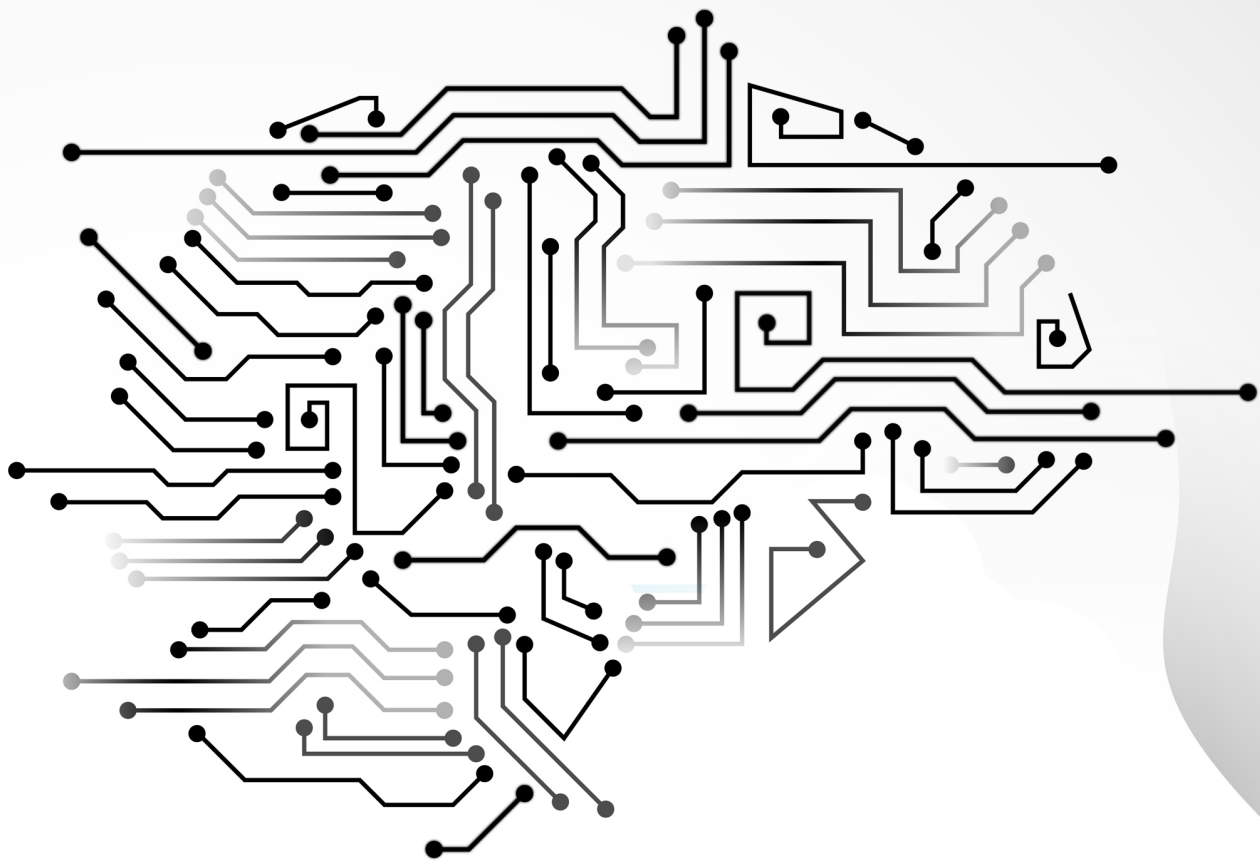


NEXT 10 YEARS



What to expect
in China's artificial
intelligence future

INTRODUCTION

Over the past several years, we have witnessed the blossoming of China's artificial intelligence industry. Thanks to generous government policy support, enthusiastic entrepreneurs and venture investors, China commandeered a position that it has not occupied for centuries: that of a global leader in an emerging critical technological field.

As we entered 2019, whispers of an AI Winter began to emerge. The venture capital market has indeed dialed back. The number of venture financing deals in China's AI sector as of mid-June 2019 stood at 131, with total deal value of US\$5.6 billion, as compared with 496 venture deals and US\$15.7 billion in total deal value in 2018. The number of mega rounds—those venture deals greater than US\$100 million—fell from 26 such deals in 2018 to 4 so far

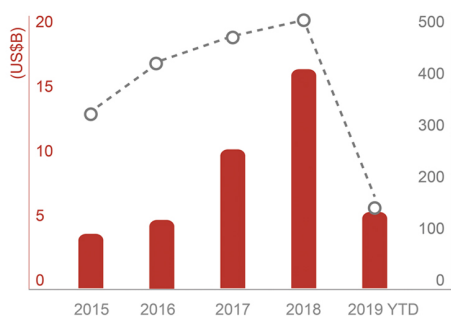
in 2019.

At the same time, the bottlenecks of deep learning—the driver of the current wave of AI enthusiasm—are more frequently discussed. Their lack of explainability, their lack of ability to reason, their need for a large amount of data for training, and the challenges of solving real world problems are constraining the technology's commercial applications.

"The current artificial intelligence systems are very susceptible to attacks or deceptions. They require a large amount of data and are unexplainable. These are very serious defects, which are fundamental and rooted in its method," said Zhang Bo, a Chinese Academy of Sciences professor focused on artificial intelligence research¹.

