

Mathematical Genealogy Project And Time
Evolution of Research Groups
CD Dissertation

Candidate Number: 775568
Department of Mathematics
University of Oxford,UK

March 18, 2011

Abstract

Mathematical Genealogy Project tracks the mentorship of mathematicians all over the world. This project has been carried out to investigate the evolution of maths departments in US. By using Matlab, degree function, clustering coefficient and hubs and authorities were calculated, one of the conclusions is that hub values and authority values were seen positively correlated with each other. The analyses of the full results will be reported.

Contents

| | | |
|----------|------------------------------------|-----------|
| 1 | Introduction | 3 |
| 2 | Background | 4 |
| 2.1 | Degree Distribution | 4 |
| 2.2 | Clustering Coefficient | 6 |
| 2.3 | Perron-Frobenius Theorem | 7 |
| 2.4 | Hubs and Authorities | 8 |
| 3 | Methods | 10 |
| 3.1 | Data | 10 |
| 3.2 | Degree Distribution | 10 |
| 3.3 | Clustering Coefficient | 11 |
| 3.4 | Hubs and Authorities | 12 |
| 4 | Results | 13 |
| 4.1 | Degree Function | 13 |
| 4.2 | Clustering Coefficient | 16 |
| 4.3 | Hubs and Authorities | 18 |
| 4.3.1 | 1946–1955 | 19 |
| 4.3.2 | 1956–1965 | 20 |
| 4.3.3 | 1966–1975 | 21 |
| 4.3.4 | 1976–1985 | 22 |
| 4.3.5 | 1986–1995 | 23 |
| 4.3.6 | 1996–2010 | 24 |
| 5 | Conclusions | 25 |
| 6 | Acknowledgement | 26 |
| 7 | Appendix | 26 |
| | References | 53 |

1 Introduction

The ebb and flow of the quality of math departments is a common argument in informal discussion among mathematicians, but how exactly can we measure the quality of a certain department/research group?

One of the primary motivations of this project is to figure out the question above, to find out what connections do they have between universities where those mathematicians received their doctorate and the ones their advisees received theirs. Mathematical Genealogy Project (MGP) is the one that tracks the mentorship record of thousands of mathematicians over several centuries. [1] It lists all individuals who have received a doctorate in mathematics and include following information: the complete name of the degree recipient, the name of the university that awarded the degree, the year in which the degree was awarded, the complete title of the dissertation, and the complete name(s) of the advisor(s). The MGP was conceived in 1994, when Harry Coonce, a mathematician at Minnesota State University in Mankato, wondered who was his own thesis adviser's adviser. After he realised such information has not been published in the public domain, he set out to establish a central repository with his two collaborators, which went online in 1997. This site gives the world a brand new perspective on mathematical history. Great mathematicians like Gauss, who laid the groundwork for number theory, and Paul Erdős, one of the most prolific mathematicians of all time, leave nary a direct academic heir. Visitors to the site can trace these genealogical paths by clicking on the names of advisers or their students. [2]

The data in this report was provided by Peter Mucha of University of North Carolina who received it from the Mathematical Genealogy Project.

The purpose of the project is to investigate the time evolution of mathematics departments/research groups. In this project, I calculate statistics like degree distribution, clustering coefficient and hub and authorities to analyse the connections among these 231 universities in 1946–2010 period.

In section 2, background knowledge of networks are introduced, so are the basic knowledge of the algorithms. In section 3, we talk about the particular method I use in this project. Results of degree distribution, clustering coefficient and hub and authority are discussed in section 4. Finally in section 5, we review the dissertation and provide a conclusion.

2 Background

2.1 Degree Distribution

Here I investigate the project by using the language of networks. In its simplest form, a *network* is a collection of points joined together in pairs by lines. We call the points *vertices* or *nodes*, and use the term *edge* for those lines that connect the points. [3] Network is widely used nowadays, many systems such as physics, biology and social science are taking the form of networks all over the world . [4] [5][6]

A *directed* network means each edge of the network has a direction pointing from one vertex to another. [7] In this case, a person who obtained his Ph.D. at Yale and then advised a graduate in Princeton is different from one who obtained his Ph.D. in Princeton and then advised a student in Yale. A *weighted* network means the strength or weight of a edge is a real number. [7] For example, in the time period 1946 to 2010, there are two people who got their Ph.D.s at Brandeis University who later advised students at Boston University. One property of this network is that it has *self-loops*, which edges connect vertices to themselves [7], meaning people in stayed in the same university where they obtained a Ph. D. and advised graduate students there.

The *degree* of a vertex is the number of edges that connected to it. We will denote the degree of vertex i by k_i . In a directed network each vertex has two types of degrees: *in-degree* and *out-degree*. The in-degree K_{in} is the number of ingoing edges connected to a vertex and the out-degree K_{out} is the number of outgoing edges. The *weight* w_{ij} are the weight of edge emanating from i to j . The *strength* s_i is the total weight of all edges that emanating from i [7].[8]

Consider, for example, the network in Figure 1.

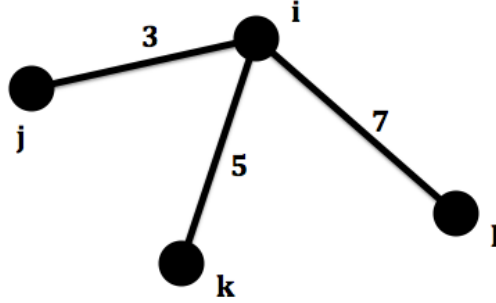


Figure 1: An undirected network.

In this undirected network,

$$k_i = 3, w_{ij} = 3, w_{ik} = 5, w_{il} = 7, s_i = 3 + 5 + 7 = 15. \quad (1)$$

The adjacency matrix of a directed network has element $A_{ij} = 1$ if there is one edge from j to i . The in-degree and out-degree are given by

$$\begin{aligned} K_{in}(i) &= \sum_{j=1}^n A_{ij} \\ K_{out}(i) &= \sum_{j=1}^n A_{ij} \end{aligned} \quad (2)$$

We denote by P_k as the fraction of vertices in network that have degree k , this notation is for undirected network, and we have $P_{in}(k)$ and $P_{out}(k)$ for in-degree and out-degree in directed network respectively.

In a undirected network,

$$P_k = \frac{\text{Number of vertices with degree } k}{\text{Total number of vertex}} \quad (3)$$

So P_k is a probability that a randomly chosen vertex in the network has degree k .

For example, consider the network in Figure 2.

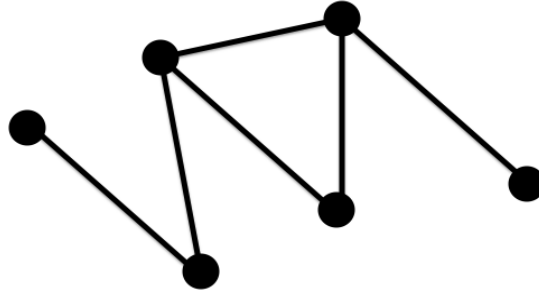


Figure 2: An undirected and unweighted network.

There are $n = 6$ vertices, of which 2 have degree 1, 3 have degree 2, and 1 has degree 3. Thus, the value of P_k for $k = 1, 2, 3$ are

$$P_1 = \frac{1}{3}, P_2 = \frac{1}{2}, P_3 = \frac{1}{6}, \quad (4)$$

and $P_k = 0$ for all $k > 3$. The quantities $\{P_k\}$ represent the *degree distribution* of the network.

2.2 Clustering Coefficient

There is a tendency for link formation between neighbouring vertices in a large number of networks. This tendency is measured using the *clustering coefficient*, which give the average probability that two neighbours of a vertex are neighbours themselves. [9] This concept was originally used in sociology; for example, in a social network, the friends of a person are very likely to know each other. Denote clustering coefficient C_i to measure the clustering around a vertex i .

In a unweighted network, for $k_i > 1$,

$$C_i = \frac{2t_i}{(k_i)(k_i - 1)} \quad (5)$$

where t_i is the number of triangles around vertex i and k_i is the degree of vertex i . Hence if none of the neighbours of a vertex are connected to each other $C_i = 0$, if all of the neighbours of a vertex are connected $C_i = 1$.

For $k_i = 0$ or 1 ,

$$C_i = 0 \quad (6)$$

In a weighted network, how weight is present in the neighbourhood of a vertex should be taken into account. There are several ways to work out C_i . Here we use *Onnela et al.*'s definition. [9]

Onnela et al. proposed a version is based on the concept of subgraph *intensity*, the geometric average of subgraph edge weights. This gives a weighted clustering coefficient.

$$\tilde{C}_i = \frac{1}{k_i(k_i - 1)} \sum_{jk} (\hat{w}_{ij}\hat{w}_{ik}\hat{w}_{jk})^{1/3}, \quad (7)$$

where $\hat{w}_{ij} = \frac{w_{ij}}{\max(w)}$ so that each edge weights are normalised by the maximum weight in the network. The edge weights determine the contribution of each triangle.

$$\tilde{C}_i = C_i \bar{I}_i \quad (8)$$

with

$$\bar{I}_i = \frac{1}{2t_i} \sum_{j,k} \hat{w}_{ij}\hat{w}_{ik}\hat{w}_{jk}^{1/3} \quad (9)$$

C_i is the unweighted clustering coefficient and \bar{I}_i is the normalised intensity that vertex i participates.

2.3 Perron-Frobenius Theorem

The Perron-Frobenius Theorem [10]: If all elements a_{ij} of an irreducible matrix A are nonnegative, then $R = \min M_\lambda$ is an eigenvalue of A and all the

eigenvalues of A lie on the disk

$$|z| \leq R, \quad (10)$$

where, if $\lambda = (\lambda_1, \lambda_2, \dots, \lambda_n)$ is a set of nonnegative numbers (which are not all zero),

$$M_\lambda = \inf\{\mu : \mu\lambda_i > \sum_{j=1}^n |a_{ij}| \lambda_j, 1 \leq i \leq n\}. \quad (11)$$

Furthermore, if A has exactly p eigenvalues ($p \leq n$) on the circle $|z| = R$, then the set of all its eigenvalue is invariant under rotations by $2\pi/p$ about the origin.

The eigenvalues of a real square matrix A are complex numbers and collectively they make up the spectrum of the matrix. The exponential growth rate of matrix powers A^k as $k \rightarrow \infty$ is controlled by the eigenvalue of A with largest absolute value. This theorem ensure the existence of eigenvalue and eigenvector, therefore ensure that hub and authority exist.[11]

2.4 Hubs and Authorities

In a large network, one of necessary properties to look at is the importance of central vertices in the network. There are, however, many possible definitions of importance, and correspondingly many methods to measure the *centrality* for networks. The simplest way to measure centrality of a network is its degree of a vertex, called *degree centrality* by social scientists. [7][12]

In a directed network, both vertices that have high centrality themselves and the ones which points to others with high centrality are defined as a vertex high centrality. For instance, in a social network a website like google, the webpage itself may contain relatively little information on the subject, but it tells us where to find the information, and this makes the webpage itself useful.

One concept needs to be introduced here in these networks: *hubs* and *authorities*, which was developed by Jon Kleinberg. [7] Authorities are nodes which contain useful information and hubs are the nodes that link to these useful information. In other words, a good hub represented a page that pointed to

many other useful pages and a good authority represented a page that was linked by many different hubs. An authority can be a hub and vice versa.

Hubs and authorities are determined using the parameter y_i and x_i respectively.

$$\begin{aligned}AA^T x &= \lambda x, \\A^T Ay &= \lambda y.\end{aligned}\tag{12}$$

where λ is the largest eigenvalue of matrix A . By the Perron-Frobenius theorem, it ensures the existence of hubs and authorities.

3 Methods

3.1 Data

The data in this report was provided by Peter Mucha of University of North Carolina, who received it from the Mathematical Genealogy Project. Two major data form was received, a cell array called `cell165.mat` and a cell array `schools.mat`.

The file `cell165.mat` is a 65×3 cell array. The first column is the adjacency matrices for each year, `cell65{1,1}` is the adjacency matrix for 1946 and `cell{2,1}` is the one for 1947 etc. For example if $B = \text{cell65}\{2,1\}$ and $B(78,218) = 1$ then there is one student who received his Ph.D. from school 78 (Princeton) in 1947 and went on to advise a graduate student at school 218 (Yale). It shows there is a link between Princeton and Yale in 1947. The file `school.mat` is a 231×1 cell array that contains the names of 231 universities that is connected in the 1946–2010 time period.

I studied by arranging the data, the 65 adjacency matrix from 1946 to 2010 was added together to form a new directed and weighted 231×231 matrix A . The element A_{ij} indicates the number of Ph.D.s at school j with a supervisor whose Ph.D. was at school i . One of the properties of this network is that it has *self-loops*, which are edges that connect vertices to themselves. For example, a person who received his Ph.D. in Harvard who later advised a student in Harvard between 1946 and 2010, and the self-loop here is represented as the diagonal of the matrix A . To make things easier, I decide to look that the network without self-loops first. In matlab notation, the new matrix is defined as $B = A - \text{diag}(\text{diag}(A))$.

3.2 Degree Distribution

Because this network is directed, in-degree and out-degree for each vertex should be calculated first, so that one can then calculate P_{in} and P_{out} for in-degree and out-degree separately.

First, I form a new 231×231 matrix M with $M_{ij} = 1$ if $B_{ij} > 0$ where $i = 1,2,3\dots231$ and $j = 1,2,3\dots231$.

According to Equation (2),

$$\begin{aligned}K_{in}(i) &= \sum_{j=1}^{231} M_{ij} \\K_{out}(i) &= \sum_{i=1}^{231} M_{ij}\end{aligned}\tag{13}$$

where $i = 1,2,3..231$ and $j = 1,2,3...231$.

A cumulative P is calculated to preserve all of the information contained in the data compared with normal degree distribution P_k , because there are no bins involved. There are as many points along the degree axis (x-axis) as there are distinct values of degree. [7]

Calculation of cumulative degree distribution is easy. The number of vertices whose in-degree is greater or equal to h can be found by matlab, where $h = 1,2...max(K_{in})$. Denote this number of vertices S_1 . This gives

For $i = 1,2,3..231$,

$$P_{in}(i) = \frac{S_1(h)}{231}\tag{14}$$

Similarly, we apply Equation (15) in order to find the number of vertices who has out-degree is greater or equal to l , where $l = 1,2...max(K_{out})$. Denote this number S_2 .

For $i = 1,2,3...231$,

$$P_{out}(i) = \frac{S_2(l)}{231}\tag{15}$$

3.3 Clustering Coefficient

The Equation (7) only gives the method to calculation the clustering coefficient in a undirected network. However, in our case, $w_{ij} \neq w_{ji}$. The original equation needs to be adjust for directed network. Largest weight for in-degree, $\max(w_{in})$ and for out-degree, $\max(w_{out})$ need to be worked out by matlab.

In a directed network,

For $i = 1, 2, 3, \dots, 231$,

If $K_{in}(i) \geq 2$ and $K_{out}(i) \geq 2$,

$$C(i) = \frac{K_{in}(i)}{(K_{in}(i) - 1)(\max(w_{in}))} \sum_{j,k} (B_{ij}B_{ik}B_{jk})^{1/3} + \frac{K_{out}(i)}{(K_{out}(i) - 1)(\max(w_{out}))} \sum_{j,k} (B_{ji}B_{ki}B_{kj})^{1/3}, \quad (16)$$

where $j = 1, 2, 3, \dots, 231$, and $k = 1, 2, 3, \dots, 231$.

Otherwise,

$$C(i) = 0.$$

3.4 Hubs and Authorities

According to the definitions given in section 2.4, a function is written here in order to calculate the hub value and authority value in this project. The input of the function is a year range and matrices from `cell165.mat` which correspond to that year range. These matrices are summed and the diagonal is removed as I did to matrix A except A stands for the whole year range. Then the matrix is condensed to only the schools that are connected in the year range to make a matrix G . To match the columns and rows of the condensed matrix G , a new list of school names is created.

Using the `eigs` function, hub scores are calculated by finding the eigenvector associated with the largest eigenvalue for $G \times G^T$ and taking its absolute value.

Similarly, the authority scores is to find the eigenvector associated with the highest eigenvalue for $G^T \times G$ and take its absolute value.

4 Results

The following results were obtained by applying the algorithms from Section 3.

4.1 Degree Function

The in-degree of network K_{in} and corresponding P_{in} from equation (13) and equation (14) are shown in Figure 3.

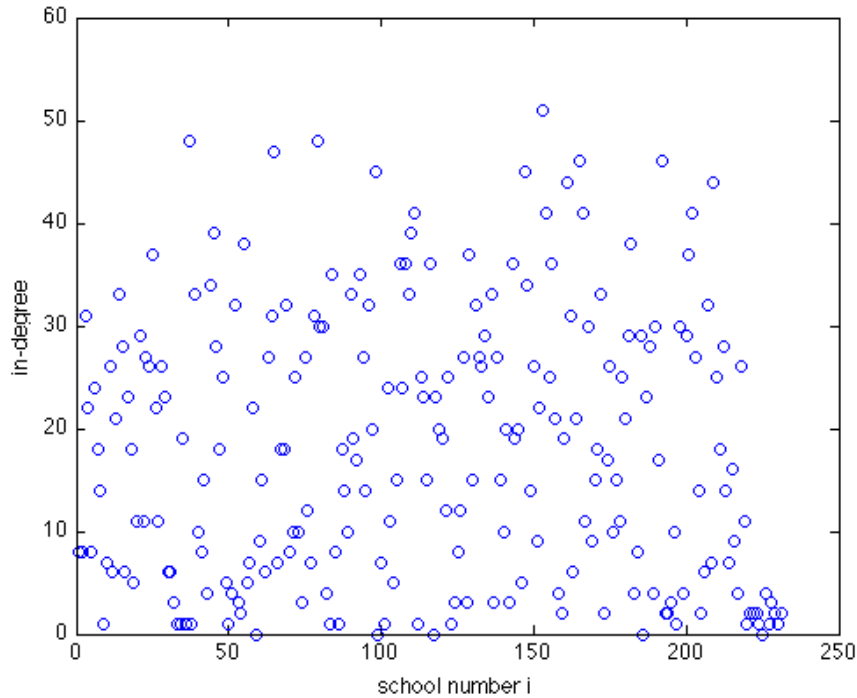


Figure 3: A plot of in-degree against each vertex i , and names of schools are classified in Appendix.

As observed from Figure 3, University of Illinois at Urbana-Champaign (school 153) has largest in-degree, which is 51. This means that from 1946 to 2010, there has been Mathematics Ph.D.s from 51 other universities who later went

to University of Illinois at Urbana-Champaign to advise graduate students there. The in-degree of Purdue University (school 79) is also quite large, which is 48. To give an example at the other extreme, University of Dayton (school 225) has in-degree 0, this was possibly because University of Dayton did not have Ph.D. program during 1946–2010.

