上海创智学院研究生课程大纲

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **基本信息**  **Basic Information** | | | | | | |
| \*课程名称 Course Name | （中文 Chinese）科学研究的人工智能方法学 | | | | | |
| （英文 English）The AI Methodologies in Scientific Research | | | | | |
| 课程代码  Cours Code |  | | \*开课学期 Semester | | 2024/10/11 | |
| \*学分 Credits |  | | \*总学时  Teaching Hours | | 12周 | |
| 适用学科专业 Discipline/Specialization |  | | 实验/实践学时  Hours for experiment/Practice | |  | |
| \*教学周数  Weeks | 12 | | \*课程性质  Course Category | | 必修/选修 | |
| \*课程类别Course Type | 公共课/核心基础课/专业进阶课 | | 课程层次  TargeringStudents | | 本科直博/硕博连读/普通博士 | |
| \*授课语言  Instruction Language | 中文 | | 主要授课方式 Teaching Method | |  | |
| 所属学科 Subject |  | | | | | |
| 课程主任/联络人  Person in charge | 姓 名 N a m e | 单位 University/Institute | | 手机 Phone | | 邮箱 E-mail |
| 徐盈辉 | Fudan/ai3 | | 18506827019 | | Xuyinghui@fudan.edu.cn |
| **课程内容**  **Course Outline** | | | | | | |
| \*课程简介  (中文)  Course Description | **课程简介**：  本课程旨在为科学研究领域的学者、工程师及相关专业人员提供一个深入了解人工智能（AI）技术在科研中的应用机会。课程从AI技术的基础概念出发，逐步探讨其发展历程，并展示AI在推动科学研究中的多重角色。学员将学习几何深度学习、自监督学习、生成式AI、Physics-Informed AI等关键AI方法，并探索AI在生命科学、材料科学、大气科学和物理等领域的实际应用。  通过本课程，学员将掌握如何利用AI技术解决科研中的复杂问题，从数据处理到实验设计，再到科学模型的构建和优化。课程还将深入探讨AI在科学领域的挑战，包括数据质量、模型解释性等，并对AI在未来科研中的前景进行展望。最终，学员将具备独立使用AI技术辅助科学研究的能力，为其科研创新提供全新的技术工具和思维框架  **课程特点**:   1. 结合理论讲解与实际案例分析，帮助学员深入理解AI的科研应用。 2. 涵盖几何深度学习、生成式AI、Physics-Informed AI等最新的AI技术。 3. 针对生命科学、材料科学、大气科学和物理等学科领域的应用进行详细解析。 4. 重点讨论AI在科研中的实际挑战和未来发展趋势。   **课程大纲**   * **课程简介与科学研究中的AI概述**   + 课程介绍   + 人工智能技术的发展与进化   + 人工智能时代的科学研究-1   + **人工智能时代的科学研究-2** * **科学研究的人工智能方法介绍**   + 几何深度学习   + 自监督学习/大模型   + 生成式AI   + Physics informed AI * **AI在科学领域的应用介绍**   + ai + 生命科学   + ai + 材料科学   + ai + 大气科学   + [ai + 物理](http://127.0.0.1:5500/ai_phy.html) * **AI在科学领域的挑战和未来展望**   + ai在科学领域的挑战   + ai在科学领域的展望   **教学目标**：   **理解人工智能技术的进化与其在科学研究中的角色** 探讨人工智能技术从理论到应用的演变，理解其对现代科学研究范式转变的影响。   **掌握几何深度学习和自监督学习等关键AI方法** 学习如何应用几何深度学习和大规模自监督学习技术，理解其在处理复杂科学问题中的能力。   **探讨生成式AI和Physics-Informed AI的研究前沿** 理解生成式AI和物理约束的AI模型在科学数据生成、建模和预测中的应用。   **探索AI在生命科学、材料科学、大气科学及物理等领域的实际应用** 通过案例分析，掌握如何利用AI工具加速各学科的科学发现和创新。   **分析AI在科学研究中的挑战与未来发展方向** 深入探讨AI在数据质量、模型解释性等方面的挑战，并展望AI推动科学研究未来发展的潜力和新兴趋势。 | | | | | |
| \*课程简介  (English)  Course Description | **Course Overview**: This course is designed to provide scholars, engineers, and professionals in scientific research with an in-depth understanding of how artificial intelligence (AI) technologies can be applied in various stages of research. Starting with foundational AI concepts, the course explores the development of AI and its transformative role in advancing scientific discovery. Participants will learn key AI methodologies, such as geometric deep learning, self-supervised learning, generative AI, and physics-informed AI, and explore real-world applications of AI in fields such as life sciences, material science, atmospheric science, and physics.  Throughout the course, participants will gain hands-on experience in applying AI techniques to solve complex research problems, from data processing and experimental design to building and optimizing scientific models. The course will also address the challenges AI faces in scientific research, including data quality and model interpretability, while discussing future opportunities for AI-driven innovation in research. By the end of the course, participants will have acquired the skills to independently leverage AI technologies to enhance their research, providing them with powerful tools and new ways of thinking for scientific innovation.  **Course Highlights**:   1. Combines theoretical explanations with real-world case studies to help participants understand the application of AI in research. 2. Covers the latest AI technologies, including geometric deep learning, generative AI, and physics-informed AI. 3. Offers detailed analysis of AI applications in fields such as life sciences, material science, atmospheric science, and physics. 4. Focuses on real challenges in AI for research and explores future trends in AI-driven scientific innovation   Contents:   1. **Course Introduction and Overview of AI in Scientific Research**    * Introduction to the course    * Overview of AI in scientific research 2. **Development and Evolution of AI Technology**    * History and progression of AI technologies 3. **AI in the Era of Scientific Research - Part 1** 4. **AI in the Era of Scientific Research - Part 2**    * AI’s impact on modern scientific research 5. **Introduction to AI Methodologies in Scientific Research**    * Overview of AI methods and their applications in research 6. **Geometric Deep Learning**    * Understanding geometric deep learning and its applications 7. **Self-Supervised Learning / Large Foundation Models**    * Exploring self-supervised learning and large-scale foundation models 8. **Generative AI**    * Applications and impact of generative AI in research 9. **Physics-Informed AI**    * Using physics-informed models in scientific research 10. **Applications of AI in Science**  * **AI + Life Sciences** * **AI + Material Science** * **AI + Atmospheric Science** * **AI + Physics**  1. **Challenges and Future of AI in Science**  * **Challenges of AI in Science** * **Future Outlook for AI in Science**   Objective: | | | | | |