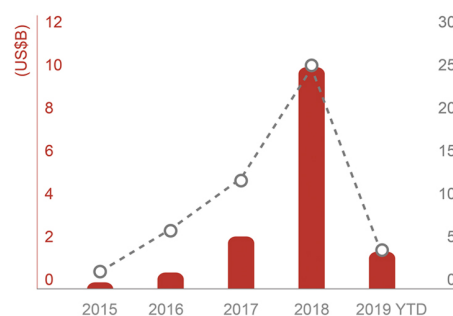
¹ Di Song. *An Interview With Academician Zhang Bo: AI Miracle Hard To Reproduce; Deep Learning Technology's Potential Is Near Its Ceiling* (专访院士张钹：AI奇迹难再现，深度学习技术潜力已近天花板). *The Economic Observer*. May 24, 2019

Venture investment in China's AI sector has cooled



* All data are from IT Juzi. Data are as of mid-June, 2019.

The number of mega rounds declines



* All data are compiled by China Money Network.

■ Total Deal Value (US\$B) --○-- Number of Deals

Complete list of mega rounds in China's AI sector

	Company	Amount (US\$M)	Round		Company	Amount (US\$M)	Round
2015	Ucloud	200-300*	Series C		Knowbox	100	Series C
	Huayun Data	100	Series C		CHJ Automotive	470	Series B
2016	Qiniu Cloud	100	Series D		SenseTime	600	Series C
	QingCloud	100	Series C		MiningLamp	160	Series C
	iCarbonX	150	Series A		Ubtech Robotics	820	Series C
	roobo	100	Series A		SenseTime	620	Series C+
	CHJ Automotive	110	Series A		Orbbec	200	Series D
	Ubtech Robotics	100	Series B		Roadstar.ai	128	Series A
	Megvii Technology	100	Series C		Unisound	100	Series C
					Yitu Technology	200	Series C+
2017	CloudMinds	100	Series A	2018	Cambricon	200-300*	Series B
	Ucloud	140	Series D		Huayun Data	150	Pre-IPO
	ByteDance	100	Series D		Megvii Technology	600	/
	Ubtech Robotics	200-300*	Series B+		Pony.ai	102	Series A+
	Mobvoi	180	Series D		Yitu Technology	100	Series C+
	QingCloud	160	Series D		SenseTime	1,000	Series D
	SenseTime	410	Series B		Video++	100	Series C+
	Qiniu Cloud	140	Series E		ByteDance	3,000	Pre-IPO
	Cambricon	100	Series A		Momenta	200	/
	ByteDance	200	Series E		Terminus Technologies	180	Series B
	Megvii Technology	460	Series C		CloudWalk Technology	150	Series B+
	MiningLamp	160	Series C		Geek+	150	Series B+
	Horizon Robotics	100	Series A+		4Paradigm	150	Series C
2018	Kingsoft Cloud	720	Series D	2019	Horizon Robotics	600	Series B
	Pony.ai	112	Series A		MiningLamp	296	Series D
	Rokid	100	Series C		Black Sesame Technologies	100	Series B
					Megvii Technology	750	Series D

* All data are compiled by China Money Network. Numbers with * indicate best estimates when official numbers are not available.

China is home to 27 AI unicorns worth US\$143.3B

Company	Valuation (US\$B)	Company	Valuation (US\$B)
 ByteDance	75	 Tongdun Technology	2
 DJI	15*	 Pony.ai	1.7
 UBTech Robotics	5	 Ucloud	1.6
 SenseTime	4.5	 Huayun Data	1.5
 Megvii Technology	4	 Tuya Smart	1.5
 Cloudwalk	3.3	 4Paradigm	1.2
 DeepBlue Technology	3.3	 MiningLamp	1.1
 Horizon Robotics	3	 iCarbonX	1
 Intellifusion	3*	 Mobvoi	1
 Cambricon	2.5	 Momenta	1
 CHJ Automotive	2.5*	 Orbbec	1
 Kingsoft Cloud	2.4	 QingCloud	1
 Yitu Technology	2.2	 Terminus	1
		 Unisound	1
Total Number: 27		Total Valuation: US\$143.3B	

* All data are compiled by China Money Network. Numbers with * indicate best estimates when official numbers are not available.

As Chinese government, businesses, tech giants, and AI startups work tirelessly to calibrate the boundaries of current AI systems' usability and scalability, the country has entered no man's land in a number of areas in terms of the scale of application. These raise unprecedented governance and ethics challenges. The rollout of facial recognition and social credit scores, for example, have generated international scrutiny as to their implications and potential risks.

The spillover of the US-China trade and technology frictions is adding additional uncertainties to the industry's future. The Chinese AI industry advanced during the heyday of free academic exchanges, thriving global open-source communities, and free talent flows between the United States and China. The continuation of these elements can no longer be taken for granted going forward.

As such, artificial intelligence in China has entered a stage of rationalization and recalibration, leading to greater unpredictability. China's AI industry is poised at an inflection point. The question of how China's AI industry will be shaped in the future becomes more significant, yet less visible.

China Money Network has invited 10 industry leaders in China's AI sector to share their predictions for the next 10 years. The 10 industry experts represent a wide range of segments, covering computer vision, speech recognition, autonomous driving, AI chips, healthcare AI, fintech AI,

AI-as-a-Service, and investment.

Despite the aforementioned challenges, these experts are overwhelmingly optimistic about AI's continued advancement and commercialization in China. Underpinned by Beijing's unwavering commitment to advance Chinese technology, AI is likely to continue expanding its disruptive powers across industries more deeply and rapidly in China than in other countries.

