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C H I N A A E R O S P A C E
S T U D I E S I N S T I T U T E

In Their Own Words:

A Next Generation Artificial Intelligence Development Plan

State Council Notice on the Issuance of the Next Generation Artificial Intelligence Development Plan

Completed: July 8, 2017
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Translated by

DIGICHINA

Stanford University

NEW AMERICA

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China Aerospace Studies Institute

CASI's mission is to advance understanding of the capabilities, development, operating concepts, strategy, doctrine, personnel, organization, and limitations of China's aerospace forces, which include: the PLA Air Force (PLAAF); PLA Naval Aviation (PLAN Aviation); PLA Rocket Force (PLARF); PLA Army (PLAA) Aviation; the PLA Strategic Support Force (PLASSF); and the civilian and commercial infrastructure that supports the above.

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In Their Own Words

The "In Their Own Words" series is dedicated to translations of Chinese documents in order to help non-Mandarin speaking audiences access and understand Chinese thinking. CASI would like to thank all of those involved in this effort, especially DigiChina, New America, and the Stanford Cyber Policy Center.

In the "In Their Own Words" series, CASI and its collaborators aim to provide Chinese texts that illustrate thoughtful, clearly articulated, authoritative foreign perspectives on approaches to warfare at the strategic, operational, and tactical levels.

The Stanford-New America DigiChina Project is a collaborative effort to understand China's digital policy developments, primarily through translating and analyzing Chinese-language sources. Focuses include data governance, artificial intelligence, internet law, and technology in geopolitics.

The document has been translated into English by a group of experienced Chinese linguists with deep backgrounds on the subject matter and on China's S&T establishment and current AI capabilities. They are: Rogier Creemers, Leiden Asia Centre; Graham Webster, Yale Law School Paul Tsai China Center; Paul Triolo, Eurasia Group; and Elsa Kania.

On July 20, China's State Council issued a [seminal document](), entitled *A Next Generation Artificial Intelligence Development Plan*. This important aspirational document sets out a top-level design blueprint charting the country's approach to developing artificial intelligence (AI) technology and applications, setting broad goals up to 2030.

Please find the full text of the document below.

The translators produced analysis on the new document and Chinese AI ambitions for New America [here]().

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The group is grateful to New America Cybersecurity Initiative Fellow John Costello for comments that helped to improve the translation.

Any errors in translation are the responsibility of the translators, and we welcome comments, which can be directed to the collaborators at this address: chinacomments@newamerica.org

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A Next Generation Artificial Intelligence Development Plan

The rapid development of artificial intelligence [AI] will profoundly change human society and life and change the world. To seize the major strategic opportunity for the development of AI, to build China's first-mover advantage in the development of AI, to accelerate the construction of an innovative nation and global power in science and technology, in accordance with the requirements of the CCP Central Committee and the State Council, this plan has been formulated.

I. The Strategic Situation

The development of AI has entered a new stage. After sixty years of evolution, especially in mobile Internet, big data, supercomputing, sensor networks, brain science, and other new theories and new technologies, under the joint impetus of powerful demands of economic and social development, AI's development has accelerated, displaying deep learning, cross-domain integration, man-machine collaboration, the opening of swarm intelligence, autonomous control, and other new characteristics. Big data-driven cognitive learning, cross-media collaborative processing, and man-machine collaboration–strengthened intelligence, swarm integrated intelligence, and autonomous intelligent systems have become the focus of the development of AI. The results of brain science research inspired human-like intelligence that awaits action; the trends involving the chips, hardware, and platform have become apparent; the development of AI has entered into a new stage. At present, the development a new generation of AI and related disciplines, theoretical modeling, technological innovation, hardware and software upgrades, etc., all advance, provoking chain-style breakthroughs, promoting the acceleration of the elevation of economic and social domains from digitization and networkization to intelligentization.

AI has become a new focus of international competition. AI is a strategic technology that will lead in the future; the world's major developed countries are taking the development of AI as a major strategy to enhance national competitiveness and protect national security; intensifying the introduction of plans and strategies for this core technology, top talent, standards and regulations, etc.; and trying to seize the initiative in the new round of international science and technology competition. At present, China's situation in national security and international competition is more complex, and [China] must, looking at the world, take the development of AI to the national strategic level with systemic layout, take the initiative in planning, firmly seize the strategic initiative in the new stage of international competition in AI development, to create new competitive advantage, opening up the development of new space, and effectively protecting national security.

AI has become a new engine of economic development. AI has become the core driving force for a new round of industrial transformation, [which] will advance the release of the

huge energy stored from the previous scientific and technological revolution and industrial transformation, and create a new powerful engine, reconstructing production, distribution, exchange, consumption, etc., links in economic activities; with new demands taking shape from the macro to the micro within each domain of intelligentization; with the birth of new technologies, new products, new industries, new formats, new models; triggering significant changes in economic structure, profound changes in human modes of production, lifestyle, and thinking; and a whole leap of achieving social productivity. China's economic development enters a new normal, deepening the supply side of structural reform task is very arduous, [and China] must accelerate the rapid application of AI, cultivating and expanding AI industries to inject new kinetic energy into China's economic development.

AI brings new opportunities for social construction. China is currently in the decisive stage of comprehensively constructing a moderately prosperous society. The challenges of population aging, environmental constraints, etc., remain serious. The widespread use of AI in education, medical care, pensions, environmental protection, urban operations, judicial services, and other fields will greatly improve the level of precision in public services, comprehensively enhancing the people's quality of life. AI technologies can accurately sense, forecast, and provide early warning of major situations for infrastructure facilities and social security operations; grasp group cognition and psychological changes in a timely manner; and take the initiative in decision-making and reactions—which will significantly elevate the capability and level of social governance, playing an irreplaceable role in effectively maintaining social stability.

The uncertainties in the development of AI create new challenges. AI is a disruptive technology with widespread influence that may cause: transformation of employment structures; impact on legal and social theories; violations of personal privacy; challenges in international relations and norms; and other problems. It will have far-reaching effects on the management of government, economic security, and social stability, as well as global governance. While vigorously developing AI, we must attach great importance to the potential safety risks and challenges, strengthen the forward-looking prevention and guidance on restraint, minimize risk, and ensure the safe, reliable, and controllable development of AI.

China possesses a favorable foundation for the development of AI. The nation has: deployed the National Key Research and Development Plan's key special projects, such as intelligent manufacturing; issued and implemented the "Internet +" and AI Three-Year Activities and Implementation Program, releasing a series of measures from science and technology research and development; and promoted applications and industrial development, and other aspects. As a result of many years of continuous accumulation, China has achieved important progress in the field of AI, with the number of international scientific and technology papers published and the number of inventions patented ranked second in the world, while achieving important breakthroughs in certain domains of core crucial technologies. Leading the world in voice recognition and visual recognition technologies; initially possessing the capability for leapfrog development in adaptive autonomous learning, intuitive sensing, comprehensive reasoning, hybrid intelligence, and swarm intelligence, etc.; with Chinese information processing, intelligent monitoring, biometric identification, industrial robots, service robots, and unmanned driving gradually entering practical application; AI innovation and entrepreneurship have become increasingly active, and a number of leading enterprises have accelerated their growth,

receiving widespread concern and recognition internationally. Accelerate the accumulation of technological capabilities and massive data resources, the organization integration of both the huge demand for applications and an open market environment, which together constitute China's unique advantage in AI development.

At the same time, we must also clearly see that there is still a gap between China's overall level of development of AI relative to that of developed countries—lacking major original results in the basic theory, core algorithms, key equipment, high-end chips, major products and systems, foundational materials, components, software and interfaces, etc. Scientific research institutions and enterprises do not yet possess international influence upon ecological cycles and supply chain, lacking a systematic research and development layout; cutting-edge talent for AI is far from meeting demand. Adapting to the development of AI requires the urgent improvement of basic infrastructure, policies and regulations, and standards systems.

Facing a new situation and new demands, we must take the initiative to pursue and adapt to change, firmly seize the major historic opportunity for the development of AI, stick closely to development, study and evaluate the general trends, take the initiative to plan, grasp the direction, seize the opportunity, lead the world in new trends in the development of AI, serve economic and social development, and support national security, promoting the overall elevation of the nation's competitiveness and leapfrog development.

II. The Overall Requirements

(1) Guiding Ideology

Comprehensively implement the spirit of the 18th Party Congress and 18th Central Committee's Third, Fourth, Fifth, and Sixth Plenary Sessions. Thoroughly study and implement the spirit of General Secretary Xi Jinping's series of important sayings and new concepts, new ideas, and new strategy for governing the country; according to the "five in one" overall layout and "four comprehensives" strategic layout, conscientiously implement the CPC Central Committee and State Council decision-making arrangements, deeply implement the innovation-driven development strategy to accelerate the deep integration of AI with the economy, society and national defense as a primary line, to enhance: scientific and technological innovation capacity for a new generation of AI as the main direction of attack; intelligent economy development; smart society construction; protecting national security; building of knowledge clusters, technology clusters, and industry clusters mutually integrated with talent, system, and culture, for a mutually supporting ecosystem, advancing intelligentization as the center of humanity's sustainable development. Comprehensively enhance society's productive forces, comprehensive national power, and national competitiveness, in order to provide strong support to accelerate the construction of an innovative new-type nation and global science and technology power, to achieve the two centennial goals and the great rejuvenation of the Chinese nation.

[2] The Basic Principles

Technology-Led. Grasp the global development trend of AI, highlight the deployment of forward-looking research and development, explore the layout in key frontier domains, long-term support, and strive to achieve transformational and disruptive breakthroughs in theory, methods, tools, and systems; comprehensively enhance original innovation capability in AI, accelerate the construction of a first-mover advantage, to achieve high-end leading development.

Systems Layout. According to the different characteristics of foundational research, technological research and development, industrial development, and commercial applications, formulate a targeted systems development strategy. Fully give play to the advantages of the socialist system to concentrate forces to do major undertakings, promote the planning and layout of projects, bases, and a talent pool, organically link already-deployed major projects and new missions, continue current urgent needs and long-term development echelons, construct innovation capacity, create a collaborative force for institutional reforms and the policy environment.

Market-Dominant. Follow the rules of the market, remain oriented toward application, highlight companies' choices on the technological line and primary role in the development of commercial product standards, accelerate the commercialization of AI technology and results, and create a competitive advantage. Grasp well the division of labor between government and the market, better take advantage of the government in planning and guidance, policy support, security and guarding, market regulation, environmental construction, the formulation of ethical regulations, etc.

Open-Source and Open. Advocate the concept of open-source sharing, and promote the concept of industry, academia, research, and production units each innovating and in principal pursuing joint innovation and sharing. Follow the coordinated development law for economic and national defense construction; promote two-way conversion and application for military and civilian scientific and technological achievements and co-construction and sharing of military and civilian innovation resources; form an all-element, multi-domain, highly efficient new pattern of civil-military integration. Actively participate in global research and development and management of AI, and optimize the allocation of innovative resources on a global scale.

[3] Strategic Objectives

These are divided into the following three steps:

First, by 2020, the overall technology and application of AI will be in step with globally advanced levels, the AI industry will have become a new important economic growth point, and AI technology applications will have become a new way to improve people's livelihoods, strongly supporting [China's] entrance into the ranks of innovative nations and comprehensively achieving the struggle toward the goal of a moderately prosperous society.

- By 2020 China will have achieved important progress in a new generation of AI theories and technologies. It will have actualized important progress in big data intelligence, cross-medium intelligence, swarm intelligence, hybrid enhanced intelligence, and autonomous intelligence systems, and will have achieved important progress in other foundational theories and core technologies; the country will have achieved iconic advances in AI models and methods, core devices, high-end equipment, and foundational software.
- The AI industry's competitiveness will have entered the first echelon internationally. China will have established initial AI technology standards, service systems, and industrial ecological system chains. It will have cultivated a number of the world's leading AI backbone enterprises, with the scale of AI's core industry exceeding 150 billion RMB, and exceeding 1 trillion RMB as driven by the scale of related industries.
- The AI development environment will be further optimized, opening up new applications in important domains, gathering a number of high-level personnel and innovation teams, and initially establishing AI ethical norms, policies, and regulations in some areas.

Second, by 2025, China will achieve major breakthroughs in basic theories for AI, such that some technologies and applications achieve a world-leading level and AI becomes the main driving force for China's industrial upgrading and economic transformation, while intelligent social construction has made positive progress.

- By 2025, a new generation of AI theory and technology system will be initially established, as AI with autonomous learning ability achieves breakthroughs in many areas to obtain leading research results.
- The AI industry will enter into the global high-end value chain. This new-generation AI will be widely used in intelligent manufacturing, intelligent medicine, intelligent city, intelligent agriculture, national defense construction, and other fields, while the scale of AI's core industry will be more than 400 billion RMB, and the scale of related industries will exceed 5 trillion RMB.
- By 2025 China will have seen the initial establishment of AI laws and regulations, ethical norms and policy systems, and the formation of AI security assessment and control capabilities.

Third, by 2030, China's AI theories, technologies, and applications should achieve world-leading levels, making China the world's primary AI innovation center, achieving visible results in intelligent economy and intelligent society applications, and laying an important foundation for becoming a leading innovation-style nation and an economic power.

- China will have formed a more mature new-generation AI theory and technology system. The country will achieve major breakthroughs in brain-inspired intelligence, autonomous intelligence, hybrid intelligence, swarm intelligence, and other areas, having important impact in the domain of international AI research and occupying the commanding heights of AI technology.
- AI industry competitiveness will reach the world-leading level. AI should be expansively deepened and greatly expanded into production and livelihood, social governance, national defense construction, and in all aspects of applications, will become an expansive core technology for key systems, support platforms, and the intelligent application of a complete industrial chain and high-end industrial

clusters, with AI core industry scale exceeding 1 trillion RMB, and with the scale of related industries exceeding 10 trillion RMB.
- China will have established a number of world-leading AI technology innovation and personnel training centers (or bases), and will have constructed more comprehensive AI laws and regulations, and an ethical norms and policy system.

(4) Overall Deployment

The development of AI is a complex systemic project related to the overall situation, that must be arranged in accordance with "build one system, grasp the two attributes, adhere to the trinity, and strengthen the four supports" to form a strategic path for the healthy and sustainable development of AI.

Construct an open and cooperative AI technology innovation system. Target the weak foundation in original theories, and the key difficulties and deficiencies in major products and systems. Establish foundational theories and a common technology system for a new generation of AI, laying out the construction of a major scientific and technological innovation base. Strengthen the high-end talent team in AI to promote innovation and cooperative interactions. Form a continuous innovation capability for AI.

