

Exploration of Applications, Challenges and Countermeasures of Large Models in Empowering the Full-Domain Digital Transformation of Cities

Xiaochun Tian

The Sate Information Center, Beijing, 100080, China

15201622482@163.com

Abstract. This paper discusses the application exploration of artificial intelligence large models in the full-domain digital transformation of cities and the challenges they face. It clarifies the potential and necessity of these models in precise urban status perception, fine-grained urban governance and scheduling, digital public services, and the simulation and handling of various urban events. Although large models show great potential in urban governance and decision support, high costs, lack of industry corpora, insufficient talent quality requirements and data security issues are the main obstacles to the implementation of large models at present. It is recommended to strengthen financial security, consolidate the data foundation, train professional talents and strengthen data security. At the same time, policy guidance and incentive mechanisms should be used to promote the innovation and application of large model technology to ensure that it plays an active role in improving urban governance efficiency and service quality.

Keywords: large model, artificial intelligence, smart city.

1 Introduction

Since 2022, the field of artificial intelligence has witnessed a major breakthrough. ChatGPT, a revolutionary product launched by OpenAI, has attracted more than 100 million users in just two months with its excellent natural language generation ability. Since then, technology companies and research institutions at home and abroad have followed up and launched a series of innovative and competitive artificial intelligence large models. Wenxin Yiyang and Zhipu Qingyan are widely used for their deeper understanding of Chinese; Copilot, as a programming assistant tool, greatly improves the work efficiency of developers; while models such as LLaMA, SAM and SORA show strong application potential in specific fields.

Cities are the comprehensive carriers for promoting the construction of Digital China. The "Guiding Opinions on Deepening the Development of Smart Cities and Promoting the Full-Domain Digital Transformation of Cities" [1] proposes "developing intelligent analysis, intelligent scheduling, intelligent supervision and auxiliary

decision-making based on technologies such as artificial intelligence to comprehensively support and empower the construction and development of urban digital transformation scenarios." The "Three-Year Action Plan for 'Data Elements ×' (2024-2026)" [2] proposes "carrying out the development and training of artificial intelligence large models. Fully relying on various databases and knowledge bases to promote interdisciplinary and cross-field collaborative innovation." Therefore, combined with various types of data accumulated by cities, focusing on how artificial intelligence large models can be deployed in the field of smart cities will become an important direction in the future.

As of March 2024, according to the "Announcement of the Cyberspace Administration of China on Publishing the Recorded Information of Generative Artificial Intelligence Services", 117 generative artificial intelligence services have been recorded in China [3]. However, looking through the recorded services, the main fields are still oriented towards consumers. There is no direct application in the government affairs field such as smart cities. Direct transplantation in the field of smart cities still faces many challenges, such as low answer quality due to lack of corpora, various data security risks involved in the use process, and output results affected by model hallucinations. [4]

In order to further promote the wide application of large models in the field of smart cities, this paper will combine practical experience to discuss the path and problems of large model implementation from the aspects of application exploration, challenges and optimization suggestions.

2 Large Models are an Inevitable Choice for Urban Digital Transformation Entering Deep Waters

The rapid development of large models is inseparable from the law of scale in technology. Although the reasons for this are not yet clear in the academic community, the ability of models rapidly improves after the parameter scale exceeds a certain threshold. Therefore, the characteristics of large models are first of all a large parameter scale in the model. For example, OpenAI's GPT-3 reaches 175 billion parameters[5]. GPT-4 even reaches 1.8 trillion parameters. Google has also launched the PaLM model with a parameter scale of about 540 billion[6]. Baidu Wenxin Yiyan large model also reaches more than one hundred billion parameters. Secondly, large models require a large amount of training data. OpenAI trained GPT-4 with 13 trillion tokens. The training data exceeds 500GB and more than one hundred billion words. Finally, large models require a large amount of computing power. GPT-4 uses 25,000 A100 GPUs for training.

Trained large models can handle various complex tasks and are regarded as an important path to general artificial intelligence [7]. Large models play a key role in urban digital transformation with their unique advantages in data processing, intention understanding, continuous dialogue and creative thinking. They can understand the complexity of urban operation, generate adaptable and forward-looking solutions, and

provide more intelligent, personalized and efficient support for urban management, promoting cities to develop in a more intelligent, efficient and livable direction.

