# Academic Ranking of World Universities By Broad Subject Fields (ARWU-FIELD)

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- Methodologies of ARWU-FIELD
- Results of ARWU-FIELD
- Discussion about ARWU-FIELD
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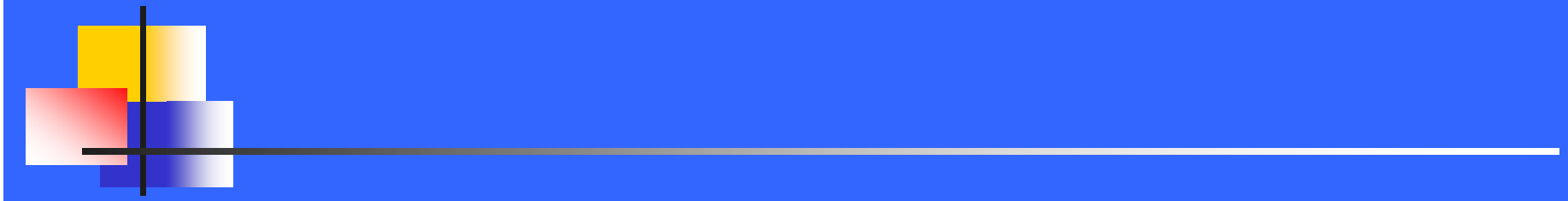


# Purposes of ARWU-FIELD

## Requests for Ranking of World Universities by

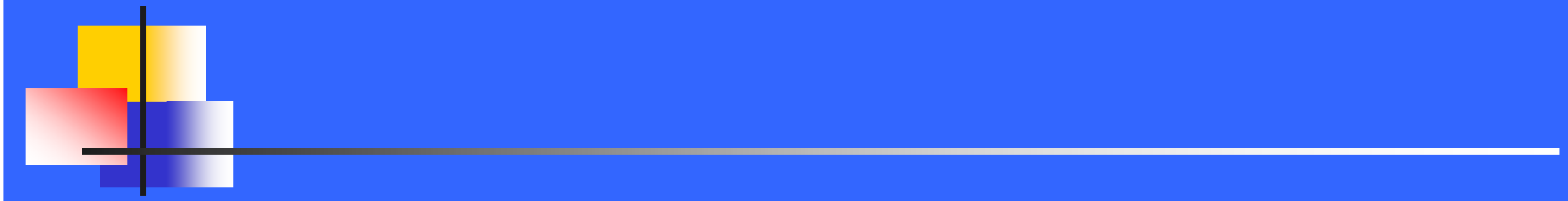
- Broad subject fields or
- Schools or
- Colleges

**And**

- Subject fields or
- Programs or
- Departments

# Special Interests from Chinese Universities

- **Many top Chinese universities want to learn their positions in the world by broad subject fields or disciplines.**
  - **History of Chinese higher education**
  - **Strategic goals of top Chinese universities**



# Brief Review of Subject Ranking

# US News & World Report

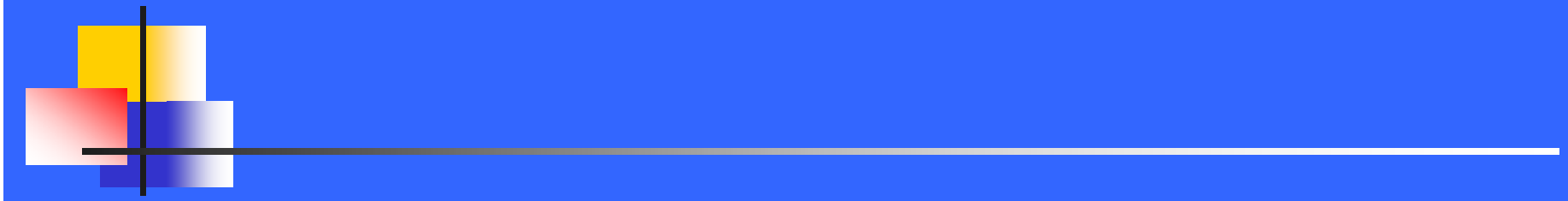
- America's Best Graduate Schools
  - Business
  - Education
  - Engineering
  - Law
  - Medicine
  - Doctoral programs in the Sciences
  - Doctoral programs in Social Sciences & Humanities
  - ……