In figure 4, I show the cumulative degree distribution for the in-degree using equation (14),

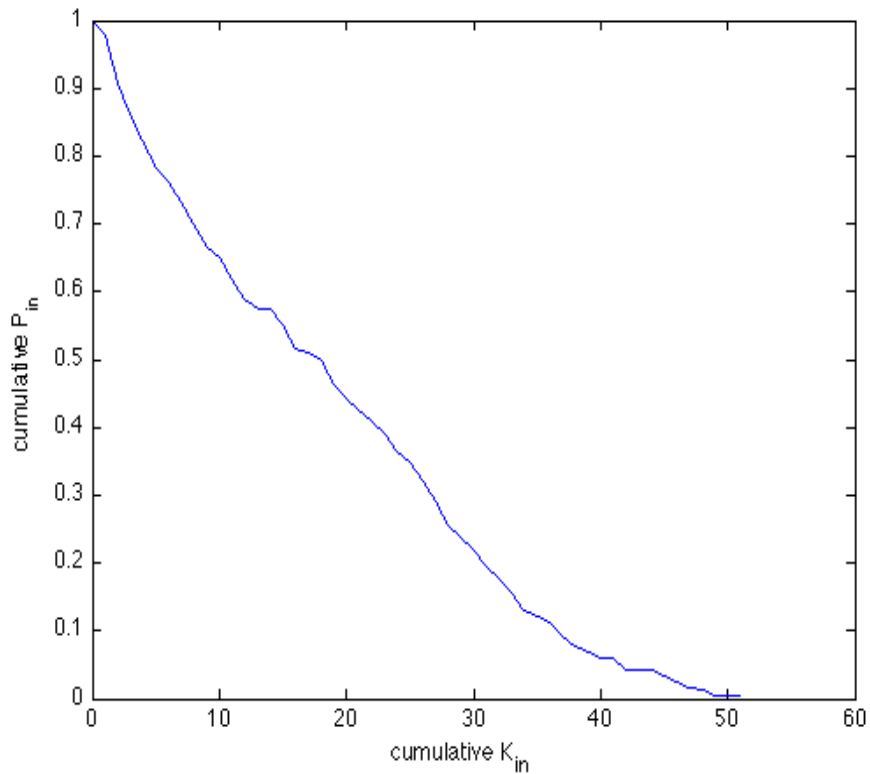


Figure 4: Cumulative degree distribution for in-degree

By calculating the cumulative in-degree distribution, the result shows that the curve decays slower than an exponential distribution, hence, the curve is a heavy tail distribution.

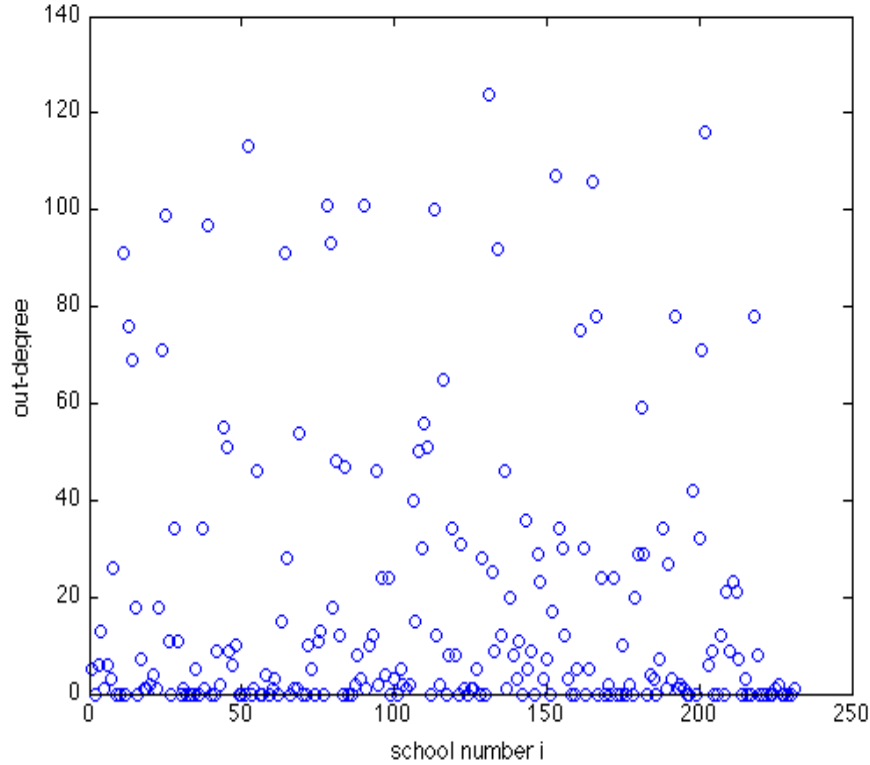


Figure 5: A plot of out-degree against each vertex i

University of California, Berkeley (school 131) is the university with greatest out-degree $K_{out} = 124$ not including the connection to itself. During time period 1946–2010, mathematics Ph.D. students from University of California, Berkeley went to 123 other universities to continue their career as a graduate advisor. Several other universities, such as Nova Southeastern University (school 227), University of Nevada (school 173), Las Vegas and Memphis State University (school 229) have 0 out-degree. None of the mathematics Ph.D.s from these schools advised Ph.D. students at other universities.

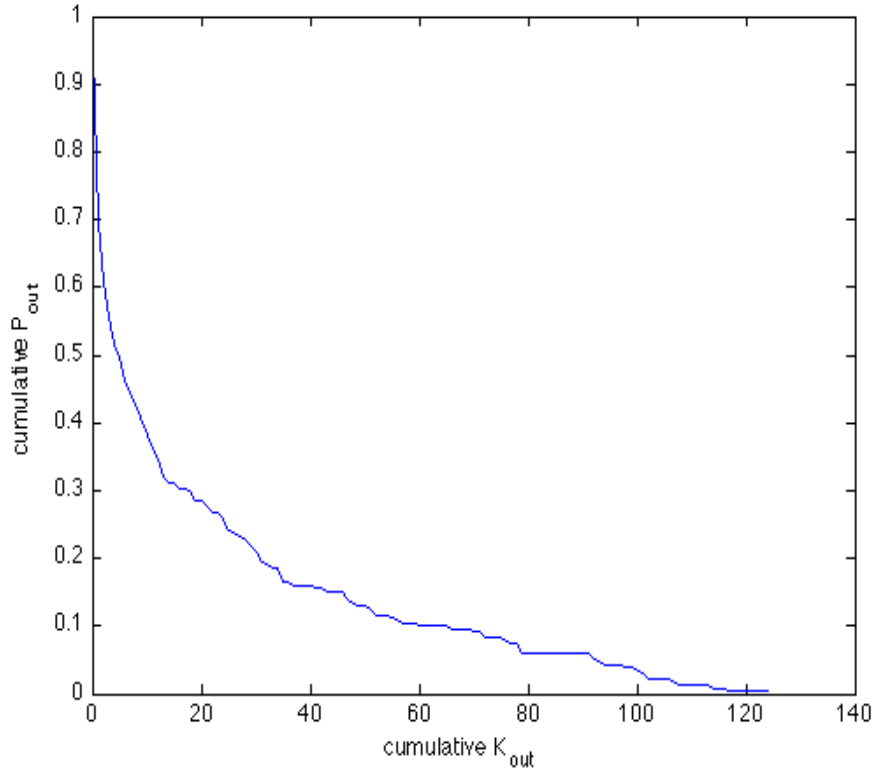


Figure 6: Cumulative degree distribution for out-degree

Again calculate the curve, the cumulative out-degree distribution is heavy-tailed distribution as well.

4.2 Clustering Coefficient

The clustering coefficient here measures the probability of potential triangle connected with vertex i .

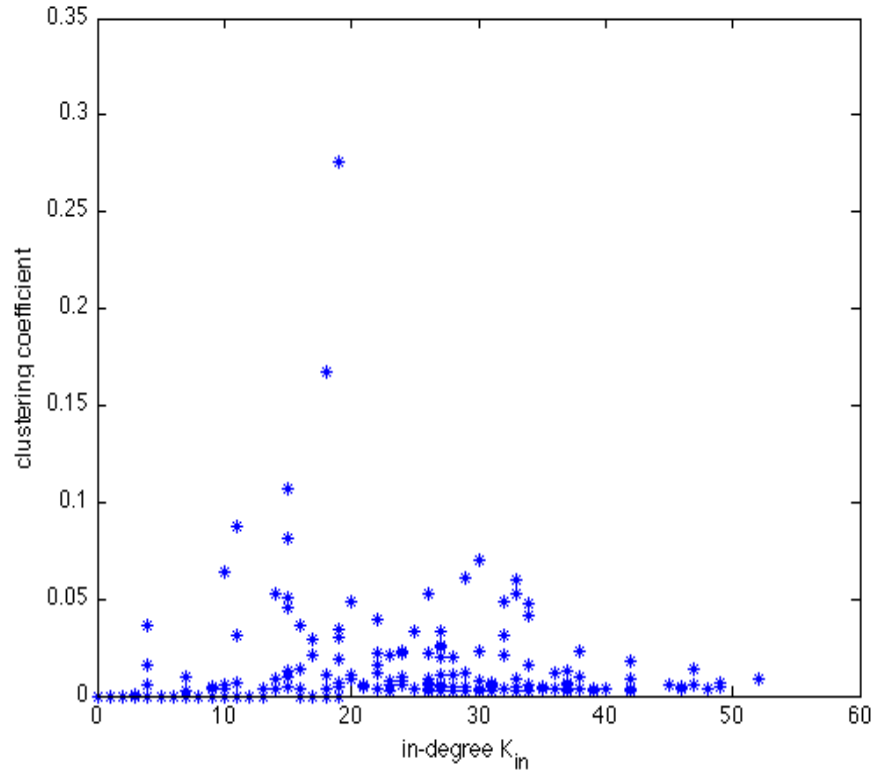


Figure 7: Clustering coefficient against in-degree.

The probability of vertices belonging to small groups increased from $K_{in} = 0$ and reached a peak at $K_{in} = 19$, then the probability fell as the in-degree got larger.

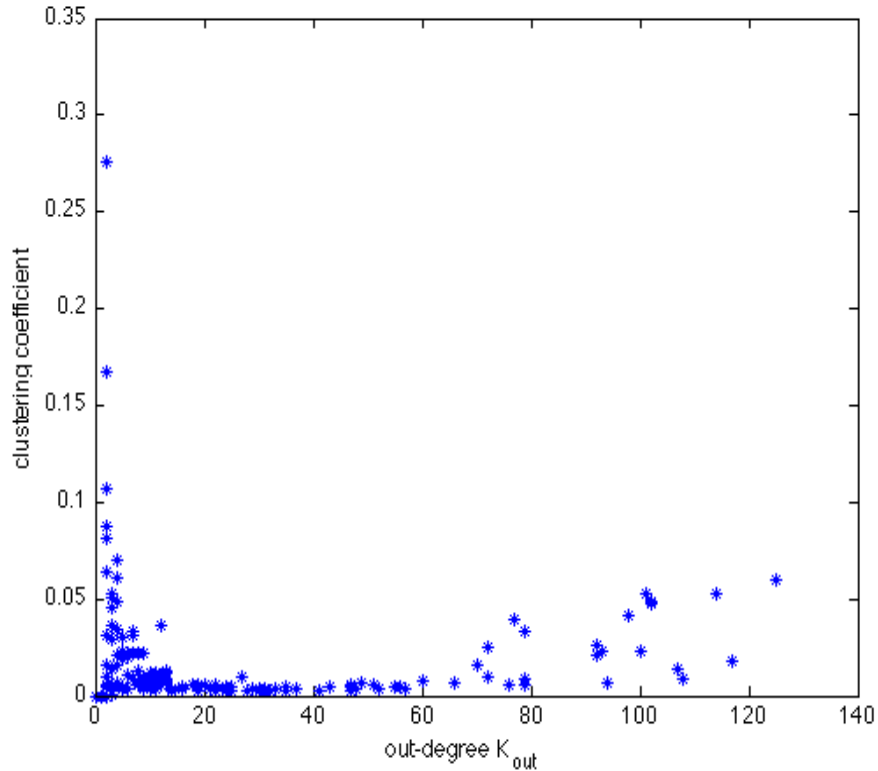


Figure 8: Clustering coefficient against out-degree.

Largest clustering coefficient is at $K_{out} = 2$. Vertices belong to more small groups when the out-degree was small, and then decreased between $K_{out} = 15$ and $K_{out} = 65$, after that the clustering coefficient increased again.

4.3 Hubs and Authorities

We investigated the cases in every ten-year period.

4.3.1 1946–1955

| Year period | Highest Hub Value | Highest Authority Value |
|-------------|-------------------|-------------------------|
| 1946–1955 | 784.3512 | 784.3512 |

Table 1: Highest hub and authority value in 1946–1955.

Both highest hub and authority value are 784.3512, as it is guaranteed by the Perron-Frobenius Theorem.

| Rank | Hub | Auth |
|------|---------------------------------------|---------------------------------------|
| 1 | Massachusetts Institute of Technology | Princeton University |
| 2 | Stanford University | The University of Chicago |
| 3 | University of California, Berkeley | Harvard University |
| 4 | New York University | Columbia University |
| 5 | University of Pennsylvania | Massachusetts Institute of Technology |
| 6 | The University of Chicago | California Institute of Technology |
| 7 | Brown University | University of California, Berkeley |
| 8 | Princeton University | Brown University |
| 9 | Columbia University | University of Michigan |
| 10 | University of Michigan | University of Wisconsin-Madison |

Table 2: Top ten schools with highest hub and authority values in 1946–1955.

Table 2 is the list of top ten school names from highest Authority Value to the lowest and with greatest Hub Value to the smallest in 1946–1955. In time period 1946–1955, Princeton University (school 78) is the one with highest authority value, who rank number 8 in hub value. Hence, Princeton has the greatest number of Ph.D.s in Mathematics who later advised graduates in other school and it also has the 8th largest number of Ph.D.s from other universities who later advised Princeton students. MIT (school 52) has the largest hub value shows that MIT is attractive to mathematics talents.

4.3.2 1956–1965

| Year period | Highest Hub value | Highest Authority Value |
|-------------|-------------------|-------------------------|
| 1956-1965 | 1547.3 | 1547.3 |

Table 3: Highest hub and authority value during 1956–1965.

Hub and authority increased up to 1547.3 during 1956–1965, so universities in this time period produced more Ph.D.s and there were more connections among schools than it was in 1946–1955.

| Rank | Hub | Auth |
|------|--|---------------------------------------|
| 1 | University of California, Berkeley | Princeton University |
| 2 | University of Wisconsin-Madison | Harvard University |
| 3 | Cornell University | Massachusetts Institute of Technology |
| 4 | University of Minnesota-Minneapolis | University of California, Berkeley |
| 5 | Stanford University | The University of Chicago |
| 6 | University of California, Los Angeles | Stanford University |
| 7 | Massachusetts Institute of Technology | University of Michigan |
| 8 | Brown University | Columbia University |
| 9 | University of Illinois at Urbana-Champaign | New York University |
| 10 | Purdue University | California Institute of Technology |

Table 4: Top ten schools with highest hub and authority values in 1956–1965.

As is shown in the table 4, University of Wisconsin-Madison (school 202) did pretty well in 1956–1965, as it ranked 2nd in hub value, many mathematicians were willing to teach graduates in Wisconsin-Madison after they obtained their Ph.D.s in other universities. Again Princeton remains its leading role in authority, followed by Harvard (school 39) and MIT.

4.3.3 1966–1975

| Year period | Highest Hub value | Highest Authority Value |
|-------------|-------------------|-------------------------|
| 1966-1975 | 2178.3 | 2178.3 |

Table 5: Highest hub and authority value during 1966–1975.

The hub and authority score remained to increase in this time period compared with 1956–1965.

| Rank | Hub | Auth |
|------|---------------------------------------|---------------------------------------|
| 1 | University of California, Berkeley | Stanford University |
| 2 | University of Maryland College Park | University of California, Berkeley |
| 3 | University of California, Los Angeles | Princeton University |
| 4 | Massachusetts Institute of Technology | Massachusetts Institute of Technology |
| 5 | Princeton University | Harvard University |
| 6 | Cornell University | University of Wisconsin-Madison |
| 7 | University of Washington | Cornell University |
| 8 | University of Michigan | University of Michigan |
| 9 | University of Texas at Austin | The University of Chicago |
| 10 | University of California, San Diego | New York University |

Table 6: Top ten schools with highest hub and authority values in 1966–1975.

Stanford (school 90) took over Princeton’s leading place in authority score, as Princeton was down to 3rd. University of California, Berkeley remained its number 1 in hub value during 1966–1975. University of Wisconsin-Madison ranked 6th place in authority from 1966 to 1975, possibly due to a great number of good Ph.D.s. joined university in 1956–1965 to increase the performance of graduates from Wisconsin-Madison.

4.3.4 1976–1985

| Year period | Highest Hub value | Highest Authority Value |
|-------------|-------------------|-------------------------|
| 1976-1985 | 1957.2 | 1957.2 |

Table 7: Highest hub and authority value during 1976–1985.

Hub and authority value decreased from 2178.3 to 1957.2.

| Rank | Hub | Auth |
|------|--|--|
| 1 | University of Washington | University of California, Berkeley |
| 2 | Massachusetts Institute of Technology | Stanford University |
| 3 | Cornell University | Massachusetts Institute of Technology |
| 4 | University of California, Los Angeles | Harvard University |
| 5 | University of Illinois at Urbana-Champaign | Princeton University |
| 6 | University of Maryland College Park | Cornell University |
| 7 | University of Michigan | Yale University |
| 8 | New York University | University of Wisconsin-Madison |
| 9 | Princeton University | The University of Chicago |
| 10 | University of Wisconsin-Madison | University of Illinois at Urbana-Champaign |

Table 8: Top ten schools with highest hub and authority values in 1976–1985.

During time period 1976–1985, University of Washington (school 201) was the top in hub value, MIT became the second, and Cornell (school 25) was the third. For authority value, University of California, Berkeley was in the lead, followed by Stanford and MIT. The relatively high rankings in both hub value and authority value of MIT showed that MIT not only attracted many maths graduates advisors but also produced many graduates itself. This also illustrated that hub and authority is related to each other and can bring a positive circle.

4.3.5 1986–1995

| Year period | Highest Hub value | Highest Authority Value |
|-------------|-------------------|-------------------------|
| 1986-1995 | 1724.7 | 1724.7 |

Table 9: Highest hub and authority value during 1986–1995.