2.1 Necessary Means to Understand and Mine Massive Operational Data

In the era of information explosion, data has become a key resource for promoting social development. According to the "National Data Resources Survey Report (2023)" released by the National Data Resources Survey Working Group, in 2023, the total national data production reached 32.85 ZB (zettabytes)[8]. The massive amount of information generated in urban operation is growing rapidly, posing unprecedented challenges to traditional data processing and analysis methods. Traditional analysis models are limited by computing power and algorithm complexity and are difficult to extract valuable information from it. Large models have become a necessary means to understand and mine massive operational data with their powerful capabilities. They can identify patterns, predict trends and generate insights from complex data to provide decision support for urban management and service optimization.

2.2 Key Foundation for Perceiving and Processing the Interconnection of all Things

With the popularization of Internet of Things (IoT) devices, sensors and smart devices in urban and industrial environments are constantly generating massive amounts of data. The diversity and complexity of these data go beyond the scope of traditional data processing technologies. Large models can understand and integrate data streams from different sources. Through high adaptability and generalization ability, they can identify potential patterns and correlations from the data to realize real-time perception of the urban pulse and provide comprehensive and in-depth insights for decision makers.

2.3 Fundamental Guarantee for Serving and Responding to the Demands of the General Public

Chinese-style modernization is people-oriented modernization. High-quality life is an important pursuit of urban digital transformation. With the acceleration of urbanization, citizens' demands for public services are increasing day by day, showing diversified and personalized characteristics. Traditional service models are often difficult to cope with due to limited resources and slow response speed. Large models can analyze the demands expressed by citizens through various channels such as social media, hotlines and government websites, and can respond to citizens' concerns and demand patterns in a timely manner, turning passive service models into active service models. In addition, large models can continuously learn and optimize service strategies according to citizens' feedback and behavior patterns to achieve personalized and accurate services.

3 Large Models Play a Vital Role in Urban Digital Transformation

As the depth and breadth boundaries of smart city construction continue to expand, the model is deeply adjusted, and the technology of large models continues to mature, the application exploration scenarios of large models in urban precise and fine governance, enriching inclusive digital public services, and improving the level of urban safety and resilience are also continuously deepened.

3.1 Precise Perception of Urban Status

Give full play to the ability of multimodal large models to process, understand and recognize massive unstructured data from different sources. Relying on carriers such as urban governance centers, obtain information from data in various fields such as public security, urban construction, urban management, emergency response, transportation and environment. After analysis and processing, achieve accurate perception and rapid processing of the situation. For example, in traffic management, analyze real-time information from traffic cameras, GPS data and social media, identify the patterns and causes of traffic congestion, predict traffic flow within a specific period of time through continuous traffic flow changes and citizens' travel intentions, and provide data support for traffic planning and improvement.

3.2 Fine Urban Governance and Scheduling

In the construction of the urban governance and scheduling system of "demand-response-disposal-feedback-evaluation", the 12345 hotline is generally integrated into the general entrance for urban management demands. Various grid members are integrated into a unified grid team and dispatched by the urban operation center or command center. The 12345 hotline can rely on the semantic understanding and intelligent reasoning capabilities of large models to provide end-to-end full-process accompanying services 24/7, providing hotline service capabilities such as government affairs consultation, policy services, handling complaints immediately, and handling government affairs, avoiding inaccuracies in manual consultation responses and limited processing capabilities. During the event handling process, demand work orders can be quickly decomposed and comprehensive governance personnel nearby can be assigned. At the same time, service capabilities such as information verification and report generation can be provided to improve disposal efficiency. [9]

3.3 Urban Digital Public Services

Guided by convenience for the people and enterprises, promote the transformation of government services from passive to active and from "able to handle" to "easy to handle" through large models. Combine the information of enterprises and individuals gathered in the city in aspects such as education, medical care, housing, employment

and elderly care, and actively push and match corresponding services. Create an intelligent customer service assistant that is online all day and personalized matching to solve problems for residents. At the same time, through differentiated supervision capabilities, avoid undifferentiated inspections and waste of resources for a large number of supervision objects. Rely on extensive data collection and real-time monitoring to build a risk early warning model and implement differentiated supervision. The Foshan Market Supervision Administration has reduced repeated inspections of law-abiding enterprises and increased the detection rate of lawbreakers at the same time by this method, optimizing the allocation of supervision resources. [10]

3.4 Simulation and Handling of Various Urban Events

In terms of urban safety and resilience, through comprehensive analysis of multi-source data of urban operation, construct handling models and handling processes for various normal and emergency events in cities, simulate and analyze multiple handling schemes, and evaluate the potential impacts and results of each scheme. Generate scenario-based decision-making suggestions when handling various events in urban planning, emergency management and other fields to help decision makers consider different factors and formulate scientific and reasonable policies and measures.