# Times Higher Education Supplement

- The world's top 100 universities in
  - Arts and Humanities
  - Social Sciences
  - Sciences
  - Engineering & IT
  - Biomedicine

# Other International Subject Rankings

- Top 100 MBA Programs
  by Financial Times
- Top 100 Business Schools
  by School of Management, Univ. Texas at Dallas
- Top 200 Political Science Departments
  by S. Hix
- Top 200 Economics Departments
  by T. Coupe
- …



# Methodologies of ARWU-FIELD

# Selection of Universities

- Any university that has any Nobel Laureates, Fields Medals, Highly Cited researchers.
- Major universities of every country with significant amount of papers indexed by SCIE, SSCI.
- Number of universities actually ranked in each broad subject field: >1000
- Same as the list for ARWU.

# Definition of Broad Subject Fields

- Natural Sciences and Mathematics (SCI)
- Engineering/Technology and Computer Sciences (ENG)
- Life and Agriculture Sciences (LIFE)
- Clinical Medicine and Pharmacy (MED)
- Social Sciences (SOC)
- Arts and humanities are not ranked

# Ranking Criteria and Weights

- **Similar to ARWU**
- **N&S was not used**
- **Two new indicators:**
  - ✓ **Percentage of articles published in the top 20% journals of each field**
  - ✓ **Engineering research expenditure**

## Table 1. Indicators and Weights for ARWU - FIELD

| Code | Weight | Indicator Description for Five Broad Subject Fields of Ranking | | | | |
|---|---|---|---|---|---|---|
| | | SCI | ENG | LIFE | MED | SOC |
| *Alumni* | 10% | Alumni of an institution winning Fields Medals in mathematics and Nobel Prizes in Chemistry and Physics since 1951 | Not Applicable | Alumni of an institution winning Nobel Prizes in Physiology or Medicine since 1951 | Alumni of an institution winning Nobel Prizes in Physiology or Medicine since 1951 | Alumni of an institution winning Nobel Prizes in Economics since 1951 |
| *Award* | 15% | Staff of an institution winning Fields Medals and Nobel Prizes in Chemistry and Physics since 1961 | Not Applicable | Staff of an institution winning Nobel Prizes in Physiology or Medicine since 1961 | Staff of an institution winning Nobel Prizes in Physiology or Medicine since 1961 | Staff of an institution winning Nobel Prizes in Economics since 1961 |
| *HiCi* | 25% | Highly cited researchers in 5 categories:<br>➢ Mathematics<br>➢ Physics<br>➢ Chemistry<br>➢ Geosciences<br>➢ Space Sciences | Highly cited researchers in 3 categories:<br>➢ Engineering<br>➢ Computer Science<br>➢ Materials Science | Highly cited researchers in 8 categories:<br>➢ Biology & Biochemistry<br>➢ Molecular Biology & Genetics<br>➢ Microbiology<br>➢ Immunology<br>➢ Neuroscience<br>➢ Agricultural Sciences<br>➢ Plant & Animal Science<br>➢ Ecology/ Environment | Highly cited researchers in 2 categories:<br>➢ Clinical Medicine<br>➢ Pharmacology | Highly cited researchers in 2 Categories:<br>➢ Social Sciences, General<br>➢ Economics/ Business |
| *PUB* | 25% | Articles Indexed in Science Citation Index-Expanded in **SCI** fields | Articles Indexed in Science Citation Index- Expanded in **ENG** fields | Articles Indexed in Science Citation Index- Expanded in **LIFE** fields | Articles Indexed in Science Citation Index- Expanded in **MED** fields | Articles Indexed in Social Science Citation Index in **SOC** fields |
| *TOP* | 25% | Percentage of articles published in top 20% journals of **SCI** fields to that in all **SCI** journals | Percentage of articles published in top 20% journals of **ENG** fields to that in all **ENG** journals | Percentage of articles published in top 20% journals of **LIFE** fields to that in all **LIFE** journals | Percentage of articles published in top 20% journals of **MED** fields to that in all **MED** journals | Percentage of articles published in top 20% journals of **SOC** fields to that in all **SOC** journals |
| *Fund* | 25% | Not Applicable | Total engineering-related research expenditures | Not Applicable | Not Applicable | Not Applicable |

