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Preface to the special topic: Machine learning and physics

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专题: 机器学习与物理

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机器学习, 尤其是深度学习, 在很多方面取得了令人瞩目的成就, 是当前科学技术领域最为热门、发展最快的方向之一. 其与物理的结合是最近几年新兴的交叉前沿领域, 受到了广泛关注. 一方面, 运用机器学习的方法可以解决一些复杂的、传统方法很难或无法解决的物理问题; 另一方面, 物理中的一些概念、理论和方法也可以用于研究机器学习. 二者的交叉融通带来了新的机遇与挑战, 将极大地促进两个领域的发展.

本专题邀请了若干活跃在该新兴领域的专家撰稿, 重点介绍机器学习与物理交叉方向的部分国际前沿课题和最新研究进展. 内容涵盖了量子人工智能中的对抗学习, 量子生成模型, 基于波动与扩散的机器学习, 自动微分, 绝热量子算法设计, 量子机器学习中的编码与初态制备, 以及基于自旋体系的量子机器学习实验进展等.

希望本专题能够帮助读者了解机器学习与物理交叉方向的研究内容, 基本思想与方法, 最新进展情况, 以及面临的挑战与机遇. 同时, 也希望这个专题能够激发读者的兴趣, 吸引更多的研究人员加入到此交叉领域的研究中.

(客座编辑: 邓东灵 清华大学)

SPECIAL TOPIC—Machine learning and physics

Preface to the special topic: Machine learning and physics

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Machine learning, especially deep learning, has achieved remarkable success in a wide range of applications. It is one of today's most rapidly growing fields in science and technology. In recent years, the interplay between machine learning and physics has attracted tremendous attention, giving rise to a new interdisciplinary research frontier. On the one hand, we may utilize machine learning methods to tackle certain intricate physical problems that are beyond the capability of traditional approaches. On the other hand, certain concepts, ideas, and methods originated in physics can also be exploited to enhance the study of machine learning. Without a doubt, the fusion of machine learning and physics will bring us new opportunities and challenges, and significantly advance the studies in both fields.

This special topic contains several review papers written by experts working actively in this emergent interdisciplinary field. These papers review a number of hot topics and some latest progresses, covering adversarial learning in quantum artificial intelligence, quantum generative models, machine learning based on waves and diffusions, automatic differentiation, machine learning assisted quantum adiabatic algorithm design, state preparation in quantum machine learning, experimental progress of quantum machine learning based on spin systems, etc.

We hope this special topic can help readers gain a primary picture of the research content, basic ideas and methods, the latest developments, and the challenges and opportunities faced in the intersection of machine learning and physics. Meanwhile, we also hope this special topic can provide some inspiration to readers, and attract more researchers to join this exciting interdisciplinary field.

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