4 Discussion on Problems Hindering the Application of Large Models in Cities

4.1 The cost of Using Large Models Continues to Rise

The cost of large models includes hardware purchase, power consumption, research and development wages, data collection and annotation fees, and model training and optimization. In terms of hardware purchase, large model training requires a large amount of GPU dedicated resources. The price of Nvidia B200 chips is as high as more than 30,000 US dollars. These hardware not only have high purchase costs, but also face continuous shortages due to international situations and become scarce goods. ChatGPT consumes 500,000 kilowatt-hours of electricity per day[11]. The accumulated electricity bills over a long period of time become an important part of the cost that cannot be ignored. In addition, the funds required for the production of training sets and transfer training when migrating from general large models to industry-specific large models are even higher. The application of large models often directly faces a large number of citizens and has a large usage scale, which has high requirements for the funds for current smart city construction and operation.

4.2 There is an Extreme Lack of Industry Corpora for Optimizing Large Models

When general large models are migrated and optimized to become industry-specific large models, high-quality industry-specific corpora are necessary learning materials to enable them to understand and generate language and knowledge in specific fields, such as professional vocabulary such as "unified management through one network" and "access to government services through one network". Urban digital transformation is developing rapidly and requires continuous updating of corpora to maintain the timeliness of the model. At present, there is no large-scale corpus in the field of smart cities. In fact, in terms of data volume, content diversity and quality, Chinese corpora are far behind English corpora, which is also a bottleneck affecting the development of Chinese large models.

4.3 Insufficient Talent Quality Requirements for Applying Large Models

The application of large models has requirements for talent qualities that involve multiple dimensions such as technical capabilities, industry knowledge, and innovative thinking. Compared to foreign artificial intelligence companies, the total number and scale of talents are difficult to match. Although large models can now relatively easily realize the customization of various needs, further needs and implementations all depend on a good foundation of prompts. Therefore, the demand for all kinds of talents for the development, migration, and application of large models is all-round.

4.4 The Data Security of Calling Large Models Needs to be Improved

The training and application of large models usually involve processing and analyzing a large amount of personal sensitive data. However, due to the low transparency and weak interpretability of large models, the use and transmission process of data cannot be tracked. Most conversations will be used as new data sets to fine-tune large models. This information becomes a part of the model itself and is thus used inappropriately under malicious induction.

4.5 The Potential Risks of Using Large Models have not yet Emerged

In recent years, problems such as "talking nonsense seriously" brought about by large model hallucinations, algorithmic biases and discrimination brought about by dataset quality or content have gradually become known to users. This will be difficult to meet the needs in the process of urban management or service. Therefore, full evaluations must be made for large-scale use to avoid the uncontrollable impact of the above risks on urban managers.

5 Countermeasures and Suggestions for Promoting the Implementation of Large Models

5.1 Strengthen Financial Security for the Application of Large Models

As the latest generation of information technology, large models are of great significance for improving urban governance and providing convenient services for the people and enterprises. In order to accelerate implementation, on the one hand, we should broaden funding channels. In addition to regular budgets, we can explore local bonds, ultra-long-term special treasury bonds, etc. On the other hand, we should fully introduce social funds. We can jointly carry out research and application with large model manufacturers. The government provides support through financial subsidies, tax incentives and research and development funding.

5.2 Consolidate the Data Foundation for the Application of Large Models

The further optimization of industry large models is closely tied to high-quality data corpora. Strengthen data sharing and the development and utilization of public data, and promote the open sharing of relevant data such as municipal affairs, transportation, meteorology, and emergency management. Through organizing forums, holding industry competitions and other means, guide and encourage relevant participants to accumulate high-quality corpora, promote the sharing and exchange of industry data, increase the stock of industry corpora, and enhance the accuracy and practicability of models in urban digital transformation scenarios.

5.3 Cultivate the Quality of Application Teams for Large Models

The improvement of the quality of application teams cannot be separated from the industry-university-research system. In the process of implementing large models, actively promote cooperation among universities, research institutions and social enterprises to jointly cultivate talents that meet industry needs. At the same time, the government side can provide various research and innovation funds for the application of large models to continuously improve the capabilities of relevant industry practitioners.

