

# Report of 2021 AI 2000 World Most Influential Scholars



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## Key Points

Based on the 2021 List of World Most Influential Scholars in Artificial Intelligence (AI 2000) jointly released by AMiner team of Tsinghua University, Chinese Association of Artificial Intelligence, Beijing Academy of Artificial Intelligence and Tsinghua-China Academy of Engineering Knowledge and Intelligence Joint Research Center, this report provides a comprehensive and in-depth analysis of the world most influential scholars in the field of artificial intelligence to show the current global pool of leading AI talents.

- Scholars on this list feature higher academic level, obvious geographical clustering, and tend to be more cross-disciplinary.
- Compared with last year, the number of American scholars on the AI 2000 decreased, but still lead the world.
- Computer vision and machine learning are two sub-fields where scholars' citation amount leads the entire AI.
- Many American scholars in the field of artificial intelligence are on the list. Tsinghua University has the most listed scholars in the sub-fields of Internet of Things and classical AI.
- Machine learning, robotics, information retrieval and recommendation and computer vision are four most difficult sub-fields for scholars to be listed on the AI 2000.

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# 1 Overview

This report analyzes the most influential talents in the field of artificial intelligence based on the “2021 AI Most Influential Scholar Annual List” released by the AMiner team of Tsinghua University, China, which is detailed in the appendix. The report has been co-released by Tsinghua-Chinese Academy of Engineering Knowledge Intelligence Joint Research Center, Knowledge Intelligence Center of Artificial Intelligence Research Institute of Tsinghua University, and China Association of Artificial Intelligence, data supported by AMiner database and Zhipu·AI.

## 1.1 Introduction to AI 2000

The AI World Most Influential Scholar Annual List (hereinafter referred to as AI 2000) aims to name 2,000 top and most influential scholars in the discipline of artificial intelligence around the world through AMiner academic database over the next 10 years. The 2021 list of AI 2000 has been selected from a total of 178,254 papers and 204,483 authors collected by 49 top international AI-related journals or proceedings over the ten years from 2011 to 2020. Following the principles of objectivity, fairness and openness, the 2021 list has been automatically generated from **Tsinghua AMiner academic data** (<https://aminer.org>) by AI algorithms, and conferred to scholars in recognition of their outstanding achievements and contributions. The top 10 most-cited scholars from the top venues of their respective subject fields over the past 10 years have been named as “**AI 2000 Most Influential Scholars**” and the top 11-100 scholars have been named as “**AI 2000 Most Influential Scholar Honorable Mention.**”

## 1.2 Selection Rules

### 1.2.1 Research Field Division of Artificial Intelligence

Artificial intelligence is a branch of computer science, as well as a cross-discipline. In recent years, its connotation and extension have also been constantly changing, and

emerging sub-fields keep coming up. When generating the list, we have comprehensively referred the classification methods of disciplines by recognized authoritative organizations in the field of computer science, such as Association for Computing Machinery (ACM), China Computer Federation (CCF) and the Institute of Electrical and Electronics Engineers (IEEE), as well as integrated suggestions of domestic and foreign experts and scholars. Twenty sub-fields of AI research are determined as *Classical AI*, *Machine Learning*, *Computer Vision*, *Natural Language Processing*, *Robotics*, *Knowledge Engineering*, *Speech Recognition*, *Data Mining*, *Information Retrieval and Recommendation*, *Databases*, *Human-Computer Interaction*, *Computer Graphics*, *Multimedia*, *Visualization*, *Security And Privacy*, *Computer Networks*, *Computer Systems*, *Computing Theory*, *Chip Technology* and *the Internet of Things*, as shown in Figure 1-1.

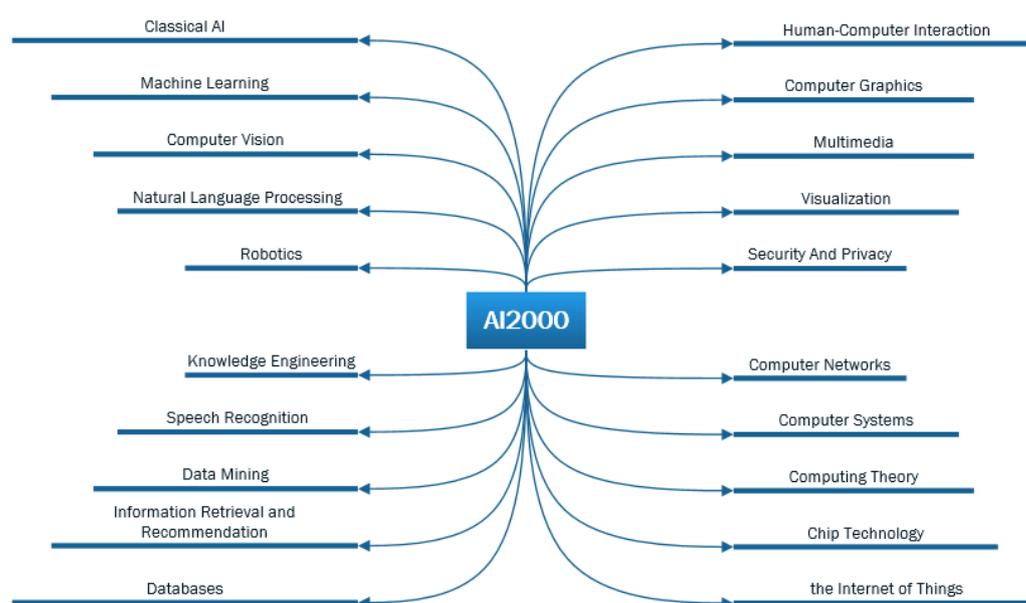


Figure 1-1 AI 2000 Artificial Intelligence Sub-Field Map

## 1.2.2 Source Selection of AI-Related Journals and Conferences

Data sources have been selected from the top journals and conference proceedings of each sub-field according to the "CCF Recommended International Academic Journals and Conference Directory" and the ACM Computer Science Classification

System. Additionally, top journals and conference proceedings in newly emerging disciplines have been supplemented by considering opinions of relevant experts and groups. A total of 49 top journals and conferences have been applied for the 20 sub-fields in 2021, which is shown in Table 1-1.

Table 1-1 Journals and Conferences of sub-fields in AI 2000

Sub-field	Journal or Conference
Classical AI	International Joint Conference on Artificial Intelligence
Computational Theory	ACM Symposium on Theory of Computing
	IEEE Symposium on Foundations of Computer Science
Security and privacy	ACM Conference on Computer and Communications Security
	IEEE Symposium on Security and Privacy
	Usenix Security Symposium
Human-Computer Interaction	ACM Conference on Human Factors in Computing Systems
	Computer Supported Cooperative Work
Visualization	IEEE Transactions on Visualization and Computer Graphics
	IEEE Visualization Conference
Information Retrieval and Recommendation	International Conference on Research on Development in Information Retrieval
	ACM Recommender Systems
	International World Wide Web Conferences
Machine Learning	Annual Conference on Neural Information Processing Systems
	International Conference on Machine Learning
	International Conference on Learning Representations
	Journal of Machine Learning Research
Data Mining	ACM Knowledge Discovery and Data Mining
	ACM International Conference on Web Search and Data Mining
Knowledge Engineering	IEEE International Semantic Web Conference
	International Conference on International Conference on Principles of Knowledge Representation and Reasoning
Computer Vision	IEEE Conference on Computer Vision and Pattern Recognition
	International Conference on Computer Vision
	European Conference on Computer Vision
	IEEE Transactions on Pattern Analysis and Machine Intelligence
Computer Graphics	ACM SIGGRAPH Annual Conference
	ACM Transactions on Graphics
Natural Language Processing	Annual Meeting of the Association for Computational Linguistics
	Conference on Empirical Methods in Natural Language Processing
	The Annual Conference of the North American Chapter of the Association for Computational Linguistics
Speech Recognition	IEEE International Conference on Acoustics, Speech and SP
Robotics	IEEE International Conference on Robotics and Automation
	IEEE\RSJ International Conference on Intelligent Robots and Systems
Database	ACM Conference on Management of Data

Sub-field	Journal or Conference
	International Conference on Very Large Data Bases
Multimedia	ACM International Conference on Multimedia
Computer System	ACM Symposium on Operating Systems Principles
	USENIX Symposium on Operating Systems Design and Implementations
Internet of Things	IEEE Internet of Things Journal
	IEEE Transactions on Wireless Communications
Chip Technology	International Solid-State Circuits Conference
	Design Automation Conference
	ACM/SIGDA International Symposium on Field-Programmable Gate Arrays
	High-Performance Computer Architecture
	International Symposium on Computer Architecture
	International Conference for High Performance Computing, Networking, Storage, and Analysis
Computer Network	ACM International Conference on Mobile Computing and Networking
	ACM International Conference on the applications, technologies, architectures, and protocols for computer communication

### 1.2.3 Selection Rules of AI 2000 List

The AI 2000 covers the 20 sub-fields of artificial intelligence mentioned above. Specifically, 10 winners for each sub-field are selected annually, referring to their citations of papers published by the most influential journals and conferences over the past 10 years. The AI 2000 list is automatically generated with intelligent algorithms through data collected in the AMiner system. The specific algorithm formula is as follows.

$$n = 1: p_1 = 100\%$$

$$n > 1: p_k = \frac{\frac{1}{\delta}}{\sum_{m=1}^{n-1} \frac{1}{m} + \frac{1}{2}}, (k < n/\delta = k, k = n/\delta = 2)$$

In the formula,  $p$  represents the weight coefficient of an author's citation in a certain paper;  $n$  represents the number of authors of a paper;  $k$  represents the  $k$ -th author of a paper. If a paper has only one author, then  $n=1, p=1$ ; if a paper has multiple authors, then  $n>1$ , using the  $p_k$  calculation formula. The distribution of weight coefficient for each author in a certain paper's citations is shown in Figure 12 when the number of authors increases.