They also share the consensus that we have only scratched the surface of what AI can bring to economies and societies. Across the next decade, AI will witness broad and deep commercialization to reshape traditional industries and beyond. Ultimately, AI will be smoothly integrated with business decision-making and user experience to create a world in which many of the headaches and unsatisfying experiences we endure today will be eliminated.

That is perhaps the best-case scenario we can hope for 10 years from now. In the immediate future, it should soon become increasingly clear how many of the dozens of AI unicorns in China today are truly creating value that matches their lofty valuations, and whether AI's application in certain sectors should be reevaluated.

Attempts to foretell the future are always filled with paradox and danger. These experts have kindly agreed to share their predictions and insights with the objective of helping us to guide our actions toward a brighter future.



KUAN CHEN
FOUNDER
INFERVISION

Kuan Chen is the founder and CEO of artificial intelligence company Infervision. In 2016, Chen dropped out of the doctoral program at the University of Chicago to found Infervision, whose mission is to apply AI and deep learning technology in medical imaging and healthcare.

Infervision utilizes deep learning to analyze medical imaging data including DR, CT and MRI to provide analytical tools to assist doctors in making clinical diagnoses with greater speed and accuracy. As of May 2019, Infervision is in partnership with over 300 hospitals globally, supporting doctors in diagnosing over 40,000 cases every day.

Since its inception, Infervision has completed four venture funding rounds from investors including CDH Investments, Sequoia Capital China, and Qiming Venture Partners.

“Over the next 10 years, artificial intelligence will provide the infrastructure of the healthcare industry and will play a key role in the clinical diagnosis and treatment process. At the same time, AI will serve as the core technological driver in China's national policy to establish a nationwide hierarchical diagnosis and treatment system.

AI will enhance the capabilities of grassroots-level hospitals and doctors, so that their diagnostic abilities will be on a

par with premium-level hospitals and doctors. Our experiments show that for medical image reading on pulmonary nodule, the performance of a junior doctor assisted by AI has no statistical difference from that of a veteran doctor. For events such as strokes, as well as for diseases, the superiority of artificial intelligence in auxiliary diagnosis is particularly prominent. Hence AI can help level the healthcare resource imbalances between urban and rural areas, and between more developed and less developed regions.

China's RMB4 trillion (US\$579 billion) healthcare market suffers from a serious capacity deficiency. AI can help solve this problem. The new round of China's healthcare reform across the next decade will focus on early screening, early diagnosis, and early treatment. AI can improve healthcare quality and reduce costs. Our experience shows that AI can detect 25 percent of advanced lung cancer cases 9.3 months earlier, thus saving a lot in social expenses.

China's massive population base and aging society create the world's biggest demand for healthcare AI products, engendering the perfect market conditions for the development of healthcare AI. This provides Chinese AI companies with a unique advantage and is where AI can bring the greatest social value. Chinese healthcare AI has the chance to become a global market leader and pacesetter. In the future, the specific needs and conditions unique to each country will lead to each having different priorities in their applications of AI in healthcare, and the discrepancies between their systems will become more pronounced.

Healthcare is a very conservative and high-standard industry with long market cycles. Anyone who attempts to enter the market pursuing quick success (a mindset that currently prevails among

Internet companies, in particular) will not succeed. The challenge we face is to figure out how to penetrate the healthcare industry in the most grounded, meticulous and patient manner. We are applying for medical product approvals from healthcare regulators around the world. We also are exploring ways to cooperate with insurance companies. All of these processes take time. It's a long journey made up of many small steps. We must set incremental objectives and then try to achieve them one at a time.

There has been a lot of US-China cooperation in the field of deep learning. Some top-level models and open source frameworks were contributed by Chinese scholars and engineers. If for any reason this cooperation breaks down or is otherwise forced to terminate, it will certainly constrain the development of the industry. On the other hand, the industry is still very open and interdependent at present. Geopolitical factors cannot adversely affect academic exchanges and cooperation quite that easily.

Global technological development is resilient, and the general trend of international cooperation will not reverse in the short term. But international friction will surely make companies—not only in China but all over the world—more conscious of seeking alternatives and backup plans to protect against unforeseen risks.



WENYUAN DAI

**FOUNDER
4PARADIGM**

WenYuan Dai is the founder of artificial intelligence company 4Paradigm. Prior to founding the company in 2014, he worked for Baidu and helped design its AI system, Feng Chao. Dai later served as the chief scientist at Huawei's Noah's Ark Lab. He is the global champion of the ACM International Collegiate Programming Contest.

Driven by its vision of creating "AI For Everyone," 4Paradigm provides AI service platforms for companies in the banking, insurance, public securities, government services, energy, smart manufacturing, retail and healthcare sectors. As of June 2019, it has helped 7,617 customers and partners to successfully apply AI in 12,648 use cases.

“We will see the largest explosion of intelligence in human history occurring in the upcoming decade. I expect that within three to five years, the proportion of Chinese companies' annual revenue driven by AI will exceed 50 percent. Within five years, the leading companies will have almost completed the shift toward AI driving most of their businesses.

Today, although many industries have begun to experiment applying AI into their business use cases, there remains a low

proportion of AI-driven revenue to overall revenue in most enterprises. This is largely because the current AI application is merely about embracing AI. Most enterprises are in the stage of effecting the change from 0 to 1. This process allows enterprises to start understanding the value of AI, but its efficiency remains poor. Indeed, for many Chinese companies, AI-generated value may constitute well under 1 percent of corporate revenue.