1 / 4

|  |  |
| --- | --- |
| \*教学大纲 (中文) Syllabus | 1. Understand the Evolution of AI Technology and its Role in Scientific Research Learn about the evolution of AI technology and its transformative impact on modern scientific research paradigms.  2. Master Key AI Methods such as Geometric Deep Learning and Self-Supervised Learning Gain proficiency in applying key AI methods, including geometric deep learning and large-scale self-supervised learning, to complex scientific problems.  3. Explore Cutting-Edge Areas like Generative AI and Physics-Informed AI Understand the frontiers of research in generative AI and physics-informed AI models, focusing on scientific data generation, modeling, and prediction.  4. Examine Practical Applications of AI in Life Sciences, Material Science, Atmospheric Science, and Physics Learn through case studies how AI tools are accelerating discoveries and innovations across these scientific domains.  5. Analyze Challenges and Future Directions of AI in Scientific Research Explore challenges such as data quality and model interpretability, while gaining insights into the emerging trends and future potential of AI in driving scientific advancements. |
|  |  |

2 / 4

|  |  |
| --- | --- |
| \*教学大纲  (English)  Syllabus |  |
| \*成绩评定  （中文）  Assessment |  |
| \*成绩评定  (English)  Assessment |  |

3 / 4

|  |  |
| --- | --- |
| \*教材  （中文）  Textbooks |  |
| \*教材  (English)  Textbooks |  |
| 教学参考资料  （中文）  Reading Materials and References |  |
| 教学参考资料  (English)  Reading Materials and References |  |
| 备注 Note |  |

4 / 4