The continue decrease of the hub and authority value reflected the decrease of number of Ph.D.s and the decrease in popularity of schools.

| Rank | Hub | Auth |
|------|--|---------------------------------------|
| 1 | Stanford University | University of California, Berkeley |
| 2 | University of Illinois at Urbana-Champaign | Massachusetts Institute of Technology |
| 3 | Massachusetts Institute of Technology | Stanford University |
| 4 | University of California, Berkeley | Harvard University |
| 5 | Carnegie Mellon University | Princeton University |
| 6 | Georgia Institute of Technology | Cornell University |
| 7 | University of Texas at Austin | Yale University |
| 8 | University of Wisconsin-Madison | Carnegie Mellon University |
| 9 | University of Washington | University of Washington |
| 10 | Harvard University | University of Wisconsin-Madison |

Table 10: Top ten schools with highest hub and authority values in 1986–1995.

In this ten-year period, Stanford, which ranked 2nd in authority during 1976–1985, became number 1 in hub value. More Ph.D.s chose to continue their careers as a graduate advisor in Stanford, possibly due to the increasing reputation, given that in 1976-1985, there were many Stanford graduates obtained their Ph.D. degree. University of California, Berkeley still obtained the outstanding performance in authority value.

4.3.6 1996–2010

| Year period | Highest Hub value | Highest Authority Value |
|-------------|-------------------|-------------------------|
| 1996-2010 | 496.0663 | 496.0663 |

Table 11: Highest hub and authority value during 1996–2010.

Our final time period appear a bit longer than before. In this 15 years, the hub and authority value is 496.0663, sharply decreased compared with 784.3512 in the first decade.

| Rank | Hub | Auth |
|------|--|--|
| 1 | Georgia Institute of Technology | Massachusetts Institute of Technology |
| 2 | University of Michigan | Stanford University |
| 3 | Columbia University | University of California, Berkeley |
| 4 | University of California, Berkeley | Harvard University |
| 5 | Carnegie Mellon University | Carnegie Mellon University |
| 6 | University of Washington | University of Illinois at Urbana-Champaign |
| 7 | Massachusetts Institute of Technology | Cornell University |
| 8 | University of Illinois at Urbana-Champaign | Princeton University |
| 9 | University of Texas at Austin | University of Wisconsin-Madison |
| 10 | University of Pennsylvania | University of California, Los Angeles |

Table 12: Top ten schools with highest hub and authority values in 1996–2010.

The hub value ranking in the final 15-year period was quite different from the last decade. Universities like Georgia Institute of Technology (school 37), University of Texas at Austin (school 192), and University of Pennsylvania (school 181) jumped up into top 10. For authority values, MIT, Stanford, and University of California, Berkeley still were the top 3, however, Princeton dropped down to number 8.

5 Conclusions

I investigated the time-evolution of maths research groups. Degree function, clustering coefficients and hub and authority were used to analyse the connections between 231 US universities in a certain time period. Here we looked at degree distribution and clustering coefficient in 1946-2010, and also hub and authority in every 10-year period to see how they changed in time.

From this project, certain assortativity is observed such as higher rank schools tend to connect with itself or other higher rank schools. Hub values and authority values were seen positively correlated with each other. Working out hubs and authorities through time allow one to examine change in university productivity and popularity over time, here I am only given a small number of example to see the interesting change.

To give some details, from 1946 to 2010, Massachusetts Institute of Technology had 172 maths Ph.D.s who later stayed in MIT to be a graduate advisor, which has the highest number of all the schools. University of Illinois at Urbana-Champaign has largest in-degree (51), so there have been Mathematics Ph.D.s from 51 other universities who later went to University of Illinois at Urbana-Champaign to advise graduate students there. The greatest out-degree, 124, was at University of California, Berkeley. Mathematics Ph.D. students from University of California, Berkeley went to 123 other universities to continue their career as a graduate advisor.

Further work could be carried out to focus on certain schools, and see how they changed over time. More research can be done to find out the reason why some schools are very popular and productive and why some others are not.

6 Acknowledgement

It is a pleasure to thank those who made this dissertation possible, my supervisor Mason Porter whose encouragement, supervision and support enabled me to develop an understanding of the subject. Peter Mucha of University of North Carolina who provided me data. Mitch Keller at Mathematical Genealogy Project, who provided original data to Peter. And Sean Myers, I am using his code which is based off the definitions and algorithms for hub and authority scores found on the Stanford website in this project.

Lastly, I offer my regards and blessings to all of those who supported me in any respect during the completion of the project.

7 Appendix

| | School Names | Kin | Kout | S1 | Pin | S2 | Pout | Clustering Coefficient |
|----|---|-----|------|-----|----------|-----|-------------|------------------------|
| 1 | 'Adelphi University' | 9 | 6 | 226 | 0.978355 | 161 | 0.696969697 | 3.39E-03 |
| 2 | 'Air Force Institute of Technology' | 8 | 0 | 225 | 0.974026 | 160 | 0.692640693 | 0 |
| 3 | 'Arizona State University' | 32 | 7 | 224 | 0.969697 | 160 | 0.692640693 | 0.031647225 |
| 4 | 'Auburn University' | 23 | 14 | 223 | 0.965368 | 159 | 0.688311688 | 2.48E-03 |
| 5 | 'Baylor University' | 9 | 2 | 222 | 0.961039 | 158 | 0.683982684 | 4.32E-03 |
| 6 | 'Boston University Graduate School' | 25 | 7 | 221 | 0.95671 | 157 | 0.67965368 | 0.032884699 |
| 7 | 'Bowling Green State University' | 19 | 4 | 220 | 0.952381 | 156 | 0.675324675 | 0.033811206 |
| 8 | 'Brandeis University' | 15 | 27 | 219 | 0.948052 | 155 | 0.670995671 | 9.42E-03 |
| 9 | 'Brescia University' | 1 | 0 | 218 | 0.943723 | 154 | 0.666666667 | 0 |
| 10 | 'Brigham Young University' | 7 | 0 | 217 | 0.939394 | 154 | 0.666666667 | 0 |
| 11 | 'Brown University' | 27 | 92 | 216 | 0.935065 | 154 | 0.666666667 | 2.66E-02 |
| 12 | 'Bryn Mawr College' | 6 | 0 | 215 | 0.930736 | 153 | 0.662337662 | 0 |
| 13 | 'California Institute of Technology' | 22 | 77 | 214 | 0.926407 | 153 | 0.662337662 | 0.039404286 |
| 14 | 'Carnegie Mellon University' | 34 | 70 | 213 | 0.922078 | 152 | 0.658008658 | 1.60E-02 |
| 15 | 'Case Western Reserve University' | 29 | 19 | 212 | 0.917749 | 151 | 0.653679654 | 4.89E-03 |
| 16 | 'Central Michigan University' | 6 | 0 | 211 | 0.91342 | 150 | 0.649350649 | 0 |
| 17 | 'City University of New York' | 24 | 8 | 210 | 0.909091 | 150 | 0.649350649 | 0.02244751 |
| 18 | 'Claremont Graduate University' | 18 | 1 | 209 | 0.904762 | 149 | 0.645021645 | 0 |
| 19 | 'Clark University' | 5 | 1 | 208 | 0.900433 | 148 | 0.640692641 | 0 |
| 20 | 'Clarkson University' | 11 | 2 | 207 | 0.896104 | 147 | 0.636363636 | 0.087418553 |
| 21 | 'Clemson University' | 29 | 4 | 206 | 0.891775 | 146 | 0.632034632 | 0.060626474 |
| 22 | 'Colorado School of Mines' | 11 | 1 | 205 | 0.887446 | 145 | 0.627705628 | 0 |
| 23 | 'Colorado State University' | 28 | 19 | 204 | 0.883117 | 144 | 0.623376623 | 2.15E-03 |
| 24 | 'Columbia University' | 27 | 72 | 203 | 0.878788 | 143 | 0.619047619 | 2.54E-02 |
| 25 | 'Cornell University' | 38 | 100 | 202 | 0.874459 | 142 | 0.614718615 | 2.33E-02 |
| 26 | 'Dartmouth College' | 22 | 11 | 201 | 0.87013 | 141 | 0.61038961 | 0.011599738 |
| 27 | 'Drexel University' | 11 | 0 | 200 | 0.865801 | 140 | 0.606060606 | 0 |
| 28 | 'Duke University' | 27 | 35 | 199 | 0.861472 | 140 | 0.606060606 | 4.43E-03 |
| 29 | 'Emory University' | 23 | 11 | 198 | 0.857143 | 139 | 0.601731602 | 5.31E-03 |
| 30 | 'Florida Atlantic University' | 6 | 0 | 197 | 0.852814 | 138 | 0.597402597 | 0 |
| 31 | 'Florida Institute of Technology' | 7 | 2 | 196 | 0.848485 | 138 | 0.597402597 | 9.92E-03 |
| 32 | 'Florida International University' | 3 | 0 | 195 | 0.844156 | 137 | 0.593073593 | 0 |
| 33 | 'Florida State University, Helsingin Yliopisto' | 1 | 0 | 194 | 0.839827 | 137 | 0.593073593 | 0 |
| 34 | 'Fordham University' | 1 | 0 | 193 | 0.835498 | 137 | 0.593073593 | 0 |
| 35 | 'George Mason University' | 20 | 6 | 192 | 0.831169 | 137 | 0.593073593 | 1.08E-02 |
| 36 | 'Georgetown University' | 1 | 0 | 191 | 0.82684 | 136 | 0.588744589 | 0 |
| 37 | 'Georgia Institute of Technology' | 49 | 35 | 190 | 0.822511 | 136 | 0.588744589 | 4.29E-03 |
| 38 | 'Georgia State University' | 1 | 1 | 189 | 0.818182 | 135 | 0.584415584 | 0 |
| 39 | 'Harvard University' | 34 | 98 | 188 | 0.813853 | 134 | 0.58008658 | 0.041203633 |
| 40 | 'Howard University' | 10 | 0 | 187 | 0.809524 | 133 | 0.575757576 | 0 |
| 41 | 'Idaho State University' | 8 | 0 | 186 | 0.805195 | 133 | 0.575757576 | 0 |
| 42 | 'Illinois Institute of Technology' | 16 | 10 | 185 | 0.800866 | 133 | 0.575757576 | 3.19E-03 |
| 43 | 'Illinois State University' | 4 | 2 | 184 | 0.796537 | 132 | 0.571428571 | 6.12E-03 |
| 44 | 'Indiana University' | 35 | 56 | 183 | 0.792208 | 131 | 0.567099567 | 4.27E-03 |
| 45 | 'Iowa State University' | 40 | 52 | 182 | 0.787879 | 130 | 0.562770563 | 3.84E-03 |
| 46 | 'Kansas State University' | 29 | 10 | 181 | 0.78355 | 129 | 0.558441558 | 0.011259668 |
| 47 | 'Kent State University' | 18 | 6 | 180 | 0.779221 | 128 | 0.554112554 | 1.05E-02 |
| 48 | 'Lehigh University' | 26 | 11 | 179 | 0.774892 | 127 | 0.54978355 | 8.54E-03 |
| 49 | 'Louisiana Tech University' | 5 | 0 | 178 | 0.770563 | 126 | 0.545454545 | 0 |
| 50 | 'Loyola University of Chicago' | 1 | 0 | 177 | 0.766234 | 126 | 0.545454545 | 0 |
| 51 | 'Marquette University' | 4 | 0 | 176 | 0.761905 | 126 | 0.545454545 | 0 |
| 52 | 'Massachusetts Institute of Technology' | 33 | 114 | 0 | 0 | 126 | 0.545454545 | 0.052868077 |
| 53 | 'Medical College of Wisconsin' | 3 | 0 | 0 | 0 | 125 | 0.541125541 | 0 |
| 54 | 'Medical University of South Carolina' | 2 | 1 | 0 | 0 | 125 | 0.541125541 | 0 |
| 55 | 'Michigan State University' | 39 | 47 | 0 | 0 | 124 | 0.536796537 | 3.03E-03 |
| 56 | 'Michigan Technological University' | 5 | 0 | 0 | 0 | 123 | 0.532467532 | 0 |
| 57 | 'Mississippi State University' | 7 | 0 | 0 | 0 | 123 | 0.532467532 | 0 |
| 58 | 'Montana State University' | 23 | 5 | 0 | 0 | 123 | 0.532467532 | 0.021164838 |
| 59 | 'Mt. Sinai School of Medicine' | 0 | 0 | 0 | 0 | 122 | 0.528138528 | 0 |
| 60 | 'Naval Postgraduate School' | 10 | 2 | 0 | 0 | 122 | 0.528138528 | 0.064319944 |
| 61 | 'New Jersey Institute of Technology' | 15 | 3 | 0 | 0 | 121 | 0.523809524 | 0.045685819 |
| 62 | 'New Mexico School of Mining and Technology' | 6 | 0 | 0 | 0 | 120 | 0.519480519 | 0 |
| 63 | 'New Mexico State University' | 28 | 16 | 0 | 0 | 120 | 0.519480519 | 4.77E-03 |
| 64 | 'New York University' | 32 | 92 | 0 | 0 | 119 | 0.515151515 | 2.08E-02 |
| 65 | 'North Carolina State University' | 48 | 29 | 0 | 0 | 118 | 0.510822511 | 3.97E-03 |
| 66 | 'North Dakota State University' | 7 | 0 | 0 | 0 | 117 | 0.506493506 | 0 |
| 67 | 'Northeastern University' | 19 | 2 | 0 | 0 | 117 | 0.506493506 | 0.275541052 |
| 68 | 'Northern Illinois University' | 18 | 1 | 0 | 0 | 116 | 0.502164502 | 0 |
| 69 | 'Northwestern University' | 33 | 55 | 0 | 0 | 115 | 0.497835498 | 5.10E-03 |
| 70 | 'Oakland University' | 8 | 0 | 0 | 0 | 114 | 0.493506494 | 0 |
| 71 | 'Ohio University' | 11 | 1 | 0 | 0 | 114 | 0.493506494 | 0 |
| 72 | 'Oklahoma State University' | 26 | 11 | 0 | 0 | 114 | 0.493506494 | 5.78E-03 |
| 73 | 'Old Dominion University' | 10 | 5 | 0 | 0 | 113 | 0.489177489 | 3.68E-03 |
| 74 | 'Oregon Graduate Institute of Science & Technology' | 3 | 0 | 0 | 0 | 112 | 0.484848485 | 0 |
| 75 | 'Oregon State University' | 28 | 12 | 0 | 0 | 112 | 0.484848485 | 1.03E-02 |
| 76 | 'Polytechnic University' | 13 | 14 | 0 | 0 | 111 | 0.480519481 | 3.08E-03 |
| 77 | 'Portland State University' | 7 | 0 | 0 | 0 | 110 | 0.476190476 | 0 |
| 78 | 'Princeton University' | 32 | 102 | 0 | 0 | 110 | 0.476190476 | 0.048850297 |
| 79 | 'Purdue University' | 49 | 94 | 0 | 0 | 109 | 0.471861472 | 6.33E-03 |
| 80 | 'Rensselaer Polytechnic Institute' | 31 | 19 | 0 | 0 | 108 | 0.467532468 | 5.38E-03 |
| 81 | 'Rice University' | 31 | 49 | 0 | 0 | 107 | 0.463203463 | 6.46E-03 |
| 82 | 'The Rockefeller University' | 4 | 12 | 0 | 0 | 106 | 0.458874459 | 0.03643904 |
| 83 | 'Rush University' | 1 | 0 | 0 | 0 | 105 | 0.454545455 | 0 |
| 84 | 'Rutgers University, New Brunswick' | 36 | 48 | 0 | 0 | 105 | 0.454545455 | 3.32E-03 |
| 85 | 'Rutgers University, Newark' | 8 | 0 | 0 | 0 | 104 | 0.45021645 | 0 |
| 86 | 'Southern Connecticut State University' | 1 | 0 | 0 | 0 | 104 | 0.45021645 | 0 |

