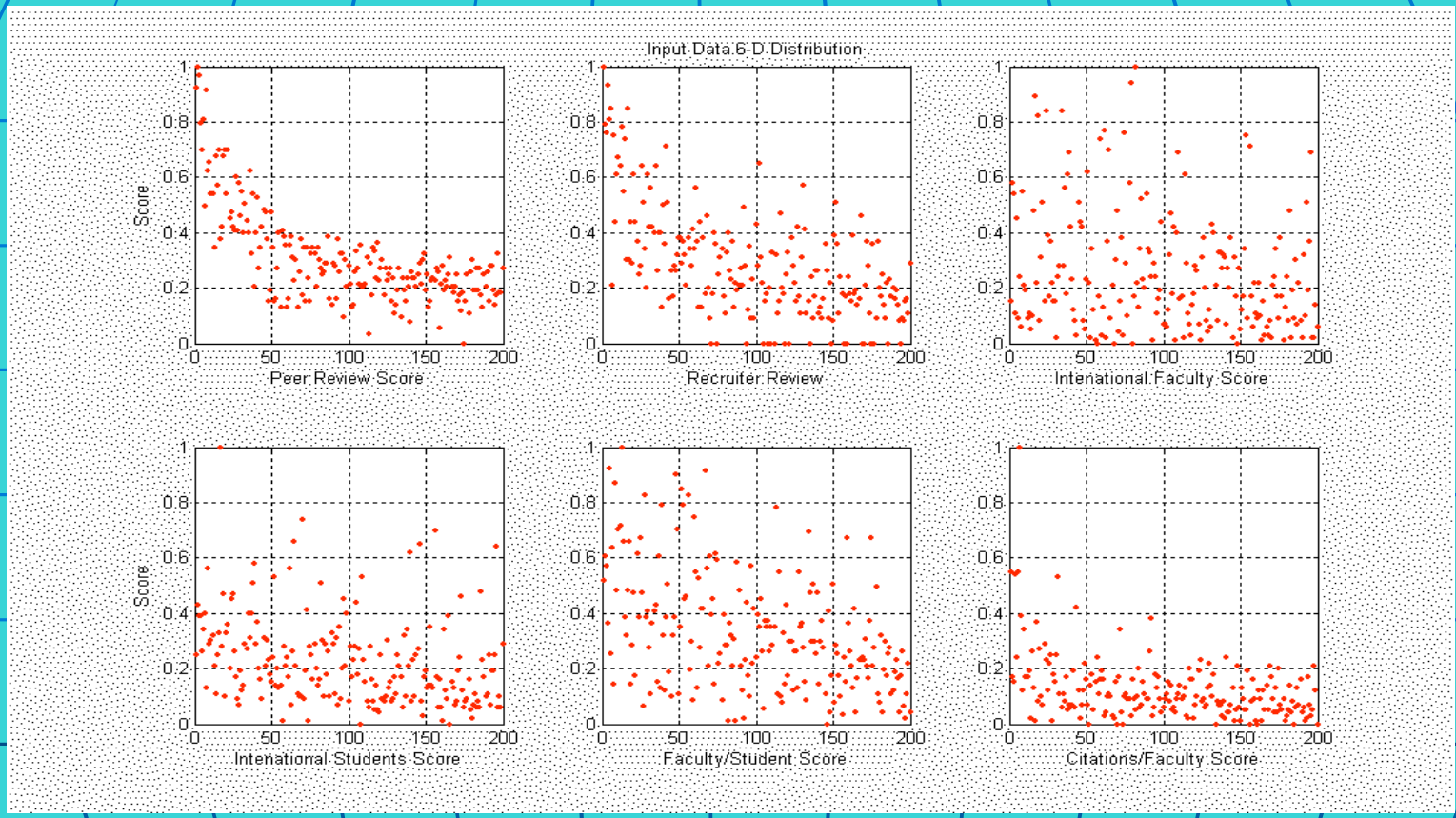
2006 RANK	2005 RANK	NAME	COUNTRY	PEER REVIEW SCORE (40%)	RECRUITER REVIEW (10%)	INT'L FACULTY SCORE (5%)	INT'L STUDENTS SCORE (5%)	FACULTY/STUDENT SCORE (20%)	CITATIONS/FACULTY SCORE (20%)	OVERALL SCORE
1	1	Harvard University	US	93	100	15	25	56	55	100.0
2	3	Cambridge University	UK	100	79	58	43	64	17	96.8
3	4	Oxford University	UK	97	76	54	39	61	15	92.7
4=	2	Massachusetts Institute of Technology	US	81	93	11	39	42	54	89.2
4=	7	Yale University	US	72	81	45	26	93	24	89.2
6	5	Stanford University	US	82	85	9	34	32	55	85.4
7	8	California Institute of Technology	US	53	21	24	40	67	100	83.8
8	6	University of California, Berkeley	US	92	75	6	13	22	39	80.4
9	13	Imperial College London	[illegible]	[illegible]	44	55	56	88	12	78.6
10	9	Princeton University	[illegible]	[illegible]	61	21	29	53	34	74.2
11	17	University of Chicago	[illegible]	[illegible]	[illegible]	19	30	73	17	69.8
12	20	Columbia University	[illegible]	[illegible]	[illegible]	9	32	74	17	69.0
13	11	Duke University	[illegible]	[illegible]	[illegible]	[illegible]	21	100	19	68.3

139	119	Liverpool University	UK	26	26	32	21	32	8	33.2
140	234	Cranfield University	UK	14	26	31	62	52	2	33.0
141=	159	University of California, Santa Barbara	US	31	11	7	8	22	24	32.9
141=	228	Cardiff University	UK	29	13	27	23	36	4	32.9
141=	219	Ghent University	Belgium	29	9	20	10	43	4	32.9
141=	206	Southampton University	UK	26	16	38	25	34	7	32.9
145	147	Georgia Institute of Technology	US	30	36	2	27	19	13	32.9
146	82	RMIT University	Australia	34	26	31	65	9	1	32.8
147=	166	Chalmers University of Technology	Sweden	27	9	17	8	46	5	32.5
147=	188	Tel Aviv University	Israel	35	22	0	3	13	21	32.4
148	172	Free University Berlin	Germany	37	0	27	17	25	6	32.4
150=	184	Korea University	South Korea	25	8	5	19	55	1	32.3
150=	125	Texas A&M University	US	30	39	12	13	16	13	32.2
152	179	Notre Dame University	US	19	51	17	14	35	9	32.2
153	130	Bath University	UK	21	36	34	35	32	5	32.0
154	178	City University of Hong Kong	Hong Kong	28	11	75	14	25	5	31.8
155	184	McMaster University	Canada	29	24	9	13	18	19	31.7
156=	101	Curtin University of Technology	Australia	28	18	71	70	12	–	31.6
156=	114	Göttingen University	Germany	32	0	17	17	31	8	31.5
158=	194	Technion – Israel Inst of Technology	Israel	31	17	6	6	23	16	31.5
158=	240	University of Ulm	Germany	12	0	22	16	70	9	31.4
158=	202	Waseda University	Japan	27	24	11	6	42	1	31.4
161=	121	Chulalongkorn University	Thailand	33	18	9	1	33	0	31.4
161=	131	University Louis Pasteur Strasbourg	France	25	15	22	34	28	12	31.2
163	121	Michigan State University	US	28	39	10	12	21	9	31.2
164	219	Saint Petersburg State University	Russia	26	18	1	9	47	1	31.1
165=	76	Brussels Free University (French)	Belgium	30	19	15	39	13	12	30.7
165=	93	China University of Sci & Technol	China	36	14	3	0	24	5	30.5
165=	175	State Univ of New York, Stony Brook	US	26	16	6	15	30	14	30.5
168=	199	George Washington University	US	24	46	3	13	30	5	30.5
168=	136	Tohoku University	Japan	26	0	8	7	31	21	30.4
170=	206	University of California, Davis	US	30	0	2	8	30	17	30.4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30.3

2005 Times World University Ranking



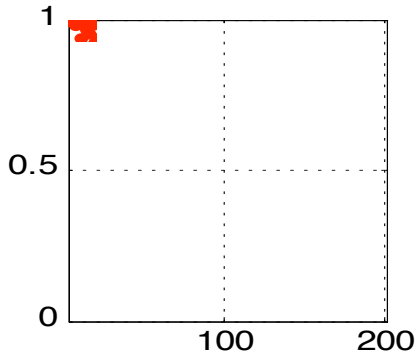
Times University Ranking (2006)



Input data distribution by each feature

The six features are Peer Review Score, Recruiter Review, Int'l Faculty Score, Int'l Students, Faculty/Student, and Citations/Faculty.

Times University Ranking (2007)



Input data distribution by each feature

The six features of a data point, which are Peer Review Score, Employer Review, Staff/Student, Citations/Staff, International Staff Score, International Students.

Are the 07 Features reliable or biased to **?

- Query on the feature of Citation, biased to the U.K.
- The "peer review" is also biased to the U.K; in which UK respondents alone were **71%** of those from the US (U.K to US population is about 5 times)
- The rankings in relation to the other criteria, the 2007 data correlations are very low and usually insignificant.

  07 data PR" .260, Emp_R -.008, Fac_stud ratio .088, Int_faculty .018, Int_stud .039

  2006 data correlation was stronger
- 06 data "Peer review" .480, emp review . 348, Faculty stud ratio .135, Int faculty –045, Int students .094
- Comments: it seems appropriate to consider the 07 ranking a new version of ranking. No comparability with the previous years."
- Source: university ranking watch http://rankingwatch.blogspot.com/

University Ranking Watch

TUESDAY, NOVEMBER 27, 2007

POSTED BY RICHARD HOLMES at 5:12 PM 0 COMMENTS LINKS TO THIS POST

The THES-QS Rankings: Citations per Faculty

This year there have been two main changes in this section of the World University Rankings. First, a new database has been used. Second, as in the other sections, scores have been converted into Z scores.

The use of the Scopus database, which is run by the Dutch-based publishing company, Elsevier, is questionable. QS correctly state that, with over 15,000 journals and many other sources, it is generally more inclusive than the ESI database, which was used in previous years. A more comprehensive database is, however, not necessarily a better one if the objective is to evaluate quality as well as quantity of research. The Scopus database includes 785 conference proceedings and 703 trade journals out of 25, 483 titles. Such items are likely to be subject to a much less rigorous process of review or perhaps to none at all. Furthermore, 7,972 of the titles are listed as inactive.