5.4 Establish and Improve the Urban Data Governance System

Establish and improve the urban data governance system, strengthen the full life cycle supervision of data collection, processing, storage and transmission. Conduct detailed classification of the data used in the full life cycle of training and usage, and adopt different levels of security measures such as de-identification, anonymization technology or obfuscation technology. Classify data according to its importance and sensitivity, determine different levels of protection requirements, and desensitize sensi-

tive data, such as hiding some fields or replacing key information. Configure monitoring or auditing functions at the input and output links of large models to timely discover and track the use of sensitive data.

5.5 Select Innovative Application Scenarios for Large Models

The application of large models needs to always adhere to an application-oriented approach and continuously innovate application scenarios. Evaluate the technical capabilities and application scopes of large models, and select scenarios with high input-output ratios and good integration of technical capabilities and scenario requirements to avoid forming “bonsai” that can be visited and reported in the short term. For scenarios with clear traditional business logic and high requirements for authority, such as legal consulting and issuing certification materials, traditional technical methods should be used to avoid the public opinion risk brought by uncontrollable models. For scenarios with fault tolerance space, such as consulting and answering questions and work order allocation, combined with a certain rule base to ensure that large models are executed as expected.

6 Conclusion

Large models have shown great potential in urban governance and decision support. However, problems such as cost, lack of industry corpora, talent quality requirements and data security are all obstacles that must be overcome to promote the implementation of large models. In the long run, by strengthening financial security, consolidating the data foundation, training professional talents and strengthening data security, large model technology can play its due role in the construction of smart cities. Future research should focus on the interpretability, transparency and compatibility with existing urban systems of large models to achieve more intelligent, efficient and safe urban management.

References

1. National Development and Reform Commission. Guiding Opinions on Deepening the Development of Smart Cities and Promoting the Full-Domain Digital Transformation of Cities [EB/OL]. (2024-05-20) [2024-07-15]. https://www.ndrc.gov.cn/xxgk/zcfb/tz/202405/t20240520_1386326.html.
2. National Bureau of Data and others. "Data Elements ×" Three-Year Action Plan (2024 - 2026) [EB/OL]. (2024-01-05) [2024-07-11]. https://www.cac.gov.cn/2024-01/05/c_1706119078060945.htm.
3. Cyberspace Administration of China. Announcement of the Cyberspace Administration of China on Publishing the Recorded Information of Generative Artificial Intelligence Services [EB/OL]. (2024-04-03) [2024-07-12]. https://www.gov.cn/lianbo/bumen/202404/content_6943924.htm.
4. Huang Zhen, Shan Wenzheng, Guo Furong, et al. Design and implementation of a trusted large model government affairs Q&A system [C]//Artificial Intelligence Security Govern-

- ance Committee of China Cyberspace Security Association. Proceedings of the Artificial Intelligence Security Governance Theme Forum of the 2024 World Intelligent Industry Expo. Jiangxi Information Center; Inspur Software Co., Ltd.; 2024: 5.
5. Radford A, Wu J, Child R, et al. Language models are unsupervised multitask learners. OpenAI blog, 2019, 1(8): 9.
 6. Chowdhery A, Narang S, Devlin J, et al. Palm: Scaling language modeling with pathways [J]. arXiv preprint arXiv:2204.02311, 2022.
 7. Liu Xuebo, Hu Baotian, Chen Kehai, et al. Key technologies and future development directions of large models - starting from ChatGPT [J]. National Natural Science Foundation of China, 2023, 37(05): 758-766.
 8. Xinhua News Agency. The latest report is out! In 2023, China's total data production reached 32.85 ZB [EB/OL]. (2024-05-24) [2024-07-15].
 9. Dong Chao, Wang Xiaodong. Exploration, challenges and suggestions of generative artificial intelligence in the construction of digital government [J]. Digital Economy, 2023, (11): 36-39.
 10. The Chinese government website. Foshan City, Guangdong Province actively promotes "artificial intelligence + double random" supervision [EB/OL]. (2020-12-14) [2024-07-15]. https://www.gov.cn/xinwen/2020-12/14/content_5569395.htm.
 11. Sun Ninghui. The development of artificial intelligence and intelligent computing [EB/OL]. (2024-04-30) [2024-07-15]. http://www.npc.gov.cn/c2/c30834/202404/t20240430_436915.html.