| | | | | | | | | |
|-----|---|----|-----|---|---|-----|-------------|-------------|
| 87 | 'Southern Illinois University at Carbondale' | 18 | 2 | 0 | 0 | 104 | 0.45021645 | 0.167409295 |
| 88 | 'Southern Methodist University' | 15 | 9 | 0 | 0 | 103 | 0.445887446 | 4.18E-03 |
| 89 | 'St. Louis University' | 11 | 4 | 0 | 0 | 102 | 0.441558442 | 6.42E-03 |
| 90 | 'Stanford University' | 34 | 102 | 0 | 0 | 101 | 0.437229437 | 0.047617573 |
| 91 | 'State University of New York at Albany' | 19 | 1 | 0 | 0 | 100 | 0.432900433 | 0 |
| 92 | 'State University of New York at Binghamton' | 18 | 11 | 0 | 0 | 99 | 0.428571429 | 3.81E-03 |
| 93 | 'State University of New York at Buffalo' | 36 | 13 | 0 | 0 | 98 | 0.424242424 | 0.011438807 |
| 94 | 'State University of New York at Stony Brook' | 28 | 47 | 0 | 0 | 97 | 0.41991342 | 4.58E-03 |
| 95 | 'Stevens Institute of Technology' | 15 | 3 | 0 | 0 | 96 | 0.415584416 | 0.050532077 |
| 96 | 'Syracuse University' | 33 | 25 | 0 | 0 | 95 | 0.411255411 | 4.42E-03 |
| 97 | 'Temple University' | 20 | 4 | 0 | 0 | 94 | 0.406926407 | 0.048888 |
| 98 | 'Texas A&M University' | 46 | 25 | 0 | 0 | 93 | 0.402597403 | 4.73E-03 |
| 99 | 'Texas A&M University - Kingsville' | 1 | 1 | 0 | 0 | 92 | 0.398268398 | 0 |
| 100 | 'Texas Christian University' | 7 | 3 | 0 | 0 | 92 | 0.398268398 | 2.40E-03 |
| 101 | 'Texas Southern University' | 1 | 0 | 0 | 0 | 91 | 0.393939394 | 0 |
| 102 | 'Texas Tech University' | 24 | 5 | 0 | 0 | 91 | 0.393939394 | 0.02288915 |
| 103 | 'The American University' | 11 | 2 | 0 | 0 | 90 | 0.38961039 | 0.031387925 |
| 104 | 'The Catholic University of America' | 5 | 1 | 0 | 0 | 89 | 0.385281385 | 0 |
| 105 | 'The College of William and Mary' | 15 | 2 | 0 | 0 | 88 | 0.380952381 | 0.107028843 |
| 106 | 'The Florida State University' | 37 | 41 | 0 | 0 | 87 | 0.37623377 | 2.08E-03 |
| 107 | 'The George Washington University' | 25 | 16 | 0 | 0 | 86 | 0.372294372 | 3.37E-03 |
| 108 | 'The Johns Hopkins University' | 37 | 51 | 0 | 0 | 85 | 0.367965368 | 6.09E-03 |
| 109 | 'The Louisiana State University' | 33 | 30 | 0 | 0 | 84 | 0.363636364 | 2.88E-03 |
| 110 | 'The Ohio State University' | 40 | 57 | 0 | 0 | 83 | 0.359307359 | 3.19E-03 |
| 111 | 'The Pennsylvania State University' | 42 | 52 | 0 | 0 | 82 | 0.354978355 | 3.23E-03 |
| 112 | 'The Union Institute' | 1 | 0 | 0 | 0 | 81 | 0.350649351 | 0 |
| 113 | 'The University of Chicago' | 26 | 101 | 0 | 0 | 81 | 0.350649351 | 0.052994909 |
| 114 | 'The University of Connecticut' | 24 | 13 | 0 | 0 | 80 | 0.346320346 | 7.94E-03 |
| 115 | 'The University of Memphis' | 16 | 3 | 0 | 0 | 79 | 0.341991342 | 0.036384063 |
| 116 | 'The University of North Carolina at Chapel Hill' | 37 | 66 | 0 | 0 | 78 | 0.337662338 | 6.30E-03 |
| 117 | 'The University of North Dakota' | 1 | 1 | 0 | 0 | 77 | 0.333333333 | 0 |
| 118 | 'The University of Oklahoma' | 24 | 9 | 0 | 0 | 77 | 0.333333333 | 9.73E-03 |
| 119 | 'The University of Rochester' | 21 | 35 | 0 | 0 | 76 | 0.329004329 | 4.61E-03 |
| 120 | 'The University of Texas at Dallas' | 19 | 8 | 0 | 0 | 75 | 0.324675325 | 6.54E-03 |
| 121 | 'Tufts University' | 13 | 1 | 0 | 0 | 74 | 0.32034632 | 0 |
| 122 | 'Tulane University' | 26 | 32 | 0 | 0 | 74 | 0.32034632 | 2.91E-03 |
| 123 | 'Union College' | 2 | 2 | 0 | 0 | 73 | 0.316017316 | 0 |
| 124 | 'University of Akron' | 3 | 0 | 0 | 0 | 72 | 0.311688312 | 0 |
| 125 | 'University of Alabama in Huntsville' | 8 | 1 | 0 | 0 | 0 | 0 | 0 |
| 126 | 'University of Alabama-Birmingham' | 12 | 1 | 0 | 0 | 0 | 0 | 0 |
| 127 | 'University of Alabama-Tuscaloosa' | 28 | 6 | 0 | 0 | 0 | 0 | 0.019776487 |
| 128 | 'University of Alaska, Fairbanks' | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 129 | 'University of Arizona' | 38 | 29 | 0 | 0 | 0 | 0 | 3.64E-03 |
| 130 | 'University of Arkansas' | 16 | 1 | 0 | 0 | 0 | 0 | 0 |
| 131 | 'University of California, Berkeley' | 33 | 125 | 0 | 0 | 0 | 0 | 0.059397205 |
| 132 | 'University of California, Davis' | 27 | 25 | 0 | 0 | 0 | 0 | 3.03E-03 |
| 133 | 'University of California, Irvine' | 26 | 9 | 0 | 0 | 0 | 0 | 0.021578201 |
| 134 | 'University of California, Los Angeles' | 30 | 93 | 0 | 0 | 0 | 0 | 2.33E-02 |
| 135 | 'University of California, Riverside' | 23 | 12 | 0 | 0 | 0 | 0 | 7.51E-03 |
| 136 | 'University of California, San Diego' | 34 | 47 | 0 | 0 | 0 | 0 | 5.30E-03 |
| 137 | 'University of California, San Francisco' | 3 | 1 | 0 | 0 | 0 | 0 | 0 |
| 138 | 'University of California, Santa Barbara' | 27 | 20 | 0 | 0 | 0 | 0 | 6.09E-03 |
| 139 | 'University of California, Santa Cruz' | 15 | 8 | 0 | 0 | 0 | 0 | 0.012695792 |
| 140 | 'University of Central Florida' | 10 | 3 | 0 | 0 | 0 | 0 | 5.71E-03 |
| 141 | 'University of Cincinnati' | 21 | 12 | 0 | 0 | 0 | 0 | 5.41E-03 |
| 142 | 'University of Colorado Health Sciences Center' | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 143 | 'University of Colorado at Boulder' | 37 | 37 | 0 | 0 | 0 | 0 | 3.26E-03 |
| 144 | 'University of Colorado at Denver' | 19 | 5 | 0 | 0 | 0 | 0 | 0.019013528 |
| 145 | 'University of Delaware' | 20 | 9 | 0 | 0 | 0 | 0 | 8.85E-03 |
| 146 | 'University of Denver' | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| 147 | 'University of Florida' | 46 | 30 | 0 | 0 | 0 | 0 | 3.82E-03 |
| 148 | 'University of Georgia' | 35 | 24 | 0 | 0 | 0 | 0 | 3.91E-03 |
| 149 | 'University of Hawaii' | 14 | 3 | 0 | 0 | 0 | 0 | 0.05297926 |
| 150 | 'University of Houston' | 26 | 7 | 0 | 0 | 0 | 0 | 0.021636357 |
| 151 | 'University of Idaho' | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 152 | 'University of Illinois at Chicago' | 23 | 18 | 0 | 0 | 0 | 0 | 5.29E-03 |
| 153 | 'University of Illinois at Urbana-Champaign' | 52 | 108 | 0 | 0 | 0 | 0 | 9.06E-03 |
| 154 | 'University of Iowa' | 42 | 35 | 0 | 0 | 0 | 0 | 2.92E-03 |
| 155 | 'University of Kansas' | 26 | 31 | 0 | 0 | 0 | 0 | 2.87E-03 |
| 156 | 'University of Kentucky' | 37 | 13 | 0 | 0 | 0 | 0 | 0.012858588 |
| 157 | 'University of Louisiana at Lafayette' | 22 | 4 | 0 | 0 | 0 | 0 | 0.015754476 |
| 158 | 'University of Louisville' | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| 159 | 'University of Maine' | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 160 | 'University of Maryland Baltimore County' | 19 | 5 | 0 | 0 | 0 | 0 | 0.030227733 |
| 161 | 'University of Maryland College Park' | 45 | 76 | 0 | 0 | 0 | 0 | 5.68E-03 |
| 162 | 'University of Massachusetts Amherst' | 32 | 31 | 0 | 0 | 0 | 0 | 3.40E-03 |
| 163 | 'University of Massachusetts Lowell' | 7 | 1 | 0 | 0 | 0 | 0 | 0 |
| 164 | 'University of Miami' | 22 | 6 | 0 | 0 | 0 | 0 | 0.021586459 |
| 165 | 'University of Michigan' | 47 | 107 | 0 | 0 | 0 | 0 | 1.39E-02 |
| 166 | 'University of Minnesota-Minneapolis' | 42 | 79 | 0 | 0 | 0 | 0 | 9.16E-03 |
| 167 | 'University of Mississippi' | 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| 168 | 'University of Missouri - Columbia' | 30 | 24 | 0 | 0 | 0 | 0 | 2.21E-03 |
| 169 | 'University of Missouri - Kansas City' | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 170 | 'Missouri University of Science and Technology' | 16 | 3 | 0 | 0 | 0 | 0 | 0.013419619 |
| 171 | 'University of Montana' | 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 172 | 'University of Nebraska-Lincoln' | 34 | 25 | 0 | 0 | 0 | 0 | 2.81E-03 |
| 173 | 'University of Nevada, Reno' | 2 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|-----|---|----|-----|---|---|---|---|-------------|
| 174 | 'University of New Hampshire' | 17 | 0 | 0 | 0 | 0 | 0 | 0 |
| 175 | 'University of New Mexico' | 27 | 11 | 0 | 0 | 0 | 0 | 1.06E-02 |
| 176 | 'University of North Carolina at Charlotte' | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| 177 | 'University of North Texas' | 15 | 2 | 0 | 0 | 0 | 0 | 0.081579405 |
| 178 | 'University of Northern Colorado' | 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| 179 | 'University of Notre Dame' | 26 | 21 | 0 | 0 | 0 | 0 | 3.83E-03 |
| 180 | 'University of Oregon' | 22 | 30 | 0 | 0 | 0 | 0 | 3.78E-03 |
| 181 | 'University of Pennsylvania' | 30 | 60 | 0 | 0 | 0 | 0 | 8.03E-03 |
| 182 | 'University of Pittsburgh' | 39 | 30 | 0 | 0 | 0 | 0 | 3.58E-03 |
| 183 | 'University of Puerto Rico at Mayaguez' | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| 184 | 'University of Rhode Island' | 9 | 5 | 0 | 0 | 0 | 0 | 4.72E-03 |
| 185 | 'University of South Carolina' | 30 | 4 | 0 | 0 | 0 | 0 | 0.069857237 |
| 186 | 'University of South Dakota' | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 187 | 'University of South Florida' | 24 | 8 | 0 | 0 | 0 | 0 | 5.89E-03 |
| 188 | 'University of Southern California' | 29 | 35 | 0 | 0 | 0 | 0 | 4.74E-03 |
| 189 | 'University of Southern Mississippi' | 4 | 1 | 0 | 0 | 0 | 0 | 0 |
| 190 | 'University of Tennessee - Knoxville' | 31 | 28 | 0 | 0 | 0 | 0 | 2.06E-03 |
| 191 | 'University of Texas at Arlington' | 17 | 3 | 0 | 0 | 0 | 0 | 0.029246886 |
| 192 | 'University of Texas at Austin' | 47 | 79 | 0 | 0 | 0 | 0 | 5.52E-03 |
| 193 | 'University of Texas at El Paso' | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| 194 | 'University of Texas at Houston' | 3 | 3 | 0 | 0 | 0 | 0 | 2.33E-04 |
| 195 | 'University of Texas at San Antonio' | 3 | 1 | 0 | 0 | 0 | 0 | 0 |
| 196 | 'University of Toledo' | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| 197 | 'University of Tulsa' | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 198 | 'University of Utah' | 31 | 43 | 0 | 0 | 0 | 0 | 4.30E-03 |
| 199 | 'University of Vermont' | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| 200 | 'University of Virginia' | 30 | 33 | 0 | 0 | 0 | 0 | 3.22E-03 |
| 201 | 'University of Washington' | 38 | 72 | 0 | 0 | 0 | 0 | 9.84E-03 |
| 202 | 'University of Wisconsin-Madison' | 42 | 117 | 0 | 0 | 0 | 0 | 1.82E-02 |
| 203 | 'University of Wisconsin-Milwaukee' | 27 | 6 | 0 | 0 | 0 | 0 | 0.019458102 |
| 204 | 'University of Wyoming' | 14 | 9 | 0 | 0 | 0 | 0 | 3.64E-03 |
| 205 | 'University of the Incarnate Word' | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 206 | 'Utah State University' | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 207 | 'Vanderbilt University' | 33 | 13 | 0 | 0 | 0 | 0 | 8.36E-03 |
| 208 | 'Virginia Commonwealth University' | 8 | 1 | 0 | 0 | 0 | 0 | 0 |
| 209 | 'Virginia Polytechnic Institute and State University' | 45 | 22 | 0 | 0 | 0 | 0 | 5.50E-03 |
| 210 | 'Washington State University' | 26 | 10 | 0 | 0 | 0 | 0 | 7.08E-03 |
| 211 | 'Washington University' | 19 | 24 | 0 | 0 | 0 | 0 | 4.45E-03 |
| 212 | 'Wayne State University' | 29 | 22 | 0 | 0 | 0 | 0 | 2.48E-03 |
| 213 | 'Wesleyan University' | 14 | 7 | 0 | 0 | 0 | 0 | 8.93E-03 |
| 214 | 'West Virginia University' | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| 215 | 'Western Michigan University' | 17 | 4 | 0 | 0 | 0 | 0 | 0.020562098 |
| 216 | 'Wichita State University' | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| 217 | 'Worcester Polytechnic Institute' | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| 218 | 'Yale University' | 27 | 79 | 0 | 0 | 0 | 0 | 3.29E-02 |
| 219 | 'Yeshiva University' | 11 | 8 | 0 | 0 | 0 | 0 | 7.11E-03 |
| 220 | 'Oregon Health & Science University' | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 221 | 'University of Missouri - St. Louis' | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 222 | 'Wright State University' | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 223 | 'Claremont Graduate University' | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 224 | 'Uniformed Services University' | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 225 | 'University of Dayton' | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 226 | 'Polytechnic Institute of New York' | 4 | 2 | 0 | 0 | 0 | 0 | 0.015777226 |
| 227 | 'Nova Southeastern University' | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 228 | 'University of Nevada, Las Vegas' | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 229 | 'Memphis State University' | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 230 | 'DePaul University' | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 231 | 'Case Institute of Technology' | 2 | 1 | 0 | 0 | 0 | 0 | 0 |

School ranking for Hub and Authority in 1946-1955

| | Hub | Authority |
|----|--|---|
| 1 | 'Massachusetts Institute of Technology' | 'Princeton University' |
| 2 | 'Stanford University' | 'The University of Chicago' |
| 3 | 'University of California, Berkeley' | 'Harvard University' |
| 4 | 'New York University' | 'Columbia University' |
| 5 | 'University of Pennsylvania' | 'Massachusetts Institute of Technology' |
| 6 | 'The University of Chicago' | 'California Institute of Technology' |
| 7 | 'Brown University' | 'University of California, Berkeley' |
| 8 | 'Princeton University' | 'Brown University' |
| 9 | 'Columbia University' | 'University of Michigan' |
| 10 | 'University of Michigan' | 'University of Wisconsin-Madison' |
| 11 | 'Yale University' | 'Cornell University' |
| 12 | 'Harvard University' | 'Stanford University' |
| 13 | 'University of Illinois at Urbana-Champaign' | 'University of California, Los Angeles' |
| 14 | 'Purdue University' | 'New York University' |
| 15 | 'University of California, Los Angeles' | 'University of Minnesota-Minneapolis' |
| 16 | 'University of Southern California' | 'The University of North Carolina at Chapel Hill' |
| 17 | 'Cornell University' | 'Iowa State University' |
| 18 | 'Indiana University' | 'University of Texas at Austin' |
| 19 | 'California Institute of Technology' | 'University of Illinois at Urbana-Champaign' |
| 20 | 'University of Texas at Austin' | 'Yale University' |
| 21 | 'City University of New York' | 'University of Pennsylvania' |
| 22 | 'University of Minnesota-Minneapolis' | 'Carnegie Mellon University' |
| 23 | 'University of Wisconsin-Madison' | 'The Ohio State University' |
| 24 | 'Rutgers University, New Brunswick' | 'Indiana University' |
| 25 | 'Washington University' | 'Duke University' |
| 26 | 'Dartmouth College' | 'Purdue University' |
| 27 | 'University of Washington' | 'Syracuse University' |
| 28 | 'Brandeis University' | 'University of Iowa' |
| 29 | 'University of Pittsburgh' | 'Tulane University' |
| 30 | 'The Louisiana State University' | 'Rice University' |
| 31 | 'Syracuse University' | 'The University of Rochester' |
| 32 | 'Claremont Graduate University' | 'North Carolina State University' |
| 33 | 'Northwestern University' | 'The Johns Hopkins University' |
| 34 | 'Yeshiva University' | 'University of Virginia' |
| 35 | 'University of Oregon' | 'University of Oregon' |
| 36 | 'Michigan State University' | 'Polytechnic University' |
| 37 | 'University of Virginia' | 'University of Southern California' |
| 38 | 'The Johns Hopkins University' | 'University of Missouri - Columbia' |
| 39 | 'Case Western Reserve University' | 'The University of Oklahoma' |
| 40 | 'State University of New York at Buffalo' | 'University of Notre Dame' |
| 41 | 'University of Iowa' | 'Michigan State University' |
| 42 | 'Boston University Graduate School' | 'University of Tennessee - Knoxville' |
| 43 | 'University of California, San Diego' | 'University of Georgia' |
| 44 | 'University of California, Santa Barbara' | 'Washington University' |
| 45 | 'Carnegie Mellon University' | 'University of Washington' |
| 46 | 'University of Arizona' | 'University of Kansas' |
| 47 | 'Illinois Institute of Technology' | 'University of Florida' |
| 48 | 'The Rockefeller University' | 'Northwestern University' |
| 49 | 'Polytechnic University' | 'University of Colorado at Boulder' |
| 50 | 'University of Colorado at Boulder' | 'Washington State University' |
| 51 | 'New Mexico State University' | 'Lehigh University' |
| 52 | 'Washington State University' | 'University of Cincinnati' |
| 53 | 'Tulane University' | 'Wesleyan University' |

