AutoAI: Autonomous AI

Longbing Cao, *Editor-in-Chief*

In the AI evolution, a significant and lasting vision and mission has been on designing autonomous AI systems (AutoAI). AutoAI differs significantly from another set of movements on automated machine learning (AutoML) and automated data science (AutoDS), which are often deemed interchangeable with automated AI. AutoML and AutoDS aim to automate some of the analytical and learning tasks, processes, and pipelines. This issue highlights the theme on AutoAI: Autonomous AI with six feature articles. My editorial further clarifies various misconceptions, myths, and pitfalls about the three related and often confused areas: AutoAI, AutoML, and AutoDS. This issue also includes an article on parallel population and human in the column AI Expert, expert–machine collaboration in the column AI Focus, and another article on intelligent mobile spaces and metaverses for the AI and Cyber-Physical-Social Systems (AI-CPSS) department.

In this issue, I am pleased to discuss the theme on AutoAI: Autonomous AI, and present a few articles for the columns Editor's Perspective, AI Expert, and AI Focus, and the AI-CPSS department.

AUTOAI FOR AUTONOMOUS AI

Automated machine learning (AutoML) and *automated data science* (AutoDS) have made significant progress in automating standard and modular analytical and learning tasks and processes. Typically, AutoML and AutoDS focus on automating standard and decomposed tasks, such as data cleaning, feature selection, hyperparameter optimization, algorithm selection, and pipeline selection. They rely on predefined and design-time techniques such as search, selection, and optimization.

The resultant systems offer standard workflows, and neutral techniques for search and selection, independent of data characteristics, problem domain, analytical and learning objectives and tasks, algorithm and model design methodologies, and business expectations. These enable the standardization, production, manufacturing, and commercialization of machine learning and data science for applications. However, they also result in limited flexibility, adaptation, and learning capabilities, hence constraining their flexible personalization, adaptive problem-solving, and actionable decision-support for specific domains, problems, requirements, data, scenarios, and applications.

Unfortunately, the above settings and limitations with AutoML and AutoDS have been carried forward to conceptualizing automated AI. There are various confusing and misleading conceptions, myths, or pitfalls about these three areas in the literature and vendor solutions. For example, some believe that automated AI shares duplicated, interchangeable or similar conceptions, designs, and techniques with AutoML and AutoDS. Over the years of developments, machine learning, data science, and AI have formed overlapping but also significant distinct visions, missions, body of knowledge, and practical specifications. It is thus essential to clarify their conceptions and differences. This drives this issue on AutoAI for autonomous AI.

AutoAI builds on the long-standing developments of autonomous systems toward autonomous (beyond automated) AI by integrating autonomy into broad-reaching AI visions and missions. AutoAI goes beyond AutoML and AutoDS and differs from automated AI in various aspects, in particular:

- their distinct disciplinary visions and missions, where AI has a much broader body of knowledge and disciplinary scope than machine learning;
- the broader AI vision and mission of incorporating, simulating, and developing ubiquitous intelligences and intelligence paradigms, in particular, in relation to human mind, emotion and action, natural intelligence, and societal intelligence;
- the much wider spectrum of AI tasks, objects, and processes in developing intelligent systems and applications; and

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- the more adaptive and evolving AI capabilities in autonomous perception, communication, learning, collaboration, behaving, and decision-making in unanticipated, uncertain, evolving, open, and new scenarios.

For more information about AutoAI, interested readers may want to read my Editor's Perspective article, "Beyond AutoML: Mindful and Actionable AI and AutoAI with Mind and Action."

FEATURE ARTICLES ON AUTOAI

Accordingly, this issue highlights six feature articles relating to various aspects, issues, and applications of AutoAI designs and systems.

The article "CACLA-Based Local Path Planner for Drones Navigating Unknown Indoor Corridors" introduces an online local path planner for autonomous drones in unknown indoor corridors. Their planner aims to build the continuous actor-critic learning automation into drones. It involves techniques including experience replay and reinforcement learning for central position alignment, steering control, and obstacle avoidance.