It is possible therefore that the shift to Scopus means that a lot of mediocre or inferior research is being counted. Whether this is desirable in a measure of quality is debatable.

The most obvious feature of the Scopus database is its geographical bias. Here are the number of titles from selected countries:

US 8,090
UK 4,968
... Hong Kong 59

In relation to population, number of universities, output of research, quality of research or almost anything else the UK appears overrepresented in relation to the USA.

Reference: http://rankingwatch.blogspot.com/

Effect on 2007 results

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7=	7	California Institute of Technology	US	100	55	100	100	100	91	96.5
7=	11	University of Chicago	US	100	97	100	86	71	90	96.5
9	25	University College London	UK	96	97	100	82	91	98	95.3
10	4=	Massachusetts Institute of Technology	US	100	99	85	98	34	94	94.6
11	12	Columbia University	US	100	96	94	91	34	89	94.5
12	21	McGill University	Canada	100	97	99	72	73	96	93.9
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15	23	Johns Hopkins University	US	99	77	98	96	35	69	92.9
16	16	Australian National University	Australia	100	91	100	66	68	91	91.6
17	19=	University of Tokyo	Japan	100	92	96	88	25	44	91.1
18	33=	University of Hong Kong	Hong Kong	95	90	85	79	100	89	90.7
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20=	15	Cornell University	US	100	98	74	93	36	69	90.0
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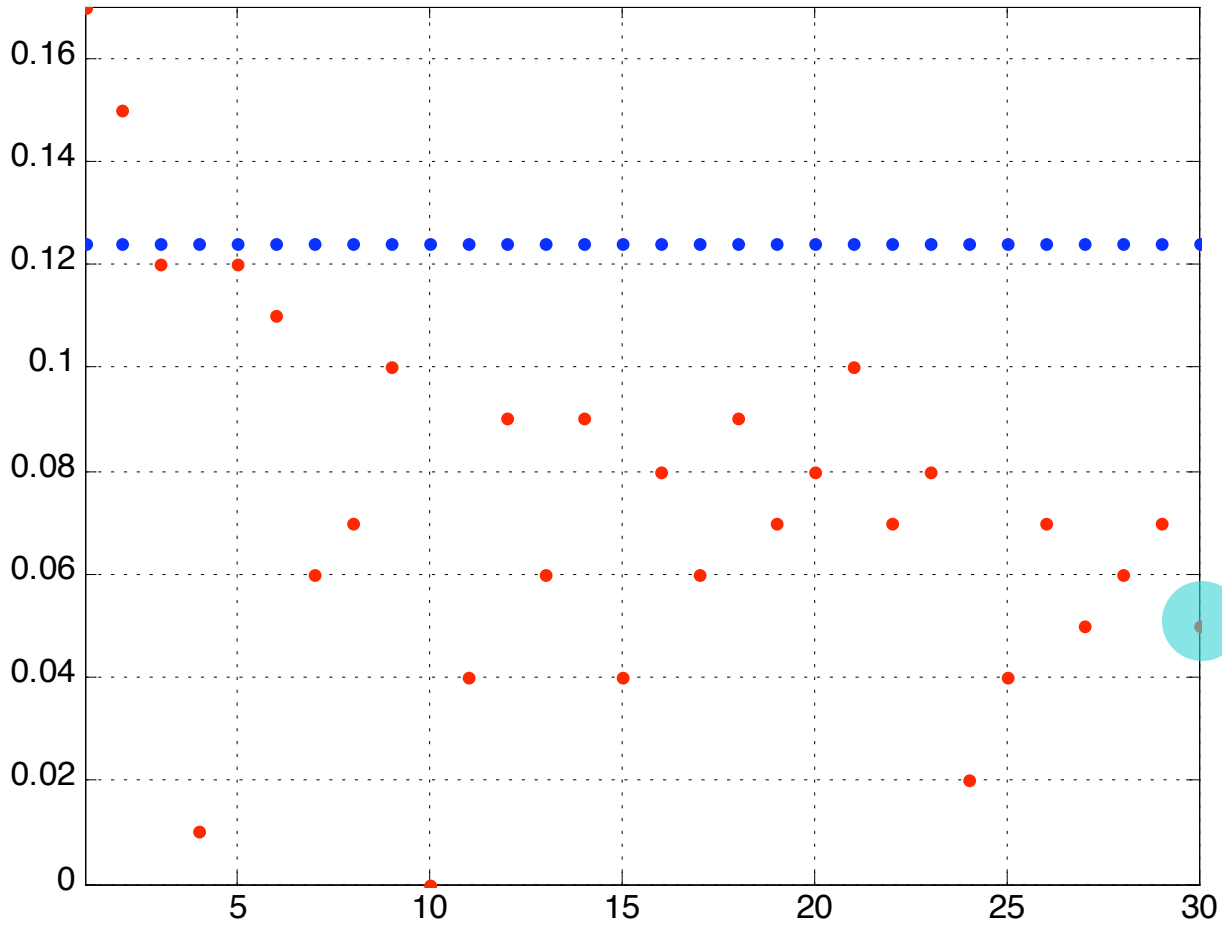
23	33=	University of Edinburgh	UK	96	98	82	76	71	80	88.8
24	46=	King's College London	UK	90	95	91	70	93	84	88.2
25	29=	Kyoto University	Japan	99	89	83	90	29	24	87.2
26	18	Ecole Normale Supérieure, Paris	France	91	60	83	98	61	81	87.1
27	22	University of Melbourne	Australia	100	99	64	70	64	95	85.9
28	37	Ecole Polytechnique	France	76	94	100	78	70	94	85.1
29	42	Northwestern University	US	88	97	77	91	35	68	85.0
30	40	University of Manchester	UK	88	99	77	70	84	86	84.7
31	35=	University of Sydney	Australia	99	95	51	71	100	96	84.6
32	54=	Brown University	US	90	77	74	89	75	58	84.5
33=	50=	University of British Columbia	Canada	100	91	70	74	35	63	84.3
33=	45	University of Queensland	Australia	95	94	70	68	79	76	84.3
33=	19=	National University of Singapore	Singapore	100	93	34	84	100	100	84.3
36	14	Peking University	China	100	98	98	53	32	26	84.2
37	64=	University of Bristol	UK	81	98	85	77	88	72	84.1
38=	50=	Chinese University of Hong Kong	Hong Kong	83	79	80	80	100	86	83.8
38=	29=	University of Michigan	US	99	96	53	89	41	52	83.8
40	28	Tsinghua University	China	95	92	100	59	20	36	83.3
41	31	University of California, Los Angeles	US	100	92	56	91	20	36	82.8
42	24	ETH Zurich	Switzerland	92	75	61	74	100	92	82.5
43	38	Monash University	Australia	98	97	53	57	99	99	82.1
44	41	University of New South Wales	Australia	97	98	39	76	89	91	81.8
45	27	University of Toronto	Canada	100	96	21	93	86	50	80.6
46	70=	Osaka University	Japan	83	75	86	91	17	29	80.0
47	66	Boston University	US	91	89	49	88	29	88	79.7
48	69	University of Amsterdam	Netherlands	84	81	81	70	76	32	78.6
49	43	New York University	US	95	93	48	77	29	49	77.8
50	46=	University of Auckland	New Zealand	95	83	38	61	100	99	77.5
51=	63	Seoul National University	South Korea	92	54	80	79	16	24	77.1
51=	32	University of Texas at Austin	US	95	94	22	92	66	47	77.1
53=	58=	Hong Kong University of Science & Technology	Hong Kong	84	82	28	92	100	96	76.9
53=	78	Trinity College Dublin	Ireland	80	92	70	58	99	77	76.9
55=	84	University of Washington	US	84	50	73	92	44	33	76.7
55=	79=	University of Wisconsin-Madison	US	94	81	31	95	50	44	76.7
57	73	University of Warwick	UK	80	98	62	58	89	96	76.4
58	44	University of California, San Diego	US	98	39	51	95	23	30	76.3
59	17	London School of Economics	UK	89	100	65	29	100	100	75.7
60	58=	Heidelberg University	Germany	84	63	61	78	42	87	75.5
61	96	Katholieke Universiteit Leuven	Belgium	88	83	39	84	51	55	75.0
62	105=	University of Adelaide	Australia	75	86	66	65	77	96	74.7
63	86	Delft University of Technology	Netherlands	75	80	66	72	83	67	74.4