Grasp AI's characteristic high degree of integration of technological attributes and social attributes. It is necessary not only to increase efforts in the research and development and applications of AI, maximizing the potential of AI, but also to predict AI's challenges, coordinate industrial policies, innovate in policies and social policies, achieve the coordination of encouraging development and reasonable regulation, and maximize risk prevention.

Adhere to the promotion of the trinity of breakthroughs in AI research and development, product applications, and fostering industry development. Adapt to the characteristics and trends of AI development. Strengthen the deep integration of the innovation chain and industrial chain, the interactive evolution of technology supply and market demand. Take technological breakthroughs to promote domain applications and industrial upgrading. Through application demonstrations, promote the optimization of technologies and systems. At the same time as greatly promoting technology applications and industrial development, strengthen long-term R&D layout and research. Achieve rolling development and continuous improvement. Ensure that theory is in the front, the technological commanding heights are occupied, and applications are secure and controllable.

Fully support science and technology, the economy, social development, and national security. Drive comprehensive elevation on national innovative capability with AI technological breakthroughs. Lead in the process of constructing a global science and technology power. Through strengthening intelligent industry and cultivating the intelligent economy, create a new growth cycle for China's next decade or even decades of economic prosperity. Through building an intelligent society, promote the improvement of people's livelihoods and welfare and implement people-centric development thinking. Through AI, elevate national defense strength and assure and protect national security.

III. Focus Tasks

Based on the overall picture of national development, accurately grasp the global development trends of AI, find the correct openings for breakthroughs and directions for the main thrust, comprehensively strengthen basic science and technology innovation capabilities, comprehensively expand the depth and breadth of application in focus areas, and comprehensively enhance the built-in intelligence levels of applications in economic and social development, as well as in national defence.

[1] Build open and coordinated AI science and technology innovation systems

Focus on increasing the supply of AI innovation sources; strengthen deployments in areas such as advanced basic theory, key general technologies, basic platforms, talent teams, etc.; stimulate open-source sharing; systematically enhance sustained innovation capabilities; ensure that our country's AI science and technology levels ascend to the leading global ranks; and make ever more contributions to the development of global AI.

1. Establish basic theory systems for a new generation of AI

Focus on major advanced scientific AI questions; concurrently deal with present needs and long-term developments; make breakthroughs in basic AI application theory bottlenecks; give priority to deploying basic research that may trigger paradigmatic change in AI; stimulate the intersection and convergence of disciplines; and provide powerful scientific reserves for the sustained development and profound application of AI.

Make breakthroughs in basic application theory bottlenecks. Aim at basic theoretical orientations with clear applied objectives, which promise to trigger an upgrade of AI technology, strengthen basic theoretical research on big data intelligence, cross-media sensing and computing, human-machine blended intelligence, mass intelligence, autonomous cooperation and decision-making, etc. Focus on breakthroughs in big data intelligence, unsupervised learning, comprehensive deep reasoning and other such difficult issues. Establish data-driven cognitive computing models with natural language understanding at the core, and shape capabilities to go from big data to knowledge, and from knowledge to decision-making. Focus on breakthroughs in cross-media sensing and computing theory, including theories and methods for: low-cost and low-energy smart sensing, active sensing in complex landscapes, listening comprehension in the natural environment as well as language sensing, autonomous multimedia learning, etc. Realize superhuman sensing and highly-dynamic, high-dimensional, and multi-model distributed large-landscape sensing. The focuses on breakthroughs in blended and enhanced intelligence theory are: theories on human-machine cooperative and blended environmental understanding, decision-making, and learning; intuitive reasoning and causal models, recall and knowledge evolution, etc.; realizing blended and enhanced intelligence where learning and reflection approach or exceed human intelligence levels. The focuses for breakthroughs in collective intelligence theory are: theories and methods for the organization, emergence and learning of collective intelligence; establishment of expressible and computable mass intelligence incentive algorithms and models; and shaping Internet-based collective intelligence theory systems. The focuses for

breakthroughs in autonomous coordination, control and optimized decision-making theory are: theories concerning coordination sensing and interaction aimed at autonomous unmanned systems; autonomous coordination control and optimized decision-making; knowledge-driven human-machine-object triangular coordination and interoperation, etc.; and shaping novel theoretical systems and frameworks for innovation in autonomous intelligence and unmanned systems.

Arrange advanced basic theoretical research. Aim for a direction that may trigger a paradigmatic change in AI, far-sightedly arrange research on high-level machine learning, brain-inspired intelligence computing, quantum smart computing, and other such cross-domain basic theories. The focuses for breakthroughs in high-level machine learning theory are theories and methods concerning self-adaptive learning, autonomous learning, etc., and realizing AI with high interpretative and strong generalization capabilities. The focuses for breakthroughs in brain-inspired intelligence computing theory are: theories concerning brain-inspired information encoding, processing, recall, learning and reasoning; the creation of brain-inspired complex systems and brain-inspired control theories and methods; and establishment of new large-scale brain-inspired intelligence computing models and brain-inspired understanding computing models. The focuses for breakthroughs in quantum computing theory are: methods for quantum-accelerated machine learning; establishment of high-performance computing and quantum computing convergence models; and shaping high-efficiency, accurate, and autonomous quantum AI system setups.

Launch cross-disciplinary exploratory research. Promote the intersection and convergence of AI with neurology, cognitive science, quantum science, psychology, mathematics, economics, sociology and other such related basic disciplines; strengthen basic theoretical mathematical research to guide the development of AI algorithms and models; focus on researching the basic theoretical questions of AI legal principles; support exploratory research that is strongly original, and where there is no consensus; encourage scientists to explore freely; dare to overcome front-line scientific difficulties in AI; create ever more original theory; and make ever more original discoveries.

Box 1: Basic Theories

> 1. *Big data intelligence theory. Research new data-driven and knowledge-driven AI methods, theories and methods for sensing computing theory with natural language understanding, images and figures at the core, comprehensive deep reasoning and creative AI theories and methods, basic theories and frameworks on smart decision-making with incomplete information, data-driven common AI data models and theories, etc.*
> 2. *Cross-media sensing and computing theory. Research sensing that exceeds human visual abilities, active visual sensing and computing aimed at the real world, auditory sensing and computing of natural acoustic scenes, language sensing and computing in an environment of natural interaction, human sensing and computing aimed at asynchronous orders, autonomous learning aimed at smart media sensing, and urban omnidimensional smart sensing and reasoning engines.*
> 3. *Hybrid and enhanced intelligence theory. Research hybridization and convergence where "the human is in the loop," behavioral strengthening through human-machine smart symbiosis and brain-machine coordination, intuitive machine*

reasoning and causal models, associative recall models and knowledge evolution methods, complex data and task blended and enhanced intelligence learning methods, cloud robotics coordination computing methods, and situational comprehension and human-machine group coordination in real-world environments.
4. *Swarm intelligence theory.* Research swarm intelligence structural theory and organizational methods, swarm intelligence incentive mechanisms and emergence mechanisms, swarm intelligence learning theories and methods, common swarm intelligence computing paradigms and models.
5. *Autonomous coordination and control, and optimized decision-making theory.* Research coordination sensing and interaction aimed at autonomous unmanned systems, coordination, control and optimized decision-making aimed at autonomous and unmanned systems, knowledge-driven human-machine-object triangular coordination and interoperability theories.
6. *High-level machine learning theory.* Research basic statistical learning theories, reasoning and decision-making under uncertainty, distributed learning and interaction, learning while protecting privacy, small-sample learning, deep intensive learning, unsupervised learning, semi-supervised learning, active learning and other such learning theories and efficient models.
7. *Brain-inspired intelligence computing theory.* Research theories and methods on brain-inspired sensing, brain-inspired learning, and brain-inspired recall mechanisms and computing blends, brain-inspired complex systems, brain-inspired control, etc.
8. *Quantum intelligent computing theory.* Explore cognitive quantum models and intrinsic mechanisms, research efficient quantum intelligence models and algorithms, high-performance and high-bitrate quantum AI processors, real-time quantum AI systems that can exchange information with the outside world, etc.

2. Build a next-generation AI key general technology system

Focusing on the urgent need to raise China's international competitiveness in AI, next-generation AI key general technology R&D and deployment should make algorithms the core; data and hardware the foundation; and upping capabilities in sensing and recognition, knowledge computing, cognitive reasoning, executing motion, and human-machine interface the emphasis; in order to form openly compatible, stable and mature technological systems.

Knowledge computing engine and knowledge service technology. Key breakthroughs in knowledge processing, deep search, and visual interactive core technology; realization of automatic acquisition of incrementally growing knowledge; possession of concept discernment, object discovery, attribute prediction, evolutionary knowledge modeling, and relationship discovery capabilities; the formation of multi-billion-scale, multi-source, multi-disciplinary, multi-data type, and cross-medium knowledge maps.

Cross-medium analytical reasoning technology. Key breakthroughs in cross-medium unified indicators; relational understanding and knowledge mining; knowledge map structure and learning; knowledge evolution and reasoning; intelligent description and

generation, etc., technology. Realization of cross-medium knowledge indicators, analysis, mining, reasoning, evolution, and utilization. Construct analytic reasoning engines.

Key swarm intelligence technology. Key breakthroughs on the basis of the popularization of the internet, mass collaboration, knowledge resource management, and open sharing, etc., technologies. Building frameworks to display swarm intelligence knowledge. Realize the integration and strengthening of swarm intelligence-based knowledge acquisition and swarm intelligence under open development conditions. Support swarm perception, cooperation, and evolution at a national, tens-of-millions scale.

New architecture and new technology for hybrid and enhanced intelligence. Key breakthroughs in human-machine interaction for perception and execution integration models, new types of intelligent computing-fronted sensors, common use hybrid architecture, etc., core technologies. Build autonomous, environmentally adaptable hybrid enhanced intelligent systems, human-machine hybrid enhanced intelligent systems and support environments.

Intelligent technologies of autonomous unmanned systems. Key breakthroughs in autonomous unmanned system computing architecture, complex situational environment perception and understanding, real-time accurate positioning, adaptable, intelligent navigation in complex environments, etc., general technologies. Unmanned and autonomously controlled systems including automobiles, ships, automatic driving in traffic, etc., intelligent technologies. Develop service robots, special-purpose robots, etc., core technologies and support unmanned system application and manufacturing development.

Intelligent virtual reality modeling technology. Key breakthroughs in intelligent modeling technology for virtual counterparts. Increasing the sociality, diversity, and lifelike quality of virtual reality intelligent counterpart behavior. Realize the organic integration, high efficiency, and interactivity of virtual reality and augmented reality, etc., technologies.

Intelligent computing chips and systems. Key breakthroughs in high energy efficiency, reconfigurable brain-inspired computing chips and brain-inspired visual sensor systems with computational imaging capabilities. Research and develop high-efficiency brain-inspired neural network architectures and hardware systems with autonomous learning capabilities. Realize brain-inspired intelligent systems with multimedia sensory information understanding, intelligence growth, and common sense reasoning capabilities.

Natural language processing technology. Key breakthroughs in natural language grammar logic, word-concept symbols, and deep semantic analysis core technologies. Advance effective human-machine communication and free interaction. Realize multi-style, multi-language, multi-domain natural language intelligent understanding and automated [results] generation.

Box 2: Key General Technologies

1. *Knowledge computing engines and knowledge service technology. Researching knowledge computing and visual interaction engines; researching innovative design, digital creation, and commercial intelligence with visual media at the core; developing large-scale organic data knowledge discovery.*
2. *Cross-medium analytic reasoning technology. Researching cross-medium unified indicators, connected understanding and knowledge mining, knowledge map building and learning, knowledge evolution and inference, intelligent description and generation, etc., technology; developing cross-medium analytic reasoning engine and verification systems.*
3. *Key swarm intelligence technology. Developing swarm intelligence's active perception and discovery, knowledge gain and generation, cooperation and sharing, evaluation and evolution, human-machine integration and enhancement, self-preservation and mutual security, etc., key technology studies; building service system architecture for the crowd intelligence space; researching mobile crowd intelligent coordinated decision making and control technologies.*
4. *Hybrid enhanced intelligent new architectures and technologies. Researching hybrid enhanced intelligent core technology and cognitive computing frameworks; new-model hybrid computing architectures, human-machine collective driving, online intelligent learning technology, and hybrid enhanced frameworks for simultaneous management and control.*
5. *Autonomous unmanned systems intelligent technology. Researching unmanned autonomous control intelligent technology for automobiles, ships, traffic, automatic driving, etc.; service, space, maritime, and polar robot technology; unmanned workshop/intelligent factory intelligent technology; high-end intelligent control technology and autonomous unmanned operating systems. Researching positioning, navigation, recognition, etc., robotic and mechanical arm autonomous control technology for visual sensing in complex environments.*
6. *Virtual reality intelligent modeling technology. Researching mathematical expression and modeling methods for virtual counterpart intelligent behavior; problems such as natural, persistent, and deep exchange between users and virtual counterparts and virtual environments; intelligent counterpart modeling technology and method systems.*
7. *Intelligent computing chips and systems. Researching neural network processors, as well as high-energy efficiency, reconfigurable brain-inspired computing chips, etc.; new-model perception chips and systems, intelligent computing system structure and systems, and AI operating systems. Researching architectures suitable for AI hybrid architectures, etc.*
8. *Natural language processing technology. Researching short text computing and analysis technology, cross-language text mining technology and turning toward semantic comprehension technology for machine cognitive intelligence, and human-machine interaction systems for multimedia information comprehension.*

3. Coordinate the layout of AI innovation platforms

Construct AI innovation platforms. Strengthen the foundational support for AI research and development and applications. AI open-source hardware and software infrastructure platforms should focus on building and supporting unified computing frameworks for knowledge reasoning, probability statistics, depth learning, and other AI paradigms. Form and promote an ecological chain of platforms for interaction and synergies among AI software, hardware, and intelligent clouds. The group intelligent service platform should focus on the construction of knowledge resource management and the open sharing tools based on the large-scale cooperation on the Internet. Create a platform and service environment for the innovation of the industry and university. The hybrid enhanced intelligent support platforms should focus on the construction of a heterogeneous real-time computing engine supporting large-scale training and a new computing clusters, providing a service-oriented, systematic platform and solution for complex intelligent computing. Autonomous unmanned system support platform focuses on the construction of autonomous system environmental awareness, autonomous collaborative control, intelligent decision-making and other AI common core technology support systems. Create development and test environments for open, modular, reconfigurable autonomous unmanned systems. AI basic data and security detection platforms should focus on the construction of AI for the public data resource library, the standard test data set, cloud service platform, the formation of AI algorithms and platform security test evaluation methods, techniques, norms and tools, promoting the open sourcing and openness of all kinds of common software and technology platform. Promote military-civilian sharing and joint use for all kinds of platforms in accordance with the requirements of deep military-civil integration related provisions.