There are certain universal pathways toward

AI application. We need to identify and summarize these best practices of enterprise AI and facilitate the infrastructure build-up of large-scale AI application. This will help companies to avoid reinventing the wheel in each AI use case, therefore achieving the intelligent transformation effectively and efficiently.

In the immediate future, companies will pay most attention to the scale of AI applications, instead of which cool technology is integrated in each use case. The questions companies ask themselves will be: How many AI applications will we achieve next year? If we deployed a hundred AI applications last year, can we achieve a thousand next year? Companies will shift their strategy from embracing AI to pursuing maximum value. This shift of the collective mindset accentuates the importance of intelligent transformation of enterprises.

I have concluded that the best pathway for enterprises to apply AI is via the following two approaches. First, each company must identify their core business and try to utilize AI's full potential in value creation. Because core business is the lifeline of the enterprise, a 1-percent improvement in this area driven by AI can maximize operational improvement. Second, enterprises must find a large number of separated use cases and strive to scale application efficiently and cross different use cases. A 1 percent efficiency improvement in one thousand use cases will also stimulate massive operational optimization.

To achieve these objectives, enterprises must set up a sound data management system. The business intelligence-oriented big data systems of the past are not suitable for artificial intelligence. Some enterprises have built AI systems based on business intelligence-oriented big data infrastructure, which has in fact become an obstacle to the application of AI. Therefore, enterprises must establish an AI-oriented data governance system that can access and store petabyte-level or even higher numbers of logs, support real-time storage, and install a closed loop of online data collection and processing.

AI computing power forms another piece of the puzzle. The trend of AI computing power optimization in the future must be the combination of software and hardware. Because AI computing power is a comprehensive architecture with a fixed computing model, it requires dedicated calculations. Therefore, the computing power architecture suitable for AI-specific algorithms will become the main solution for AI applications in the future. This will also usher in a revolution in computing power.

The next three to five years will be a very critical period for the mass-scale application of AI. As long as companies are able to efficiently manage methods for AI application and build the necessary infrastructure, they will be able to quickly increase the portion of AI-driven business to over 50 percent of their revenue.



WEI HUANG

**FOUNDER
UNISOUND**

Dr. Wei Huang is the founder of Chinese speech recognition-focused AI company Unisound. Previously, he worked at Motorola China Research Center and Shanda Innovation Institute and led the development of the world's first mobile phone voiceprint authentication system.

Dr. Huang founded Unisound in 2012 with a team of experts in algorithms, software/hardware, cloud architecture, and chip design. Unisound focuses on providing AI services in two categories: intelligent life covering smart homes and automobiles; and intelligent services encompassing healthcare, education, and robotics.

To date, Unisound has raised financing totaling US\$300 million from investors. The company has over 20,000 partners and serves 200 million users. Its Open Voice Cloud service covers more than 647 cities and 250 million devices.

“**W**hile artificial intelligence (including speech recognition, natural language understanding and machine translation) has advanced rapidly over the past few years, there are two primary bottlenecks constraining its further development. First, there are no foreseeable major breakthroughs in the theoretical framework of deep learning. Although researchers have proposed new directions, there has been no clear proof of a fundamental breakthrough comparable with the shift from statistical learning to

deep learning. Second, current technologies generate good-looking results in labs, but these exhibit clear technological weaknesses once deployed in real-world use cases. Many AI tools that appear impressive at first prove to be quite dumb in complicated real-world situations.

I think we must try to overcome both challenges, especially at the theoretical framework level. Today, we all know how to train a massive amount of data to achieve better performance. But why is that so? We

don't really know. Deep learning remains a mystery to us. In order to achieve a breakthrough, we first need to make deep neural networks more explainable.

If we can achieve this theoretical breakthrough, it will be possible to make our artificial intelligence systems more adaptable with greater ability of reasoning. They will be able to perform well in different use cases. But the discovery and improvement of any kind of theoretical framework is likely to take decades. The popularization of deep learning has lasted less than a decade, and we are still in the initial stage of exploring its potential. It will take a long time to perfect deep learning.

But before the arrival of a breakthrough, we can still apply AI to solve very practical problems. In the absence of artificial general intelligence, narrow AI can solve valuable issues in well-defined scenarios. AI companies in China are creating real business value by providing deeply customized and optimized solutions, which encompasses data optimization, algorithms optimization, and engineering optimization.

Chinese AI companies are expanding their technological tentacles and trying to achieve full-stack, cross-industry capabilities. This is an enormous challenge, testing every

team's resources, capital, talent pool, and business development abilities. In addition, there is a growing consensus that focusing on use case-specific solutions and deep optimization is the passage to the future. AI startups realize that the emphasis on building platforms, as companies did during the Internet era, doesn't work well in the AI era.

The best opportunity for AI startups is to focus on use case-specific solutions, which is how AI companies will achieve sustainable growth in the future. In general, technology giants and AI startups will compete and cooperate in a dynamic and complementary manner going forward. Startups in China have a better chance than their counterparts in the United States of emerging as the new leaders in AI.

The increasing US-China technology rivalry will present Chinese AI companies with more opportunities than challenges. China will strategically place more importance on the development of cutting-edge technologies. Chinese customers of AI solutions are of massive scale and in urgent need of services. Over the next three to five years, Chinese AI companies will be busy focusing on achieving their missions, and likely talking less and doing more.