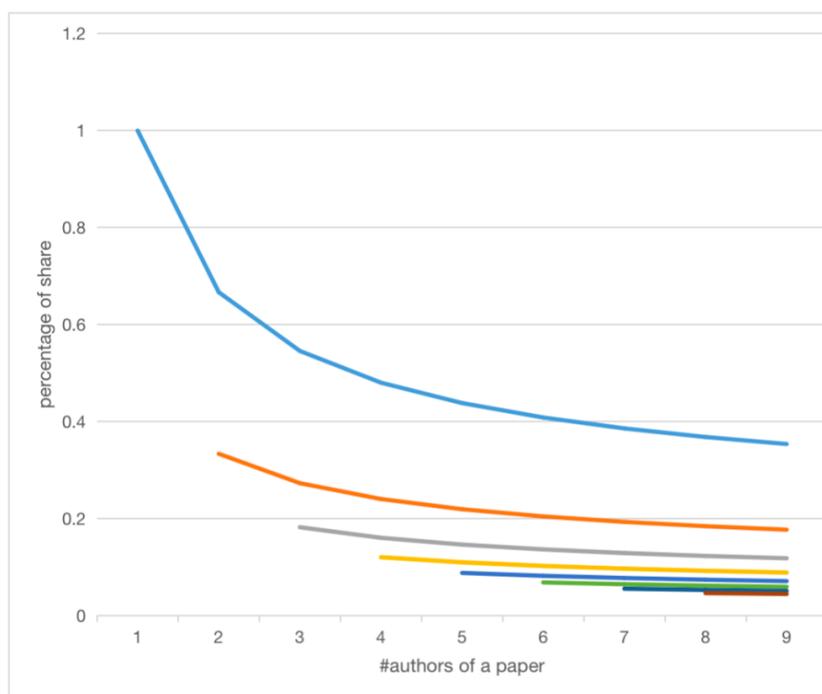


Figure 1-2 Distribution of weight coefficients of paper citations occupied by authors of different ranks in a paper

The 2021 list has been made from papers in 49 international journals or conference proceedings covering the 20 sub-fields of artificial intelligence over years from 2011 to 2020. Citations on Google Scholar have been referred by the end of March 29, 2021.

### 1.3 Candidates of AI 2000 in 2021

A total of 178,254 journal or conference papers and 204,483 scholar candidates have been evaluated for the 2021 AI 2000. The TOP three sub-fields of paper volumes are computer vision, machine learning, and robotics, reflecting their more research outputs. And there are more on-list scholars in the sub-fields of machine learning, robotics, information retrieval and recommendation, and computer vision, with more than 19,000 each.

Table 1-2 Journals and conferences of AI sub-fields in AI 2000

Sub-fields	Papers selected	Scholar candidates (person)
Computer vision	22,853	19366
Machine learning	20,521	21646
Robotics	18,299	19948
Speech recognition	15,187	16829

Classic AI	14,272	17159
Human-computer interaction	12,094	12497
Natural language processing	11,350	8044
Information retrieval and recommendation	10,533	19428
Internet of Things	9,509	9876
Chip technology	7,779	16231
Computer graphics	6,225	5103
Security and privacy	6,061	6804
Data mining	4,346	7075
Multimedia	4,069	5082
Knowledge engineering	3,704	3568
database	3,113	4234
Computer network	3,026	4588
Visualization	2,619	3946
Computational theory	2,088	1800
Computer system	606	1259

## 2 Overall Analysis

The 2021 AI 2000 most influential scholars (200) and nominated scholars (1800) are from different institutions around the world. Since one scholar may be nominated in more than one sub-field, the number of 2021 AI 2000 scholars totals 1,651 after de-duplication.

### 2.1 Gender Characteristics of AI 2000 Scholars

#### 2.1.1 More Men Than Women Scholars on the AI 2000 list

There are still more men than women scholars on the AI 2000 list of 2021. Male scholars take the majority in all sub-fields of AI, with a total of 1,774 person-times, accounting for 88.6%; female scholars take a total of 180 person-times, which is fewer than males. Considering one same scholar may have been selected in several sub-fields, there are 1501 males and 154 female scholars after de-duplication. The male-to-female ratio on the 2021 list is about 9:7:1.

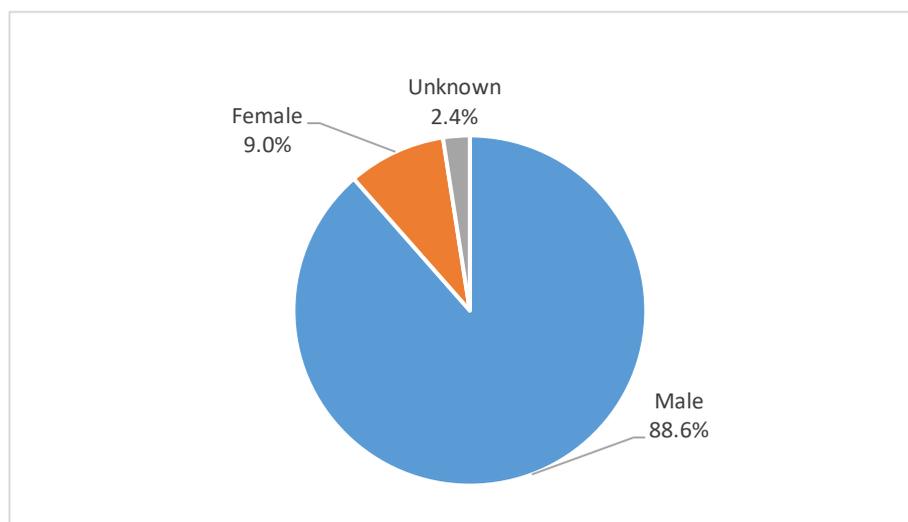


Figure 2-1 Gender distribution of AI 2000 scholars

### 2.1.2 More Female on the TOP 10s of Visualization and HCI

Generally speaking, male scholars dominate on the TOP10 of all sub-fields as well as on the overall list of AI 2000. Especially, the top 10 scholars of “AI 2000 Most Influential Scholar” are all male in the 10 areas of Classical AI, machine learning, robotics, data mining, databases, computer graphics, multimedia, and the Internet of Things.

There are 16 women among the 200 scholars of " AI 2000 Most Influential Scholar " this year, accounting for 8%. They are distributed in the 10 AI sub-fields including human-computer interaction, visualization, security and privacy. In particular, the sub-field of visualization has the most female scholars of “World's Most Influential Scholar” award, with a total of four female scholars. Secondly, three female scholars have appeared in the field of human-computer interaction. Thirdly, there are two women scholars in the field of security and privacy, which is followed by computer networks, knowledge engineering, and natural language processing with one female scholar each. As shown in Figure 2-2, no female scholar appears on the top ten of the other 10 fields such as machine learning, information retrieval and recommendation, and computer vision this year.

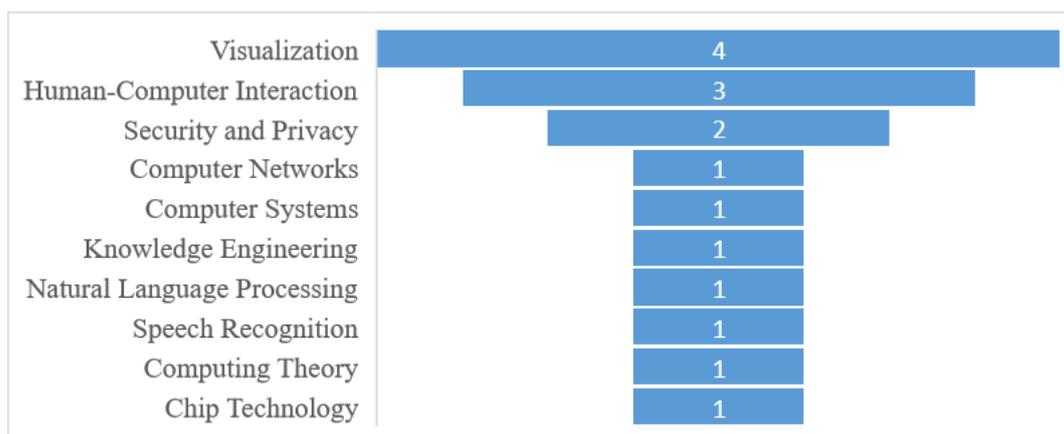


Figure 2-2 Distribution of AI 2000 Most Influential Female Scholars

### 2.1.3 Less Female Scholars in Machine Learning Than Other Fields

It is particularly prominent for the field of machine learning in which male scholars take the majority. There are only two female scholars in the machine learning field, who have been respectively nominated as the 47th and 96th "Most Influential Scholars Honorable Mention". They are Jamie Kiros, founder of Ezis Technologies, and Raquel Urtasun of the University of Toronto, Canada. Human-computer interaction is an AI sub-field in which female scholars appear more often, and there are 28 female scholars on its list.