Box 3: Basic Support Platforms

1. *AI Open-Source Hardware and Software Infrastructure and Platforms. Establish big data and AI open-source software platforms, terminal, and cloud collaborative AI cloud service platforms, new multi-intelligent sensor and integrated platforms, new product design platforms based on AI hardware, and future network, big data intelligent service platforms.*
2. *Group Intelligent Service Platforms. Establish group knowledge-based computing and support platforms, science and technology public service systems, group intelligent software development and verification automation systems, group intelligent software learning and innovation systems, open environment cluster decision-making systems, and group-sharing economic service systems.*
3. *Hybrid Enhanced Intelligent Support Platforms. Establish AI supercomputing centers, large-scale super intelligent computing support environments, online intelligent education platforms, "human-in-the-loop" driving brains, intelligent platforms for complexity analyses and risk assessment in industrial development, intelligent security platforms to support nuclear power security operations, and research and development and testing platforms for human-machine joint driving technology.*
4. *Autonomous Unmanned System Support Platforms. Establish common core technology and support platforms, independent unmanned systems, independent control of unmanned aerial vehicles, and automatic driving support platforms for auto, ship and rail traffic, service robots, space robots, marine robots, polar robot*

> support platforms, technical support platforms for intelligent factory and intelligent control equipment, etc.
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> 5. *AI Basic Data and Security Detection Platforms. Construct artificial data-oriented public data resource libraries, standard test data sets, and cloud service platforms. Establish test models and evaluation models for the security of AI algorithms and platforms. Research and develop security evaluation tools for AI algorithms and platforms.*

4. Accelerate the training and gathering of high-end AI talent

Make the construction of a high-end talent team of the utmost importance in the development of AI. Adhere to the combination of training and introduction. Improve the AI education system, strengthen the construction of a talent pool and echelons, especially accelerate the introduction of the world's top talent and young talent, forming China's AI top talent base.

Cultivate high-level of AI innovative talents and teams. Support and cultivate the development potential of leading AI talent. Strengthen professional and technical personnel training for basic research, applied research, operations and maintenance aspects of AI. Pay attention to the training of compound talents, focusing on cultivating vertical composite talents for AI theory, methods, technology, products, and application, and compound talents who master the "AI +" economy, society, management, standards, law, and other horizontal areas. Through major research and development tasks and base and platform construction, converge high-end talents in AI. Create high-level innovation teams in a number of AI key domains. Encourage and guide domestic innovative talents and the teams to strengthen cooperation with the world's top AI research institutions.

Increase the introduction of high-end AI talent. Open up specialized channels and implement special policies to achieve the precise introduction of peak AI talent. Focus on the introduction of international top scientists and high-level innovation teams in neural awareness, machine learning, automatic driving, intelligent robots, and other areas. Encourage the use of flexible introduction of AI talent through project cooperation, technical advice, etc. Coordinate the use of the "Thousands Talents" plan and other existing talent plans to strengthen the field of AI talents, especially through the introduction of outstanding young talent. Improve enterprise human capital cost accounting and related policies. Encourage enterprises and scientific research institutions to introduce AI talent.

Construct an AI academic discipline. Improve the disciplinary layout of the AI domain. Establish AI majors. Promote the construction of a discipline in the domain of AI. Establish AI institutes as soon as possible in pilot institutions. Increase the enrollment places for masters and PhDs in working in AI and related disciplines. Encourage colleges and universities to broaden the content of AI professional education on an original basis. Create a new model of "AI + X" compound professional training, attaching importance to cross-integration of professional education for AI and mathematics, computer science, physics, biology, psychology, sociology, law, and other disciplines. Strengthen cooperation in production and research. Encourage universities, research institutes, enterprises and other institutions to carry out the construction of an AI discipline.

(2) Fostering a high-end, highly efficient smart economy

Accelerate the fostering of an AI industry with a major leading and driving effect, stimulate the profound convergence of AI and all industrial areas, and create data-driven smart economic patterns with human-machine coordination, cross-sectoral convergence, and joint creation and sharing. Data and knowledge will become the first factor for economic growth; human-machine coordination will become the mainstream method of production and service; cross-sectoral convergence will become an important economic model; joint creation and sharing will become basic characteristics of the economic ecology; individualized demands and made-to-order will become new consumption trends; and productivity will increase substantially, drive industries to migrate towards the high end of value chains, powerfully support the development of the real economy, and comprehensively increase the quality and efficiency of economic development.

1. Forcefully develop new AI industries

Accelerate the transformation and application of key AI technologies, stimulate the integration of technologies with commercial model innovation, promote the innovation of smart products in focus areas, vigorously foster new AI business models, compose high-end industry chains, and forge AI industry groups with international competitiveness.

Smart software and hardware. Develop operating systems, databases, intermediary devices, development tools, and other such key software and hardware aimed at AI; make breakthroughs in graphic processing and other such core hardware; research solution plans for smart systems in pattern recognition, voice understanding, machine translation, smart interaction, knowledge processing, control and decision-making, etc.; and foster and expand basic software and hardware industries aimed at AI.

Smart robots. Tackle core components and special sensors for smart robots, perfect hardware interface standards, software interface standards, and safe usage standards for smart robots. Research and develop smart industrial robots and smart service robots, realize large-scale application, and enter into global markets. Research, produce, and popularize space robots, maritime robots, polar robots, and other such special kinds of smart robots. Establish smart robot standard systems and security norms.

Smart delivery tools. Develop self-driving vehicles and rail traffic systems; strengthen the integration and coordination of vehicle load sensing, automatic driving, the Internet of cars, the Internet of Things, and other such technologies; develop smart traffic sensing systems, create national indigenous automatic driving platform technology systems and industrial assembly capabilities; and explore self-driving vehicle sharing models. Develop consumer and commercial unmanned aircraft and unmanned ships, and establish and trial specialized service systems for authentication, monitoring, technology competition, etc., perfect management measures for the space and maritime areas.

Virtual reality and augmented reality. Make breakthroughs in key technologies such as high-performance software modelling, content capturing and generation, augmented reality and human-machine interaction, integrated environments and tools, etc. Research and create virtual display devices, optical devices, high-performance three-dimensional display devices, development engines, and other such products. Establish standards and

evaluation systems for virtual reality and augmented reality technologies, products, and services, and promote their converged application in focus sectors.

Smart terminals. Accelerate the research and development of smart terminal core technologies and products, develop new-generation smart phones, on-board smart terminals for cars, and other such mobile smart terminal products and equipment. Encourage the research and development of smart watches, smart earpieces, smart glasses, and other such wearable terminal products, and expand product forms and application services.

Basic Internet of Things devices. Develop high-sensitivity and highly reliable smart sensors and chips supporting the new-generation Internet of Things. Make progress in core Internet of Things technologies such as RFID and short-distance machine communications, as well as key components such as low-power processors.

2. Accelerate and promote the upgrade of industrial intelligentization

Promote the converged innovation of AI in all sectors. Launch AI application demonstrations and trials in focus sectors and areas such as manufacturing, agriculture, logistics, finance, commerce, household goods, etc. Promote the application of AI at scale, and comprehensively upgrade the smartness level of industrial development.

Smart manufacturing. Focus on the major demands for building a strong manufacturing country, move forward the integrated application of systems such as key technologies and equipment for smart manufacturing, core supporting software, the industrial internet, etc. Research and develop smart products and smart connected products, tools and systems that can be used in smart manufacturing, and smart manufacturing cloud service platforms. Popularize smart manufacturing processes, distributed smart manufacturing, networked coordinated manufacturing, long-distance diagnosis and operational services, and other such novel manufacturing models. Establish smart manufacturing standard systems, and move forward with the intelligentization of manufacturing activities across the entire lifecycle.

Smart agriculture. Research and formulate smart agricultural sensing and control systems, smart agricultural equipment, autonomous tasking systems for farming equipment across fields, etc. Establish and complete smart agriculture information remote sensing and monitoring networks integrating air, space, and land components. Establish model agriculture big data smart decision-making and analysis systems, launch trials of smart farms, smart plant factories, smart pastures, smart fisheries, smart orchards, smart farm produce processing workshops, green and smart farm product supply chains and other such integrated applications.

Smart logistics. Strengthen research, development and broad use of smart logistics equipment for smart loading, unloading, and transportation; parcel sorting, processing and delivery; etc. Establish smart deep-sensing storage systems, and enhance storage and operational management levels and efficiency. Perfect smart logistics public information platforms and command systems, product quality authentication and tracing systems, smart distribution and dispatch systems, etc.

Smart finance. Establish big data systems for finance, and enhance multimedia data processing and comprehension capabilities for finance. Innovate smart financial products and services, develop new financial business models. Encourage the financial sector to use smart customer service, smart inspection, and other such technologies and equipment. Build smart warning and prevention systems for financial risk.

Smart commerce. Encourage the application of cross-media analysis and reasoning, knowledge computing engines and knowledge services, and other such new technologies in the commercial area, and popularize AI-based novel commercial services and decision-making systems. Build cross-medium data platforms covering geographic positioning, online media, urban basic data, etc., and support enterprises' launching smart services. Encourage the provision of made-to-order commercial smart decision-making services focusing on individual demands and enterprise management.

Smart household goods. Strengthen the converged application of AI technology and household and building systems, and enhance the smartness levels of building facilities and household goods. Research, develop, and use household connection and interactivity agreements, as well as interface standards suited for different application settings. Enhance sensing and connection capabilities of household electrical appliances, durable goods and other such household products. Support smart household enterprises in innovating new service models, and promote interactive and sharing solutions and plans.

3. Forcefully develop smart enterprises

Promote the upgrading of enterprises' smartness levels on a large scale. Support and guide enterprises to use new AI technologies in core operational segments such as design, production, management, logistics, sales, etc. Build novel enterprise organization structures and operational models; create smart and converged business models for manufacturing, services, and finance; and develop individualized made-to-order; and broaden smart product supply. Encourage large-scale Internet enterprises to build cloud manufacturing platforms and service platforms, and provide online key industry software and model databases aimed at manufacturing enterprises. Launch outsourcing services for manufacturing capacity, and promote the development of smartness among small and mid-size enterprises.

Popularize the use of smart factories. Strengthen the application and demonstration of key technologies and system methods for smart factories. Focus on popularizing production line reconstruction and dynamic smart control, production faculty smart interconnection and cloud data collection, multi-dimensional human-machine-object coordination, interoperability, and other such technologies. Encourage and guide enterprises to build factory big data systems, networked distributed production facilities, etc. Realize the networking of production equipment, the visualization of production data, the transparency of production processes, and the automation of production sites; and enhance the smartness levels of factory operational management.

Accelerate the fostering of AI industry-leading enterprises. Accelerate the creation of global leading AI enterprises and brands in advantageous areas such as unmanned aircraft, speech recognition, pattern recognition, etc. Accelerate the fostering of a batch of key enterprises in novel areas such as smart robots, smart cars, wearable equipment, virtual reality, etc. Support AI enterprises to strengthen their patent structures, and take the lead

in or participate in the formulation of international standards. Promote domestic advantageous enterprises, sectoral organizations, scientific research bodies, higher education institutes, etc., to jointly establish the AI Industry and Technology Innovation Alliance of China. Support key backbone enterprises to build open source hardware factories, open source software platforms, create innovative ecologies integrating all kinds of resources, stimulate small and mid-size AI enterprises to develop and to be used in all areas. Support all kinds of bodies and platforms to provide specialized services aimed at AI enterprises.

4. Create AI innovation heights

Combined with each locality's foundation and advantages, according to the field of AI applications classifications, advance the layout of the relevant industries. Encourage local industry chains and innovation chains around AI. Gather high-end factors, high-end enterprises, and high-end talent. Build AI industry clusters and heights of innovation.

Launch AI innovation application pilot demonstrations. In areas where the AI foundation is favorable and its development potential bigger, organize and launch national AI innovation experiments. Explore systems and mechanisms, policy and regulation, the cultivation of talent, and other major reforms. Promote the transformation of the AI achievements, major product integrated innovation, and demonstration of applications. Form replicable, promotable experience, leading to the promotion of intelligent economy and intelligent social development.

Construct national AI industrial parks. Rely upon national independent innovation demonstration areas and the national high-tech industry development zone and other innovative vectors. Strengthen science and technology talent, finance, policy, and other elements of the optimal allocation and combination. Accelerate the construction of AI industry innovation cluster.

Construct national AI mass innovation bases. Relying on colleges and universities and scientific research institutes concentrated in localities, build AI field professionalized innovation platforms and other new entrepreneurial service agencies. Construct a number of low-cost, convenient, all-factor, open-style AI 'hackerspaces.' Improve incubation services system, promote the transformation of AI scientific and technological achievements, and support AI innovation and entrepreneurship.

(3) Construct a safe and convenient intelligent society

Based on the goal of improving people's living standards and quality, speed up and deepen the applications of AI, increase the level of intelligentization of the whole society to form an all-encompassing and ubiquitous intelligent environment. Increasingly, repetitive, dangerous tasks will be completed by AI, while individual creativity will play a greater role. Form more high-quality and high comfort jobs; make precision intelligent services more diverse, such that people can maximize their enjoyment of high quality services and convenient life. Through a substantial increase in the level of intelligentization of social governance, make social operations more safe and efficient.

1. Develop convenient and efficient intelligent services

Accelerate the application of innovative AI throughout education, health care, pension and other urgent needs involving people's livelihood, to provide for the public personalized, diversified, high-quality services.

Intelligent Education. Utilize intelligent technology to accelerate and promote a personnel training model and reform to teaching methods; establish new-type education systems, including intelligent learning and interactive learning. Launch the construction of intelligent campuses; promote AI in teaching, management, resource construction, and other full-scale applications. Develop three-dimensional integrated teaching field, based on big data intelligent online learning and education platforms. Develop intelligent educational assistants; establish intelligent, fast and comprehensive education analysis system. Establish a learner-centered educational environment, and provide precision-deployed education services, achieve daily education and lifelong education.