64	111=	University of Western Australia	Australia	72	88	56	78	96	78	74.3
65=	90=	University of Birmingham	UK	71	93	62	75	84	70	74.1
65=	98	Ludwig-Maximilians-Universität München	Germany	80	60	70	72	58	71	74.1
67	82=	Technische Universität München	Germany	68	71	88	69	59	83	73.9
68	102=	University of Sheffield	UK	69	96	71	69	81	67	73.7
69	61=	Nanyang Technological University	Singapore	81	82	37	72	100	99	73.6
70	85	University of Nottingham	UK	69	98	64	65	84	88	73.2
71=	61=	Dartmouth College	US	60	89	91	83	26	53	73.0
71=	111=	Uppsala University	Sweden	85	34	81	72	51	26	73.0
73	77	University of Illinois	US	94	64	29	86	34	51	72.6
74=	56	Emory University	US	61	75	99	85	13	39	72.4
74=	124=	University of York	UK	62	91	77	69	76	83	72.4
76	109=	University of St Andrews	UK	57	95	78	69	91	99	72.3
77=	88	University of Pittsburgh	US	62	45	94	85	78	38	72.2
77=	127	Purdue University	US	87	79	24	82	76	64	72.2
79	111=	University of Maryland	US	71	62	71	85	48	45	72.1
80=	121	University of Leeds	UK	74	97	56	69	76	59	72.0
80=	141=	University of Southampton	UK	60	90	71	76	88	74	72.0
82	53	Vanderbilt University	US	55	81	99	87	28	41	71.9
83	81	University of Glasgow	UK	71	84	71	75	42	54	71.8
84	90=	Leiden University	Netherlands	81	63	35	93	78	40	71.7
85=	60	Case Western Reserve University	US	59	50	99	85	18	80	71.6
85=	116=	Fudan University	China	87	96	45	68	31	31	71.6
85=	87	University of Vienna	Austria	86	80	12	90	63	89	71.6
88	176	Queen's University	Canada	74	88	49	79	87	34	71.2
89	95	Utrecht University	Netherlands	80	55	65	80	38	24	70.9
90=	99=	Pennsylvania State University	US	84	82	63	64	18	24	70.5
90=	118	Tokyo Institute of Technology	Japan	67	86	59	91	34	42	70.5
92	102=	Rice University	US	65	45	80	88	39	58	70.3
93=	54=	University of Copenhagen	Denmark	82	55	51	70	66	62	70.1
93=	181=	University of Montreal	Canada	88	50	31	80	89	41	70.1
95	48=	University of Rochester	US	58	38	100	84	24	63	69.3
96	170=	University of California, Davis	US	83	34	60	82	31	26	69.1
97=	133=	University of Alberta	Canada	88	30	23	87	88	62	68.8
97=	145	Georgia Institute of Technology	US	79	77	25	93	18	74	68.8
99	141=	Cardiff University	UK	62	84	70	65	72	75	68.6
100	116=	University of Helsinki	Finland	79	45	28	93	56	78	68.2
101	139	University of Liverpool	UK	55	85	70	76	83	64	68.1
102=	102=	Georgetown University	US	57	94	69	80	28	73	68.0
102=	108	National Taiwan University	Taiwan	86	68	39	79	18	24	68.0
102=	168=	Tohoku University	Japan	53	59	96	84	40	32	68.0
105	39	University of Geneva	Switzerland	62	54	39	91	100	100	67.2
106	122	Lund University	Sweden	76	41	43	81	77	52	66.9
107	211=	University of Colorado	US	60	15	100	85	33	31	66.8
108	155	McMaster University	Canada	84	49	31	89	28	37	66.6
109	132	Durham University	UK	59	98	49	74	92	61	66.5
110	130=	University of Virginia	US	63	94	52	86	22	36	66.4
111	172=	Maastricht University	Netherlands	43	72	80	81	68	99	66.2
112=	128=	Nagoya University	Japan	53	74	83	85	25	30	66.1
112=	204=	University of Waterloo	Canada	82	82	17	75	63	49	66.1
114=	126	University of Aarhus	Denmark	65	19	89	69	59	37	65.6
114=	75	University of Basel	Switzerland	52	20	99	67	89	81	65.6
114=	79=	University of Otago	New Zealand	69	61	39	66	100	92	65.6
117=	141=	University of California, Santa Barbara	US	88	31	25	89	43	21	65.5
117=	64=	Ecole Polytechnique Fédérale De Lausanne	Switzerland	58	58	97	29	100	100	65.5
119	101	University of Southern California	US	62	77	52	80	25	78	65.4
120	219=	Ohio State University	US	69	77	39	79	67	38	65.3
121	105=	University of Sussex	UK	58	51	58	77	90	83	65.2
122	150=	Texas A&M University	US	76	75	27	81	41	39	64.9
123	76	Université Catholique de Louvain	Belgium	78	60	28	73	50	74	64.8
124	141=	University of Ghent	Belgium	63	29	88	69	47	30	64.5
125	180	Nanjing University	China	74	72	45	69	59	14	64.4
126=	105=	Humboldt-Universität zu Berlin	Germany	71	38	71	57	44	68	64.3

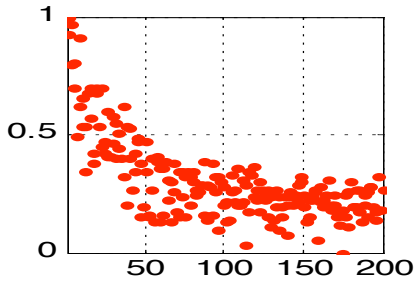
			Co	Pe sc	Em re	St sc	Ci sc	In st	In st	Ov
126=	215=	University of Western Ontario	Canada	68	90	30	80	72	30	64.3
128	119	Hebrew University of Jerusalem	Israel	86	20	18	91	83	14	64.0
129	133=	Newcastle University	UK	45	87	74	67	80	80	63.9
130=	194	Technical University of Denmark	Denmark	47	23	86	84	91	59	63.8
130=	67	Eindhoven University of Technology	Netherlands	48	48	99	69	60	48	63.8
132=	198=	Korea Advanced Institute of Science & Technol	South Korea	65	27	64	85	53	28	63.7
132=	93=	Université Pierre et Marie Curie, Paris VI	France	60	5	90	73	20	92	63.7
134	224=	University of Arizona	US	69	57	37	88	28	45	63.1
135	226=	University of Florida	US	62	41	77	74	27	32	63.0
136	128=	Kyushu University	Japan	50	68	80	82	17	31	62.8
137=	195	University of Aberdeen	UK	45	64	78	67	91	73	62.7
137=	232=	Indiana University Bloomington	US	67	79	28	85	45	37	62.7
139	282=	Simon Fraser University	Canada	72	72	22	67	97	62	62.6
140=	198=	University of California, Irvine	US	79	30	38	82	27	30	62.5
140=	109=	University of Zurich	Switzerland	71	32	13	95	99	58	62.5
142=	187=	University of Minnesota	US	76	43	28	89	26	35	62.3
142=	170=	Universität Tübingen	Germany	60	52	46	79	76	65	62.3
144	219=	Universität Freiburg	Germany	57	23	93	61	24	76	62.2
145	153	University of Bath	UK	46	96	49	71	91	91	62.0
146	149	Freie Universität Berlin	Germany	79	16	31	70	70	81	61.9
147	228=	University of Lancaster	UK	49	80	65	57	88	81	61.7
148	97	Wageningen University	Netherlands	39	28	88	87	46	97	61.5
149=	154	City University of Hong Kong	Hong Kong	62	51	37	76	100	51	61.2
149=	99=	Queen Mary, University of London	UK	55	65	81	30	94	92	61.2
151=	133=	Hokkaido University	Japan	49	69	76	82	19	21	61.1
151=	123	University of North Carolina	US	72	86	28	74	22	20	61.1
151=	147=	Tel Aviv University	Israel	81	36	26	89	13	13	61.1
154	165=	Université Libre de Bruxelles	Belgium	56	52	57	69	43	96	61.0
155=	165=	University of Science and Technology of China	China	75	77	28	76	16	11	60.9
155=	152	University of Notre Dame	US	56	88	43	81	25	50	60.9
157	72	Ecole Normale Supérieure de Lyon	France	42	45	100	67	41	58	60.8
158	140	Cranfield University	UK	31	74	100	57	74	100	60.7
159=	163	Michigan State University	US	63	71	33	76	65	45	60.6
159=	130=	Tufts University	US	42	78	61	90	46	44	60.6
161=	120	Keio University	Japan	52	88	91	45	25	16	59.9
161=	48=	Washington University in St Louis	US	72	62	100	1	27	48	59.9
163=	92	Erasmus University Rotterdam	Netherlands	51	97	28	88	64	45	59.7
163=	179	Shanghai Jiao Tong University	China	72	92	38	55	35	11	59.7
165	201=	Universität Stuttgart	Germany	47	81	71	50	52	90	59.4
166=	266=	University of Calgary	Canada	67	61	28	81	24	37	58.9
166=	138	Vienna University of Technology	Austria	53	44	68	52	75	88	58.9
168=	156=	Universität Göttingen	Germany	66	-	73	59	41	54	58.8
168=	82=	Macquarie University	Australia	61	89	23	52	85	99	58.8
170	291	Helsinki University of Technology	Finland	52	17	94	57	56	44	58.7
171=	238	University of Dundee	UK	44	51	65	71	84	66	58.3
171=	222=	Universität Karlsruhe	Germany	45	60	73	59	56	85	58.3
173=	207=	University of Bologna	Italy	78	66	24	62	21	26	58.2
173=	232=	University of Groningen	Netherlands	48	51	69	74	62	29	58.2
175=	124=	University of Massachusetts, Amherst	US	62	45	34	90	24	31	57.9
175=	284=	University of São Paulo	Brazil	65	59	51	63	24	14	57.9
177=	448	University of Campinas	Brazil	52	30	78	73	43	16	57.8
177=	219=	University College Dublin	Ireland	56	85	29	63	89	58	57.8
177=	215=	Rutgers, The State University of New Jersey	US	72	33	30	73	60	24	57.8
180=	190=	University of Reading	UK	45	67	52	69	78	78	57.7
180=	158=	Waseda University	Japan	68	92	64	25	26	23	57.7
182	172=	Rheinisch-Westfälische Technische Hochschule Aachen	Germany	40	80	80	48	53	81	57.5
183	197	Università Degli Studi Di Roma, La Sapienza	Italy	79	63	11	71	15	21	57.3
184	161=	Université Louis Pasteur, Strasbourg I	France	58	64	19	82	45	77	57.1
185=	239=	University of Leicester	UK	37	60	60	76	77	86	57.0
185=	115	University of Twente	Netherlands	46	42	61	76	75	51	57.0
187	252=	University of Antwerp	Belgium	41	7	99	67	57	59	56.9
188=	333=	University of Canterbury	New Zealand	62	77	30	55	55	66	56.6
188=	177	University of Oslo	Norway	61	25	54	62	51	55	56.6

UK University Performance on Citation (2006 Data)

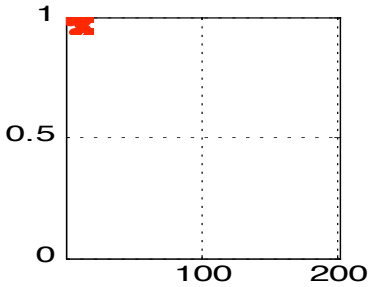


Input data distribution by the feature

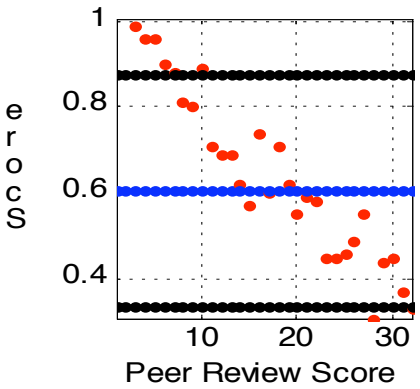
2006



2007



Analysis on the UK University Performance (2007 Data)