TAO JIANG
FOUNDER
TONGDUN
TECHNOLOGY

Tao Jiang is the founder of artificial intelligence company Tongdun Technology, and an expert in smart anti-fraud and financial risk control systems. Prior to founding Tongdun, Jiang worked at IBM, StarCite, and Alibaba Group, focusing on developing anti-fraud and intelligent risk control solutions. He holds a master's degree in computer software and theory from Fudan University.

Tongdun Technology is a third-party provider of intelligent risk management and decision-making services in China. It currently employs more than 1,200 people and has served over 10,000 customers in the financial services industry, Internet, logistics, healthcare, retail, smart cities and government sectors. Since its inception the company has raised more than US\$200 million in financing, and it is currently valued at nearly US\$2 billion.

“In the future, intelligent risk control systems within the financial services sector will follow three major trends. First, in terms of timeliness, it will transition from after-the-fact, stop-loss risk control to a real-time feedback model. Second, in terms of decision-making, it will gradually shift from human manual review and a posteriori strategy to machines replacing most of the manual work and an automated decision-making process. Third, the balance between risk control and user experience will gradually reach an equilibrium.

In the future, anti-fraud and financial risk control systems will become so efficient and frictionless that end users will not feel the effort behind significantly enhanced security.

Digital identification based on biometric technology will become the mainstream identification method. The current mainstream identification items such as keys, certificates, and bank cards, as well as knowledge-based identification such as usernames and passwords, will become less important. The financial sector will be an

important area for biometric applications.

In addition, I believe the potential for future application of voiceprint recognition in the financial sector will be significant. Voice is one of the most convenient and natural entrance points in the era of Internet of things (IoT).

Voiceprint identification can be used in various use cases in banking and insurance sectors. However, biometric identification is still in its infancy. Its major challenges relate to robustness and security.

Data is the foundation of artificial intelligence technology. Only a large quantity of high-quality data is sufficient to train models. I believe federated learning is a technology that can achieve great intelligence with a small amount of data. Based on the decentralized algorithmic logic of federated learning, no one party can have access to all the data, nor does one party have full ownership of all the models. The method calls for sharing open data, instead of having exclusive ownership of the data. This can maximize data security and data privacy in the age of artificial

intelligence. Federated learning will also elevate the position of small- and medium-sized enterprises, breaking today's data monopoly, in which the company that owns the largest amount of data has the greatest power.

For Chinese AI companies in the financial services sector, the Asia-Africa-Latin America region is full of great opportunities. These countries are in a situation very similar to that of China a few years ago. Therefore, they can better replicate China's experience and technology. Indonesia, the Philippines, Nigeria, Brazil, and Chile all have large populations with rising local resident income. Consumer demand is increasing, and smartphone penetration is high, yet financial service coverage is low. These factors make them the ideal target for Chinese fintech AI companies when they expand overseas in mobile payment, consumer finance, and risk control management.



KAI-FU LEE
CEO
SINOVAION
VENTURES

Dr. Kai-Fu Lee founded Chinese venture capital firm Sinovation Ventures in 2009 as the chairman and chief executive officer, as well as president of Sinovation Ventures' Artificial Intelligence Institute. Sinovation Ventures focuses on cutting-edge technology investments, managing over US\$2 billion in total. He was the global vice president of Google and founding president of Google China, and has held executive positions at Microsoft, Apple, and SGI.

Dr. Lee holds a bachelor's degree in computer science from Columbia University, and graduated summa cum laude from the doctoral degree program at Carnegie Mellon University. He has published more than one hundred journal articles and conference papers, eight Chinese bestselling books, and the New York Times Best Seller *AI Superpowers*. He is co-chair for the AI Council at the Center for the Fourth Industrial Revolution of the World Economic Forum.

“**A**rtificial intelligence has progressed past the phase of technology discovery, during which technology breakthroughs played a key role and domain experts ruled the industry. We have now entered the age of implementation for AI, where deployment and execution are critical, and data becomes the new gold. AI will become more akin to a platform, on which many commercial applications can be built and can flourish. You might perceive AI as a new form of electricity, empowering business transformations going forward.

There are four waves of AI applications: Internet AI, Business AI, Perception AI, and Automation AI. In the years ahead, AI applications will evolve from Internet to business, from perception (such as computer vision and speech recognition) to full intelligence that can move and work autonomously, just like humans.

Artificial intelligence is on the verge of explosive applications and deployments. Research has shown that AI will make US\$15.7 trillion potential contribution to

the global economy by 2032². I predict that the biggest contribution will come from the infusion of AI with the real economy and real-world industries. Just as the Internet empowered traditional industries, the biggest beneficiaries of AI's broad-range deployment will be traditional enterprises.

Traditional enterprises have unparalleled advantages in embracing AI, including their deep industry business experience and know-how, existing business processes that work well in plug-and-play scenarios, and a large amount of timely and available data. All these provide fuel critical to the AI implementation process.

Conversely, AI will empower traditional companies just as electricity did over a century ago, boosting their transformation, improving efficiency, and lowering cost. Traditional companies that embrace AI first will win the market and create great value; while those who are slow to adopt it will be outpaced by competitors.