Table 2-3 Number of female AI2000 scholars on list

Sub-Field	Number of women	Sub-Field	Number of women
Human-computer interaction	28	Database	8
Visualization	19	Data mining	7
Security and privacy	11	Computational theory	7
Knowledge engineering	11	Computer system	4
Natural language processing	11	Computer vision	8
Classic AI	11	Computer graphics	4
Chip technology	10	Speech recognition	4
Multimedia	8	Robotics	4
Information retrieval and re commendation	8	Internet of Things	4
Computer network	8	Machine learning	2

## 2.1.4 MIT Female Scholar Ranking No. One in Computing

### Theory

It is worth noting that Virginia Vassilevska Williams, a female scholar from Massachusetts Institute of Technology in the United States, has been successfully ranked the first of “Most Influential Scholars” in the field of computational theory, because her 15 papers have been selected with a total citation of 2,157 times. She is also the only female scholar to win the top prize in AI 2000. Her academic portrait in Aminer is shown as below.

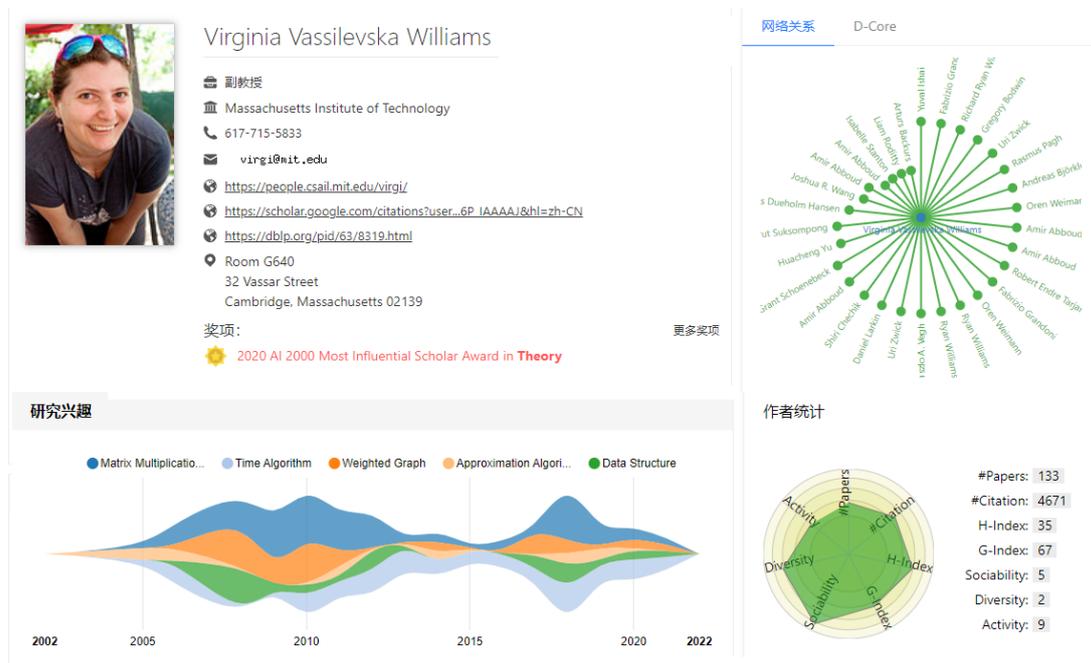


Figure 2 4 Academic portrait of Virginia Vassilevska William from MIT, the only female scholar with the first prize in AI 2000

## 2.2 Country Analysis of AI 2000 Scholars

Scholars on the 2021 AI 2000 list are from more than 40 countries around the world. Especially, the United States in North America has the most AI scholars and is competitive in multiple AI sub-fields.

### 2.2.1 AI 2000 Scholars From 41 Countries

According to institution geographical location of a scholar's affiliation, a global distribution map of all AI 2000 scholars is drawn as Figure 2-5, in which different colors represent different regions, and the icon size represents the number of scholars.

The result shows that AI 2000 scholars selected this year came from 41 countries around the world, covering Asia, Europe, Oceania and America continents. From a geographical perspective, AI 2000 scholars are mainly located in the United States of North America; there are also a certain number of scholars in central and western Europe; Asian talents are mainly located in regions such as China, Singapore, Japan and South Korea; the number of scholars in other regions such as South America and Africa is scarce.

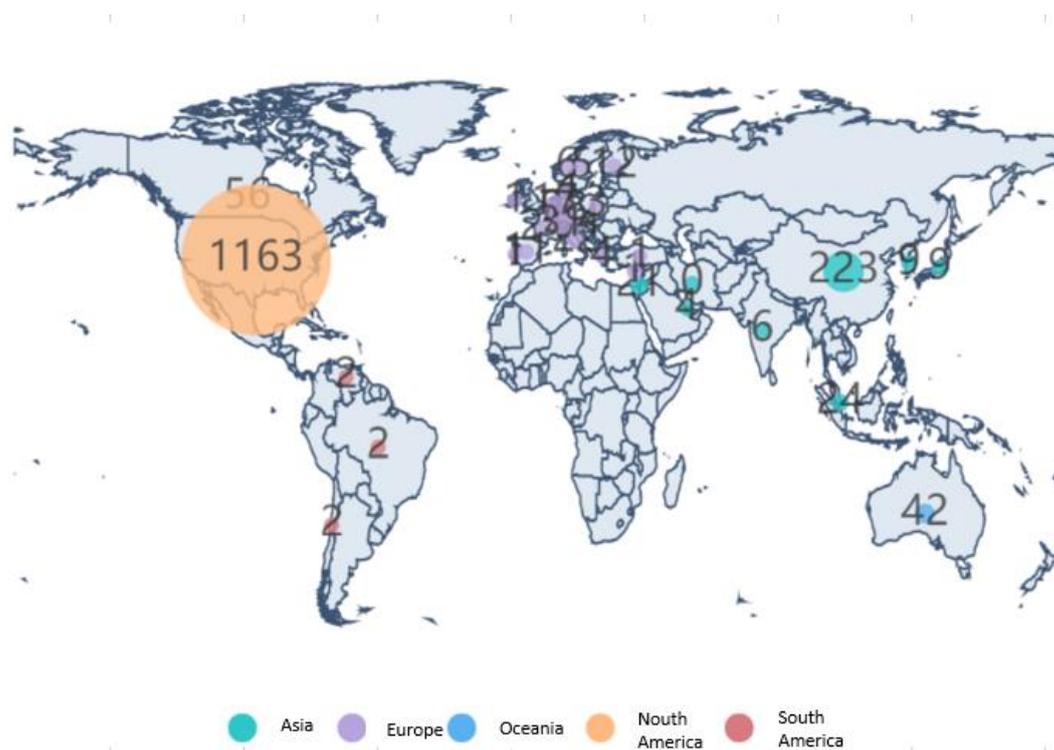


Figure 2-5 Geographical distribution of AI 2000 scholars

### 2.2.2 The Number of US Scholars on the List Lower Than Last Year but Still on Top

The United States has the most AI 2000 scholars than other countries, with 1163

person-times, and a percentage of 58.2%. More than half of AI 2000 scholars are from the US, which is more than 5 times as the number of the No. 2 country. However, the number of US scholars on the 2021 list has dropped by 6.5% than last year. China ranks the second after the US, with 223 scholars on the list, accounting for 11.2%. Germany ranks the third, with the most scholars in Europe; the number of scholars in other countries is all less than 100. TOP 10 countries with the most AI 2000 scholars are shown as Figure 2-6.

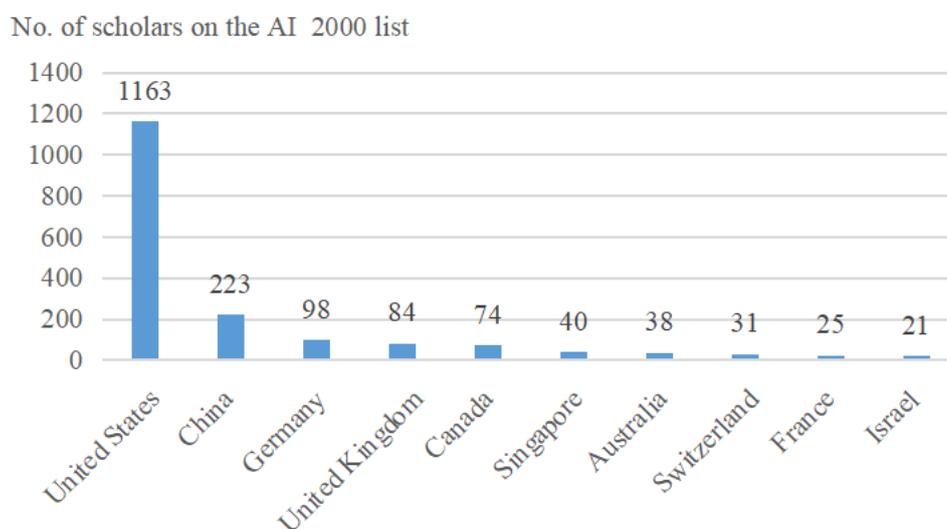


Figure 2-6 Top 10 countries with the most scholars on the AI 2000 list

### 2.2.3 Scholars' Citations in Computer Vision and Machine Learning Leading in AI

Citation is an important quantitative indicator for evaluating scholars' academic influence and paper quality. This report has analyzed citations of all scholars on the AI2000 list in all publications by field. It finds that citations of scholars in the sub-fields of both computer vision and machine learning have exceeded two million, and their influence has been highest among all artificial intelligence sub-fields. Citations of scholars in other fields are shown as Figure 2-7.

Ilya Sutskever has the most citations among all scholars on the list of machine learning. He comes from OpenAI in the United States with 220,625 citations. His

AMiner academic portrait is shown in Figure 2-8.