Intelligent Medical Care. Promote the use of new models and new methods of AI treatment, establish a rapid, accurate intelligent medical system. Explore intelligent hospital construction, develop human-machine coordinated surgical robots and intelligent clinic assistants. Pursue research and development on flexible wearable, biologically compatible physiological monitoring systems, research and development of human-computer collaboration intelligent clinical diagnosis and treatment programs. Achieve intelligent image recognition, pathology classification, and intelligent multi-disciplinary consultation. Carry out large-scale genome recognition, proteomics, metabolomics, and other research and development of new drugs based on AI, promote intelligent pharmaceutical regulation. Strengthen epidemic intelligence monitoring, prevention, and control.

Intelligent Health and Elder Care Systems. Strengthen community intelligent health management, achieve breakthroughs in big data analysis, Internet of Things, and other key technologies. Research and develop health management wearable equipment and home intelligent health testing and monitoring equipment. Promote changes in health management from point-like monitoring to continuous monitoring, from short process management to long process management. Construct intelligent elder care communities and institutions; build a safe and convenient intelligent pension infrastructure system. Strengthen the intelligentization of products for elderly persons and intelligent products suitable for the aged. Develop audio-visual aid equipment, physical auxiliary equipment, and other intelligent home care equipment, expanding the elderly's activity space. Develop mobile social and service platform for the elderly and emotional escort assistant to enhance the quality of life of the elderly.

2. Promote the intelligentization of social governance

Promote the application of AI technology for administrative management, judicial management, urban management, environmental protection, and other hot and difficult issues in social governance, to promote the modernization of social governance.

Intelligent Government. Develop an AI platform for government services and decision-making. Develop a decision-making engine for the open environment. Promote applications in research on complex social problems, policy assessment, risk warning,

emergency response, and other major matters of strategic decision-making. Strengthen the integration of government information resources and accurate forecasting of public demands, and smooth communication channels between the government and the public.

Smart Courts. Construct a set of trial, personnel, data applications, judicial disclosure, and dynamic monitoring into an integrated court data platform. Promote AI applications for applications including evidence collection, case analysis, and legal document reading and analysis. Achieve the intelligentization of courts and trial systems and trial capacity.

Smart Cities. Build an intelligentized city infrastructure, develop intelligent buildings, and promote the intelligentization, transformation, and upgrading of underground corridors and other municipal infrastructure. Construct urban big data platforms to build a heterogeneous, integrated data system for urban operations and management. Achieve comprehensive perception and deep understanding of the operation of complex urban systems for urban infrastructure and urban green space, wetlands, and other important ecological elements. Research and develop to build community public service information systems. Promote community service system and residents' intelligent home system collaboration. Promote the intelligentization of the full lifecycle of urban planning, construction, and management.

Smart Transportation. Research, establish, and operate vehicle automatic driving and road coordination technology systems. Research and develop information and integrated data platforms for transportation under complex multi-dimensional conditions. Establish intelligentized transportation command, control, and integrated operations. Actualize intelligent transportation obstacle removal and integrated management and coordination and command. Build intelligent transportation monitoring, management, and service systems covering the ground, tracks, low altitude, and the sea.

Intelligent Environmental Protection. Establish an intelligent monitoring large data platforms and systems covering the atmosphere, water, soil, and other environmental areas. Build information-sharing and intelligent environmental monitoring networks and service platforms for coordination of land and sea, integration of atmosphere and earth, and upwards and downwards synergies. Research and develop intelligent forecasting models and method and early warning programs for energy resource consumption and environmental pollutant discharge. Strengthen the Beijing-Tianjin-Hebei, Yangtze River Economic Zone, and other major national strategic regions' construction of intelligent prevention and control system for environmental protection and sudden environmental events.

3. Use AI to enhance public safety and security capabilities

Advance the deepening of AI applications in the field of public safety. Promote the construction of public safety and intelligent monitoring and early warning and control systems. Research and develop a variety of detection sensor technology, video image information analysis and identification technology, biometric identification technology, intelligent security and police products. Establish intelligent monitoring platform for comprehensive community management, new criminal investigations, anti-terrorism, and other urgent needs. Strengthen the upgrading and intelligentization of security equipment for key public areas. Support carrying out public security regional demonstrations based on AI according to the conditions of the community or the city. Strengthen the use of AI for food safety protection, food classification, warning level, food safety risks and assessment,

and the establishment of intelligent food safety early warning system. Strengthen the effective monitoring of natural disasters, natural disasters, around the earthquake disaster, geological disasters, meteorological disasters, floods and disasters and marine disasters and other major natural disasters, to build an intelligent monitoring and early warning and comprehensive response platform.

4. Promote social interaction and mutual trust

Give full play to the role of AI technology in enhancing social interaction and promoting credible communication. Strengthen the next generation of social network research and development, accelerate innovation in augmented reality, virtual reality, and other technologies to promote the integrative use of virtual environments and physical environments to meet personal perception, analysis, judgment and decision-making real-time information needs, and to achieve the smooth transition of different scenes of work, study, life, and entertainment. In order to improve the interpersonal communication needs, develop intelligent assistant products with the ability to accurately understand the needs of emotional interaction. Promote the integration of blockchain technology and AI, establish a new social credit system, and minimize the cost and risks of interpersonal communication.

[4] Strengthen military-civilian integration in the AI domain

Deepen implementation of military-civilian integration development strategy, to promote the formation of an all-element, multi-field, high efficiency AI military-civilian integration pattern. Build new generation AI based on research and development in the common theory and critical common technology. Establish mechanisms to normalize communication and coordination among scientific research institutes, universities, enterprises and military industry units. Promote military-civilian two-way transformation of AI technology. Strengthen a new generation of AI technology as a strong support to command and decision-making, military deduction, defense equipment, and other applications. Guide defense domain AI technology toward civilian applications. Encourage and advantage people's scientific research forces to participate in the domain of national defense for major scientific and technological innovation tasks in AI. Promote all kinds of AI technology to become quickly embedded in the field of national defense innovation. Strengthen the construction of military and civilian AI technology standard systems. Promote the overall layout and open sharing of science and technology innovation platforms and bases.

[5] Build a safe and efficient intelligent infrastructure system

Vigorously promote the construction of intelligent information infrastructure. Enhance the traditional level of intelligent infrastructure to form a smart economy, intelligent society and national defense needs of the infrastructure system. Speed up the promotion of information transmission as the core of the digital, network information infrastructure. Take integration awareness, transmission, storage, computing, and processing in intelligent information infrastructure changes. Optimize network infrastructure, research and develop the layout of fifth generation mobile communication [5G] systems. Improve the Internet of Things infrastructure. Accelerate the integration of information network construction. Improve low-latency, high-throughput transmission capacity. Coordinate the

use of big data infrastructure, strengthen data security and privacy protection, to provide massive data support for AI research and development and extensive applications. Build high-performance computing infrastructure, and enhance the service support capabilities of supercomputing centers for AI applications. Construct distributed and efficient energy Internet, form multi-energy support complementary, timely, and effective access to new energy networks. Promote intelligent energy storage facilities, intelligent electricity facilities, energy supply and demand information to achieve real-time matching and intelligent response.

Box 4: Intelligentized Infrastructure

1. *Network Infrastructure. Speed up the layout of real-time collaborative AI 5G enhanced technology research and the development and application of space-oriented collaborative AI for the construction of high-precision navigation and positioning networks to strengthen the core of intelligent sensing technology research and key facilities. Develop intelligent industrial support, driving networks, etc., to study the intelligent network security architecture. Speed up the construction of integrated information network for space and earth, promoting a space-based information network, the future of the Internet, mobile communication network of the full integration.*
2. *Big Data Infrastructure. Rely on a national data sharing exchange platform, open data platform and other public infrastructure. Construct governance, public services, industrial development, technology research and development, and other fields of big data information databases Support the implementation of national governance data applications. Integrate various types of social data platforms and data center resources. Create nationwide integrated service capabilities with reasonable layout and linkages.*
3. *High-performance computing infrastructure. Continue to strengthen the supercomputing infrastructure, distributed computing infrastructure and cloud computing center construction. Build sustainable development of high-performance computing application for the ecological environment. Promote the next generation of supercomputer research and development and applications.*

(6) Plan a new generation of AI major science and technology projects

For the development of China's AI needs and weak links, establish of a new generation of AI major scientific and technological projects. Strengthen the overall co-ordination, clear the boundaries of the tasks and the focus of research and development. Form a new generation of AI major scientific and technological projects as the core, and use existing R&D layout to support the "1 + N" AI program.

"1" refers to a new generation of AI scientific and technological mega-projects, focusing on forward-looking layout for basic theories and key common technologies, including the study of big data intelligence, cross-media perception and computing, hybrid enhanced intelligence, group intelligence, autonomous collaborative control, and decision-making theory. Research knowledge computing engines and knowledge service technologies, cross-medium analysis reasoning technology, key swarm intelligence technologies, new

architecture and new technology for hybrid enhanced intelligent, autonomous unmanned control technology, and basic theory and common technology for open-source shared AI. Continue to carry out the development of AI prediction and research, strengthening the economic and social impact of and countermeasures for AI.

"N" refers to the national planning and deployment of AI research and development projects. Focusing on strengthening the new generation of AI with the convergence major scientific and technological projects, collaborative impetus for research, technological breakthroughs and product development applications. Strengthen the convergence of major national science and technology projects. Support AI hardware and software development in the "*Hegaoji*" Megaproject,[1] integrated circuit equipment and other national science and technology major projects. Strengthen mutual support for AI and other "Technological Innovation 2030 - Mega-Projects." Accelerate the use of AI to provide support for major technical breakthroughs in brain science and brain computing, quantum information and quantum computing, intelligent manufacturing and robotics, and big data research. The National Key Research and Development Plan will continue to promote high-performance computing and other key special applications, while increasing support for AI-related technology research and development and application; the National Natural Science Foundation will strengthen cross-disciplinary research and support for free exploration in the field of AI. Focus on special deployment and strengthen the application of AI technology demonstrations to the deep sea space station, health protection, and other major projects, smart cities, intelligent agricultural equipment and other Key National R&D Projects. Support the openness and sharing of research results on basic theory of AI and common technology through other basic science and technology plans.

Innovate in the organization and implementation of models for new generation AI major scientific and technological projects. Adhere to focus on doing things, focusing on the principle of breakthrough. Give full play to the role of market mechanisms to mobilize departments, local, business and social forces to promote the implementation of all aspects. Pursue clear management responsibility, regular assessments, to strengthen the dynamic adjustments and improve management efficiency.

IV. Resource Allocation

Fully use existing finances, bases and other such stored resources, comprehensively plan the allocation of international and domestic innovation resources, give rein to the guiding role of finance administration input and policy incentives, and the dominant role of the market in allocating resources, impel enterprises and society to expand input, and create a new pattern of multi-sided support through finance administration funding, financial capital, and social capital.

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[1] Translator's note: This refers to the Medium and Long-term Plan for S&T Development 2006-2020 megaproject: core [*he*] electronic devices, high-end [*gao*] general-purpose chips, and basic [*ji*] software.

[1] Establish financial support mechanisms guided by the financial administration and dominated by the market

Comprehensively plan multiple-channel financial input by government and markets, strengthen support through finance administration funding, enliven existing resources, and provide support for fundamental and advanced AI research, critical public technology breakthroughs, result transformation, base and platform construction, innovative application demonstrations, etc. Use existing policy input funds to support AI programs to meet conditions, encourage leading and backbone enterprises and industrial innovation alliances to take the lead in establishing marketized AI development bases. Use angel investment, risk investment, start-up investment funds, financial market funding and many other such channels to guide social capital to support AI development. Vigorously use governmental and social capital cooperation and other such models and guide social capital to participate in the implementation of major AI programmes and the transformation and application of scientific and technological achievements.

[2] Optimize arrangements to build AI innovation bases

According to the national-level science and technology innovation base arrangements and frameworks, comprehensively promote a few internationally advanced innovation bases in the area of AI construction. Guide existing AI-related national focus laboratories, corporate national focus laboratories, national engineering laboratories, and other such bases, and conduct research focused on an advanced direction of a new generation of AI. According to regulatory procedure, build technological and industrial innovation bases related to the AI area with enterprises in the lead, and in cooperation between industry, scholarship, and research. Give rein to the driving role of leading and backbone enterprises concerning technological innovation demonstrations. Develop specialized public maker spaces in the AI area, stimulate the precise linkage of the newest technological achievements, resources and services. Fully give rein to the role of all kinds of innovation bases in concentrating talent, finance, and other such innovation resources; make breakthroughs in basic and advanced AI theory and key common technologies; and launch application demonstrations.

[3] Comprehensively plan international and domestic innovation resources

Support domestic AI enterprises to cooperate with international leading AI schools, scientific research institutes and teams. Encourage domestic AI enterprises to "go out," and provide conveniences and services to powerful AI enterprises conducting foreign mergers or acquisitions, share investment, start-up investment, establishing foreign research centres, etc. Encourage foreign AI enterprises and research institutes to establish research and development centers in China. With the support of the "One Belt, One Road" strategy, promote the construction of international AI science and technology cooperation bases, joint research centres, etc.; accelerate the broad application of AI technologies in countries along the "One Belt, One Road." Promote the establishment of international AI organizations, jointly formulate related international standards. Support related sectoral associations, alliances, and service bodies to build globalized service platforms aimed at AI enterprises.

V. Guarantee Measures

Aiming at the realistic requirements of promoting the healthy and rapid development of AI in China, it is necessary to deal with the possible challenges of AI, form an institutional arrangement to adapt to the development of AI, build an open and inclusive international environment, and reinforce the social foundation of AI development.

[1] Develop laws, regulations, and ethical norms that promote the development of AI

Strengthen research on legal, ethical, and social issues related to AI, and establish laws, regulations and ethical frameworks to ensure the healthy development of AI. Conduct research on legal issues such as civil and criminal responsibility confirmation, proteciton of privacy and property, and information security utilization related to AI applications. Establish a traceability and accountability system, and clarify the main body of AI and related rights, obligations, and responsibilities. Focus on autonomous driving, service robots, and other application subsectors with a comparatively good usage foundation, and speed up the study and development of relevant safety management laws and regulations, to lay a legal foundation for the rapid application of new technology. Launch research on AI behavior science and ethics and other issues, establish an ethical and moral multi-level judgment structure and human-computer collaboration ethical framework. Develop an ethical code of conduct and R&D design for AI products, strengthen the assessment of the potential hazards and benefits of AI, and build solutions for emergencies in complex AI scenarios. China will actively participate in global governance of AI, strengthen the study of major international common problems such as robot alienation and safety supervision, deepen international cooperation on AI laws and regulations, international rules and so on, and jointly cope with global challenges.