# Scoring Procedures

- For each indicator, the highest scoring institution is assigned a score of 100, and other institutions are calculated as a percentage of the top score.
- The distribution of data for each indicator is examined for any significant distorting effect; statistical techniques are used to adjust the indicator if necessary.
- Scores for each indicator are weighted to arrive at a final overall score for an institution. The highest scoring institution is assigned a score of 100, and other institutions are calculated as a percentage of the top score.
- The scores are then placed in descending order. An institution's rank reflects the number of institutions that sit above it.

# Definition of Indicator: *Alumni*

- **The total number of the alumni of winning Nobel prizes in physics, chemistry, medicine and economics and Fields Medal in Mathematics.**
- **Alumni are defined as those who obtain bachelor, Master's or doctoral degrees from the institution.**
- **Different weights are set according to the periods of obtaining degrees. The weight is 100% for alumni of 1991-2000, 80% for alumni of 1981-1990, 60% for alumni of 1971-1980, 40% for alumni of 1961-1970, and finally 20% for alumni of 1951-1960.**
- **If a person obtains more than one degrees from an institution, the institution is considered once only.**
- **Nobel Laureates in Physiology or Medicine are used in both LIFE and MED ranking**

# Definition of Indicator: *Award*

- The total number of the staff of an institution winning Nobel prizes in physics, chemistry, medicine and economics and Fields Medal in Mathematics.
- Staff is defined as those who work at an institution at the time of winning the prize.
- Different weights are set according to the periods of winning the prizes. The weight is 100% for winners since 2001, 80% for winners in 1991-2000, 60% for winners in 1981-1990, 40% for winners in 1971-1980, and finally 20% for winners in 1961-1970.
- If a winner is affiliated with more than one institution, each institution is assigned the reciprocal of the number of institutions.
- For Nobel prizes, if a prize is shared by more than one person, weights are set for winners according to their proportion of prize.
- Nobel Laureates in Physiology or Medicine are used in both LIFE and MED ranking.

# Definition of Indicator: *HiCi*

- The number of highly cited researchers in 20 broad subject categories in life sciences, medicine, physical sciences, engineering and social sciences.
- The definition of categories and detailed procedures can be found at the website of Institute of Scientific Information.
- These highly cited researchers are assigned to five broad subject fields ranked.
- If a researcher is listed in more than one subject category, his/her weight for each category is the reciprocal of the number of categories listed.

# Definition of Indicator: *PUB*

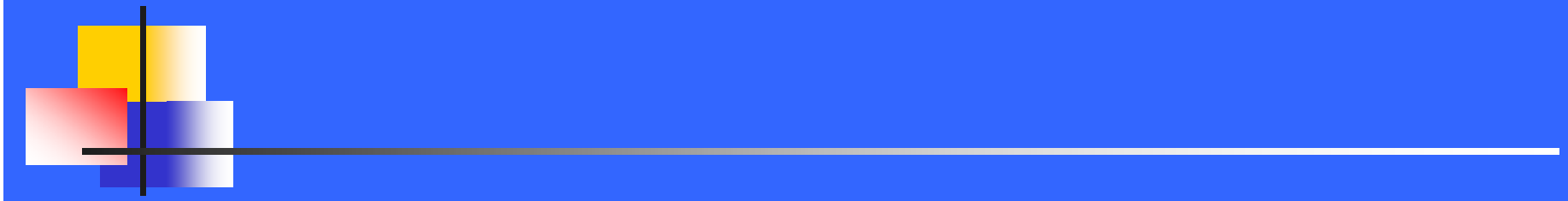
- Total number of articles indexed by Science Citation Index-Expanded and Social Science Citation Index in 2004.
- Each article published by an institution is assigned into one of the six broad subject fields.
  (5 ranked + Interdisciplinary & Multidisciplinary Sciences )
- If an article is published in a multi-assigned journal (which is assigned to more than one ISI category), it is divided into related groups.
- Only publications of article type are considered.