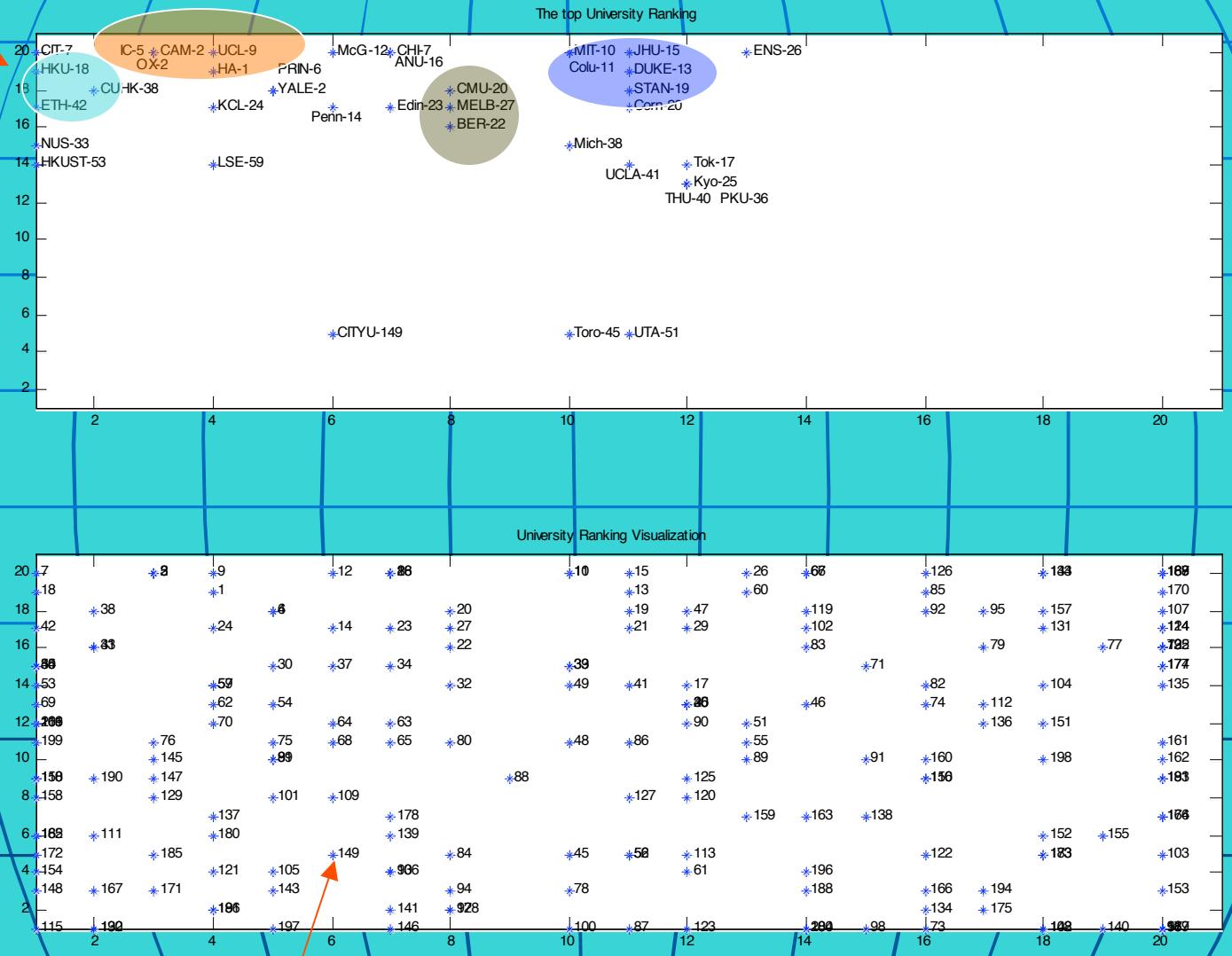


Input data distribution by each feature

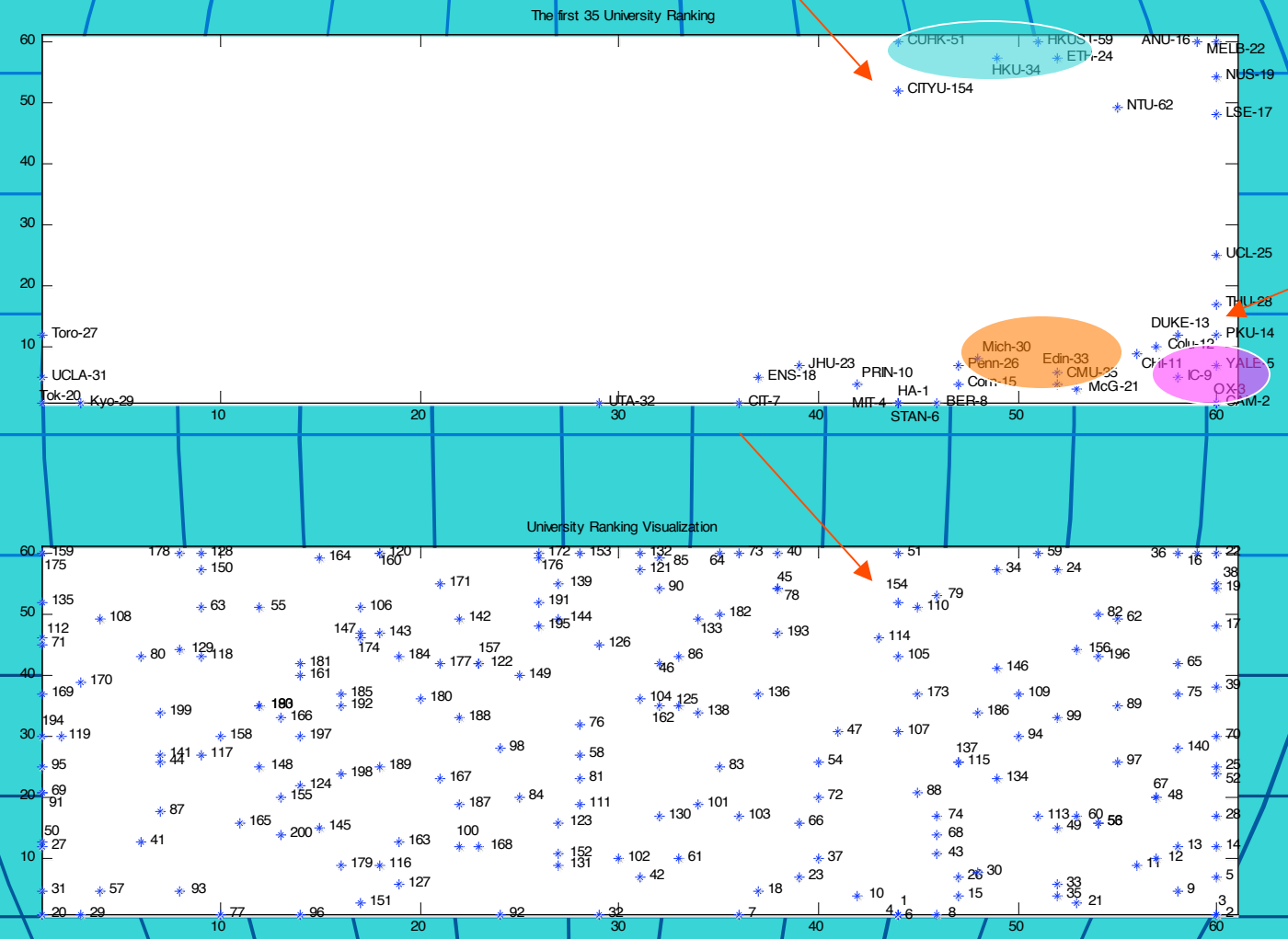
There are six features of a data point, which are Peer Review Score, Employer Review, Staff/Student, Citations/Staff, International Staff Score, International Students.