In the era of AI implementation, personal privacy and data security have always been important issues. We should not view this simply as a regulatory problem. Instead, we should try to fight and solve the challenges that accompany new technology by creating better technology. For example, technologies such as homomorphic encryption and federated learning can protect personal data, as well as enabling data to empower our AI algorithms and improve their efficacy.

We can perhaps imagine a personal data preference option, allowing everyone to select either higher privacy or more convenience via a slider. This way, each person can set his or her own data preferences, rather than taking a one-size-fits-all approach. This may make it easier for people to welcome AI into their lives.

The era of AI has arrived. We should proactively embrace the possibilities for how this new technology can benefit us.

² Gerard Verweij, Anand Rao. *PwC's Global Artificial Intelligence Study: Exploiting the AI Revolution*. PwC, 2017



CHENXI LIN
CO-FOUNDER,
YITU TECHNOLOGY

Chenxi Lin is a co-founder of artificial intelligence company Yitu Technology. Lin was formerly at Alibaba Cloud, where he led a team to build its distributed cloud-computing operating system. He also worked at Microsoft Research Asia, where he focused on research in computer vision, machine learning, information retrieval and distributed systems.

Lin holds a master's degree from Shanghai Jiaotong University. He is the 2002 global champion of the ACM International Collegiate Programming Contest as the team leader representing Shanghai Jiaotong University.

Founded in 2012, Yitu is committed to commercializing artificial intelligence technology across different industries and has achieved large scale application in public security, financial services, healthcare, business parks, and retail sectors. In addition to computer vision technology, Yitu is also developing and expanding its business in areas including AI chips, speech recognition, and natural language understanding.

“Since the 1950s, artificial intelligence has gone through different historical development periods. Throughout AI's history, there have been significant changes every 10 or 20 years. We define the current stage as the new AI era, during which deep learning, big data, and high-performance computing are the main engines driving the industry's advances.

Today, we are seeing AI achieving widespread commercialization. Across the next decade, AI will witness a burst of

explosive growth. In particular, image recognition, speech recognition, and natural language processing will all usher in tremendous growth.

In mid-2019, the boundaries of what AI technology can achieve in the future are still difficult to predict. AI technology can be considered to be undergoing a dark age before it transcends human intelligence in a particular task. But once AI surpasses human capability, it will begin to advance exponentially. The technological

advancement curve is very steep.

Let's take our facial recognition technology as an example. In the four years since first surpassing human capability in 2015, the accuracy rate of facial recognition technology has increased by 100,000 times. This, in turn, has brought about breakthroughs in various real-world use cases.

The boundaries of AI technology are far from certain. Today, AI algorithms are not converging. On the contrary, the gap between algorithms is widening. Many application breakthroughs will take place in the industrial sector. At the same time, the development of AI technology is cross-industry. It can directly enter an industry, breaking the existing structure of the industry and reshape it, allowing the industry to leap forward.

Another characteristic of AI is the Matthew effect, which can be summarized as "the rich get richer and the poor get poorer." It applies to companies as well as to countries. I often feel that China's AI companies are leading this technology. China faces many enormous challenges that provide the best use cases of AI. In the new AI era, China and the United States stand shoulder to shoulder.

In the United States, informationization, SaaSization, mobilization, and intelligence revolution have taken place or are taking place one stage after another. In China, the aforementioned four waves of technological evolution are happening simultaneously. This gives China the opportunity to overtake on the curve in the advancement of AI.



TIANGCHENG LOU

**CO-FOUNDER
PONY.AI**

Dr. Tiangcheng Lou is a co-founder of Chinese autonomous driving company Pony.ai. Dr. Lou worked at Waymo's predecessor GoogleX, where he focused on the development of self-driving technology, before joining Baidu to serve as chairman of the Baidu Autonomous Driving Vehicle Technology Committee.

Dr. Lou has won the TopCoder China championship for 10 consecutive years and has twice won the Google Code Jam championship. He holds bachelor's and doctoral degrees in computer science from Tsinghua University.

Founded in 2016, Pony.ai has raised US\$300 million in total as of April 2019 and is valued at US\$1.7 billion. Pony.ai is currently testing self-driving robo-taxi fleets in Guangzhou and Beijing, and in Fremont, California. It is also developing an autonomous driving system for long-distance trucks.

“When we predict the future of self-driving cars, we must first understand that this does not depend entirely on technology readiness but is also greatly influenced by regulations, ethics, insurance schemes, people's driving habits, social acceptance level, and other factors. These factors vary greatly from country to country.

All of these different combinations of factors will determine when self-driving cars can be deployed in a particular locale,

especially during the early days. This, in turn, will impact the further development of the technology, which is highly dependent on real road testing. The countries and regions where self-driving cars are deployed earlier will harvest faster technological advances than areas where they are deployed later.

Over the next five to ten years, the countries and regions where self-driving cars are deployed earlier will see increasing maturity of the technology, while other areas will lag

ever farther behind. As time goes on, this disparity will increase. China enjoys certain advantages including diverse and challenging road conditions, strong policy support, and high public acceptance. I think China has the potential to be a frontrunner for the advancement of self-driving technologies and the commercialization of the technologies.

Considering China's rule-making characteristic, some free trade zones and smart transportation and smart-city demonstration zones that encourage early trials will likely empower small-scale commercialization first. These zones already permit companies to conduct testing on open urban roads, so they've got some first-player advantage in designing future regulation frameworks for self-driving car commercialization. Their acquired expertise will extend to other areas. In addition, the expected 5G deployment in China will speed up the development of V2X (vehicle-to-everything) communication technologies, which ultimately benefits autonomous driving industry.