# Definition of Indicator: *TOP*

- **Percentage of articles published in the top 20% journals of each broad subject field.**
- **Top 20% journals are defined as their impact factors in the top 20% of each ISI category according to Journal Citation Report, 2004.**
- **Articles in the top journals are aggregated into the six broad subject fields and the TOP is calculated as the number of articles in the top 20% journals of a particular broad subject field to that in all journals of the field.**
- **A threshold was set for the minimum number of top articles in each broad subject field. The threshold was defined as 10% of the average of top articles by the top three institutions in each broad subject field. If an institution does not meet the minimum threshold, the *TOP* weight is relocated to other indicators.**
- **Only publications of article type are considered.**

# Definition of Indicator: *Fund*

- **Total engineering-related research expenditures in 2004.**
- **This indicator is only used for ENG ranking.**
- **If the data for all institutions of a country cannot be obtained, its weight will be relocated to other indicators.**
- **For this ranking, the amounts of engineering-related research expenditures are obtained only for institutions in USA and some institutions in Canada.**



# Results of ARWU-FIELD

# Top 100 Institutions by Region and Broad Subject Fields

| | Region | North and Latin America | Europe | Asia/Pacific | Total |
|---|---|---|---|---|---|
| Top 20 | SCI | 16 | 3 | 2 | 21 |
| | ENG | 14 | 1 | 5 | 20 |
| | LIFE | 17 | 3 | 0 | 20 |
| | MED | 15 | 5 | 0 | 20 |
| | SOC | 20 | 0 | 0 | 20 |
| Top 100 | SCI | 62 | 28 | 10 | 100 |
| | ENG | 52 | 22 | 26 | 100 |
| | LIFE | 68 | 26 | 6 | 100 |
| | MED | 64 | 32 | 7 | 103 |
| | SOC | 82 | 13 | 5 | 100 |

# Top 100 Institutions by Country and Broad Subject Fields

| Country | Top 20 | | | | | | Top 100 | | | | | | ARWU 2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SCI | ENG | LIFE | MED | SOC | Sub-Total | SCI | ENG | LIFE | MED | SOC | Sub-Total | Top 20 | Top 100 |
| United States | 16 | 14 | 17 | 15 | 20 | **82** | 60 | 47 | 64 | 58 | 76 | 305 | 17 | 53 |
| United Kingdom | 2 | 1 | 2 | 4 | | **9** | 9 | 7 | 9 | 12 | 10 | 47 | 2 | 11 |
| Japan | 2 | 4 | | | | **6** | 5 | 6 | 3 | 3 | | 17 | 1 | 5 |
| Sweden | | | 1 | 1 | | **2** | 1 | 4 | 3 | 1 | | 9 | | 4 |
| Switzerland | 1 | | | | | **1** | 4 | 1 | 4 | 2 | | 11 | | 3 |
| Singapore | | 1 | | | | **1** | | 2 | | | | 2 | | |
| Canada | | | | | | | 2 | 5 | 4 | 5 | 6 | **22** | | 4 |
| Germany | | | | | | | 4 | | 6 | 6 | | **16** | | 6 |
| Netherlands | | | | | | | 2 | 4 | 2 | 4 | 2 | **14** | | 2 |
| Australia | | | | | | | 1 | 4 | 2 | 2 | 2 | **11** | | 2 |
| Israel | | | | | | | 4 | 3 | 1 | | 2 | **10** | | 1 |
| China | | | | | | | | 7 | | 2 | 1 | **10** | | |
| … | | | | | | | | | | | | | | |