2007 data set using simple 20x20 SOM

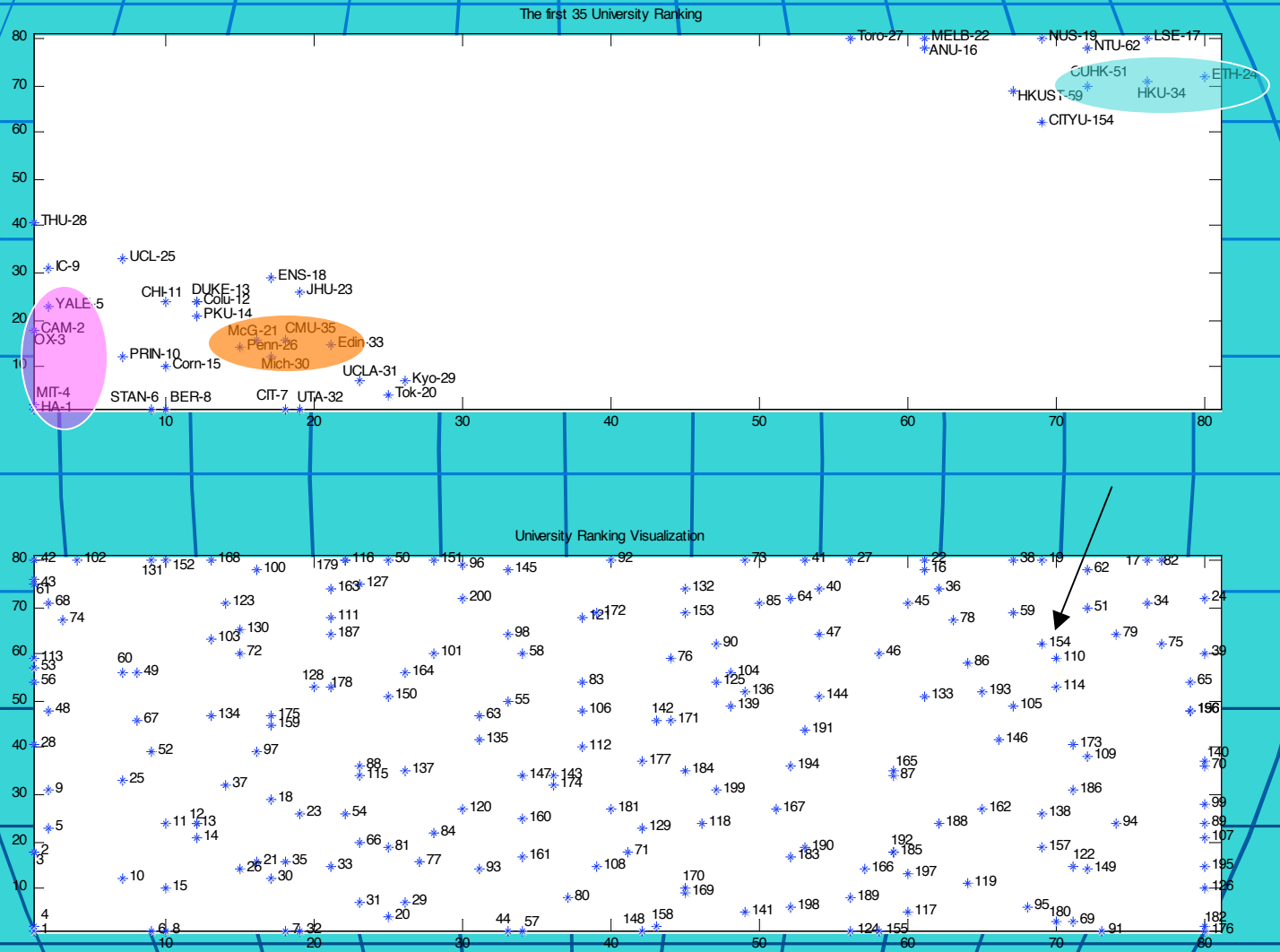
The 3 HK colleges



2006 data set using SOM with a map size of 60x60



2006 data set using SOM with a map size of 80x80



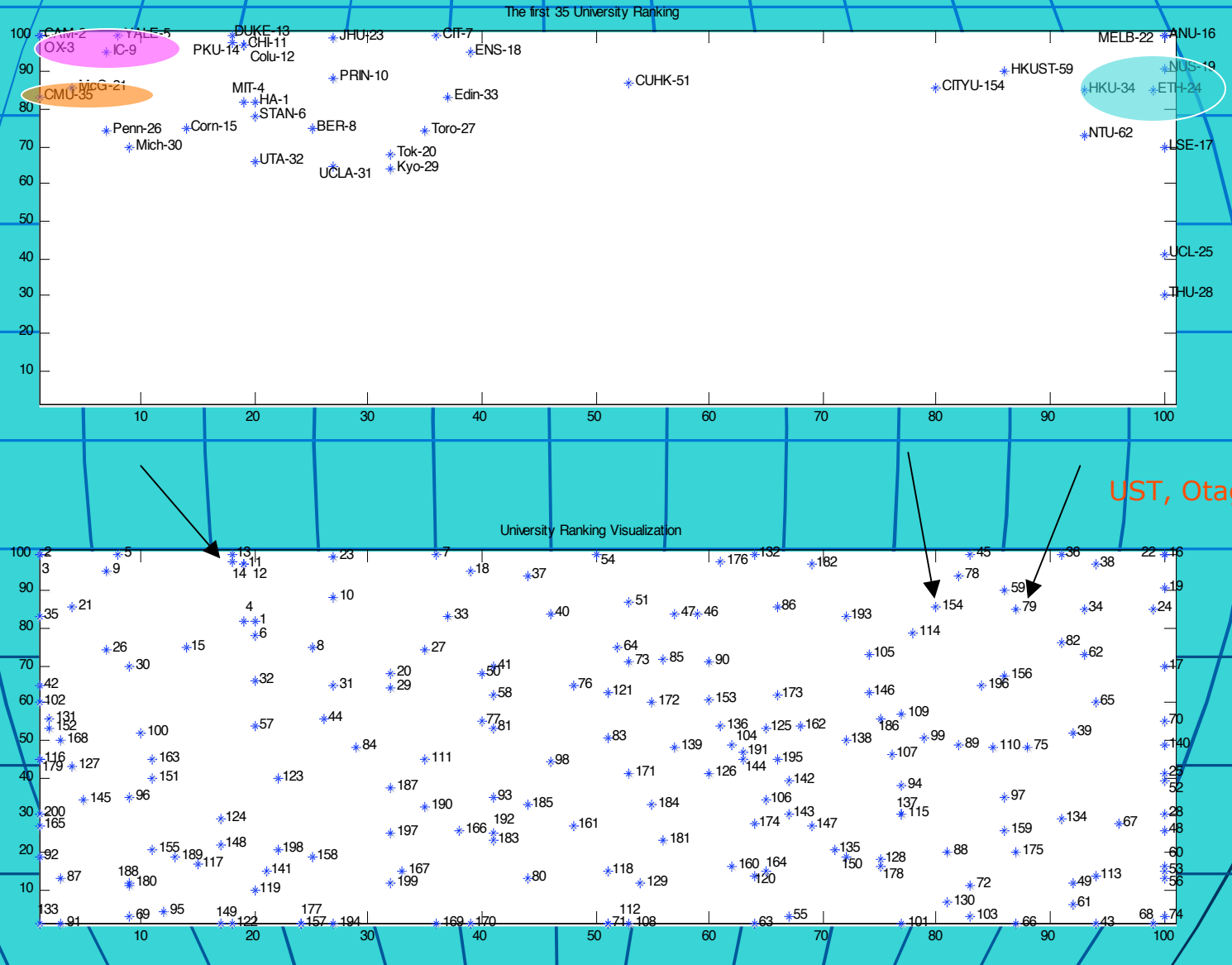
Maryland

Uppsala

Wake Forest

Western Australia

2006 data set using SOM with a map size of 100x100



UST, Otago U NZ

Disadvantages of conventional SOM

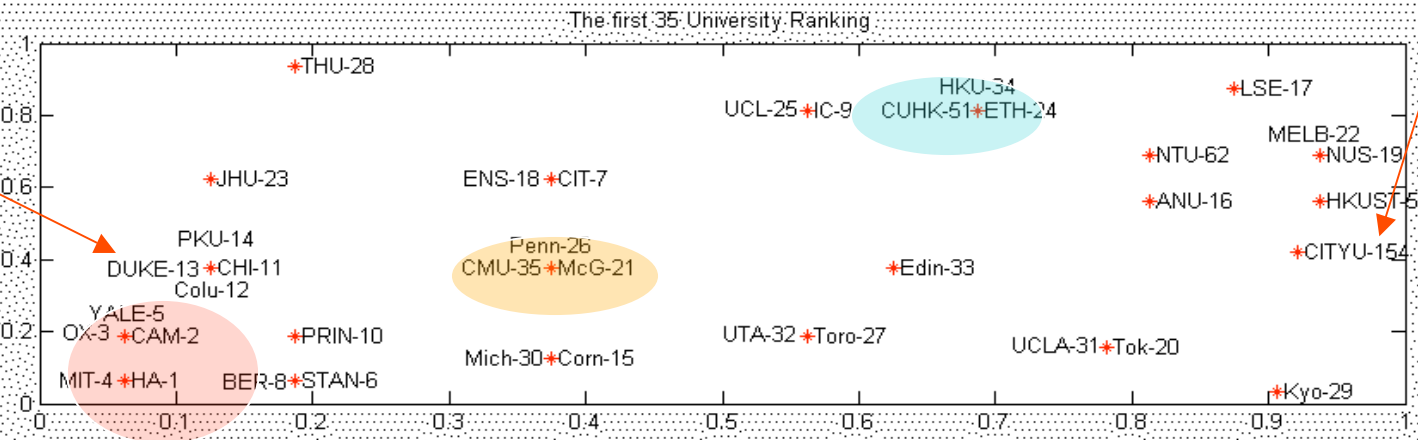
- Structure is fixed before training
  - Neurons are uniformly distributed in the output space.
  - SOM is heuristically derived
  - SOM input is in a flat vector; problem with tree-data

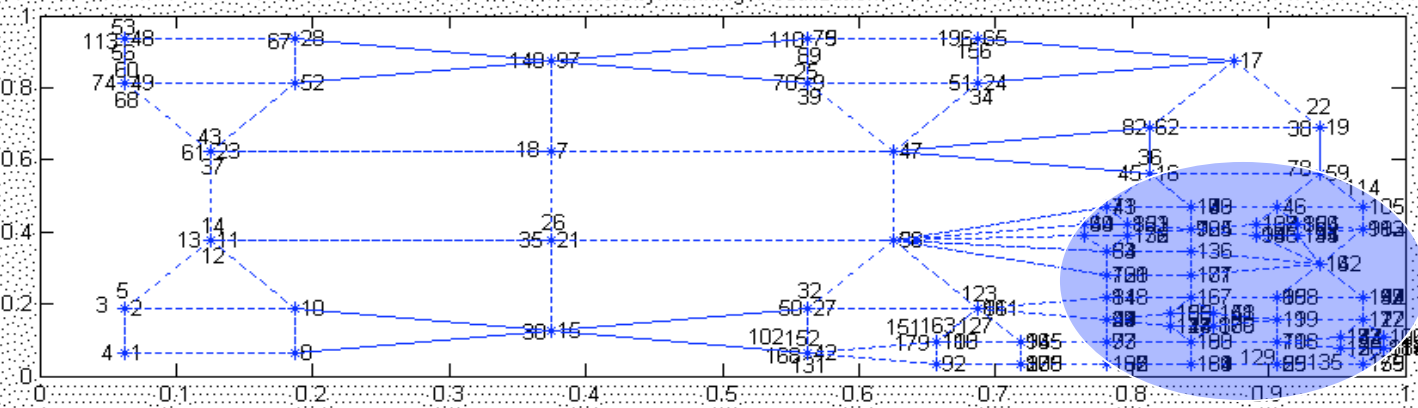
Growing SOM : CSG

- Networks are adaptively formed in one-level
- Neurons in the output space are distributed according to input distribution