| | | |
|-----|---|---|
| 54 | 'Oregon State University' | 'Temple University' |
| 55 | 'University of Utah' | 'University of Wisconsin-Milwaukee' |
| 56 | 'University of Notre Dame' | 'Case Western Reserve University' |
| 57 | 'The Florida State University' | 'The Louisiana State University' |
| 58 | 'State University of New York at Stony Brook' | 'Vanderbilt University' |
| 59 | 'University of New Mexico' | 'University of Pittsburgh' |
| 60 | 'University of California, Santa Cruz' | 'Stevens Institute of Technology' |
| 61 | 'University of Kansas' | 'University of Kentucky' |
| 62 | 'Arizona State University' | 'Emory University' |
| 63 | 'Rice University' | 'Arizona State University' |
| 64 | 'University of California, Davis' | 'Rutgers University, Newark' |
| 65 | 'Stevens Institute of Technology' | 'University of California, Santa Cruz' |
| 66 | 'The University of North Carolina at Chapel Hill' | 'Kansas State University' |
| 67 | 'Rensselaer Polytechnic Institute' | 'University of Nebraska-Lincoln' |
| 68 | 'University of California, Riverside' | 'St. Louis University' |
| 69 | 'Wayne State University' | 'University of Alabama-Tuscaloosa' |
| 70 | 'Temple University' | 'University of New Mexico' |
| 71 | 'University of Florida' | 'Texas A&M University' |
| 72 | 'University of Maryland College Park' | 'City University of New York' |
| 73 | 'The University of Connecticut' | 'Oklahoma State University' |
| 74 | 'The University of Rochester' | 'Claremont Graduate University' |
| 75 | 'Duke University' | 'The Pennsylvania State University' |
| 76 | 'The Ohio State University' | 'University of Hawaii' |
| 77 | 'The Catholic University of America' | 'Georgia Institute of Technology' |
| 78 | 'The University of Oklahoma' | 'The University of Connecticut' |
| 79 | 'Texas A&M University' | 'Clarkson University' |
| 80 | 'Northeastern University' | 'Yeshiva University' |
| 81 | 'University of Illinois at Chicago' | 'Texas Tech University' |
| 82 | 'Tufts University' | 'University of Massachusetts Amherst' |
| 83 | 'Auburn University' | 'University of California, Riverside' |
| 84 | 'Kent State University' | 'University of Illinois at Chicago' |
| 85 | 'University of Kentucky' | 'University of California, San Diego' |
| 86 | 'University of Alabama-Tuscaloosa' | 'State University of New York at Binghamton' |
| 87 | 'The George Washington University' | 'Ohio University' |
| 88 | 'Georgia Institute of Technology' | 'University of Missouri - Kansas City' |
| 89 | 'University of Georgia' | 'University of Houston' |
| 90 | 'Iowa State University' | 'Virginia Polytechnic Institute and State University' |
| 91 | 'Vanderbilt University' | 'New Mexico State University' |
| 92 | 'Adelphi University' | 'Kent State University' |
| 93 | 'University of Arkansas' | 'Tufts University' |
| 94 | 'Montana State University' | 'State University of New York at Stony Brook' |
| 95 | 'University of New Hampshire' | 'University of Colorado at Denver' |
| 96 | 'The Pennsylvania State University' | 'Rensselaer Polytechnic Institute' |
| 97 | 'North Carolina State University' | 'The Rockefeller University' |
| 98 | 'University of Nebraska-Lincoln' | 'University of California, Irvine' |
| 99 | 'University of Tennessee - Knoxville' | 'Illinois Institute of Technology' |
| 100 | 'University of Hawaii' | 'University of Montana' |
| 101 | 'University of California, Irvine' | 'Southern Illinois University at Carbondale' |
| 102 | 'University of Cincinnati' | 'State University of New York at Buffalo' |
| 103 | 'Lehigh University' | 'Dartmouth College' |
| 104 | 'Western Michigan University' | 'University of Idaho' |
| 105 | 'University of Colorado at Denver' | 'University of Utah' |
| 106 | 'University of Missouri - Columbia' | 'University of Arkansas' |
| 107 | 'Clarkson University' | 'Wayne State University' |
| 108 | 'University of Montana' | 'Missouri University of Science and Technology' |

| | | |
|-----|---|---|
| 109 | 'University of Idaho' | 'University of California, Santa Barbara' |
| 110 | 'University of Wisconsin-Milwaukee' | 'The Catholic University of America' |
| 111 | 'Ohio University' | 'Oregon State University' |
| 112 | 'University of Houston' | 'University of New Hampshire' |
| 113 | 'Virginia Polytechnic Institute and State University' | 'Colorado State University' |
| 114 | 'Rutgers University, Newark' | 'University of Maryland College Park' |
| 115 | 'Colorado State University' | 'University of Arizona' |
| 116 | 'Texas Tech University' | 'Boston University Graduate School' |
| 117 | 'State University of New York at Binghamton' | 'Montana State University' |
| 118 | 'Oklahoma State University' | 'University of Miami' |
| 119 | 'Southern Illinois University at Carbondale' | 'Northeastern University' |
| 120 | 'University of Missouri - Kansas City' | 'Auburn University' |
| 121 | 'Missouri University of Science and Technology' | 'University of California, Davis' |
| 122 | 'Wesleyan University' | 'Brandeis University' |
| 123 | 'Kansas State University' | 'Southern Methodist University' |
| 124 | 'Emory University' | 'The George Washington University' |
| 125 | 'University of Miami' | 'University of California, San Francisco' |
| 126 | 'University of Massachusetts Amherst' | 'Rutgers University, New Brunswick' |
| 127 | 'St. Louis University' | 'Adelphi University' |
| 128 | 'Southern Methodist University' | 'Western Michigan University' |
| 129 | 'University of California, San Francisco' | 'The Florida State University' |

School ranking for Hub and Authority in 1956-1965

| | Hub | Authority |
|----|---|---|
| 1 | 'University of California, Berkeley' | 'Princeton University' |
| 2 | 'University of Wisconsin-Madison' | 'Harvard University' |
| 3 | 'Cornell University' | 'Massachusetts Institute of Technology' |
| 4 | 'University of Minnesota-Minneapolis' | 'University of California, Berkeley' |
| 5 | 'Stanford University' | 'The University of Chicago' |
| 6 | 'University of California, Los Angeles' | 'Stanford University' |
| 7 | 'Massachusetts Institute of Technology' | 'University of Michigan' |
| 8 | 'Brown University' | 'Columbia University' |
| 9 | 'University of Illinois at Urbana-Champaign' | 'New York University' |
| 10 | 'Purdue University' | 'California Institute of Technology' |
| 11 | 'Harvard University' | 'University of Illinois at Urbana-Champaign' |
| 12 | 'University of Maryland College Park' | 'Yale University' |
| 13 | 'University of Washington' | 'University of Wisconsin-Madison' |
| 14 | 'The University of Chicago' | 'University of California, Los Angeles' |
| 15 | 'Rutgers University, New Brunswick' | 'Cornell University' |
| 16 | 'University of Michigan' | 'Carnegie Mellon University' |
| 17 | 'City University of New York' | 'University of Minnesota-Minneapolis' |
| 18 | 'University of Pennsylvania' | 'Brown University' |
| 19 | 'State University of New York at Stony Brook' | 'Purdue University' |
| 20 | 'Yale University' | 'The Johns Hopkins University' |
| 21 | 'Brandeis University' | 'Syracuse University' |
| 22 | 'Princeton University' | 'University of Washington' |
| 23 | 'University of California, San Diego' | 'The University of North Carolina at Chapel Hill' |
| 24 | 'Carnegie Mellon University' | 'University of Texas at Austin' |
| 25 | 'The University of Rochester' | 'University of Pennsylvania' |
| 26 | 'University of Illinois at Chicago' | 'Tulane University' |
| 27 | 'Rice University' | 'The Louisiana State University' |
| 28 | 'California Institute of Technology' | 'Northwestern University' |
| 29 | 'Northwestern University' | 'University of Oregon' |
| 30 | 'University of Texas at Austin' | 'University of Maryland College Park' |
| 31 | 'Washington University' | 'Indiana University' |
| 32 | 'Michigan State University' | 'Michigan State University' |
| 33 | 'Columbia University' | 'Rice University' |
| 34 | 'University of Colorado at Boulder' | 'University of Kansas' |
| 35 | 'University of Arizona' | 'The Pennsylvania State University' |
| 36 | 'New Mexico State University' | 'University of Virginia' |
| 37 | 'The Pennsylvania State University' | 'The Ohio State University' |
| 38 | 'New York University' | 'Duke University' |
| 39 | 'University of California, Santa Barbara' | 'Case Western Reserve University' |
| 40 | 'University of Massachusetts Amherst' | 'New Mexico State University' |
| 41 | 'Yeshiva University' | 'University of Cincinnati' |
| 42 | 'University of Virginia' | 'University of Iowa' |
| 43 | 'University of Southern California' | 'Polytechnic University' |
| 44 | 'The University of North Carolina at Chapel Hill' | 'Yeshiva University' |
| 45 | 'University of Notre Dame' | 'University of Pittsburgh' |
| 46 | 'University of New Mexico' | 'University of Georgia' |
| 47 | 'Syracuse University' | 'Illinois Institute of Technology' |
| 48 | 'University of Oregon' | 'Oregon State University' |
| 49 | 'University of Florida' | 'Iowa State University' |
| 50 | 'University of California, Santa Cruz' | 'Wayne State University' |
| 51 | 'Indiana University' | 'University of Notre Dame' |
| 52 | 'University of Utah' | 'University of Tennessee - Knoxville' |

| | | |
|-----|---|---|
| 53 | 'The Johns Hopkins University' | 'Brandeis University' |
| 54 | 'Arizona State University' | 'University of Southern California' |
| 55 | 'University of California, Irvine' | 'University of Utah' |
| 56 | 'University of Pittsburgh' | 'Washington University' |
| 57 | 'Duke University' | 'The University of Rochester' |
| 58 | 'University of California, Davis' | 'Rutgers University, New Brunswick' |
| 59 | 'Case Western Reserve University' | 'University of Colorado at Boulder' |
| 60 | 'Polytechnic University' | 'University of Missouri - Columbia' |
| 61 | 'State University of New York at Buffalo' | 'North Carolina State University' |
| 62 | 'University of California, Riverside' | 'University of Delaware' |
| 63 | 'Dartmouth College' | 'Lehigh University' |
| 64 | 'University of Kentucky' | 'Washington State University' |
| 65 | 'Iowa State University' | 'Rensselaer Polytechnic Institute' |
| 66 | 'Tulane University' | 'Oklahoma State University' |
| 67 | 'Lehigh University' | 'University of California, Davis' |
| 68 | 'The University of Connecticut' | 'University of Kentucky' |
| 69 | 'The Ohio State University' | 'Auburn University' |
| 70 | 'Adelphi University' | 'University of Nebraska-Lincoln' |
| 71 | 'University of Nebraska-Lincoln' | 'Boston University Graduate School' |
| 72 | 'University of Delaware' | 'The Florida State University' |
| 73 | 'Polytechnic Institute of New York' | 'The George Washington University' |
| 74 | 'University of Maryland Baltimore County' | 'University of California, Santa Barbara' |
| 75 | 'Wayne State University' | 'University of New Mexico' |
| 76 | 'University of Kansas' | 'University of Arizona' |
| 77 | 'University of Missouri - Columbia' | 'St. Louis University' |
| 78 | 'Washington State University' | 'The University of Oklahoma' |
| 79 | 'Georgia Institute of Technology' | 'Vanderbilt University' |
| 80 | 'University of New Hampshire' | 'Wesleyan University' |
| 81 | 'The Florida State University' | 'State University of New York at Buffalo' |
| 82 | 'Oregon State University' | 'Adelphi University' |
| 83 | 'Rensselaer Polytechnic Institute' | 'The University of Connecticut' |
| 84 | 'Vanderbilt University' | 'University of Florida' |
| 85 | 'University of Houston' | 'Georgia Institute of Technology' |
| 86 | 'University of Iowa' | 'Colorado State University' |
| 87 | 'Colorado State University' | 'University of California, Riverside' |
| 88 | 'Temple University' | 'Virginia Polytechnic Institute and State University' |
| 89 | 'University of Miami' | 'University of North Texas' |
| 90 | 'State University of New York at Albany' | 'Old Dominion University' |
| 91 | 'University of Toledo' | 'University of Massachusetts Lowell' |
| 92 | 'Virginia Polytechnic Institute and State University' | 'University of Colorado at Denver' |
| 93 | 'Western Michigan University' | 'Dartmouth College' |
| 94 | 'University of Tennessee - Knoxville' | 'Howard University' |
| 95 | 'Boston University Graduate School' | 'Kent State University' |
| 96 | 'Illinois Institute of Technology' | 'Clemson University' |
| 97 | 'Northern Illinois University' | 'Bowling Green State University' |
| 98 | 'The Louisiana State University' | 'Clarkson University' |
| 99 | 'Southern Illinois University at Carbondale' | 'University of Denver' |
| 100 | 'North Carolina State University' | 'Colorado School of Mines' |
| 101 | 'University of Georgia' | 'University of Alabama in Huntsville' |
| 102 | 'Tufts University' | 'Western Michigan University' |
| 103 | 'University of Texas at Houston' | 'University of the Incarnate Word' |
| 104 | 'Stevens Institute of Technology' | 'Missouri University of Science and Technology' |
| 105 | 'University of Missouri - Kansas City' | 'University of Alabama-Tuscaloosa' |
| 106 | 'St. Louis University' | 'University of Massachusetts Amherst' |

| | | |
|-----|---|---|
| 107 | 'Howard University' | 'Rutgers University, Newark' |
| 108 | 'University of Wyoming' | 'Arizona State University' |
| 109 | 'Wesleyan University' | 'Southern Methodist University' |
| 110 | 'Clark University' | 'Texas Christian University' |
| 111 | 'University of Alabama-Tuscaloosa' | 'University of Wyoming' |
| 112 | 'University of Rhode Island' | 'Texas A&M University' |
| 113 | 'The George Washington University' | 'State University of New York at Stony Brook' |
| 114 | 'University of Hawaii' | 'University of Arkansas' |
| 115 | 'Florida Atlantic University' | 'State University of New York at Binghamton' |
| 116 | 'Clarkson University' | 'Emory University' |
| 117 | 'Emory University' | 'Louisiana Tech University' |
| 118 | 'The University of Texas at Dallas' | 'Memphis State University' |
| 119 | 'Claremont Graduate University' | 'University of South Florida' |
| 120 | 'University of Montana' | 'Bryn Mawr College' |
| 121 | 'Bowling Green State University' | 'University of Maryland Baltimore County' |
| 122 | 'State University of New York at Binghamton' | 'University of Missouri - Kansas City' |
| 123 | 'University of Wisconsin-Milwaukee' | 'University of California, Santa Cruz' |
| 124 | 'Clemson University' | 'Texas Tech University' |
| 125 | 'University of Cincinnati' | 'Stevens Institute of Technology' |
| 126 | 'Texas Tech University' | 'University of Northern Colorado' |
| 127 | 'Montana State University' | 'University of Wisconsin-Milwaukee' |
| 128 | 'New Jersey Institute of Technology' | 'University of Colorado Health Sciences Center' |
| 129 | 'Southern Methodist University' | 'Claremont Graduate University' |
| 130 | 'Kansas State University' | 'University of Houston' |
| 131 | 'Auburn University' | 'Drexel University' |
| 132 | 'The University of Memphis' | 'University of Puerto Rico at Mayaguez' |
| 133 | 'Colorado School of Mines' | 'City University of New York' |
| 134 | 'The Rockefeller University' | 'University of Montana' |
| 135 | 'Texas A&M University' | 'Tufts University' |
| 136 | 'University of North Texas' | 'University of Mississippi' |
| 137 | 'Rutgers University, Newark' | 'University of South Carolina' |
| 138 | 'Kent State University' | 'New Jersey Institute of Technology' |
| 139 | 'University of Puerto Rico at Mayaguez' | 'University of Idaho' |
| 140 | 'University of Denver' | 'State University of New York at Albany' |
| 141 | 'Bryn Mawr College' | 'Temple University' |
| 142 | 'Missouri University of Science and Technology' | 'University of Louisiana at Lafayette' |
| 143 | 'Drexel University' | 'The University of Memphis' |
| 144 | 'The University of Oklahoma' | 'University of Toledo' |
| 145 | 'University of Colorado Health Sciences Center' | 'Ohio University' |
| 146 | 'University of Colorado at Denver' | 'Case Institute of Technology' |
| 147 | 'Texas Christian University' | 'University of New Hampshire' |
| 148 | 'Memphis State University' | 'The Rockefeller University' |
| 149 | 'University of Central Florida' | 'Clark University' |
| 150 | 'University of Mississippi' | 'North Dakota State University' |
| 151 | 'University of Arkansas' | 'Kansas State University' |
| 152 | 'University of Idaho' | 'University of Texas at Houston' |
| 153 | 'University of Massachusetts Lowell' | 'University of Hawaii' |
| 154 | 'University of South Carolina' | 'The University of Texas at Dallas' |
| 155 | 'University of South Florida' | 'Southern Illinois University at Carbondale' |
| 156 | 'Oklahoma State University' | 'University of California, San Diego' |
| 157 | 'The American University' | 'Montana State University' |
| 158 | 'University of Northern Colorado' | 'West Virginia University' |
| 159 | 'Ohio University' | 'Northern Illinois University' |
| 160 | 'Case Institute of Technology' | 'University of Miami' |

| | | |
|-----|--|-------------------------------------|
| 161 | 'University of Louisiana at Lafayette' | 'University of Rhode Island' |
| 162 | 'West Virginia University' | 'Florida Atlantic University' |
| 163 | 'Louisiana Tech University' | 'University of Central Florida' |
| 164 | 'Old Dominion University' | 'Polytechnic Institute of New York' |
| 165 | 'University of Alabama in Huntsville' | 'University of California, Irvine' |
| 166 | 'University of the Incarnate Word' | 'University of Illinois at Chicago' |
| 167 | 'North Dakota State University' | 'The American University' |