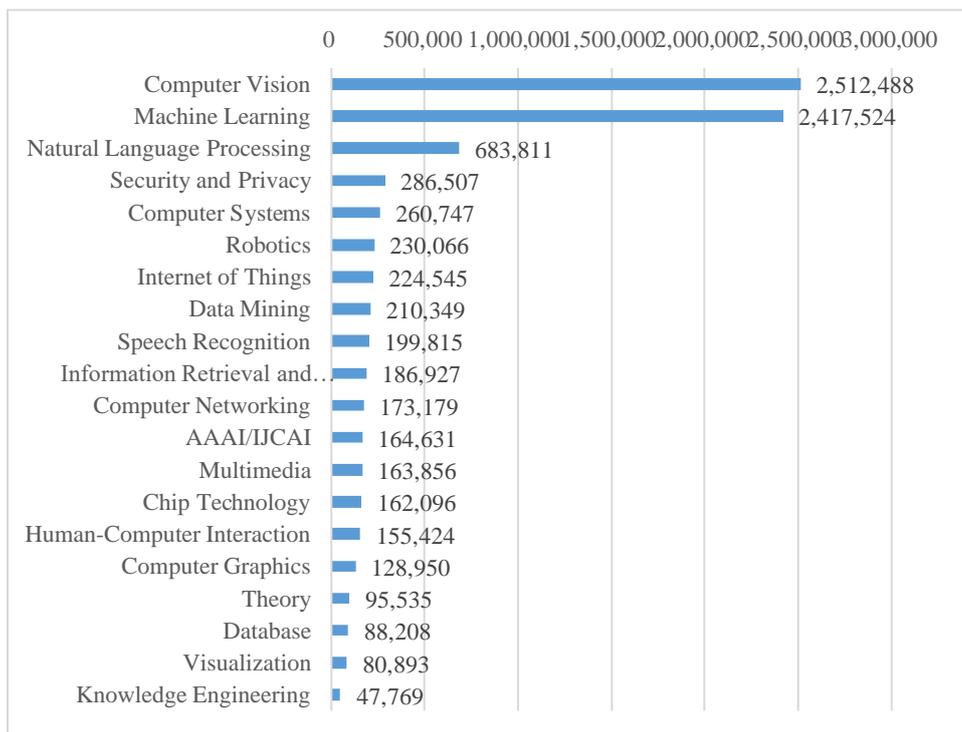


Figure 2 -7 Citations of scholars on the list of AI 2000 in sub-fields

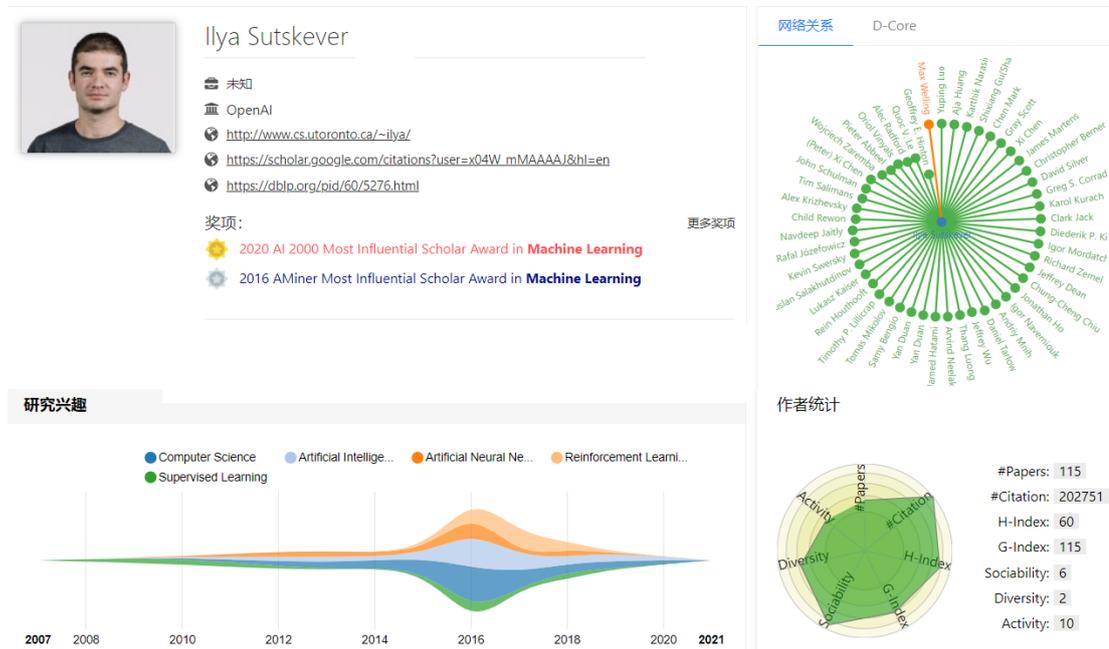


Figure 2-8 Ilya Sutskever of OpenAI, the most cited scholar in the 2021 AI 2000 list

## 2.2.4 Citations of US Scholars in Computer Vision About Three Times Those of China's

The most cited country in computer vision is the United States, followed by China and the United Kingdom, as shown in Figure 2-9. Scholars in the field of computer vision in the United States have the highest influence in the world, whose citations are more than twice the citations of the secondly-ranked China's scholars in the same field. In terms of personal citations, the most cited scholar in computer vision is Kaiming He from Facebook in the United States, with 182,655 citations and 63 selected papers.

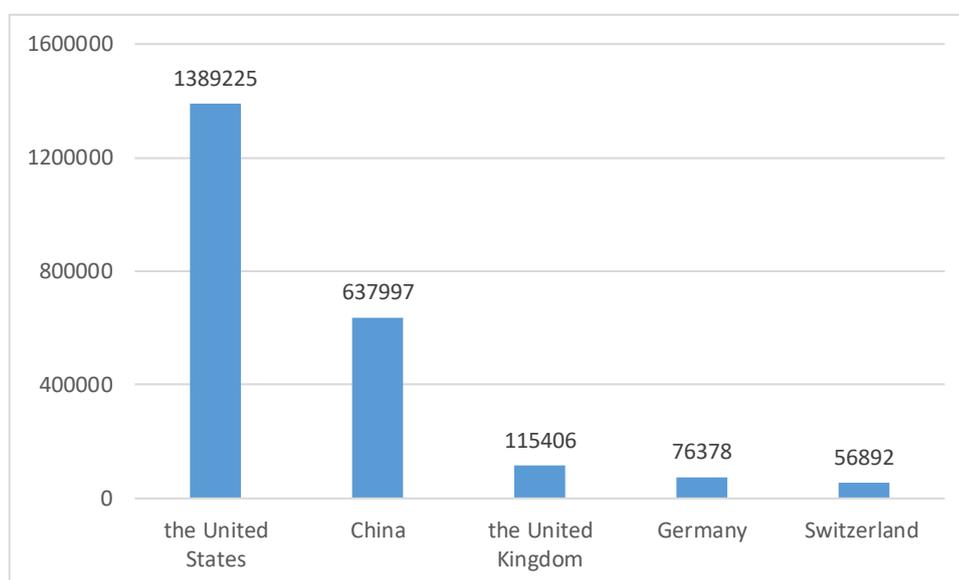


Figure 2-9 Top 5 Most Cited countries in the field of computer vision

## 2.2.5 Citations of Chinese Scholars in Machine Learning Less Than One-Tenth of American Scholars'

In the field of machine learning, the top five cited countries are the United States, Canada, the United Kingdom, China, and Germany, as shown in Figure 2-10. American scholars' citations rank the first in the world with a total of more than 160,000, significantly ahead of those of scholars from other countries. It demonstrates the strength of the United States in machine learning of artificial intelligence. The citations of Chinese scholars in machine learning are less than one-tenth of those of the US

scholars, reflecting their influence needs to be improved.

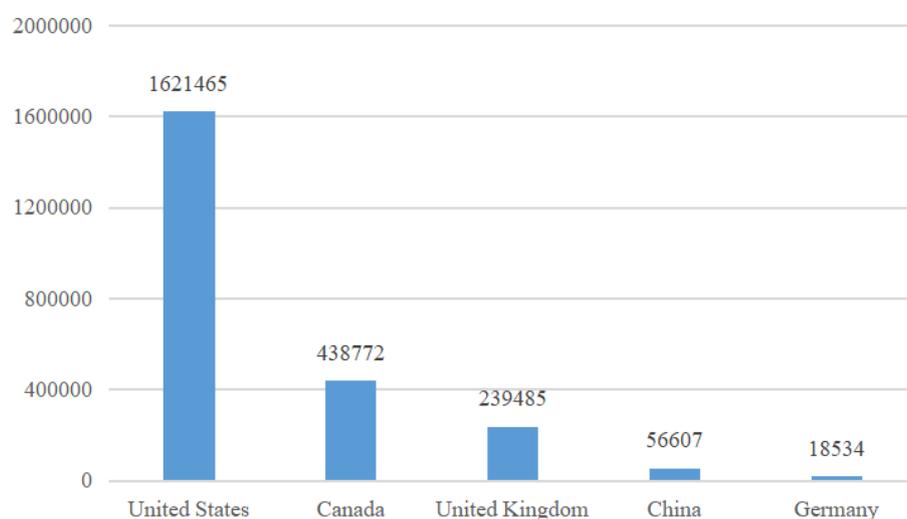


Figure 2-10 Top 5 cited countries in the field of machine learning

### 2.3 American Scholars Keeping Ahead in 16 Sub-Fields of AI

Most of the top talents in the 20 sub-fields of the AI 2000 list are located in the United States, followed by China, Singapore, Canada, Germany and other countries. The details of the first place in each field are shown in Table 2-1. Except the four sub-fields of the Internet of Things, speech recognition, multimedia and knowledge engineering, American talents stay on top of the other 16 AI sub-fields.