2006 data set using CSG: Neuron number is 73

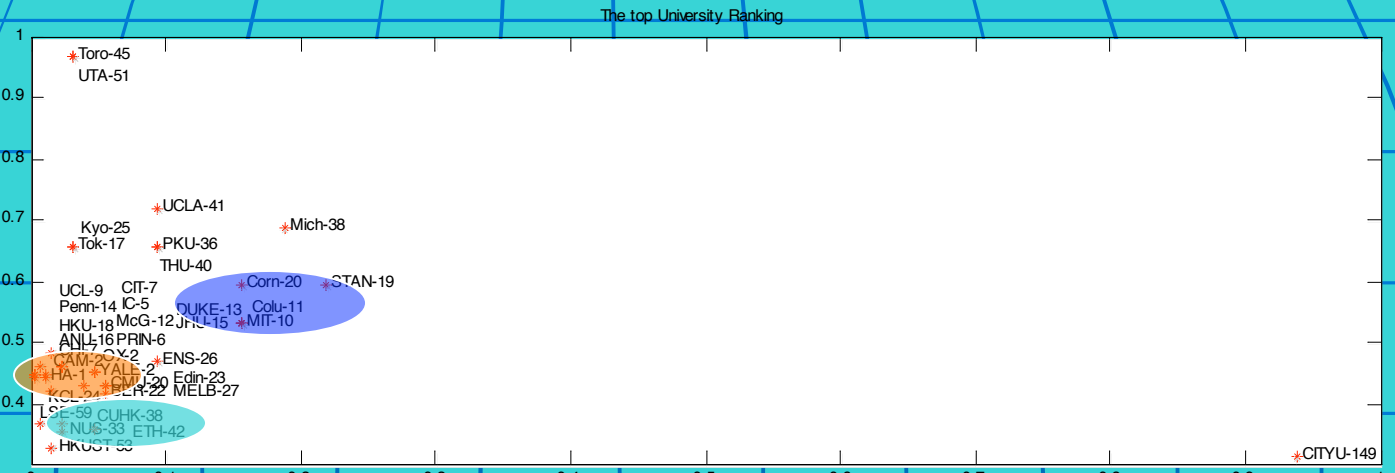
Training time 6.11 sec

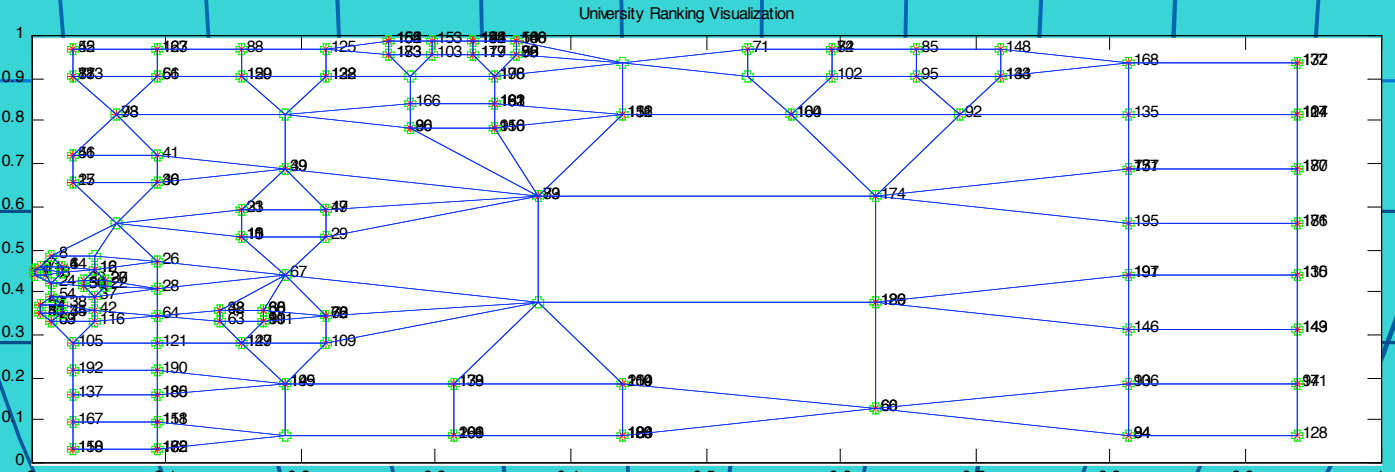




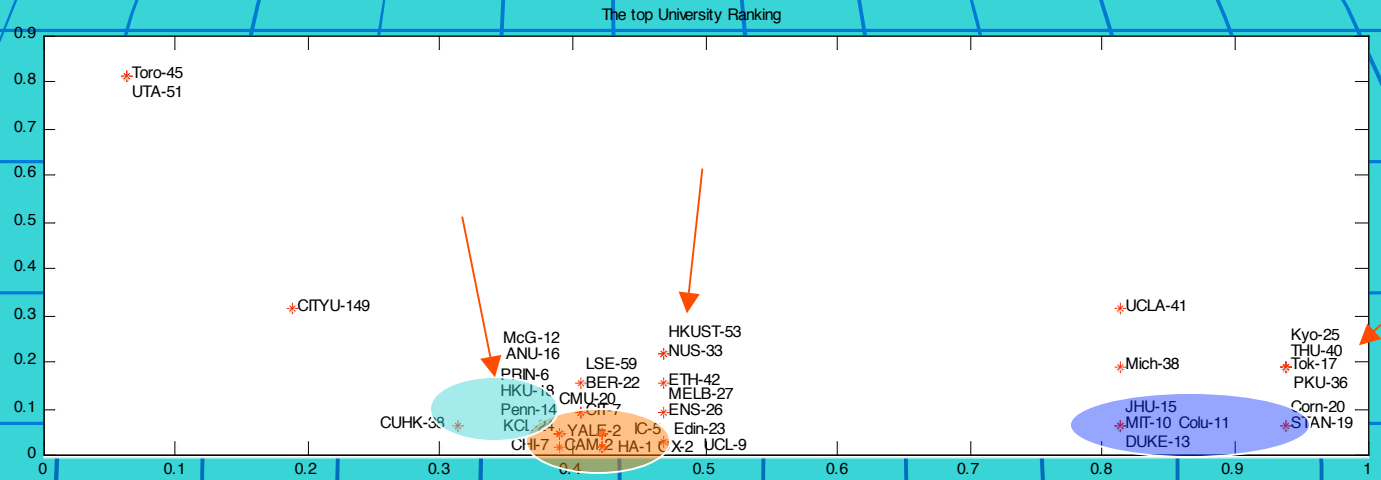
2007 data set using CSG: Neuron number is 118