There is a long-running debate in the realm of autonomous vehicles about whether self-driving cars need to be equipped with LiDAR sensors, HD maps or something else. We need to see the core matter—the industry's ultimate objective should be maximizing the safety of driverless cars and bringing them into to people's lives. However, with today's level of end-to-end machine learning and computer vision-only solutions, one is not able to ensure 100 percent safety

for level-four (and higher) autonomous driving. Solutions such as LiDAR help ensure safety, thus we should consider them. In summary, we should use a variety of technologies to make self-driving cars safe.

As technology matures, we can consider reducing reliance on certain technical components. Today, some people question the use of LiDAR and high-definition maps, mainly because of the associated high costs. The costs have been driven up primarily by the low production volume created by limited orders to suppliers. When driverless cars become mass-produced, demand will rise and suppliers will receive more orders, and the cost of both LiDAR and high-definition maps will likely fall to within an acceptable range. Therefore, even if we can get rid of LiDAR and other tools someday without sacrificing safety, there may no longer be any strong incentive to do so, since they will no longer be prohibitively expensive.

While massive data does help to advance autonomous driving technology, in recent years we have seen some innovations in deep learning networks and training models that really improved the performance of autonomous vehicles. Many other vehicle-related factors are vital as well and will further empower the future autonomous driving technologies. These include improving vehicle stability and developing more robust sensors and more powerful computing chips.



NINA XIANG
FOUNDER
CHINA MONEY
NETWORK

Nina Xiang is the founder of China Money Network, an intelligence platform tracking Chinese venture investments and technology innovations. She is the author of *Red AI*, an analysis of China's artificial intelligence industry.

Before founding China Money Network in 2011, she held editorial positions at Bloomberg BusinessWeek, Euromoney Institutional Investor, China Radio International, and China Business Network in Beijing, New York, Shanghai, and Hong Kong.

“The US-China trade war will have an enduring impact on China's artificial intelligence industry. China's AI sector is likely to reorder its priorities. While in the past it has valued industry size, development speed, and technological advances; going forward, self-reliance will become its most prized objective.

Under Beijing's guidance, China's technology players will likely double down on their efforts to lengthen the shortest staves of the proverbial wood barrel. This process will be lengthy and painful, but a nation of China's

size has the infrastructure and resources to make it happen.

The worst-case scenario is that the world will face a balkanization of its digital and AI-powered future, in which the United States and China—and perhaps other countries as well—each have their own independent IT infrastructure and ecosystem. The division and disjuncture of the physical world will extend into the digital and virtual spheres, greatly inconveniencing users and creating greater uncertainty for our

collective future. A more favorable outcome would include the continuation of the status quo with minor disruptions, moving toward accelerated AI applications across industries globally and enhanced international collaboration.

An AI race (likely primarily between the United States and China) will continue to generate skirmishes and frictions as countries diverge on values, regulations, and ethics, and thus may further augment the inequalities and widen the rifts afflicting our societies. Within China, such risks may be contained; however, externally, these risks could escalate.

In order to have a chance at winning the AI race, China must make fundamental changes. These include shifting the attention from courting media attention and hyperbole to establishing a razor-sharp focus on technology; from demonstration tech to practical real-life usages; from seeking instant success to patiently pursuing

true innovation.

For Chinese AI companies expanding internationally, the regulatory landscape will become ever more rocky and uneven. Though Chinese AI companies will face many challenges in the bid for global expansion, they will not stop fighting.

Nevertheless, the main theme of the next decade will be widespread applications of AI technology in all industries. This process requires increasing international partnerships, which, unfortunately, appear destined to decline going forward. This may raise the likelihood of AI systems growing out of control, but not to the level of any existential risks.

To consumers, AI's wider application will feel like a slow and gradual process.

Consumer-facing AI products such as robotics, self-driving cars, and personal speakers will progress very slowly, due to mounting challenges in these areas.



KAI YU
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HORIZON ROBOTICS

Kai Yu is founder of Horizon Robotics, a company focused on AI chips and solutions. He previously served as executive vice president of Baidu Institute of Deep Learning and executive director of Baidu Research. Prior to that, he worked at NEC Research Institute, Microsoft, and Siemens.

Dr. Yu has focused on machine learning for over a decade and has published more than 70 research papers on speech and image recognition, data mining, and human-computer interaction. He holds a doctorate in computer science from the University of Munich.

Horizon Robotics provides edge computing AI chips and solutions, specializing in autonomous driving and AIoT (artificial intelligence of things). The company has mass-produced two edge AI chips and has deployed its chips in autonomous driving and intelligent IoT. Since its inception the company has raised more than US\$700 million, and it is valued at US\$3 billion.

“In the next 10 years, we will enter an era of inclusive artificial intelligence, but will also face great challenges. Two principal challenges are energy overconsumption and data security. In 2016, Chinese data centers consumed more than 120 billion kilowatt hours of electricity, or 2 percent of China's total electric production³. In the future, the amount of data generated by artificial intelligence will jump by two orders of magnitude, perhaps accounting for the vast majority of global data. At its current pace, the global energy supply system may not be

able to support the energy consumption needed for future artificial intelligence-related calculations. Therefore, the AI chip of the future must first and foremost be very energy sufficient.