Table 2-1 Top talents in sub-fields of AI 2000

Field	Name	Affiliation	Country	h-index
Natural language processing	Christopher Manning	Stanford University	United States	126
Internet of Things	Rui Zhang	National University of Singapore	Singapore	109
Information retrieval and recommendation	Chengxiang Zhai	University of Illinois at Urbana-Champaign	United States	87
Computer vision	Kaiming He	Facebook	United States	63
Human-computer interaction	Jacob O. Wobbrock	Washington University	United States	62

computer system	Jianmin Chen	Cerebras Systems	United States	61
Machine learning	Ilya Sutskever	OpenAI	United States	60
Speech Recognition	Alex Graves	University of Toronto	Canada	54
Robotics	Radu Bogdan Rusu	Open Perception, Inc	United States	44
multimedia	Yangqing Jia	Alibaba	China	38
Knowledge engineering	Heiko Paulheim	University of Mannheim	Germany	34
Computational theory	Virginia Williams Vassilevska	Massachusetts Institute of Technology	United States	30
Security and privacy	Nicholas Carlini	Google	United States	27
Computer graphics	Michael Kazhdan	Johns Hopkins University	United States	26
Data mining	Tianqi Chen	Carnegie Mellon University	United States	25
computer network	Dinesh Bharadia	University of California, San Diego	United States	23
Database	Reynold S. Xin	Databricks	United States	21
Chip technology	Yu-Hsin Chen	Facebook	United States	20
Classic AI	Christian Szegedy	Google	United States	19
Visualization	Mike Bostock	Observable	United States	11

## 2.4 Analysis of Scholars' Institutions

The institutions to which the 2021 AI 2000 scholars are affiliated are mostly universities and colleges in various countries, as well as scientific research departments of high-tech companies. From the perspective of the number of scholars selected, companies such as Google and Microsoft have more AI scholars, whether they are awarded or nominated, than universities.

### 2.4.1 More AI Scholars From US Institutions on the List

The TOP10 research institutions in the number of AI 2000 scholars include nine

American institutions and one Chinese institution, as shown in Figure 2-11. The first place is Google Inc. of the United States, with a total of 135 people selected on the list. And it is also the only institution with more than one hundred scholars. Moreover, Google has 25 talents awarded as "Most Influential Scholars" and 110 talents as "Most Influential Scholars Honorable Mention". From the perspective of country distribution, Tsinghua University is the only Chinese institution on the TOP10, and the rest are US institutions. The overall number of scholars from US institutions is far ahead.

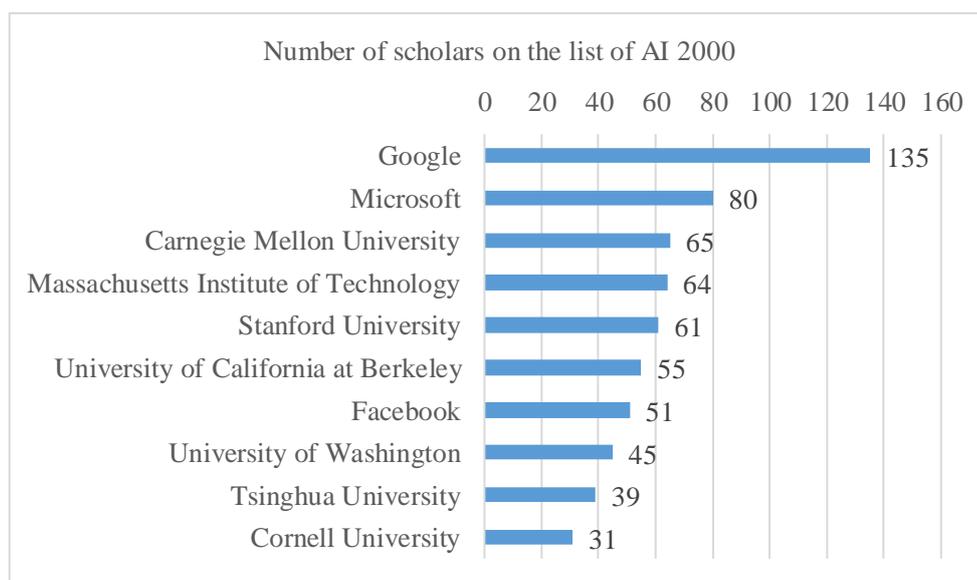


Figure 2-11 TOP10 institutions in the number of AI 2000 scholars

#### **2.4.2 Tsinghua University Proving to be the Institution with the Most Scholars in the Internet of Things and Classical AI**

There are 24 institutions with the most scholars in various sub-fields, including 13 commercial companies, such as Google or Microsoft, and 11 top universities, such as Massachusetts Institute of Technology and Stanford University.

The institutions with the largest number of scholars in the 17 sub-fields are all from the United States, including machine learning, speech recognition, data mining, natural language processing, and robotics, which demonstrates the rich scholar resources of American institutions in such fields. Two European universities have tied with American institutions in knowledge engineering, which are Ghent University in

Belgium and Leipzig University in Germany.

Institutions with the largest number of scholars in multimedia, Internet of Things, and Classical AI are from Asian countries instead of the US. In the multimedia field, both University of Electronic Science and Technology of China and National University of Singapore have the largest number of selected scholars; Tsinghua University of China has the largest number of selected scholars in fields of the Internet of Things and Classical AI.

Table 2-2 Institutions with the largest number of AI2000 scholars

Sub-field	Institutions with the most selected scholars	Number of selected scholars (persons)	Country of institution
<b>Machine learning</b>	Google	25	United States
<b>Speech recognition</b>	Google	24	United States
<b>Data mining</b>	Microsoft Corporation	10	United States
<b>Natural language processing</b>	Facebook	10	United States
<b>Robotics</b>	Massachusetts Institute of Technology	10	United States
<b>Computer system</b>	Google	9	United States
<b>Computer vision</b>	Google	9	United States
<b>Human-computer interaction</b>	University of Washington, Microsoft Corporation	9	United States
<b>Computational theory</b>	Massachusetts Institute of Technology	9	United States
<b>Database</b>	Microsoft Corporation	8	United States
<b>Computer network</b>	Microsoft Corporation	8	United States
<b>Classic AI</b>	Tsinghua University	7	China
<b>Security and privacy</b>	Google	7	United States
<b>Chip technology</b>	University of California, Los Angeles	7	United States
<b>Information retrieval and recommendation</b>	Microsoft Corporation	6	United States
<b>Computer graphics</b>	Massachusetts Institute of Technology	6	United States
<b>Visualization</b>	Microsoft Corporation	6	United States
<b>Multimedia</b>	University of Electronic Science and Technology of	5	China, Singapore

	China, National University of Singapore		
<b>Knowledge engineering</b>	Ghent University, Leipzig University, Google	4	Belgium, Germany, United States
<b>Internet of Things</b>	Tsinghua University	4	China

## 2.5 Analysis of Scholars' Achievements and Research Fields

The AI 2000 scholars have high h-index values and outstanding achievements in their scientific research. It is worth noting that some scholars' research directions cover multiple AI sub-fields. They have been successfully awarded because of their excellent achievements in these fields.

### 2.5.1 H-index Values of Scholars on the List Higher Than Last Year

H-index is a recognized indicator for evaluating scholars' academic achievements at home and abroad. The results show that the overall academic level of the 2021 AI 2000 scholars is higher than that of last year. The H-index distribution of AI 2000 scholars in 2021 is shown in Figure 2-12. There are 591 people with an H-index higher than 60, accounting for 29.6%, and an increase of 24.9% over the same interval in 2020.

Professor Jiawei Han from University of Illinois at Urbana-Champaign has the highest H-index in the current AI 2000, who has been listed in the sub-fields of data mining, database, information retrieval and recommendation. His H-index is 189. The portrait of Professor Han is shown in Figure 2-13.