This giant cluster shows the features were not well extracted

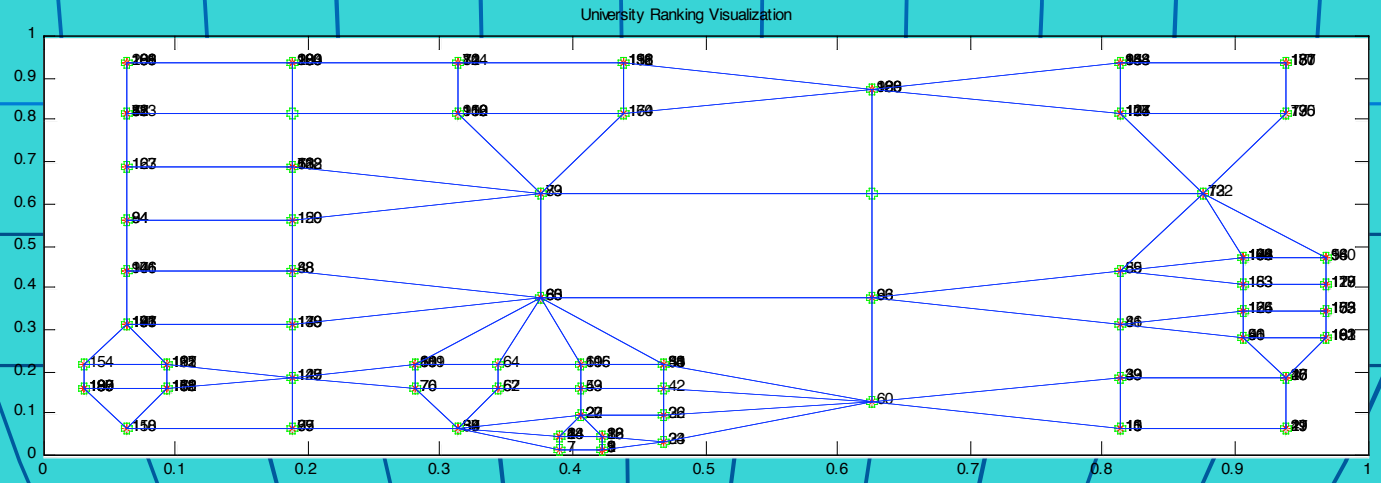




2007 data set using CSG: Neuron number is 166

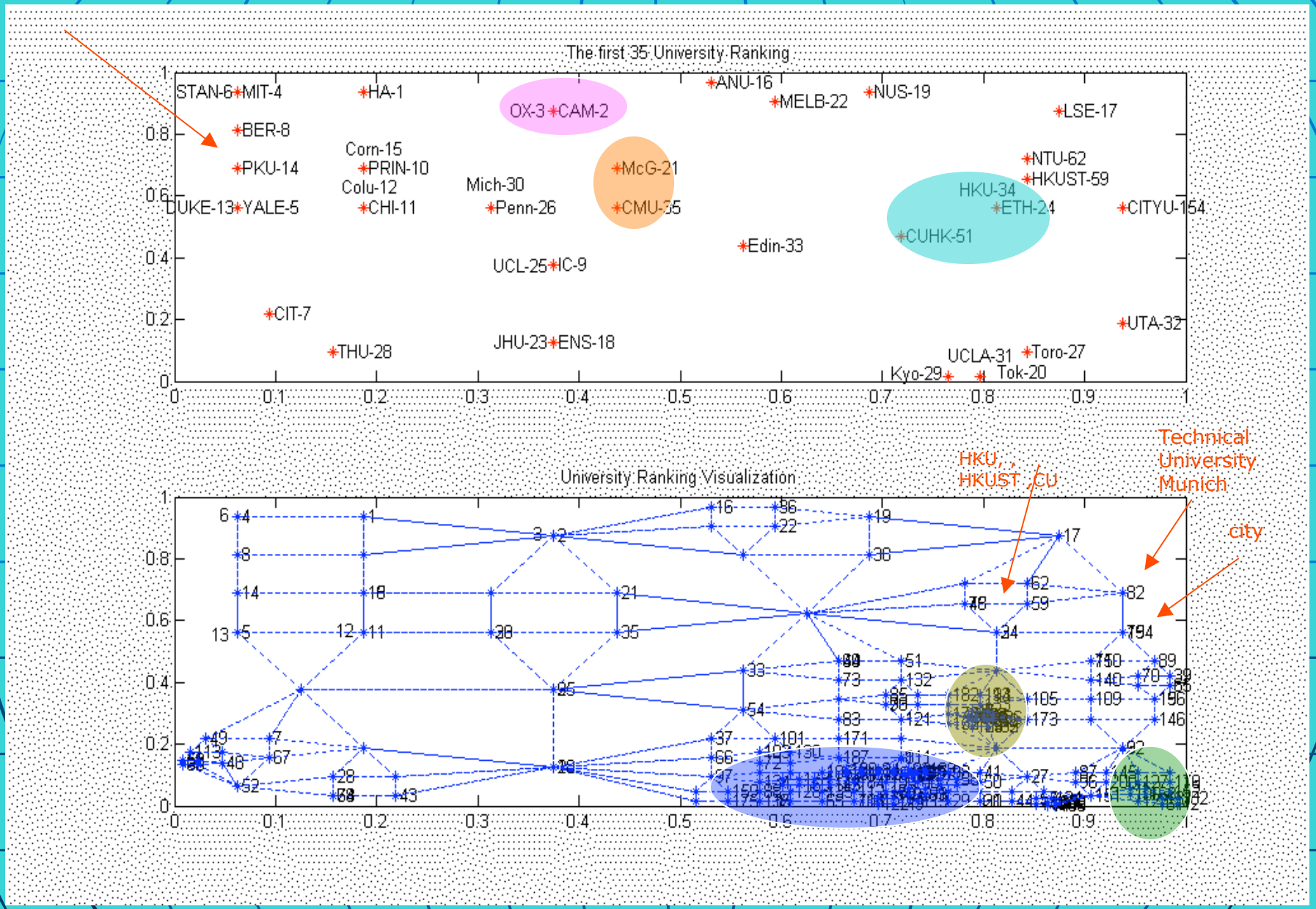


Too crowd in the clusters



2006 data set using CSG: Neuron number is 304

Training time 118 sec

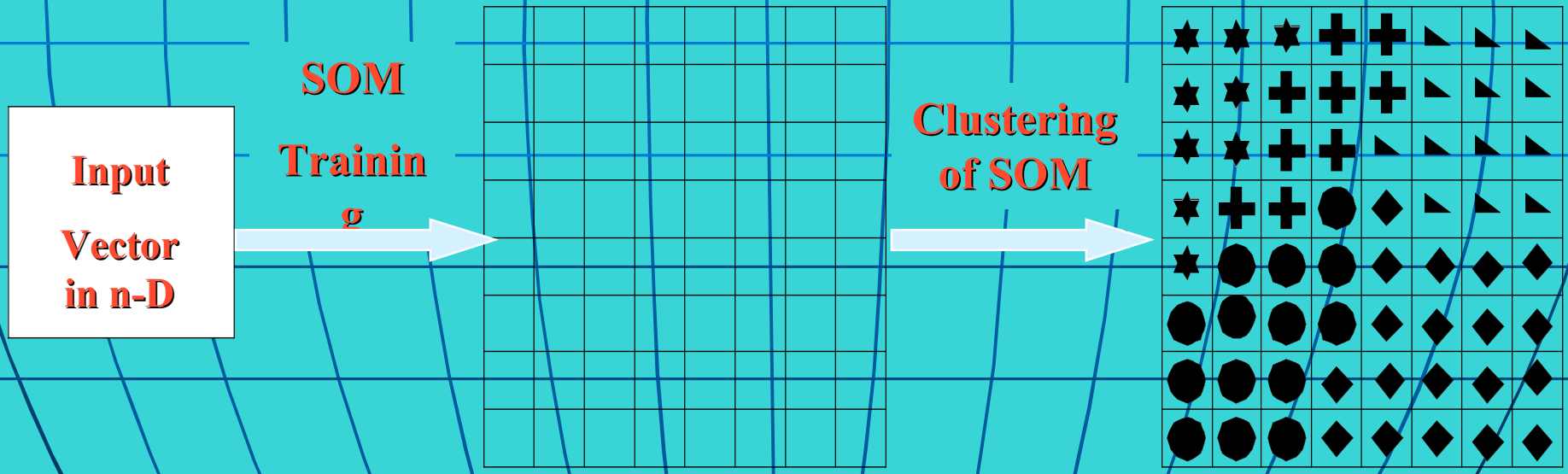


2006 Ranking

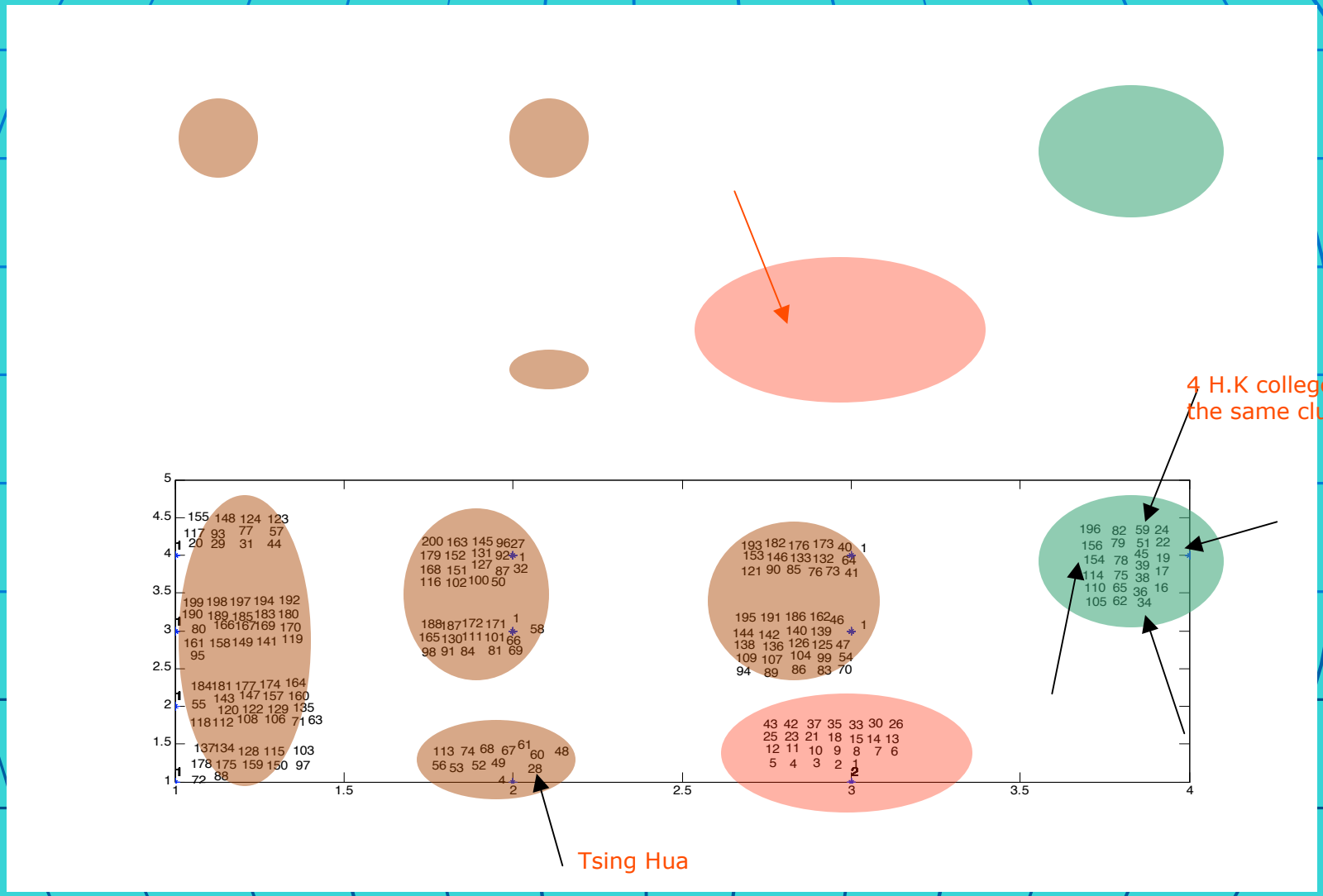
2006 Ranking	Name Ab.	Peer Review Score(40%)	Recruiter Review(10%)	Int'l Faculty Score(5%)	Int'l Students Score(5%)	Faculty/Student Score(20%)	Citations/Faculty Score(20%)	Overall Score
1	HA	93	100	15	25	56	55	100
2	CAM	100	79	58	43	64	17	96.8
3	OX	97	76	54	39	61	15	92.7
4	MIT	81	93	11	39	42	54	89.2
5	YALE	72	81	45	26	93	24	89.2
21	McG	57	61	31	33	52	10	62.3
26	Penn	45	64	17	26	52	22	57.8
35	CMU	44	64	28	40	48	11	54.6
24	ETH	51	25	84	45	44	23	59.7
34	HKU	48	40	84	27	46	6	54.8
51	CUHK	39	38	62	24	41	7	46.4

-The basic idea of Clustering of the Self-Organizing Map Using a Clustering Validity Index Based on **Inter-Cluster and Intra-Cluster Density**

- Cluster data better than the classical clustering algorithms used on the SOM, and find an optimal number of clusters



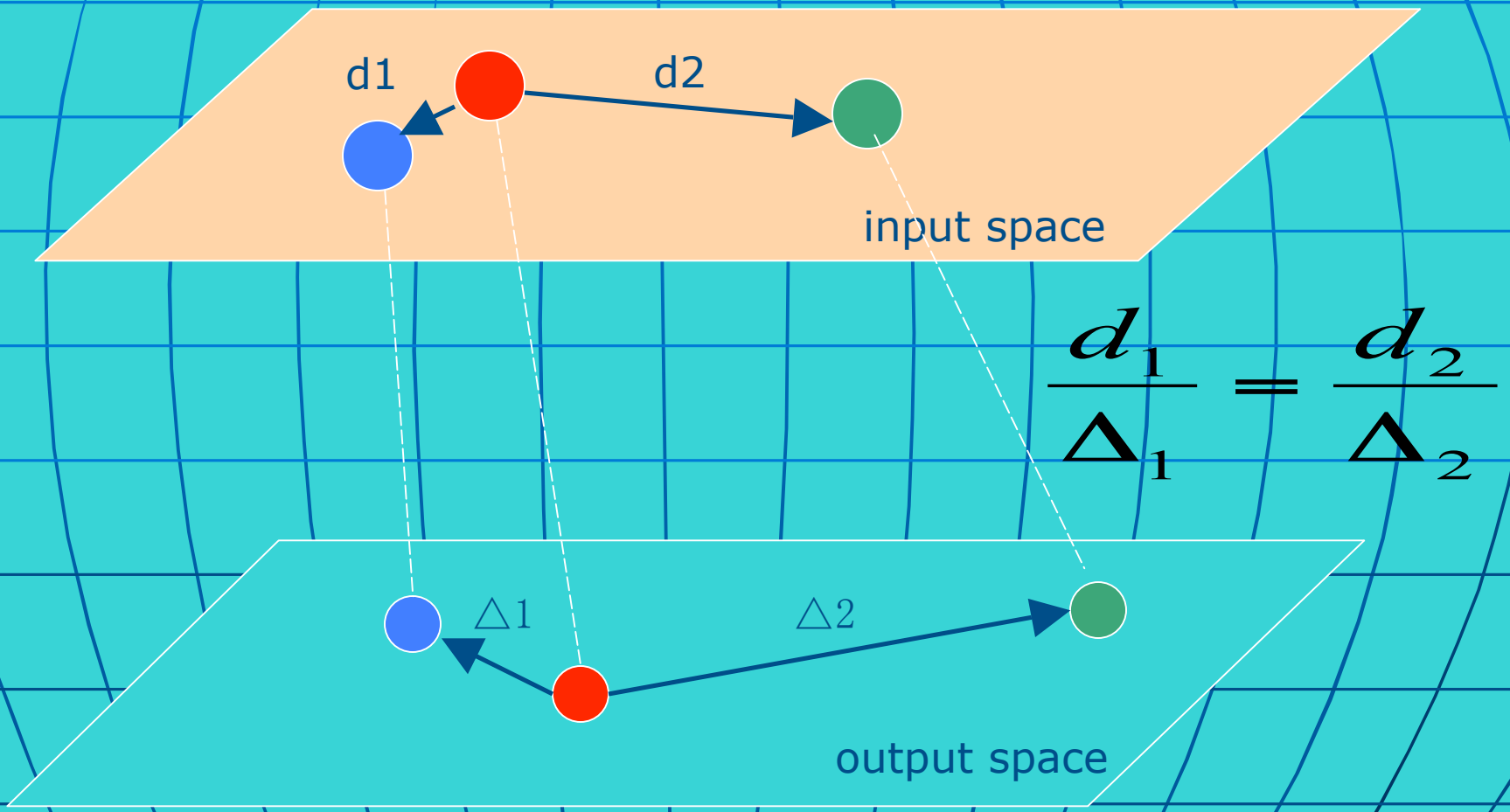
Cluster by Inter-cluster and Intra-cluster density (06 Data)