# Top 100 Institutions by Country and Broad Subject Fields (Cont.)

| Country | Top 20 | | | | | | Top 100 | | | | | | ARWU 2005 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SCI | ENG | LIFE | MED | SOC | Sub-Total | SCI | ENG | LIFE | MED | SOC | Sub-Total | Top 20 | Top 100 |
| … | | | | | | | | | | | | | | |
| France | | | | | | | 4 | 1 | 1 | 1 | | **7** | | 4 |
| Denmark | | | | | | | 2 | 1 | 1 | 1 | | **5** | | 1 |
| Italy | | | | | | | 1 | 3 | | 1 | | **5** | | 1 |
| Belgium | | | | | | | | 1 | | 2 | | **3** | | |
| South Korea | | | | | | | | 3 | | | | **3** | | |
| Austria | | | | | | | | | | 1 | | **1** | | 1 |
| Norway | | | | | | | | | | | 1 | **1** | | 1 |
| Russia | | | | | | | 1 | | | | | **1** | | 1 |
| Brazil | | | | | | | | | | 1 | | **1** | | |
| India | | | | | | | | 1 | | | | **1** | | |
| Spain | | | | | | | | | | 1 | | **1** | | |

# Statistics by Country and Number of Top Fields in Each Institution

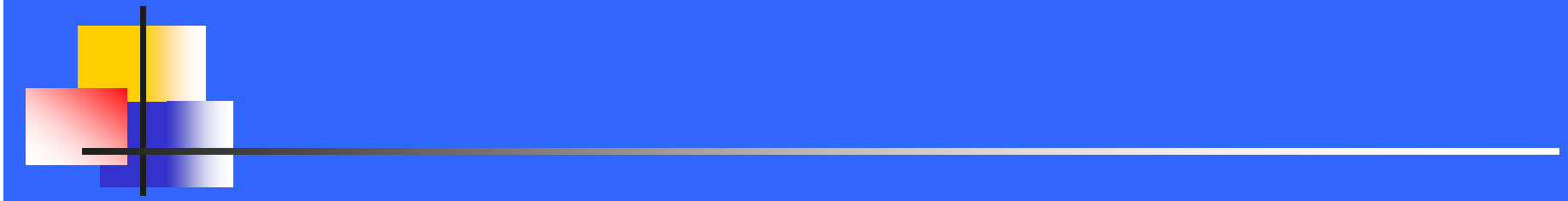
| Country | Number of Institutions in Top 20 of | | | | | | Number of Institutions in Top 100 of | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 Fields | 4 Fields | 3 Fields | 2 Fields | 1 Fields | Sub-Total | 5 Fields | 4 Fields | 3 Fields | 2 Fields | 1 Fields | Sub-Total |
| United States | 1 | 3 | 10 | 9 | 17 | 40 | 19 | 20 | 16 | 23 | 36 | 114 |
| United Kingdom | | 1 | 1 | | 2 | 4 | 2 | 2 | 4 | 4 | 9 | 21 |
| Japan | | | | 1 | 4 | 5 | | 2 | 1 | 2 | 2 | 7 |
| Sweden | | | | 1 | | 1 | | | | 2 | 5 | 7 |
| Switzerland | | | | | 1 | 1 | | | 1 | 4 | | 5 |
| Singapore | | | | | 1 | 1 | | | | | 2 | 2 |
| Canada | | | | | | | 1 | 2 | 1 | | 6 | 10 |
| Israel | | | | | | | | | 2 | 2 | | 4 |
| Germany | | | | | | | | | 1 | 5 | 3 | 9 |
| Netherlands | | | | | | | | | 1 | 3 | 5 | 9 |
| Australia | | | | | | | | | 1 | 3 | 2 | 6 |
| China | | | | | | | | | | 2 | 6 | 8 |
| … | | | | | | | | | | | | |

# Statistics by Country and Number of Top Fields in Each Institution (Cont.)

| Country | Number of Institutions in Top 20 of | | | | | | Number of Institutions in Top 100 of | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 Fields | 4 Fields | 3 Fields | 2 Fields | 1 Fields | Sub-Total | 5 Fields | 4 Fields | 3 Fields | 2 Fields | 1 Fields | Sub-Total |
| … | | | | | | | | | | | | |
| France | | | | | | | | | | 1 | 5 | 6 |
| Denmark | | | | | | | | | | 1 | 3 | 4 |
| Belgium | | | | | | | | | | 1 | 1 | 2 |
| Italy | | | | | | | | | | | 5 | 5 |
| South Korea | | | | | | | | | | | 3 | 3 |
| Spain | | | | | | | | | | | 1 | 1 |
| Austria | | | | | | | | | | | 1 | 1 |
| Brazil | | | | | | | | | | | 1 | 1 |
| India | | | | | | | | | | | 1 | 1 |
| Norway | | | | | | | | | | | 1 | 1 |
| Russia | | | | | | | | | | | 1 | 1 |
| **Total** | **1** | **4** | **11** | **11** | **25** | **52** | **22** | **26** | **28** | **53** | **99** | **228** |