On the other hand, data security is of great importance to the future of artificial intelligence industry. With the arrival of 5G, the era of the Internet of things (IoT) will bring about a great expansion of the terminal access network. However, the cost of major network thoroughways' expansion

³ Green Data Center Technology Committee: Green Data Center Technology Committee Secretary Lv Tianwen Interview(数据中心节能技术委员会吕天文秘书长专访)。November 29, 2017. <http://www.gdctech.cn/c20271.jsp>

of the terminal access network. However, the cost of major network thoroughways' expansion is high and has great latency, which could create significant blockages around edge computing facilities. This will power the rise of edge computing. From safety checkups of construction site helmets to smart speakers, in-vehicle intelligent man-machine interactions, and autonomous driving, these edge devices and embedded software will become critical data filters and control valves. Through this process, we only need to upload 1/10,000th of desensitized data to the cloud for processing. This will provide us with greater control over data security.

The application of artificial intelligence will be highly customized to real-world use cases. Whether we are talking about autonomous driving, smart cities or smart retail, the use case determines the type of algorithms needed. China's future development of the Internet of things powered by smart cities, smart transportation, industrial 4.0 and 5G means AI chips need to focus on edge computing, as well as the simultaneous development of chips and algorithms.

One of the major challenges faced by AI

chip companies is the mismatch between chip development and algorithm iteration. Chip development is like blues music, which has a slow pace and long cycles. Algorithm iterations, however, are like rock music, which has a fast pace and short cycles. This requires AI chip companies to have the ability to come up with forward-looking insights into the future trends and evolution of algorithms, so that a chip that comes to market after a couple of years of research and development is still able to adapt to the latest mainstream algorithms.

China is undergoing a transformation from business model innovation to technological innovation, and certain innovations in China have long entered into no man's land. But no matter how things change in the future, I believe AI chip companies must be dedicated to creating open AI chip ecosystems and strive to achieve global AI ecosystem compatibility. This is an irreversible trend in the development of science and technology.

The development of artificial intelligence in the future will be inclusive, safe, and green. All of these elements depend on the advance of the most fundamental infrastructure: AI chips.



XI ZHOU
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CLOUDWALK
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Xi Zhou is the founder of CloudWalk Technology, an artificial intelligence company with a focus on computer vision-based products. Previously, Dr. Zhou worked at IBM's TJ Watson Research Center, Microsoft Research, NEC Research Institute, and the Chinese Academy of Sciences, specializing in computer vision research.

Dr. Zhou has published more than 60 articles at international conferences and in journals. He holds bachelor's and master's degrees from the University of Science and Technology of China, and a doctoral degree from the University of Illinois.

In 2015, Dr. Zhou led the professional team who created CloudWalk, which has gone on to raise more than US\$500 million in venture funding. The company is currently valued at US\$3.3 billion. CloudWalk's main businesses include providing facial recognition and other AI services to financial services, public security, civil aviation, retail and other sectors.

“**A**lthough the commercial application of computer vision in China is the most advanced globally, it is still in its early stages. Similar to a runner having completed the first ten kilometers of a marathon, this technology has great potential for future applications. For example, there is much room for exploration in the application of facial expression recognition, motion recognition, posture recognition, object recognition, animal recognition, and environment recognition.

As an AI solutions provider, we are seeing a limitless ocean of enterprise demand for this technology and its commercial application. Therefore, building platform-level technological reserves and solving practical problems for enterprises will be the main challenges for AI companies in the future. This also means today's leading companies will have greater competitive advantages, while in capital markets the bifurcation between leading AI companies and others will become more accentuated.

Across the next decade, artificial intelligence will no longer be all about creating awe-inducing lab results. It will begin to thoroughly transform industries. Each industry will figure out how AI will disrupt and reshape its industrial processes. When this transformation is completed, the operations and efficiencies of the industry will be elevated to an unprecedented level. Like the disruption brought about by the electricity revolution over a century ago, AI will revolutionize the existing industries beyond our imagination.

While the long-term outlook is exciting, AI companies must focus on the trivial and pragmatic things first. Only through gradual penetration of each industry and incremental improvements of the technology can fundamental transformation be achieved after years of accumulated know-how. For example, we are helping banks to upgrade their ATM terminals. Upgrading this small machine could lead to a thorough reconstruction of the ways in which users interact with their banks on the terminal and on the cloud.

Even without a major theoretical breakthrough, I am very optimistic about

the potential of AI's commercialization. It's because other factors such as hardware upgrades, new applications, and algorithm optimization will continue to push forward AI's industrialization.

Once Chinese AI companies achieve the ability to provide the best AI products globally, they will have wonderful opportunities to expand overseas. But this global expansion will take a long time—at least five years. Also, because Chinese AI companies may have reached world-leading levels in terms of technology sophistication, they will be able to expand around the world. Unlike earlier Chinese Internet companies that focused on expansions in developing countries, Chinese AI companies will not be confined to seeking market share only in emerging markets.

Because the ultimate product formats of AI solutions are industry-specific and use case-specific, AI solutions won't be highly standardized products. This will be the main obstacle to the globalization of AI companies. As a result, this process of AI companies' global expansions will not be easy, nor will it be rapid.

About China Money Network:

Founded in 2011, China Money Network is an artificial intelligence-based platform tracking China's smart investments and technology innovations. It is a leading platform for international investors to stay abreast with the Chinese venture capital and technology market.

For more information, please visit www.chinamoneynetwork.com