Probabilistic Regularized SOM

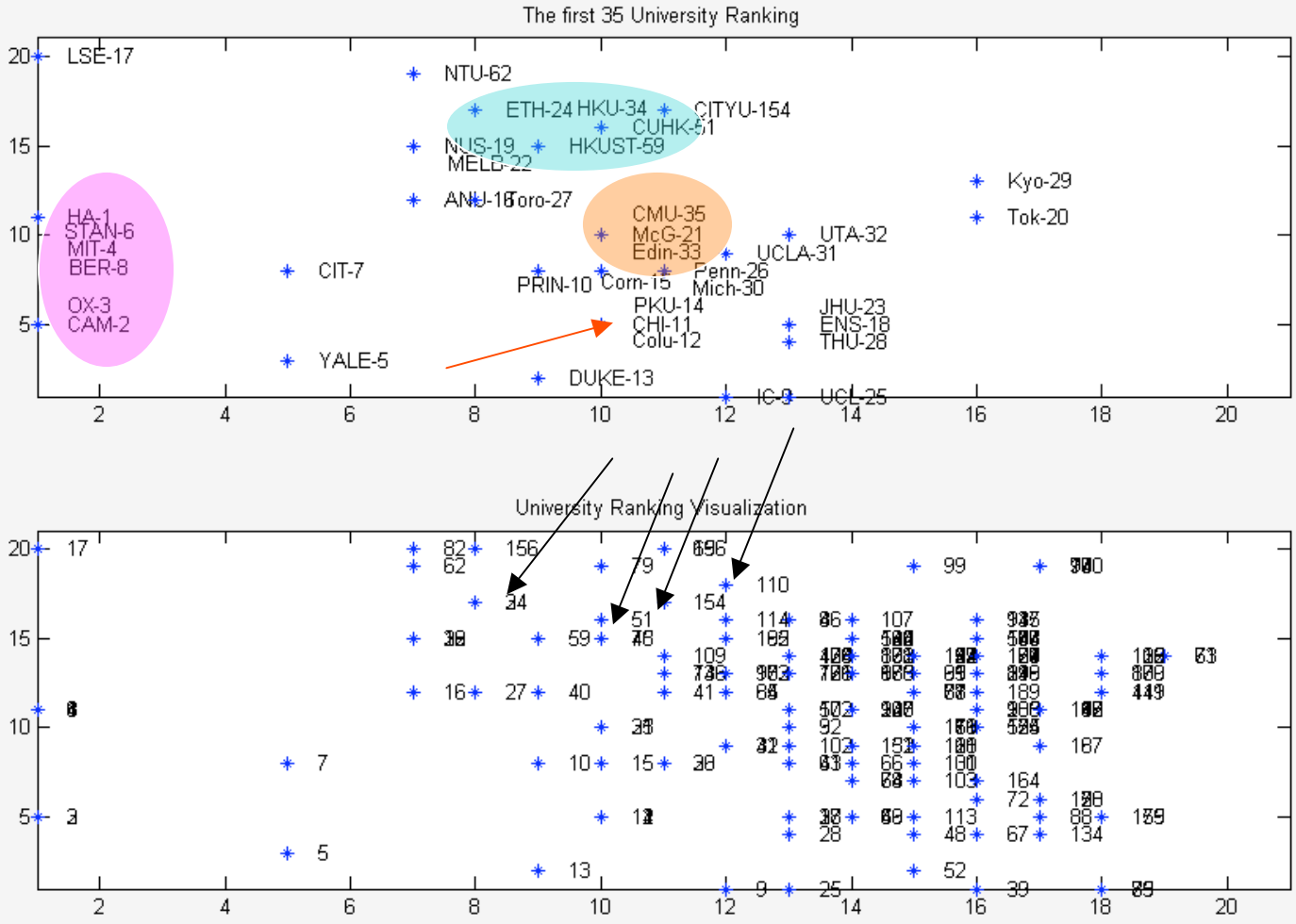
- The weight-updating rule is an optimization of a cost function
  - The assignment is soft by certain probability
    - The interneuron distances are preserved from input space into output space

Interneuron Distances



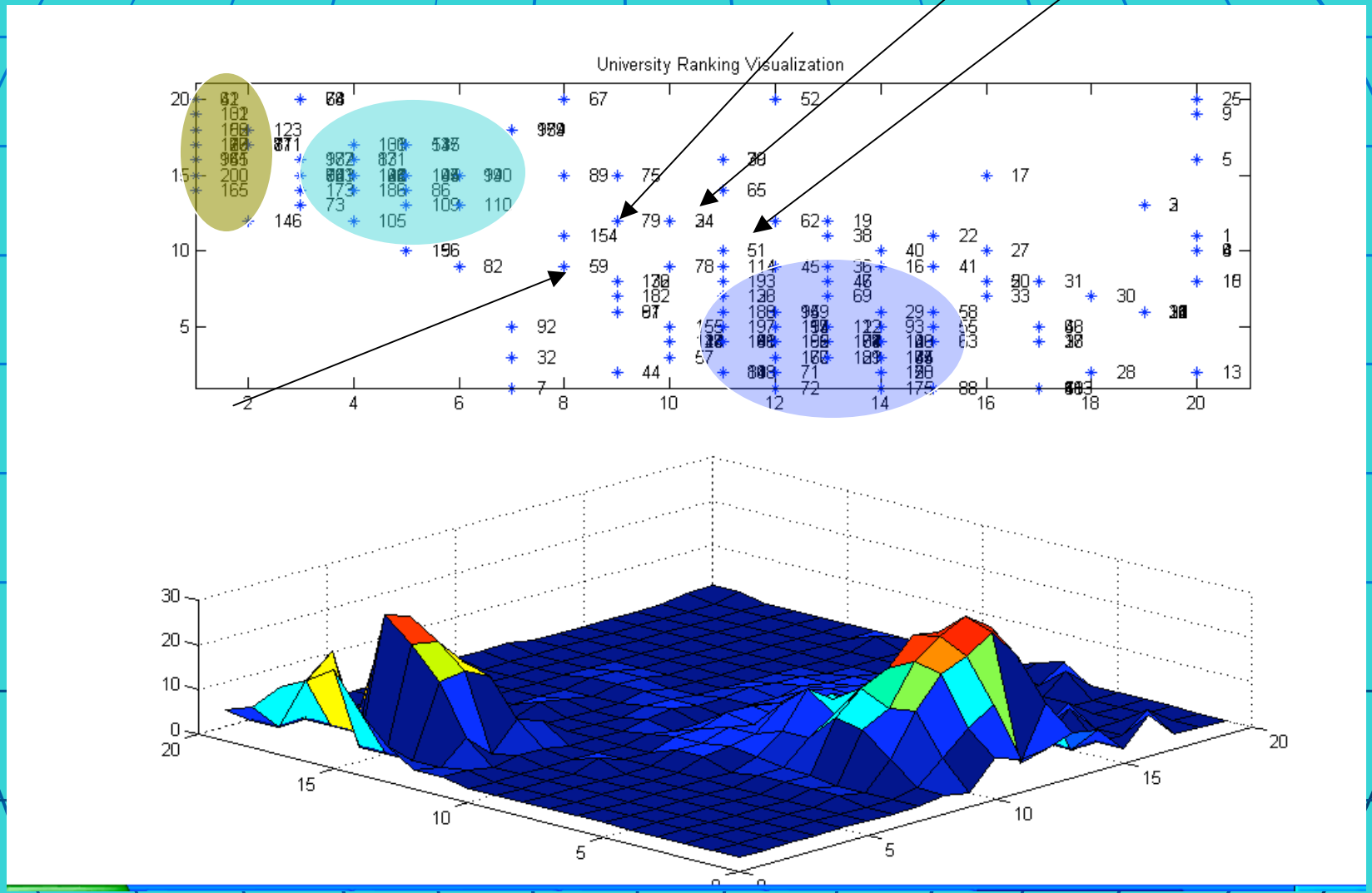
$$\frac{d_1}{\Delta_1} = \frac{d_2}{\Delta_2}$$

2006 Data



PRSOM Resultant map

200 University Ranking (2006)



3D visualization Using H Matrix and PRSOM

Concluding Comments

- The 3 local University exhibit similar characteristics (similar to the 2 Singapore U)
- City University together with Singapore Universities, and Australian University have similar characteristics
- The Top US colleges are on their own league/clusters
- Oxford and Cambridge are clustered together with the US top Colleges
- The data collected by the Times and the way they processed them (2007) is highly controversial
- Students/parents view maybe very different

- SOM is very useful for administrative, business analysis and other non-engineering applications, financial data etc.

Thank You