[2] Improve key policies for the support of AI development

Implement tax incentives for small and mid-sized enterprise and startup AI development, and, using high-tech enterprises, tax incentives, R&D cost deductions, and other policies, support the development of AI enterprises. Improve the implementation of open data and protection-related policies, launch open public data reform pilots to support the public and enterprises in fully tapping the commercial value of public data, and promote the application of AI innovation. China will study the policy system of education, medical care, insurance, and social assistance to adapt to AI, and effectively deal with the social problems brought by AI.

[3] Establish an AI technology standards and intellectual property system

Conduct research on strengthening the AI standards framework system. Adhere to the principles of security, availability, interoperability, and traceability; and gradually establish and improve the basic basis of AI, interoperability, industry applications, network security, privacy protection, and other technical standards. Speed up the promotion of autonomous driving, service robot, and other application sector industry associations in developing relevant standards. Encourage AI enterprises to participate in or lead the development of

international standards, and a technical standards "going out" approach to promote AI products and services in overseas applications. Strengthen the protection of intellectual property in the field of AI, improve the field of AI technology innovation, patent protection, and standardization of interactive support mechanisms to promote the innovation of AI intellectual property rights. Establish AI public patent pools to promote the use of AI and the spread of new technologies.

[4] Establish an AI security supervision and evaluation system

Strengthen research and evaluation of the influence of AI on national security and secrecy protection; improve the security protection system of human, technology, material, and management support; and construct an early warning mechanism of AI security monitoring. Strengthen the development of AI technology prediction, research and follow-up research, adhere to a problem-oriented, accurate grasping of technology and industry trends. Enhance the awareness of risk, pay attention to risk assessment and prevention and control, and strengthen prospective prevention and restraint guidance. In the near term focus on the impact on employment, with a long-term focus on the impact on social ethics, to ensure that the development of AI falls with the sphere of secure and controllable. Establish and improve an open and transparent AI supervision system, the implementation of design accountability, and application of the supervision of a two-tiered regulatory structure, to achieve management of the whole process of AI algorithm design, product development and results application. Promote AI industry and enterprise self-discipline, and earnestly strengthen management, increase disciplinary efforts aimed at the abuse of data, violations of personal privacy, and actions contrary to moral ethics. Strengthen AI cybersecurity technology research and development, strengthen AI products and systems cybersecurity protection. Develop dynamic AI research and development evaluation mechanisms, focus on AI design, product and system complexity, risk, uncertainty, interpretability, potential economic impact, and other issues. Develop a systematic testing methods and indicators system. Construct a cross-domain AI test platform to promote AI security certification, and assessment of AI products and systems key performance.

[5] Vigorously strengthen the training of an AI labor force

Accelerate the study of the employment structure brought on by AI, changes in employment methods, and the skills demand of new occupations and jobs, establish a lifelong learning and employment training system to meet the needs of the intelligent economy and intelligent society, and support institutions of higher learning, vocational schools and socialization training Institutions to carry out AI skills training. Substantially increase the professional skills of workers to meet the development requirements of China's AI to bring high-quality jobs. Encourage enterprises and organizations to provide AI skills training for employees. Strengthen the re-employment training and guidance of workers to ensure the smooth transfer of simple and repetitive workers due to AI.

[6] Carry out a wide range of AI scientific activities

Support the development of a variety of AI scientific activities, encourage the broad masses of scientific and technological workers to join the promotion of AI popular science, and

comprehensively improve the level of the whole society on the application of AI. Implement a universal intelligence education project. In the primary and secondary schools, set up AI-related courses, and gradually promote programming education to encourage social forces to participate in the promotion and development of educational programming software and games. Construct and improve the AI science infrastructure, give full play to all kinds of AI innovation base platforms and other popular science roles, encourage AI enterprises, and research institutions to build open source platforms for public open AI research and development, plus production facilities or exhibition halls. Support the development of AI competitions, encourage the formation of a variety of AI science creational work efforts. Encourage scientists to participate in AI science.

VI. Organization and Implementation

The development plan for a new generation of AI is a far-sighted scheme affecting the overall picture and the long term. We must strengthen organizational leadership, complete mechanisms, take aim at objectives, keep tasks closely in view, realistically grasp implementation with a spirit of hammering nails, and carry out the blueprint to the end.

(1) Organizational leadership

According to the unified deployment of the Party Center and the State Council, the National Science and Technology Structural Reform and Innovation System Construction Leading Small Group will take the lead in comprehensive planning and coordination, it will deliberate major tasks, major policies, major questions, and major work arrangements. Promote AI-related legal and regulatory construction. Guide, coordinate and supervise relevant departments in carrying out the deployment and implementation of tasks from the plan. With the support of the interministerial joint conferences for national science and technology planning (earmarks, funding, etc.) management, the Ministry of Science and Technology will, together with relevant departments, be responsible for moving forward the implementation of major science and technology programmes for a new generation of AI, and strengthen linkages and coordination with other programmatic tasks. Establish an AI Plan Implementation Office. This office will be part of the Ministry of Science and Technology and will be concretely responsible for moving the implementation of the plan forward. Establish an AI Strategy Advisory Committee, to research major far-sighted and strategic questions concerning AI and to provide advice and assessment concerning major policy decisions on AI. Move forward with the construction of an AI think tank, support all kinds of think tanks to launch research on major AI questions, and provide strong and powerful support for the development of AI.

(2) Guarantee implementation

Strengthen the deconstruction of plan tasks, clarify responsible work units, schedules and arrangements, formulate annual and phase-type implementation plans. Establish monitoring and evaluation mechanisms for the implementation situation of the plan, such as annual assessment and intermediate evaluation. Adapt to the characteristics of the rapid development of AI, and strengthen dynamic adjustment of plans and programs on the

basis of the progress of tasks, the completion of intermediate objectives, new trends in technological development, etc.

(3) Trials and demonstrations

We must formulate concrete plans for major AI tasks and focus policy measures, and launch trials and demonstrations. Strengthen comprehensive guidance over trials and demonstrations in all departments and all localities, quickly summarize and disseminate replicable experiences and methods. Advance the healthy and orderly development of AI through advance trials and guiding demonstrations.

(4) Public opinion guidance

Fully use all kinds of traditional media and new media to quickly propagate new progress and new achievements in AI, to let the healthy development of AI become a consensus in all of society, and muster the vigor of all of society to participate in and support the development of AI. Conduct timely public opinion guidance, and respond even better to social, theoretical, and legal challenges that may be brought about by the development of AI.

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国务院关于印发
新一代人工智能发展规划的通知

国发〔2017〕35号

各省、自治区、直辖市人民政府，国务院各部委、各直属机构：

现将《新一代人工智能发展规划》印发给你们，请认真贯彻执行。

国务院
2017年7月8日

（此件公开发布）

新一代人工智能发展规划

人工智能的迅速发展将深刻改变人类社会生活、改变世界。为抢抓人工智能发展的重大战略机遇，构筑我国人工智能发展的先发优势，加快建设创新型国家和世界科技强国，按照党中央、国务院部署要求，制定本规划。

一、战略态势

人工智能发展进入新阶段。经过60多年的演进，特别是在移动互联网、大数据、超级计算、传感网、脑科学等新理论新技术以及经济社会发展强烈需求的共同驱动下，人工智能加速发展，呈现出深度学习、跨界融合、人机协同、群智开放、自主操控等新特征。大数据驱动知识学习、跨媒体协同处理、人机协同增强智能、群体集成智能、自主智能系统成为人工智能的发展重点，受脑科学研究成果启发的类脑智能蓄势待发，芯片化硬件化平台化趋势更加明显，人工智能发展进入新阶段。当前，新一代人工智能相关学科发展、理论建模、技术创新、软硬件升级等整体推进，正在引发链式突破，推动经济社会各领域从数字化、网络化向智能化加速跃升。

人工智能成为国际竞争的新焦点。人工智能是引领未来的战略性技术，世界主要发达国家把发展人工智能作为提升国家竞争力、维护国家安全的重大战略，加紧出台规划和政策，围绕核心技术、顶尖人才、标准规范等强化部署，力图在新一轮国际科技竞争中掌握主导权。当前，我国国家安全和国际竞争形势更加复杂，必须放眼全球，把人工智能发展放在国家战略层面系统布局、主动谋划，牢牢把握人工智能发展新阶段国际竞争的战略主动，打造竞争新优势、开拓发展新空间，有效保障国家安全。

人工智能成为经济发展的新引擎。人工智能作为新一轮产业变革的核心驱动力，将进一步释放历次科技革命和产业变革积蓄的巨大能量，并创造新的强大引擎，重构生产、分配、交换、消费等经济活动各环节，形成从宏观到微观各领域的智能化新需求，催生新技术、新产品、新产业、新业态、新模式，引发经济结构重大变革，深刻改变人类生产生活方式和思维模式，实现社会生产力的整体跃升。我国经济发展进入新常态，深化供给侧结构性改革任务非常艰巨，必须加快人工智能深度应用，培育壮大人工智能产业，为我国经济发展注入新动能。

人工智能带来社会建设的新机遇。我国正处于全面建成小康社会的决胜阶段，人口老龄化、资源环境约束等挑战依然严峻，人工智能在教育、医疗、养老、环境保护、城市运行、司法服务等领域广泛应用，将极大提高公共服务精准化水平，全面提升人民生活品质。人工智能技术可准确感知、预测、预警基础设施和社会安全运行的重大态势，及时把握群体认知及心理变化，主动决策反应，将显著提高社会治理的能力和水平，对有效维护社会稳定具有不可替代的作用。

人工智能发展的不确定性带来新挑战。人工智能是影响面广的颠覆性技术，可能带来改变就业结构、冲击法律与社会伦理、侵犯个人隐私、挑战国际关系准则等问题，将对政府管理、经济安全和社会稳定乃至全球治理产生深远影响。在大力发展人工智能的同时，必须高度重视可能带来的安全风险挑战，加强前瞻预防与约束引导，最大限度降低风险，确保人工智能安全、可靠、可控发展。

我国发展人工智能具有良好基础。国家部署了智能制造等国家重点研发计划重点专项，印发实施了"互联网+"人工智能三年行动实施方案，从科技研发、应用推广和产业发展等方面提出了一系列措施。经过多年的持续积累，我国在人工智能领域取得重要进展，国际科技论文发表量和发明专利授权量已居世界第二，部分领域核心关键技术实现重要突破。语音识别、视觉识别技术世界领先，自适应自主学习、直觉感知、综合推理、混合智能和群体智能等初步具备跨越发展的能力，中文信息处理、智能监控、生物特征识别、工业机器人、服务机器人、无人驾驶逐步进入实际应用，人工智能创新创业日益活跃，一批龙头骨干企业加速成长，在国际上获得广泛关注和认可。加速积累的技术能力与海量的数据资源、巨大的应用需求、开放的市场环境有机结合，形成了我国人工智能发展的独特优势。

同时，也要清醒地看到，我国人工智能整体发展水平与发达国家相比仍存在差距，缺少重大原创成果，在基础理论、核心算法以及关键设备、高端芯片、重大产品与系统、基础材料、元器件、软件与接口等方面差距较大；科研机构和企业尚未形成具有国际影响力的生态圈和产业链，缺乏系统的超前研发布局；人工智能尖端人才远远不能满足需求；适应人工智能发展的基础设施、政策法规、标准体系亟待完善。

面对新形势新需求，必须主动求变应变，牢牢把握人工智能发展的重大历史机遇，紧扣发展、研判大势、主动谋划、把握方向、抢占先机，引领世界人工智能发展新潮流，服务经济社会发展和支撑国家安全，带动国家竞争力整体跃升和跨越式发展。

二、总体要求

（一）指导思想。

全面贯彻党的十八大和十八届三中、四中、五中、六中全会精神，深入学习贯彻习近平总书记系列重要讲话精神和治国理政新理念新思想新战略，按照"五位一体"总体布局和"四个全面"战略布局，认真落实党中央、国务院决策部署，深入实施创新驱动发展战略，以加快人工智能与经济、社会、国防深度融合为主线，以提升新一代人工智能科技创新能力为主攻方向，发展智能经济，建设智能社会，维护国家安全，构筑知识群、技术群、产业群互动融合和人才、制度、文化相互支撑的生态系统，前瞻应对风险挑战，推动以人类可持续发展为中心的智能化，全面提升社会生产力、综合国力和国家竞争力，为加快建设创新型国家和世界科技强国、实现"两个一百年"奋斗目标和中华民族伟大复兴中国梦提供强大支撑。

（二）基本原则。

科技引领。把握世界人工智能发展趋势，突出研发部署前瞻性，在重点前沿领域探索布局、长期支持，力争在理论、方法、工具、系统等方面取得变革性、颠覆性突破，全面增强人工智能原始创新能力，加速构筑先发优势，实现高端引领发展。

系统布局。根据基础研究、技术研发、产业发展和行业应用的不同特点，制定有针对性的系统发展策略。充分发挥社会主义制度集中力量办大事的优势，推进项目、基地、人才统筹布局，已部署的重大项目与新任务有机衔接，当前急需与长远发展梯次接续，创新能力建设、体制机制改革和政策环境营造协同发力。

市场主导。遵循市场规律，坚持应用导向，突出企业在技术路线选择和行业产品标准制定中的主体作用，加快人工智能科技成果商业化应用，形成竞争优势。把握好政府和市场分工，更好发挥政府在规划引导、政策支持、安全防范、市场监管、环境营造、伦理法规制定等方面的重要作用。

开源开放。倡导开源共享理念，促进产学研用各创新主体共创共享。遵循经济建设和国防建设协调发展规律，促进军民科技成果双向转化应用、军民创新资源共建共享，形成全要素、多领域、高效益的军民深度融合发展新格局。积极参与人工智能全球研发和治理，在全球范围内优化配置创新资源。

（三）战略目标。

分三步走：

第一步，到2020年人工智能总体技术和应用与世界先进水平同步，人工智能产业成为新的重要经济增长点，人工智能技术应用成为改善民生的新途径，有力支持进入创新型国家行列和实现全面建成小康社会的奋斗目标。

——新一代人工智能理论和技术取得重要进展。大数据智能、跨媒体智能、群体智能、混合增强智能、自主智能系统等基础理论和核心技术实现重要进展，人工智能模型方法、核心器件、高端设备和基础软件等方面取得标志性成果。

——人工智能产业竞争力进入国际第一方阵。初步建成人工智能技术标准、服务体系和产业生态链，培育若干全球领先的人工智能骨干企业，人工智能核心产业规模超过1500亿元，带动相关产业规模超过1万亿元。