# Performance of Individual Institutions

| Institution | Country | Number of Fields in | | ARWU 2005 Rank |
|---|---|---|---|---|
| | | Top 20 | Top 100 | |
| Stanford Univ | USA | 5 | 5 | 3 |
| Harvard Univ | USA | 4 | 5 | 1 |
| Univ Cambridge | UK | 4 | 5 | 2 |
| Massachusetts Inst Tech (MIT) | USA | 4 | 5 | 5 |
| Columbia Univ | USA | 4 | 4 | 7 |
| Univ California - Berkeley | USA | 3 | 5 | 4 |
| Univ Oxford | UK | 3 | 5 | 10 |
| Yale Univ | USA | 3 | 5 | 11 |
| Cornell Univ | USA | 3 | 5 | 12 |
| Univ California - San Diego | USA | 3 | 5 | 13 |
| Univ California - Los Angeles | USA | 3 | 5 | 14 |
| Univ Wisconsin - Madison | USA | 3 | 5 | 16 |
| Univ Washington - Seattle | USA | 3 | 5 | 17 |
| Univ Michigan - Ann Arbor | USA | 3 | 5 | 21 |
| ..... | | | | |
| Kyoto Univ | Japan | 2 | 4 | 22 |
| ..... | | | | |
| Tokyo Univ | Japan | 1 | 4 | 20 |



# Discussion about ARWU-FIELD

# Qualitative versus Quantitative

- There are always complaint that whether the quality of students can be precisely measured by scores. However, universities and professors are continuing to score students without any significant changes, and the students are usually informed that they will not be judged by scores absolutely, the university and the potential employers will have the capacity to make sophisticated, independent judgments.
- Similarly, there is always the question that whether the quality of universities can be precisely measured by mere numbers. Therefore, people should be cautious about any ranking and should not rely on any ranking either, including ARWU and ARWU-FIELD. Instead, people should use rankings simply as one kind of reference and make their own judgment about ranking results based on ranking methodologies.

# Education versus Research

- Since different stakeholders have different expectations about quality, the quality of higher education institutions is not easy to compare internationally. It would be impossible to rank the quality of university education worldwide because of the huge differences of universities in the large variety of countries and the technical difficulties in obtaining internationally comparable data.
- If one wants to construct a reliable ranking of world universities, the only possible ranking will be a comparative display of research performance. Therefore, we chose to rank research universities in the world by five broad subject fields using their academic or research performance based on internationally comparable data that everyone could check. No subjective measures were taken. No data is obtained from any kind of university reports.

# Language Bias

- English is the language of international academic community.
- Any ranking based on academic performance will be biased towards institutions in English-speaking countries.
- Possible solution: papers published in non-native languages are offered a special weight.

# Type of Publication

- Only publication of original article type is considered in ARWU-FIELD.
- Papers of communication type are important sources of original research; they are not considered based on the assumption that most of the work in communications is eventually published in articles.
- Academic books are important sources of original research and are more common in some subject fields than in others. Books are not considered due to the technical difficulties in obtaining internationally comparable data.

# Award and Alumni

- Only Nobel Prize and Fields Medal are used in ARWU-FIELD.
- In order to compensate the bias against other disciplines, other prizes will be considered in our future rankings once the weight are decided for each prize in a scientific way.
- Nobel prizes in Physiology or Medicine are used in both LIFE and MED rankings due to the technical difficulties in dividing the prizes precisely into LIFE and MED fields.
- Institutions for winning awards and those for doing the researches may not be the same.
- Institutions for obtaining degrees and those for pursuing the studies may not be the same.
- Some prize- winners had obtained degrees in disciplines other than those of the prize awarding fields.