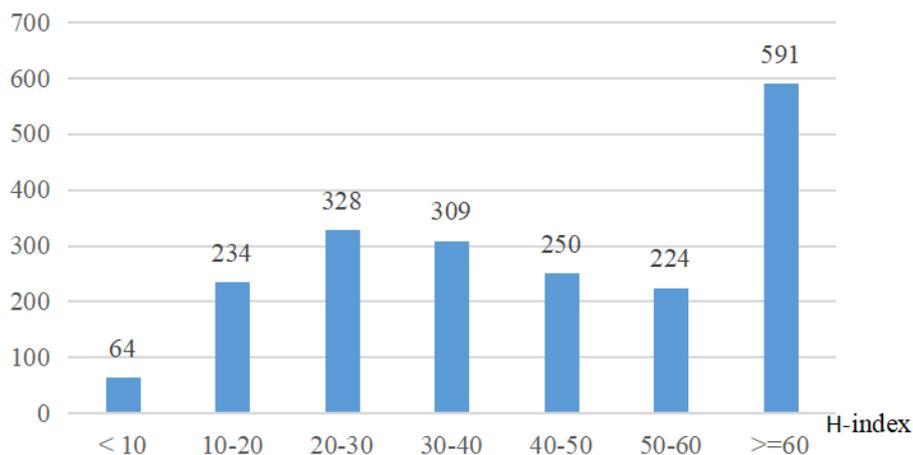


Figure 2-12 H-index distribution of AI 2000 scholars in 2021

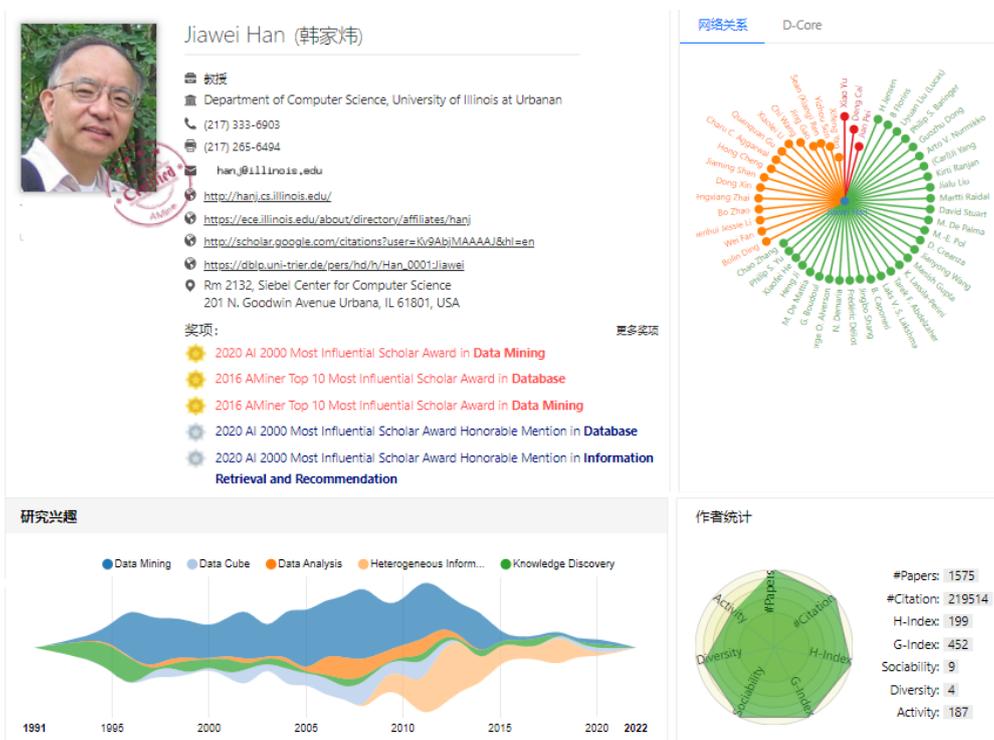


Figure 2-13 Academic portrait of Han Jiawei from University of Illinois with the highest H-index on the AI 2000 list

## **2.5.2 14% of Scholars on the List due to Their Outstanding Achievements in Multiple Sub-Fields of AI**

There are 278 scholars who have multiple research fields and achieved outstanding achievements among the AI 2000 scholars of 2021, accounting for 14% and with an increase of 88.6% over the previous year. Among them, one scholar has been listed in five sub-fields, five scholars have been listed in four sub-fields, and another 55 scholars have outstanding performance in three sub-fields, and 217 scholars have been on the list in two sub-fields.

It is Yoshua Bengio that is on the list in five sub-fields, who was the winner of the 2018 Turing Prize for his breakthroughs in deep neural network concepts and engineering. He is currently a professor at the University of Montreal in Canada. Yoshua Bengio's h-index value is as high as 188, and his 994 papers have been selected with 457,997 citations. Bengio has been selected for five areas of AI 2000 for his outstanding scientific research achievements in artificial intelligence. He has been awarded "AI 2000 Most Influential Scholar" in machine learning and natural language processing respectively, as well as the "AI 2000 Most Influential Scholar Honorable Mention" in the three fields of Classical AI, speech recognition and computer vision.

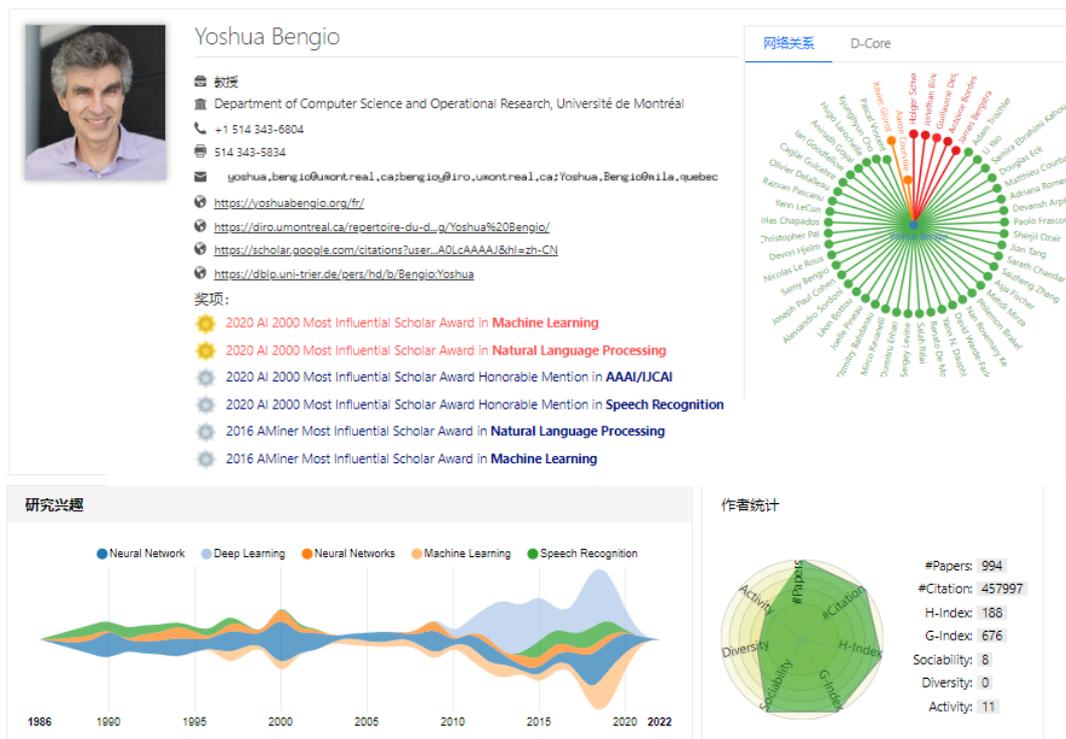


Figure 2-14 Academic portrait of AI 2000 scholar Yoshua Bengio

Among the five scholars listed on AI 2000 in four sub-fields, three scholars are from the United States, and the other two are from Australia and Germany. Additionally, there are two Chinese scholars among the five scholars. They are Yi Yang from University of Technology Sydney and Bing Liu from University of Illinois at Chicago, whose h-index values are both above 100. The details are shown in Table 2-3.

Table 2-3 Five scholars listed in four AI sub-fields of AI2000 in 2021

Name	Affiliation	Country	h-index	Listed areas
Yi Yang	University of Technology Sydney	Australia	103	Multimedia Computer vision Classical AI Database
Bing Liu	University of Illinois at Chicago	USA	100	Information retrieval and recommendation Natural language processing Classical AI Data mining
Gerhard Weikum	Max Planck Institute for	Germany	89	Information retrieval and recommendation

	Informatics			Natural language processing Classical AI Knowledge engineering
Quoc V. Le	Google	USA	85	Language recognition Computer vision Classical AI Machine learning
Carlos Guestrin	Apple	USA	78	Natural language processing Computer system Classical AI Data mining

### 2.5.3 Most Difficult Sub-Fields to be Listed Proving to be Machine Learning and Robotics

A total of 20,4483 global scholars have been evaluated for AI 2000 based on their papers published in top journals or conference proceedings in the field of artificial intelligence this year, and about 1% of scholars have been finally selected on the 2021 AI 2000 list. The scholar listing rate in the 10 sub-fields of computer systems, computational theory, knowledge engineering, computer networks, databases, and multimedia is above average. In contrast, the listing rate in computer vision, Classical AI, speech recognition and robotics is lower than the average.

Table 2-4 Listing Rate of scholars in AI 2000

Sub-Field	Number of scholar candidates (person)	AI2000 scholars' listing rate
Machine learning	21646	0.5%
Robotics	19948	0.5%
Information retrieval and recommendation	19428	0.5%
Computer vision	19366	0.5%
Classic AI	17159	0.6%
Speech recognition	16829	0.6%
Chip technology	16231	0.6%

Sub-Field	Number of scholar candidates (person)	AI2000 scholars' listing rate
Human-computer interaction	12497	0.8%
Internet of Things	9876	1.0%
Natural language processing	8044	1.2%
Data mining	7075	1.4%
Security and privacy	6804	1.5%
Computer graphics	5103	2.0%
Multimedia	5082	2.0%
Computer network	4588	2.2%
Database	4234	2.4%
Visualization	3946	2.5%
Knowledge engineering	3568	2.8%
Computational theory	1800	5.6%
Computer system	1259	7.9%

## 2.6 Technology Trend Analysis

The AI technology analysis can be taken as a reference for scholars to determine their future research directions or plans. Based on the AMiner technology analysis system (<http://trend.aminer.cn>), this report has conducted in-depth excavation of all papers and scholar information published on the top AI journals or proceedings over the past ten years, explored and analyzed the time trend of AI technology development, research trends in various countries and cross-border cooperation in scientific research.

### 2.6.1 Trend of Technology Development

The trend analysis of AI 2000 technology development is shown in Figure 2-15. In the figure, each color band represents a research topic, and its width represents the topic's popularity in the current year which is positively correlated with the number of relevant papers that year. Topics are ordered according to their popularity of that year

from high to low. From analysis of technology development trends, we can find that the current 10 hot research topics are: Deep Neural Network, Machine Learning, Feature Extraction, Social Media, Social Network, Computer Vision, Information Retrieval, Internet of Things, Data Mining, and Speech Recognition. Trend analysis of technology development describes the emergence and change process of technology, which can help researchers understand the history and status of technology, and quickly identify the frontier and hot issues of research. For example, research topics of deep neural networks and machine learning have developed rapidly in the past few years, which is shown in Figure 2-15.