School ranking for Hub and Authority in 1966-1975

| | Hub | Authority |
|----|---|---|
| 1 | 'University of California, Berkeley' | 'Stanford University' |
| 2 | 'University of Maryland College Park' | 'University of California, Berkeley' |
| 3 | 'University of California, Los Angeles' | 'Princeton University' |
| 4 | 'Massachusetts Institute of Technology' | 'Massachusetts Institute of Technology' |
| 5 | 'Princeton University' | 'Harvard University' |
| 6 | 'Cornell University' | 'University of Wisconsin-Madison' |
| 7 | 'University of Washington' | 'Cornell University' |
| 8 | 'Rutgers University, New Brunswick' | 'University of Michigan' |
| 9 | 'University of Michigan' | 'The University of Chicago' |
| 10 | 'University of Texas at Austin' | 'New York University' |
| 11 | 'University of California, San Diego' | 'Yale University' |
| 12 | 'Stanford University' | 'University of California, Los Angeles' |
| 13 | 'Carnegie Mellon University' | 'Columbia University' |
| 14 | 'University of Illinois at Urbana-Champaign' | 'University of Illinois at Urbana-Champaign' |
| 15 | 'Yale University' | 'The Johns Hopkins University' |
| 16 | 'Harvard University' | 'University of Minnesota-Minneapolis' |
| 17 | 'The Ohio State University' | 'California Institute of Technology' |
| 18 | 'University of Minnesota-Minneapolis' | 'Brown University' |
| 19 | 'State University of New York at Stony Brook' | 'University of Washington' |
| 20 | 'New York University' | 'Carnegie Mellon University' |
| 21 | 'The University of Chicago' | 'Purdue University' |
| 22 | 'City University of New York' | 'Rice University' |
| 23 | 'The Pennsylvania State University' | 'University of Maryland College Park' |
| 24 | 'Purdue University' | 'The Rockefeller University' |
| 25 | 'University of Wisconsin-Madison' | 'University of Texas at Austin' |
| 26 | 'University of Massachusetts Amherst' | 'The University of North Carolina at Chapel Hill' |
| 27 | 'University of Illinois at Chicago' | 'Northwestern University' |
| 28 | 'Indiana University' | 'Brandeis University' |
| 29 | 'Northwestern University' | 'University of California, San Diego' |
| 30 | 'The Johns Hopkins University' | 'University of Utah' |
| 31 | 'University of Arizona' | 'University of Kansas' |
| 32 | 'California Institute of Technology' | 'The University of Rochester' |
| 33 | 'The University of North Carolina at Chapel Hill' | 'Michigan State University' |
| 34 | 'Columbia University' | 'Yeshiva University' |
| 35 | 'Rensselaer Polytechnic Institute' | 'University of Pennsylvania' |
| 36 | 'Duke University' | 'University of Southern California' |
| 37 | 'University of Pennsylvania' | 'Iowa State University' |
| 38 | 'Michigan State University' | 'The Florida State University' |
| 39 | 'University of Notre Dame' | 'Syracuse University' |
| 40 | 'Brown University' | 'Indiana University' |
| 41 | 'University of Florida' | 'University of Colorado at Boulder' |
| 42 | 'Rice University' | 'Rutgers University, New Brunswick' |
| 43 | 'University of Virginia' | 'Washington University' |
| 44 | 'University of Pittsburgh' | 'Dartmouth College' |
| 45 | 'Texas A&M University' | 'Tulane University' |
| 46 | 'The University of Connecticut' | 'University of Iowa' |
| 47 | 'North Carolina State University' | 'University of Tennessee - Knoxville' |
| 48 | 'University of Kansas' | 'University of Nebraska-Lincoln' |
| 49 | 'University of California, Santa Barbara' | 'University of Massachusetts Amherst' |
| 50 | 'Washington University' | 'University of Virginia' |
| 51 | 'University of Colorado at Boulder' | 'The Ohio State University' |
| 52 | 'University of Southern California' | 'University of Notre Dame' |
| 53 | 'State University of New York at Buffalo' | 'North Carolina State University' |
| 54 | 'Virginia Polytechnic Institute and State University' | 'Case Western Reserve University' |
| 55 | 'Georgia Institute of Technology' | 'Wesleyan University' |

| | | |
|-----|--|---|
| 56 | 'Brandeis University' | 'State University of New York at Stony Brook' |
| 57 | 'The University of Rochester' | 'The Louisiana State University' |
| 58 | 'Case Western Reserve University' | 'University of Oregon' |
| 59 | 'Iowa State University' | 'Georgia Institute of Technology' |
| 60 | 'University of California, Riverside' | 'Oregon State University' |
| 61 | 'University of California, Davis' | 'University of California, Riverside' |
| 62 | 'University of California, Irvine' | 'The Pennsylvania State University' |
| 63 | 'The Florida State University' | 'University of Pittsburgh' |
| 64 | 'University of Georgia' | 'University of Georgia' |
| 65 | 'University of Hawaii' | 'Wayne State University' |
| 66 | 'University of Iowa' | 'Duke University' |
| 67 | 'Dartmouth College' | 'Polytechnic Institute of New York' |
| 68 | 'University of Utah' | 'Lehigh University' |
| 69 | 'University of Oregon' | 'Polytechnic University' |
| 70 | 'Oregon State University' | 'The George Washington University' |
| 71 | 'University of New Mexico' | 'City University of New York' |
| 72 | 'University of California, Santa Cruz' | 'University of Florida' |
| 73 | 'The Louisiana State University' | 'State University of New York at Buffalo' |
| 74 | 'Boston University Graduate School' | 'University of Hawaii' |
| 75 | 'Vanderbilt University' | 'Adelphi University' |
| 76 | 'Northeastern University' | 'University of Rhode Island' |
| 77 | 'Syracuse University' | 'University of California, Irvine' |
| 78 | 'Stevens Institute of Technology' | 'Stevens Institute of Technology' |
| 79 | 'State University of New York at Binghamton' | 'University of Houston' |
| 80 | 'Clemson University' | 'The University of Oklahoma' |
| 81 | 'The George Washington University' | 'University of Illinois at Chicago' |
| 82 | 'University of Wisconsin-Milwaukee' | 'New Mexico State University' |
| 83 | 'Oklahoma State University' | 'University of Missouri - Columbia' |
| 84 | 'University of Houston' | 'State University of New York at Binghamton' |
| 85 | 'Tufts University' | 'Emory University' |
| 86 | 'Wayne State University' | 'Illinois Institute of Technology' |
| 87 | 'Tulane University' | 'Washington State University' |
| 88 | 'New Jersey Institute of Technology' | 'University of Alabama-Tuscaloosa' |
| 89 | 'The University of Texas at Dallas' | 'Texas A&M University' |
| 90 | 'Washington State University' | 'Kansas State University' |
| 91 | 'State University of New York at Albany' | 'University of Kentucky' |
| 92 | 'Clarkson University' | 'University of Delaware' |
| 93 | 'Kent State University' | 'Colorado State University' |
| 94 | 'Montana State University' | 'University of Arizona' |
| 95 | 'Lehigh University' | 'Virginia Polytechnic Institute and State University' |
| 96 | 'University of Montana' | 'St. Louis University' |
| 97 | 'University of Delaware' | 'Southern Methodist University' |
| 98 | 'University of South Carolina' | 'Rensselaer Polytechnic Institute' |
| 99 | 'University of Miami' | 'University of California, Santa Barbara' |
| 100 | 'University of Rhode Island' | 'University of Miami' |
| 101 | 'University of Kentucky' | 'Texas Christian University' |
| 102 | 'University of Texas at Arlington' | 'Case Institute of Technology' |
| 103 | 'Howard University' | 'University of Alabama in Huntsville' |
| 104 | 'University of Tennessee - Knoxville' | 'University of Wyoming' |
| 105 | 'Arizona State University' | 'Union College' |
| 106 | 'Auburn University' | 'Boston University Graduate School' |
| 107 | 'The College of William and Mary' | 'Clark University' |
| 108 | 'Southern Methodist University' | 'University of California, Davis' |
| 109 | 'Northern Illinois University' | 'Claremont Graduate University' |
| 110 | 'University of Nebraska-Lincoln' | 'Oklahoma State University' |
| 111 | 'Temple University' | 'Vanderbilt University' |
| 112 | 'Bowling Green State University' | 'The University of Connecticut' |

| | | |
|-----|---|---|
| 113 | 'Claremont Graduate University' | 'University of Wisconsin-Milwaukee' |
| 114 | 'The University of Memphis' | 'Auburn University' |
| 115 | 'Texas Tech University' | 'The Catholic University of America' |
| 116 | 'Naval Postgraduate School' | 'Baylor University' |
| 117 | 'Southern Illinois University at Carbondale' | 'Georgia State University' |
| 118 | 'Colorado State University' | 'Texas Tech University' |
| 119 | 'University of Massachusetts Lowell' | 'University of New Mexico' |
| 120 | 'Rutgers University, Newark' | 'Southern Illinois University at Carbondale' |
| 121 | 'Clark University' | 'Missouri University of Science and Technology' |
| 122 | 'University of North Texas' | 'Temple University' |
| 123 | 'University of Alaska, Fairbanks' | 'University of South Florida' |
| 124 | 'Texas Southern University' | 'Clemson University' |
| 125 | 'The Union Institute' | 'Bryn Mawr College' |
| 126 | 'University of Puerto Rico at Mayaguez' | 'University of Northern Colorado' |
| 127 | 'Florida Atlantic University' | 'Michigan Technological University' |
| 128 | 'University of Vermont' | 'The University of Memphis' |
| 129 | 'University of Cincinnati' | 'George Mason University' |
| 130 | 'Wesleyan University' | 'University of California, San Francisco' |
| 131 | 'Brigham Young University' | 'University of Arkansas' |
| 132 | 'University of Texas at San Antonio' | 'University of Maryland Baltimore County' |
| 133 | 'Western Michigan University' | 'New Jersey Institute of Technology' |
| 134 | 'Bryn Mawr College' | 'University of Texas at Houston' |
| 135 | 'University of South Florida' | 'Tufts University' |
| 136 | 'University of Wyoming' | 'University of Cincinnati' |
| 137 | 'University of Central Florida' | 'Illinois State University' |
| 138 | 'New Mexico State University' | 'North Dakota State University' |
| 139 | 'University of Louisiana at Lafayette' | 'Northern Illinois University' |
| 140 | 'University of Colorado at Denver' | 'Texas Southern University' |
| 141 | 'Adelphi University' | 'Mississippi State University' |
| 142 | 'University of Idaho' | 'New Mexico School of Mining and Technology' |
| 143 | 'University of Missouri - Columbia' | 'Western Michigan University' |
| 144 | 'Kansas State University' | 'University of Vermont' |
| 145 | 'Medical University of South Carolina' | 'Air Force Institute of Technology' |
| 146 | 'University of Toledo' | 'University of Alaska, Fairbanks' |
| 147 | 'University of Missouri - Kansas City' | 'Howard University' |
| 148 | 'University of Alabama-Tuscaloosa' | 'University of Montana' |
| 149 | 'University of North Carolina at Charlotte' | 'University of Akron' |
| 150 | 'University of Arkansas' | 'Florida Atlantic University' |
| 151 | 'Old Dominion University' | 'University of California, Santa Cruz' |
| 152 | 'University of Missouri - St. Louis' | 'Clarkson University' |
| 153 | 'University of California, San Francisco' | 'University of Denver' |
| 154 | 'Baylor University' | 'Central Michigan University' |
| 155 | 'The University of Oklahoma' | 'University of Nevada, Las Vegas' |
| 156 | 'Utah State University' | 'Drexel University' |
| 157 | 'Emory University' | 'Oakland University' |
| 158 | 'University of Maryland Baltimore County' | 'The American University' |
| 159 | 'Drexel University' | 'Idaho State University' |
| 160 | 'Worcester Polytechnic Institute' | 'University of South Carolina' |
| 161 | 'Yeshiva University' | 'University of Tulsa' |
| 162 | 'Polytechnic University' | 'Rush University' |
| 163 | 'University of New Hampshire' | 'Northeastern University' |
| 164 | 'Missouri University of Science and Technology' | 'University of Idaho' |
| 165 | 'St. Louis University' | 'Bowling Green State University' |
| 166 | 'Texas Christian University' | 'University of Massachusetts Lowell' |
| 167 | 'Colorado School of Mines' | 'University of Texas at San Antonio' |
| 168 | 'North Dakota State University' | 'The University of Texas at Dallas' |
| 169 | 'Illinois State University' | 'University of Texas at Arlington' |

| | | |
|-----|--|---|
| 170 | 'Air Force Institute of Technology' | 'University of Louisiana at Lafayette' |
| 171 | 'University of Mississippi' | 'University of Central Florida' |
| 172 | 'Georgetown University' | 'University of Puerto Rico at Mayaguez' |
| 173 | 'Oakland University' | 'Kent State University' |
| 174 | 'Ohio University' | 'Florida Institute of Technology' |
| 175 | 'Idaho State University' | 'University of North Texas' |
| 176 | 'University of Nevada, Las Vegas' | 'Memphis State University' |
| 177 | 'New Mexico School of Mining and Technology' | 'University of Toledo' |
| 178 | 'Wichita State University' | 'Montana State University' |
| 179 | 'University of Alabama-Birmingham' | 'Naval Postgraduate School' |
| 180 | 'The Catholic University of America' | 'Medical University of South Carolina' |
| 181 | 'Rush University' | 'Ohio University' |
| 182 | 'University of Akron' | 'University of New Hampshire' |
| 183 | 'University of Northern Colorado' | 'University of Missouri - Kansas City' |
| 184 | 'George Mason University' | 'Utah State University' |
| 185 | 'Michigan Technological University' | 'Arizona State University' |
| 186 | 'University of Tulsa' | 'University of Colorado at Denver' |
| 187 | 'University of Denver' | 'Brigham Young University' |
| 188 | 'Central Michigan University' | 'Rutgers University, Newark' |
| 189 | 'University of Alabama in Huntsville' | 'University of North Carolina at Charlotte' |
| 190 | 'University of Texas at Houston' | 'Old Dominion University' |
| 191 | 'Georgia State University' | 'University of Alabama-Birmingham' |
| 192 | 'Louisiana Tech University' | 'The Union Institute' |
| 193 | 'Memphis State University' | 'University of Mississippi' |
| 194 | 'The American University' | 'University of Missouri - St. Louis' |
| 195 | 'Mississippi State University' | 'Louisiana Tech University' |
| 196 | 'Florida Institute of Technology' | 'Colorado School of Mines' |
| 197 | 'Illinois Institute of Technology' | 'Georgetown University' |
| 198 | 'Union College' | 'The College of William and Mary' |
| 199 | 'Polytechnic Institute of New York' | 'Worcester Polytechnic Institute' |
| 200 | 'The Rockefeller University' | 'State University of New York at Albany' |
| 201 | 'Case Institute of Technology' | 'Wichita State University' |

School ranking for Hub and Authority in 1976-1985

| | Hub | Authority |
|----|---|---|
| 1 | 'University of Washington' | 'University of California, Berkeley' |
| 2 | 'Massachusetts Institute of Technology' | 'Stanford University' |
| 3 | 'Cornell University' | 'Massachusetts Institute of Technology' |
| 4 | 'University of California, Los Angeles' | 'Harvard University' |
| 5 | 'University of Illinois at Urbana-Champaign' | 'Princeton University' |
| 6 | 'University of Maryland College Park' | 'Cornell University' |
| 7 | 'University of Michigan' | 'Yale University' |
| 8 | 'New York University' | 'University of Wisconsin-Madison' |
| 9 | 'Princeton University' | 'The University of Chicago' |
| 10 | 'University of Wisconsin-Madison' | 'University of Illinois at Urbana-Champaign' |
| 11 | 'Carnegie Mellon University' | 'Carnegie Mellon University' |
| 12 | 'University of Texas at Austin' | 'New York University' |
| 13 | 'Purdue University' | 'California Institute of Technology' |
| 14 | 'University of California, Berkeley' | 'University of Michigan' |
| 15 | 'Stanford University' | 'Purdue University' |
| 16 | 'Brown University' | 'University of California, Los Angeles' |
| 17 | 'Georgia Institute of Technology' | 'Brown University' |
| 18 | 'The Ohio State University' | 'University of Minnesota-Minneapolis' |
| 19 | 'University of California, San Diego' | 'University of Maryland College Park' |
| 20 | 'University of Pennsylvania' | 'University of Washington' |
| 21 | 'The University of Chicago' | 'State University of New York at Stony Brook' |
| 22 | 'Columbia University' | 'The Johns Hopkins University' |
| 23 | 'Yale University' | 'University of California, San Diego' |
| 24 | 'The Pennsylvania State University' | 'Northwestern University' |
| 25 | 'State University of New York at Stony Brook' | 'The University of North Carolina at Chapel Hill' |
| 26 | 'Boston University Graduate School' | 'University of Utah' |
| 27 | 'California Institute of Technology' | 'University of Arizona' |
| 28 | 'Harvard University' | 'Columbia University' |
| 29 | 'University of California, Davis' | 'Indiana University' |
| 30 | 'University of Southern California' | 'University of Pennsylvania' |
| 31 | 'The Johns Hopkins University' | 'University of Texas at Austin' |
| 32 | 'Oregon State University' | 'University of Colorado at Boulder' |
| 33 | 'Duke University' | 'The Pennsylvania State University' |
| 34 | 'University of Minnesota-Minneapolis' | 'Iowa State University' |
| 35 | 'Northwestern University' | 'Rutgers University, New Brunswick' |
| 36 | 'University of Massachusetts Amherst' | 'University of Virginia' |
| 37 | 'University of Colorado at Boulder' | 'Brandeis University' |
| 38 | 'Rutgers University, New Brunswick' | 'The University of Rochester' |
| 39 | 'The University of Rochester' | 'The Ohio State University' |
| 40 | 'The University of North Carolina at Chapel Hill' | 'Michigan State University' |
| 41 | 'Rensselaer Polytechnic Institute' | 'University of Tennessee - Knoxville' |
| 42 | 'University of Pittsburgh' | 'University of Pittsburgh' |
| 43 | 'Brandeis University' | 'State University of New York at Buffalo' |
| 44 | 'University of Arizona' | 'The George Washington University' |
| 45 | 'University of Georgia' | 'University of Kentucky' |
| 46 | 'Northeastern University' | 'Rice University' |
| 47 | 'University of Illinois at Chicago' | 'Duke University' |
| 48 | 'University of Iowa' | 'The Rockefeller University' |
| 49 | 'Rice University' | 'University of Illinois at Chicago' |
| 50 | 'Oklahoma State University' | 'The University of Texas at Dallas' |
| 51 | 'Michigan State University' | 'University of Florida' |
| 52 | 'Indiana University' | 'Rensselaer Polytechnic Institute' |
| 53 | 'Lehigh University' | 'University of Georgia' |
| 54 | 'Texas A&M University' | 'University of California, Santa Barbara' |
| 55 | 'Dartmouth College' | 'University of Massachusetts Amherst' |
| 56 | 'University of Kentucky' | 'Georgia Institute of Technology' |