The article "Knowledge-Based Entity Prediction for Improved Machine Perception in Autonomous Systems" improves machine perception through knowledge-based entity prediction. The cyclic perception through knowledge completion aims to infer and predict unrecognized entities. The proposal was tested in autonomous driving and smart manufacturing.

In the article titled "Toward Social Situation Awareness in Support Agents," the authors discuss the key requirements for an agent to be aware of social situations. A taxonomy with a conceptual architecture is provided for social situation awareness. The proposal is useful for defining and developing social situation-aware agents.

Cryptography plays an important role in ensuring the security of autonomous systems. The article "CryptoCliqIn: Graph-Theoretic Cryptography Using Clique Injection" introduces a graph-theoretic encryption method using clique injection. It provides a more secure mechanism without delays in encryption and decryption.

Further, the article "Sensitivity of Logic Learning Machine for Reliability in Safety-Critical Systems" addresses the safety of autonomous systems. It studies how explainable AI can achieve reliability using logic learning machine for rule tuning around safety regions. They show that the reliability is dependent on the characteristics of data analyzed rather than algorithms at hand.

Lastly, the article titled "Recognizing Slanted Deck Scenes by Non-Manhattan Spatial Right Angle Projection" further addresses safety monitoring. They aim to understand deck scenes in a deck environment. On decks with slanted structures, their method clusters slanted angle projections and estimates angle projections using a resource-constrained monocular camera.

COLUMN AND DEPARTMENT ARTICLES

This issue includes three column articles and one department article.

In the Editor's Perspective column, my article "Beyond AutoML: Mindful and Actionable AI and AutoAI with Mind and Action" further expands the above discussion on autonomous AI in a comprehensive manner. I review the concepts of AutoML and AutoDS and summarize their research landscape and automation engineering of analytics and learning. I then clarify the various misconceptions about AutoML, AutoDS, and AutoAI. My focus is then on discussing what makes AutoAI and present the research conceptual framework of AutoAI for autonomous AI. In this article, I highlight the requirements for incorporating mind and action into AI and AutoAI. Accordingly, a research landscape is presented to introduce the concepts, developments, and directions of *AI mind* and *AI mindfulness* for *mindful AI* and *AI action* and *AI actionability* for *actionable AI*, two critical areas for AI and AutoAI.

AI Expert presents the editor's view on "Parallel Population and Parallel Human—A Cyber Physical Social Approach." From the perspective of cyber physical social systems (CPSS), the editor Fei-Yue Wang and his coauthor discuss the ideas, structure, and operational flow of parallel population and parallel human for human-centered hybrid CPSS. They believe such development is useful for constructing virtual metaverses, a topic highlighted by several articles in the recent issues of *IS*.

AI Focus presents the article titled "Expert-Machine Collaborative Decision-Making: We Need Healthy Competition" by Uwe Aickelin and his coauthors. They argue the differences and need of expert–machine collaborations, going beyond normal human–AI interaction. They further discuss group decision-making and competitive game theory for expert–machine collaborative decision-making.

In addition, the Department on AI and Cyber-Physical-Social Systems introduces the article titled "Xsickness in Intelligent Mobile Spaces and Metaverses." The authors discuss multifactorial motion sickness in mobile spaces. They further discuss motion reduction and human perception for motion sickness mitigation and intelligent mobile spaces.

CONCLUDING REMARKS

It is hoped that my editor's perspective and the six feature articles in this issue present a snapshot of the conception, research issues, directions, techniques, and applications of autonomous AI: AutoAI and clarify various misconceptions and differences between automated AI and AutoAI for autonomous AI. I hope this issue will inspire your thinking and developments on autonomous AI beyond the existing landscape of automated machine learning, neural architecture search, and automated data science.