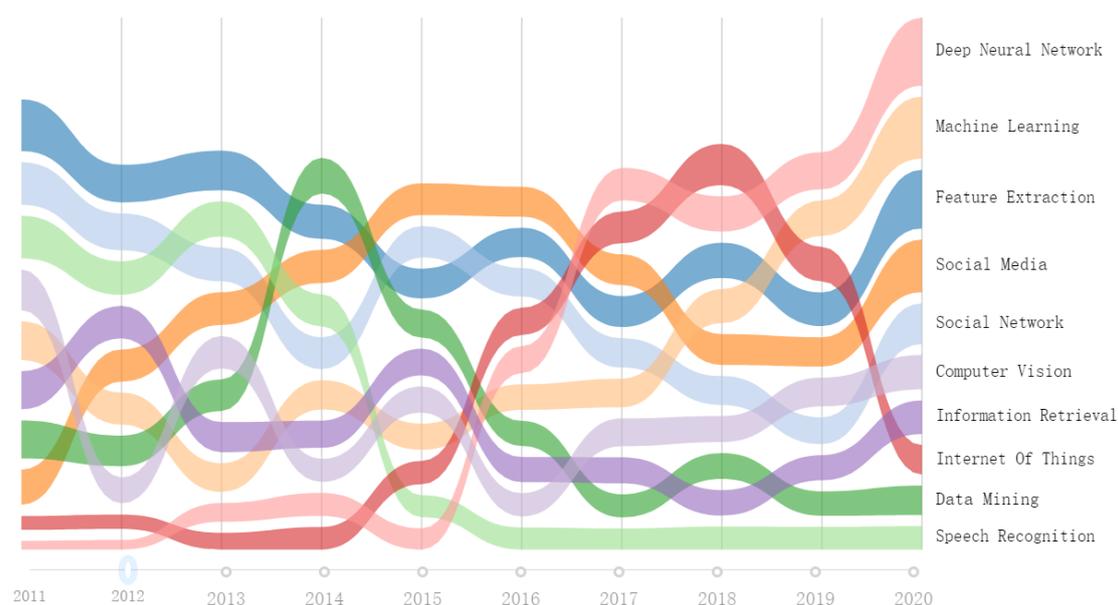


Figure 2-15 Development trend of AI technology

## 2.6.2 Popularity Trend of National Research

Trend analysis of national research popularity is shown in Figure 2-16. In the figure, each color band represents a country, and its width represents the country's research popularity in that year, which is positively correlated with the number of papers by that country's scholars that year. Countries are ordered according to their research popularity from high to low each year. Based on national research popularity analysis, it can be found that the current top 10 countries are: China, United States, Germany, United Kingdom, Canada, Japan, France, Italy, Australia, South Korea, as

shown in Figure 2-16. Overall speaking, the United States has an early advantage and has maintained the highest enthusiasm, while China's research popularity has surpassed the United States in recent years. China currently has the highest AI research enthusiasm.

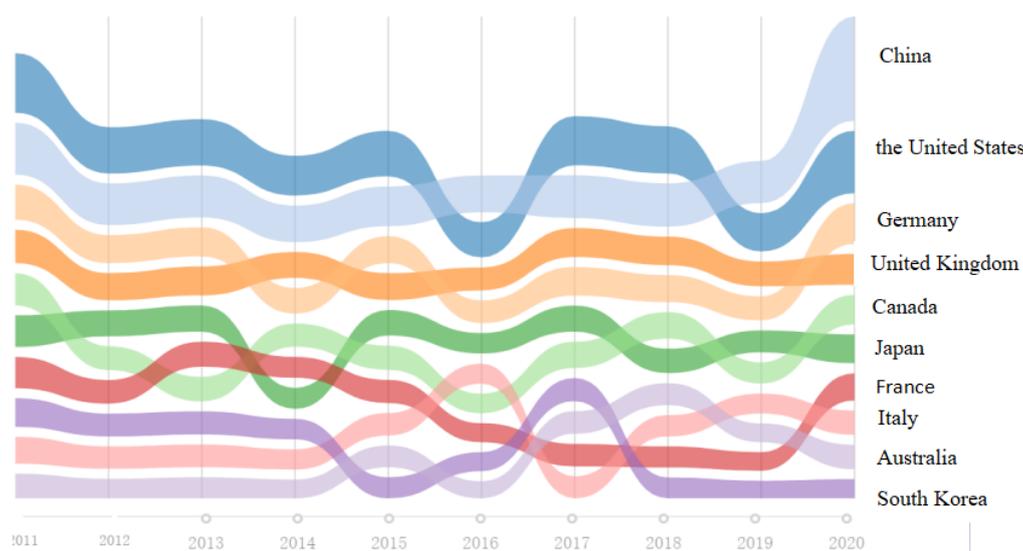


Figure 2-16 Popularity trend of national AI research

### 2.6.3 Transnational Cooperation in AI Research

Research papers are one form of scientific research achievements. It has become more and more common for scholars from different countries to cooperate in scientific research and co-authored papers. For papers co-published by scholars from different countries, authors can be located and mapped to each country, and then the number of papers cooperated among countries can be counted. The cooperative relations among the top 10 countries in the number of AI 2000 collaborative papers are shown in Figure 2-17. It shows that the number of papers cooperated between China and the United States is far ahead; the United States is the most cooperation partner, which reflects the prominent position of the United States in AI research.

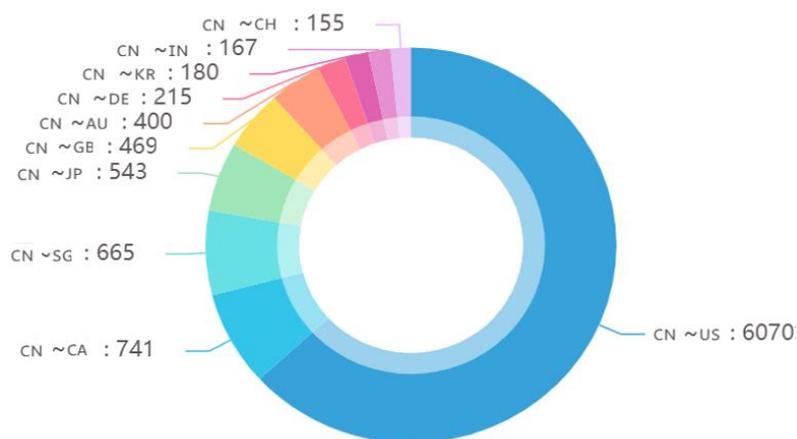


Figure 2-17 AI research paper Collaboration between China and other countries

### 3 Conclusion

This report shows the status of global outstanding talents in the field of artificial intelligence, based on big data mining of the world's AI-related top journals and conference proceedings and the 2021 AI 2000 list which has been automatically generated by the intelligent algorithm of the AMiner system.

The report finds that this year's AI 2000 scholars have the characteristics of overall rising h-index values, increasing number of cross-subfield scholars, and geographical concentration. The number of scholars with an h-index greater than 60 has a 24.9% increase from last year. More than 200 scholars have been listed in multiple sub-fields due to their outstanding AI research achievements, with an increase of 88.6% from the previous year. And more than half of scholars on the list are affiliated to various institutions in the United States.

There are 1163 AI 2000 scholars from the United States and 223 from China, respectively ranking the first and second place. Although the number of scholars from the US this year has dropped by 6.5% compared with last year, the US still has an absolute advantage in the overall human resources of artificial intelligence and high-level scientific research outputs, which works as the solid talent foundation for its AI development. China is currently the country with the highest AI research enthusiasm,

and it has also led other countries into its cooperation. Although China ranks the second place in terms of the number of scholars, it is still much behind the United States. China needs to urgently strengthen its talent team building in the field of artificial intelligence.

In the next 10 years, artificial intelligence will make more key technological breakthroughs, and many countries will also cultivate more outstanding talents into their AI development and construction. Correspondingly, more top and influential scholars will emerge around the world, and the scholars of AI 2000 will become even more dazzling in the future.

-the End-

## Appendix List of AI2000 Most Influential Scholars in 2021

Sub-field of AI	Rank	Name	Gender	Country	h-index
Classical AI	1	Christian Szegedy	Male	USA	19
	2	Vincent Vanhoucke	Male	USA	32
	2	Feiping Nie	Male	China	81
	2	Zhiyuan Liu	Male	China	49
	5	Zhihua Zhou	Male	China	106
	6	David Silver	Male	USA	66
	7	Arthur Guez	Male	USA	17
	8	Wujun Li	Male	China	27
	9	Maosong Sun	Male	China	61
	10	Yankai Lin	Male	China	17
Machine Learning	1	Ilya Sutskever	Male	USA	60
	2	Diederik P. Kingma	Male	USA	23
	3	Geoffrey E. Hinton	Male	Canada	164
	4	Karen Simonyan	Male	USA	42
	5	Alex Krizhevsky	Male	USA	17
	6	Yoshua Bengio	Male	Canada	188
	7	Jimmy Ba	Male	Canada	6
	8	Andrew Zisserman	Male	UK	171
	9	Ian Goodfellow	Male	USA	63
	10	Quoc V. Le	Male	USA	85
Computer Vision	1	Kaiming He	Male	USA	63
	2	Ross B. Girshick	Male	USA	65
	3	Jian Sun	Male	China	103
	4	Shaoqing Ren	Male	China	15
	5	Xiangyu Zhang	Male	China	54
	6	Christian Szegedy	Male	USA	19
	7	Trevor Darrell	Male	USA	126
	8	Xiaoou Tang	Male	China	125
	9	Piotr Dollár	Male	USA	53
	10	Tsung-Yi Lin	Male	USA	15
Natural Language Processing	1	Christopher David Manning	Male	USA	126
	2	Jeffrey Pennington	Male	USA	23
	3	Richard Socher	Male	USA	56
	4	Kyunghyun Cho	Male	USA	50
	5	Thang Luong	Male	USA	26
	6	Mingwei Chang	Male	USA	29
	7	Kristina Toutanova	Female	USA	42
	8	Kenton Lee	Male	USA	19