| | | |
|-----|---|---|
| 57 | 'Temple University' | 'University of Wisconsin-Milwaukee' |
| 58 | 'The Florida State University' | 'University of Delaware' |
| 59 | 'Virginia Polytechnic Institute and State University' | 'University of Iowa' |
| 60 | 'University of California, Santa Cruz' | 'University of Kansas' |
| 61 | 'University of Utah' | 'University of California, Davis' |
| 62 | 'Arizona State University' | 'Bowling Green State University' |
| 63 | 'University of California, Irvine' | 'Vanderbilt University' |
| 64 | 'University of California, Riverside' | 'Washington State University' |
| 65 | 'Vanderbilt University' | 'University of Oregon' |
| 66 | 'Iowa State University' | 'University of California, San Francisco' |
| 67 | 'University of Florida' | 'The Florida State University' |
| 68 | 'University of Cincinnati' | 'Clarkson University' |
| 69 | 'University of New Mexico' | 'Southern Methodist University' |
| 70 | 'University of North Texas' | 'Case Western Reserve University' |
| 71 | 'North Carolina State University' | 'University of Southern California' |
| 72 | 'Case Western Reserve University' | 'Dartmouth College' |
| 73 | 'State University of New York at Buffalo' | 'University of New Mexico' |
| 74 | 'Colorado State University' | 'University of Cincinnati' |
| 75 | 'State University of New York at Albany' | 'Tulane University' |
| 76 | 'Kansas State University' | 'Naval Postgraduate School' |
| 77 | 'University of Houston' | 'Temple University' |
| 78 | 'University of Hawaii' | 'State University of New York at Binghamton' |
| 79 | 'University of Miami' | 'Colorado State University' |
| 80 | 'The University of Connecticut' | 'Clemson University' |
| 81 | 'University of California, Santa Barbara' | 'Arizona State University' |
| 82 | 'Naval Postgraduate School' | 'University of California, Riverside' |
| 83 | 'University of Nebraska-Lincoln' | 'Wesleyan University' |
| 84 | 'Washington University' | 'Washington University' |
| 85 | 'The Louisiana State University' | 'North Carolina State University' |
| 86 | 'University of South Carolina' | 'Wayne State University' |
| 87 | 'Bryn Mawr College' | 'Virginia Polytechnic Institute and State University' |
| 88 | 'Illinois Institute of Technology' | 'University of Hawaii' |
| 89 | 'University of Tennessee - Knoxville' | 'The University of Connecticut' |
| 90 | 'University of Kansas' | 'University of Missouri - Columbia' |
| 91 | 'State University of New York at Binghamton' | 'University of North Texas' |
| 92 | 'Tufts University' | 'The Louisiana State University' |
| 93 | 'University of Oregon' | 'University of South Florida' |
| 94 | 'The George Washington University' | 'Syracuse University' |
| 95 | 'City University of New York' | 'Oregon State University' |
| 96 | 'Tulane University' | 'University of California, Santa Cruz' |
| 97 | 'Wesleyan University' | 'University of Houston' |
| 98 | 'The University of Oklahoma' | 'Emory University' |
| 99 | 'Montana State University' | 'Western Michigan University' |
| 100 | 'University of Virginia' | 'State University of New York at Albany' |
| 101 | 'Drexel University' | 'City University of New York' |
| 102 | 'Syracuse University' | 'University of Wyoming' |
| 103 | 'New Mexico State University' | 'Kent State University' |
| 104 | 'George Mason University' | 'Texas A&M University' |
| 105 | 'University of Texas at Arlington' | 'Adelphi University' |
| 106 | 'Emory University' | 'University of Nebraska-Lincoln' |
| 107 | 'University of Notre Dame' | 'New Mexico State University' |
| 108 | 'University of Missouri - Columbia' | 'University of California, Irvine' |
| 109 | 'Washington State University' | 'The University of Memphis' |
| 110 | 'University of Colorado at Denver' | 'Montana State University' |
| 111 | 'University of Wyoming' | 'Kansas State University' |
| 112 | 'University of Wisconsin-Milwaukee' | 'University of Northern Colorado' |
| 113 | 'Stevens Institute of Technology' | 'Illinois Institute of Technology' |
| 114 | 'Wayne State University' | 'Marquette University' |

| | | |
|-----|---|---|
| 115 | 'University of Massachusetts Lowell' | 'Texas Tech University' |
| 116 | 'Rutgers University, Newark' | 'The University of Oklahoma' |
| 117 | 'University of Maryland Baltimore County' | 'Boston University Graduate School' |
| 118 | 'Texas Tech University' | 'Auburn University' |
| 119 | 'University of New Hampshire' | 'Rutgers University, Newark' |
| 120 | 'Portland State University' | 'Air Force Institute of Technology' |
| 121 | 'University of Colorado Health Sciences Center' | 'Oklahoma State University' |
| 122 | 'St. Louis University' | 'New Mexico School of Mining and Technology' |
| 123 | 'Polytechnic University' | 'Utah State University' |
| 124 | 'Oregon Graduate Institute of Science & Technol | 'University of North Carolina at Charlotte' |
| 125 | 'Florida Institute of Technology' | 'Bryn Mawr College' |
| 126 | 'University of Arkansas' | 'Mississippi State University' |
| 127 | 'Old Dominion University' | 'Virginia Commonwealth University' |
| 128 | 'Southern Methodist University' | 'Southern Illinois University at Carbondale' |
| 129 | 'The University of Memphis' | 'University of Maine' |
| 130 | 'University of Delaware' | 'Stevens Institute of Technology' |
| 131 | 'The American University' | 'Tufts University' |
| 132 | 'University of Alabama in Huntsville' | 'George Mason University' |
| 133 | 'West Virginia University' | 'St. Louis University' |
| 134 | 'Ohio University' | 'Polytechnic University' |
| 135 | 'Clemson University' | 'University of Maryland Baltimore County' |
| 136 | 'Florida Atlantic University' | 'The American University' |
| 137 | 'University of Toledo' | 'Missouri University of Science and Technology' |
| 138 | 'Virginia Commonwealth University' | 'Old Dominion University' |
| 139 | 'University of North Carolina at Charlotte' | 'Uniformed Services University' |
| 140 | 'Kent State University' | 'Florida State University, Helsingin Yliopisto' |
| 141 | 'University of Alabama-Tuscaloosa' | 'Lehigh University' |
| 142 | 'The College of William and Mary' | 'Florida Institute of Technology' |
| 143 | 'University of Mississippi' | 'Central Michigan University' |
| 144 | 'Mississippi State University' | 'Northeastern University' |
| 145 | 'Auburn University' | 'University of South Carolina' |
| 146 | 'Bowling Green State University' | 'Wichita State University' |
| 147 | 'University of Akron' | 'University of Montana' |
| 148 | 'Wichita State University' | 'Oakland University' |
| 149 | 'Western Michigan University' | 'North Dakota State University' |
| 150 | 'Idaho State University' | 'Baylor University' |
| 151 | 'Clarkson University' | 'University of Louisiana at Lafayette' |
| 152 | 'University of South Florida' | 'University of Alabama-Tuscaloosa' |
| 153 | 'Northern Illinois University' | 'Medical College of Wisconsin' |
| 154 | 'University of Alabama-Birmingham' | 'University of Miami' |
| 155 | 'Southern Illinois University at Carbondale' | 'University of New Hampshire' |
| 156 | 'University of Vermont' | 'Idaho State University' |
| 157 | 'North Dakota State University' | 'University of Mississippi' |
| 158 | 'Howard University' | 'University of Arkansas' |
| 159 | 'University of Maine' | 'University of Colorado Health Sciences Center' |
| 160 | 'The University of Texas at Dallas' | 'Brigham Young University' |
| 161 | 'Marquette University' | 'Ohio University' |
| 162 | 'New Mexico School of Mining and Technology' | 'Portland State University' |
| 163 | 'Utah State University' | 'University of Alabama-Birmingham' |
| 164 | 'The Catholic University of America' | 'Howard University' |
| 165 | 'Uniformed Services University' | 'Northern Illinois University' |
| 166 | 'Baylor University' | 'Union College' |
| 167 | 'Brigham Young University' | 'Claremont Graduate University' |
| 168 | 'Central Michigan University' | 'University of Alabama in Huntsville' |
| 169 | 'Florida State University, Helsingin Yliopisto' | 'Florida Atlantic University' |
| 170 | 'Oakland University' | 'University of Colorado at Denver' |
| 171 | 'University of Louisiana at Lafayette' | 'Colorado School of Mines' |
| 172 | 'University of Montana' | 'University of Massachusetts Lowell' |

| | | |
|-----|---|---|
| 173 | 'Colorado School of Mines' | 'University of Toledo' |
| 174 | 'Medical College of Wisconsin' | 'The Catholic University of America' |
| 175 | 'Union College' | 'Oregon Graduate Institute of Science & Technology' |
| 176 | 'Claremont Graduate University' | 'West Virginia University' |
| 177 | 'University of Northern Colorado' | 'University of Alaska, Fairbanks' |
| 178 | 'Missouri University of Science and Technology' | 'University of Akron' |
| 179 | 'Michigan Technological University' | 'Drexel University' |
| 180 | 'University of Missouri - Kansas City' | 'University of Vermont' |
| 181 | 'University of Alaska, Fairbanks' | 'Michigan Technological University' |
| 182 | 'University of California, San Francisco' | 'University of Missouri - Kansas City' |
| 183 | 'Air Force Institute of Technology' | 'The College of William and Mary' |
| 184 | 'The Rockefeller University' | 'University of Texas at Arlington' |
| 185 | 'Adelphi University' | 'University of Notre Dame' |

School ranking for Hub and Authority in 1986-1995

| | Hub | Authority |
|----|---|---|
| 1 | 'Stanford University' | 'University of California, Berkeley' |
| 2 | 'University of Illinois at Urbana-Champaign' | 'Massachusetts Institute of Technology' |
| 3 | 'Massachusetts Institute of Technology' | 'Stanford University' |
| 4 | 'University of California, Berkeley' | 'Harvard University' |
| 5 | 'Carnegie Mellon University' | 'Princeton University' |
| 6 | 'Georgia Institute of Technology' | 'Cornell University' |
| 7 | 'University of Texas at Austin' | 'Yale University' |
| 8 | 'University of Wisconsin-Madison' | 'Carnegie Mellon University' |
| 9 | 'University of Washington' | 'University of Washington' |
| 10 | 'Harvard University' | 'University of Wisconsin-Madison' |
| 11 | 'Cornell University' | 'The University of Chicago' |
| 12 | 'University of Michigan' | 'California Institute of Technology' |
| 13 | 'Princeton University' | 'University of Illinois at Urbana-Champaign' |
| 14 | 'University of California, Los Angeles' | 'Brown University' |
| 15 | 'Columbia University' | 'University of California, Los Angeles' |
| 16 | 'University of Minnesota-Minneapolis' | 'University of California, San Diego' |
| 17 | 'University of Maryland College Park' | 'University of Maryland College Park' |
| 18 | 'University of California, San Diego' | 'New York University' |
| 19 | 'University of Pennsylvania' | 'Purdue University' |
| 20 | 'California Institute of Technology' | 'University of Minnesota-Minneapolis' |
| 21 | 'Northwestern University' | 'University of Pennsylvania' |
| 22 | 'Purdue University' | 'University of Michigan' |
| 23 | 'University of California, Santa Cruz' | 'Rice University' |
| 24 | 'The University of Chicago' | 'Columbia University' |
| 25 | 'University of Southern California' | 'University of Massachusetts Amherst' |
| 26 | 'Brown University' | 'University of Texas at Austin' |
| 27 | 'University of Colorado at Boulder' | 'The Pennsylvania State University' |
| 28 | 'Boston University Graduate School' | 'University of Southern California' |
| 29 | 'University of California, Santa Barbara' | 'The University of North Carolina at Chapel Hill' |
| 30 | 'Yale University' | 'Northwestern University' |
| 31 | 'The University of North Carolina at Chapel Hill' | 'Rutgers University, New Brunswick' |
| 32 | 'Texas A&M University' | 'University of Utah' |
| 33 | 'Rutgers University, New Brunswick' | 'Washington University' |
| 34 | 'New York University' | 'The University of Rochester' |
| 35 | 'Washington University' | 'State University of New York at Stony Brook' |
| 36 | 'The Pennsylvania State University' | 'University of Florida' |
| 37 | 'Rice University' | 'Georgia Institute of Technology' |
| 38 | 'Dartmouth College' | 'University of Colorado at Boulder' |
| 39 | 'State University of New York at Stony Brook' | 'Texas A&M University' |
| 40 | 'The Johns Hopkins University' | 'The Ohio State University' |
| 41 | 'Iowa State University' | 'University of California, Santa Barbara' |
| 42 | 'Duke University' | 'University of Virginia' |
| 43 | 'Indiana University' | 'University of Arizona' |
| 44 | 'University of California, Davis' | 'University of California, Santa Cruz' |
| 45 | 'Michigan State University' | 'Michigan State University' |
| 46 | 'University of Massachusetts Amherst' | 'Virginia Polytechnic Institute and State University' |
| 47 | 'University of Notre Dame' | 'North Carolina State University' |
| 48 | 'University of Kentucky' | 'The Johns Hopkins University' |
| 49 | 'University of Florida' | 'The Florida State University' |
| 50 | 'The Ohio State University' | 'University of California, Davis' |
| 51 | 'University of Arizona' | 'Vanderbilt University' |
| 52 | 'University of Maryland Baltimore County' | 'University of Georgia' |
| 53 | 'University of Iowa' | 'Brandeis University' |
| 54 | 'Rensselaer Polytechnic Institute' | 'Iowa State University' |
| 55 | 'University of Missouri - Columbia' | 'University of Illinois at Chicago' |

| | | |
|-----|---|--|
| 56 | 'The University of Connecticut' | 'University of Pittsburgh' |
| 57 | 'University of California, Irvine' | 'Indiana University' |
| 58 | 'Kansas State University' | 'University of Colorado at Denver' |
| 59 | 'North Carolina State University' | 'The University of Connecticut' |
| 60 | 'University of Pittsburgh' | 'Arizona State University' |
| 61 | 'University of Virginia' | 'University of Hawaii' |
| 62 | 'Virginia Polytechnic Institute and State University' | 'University of New Mexico' |
| 63 | 'Arizona State University' | 'Florida Institute of Technology' |
| 64 | 'Case Western Reserve University' | 'University of Texas at Arlington' |
| 65 | 'Bowling Green State University' | 'University of California, Irvine' |
| 66 | 'The Florida State University' | 'Duke University' |
| 67 | 'Wesleyan University' | 'George Mason University' |
| 68 | 'University of Cincinnati' | 'Colorado State University' |
| 69 | 'University of California, Riverside' | 'University of South Carolina' |
| 70 | 'University of Nebraska-Lincoln' | 'University of Wisconsin-Milwaukee' |
| 71 | 'Lehigh University' | 'Boston University Graduate School' |
| 72 | 'Naval Postgraduate School' | 'Rensselaer Polytechnic Institute' |
| 73 | 'University of Georgia' | 'Dartmouth College' |
| 74 | 'University of Kansas' | 'University of Houston' |
| 75 | 'University of Miami' | 'City University of New York' |
| 76 | 'Claremont Graduate University' | 'University of Iowa' |
| 77 | 'University of Illinois at Chicago' | 'University of Notre Dame' |
| 78 | 'The University of Rochester' | 'University of Missouri - Columbia' |
| 79 | 'University of Colorado at Denver' | 'The University of Texas at Dallas' |
| 80 | 'University of New Mexico' | 'State University of New York at Buffalo' |
| 81 | 'University of Utah' | 'Oregon State University' |
| 82 | 'The University of Oklahoma' | 'Western Michigan University' |
| 83 | 'Tulane University' | 'Old Dominion University' |
| 84 | 'Emory University' | 'University of Wyoming' |
| 85 | 'City University of New York' | 'The George Washington University' |
| 86 | 'Tufts University' | 'University of Kansas' |
| 87 | 'The Louisiana State University' | 'Tulane University' |
| 88 | 'Syracuse University' | 'University of Cincinnati' |
| 89 | 'Oregon State University' | 'Montana State University' |
| 90 | 'University of Tennessee - Knoxville' | 'University of Maryland Baltimore County' |
| 91 | 'The University of Memphis' | 'Kent State University' |
| 92 | 'Brandeis University' | 'University of Louisiana at Lafayette' |
| 93 | 'University of Houston' | 'The Louisiana State University' |
| 94 | 'Oregon Graduate Institute of Science & Technolo | 'Clemson University' |
| 95 | 'Drexel University' | 'University of Alabama-Birmingham' |
| 96 | 'Bryn Mawr College' | 'University of Texas at Houston' |
| 97 | 'Wayne State University' | 'Syracuse University' |
| 98 | 'Utah State University' | 'University of Delaware' |
| 99 | 'The George Washington University' | 'Temple University' |
| 100 | 'University of Oregon' | 'The American University' |
| 101 | 'University of Delaware' | 'Lehigh University' |
| 102 | 'Clemson University' | 'University of Oregon' |
| 103 | 'University of South Carolina' | 'State University of New York at Binghamton' |
| 104 | 'State University of New York at Albany' | 'Case Western Reserve University' |
| 105 | 'University of Puerto Rico at Mayaguez' | 'University of Tennessee - Knoxville' |
| 106 | 'New Mexico State University' | 'University of Central Florida' |
| 107 | 'The University of Texas at Dallas' | 'Wayne State University' |
| 108 | 'University of Alabama-Tuscaloosa' | 'Kansas State University' |
| 109 | 'Temple University' | 'University of Nebraska-Lincoln' |
| 110 | 'Air Force Institute of Technology' | 'Medical University of South Carolina' |
| 111 | 'Kent State University' | 'Southern Methodist University' |
| 112 | 'Colorado State University' | 'University of North Texas' |

| | | |
|-----|--|---|
| 113 | 'Oregon Health & Science University' | 'Polytechnic University' |
| 114 | 'University of Wisconsin-Milwaukee' | 'Colorado School of Mines' |
| 115 | 'Polytechnic University' | 'Auburn University' |
| 116 | 'George Mason University' | 'University of Miami' |
| 117 | 'The College of William and Mary' | 'Texas Tech University' |
| 118 | 'Northern Illinois University' | 'Emory University' |
| 119 | 'New Jersey Institute of Technology' | 'The College of William and Mary' |
| 120 | 'Illinois Institute of Technology' | 'Northeastern University' |
| 121 | 'Auburn University' | 'Illinois State University' |
| 122 | 'Washington State University' | 'Wesleyan University' |
| 123 | 'University of Wyoming' | 'Clarkson University' |
| 124 | 'Northeastern University' | 'Oklahoma State University' |
| 125 | 'Southern Methodist University' | 'University of Kentucky' |
| 126 | 'Wichita State University' | 'The University of Memphis' |
| 127 | 'Montana State University' | 'Rutgers University, Newark' |
| 128 | 'University of South Florida' | 'University of Louisville' |
| 129 | 'University of Montana' | 'Oregon Health & Science University' |
| 130 | 'Stevens Institute of Technology' | 'North Dakota State University' |
| 131 | 'State University of New York at Binghamton' | 'University of Massachusetts Lowell' |
| 132 | 'University of Louisiana at Lafayette' | 'University of Nevada, Las Vegas' |
| 133 | 'Vanderbilt University' | 'University of California, Riverside' |
| 134 | 'University of Idaho' | 'Howard University' |
| 135 | 'University of Texas at Arlington' | 'Adelphi University' |
| 136 | 'North Dakota State University' | 'Florida Atlantic University' |
| 137 | 'University of Toledo' | 'University of Denver' |
| 138 | 'University of Texas at El Paso' | 'University of Northern Colorado' |
| 139 | 'University of Rhode Island' | 'Medical College of Wisconsin' |
| 140 | 'Colorado School of Mines' | 'West Virginia University' |
| 141 | 'Florida Atlantic University' | 'New Mexico State University' |
| 142 | 'Brigham Young University' | 'University of Missouri - St. Louis' |
| 143 | 'St. Louis University' | 'University of Toledo' |
| 144 | 'State University of New York at Buffalo' | 'Utah State University' |
| 145 | 'Clarkson University' | 'University of South Florida' |
| 146 | 'Rutgers University, Newark' | 'University of Rhode Island' |
| 147 | 'Marquette University' | 'Brigham Young University' |
| 148 | 'University of Missouri - Kansas City' | 'University of Akron' |
| 149 | 'Michigan Technological University' | 'New Jersey Institute of Technology' |
| 150 | 'Oakland University' | 'University of Vermont' |
| 151 | 'Southern Illinois University at Carbondale' | 'University of Texas at El Paso' |
| 152 | 'Loyola University of Chicago' | 'University of Missouri - Kansas City' |
| 153 | 'University of Texas at San Antonio' | 'Loyola University of Chicago' |
| 154 | 'Texas Tech University' | 'Missouri University of Science and Technology' |
| 155 | 'University of Central Florida' | 'State University of New York at Albany' |
| 156 | 'University of Louisville' | 'Fordham University' |
| 157 | 'Western Michigan University' | 'Wright State University' |
| 158 | 'Fordham University' | 'St. Louis University' |
| 159 | 'Howard University' | 'Worcester Polytechnic Institute' |
| 160 | 'Portland State University' | 'University of Alabama-Tuscaloosa' |
| 161 | 'University of California, San Francisco' | 'Stevens Institute of Technology' |
| 162 | 'Adelphi University' | 'University of Montana' |
| 163 | 'University of New Hampshire' | 'Virginia Commonwealth University' |
| 164 | 'The American University' | 'Marquette University' |
| 165 | 'New Mexico School of Mining and Technology' | 'Northern Illinois University' |
| 166 | 'University of Missouri - St. Louis' | 'Oregon Graduate Institute of Science & Technology' |
| 167 | 'University of Southern Mississippi' | 'Naval Postgraduate School' |
| 168 | 'University of Nevada, Las Vegas' | 'Louisiana Tech University' |
| 169 | 'Worcester Polytechnic Institute' | 'Air Force Institute of Technology' |