——人工智能发展环境进一步优化，在重点领域全面展开创新应用，聚集起一批高水平的人才队伍和创新团队，部分领域的人工智能伦理规范和政策法规初步建立。

第二步，到2025年人工智能基础理论实现重大突破，部分技术与应用达到世界领先水平，人工智能成为带动我国产业升级和经济转型的主要动力，智能社会建设取得积极进展。

——新一代人工智能理论与技术体系初步建立，具有自主学习能力的人工智能取得突破，在多领域取得引领性研究成果。

——人工智能产业进入全球价值链高端。新一代人工智能在智能制造、智能医疗、智慧城市、智能农业、国防建设等领域得到广泛应用，人工智能核心产业规模超过4000亿元，带动相关产业规模超过5万亿元。

——初步建立人工智能法律法规、伦理规范和政策体系，形成人工智能安全评估和管控能力。

第三步，到2030年人工智能理论、技术与应用总体达到世界领先水平，成为世界主要人工智能创新中心，智能经济、智能社会取得明显成效，为跻身创新型国家前列和经济强国奠定重要基础。

——形成较为成熟的新一代人工智能理论与技术体系。在类脑智能、自主智能、混合智能和群体智能等领域取得重大突破，在国际人工智能研究领域具有重要影响，占据人工智能科技制高点。

——人工智能产业竞争力达到国际领先水平。人工智能在生产生活、社会治理、国防建设各方面应用的广度深度极大拓展，形成涵盖核心技术、关键系统、支撑平台和智能应用的完备产业链和高端产业群，人工智能核心产业规模超过1万亿元，带动相关产业规模超过10万亿元。

——形成一批全球领先的人工智能科技创新和人才培养基地，建成更加完善的人工智能法律法规、伦理规范和政策体系。

（四）总体部署。

发展人工智能是一项事关全局的复杂系统工程，要按照"构建一个体系、把握双重属性、坚持三位一体、强化四大支撑"进行布局，形成人工智能健康持续发展的战略路径。

构建开放协同的人工智能科技创新体系。针对原创性理论基础薄弱、重大产品和系统缺失等重点难点问题，建立新一代人工智能基础理论和关键共性技术体系，布局建设重大科技创新基地，壮大人工智能高端人才队伍，促进创新主体协同互动，形成人工智能持续创新能力。

把握人工智能技术属性和社会属性高度融合的特征。既要加大人工智能研发和应用力度，最大程度发挥人工智能潜力；又要预判人工智能的挑战，协调产业政策、创新政策与社会政策，实现激励发展与合理规制的协调，最大限度防范风险。

坚持人工智能研发攻关、产品应用和产业培育"三位一体"推进。适应人工智能发展特点和趋势，强化创新链和产业链深度融合、技术供给和市场需求互动演进，以技术突破推动领域应用和产业升级，以应用示范推动技术和系统优化。在当前大规模推动技术应用和产业发展的同时，加强面向中长期的研发布局和攻关，实现滚动发展和持续提升，确保理论上走在前面、技术上占领制高点、应用上安全可控。

全面支撑科技、经济、社会发展和国家安全。以人工智能技术突破带动国家创新能力全面提升，引领建设世界科技强国进程；通过壮大智能产业、培育智能经济，为我国未来十几年乃至几十年经济繁荣创造一个新的增长周期；以建设智能社会促进民生福祉改善，落实以人民为中心的发展思想；以人工智能提升国防实力，保障和维护国家安全。

三、重点任务

立足国家发展全局，准确把握全球人工智能发展态势，找准突破口和主攻方向，全面增强科技创新基础能力，全面拓展重点领域应用深度广度，全面提升经济社会发展和国防应用智能化水平。

（一）构建开放协同的人工智能科技创新体系。

围绕增加人工智能创新的源头供给，从前沿基础理论、关键共性技术、基础平台、人才队伍等方面强化部署，促进开源共享，系统提升持续创新能力，确保我国人工智能科技水平跻身世界前列，为世界人工智能发展作出更多贡献。

1.建立新一代人工智能基础理论体系。

聚焦人工智能重大科学前沿问题，兼顾当前需求与长远发展，以突破人工智能应用基础理论瓶颈为重点，超前布局可能引发人工智能范式变革的基础研究，促进学科交叉融合，为人工智能持续发展与深度应用提供强大科学储备。

突破应用基础理论瓶颈。瞄准应用目标明确、有望引领人工智能技术升级的基础理论方向，加强大数据智能、跨媒体感知计算、人机混合智能、群体智能、自主协同与决策等基础理论研究。大数据智能理论重点突破无监督学习、综合深度推理等难点问题，建立数据驱动、以自然语言理解为核心的认知计算模型，形成从大数据到知识、从知识到决策的能力。跨媒体感知计算理论重点突破低成本低能耗智能感知、复杂场景主动感知、自然环境听觉与言语感知、多媒体自主学习等理论方法，实现超人感知和高动态、高维度、多模式分布式大场景感知。混合增强智能理论重点突破人机协同共融的情境理解与决策学习、直觉推理与因果模型、记忆与知识演化等理论，实现学习与思考接近或超过人类智能水平的混合增强智能。群体智能理论重点突破群体智能的组织、涌现、学习的理论与方法，建立可表达、可计算的群智激励算法和模型，形成基于互联网的群体智能理论体系。自主协同控制与优化决策理论重点突破面向自主无人系统的协同感知与交互、自主协同控制与优化决策、知识驱动的人机物三元协同与互操作等理论，形成自主智能无人系统创新性理论体系架构。

布局前沿基础理论研究。针对可能引发人工智能范式变革的方向，前瞻布局高级机器学习、类脑智能计算、量子智能计算等跨领域基础理论研究。高级机器学习理论重点突破自适应学习、自主学习等理论方法，实现具备高可解释性、强泛化能力的人工智能。类脑智能计算理论重点突破类脑的信息编码、处理、记忆、学习与推理理论，形成类脑复杂系统及类脑控制等理论与方法，建立大规模类脑智能计算

的新模型和脑启发的认知计算模型。量子智能计算理论重点突破量子加速的机器学习方法，建立高性能计算与量子算法混合模型，形成高效精确自主的量子人工智能系统架构。

开展跨学科探索性研究。推动人工智能与神经科学、认知科学、量子科学、心理学、数学、经济学、社会学等相关基础学科的交叉融合，加强引领人工智能算法、模型发展的数学基础理论研究，重视人工智能法律伦理的基础理论问题研究，支持原创性强、非共识的探索性研究，鼓励科学家自由探索，勇于攻克人工智能前沿科学难题，提出更多原创理论，作出更多原创发现。

专栏1 基础理论

1. 大数据智能理论。研究数据驱动与知识引导相结合的人工智能新方法、以自然语言理解和图像图形为核心的认知计算理论和方法、综合深度推理与创意人工智能理论与方法、非完全信息下智能决策基础理论与框架、数据驱动的通用人工智能数学模型与理论等。

2. 跨媒体感知计算理论。研究超越人类视觉能力的感知获取、面向真实世界的主动视觉感知及计算、自然声学场景的听知觉感知及计算、自然交互环境的言语感知及计算、面向异步序列的类人感知及计算、面向媒体智能感知的自主学习、城市全维度智能感知推理引擎。

3. 混合增强智能理论。研究"人在回路"的混合增强智能、人机智能共生的行为增强与脑机协同、机器直觉推理与因果模型、联想记忆模型与知识演化方法、复杂数据和任务的混合增强智能学习方法、云机器人协同计算方法、真实世界环境下的情境理解及人机群组协同。

4. 群体智能理论。研究群体智能结构理论与组织方法、群体智能激励机制与涌现机理、群体智能学习理论与方法、群体智能通用计算范式与模型。

5. 自主协同控制与优化决策理论。研究面向自主无人系统的协同感知与交互，面向自主无人系统的协同控制与优化决策，知识驱动的人机物三元协同与互操作等理论。

6. 高级机器学习理论。研究统计学习基础理论、不确定性推理与决策、分布式学习与交互、隐私保护学习、小样本学习、深度强化学习、无监督学习、半监督学习、主动学习等学习理论和高效模型。

7. 类脑智能计算理论。研究类脑感知、类脑学习、类脑记忆机制与计算融合、类脑复杂系统、类脑控制等理论与方法。

8. 量子智能计算理论。探索脑认知的量子模式与内在机制，研究高效的量子智能模型和算法、高性能高比特的量子人工智能处理器、可与外界环境交互信息的实时量子人工智能系统等。

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2. 建立新一代人工智能关键共性技术体系。

围绕提升我国人工智能国际竞争力的迫切需求，新一代人工智能关键共性技术的研发部署要以算法为核心，以数据和硬件为基础，以提升感知识别、知识计算、认知推理、运动执行、人机交互能力为重点，形成开放兼容、稳定成熟的技术体系。

知识计算引擎与知识服务技术。重点突破知识加工、深度搜索和可视交互核心技术，实现对知识持续增量的自动获取，具备概念识别、实体发现、属性预测、知识演化建模和关系挖掘能力，形成涵盖数十亿实体规模的多源、多学科和多数据类型的跨媒体知识图谱。

跨媒体分析推理技术。重点突破跨媒体统一表征、关联理解与知识挖掘、知识图谱构建与学习、知识演化与推理、智能描述与生成等技术，实现跨媒体知识表征、分析、挖掘、推理、演化和利用，构建分析推理引擎。

群体智能关键技术。重点突破基于互联网的大众化协同、大规模协作的知识资源管理与开放式共享等技术，建立群智知识表示框架，实现基于群智感知的知识获取和开放动态环境下的群智融合与增强，支撑覆盖全国的千万级规模群体感知、协同与演化。

混合增强智能新架构与新技术。重点突破人机协同的感知与执行一体化模型、智能计算前移的新型传感器件、通用混合计算架构等核心技术，构建自主适应环境的混合增强智能系统、人机群组混合增强智能系统及支撑环境。

自主无人系统的智能技术。重点突破自主无人系统计算架构、复杂动态场景感知与理解、实时精准定位、面向复杂环境的适应性智能导航等共性技术，无人机自主控制以及汽车、船舶和轨道交通自动驾驶等智能技术，服务机器人、特种机器人等核心技术，支撑无人系统应用和产业发展。

虚拟现实智能建模技术。重点突破虚拟对象智能行为建模技术，提升虚拟现实中智能对象行为的社会性、多样性和交互逼真性，实现虚拟现实、增强现实等技术与人工智能的有机结合和高效互动。

智能计算芯片与系统。重点突破高能效、可重构类脑计算芯片和具有计算成像功能的类脑视觉传感器技术，研发具有自主学习能力的高效能类脑神经网络架构和硬件系统，实现具有多媒体感知信息理解和智能增长、常识推理能力的类脑智能系统。

自然语言处理技术。重点突破自然语言的语法逻辑、字符概念表征和深度语义分析的核心技术，推进人类与机器的有效沟通和自由交互，实现多风格多语言多领域的自然语言智能理解和自动生成。

专栏2 关键共性技术
1.知识计算引擎与知识服务技术。研究知识计算和可视交互引擎，研究创新设计、数字创意和以可视媒体为核心的商业智能等知识服务技术，开展大规模生物数据的知识发现。
2.跨媒体分析推理技术。研究跨媒体统一表征、关联理解与知识挖掘、知识图谱构建与学习、知识演化与推理、智能描述与生成等技术，开发跨媒体分析推理引擎与验证系统。
3.群体智能关键技术。开展群体智能的主动感知与发现、知识获取与生成、协同与共享、评估与演化、人机整合与增强、自我维持与安全交互等关键技术研究，构建群智空间的服务体系结构，研究移动群体智能的协同决策与控制技术。
4.混合增强智能新架构和新技术。研究混合增强智能核心技术、认知计算框架，新型混合计算架构，人机共驾、在线智能学习技术，平行管理与控制的混合增强智能框架。
5.自主无人系统的智能技术。研究无人机自主控制和汽车、船舶、轨道交通自动驾驶等智能技术，服务机器人、空间机器人、海洋机器人、极地机器人技术，无人车间/智能工厂智能技术，高端智能控制技术和自主无人操作系统。研究复杂环境下基于计算机视觉的定位、导航、识别等机器人及机械手臂自主控制技术。
6.虚拟现实智能建模技术。研究虚拟对象智能行为的数学表达与建模方法，虚拟对象与虚拟环境和用户之间进行自然、持续、深入交互等问题，智能对象建模的技术与方法体系。
7.智能计算芯片与系统。研发神经网络处理器以及高能效、可重构类脑计算芯片等，新型感知芯片与系统、智能计算体系结构与系统，人工智能操作系统。研究适合人工智能的混合计算架构等。
8.自然语言处理技术。研究短文本的计算与分析技术，跨语言文本挖掘技术和面向机器认知智能的语义理解技术，多媒体信息理解的人机对话系统。

3.统筹布局人工智能创新平台。

建设布局人工智能创新平台，强化对人工智能研发应用的基础支撑。人工智能开源软硬件基础平台重点建设支持知识推理、概率统计、深度学习等人工智能范式的统一计算框架平台，形成促进人工智能软件、硬件和智能云之间相互协同的生态链。群体智能服务平台重点建设基于互联网大规模协作的知识资源管理与开放式共享工具，形成面向产学研用创新环节的群智众创平台和服务环境。混合增强智能支撑平台重点建设支持大规模训练的异构实时计算引擎和新型计算集群，为复杂智能计算提供服务化、系统化平台和解决方案。自主无人系统支撑平台重点建设面向自主无人系统复杂环境下环境感知、自主协同控制、智能决策等人工智能共性核心技术的支撑系统，形成开放式、模块化、可重构的自主无人系统开发与试验环境。人工智能基础数据与安全检测平台重点建设面向人工智能的公共数据资源库、标准测试数据集、云服务平台等，形成人工智能算法与平台安全性测试评估的方法、技术、规范和工具集。促进各类通用软件和技术平台的开源开放。各类平台要按照军民深度融合的要求和相关规定，推进军民共享共用。

1. 人工智能开源软硬件基础平台。建立大数据人工智能开源软件基础平台、终端与云端协同的人工智能云服务平台、新型多元智能传感器件与集成平台、基于人工智能硬件的新产品设计平台、未来网络中的大数据智能化服务平台等。

2. 群体智能服务平台。建立群智众创计算支撑平台、科技众创服务系统、群智软件开发与验证自动化系统、群智软件学习与创新系统、开放环境的群智决策系统、群智共享经济服务系统。