Sub-field of AI	Rank	Name	Gender	Country	h-index
	9	Yoshua Bengio	Male	Canada	188
	10	Chris Dyer	Male	USA	59
<b>Robotics</b>	1	Radu Bogdan Rusu	Male	USA	44
	2	Jürgen Sturm	Male	Germany	35
	3	Emanuel Todorov	Male	USA	52
	4	Roland Siegwart	Male	Switzerland	102
	5	Vijay Kumar	Male	USA	99
	6	Daniel Cremers	Male	Germany	84
	7	Steve Cousins	Male	USA	2
	8	Pieter Abbeel	Male	USA	118
	9	Wolfram Burgard	Male	Germany	111
	10	Daniel Maturana	Male	USA	12
<b>Knowledge Engineering</b>	1	Heiko Paulheim	Male	Germany	34
	2	Axel-Cyrille Ngonga Ngomo	Male	Germany	38
	3	Ernesto Jiménez Ruiz	Male	UK	30
	4	Jens Lehmann	Male	Germany	49
	5	Hassan Saif	Male	UK	14
	6	Danh Le Phuoc	Male	Germany	16
	7	Bernardo Cuenca Grau	Male	UK	46
	8	Christian Bizer	Male	Germany	60
	9	Michelle Cheatham	Female	USA	13
	10	Sören Auer	Male	Germany	53
<b>Speech Recognition</b>	1	Alex Graves	Male	Canada	54
	2	Abdelrahman Mohamed	Male	USA	32
	3	Geoffrey E. Hinton	Male	Canada	164
	4	Tara Sainath	Female	USA	51
	5	Dong Yu	Male	China	70
	6	Li Deng	Male	USA	101
	7	Guoguo Chen	Male	Australia	14
	8	Quoc V. Le	Male	USA	85
	8	George E. Dahl	Male	USA	32
	10	Daniel Povey	Male	USA	54
<b>Data Mining</b>	1	Tianqi Chen	Male	USA	25
	2	Jure Leskovec	Male	USA	112
	3	Carlos Guestrin	Male	USA	78
	4	Aditya Grover	Male	USA	14
	5	Marco Túlio Ribeiro	Male	USA	9
	6	Bryan Perozzi	Male	USA	15

Sub-field of AI	Rank	Name	Gender	Country	h-index
	7	Eunjoon Cho	Male	USA	6
	8	Yu Zheng	Male	China	80
	9	Sameer Singh	Male	USA	26
	10	Steven Skiena	Male	USA	57
<b>Information Retrieval and Recommendation</b>	1	Chengxiang Zhai	Male	Qatar	87
	2	W. Bruce Croft	Female	South Korea	116
	3	Xiangnan He	Male	South Korea	37
	4	Coleman Jonathan N	Male	Ireland	1
	5	Jian Tang	Male	USA	47
	6	Tat-Seng Chua	Male	USA	84
	7	Jure Leskovec	Male	Japan	112
	8	Julian McAuley	Male	Japan	35
	9	Carlos Castillo	Male	Japan	68
	10	Jon M. Kleinberg	Male	Singapore	114
<b>Databases</b>	1	Reynold S. Xin	Male	USA	21
	2	Michael J. Franklin	Male	USA	103
	2	Xiaokui Xiao	Male	Singapore	51
	2	Ion Stoica	Male	USA	129
	2	Michael Armbrust	Male	USA	20
	2	Guoliang Li	Male	China	52
	2	Andrew Pavlo	Male	USA	32
	2	Tim Kraska	Male	USA	41
	9	Wentao Wu	Male	USA	18
	10	Jiannan Wang	Male	Canada	27
<b>Human-Computer Interaction</b>	1	Jacob O. Wobbrock	Male	USA	62
	2	Sebastian Deterding	Male	UK	26
	3	Aniket (Niki) Kittur	Male	USA	42
	4	Michael Bernstein	Male	USA	45
	5	Munmun De Choudhury	Female	USA	47
	6	Leah Findlater	Female	USA	33
	7	Moira Burke	Female	USA	29
	8	Robert E. Kraut	Male	USA	105
	9	Kasper Hornbæk	Male	Denmark	42
	10	Lennart E. Nacke	Male	Canada	40
<b>Computer Graphics</b>	1	Michael Kazhdan	Male	USA	26
	2	Frédo Durand	Male	USA	82
	3	Matthias Nießner	Male	Germany	40

Sub-field of AI	Rank	Name	Gender	Country	h-index
	4	Eduardo Simões Lopes Gastal	Male	巴西	5
	5	Gordon Wetzstein	Male	USA	45
	6	William T. Freeman	Male	USA	119
	7	Satoshi Iizuka	Male	Japan	7
	8	Michael Zollhoefer	Male	USA	32
	9	Markus Gross	Male	Switzerland	93
	10	Chen Cao	Male	USA	9
<b>Multimedia</b>	1	Yangqing Jia	Male	China	38
	2	Trevor Darrell	Male	USA	126
	3	Jeff Donahue	Male	UK	26
	4	Andrea Vedaldi	Male	UK	75
	5	Sergey Karayev	Male	USA	11
	6	Ross B. Girshick	Male	USA	65
	7	Karel Lenc	Male	UK	9
	8	Sergio Guadarrama	Male	USA	25
	9	Björn W. Schuller	Male	Germany	93
	10	Florian Eyben	Male	Germany	44
<b>Visualization</b>	1	Mike Bostock	Male	USA	11
	2	Jeffrey Michael Heer	Male	USA	67
	3	Natalia Andrienko	Female	UK	54
	4	Gennady Andrienko	Male	UK	55
	5	Shimin Hu	Male	China	58
	6	Jessica Hullman	Female	USA	21
	7	Petra Isenberg	Female	France	34
	8	Matthew Brehmer	Male	USA	13
	9	Shixia Liu	Female	China	44
	10	Enrico Bertini	Male	USA	31
<b>Security and Privacy</b>	1	Nicholas Carlini	Male	USA	27
	2	David A. Wagner	Male	USA	94
	3	Adrienne Porter Felt	Female	USA	28
	4	Reza Shokri	Male	Singapore	27
	5	Joseph Bonneau	Male	USA	37
	6	Yajin Zhou	Male	China	20
	7	Nicolas Papernot	Male	Canada	27
	8	Patrick Drew McDaniel	Male	USA	69
	9	Thomas Ristenpart	Male	USA	46

Sub-field of AI	Rank	Name	Gender	Country	h-index
	10	Elaine Shi	Female	USA	59
<b>Computer Networks</b>	1	Dinesh Bharadia	Male	USA	23
	2	Sachin Katti	Male	USA	51
	3	Dina Katabi	Female	USA	75
	4	Vyas Sekar	Male	USA	55
	5	Shyamnath Gollakota	Male	USA	35
	6	Mosharaf Chowdhury	Male	USA	23
	7	Mohammad Alizadeh	Male	USA	37
	8	Ion Stoica	Male	USA	129
	9	Nick Mckeown	Male	USA	94
	10	Brandon Heller	Male	USA	22
<b>Computer Systems</b>	1	Jianmin Chen	Male	USA	61
	2	Joseph E. Gonzalez	Male	USA	34
	3	Jeffrey Dean	Male	USA	85
	4	Andy Davis	Male	USA	8
	5	David G. Andersen	Male	USA	57
	6	Matthieu Devin	Male	USA	15
	7	Carlos Guestrin	Male	USA	78
	8	Ion Stoica	Male	USA	129
	9	Peter Gilbert	Male	USA	13
	10	Raluca Ada Popa	Female	USA	31
<b>Computing Theory</b>	1	Virginia Vassilevska Williams	Female	USA	30
	2	Zvika Brakerski	Male	Israel	33
	3	Vinod Vaikuntanathan	Male	USA	52
	4	Craig Gentry	Male	USA	59
	5	Yin Tat Lee	Male	USA	25
	6	Mark Braverman	Male	USA	34
	7	Brent Waters	Male	USA	72
	8	Zeyuan Allen-Zhu	Male	USA	33
	9	Sanjam Garg	Male	USA	31
	10	Adam Davison Smith	Male	USA	66
<b>Chip Technology</b>	1	Yu-Hsin Chen	Male	USA	20
	2	Song Han	Male	USA	28
	3	Nam-Soon Choi	Female	South Korea	38
	4	Chen Zhang	Male	USA	8
	5	Joel Emer	Male	USA	62
	6	Chen Chen	Male	China	68
	7	David A. Patterson	Male	USA	107
	8	Daniel Sanchez	Male	USA	22

Sub-field of AI	Rank	Name	Gender	Country	h-index
	9	Trevor E. Carlson	Male	Singapore	16
	10	William J. Dally	Male	USA	109
<b>the Internet of Things</b>	1	Rui Zhang	Male	Singapore	109
	2	Andrea Zanella	Male	Italy	38
	3	Jeffrey G. Andrews	Male	USA	104
	4	Robert W. Heath Jr.	Male	USA	125
	5	John A. Stankovic	Male	USA	110
	6	Zhiguo Ding	Male	UK	82
	7	Robert Schober	Male	Canada	85
	8	Weisong Shi	Male	USA	40
	9	Derrick Wing Kwan Ng	Male	Australia	55
	10	Yong Zeng	Male	China	40

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