| | | |
|-----|---|--|
| 170 | 'University of Northern Colorado' | 'University of Southern Mississippi' |
| 171 | 'Illinois State University' | 'Bryn Mawr College' |
| 172 | 'University of Akron' | 'University of Arkansas' |
| 173 | 'University of Denver' | 'Illinois Institute of Technology' |
| 174 | 'University of Arkansas' | 'Washington State University' |
| 175 | 'Mississippi State University' | 'Wichita State University' |
| 176 | 'Wright State University' | 'Claremont Graduate University' |
| 177 | 'University of North Carolina at Charlotte' | 'Claremont Graduate University' |
| 178 | 'Ohio University' | 'Tufts University' |
| 179 | 'Florida International University' | 'The University of Oklahoma' |
| 180 | 'Missouri University of Science and Technology' | 'University of Alabama in Huntsville' |
| 181 | 'University of Vermont' | 'University of California, San Francisco' |
| 182 | 'University of Maine' | 'University of New Hampshire' |
| 183 | 'Florida Institute of Technology' | 'Nova Southeastern University' |
| 184 | 'Virginia Commonwealth University' | 'Michigan Technological University' |
| 185 | 'Old Dominion University' | 'University of Mississippi' |
| 186 | 'Central Michigan University' | 'Mississippi State University' |
| 187 | 'Southern Connecticut State University' | 'Florida International University' |
| 188 | 'Medical College of Wisconsin' | 'Portland State University' |
| 189 | 'Oklahoma State University' | 'Oakland University' |
| 190 | 'Claremont Graduate University' | 'Southern Illinois University at Carbondale' |
| 191 | 'University of Massachusetts Lowell' | 'University of Maine' |
| 192 | 'Louisiana Tech University' | 'Baylor University' |
| 193 | 'West Virginia University' | 'Central Michigan University' |
| 194 | 'University of Mississippi' | 'University of Texas at San Antonio' |
| 195 | 'Baylor University' | 'University of Idaho' |
| 196 | 'University of North Texas' | 'Drexel University' |
| 197 | 'University of Alabama-Birmingham' | 'New Mexico School of Mining and Technology' |
| 198 | 'Nova Southeastern University' | 'Southern Connecticut State University' |
| 199 | 'University of Alabama in Huntsville' | 'Bowling Green State University' |
| 200 | 'Medical University of South Carolina' | 'University of North Carolina at Charlotte' |
| 201 | 'University of Hawaii' | 'University of Puerto Rico at Mayaguez' |
| 202 | 'University of Texas at Houston' | 'Ohio University' |

School ranking for Hub and Authority in 1996-2010

| | Hub | Authority |
|----|---|---|
| 1 | 'Georgia Institute of Technology' | 'Massachusetts Institute of Technology' |
| 2 | 'University of Michigan' | 'Stanford University' |
| 3 | 'Columbia University' | 'University of California, Berkeley' |
| 4 | 'University of California, Berkeley' | 'Harvard University' |
| 5 | 'Carnegie Mellon University' | 'Carnegie Mellon University' |
| 6 | 'University of Washington' | 'University of Illinois at Urbana-Champaign' |
| 7 | 'Massachusetts Institute of Technology' | 'Cornell University' |
| 8 | 'University of Illinois at Urbana-Champaign' | 'Princeton University' |
| 9 | 'University of Texas at Austin' | 'University of Wisconsin-Madison' |
| 10 | 'University of Pennsylvania' | 'University of California, Los Angeles' |
| 11 | 'University of California, San Diego' | 'University of Washington' |
| 12 | 'Stanford University' | 'University of Texas at Austin' |
| 13 | 'Harvard University' | 'California Institute of Technology' |
| 14 | 'Cornell University' | 'Georgia Institute of Technology' |
| 15 | 'Texas A&M University' | 'The University of Chicago' |
| 16 | 'New York University' | 'University of Michigan' |
| 17 | 'Princeton University' | 'Yale University' |
| 18 | 'Boston University Graduate School' | 'The University of North Carolina at Chapel Hill' |
| 19 | 'Duke University' | 'Brown University' |
| 20 | 'Northwestern University' | 'Columbia University' |
| 21 | 'University of Wisconsin-Madison' | 'University of Minnesota-Minneapolis' |
| 22 | 'University of Southern California' | 'Purdue University' |
| 23 | 'University of Minnesota-Minneapolis' | 'University of Georgia' |
| 24 | 'North Carolina State University' | 'Rutgers University, New Brunswick' |
| 25 | 'Purdue University' | 'University of Massachusetts Amherst' |
| 26 | 'University of California, Davis' | 'The University of Connecticut' |
| 27 | 'University of California, Los Angeles' | 'The Ohio State University' |
| 28 | 'The Pennsylvania State University' | 'University of Southern California' |
| 29 | 'The University of Chicago' | 'Duke University' |
| 30 | 'The Johns Hopkins University' | 'University of Pennsylvania' |
| 31 | 'State University of New York at Stony Brook' | 'New York University' |
| 32 | 'Rutgers University, New Brunswick' | 'University of Florida' |
| 33 | 'The University of Connecticut' | 'University of California, Irvine' |
| 34 | 'California Institute of Technology' | 'University of Pittsburgh' |
| 35 | 'University of Maryland College Park' | 'Rice University' |
| 36 | 'University of Oregon' | 'Northwestern University' |
| 37 | 'Rensselaer Polytechnic Institute' | 'University of Maryland College Park' |
| 38 | 'University of California, Irvine' | 'University of California, Santa Barbara' |
| 39 | 'Rice University' | 'University of Colorado at Boulder' |
| 40 | 'University of Florida' | 'The Johns Hopkins University' |
| 41 | 'University of California, Santa Barbara' | 'The Pennsylvania State University' |
| 42 | 'Yale University' | 'University of California, Santa Cruz' |
| 43 | 'University of Pittsburgh' | 'University of California, Davis' |
| 44 | 'Lehigh University' | 'Emory University' |
| 45 | 'University of Virginia' | 'North Carolina State University' |
| 46 | 'Northeastern University' | 'City University of New York' |
| 47 | 'University of Massachusetts Amherst' | 'The University of Rochester' |
| 48 | 'University of Utah' | 'Dartmouth College' |
| 49 | 'Washington University' | 'University of Kansas' |
| 50 | 'The University of North Carolina at Chapel Hill' | 'University of Texas at Houston' |
| 51 | 'Iowa State University' | 'University of Notre Dame' |
| 52 | 'Brown University' | 'Iowa State University' |
| 53 | 'Virginia Polytechnic Institute and State University' | 'Southern Methodist University' |
| 54 | 'University of Nebraska-Lincoln' | 'State University of New York at Stony Brook' |

| | | |
|-----|---|---|
| 55 | 'Polytechnic University' | 'The George Washington University' |
| 56 | 'University of Houston' | 'Old Dominion University' |
| 57 | 'University of Kentucky' | 'Boston University Graduate School' |
| 58 | 'Kansas State University' | 'Washington University' |
| 59 | 'University of South Carolina' | 'University of Utah' |
| 60 | 'George Mason University' | 'University of Southern Mississippi' |
| 61 | 'Bowling Green State University' | 'Colorado State University' |
| 62 | 'University of Georgia' | 'The Florida State University' |
| 63 | 'University of California, Santa Cruz' | 'University of New Mexico' |
| 64 | 'The University of Rochester' | 'Polytechnic University' |
| 65 | 'University of Cincinnati' | 'Indiana University' |
| 66 | 'The Ohio State University' | 'Michigan State University' |
| 67 | 'Emory University' | 'George Mason University' |
| 68 | 'University of Iowa' | 'Rensselaer Polytechnic Institute' |
| 69 | 'Worcester Polytechnic Institute' | 'New Jersey Institute of Technology' |
| 70 | 'Wesleyan University' | 'University of California, San Diego' |
| 71 | 'Michigan State University' | 'University of Iowa' |
| 72 | 'University of Colorado at Boulder' | 'Virginia Polytechnic Institute and State University' |
| 73 | 'Vanderbilt University' | 'University of Arizona' |
| 74 | 'State University of New York at Albany' | 'Texas A&M University' |
| 75 | 'University of Illinois at Chicago' | 'University of Maryland Baltimore County' |
| 76 | 'The University of Texas at Dallas' | 'Case Western Reserve University' |
| 77 | 'Illinois Institute of Technology' | 'The University of Texas at Dallas' |
| 78 | 'Arizona State University' | 'University of Illinois at Chicago' |
| 79 | 'University of Delaware' | 'University of Nebraska-Lincoln' |
| 80 | 'Indiana University' | 'Oregon State University' |
| 81 | 'The Florida State University' | 'Claremont Graduate University' |
| 82 | 'Oregon State University' | 'University of Wyoming' |
| 83 | 'University of Texas at Arlington' | 'University of South Carolina' |
| 84 | 'Brandeis University' | 'University of Tennessee - Knoxville' |
| 85 | 'University of Missouri - Kansas City' | 'Texas Tech University' |
| 86 | 'University of South Florida' | 'Missouri University of Science and Technology' |
| 87 | 'University of New Hampshire' | 'The University of Oklahoma' |
| 88 | 'Claremont Graduate University' | 'Illinois State University' |
| 89 | 'University of Massachusetts Lowell' | 'University of Texas at San Antonio' |
| 90 | 'Claremont Graduate University' | 'Illinois Institute of Technology' |
| 91 | 'Rutgers University, Newark' | 'University of Louisiana at Lafayette' |
| 92 | 'University of Maryland Baltimore County' | 'Tulane University' |
| 93 | 'Colorado State University' | 'University of Texas at Arlington' |
| 94 | 'University of New Mexico' | 'Bowling Green State University' |
| 95 | 'Southern Methodist University' | 'Western Michigan University' |
| 96 | 'University of the Incarnate Word' | 'University of Alabama-Birmingham' |
| 97 | 'Florida International University' | 'Medical College of Wisconsin' |
| 98 | 'Clemson University' | 'Kent State University' |
| 99 | 'State University of New York at Buffalo' | 'University of California, Riverside' |
| 100 | 'Missouri University of Science and Technology' | 'New Mexico State University' |
| 101 | 'University of Alabama-Birmingham' | 'University of New Hampshire' |
| 102 | 'Case Institute of Technology' | 'Rutgers University, Newark' |
| 103 | 'The George Washington University' | 'State University of New York at Binghamton' |
| 104 | 'University of California, Riverside' | 'The American University' |
| 105 | 'University of Notre Dame' | 'University of Montana' |
| 106 | 'Oakland University' | 'University of Central Florida' |
| 107 | 'University of Northern Colorado' | 'Stevens Institute of Technology' |
| 108 | 'DePaul University' | 'University of South Florida' |
| 109 | 'Case Western Reserve University' | 'University of Mississippi' |
| 110 | 'University of Arkansas' | 'State University of New York at Buffalo' |

| | | |
|-----|--|--|
| 111 | 'New Jersey Institute of Technology' | 'Claremont Graduate University' |
| 112 | 'The University of Oklahoma' | 'Portland State University' |
| 113 | 'University of Vermont' | 'Vanderbilt University' |
| 114 | 'Drexel University' | 'North Dakota State University' |
| 115 | 'Virginia Commonwealth University' | 'University of Dayton' |
| 116 | 'University of Alabama in Huntsville' | 'DePaul University' |
| 117 | 'The College of William and Mary' | 'Montana State University' |
| 118 | 'Dartmouth College' | 'Michigan Technological University' |
| 119 | 'Texas Tech University' | 'Brescia University' |
| 120 | 'City University of New York' | 'Syracuse University' |
| 121 | 'Mississippi State University' | 'University of Wisconsin-Milwaukee' |
| 122 | 'Tufts University' | 'University of Texas at El Paso' |
| 123 | 'University of Wisconsin-Milwaukee' | 'University of the Incarnate Word' |
| 124 | 'Syracuse University' | 'University of Cincinnati' |
| 125 | 'University of Arizona' | 'Brandeis University' |
| 126 | 'Brescia University' | 'Clemson University' |
| 127 | 'North Dakota State University' | 'University of North Texas' |
| 128 | 'University of Colorado at Denver' | 'Tufts University' |
| 129 | 'Oklahoma State University' | 'University of Denver' |
| 130 | 'University of Denver' | 'Oakland University' |
| 131 | 'The American University' | 'University of Colorado at Denver' |
| 132 | 'University of Missouri - Columbia' | 'University of North Carolina at Charlotte' |
| 133 | 'Wayne State University' | 'The Louisiana State University' |
| 134 | 'University of North Carolina at Charlotte' | 'University of Nevada, Las Vegas' |
| 135 | 'Illinois State University' | 'University of Missouri - Columbia' |
| 136 | 'University of Nevada, Las Vegas' | 'Arizona State University' |
| 137 | 'University of Nevada, Reno' | 'University of Vermont' |
| 138 | 'Montana State University' | 'Wesleyan University' |
| 139 | 'The Louisiana State University' | 'Wayne State University' |
| 140 | 'University of Central Florida' | 'University of Nevada, Reno' |
| 141 | 'University of Louisville' | 'Drexel University' |
| 142 | 'Auburn University' | 'Southern Illinois University at Carbondale' |
| 143 | 'New Mexico School of Mining and Technology' | 'Northern Illinois University' |
| 144 | 'Colorado School of Mines' | 'University of Oregon' |
| 145 | 'New Mexico State University' | 'Northeastern University' |
| 146 | 'University of Kansas' | 'University of Houston' |
| 147 | 'University of North Texas' | 'University of Kentucky' |
| 148 | 'University of Dayton' | 'Auburn University' |
| 149 | 'The Catholic University of America' | 'University of Northern Colorado' |
| 150 | 'Stevens Institute of Technology' | 'Florida International University' |
| 151 | 'Portland State University' | 'New Mexico School of Mining and Technology' |
| 152 | 'Tulane University' | 'West Virginia University' |
| 153 | 'University of Mississippi' | 'University of Delaware' |
| 154 | 'Northern Illinois University' | 'The Catholic University of America' |
| 155 | 'Kent State University' | 'University of Missouri - Kansas City' |
| 156 | 'State University of New York at Binghamton' | 'Virginia Commonwealth University' |
| 157 | 'West Virginia University' | 'State University of New York at Albany' |
| 158 | 'University of Southern Mississippi' | 'Colorado School of Mines' |
| 159 | 'University of Tennessee - Knoxville' | 'Kansas State University' |
| 160 | 'Old Dominion University' | 'Louisiana Tech University' |
| 161 | 'Medical College of Wisconsin' | 'University of Massachusetts Lowell' |
| 162 | 'University of Montana' | 'Case Institute of Technology' |
| 163 | 'University of Texas at El Paso' | 'The College of William and Mary' |
| 164 | 'Michigan Technological University' | 'University of Virginia' |
| 165 | 'University of Texas at Houston' | 'University of Louisville' |
| 166 | 'Louisiana Tech University' | 'Lehigh University' |

| | | |
|-----|--|---------------------------------------|
| 167 | 'University of Louisiana at Lafayette' | 'University of Alabama in Huntsville' |
| 168 | 'Southern Illinois University at Carbondale' | 'Baylor University' |
| 169 | 'University of Wyoming' | 'Worcester Polytechnic Institute' |
| 170 | 'Western Michigan University' | 'Mississippi State University' |
| 171 | 'Baylor University' | 'University of Arkansas' |
| 172 | 'University of Texas at San Antonio' | 'Oklahoma State University' |

References

- [1] R. Dean Malmgren, Julio M. Ottino, and Luís A. Nunes Amaral The role of mentorship in protégé performance *Nature*, 465 : 622-626, 2010.
- [2] Climbing Math's Family Tree *Science*, 285 (5436) : 2027, 1999.
- [3] Mark E. J. Newman The structure and Function of Complex Networks *SIAM Review*, 45 : 167-256, 2003.
- [4] Steve H. Strogatz Exploring Complex Networks *Nature*, 410: 268-276, 2001.
- [5] Complex networks: The Key To Systems Biology *Genet. Mol. Biol.* 31: 3, 2008
- [6] Schweizer, T. and White, D. R. (Eds) *Kinship, Networks, and Exchange*. Cambridge University Press, Cambridge, 1998.
- [7] Mark E. J. Newman *Networks: An introduction*. Oxford University Press, Oxford, 2010.
- [8] Boccaletti et al. Synchronization in dynamical network: Evolution along commutative graphs *Phys. Rev. E*74: 016102, 2006.
- [9] Jari Saramäki, Mikko Kivelä, Jukka-Pekka Onnela, Kimmo Kaski, and János Kertész Generalizations of the clustering coefficient to weighted complex networks *Physical Review E*, 75(2) : 1539-3755, 2007.
- [10] Gradshteyn, I. S. and Ryzhik, I. M. *Tables of Integrals, Series, and Products* CA: Academic Press, San Diego, 2000.
- [11] The Perron-Frobenius Theorem and the Ranking of Football Teams *SIAM Review*, 35: 80-93, 1993.
- [12] Brian Karrer and Mark E. J. Newman Random acyclic networks *Phys. Rev. Lett* 102 : 128701, 2009.