3. 混合增强智能支撑平台。建立人工智能超级计算中心、大规模超级智能计算支撑环境、在线智能教育平台、"人在回路"驾驶脑、产业发展复杂性分析与风险评估的智能平台、支撑核电安全运营的智能保障平台、人机共驾技术研发与测试平台等。

4. 自主无人系统支撑平台。建立自主无人系统共性核心技术支撑平台，无人机自主控制以及汽车、船舶和轨道交通自动驾驶支撑平台，服务机器人、空间机器人、海洋机器人、极地机器人支撑平台，智能工厂与智能控制装备技术支撑平台等。

5. 人工智能基础数据与安全检测平台。建设面向人工智能的公共数据资源库、标准测试数据集、云服务平台，建立人工智能算法与平台安全性测试模型及评估模型，研发人工智能算法与平台安全性测评工具集。

4. 加快培养聚集人工智能高端人才。

把高端人才队伍建设作为人工智能发展的重中之重，坚持培养和引进相结合，完善人工智能教育体系，加强人才储备和梯队建设，特别是加快引进全球顶尖人才和青年人才，形成我国人工智能人才高地。

培育高水平人工智能创新人才和团队。支持和培养具有发展潜力的人工智能领军人才，加强人工智能基础研究、应用研究、运行维护等方面专业技术人才培养。重视复合型人才培养，重点培养贯通人工智能理论、方法、技术、产品与应用等的纵向复合型人才，以及掌握"人工智能+"经济、社会、管理、标准、法律等的横向复合型人才。通过重大研发任务和基地平台建设，汇聚人工智能高端人才，在若干人工智能重点领域形成一批高水平创新团队。鼓励和引导国内创新人才、团队加强与全球顶尖人工智能研究机构合作互动。

加大高端人工智能人才引进力度。开辟专门渠道，实行特殊政策，实现人工智能高端人才精准引进。重点引进神经认知、机器学习、自动驾驶、智能机器人等国际顶尖科学家和高水平创新团队。鼓励采取项目合作、技术咨询等方式柔性引进人工智能人才。统筹利用"千人计划"等现有人才计划，加强人工智能领域优秀人才特别是优秀青年人才引进工作。完善企业人力资本成本核算相关政策，激励企业、科研机构引进人工智能人才。

建设人工智能学科。完善人工智能领域学科布局，设立人工智能专业，推动人工智能领域一级学科建设，尽快在试点院校建立人工智能学院，增加人工智能相关学科方向的博士、硕士招生名额。鼓励高校在原有基础上拓宽人工智能专业教育内容，形成"人工智能+X"复合专业培养新模式，重视人工智能与数学、计算机科学、物理学、生物学、心理学、社会学、法学等学科专业教育的交叉融合。加强产学研合作，鼓励高校、科研院所与企业等机构合作开展人工智能学科建设。

（二）培育高端高效的智能经济。

加快培育具有重大引领带动作用的人工智能产业，促进人工智能与各产业领域深度融合，形成数据驱动、人机协同、跨界融合、共创分享的智能经济形态。数据和知识成为经济增长的第一要素，人机协同成为主流生产和服务方式，跨界融合成为重要经济模式，共创分享成为经济生态基本特征，个性化需求与定制成为消费新潮流，生产率大幅提升，引领产业向价值链高端迈进，有力支撑实体经济发展，全面提升经济发展质量和效益。

1. 大力发展人工智能新兴产业。

加快人工智能关键技术转化应用，促进技术集成与商业模式创新，推动重点领域智能产品创新，积极培育人工智能新兴业态，布局产业链高端，打造具有国际竞争力的人工智能产业集群。

智能软硬件。开发面向人工智能的操作系统、数据库、中间件、开发工具等关键基础软件，突破图形处理器等核心硬件，研究图像识别、语音识别、机器翻译、智能交互、知识处理、控制决策等智能系

统解决方案，培育壮大面向人工智能应用的基础软硬件产业。

智能机器人。攻克智能机器人核心零部件、专用传感器，完善智能机器人硬件接口标准、软件接口协议标准以及安全使用标准。研制智能工业机器人、智能服务机器人，实现大规模应用并进入国际市场。研制和推广空间机器人、海洋机器人、极地机器人等特种智能机器人。建立智能机器人标准体系和安全规则。

智能运载工具。发展自动驾驶汽车和轨道交通系统，加强车载感知、自动驾驶、车联网、物联网等技术集成和配套，开发交通智能感知系统，形成我国自主的自动驾驶平台技术体系和产品总成能力，探索自动驾驶汽车共享模式。发展消费类和商用类无人机、无人船，建立试验鉴定、测试、竞技等专业化服务体系，完善空域、水域管理措施。

虚拟现实与增强现实。突破高性能软件建模、内容拍摄生成、增强现实与人机交互、集成环境与工具等关键技术，研制虚拟显示器件、光学器件、高性能真三维显示器、开发引擎等产品，建立虚拟现实与增强现实的技术、产品、服务标准和评价体系，推动重点行业融合应用。

智能终端。加快智能终端核心技术和产品研发，发展新一代智能手机、车载智能终端等移动智能终端产品和设备，鼓励开发智能手表、智能耳机、智能眼镜等可穿戴终端产品，拓展产品形态和应用服务。

物联网基础器件。发展支撑新一代物联网的高灵敏度、高可靠性智能传感器件和芯片，攻克射频识别、近距离机器通信等物联网核心技术和低功耗处理器等关键器件。

2.加快推进产业智能化升级。

推动人工智能与各行业融合创新，在制造、农业、物流、金融、商务、家居等重点行业和领域开展人工智能应用试点示范，推动人工智能规模化应用，全面提升产业发展智能化水平。

智能制造。围绕制造强国重大需求，推进智能制造关键技术装备、核心支撑软件、工业互联网等系统集成应用，研发智能产品及智能互联产品、智能制造使能工具与系统、智能制造云服务平台，推广流程智能制造、离散智能制造、网络化协同制造、远程诊断与运维服务等新型制造模式，建立智能制造标准体系，推进制造全生命周期活动智能化。

智能农业。研制农业智能传感与控制系统、智能化农业装备、农机田间作业自主系统等。建立完善天空地一体化的智能农业信息遥感监测网络。建立典型农业大数据智能决策分析系统，开展智能农场、智能化植物工厂、智能牧场、智能渔场、智能果园、农产品加工智能车间、农产品绿色智能供应链等集成应用示范。

智能物流。加强智能化装卸搬运、分拣包装、加工配送等智能物流装备研发和推广应用，建设深度感知智能仓储系统，提升仓储运营管理水平和效率。完善智能物流公共信息平台和指挥系统、产品质量认证及追溯系统、智能配货调度体系等。

智能金融。建立金融大数据系统，提升金融多媒体数据处理与理解能力。创新智能金融产品和服务，发展金融新业态。鼓励金融行业应用智能客服、智能监控等技术和装备。建立金融风险智能预警与防控系统。

智能商务。鼓励跨媒体分析与推理、知识计算引擎与知识服务等新技术在商务领域应用，推广基于人工智能的新型商务服务与决策系统。建设涵盖地理位置、网络媒体和城市基础数据等跨媒体大数据平台，支撑企业开展智能商务。鼓励围绕个人需求、企业管理提供定制化商务智能决策服务。

智能家居。加强人工智能技术与家居建筑系统的融合应用，提升建筑设备及家居产品的智能化水平。研发适应不同应用场景的家庭互联互通协议、接口标准，提升家电、耐用品等家居产品感知和联通能力。支持智能家居企业创新服务模式，提供互联共享解决方案。

3.大力发展智能企业。

大规模推动企业智能化升级。支持和引导企业在设计、生产、管理、物流和营销等核心业务环节应用人工智能新技术，构建新型企业组织结构和运营方式，形成制造与服务、金融智能化融合的业态模式，发展个性化定制，扩大智能产品供给。鼓励大型互联网企业建设云制造平台和服务平台，面向制造企业在线提供关键工业软件和模型库，开展制造能力外包服务，推动中小企业智能化发展。

推广应用智能工厂。加强智能工厂关键技术和体系方法的应用示范，重点推广生产线重构与动态智能调度、生产装备智能物联与云化数据采集、多维人机物协同与互操作等技术，鼓励和引导企业建设工厂大数据系统、网络化分布式生产设施等，实现生产设备网络化、生产数据可视化、生产过程透明化、生产现场无人化，提升工厂运营管理智能化水平。

加快培育人工智能产业领军企业。在无人机、语音识别、图像识别等优势领域加快打造人工智能全球领军企业和品牌。在智能机器人、智能汽车、可穿戴设备、虚拟现实等新兴领域加快培育一批龙头企业。支持人工智能企业加强专利布局，牵头或参与国际标准制定。推动国内优势企业、行业组织、科研机构、高校等联合组建中国人工智能产业技术创新联盟。支持龙头骨干企业构建开源硬件工厂、开源软

件平台，形成集聚各类资源的创新生态，促进人工智能中小微企业发展和各领域应用。支持各类机构和平台面向人工智能企业提供专业化服务。

4.打造人工智能创新高地。

结合各地区基础和优势，按人工智能应用领域分门别类进行相关产业布局。鼓励地方围绕人工智能产业链和创新链，集聚高端要素、高端企业、高端人才，打造人工智能产业集群和创新高地。

开展人工智能创新应用试点示范。在人工智能基础较好、发展潜力较大的地区，组织开展国家人工智能创新试验，探索体制机制、政策法规、人才培育等方面的重大改革，推动人工智能成果转化、重大产品集成创新和示范应用，形成可复制、可推广的经验，引领带动智能经济和智能社会发展。

建设国家人工智能产业园。依托国家自主创新示范区和国家高新技术产业开发区等创新载体，加强科技、人才、金融、政策等要素的优化配置和组合，加快培育建设人工智能产业创新集群。

建设国家人工智能众创基地。依托从事人工智能研究的高校、科研院所集中地区，搭建人工智能领域专业化创新平台等新型创业服务机构，建设一批低成本、便利化、全要素、开放式的人工智能众创空间，完善孵化服务体系，推进人工智能科技成果转移转化，支持人工智能创新创业。

（三）建设安全便捷的智能社会。

围绕提高人民生活水平和质量的目标，加快人工智能深度应用，形成无时不有、无处不在的智能化环境，全社会的智能化水平大幅提升。越来越多的简单性、重复性、危险性任务由人工智能完成，个体创造力得到极大发挥，形成更多高质量和高舒适度的就业岗位；精准化智能服务更加丰富多样，人们能够最大限度享受高质量服务和便捷生活；社会治理智能化水平大幅提升，社会运行更加安全高效。

1.发展便捷高效的智能服务。

围绕教育、医疗、养老等迫切民生需求，加快人工智能创新应用，为公众提供个性化、多元化、高品质服务。

智能教育。利用智能技术加快推动人才培养模式、教学方法改革，构建包含智能学习、交互式学习的新型教育体系。开展智能校园建设，推动人工智能在教学、管理、资源建设等全流程应用。开发立体综合教学场、基于大数据智能的在线学习教育平台。开发智能教育助理，建立智能、快速、全面的教育分析系统。建立以学习者为中心的教育环境，提供精准推送的教育服务，实现日常教育和终身教育定制化。

智能医疗。推广应用人工智能治疗新模式新手段，建立快速精准的智能医疗体系。探索智慧医院建设，开发人机协同的手术机器人、智能诊疗助手，研发柔性可穿戴、生物兼容的生理监测系统，研发人机协同临床智能诊疗方案，实现智能影像识别、病理分型和智能多学科会诊。基于人工智能开展大规模基因组识别、蛋白组学、代谢组学等研究和新药研发，推进医药监管智能化。加强流行病智能监测和防控。

智能健康和养老。加强群体智能健康管理，突破健康大数据分析、物联网等关键技术，研发健康管理可穿戴设备和家庭智能健康检测监测设备，推动健康管理实现从点状监测向连续监测、从短流程管理向长流程管理转变。建设智能养老社区和机构，构建安全便捷的智能化养老基础设施体系。加强老年人产品智能化和智能产品适老化，开发视听辅助设备、物理辅助设备等智能家居养老设备，拓展老年人活动空间。开发面向老年人的移动社交和服务平台、情感陪护助手，提升老年人生活质量。

2.推进社会治理智能化。

围绕行政管理、司法管理、城市管理、环境保护等社会治理的热点难点问题，促进人工智能技术应用，推动社会治理现代化。

智能政务。开发适于政府服务与决策的人工智能平台，研制面向开放环境的决策引擎，在复杂社会问题研判、政策评估、风险预警、应急处置等重大战略决策方面推广应用。加强政务信息资源整合和公共需求精准预测，畅通政府与公众的交互渠道。

智慧法庭。建设集审判、人员、数据应用、司法公开和动态监控于一体的智慧法庭数据平台，促进人工智能在证据收集、案例分析、法律文件阅读与分析中的应用，实现法院审判体系和审判能力智能化。

智慧城市。构建城市智能化基础设施，发展智能建筑，推动地下管廊等市政基础设施智能化改造升级；建设城市大数据平台，构建多元异构数据融合的城市运行管理体系，实现对城市基础设施和城市绿地、湿地等重要生态要素的全面感知以及对城市复杂系统运行的深度认知；研发构建社区公共服务信息系统，促进社区服务系统与居民智能家庭系统协同；推进城市规划、建设、管理、运营全生命周期智能化。

智能交通。研究建立营运车辆自动驾驶与车路协同的技术体系。研发复杂场景下的多维交通信息综合大数据应用平台，实现智能化交通疏导和综合运行协调指挥，建成覆盖地面、轨道、低空和海上的智能交通监控、管理和服务系统。

智能环保。建立涵盖大气、水、土壤等环境领域的智能监控大数据平台体系，建成陆海统筹、天地一体、上下协同、信息共享的智能环境监测网络和服务平台。研发资源能源消耗、环境污染物排放智能预测模型方法和预警方案。加强京津冀、长江经济带等国家重大战略区域环境保护和突发环境事件智能防控体系建设。

3. 利用人工智能提升公共安全保障能力。

促进人工智能在公共安全领域的深度应用，推动构建公共安全智能化监测预警与控制体系。围绕社会综合治理、新型犯罪侦查、反恐等迫切需求，研发集成多种探测传感技术、视频图像信息分析识别技术、生物特征识别技术的智能安防与警用产品，建立智能化监测平台。加强对重点公共区域安防设备的智能化改造升级，支持有条件的社区或城市开展基于人工智能的公共安防区域示范。强化人工智能对食品安全的保障，围绕食品分类、预警等级、食品安全隐患及评估等，建立智能化食品安全预警系统。加强人工智能对自然灾害的有效监测，围绕地震灾害、地质灾害、气象灾害、水旱灾害和海洋灾害等重大自然灾害，构建智能化监测预警与综合应对平台。