# Assign of Articles to Fields

- As mentioned in Methodology, articles of an institution are assigned to six broad subject fields and those in five broad subject fields are used in ARWU-FIELD.
- Articles in journals of Interdisciplinary and Multidisciplinary Sciences and of psychology are not used in ARWU-FIELD.
- Those institutions that are strong in the above fields could be unfairly represented. Journals of Interdisciplinary and Multidisciplinary Sciences and of psychology categories include some of the most prestigious journals such as *Nature* and *Science*.

# Definition of Institution

- **University systems: such as Univ California system, Univ London system.**
- **Affiliated institutions and research organizations: such as *Ecole Polytechnique Montreal* (affiliated to University of Montreal), CNRS Labs (affiliated to French universities).**
- **Teaching and affiliated Hospitals: complex!**
- **Our answer: according to author's expression.**

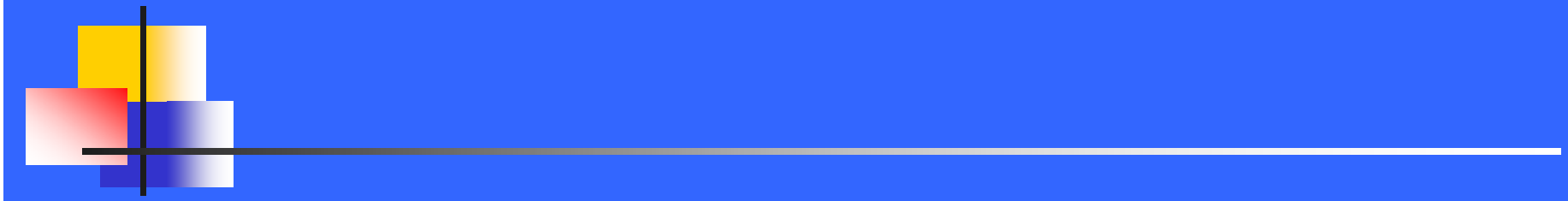
# Attributions of Articles

- **Many universities have more than one commonly used names: such as Virginia Tech and Virginia Polytechnic and State University.**
- **Variations due to translation: such as *Univ Koln* and Univ Cologne, Univ Vienna and Univ Wien.**
- **Abbreviated names: such as ETH Zurich for Swiss Federal Institute of Technology Zurich.**
- **Some authors only write their departmental or institute name without mentioning their university name.**

# Merging and Splitting

**Merging, splitting, inheriting, discontinuing, name-changing of institutions such as:**

- **Univ Kwazulu-Natal in South Africa merged from Univ Natal and Univ Durban-Westville.**
- **University of Innsbruck in Austria splitted into Univ Innsbruck and Innsbruck Medical Univ.**
- ***Vrjie Universiteit Brussel* and *Universite Libre Bruxelles* share the same English name of Free University of Brussels.**



# Final Remarks

# Controversy of Ranking

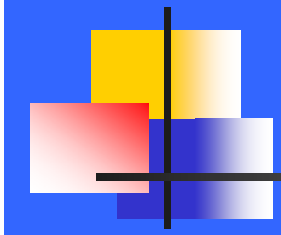
- Any ranking is controversial and no ranking is absolutely objective.
- Nevertheless, university rankings become popular in many countries. Whether universities and other organizations agree with the various ranking systems; ranking systems clearly are here to stay.
- The key issue then becomes how to improve ranking systems for the benefits of higher education.

# Features of ARWU-FIELD

- **ARWU-FIELD is an independent academic research without any external support.**
- **It uses a few carefully selected, non-subjective criteria and internationally comparable data that everyone could verify in some way.**
- **Nevertheless, there are still many problems with the ranking as discussed above.**

# Future Efforts

- We will carefully study all of problems related to ARWU-FIELD and continuously improve the rankings.
- The final results of ARWU-FIELD will be published on our website (http://ed.sjtu.edu.cn/ARWU-FIELD.htm) in February 2007 and updated annually.



# Thank you very much for your attention!

http://ed.sjtu.edu.cn/ranking.htm

http://ed.sjtu.edu.cn/en/