4. 促进社会交往共享互信。

充分发挥人工智能技术在增强社会互动、促进可信交流中的作用。加强下一代社交网络研发，加快增强现实、虚拟现实等技术推广应用，促进虚拟环境和实体环境协同融合，满足个人感知、分析、判断与决策等实时信息需求，实现在工作、学习、生活、娱乐等不同场景下的流畅切换。针对改善人际沟通障碍的需求，开发具有情感交互功能、能准确理解人的需求的智能助理产品，实现情感交流和需求满足的良性循环。促进区块链技术与人工智能的融合，建立新型社会信用体系，最大限度降低人际交往成本和风险。

（四）加强人工智能领域军民融合。

深入贯彻落实军民融合发展战略，推动形成全要素、多领域、高效益的人工智能军民融合格局。以军民共享共用为导向部署新一代人工智能基础理论和关键共性技术研发，建立科研院所、高校、企业和军工单位的常态化沟通协调机制。促进人工智能技术军民双向转化，强化新一代人工智能技术对指挥决策、军事推演、国防装备等的有力支撑，引导国防领域人工智能科技成果向民用领域转化应用。鼓励优势民口科研力量参与国防领域人工智能重大科技创新任务，推动各类人工智能技术快速嵌入国防创新领域。加强军民人工智能技术通用标准体系建设，推进科技创新平台基地的统筹布局和开放共享。

（五）构建泛在安全高效的智能化基础设施体系。

大力推动智能化信息基础设施建设，提升传统基础设施的智能化水平，形成适应智能经济、智能社会和国防建设需要的基础设施体系。加快推动以信息传输为核心的数字化、网络化信息基础设施，向集融合感知、传输、存储、计算、处理于一体的智能化信息基础设施转变。优化升级网络基础设施，研发布局第五代移动通信（5G）系统，完善物联网基础设施，加快天地一体化信息网络建设，提高低时延、高通量的传输能力。统筹利用大数据基础设施，强化数据安全与隐私保护，为人工智能研发和广泛应用提供海量数据支撑。建设高效能计算基础设施，提升超级计算中心对人工智能应用的服务支撑能力。建设分布式高效能源互联网，形成支撑多能源协调互补、及时有效接入的新型能源网络，推广智能储能设施、智能用电设施，实现能源供需信息的实时匹配和智能化响应。

专栏4　智能化基础设施

1. 网络基础设施。加快布局实时协同人工智能的5G增强技术研发及应用，建设面向空间协同人工智能的高精度导航定位网络，加强智能感知物联网核心技术攻关和关键设施建设，发展支撑智能化的工业互联网、面向无人驾驶的车联网等，研究智能化网络安全架构。加快建设天地一体化信息网络，推进天基信息网、未来互联网、移动通信网的全面融合。

2. 大数据基础设施。依托国家数据共享交换平台、数据开放平台等公共基础设施，建设政府治理、公共服务、产业发展、技术研发等领域大数据基础信息数据库，支撑开展国家治理大数据应用。整合社会各类数据平台和数据中心资源，形成覆盖全国、布局合理、链接畅通的一体化服务能力。

3. 高效能计算基础设施。继续加强超级计算基础设施、分布式计算基础设施和云计算中心建设，构建可持续发展的高性能计算应用生态环境。推进下一代超级计算机研发应用。

（六）前瞻布局新一代人工智能重大科技项目。

针对我国人工智能发展的迫切需求和薄弱环节，设立新一代人工智能重大科技项目。加强整体统筹，明确任务边界和研发重点，形成以新一代人工智能重大科技项目为核心、现有研发布局为支撑的"1+N"人工智能项目群。

"1"是指新一代人工智能重大科技项目，聚焦基础理论和关键共性技术的前瞻布局，包括研究大数据智能、跨媒体感知计算、混合增强智能、群体智能、自主协同控制与决策等理论，研究知识计算引擎与知识服务技术、跨媒体分析推理技术、群体智能关键技术、混合增强智能新架构与新技术、自主无人控制技术等，开源共享人工智能基础理论和共性技术。持续开展人工智能发展的预测和研判，加强人工智能对经济社会综合影响及对策研究。

"N"是指国家相关规划计划中部署的人工智能研发项目，重点是加强与新一代人工智能重大科技项目的衔接，协同推进人工智能的理论研究、技术突破和产品研发应用。加强与国家科技重大专项的衔接，在"核高基"（核心电子器件、高端通用芯片、基础软件）、集成电路装备等国家科技重大专项中支持人工智能软硬件发展。加强与其他"科技创新2030—重大项目"的相互支持，加快脑科学与类脑计算、量子信息与量子计算、智能制造与机器人、大数据等研究，为人工智能重大技术突破提供支撑。国家重点研发计划继续推进高性能计算等重点专项实施，加大对人工智能相关技术研发和应用的支持；国家自然科学基金加强对人工智能前沿领域交叉学科研究和自由探索的支持。在深海空间站、健康保障等重大项目，以及智慧城市、智能农机装备等国家重点研发计划重点专项部署中，加强人工智能技术的应用示范。其他各类科技计划支持的人工智能相关基础理论和共性技术研究成果应开放共享。

创新新一代人工智能重大科技项目组织实施模式，坚持集中力量办大事、重点突破的原则，充分发挥市场机制作用，调动部门、地方、企业和社会各方面力量共同推进实施。明确管理责任，定期开展评估，加强动态调整，提高管理效率。

四、资源配置

充分利用已有资金、基地等存量资源，统筹配置国际国内创新资源，发挥好财政投入、政策激励的引导作用和市场配置资源的主导作用，撬动企业、社会加大投入，形成财政资金、金融资本、社会资本多方支持的新格局。

（一）建立财政引导、市场主导的资金支持机制。

统筹政府和市场多渠道资金投入，加大财政资金支持力度，盘活现有资源，对人工智能基础前沿研究、关键共性技术攻关、成果转移转化、基地平台建设、创新应用示范等提供支持。利用现有政府投资基金支持符合条件的人工智能项目，鼓励龙头骨干企业、产业创新联盟牵头成立市场化的人工智能发展基金。利用天使投资、风险投资、创业投资基金及资本市场融资等多种渠道，引导社会资本支持人工智能发展。积极运用政府和社会资本合作等模式，引导社会资本参与人工智能重大项目实施和科技成果转化应用。

（二）优化布局建设人工智能创新基地。

按照国家级科技创新基地布局和框架，统筹推进人工智能领域建设若干国际领先的创新基地。引导现有与人工智能相关的国家重点实验室、企业国家重点实验室、国家工程实验室等基地，聚焦新一代人工智能的前沿方向开展研究。按规定程序，以企业为主体、产学研合作组建人工智能领域的相关技术和产业创新基地，发挥龙头骨干企业技术创新示范带动作用。发展人工智能领域的专业化众创空间，促进最新技术成果和资源、服务的精准对接。充分发挥各类创新基地聚集人才、资金等创新资源的作用，突破人工智能基础前沿理论和关键共性技术，开展应用示范。

（三）统筹国际国内创新资源。

支持国内人工智能企业与国际人工智能领先高校、科研院所、团队合作。鼓励国内人工智能企业"走出去"，为有实力的人工智能企业开展海外并购、股权投资、创业投资和建立海外研发中心等提供便利和服务。鼓励国外人工智能企业、科研机构在华设立研发中心。依托"一带一路"战略，推动建设人工智能国际科技合作基地、联合研究中心等，加快人工智能技术在"一带一路"沿线国家推广应用。推动成立人工智能国际组织，共同制定相关国际标准。支持相关行业协会、联盟及服务机构搭建面向人工智能企业的全球化服务平台。

五、保障措施

围绕推动我国人工智能健康快速发展的现实要求，妥善应对人工智能可能带来的挑战，形成适应人工智能发展的制度安排，构建开放包容的国际化环境，夯实人工智能发展的社会基础。

（一）制定促进人工智能发展的法律法规和伦理规范。

加强人工智能相关法律、伦理和社会问题研究，建立保障人工智能健康发展的法律法规和伦理道德框架。开展与人工智能应用相关的民事与刑事责任确认、隐私和产权保护、信息安全利用等法律问题研究，建立追溯和问责制度，明确人工智能法律主体以及相关权利、义务和责任等。重点围绕自动驾驶、服务机器人等应用基础较好的细分领域，加快研究制定相关安全管理法规，为新技术的快速应用奠定法律基础。开展人工智能行为科学和伦理等问题研究，建立伦理道德多层次判断结构及人机协作的伦理框

架。制定人工智能产品研发设计人员的道德规范和行为守则，加强对人工智能潜在危害与收益的评估，构建人工智能复杂场景下突发事件的解决方案。积极参与人工智能全球治理，加强机器人异化和安全监管等人工智能重大国际共性问题研究，深化在人工智能法律法规、国际规则等方面的国际合作，共同应对全球性挑战。

（二）完善支持人工智能发展的重点政策。

落实对人工智能中小企业和初创企业的财税优惠政策，通过高新技术企业税收优惠和研发费用加计扣除等政策支持人工智能企业发展。完善落实数据开放与保护相关政策，开展公共数据开放利用改革试点，支持公众和企业充分挖掘公共数据的商业价值，促进人工智能应用创新。研究完善适应人工智能的教育、医疗、保险、社会救助等政策体系，有效应对人工智能带来的社会问题。

（三）建立人工智能技术标准和知识产权体系。

加强人工智能标准框架体系研究。坚持安全性、可用性、互操作性、可追溯性原则，逐步建立并完善人工智能基础共性、互联互通、行业应用、网络安全、隐私保护等技术标准。加快推动无人驾驶、服务机器人等细分应用领域的行业协会和联盟制定相关标准。鼓励人工智能企业参与或主导制定国际标准，以技术标准"走出去"带动人工智能产品和服务在海外推广应用。加强人工智能领域的知识产权保护，健全人工智能领域技术创新、专利保护与标准化互动支撑机制，促进人工智能创新成果的知识产权化。建立人工智能公共专利池，促进人工智能新技术的利用与扩散。

（四）建立人工智能安全监管和评估体系。

加强人工智能对国家安全和保密领域影响的研究与评估，完善人、技、物、管配套的安全防护体系，构建人工智能安全监测预警机制。加强对人工智能技术发展的预测、研判和跟踪研究，坚持问题导向，准确把握技术和产业发展趋势。增强风险意识，重视风险评估和防控，强化前瞻预防和约束引导，近期重点关注对就业的影响，远期重点考虑对社会伦理的影响，确保把人工智能发展规制在安全可控范围内。建立健全公开透明的人工智能监管体系，实行设计问责和应用监督并重的双层监管结构，实现对人工智能算法设计、产品开发和成果应用等的全流程监管。促进人工智能行业和企业自律，切实加强管理，加大对数据滥用、侵犯个人隐私、违背道德伦理等行为的惩戒力度。加强人工智能网络安全技术研发，强化人工智能产品和系统网络安全防护。构建动态的人工智能研发应用评估评价机制，围绕人工智能设计、产品和系统的复杂性、风险性、不确定性、可解释性、潜在经济影响等问题，开发系统性的测试方法和指标体系，建设跨领域的人工智能测试平台，推动人工智能安全认证，评估人工智能产品和系统的关键性能。

（五）大力加强人工智能劳动力培训。

加快研究人工智能带来的就业结构、就业方式转变以及新型职业和工作岗位的技能需求，建立适应智能经济和智能社会需要的终身学习和就业培训体系，支持高等院校、职业学校和社会化培训机构等开展人工智能技能培训，大幅提升就业人员专业技能，满足我国人工智能发展带来的高技能高质量就业岗位需要。鼓励企业和各类机构为员工提供人工智能技能培训。加强职工再就业培训和指导，确保从事简单重复性工作的劳动力和因人工智能失业的人员顺利转岗。

（六）广泛开展人工智能科普活动。

支持开展形式多样的人工智能科普活动，鼓励广大科技工作者投身人工智能的科普与推广，全面提高全社会对人工智能的整体认知和应用水平。实施全民智能教育项目，在中小学阶段设置人工智能相关课程，逐步推广编程教育，鼓励社会力量参与寓教于乐的编程教学软件、游戏的开发和推广。建设和完善人工智能科普基础设施，充分发挥各类人工智能创新基地平台等的科普作用，鼓励人工智能企业、科研机构搭建开源平台，面向公众开放人工智能研发平台、生产设施或展馆等。支持开展人工智能竞赛，鼓励进行形式多样的人工智能科普创作。鼓励科学家参与人工智能科普。

六、组织实施

新一代人工智能发展规划是关系全局和长远的前瞻谋划。必须加强组织领导，健全机制，瞄准目标，紧盯任务，以钉钉子的精神切实抓好落实，一张蓝图干到底。

（一）组织领导。

按照党中央、国务院统一部署，由国家科技体制改革和创新体系建设领导小组牵头统筹协调，审议重大任务、重大政策、重大问题和重点工作安排，推动人工智能相关法律法规建设，指导、协调和督促有关部门做好规划任务的部署实施。依托国家科技计划（专项、基金等）管理部际联席会议，科技部会同有关部门负责推进新一代人工智能重大科技项目实施，加强与其他计划任务的衔接协调。成立人工智能规划推进办公室，办公室设在科技部，具体负责推进规划实施。成立人工智能战略咨询委员会，研究人工智能前瞻性、战略性重大问题，对人工智能重大决策提供咨询评估。推进人工智能智库建设，支持各类智库开展人工智能重大问题研究，为人工智能发展提供强大智力支持。

（二）保障落实。

加强规划任务分解，明确责任单位和进度安排，制定年度和阶段性实施计划。建立年度评估、中期评估等规划实施情况的监测评估机制。适应人工智能快速发展的特点，根据任务进展情况、阶段目标完成情况、技术发展新动向等，加强对规划和项目的动态调整。

　　（三）试点示范。

　　对人工智能重大任务和重点政策措施，要制定具体方案，开展试点示范。加强对各部门、各地方试点示范的统筹指导，及时总结推广可复制的经验和做法。通过试点先行、示范引领，推进人工智能健康有序发展。

　　（四）舆论引导。

　　充分利用各种传统媒体和新兴媒体，及时宣传人工智能新进展、新成效，让人工智能健康发展成为全社会共识，调动全社会参与支持人工智能发展的积极性。及时做好舆论引导，更好应对人工智能发展可能带来的社会、伦理和法律等挑战。