课程一：《人工智能：机器学习在数据分析及自然语言处理中的实际运用》

Machine Learning and Data Analysis

学科方向： 机器学习/数据科学

1. 教授介绍

Raja Sooriamurthi

卡内基梅隆大学 信息系统教授

- 卡内基梅隆大学信息系统专业主任
- 印第安纳大学学生事务副校长兼学生办公室主任
- 曾获决策科学研究所 (DSI)教学创新奖
- 曾获 Elliott Dunlap Smith 杰出教学和教育服务奖
- 曾获卡内基梅隆大学 Martcia Wade 教学奖
- 曾获印第安纳大学文理学院校友会杰出讲师奖

Raja Sooriamurthi 教授是卡内基梅隆大学信息系统教授，同时也是决策分析与系统专业项目的主任。在他的教学工作中，Sooriamurthi 强调基于项目的学习，旨在解决信息系统问题的模糊性和复杂性，同时整合各种方法。在研究方面，Raja Sooriamurthi 专注于人工智能和认知科学，尤其关注基于知识管理、分布式推理和机器学习等领域。

除了创新的教学方法之外，Sooriamurthi 教授还因其对教育的贡献而获得了无数奖项和赞誉。 其中包括决策科学研究所 (DSI) 教学创新奖、Elliott Dunlap Smith 杰出教学和教育服务奖以及 Martcia Wade 教学奖等。

Raja Sooriamurthi is a professor of Information Systems at Carnegie Mellon University and serves as the Program Director for the Decision Analytics and Systems program. In his teaching, he emphasizes project-based learning to tackle the ambiguity and complexity of information system issues while integrating various methods. In his research, Sooriamurthi focuses on artificial intelligence and cognitive science, particularly in areas such as case-based reasoning, knowledge management, distributed reasoning, and machine learning.

Apart from his innovative teaching methods, Professor Sooriamurthi has received numerous awards and accolades for his contributions to education, including the Decision Sciences Institute (DSI) Instructional Innovation Award, the Elliott Dunlap Smith Award for Distinguished Teaching and Educational Service, and the Martcia Wade Teaching Award, etc.

2. 课程介绍

人工智能与机器学习正日益应用于教育技术和社会决策的实际场景。本课程由系统讲解数据分析与机器学习在现实问题中的应用。课程内容包括数据分析与机器学习基础、整洁数

据处理、数据可视化、监督学习基础、贝叶斯分类及分类器性能评估、聚类分析、决策树与随机森林、推荐系统，以及深度学习方法。通过理论与实践结合，学生将掌握利用人工智能技术进行教育创新、个性化学习分析和社会决策支持的能力。

Artificial intelligence and machine learning are increasingly applied in educational technology and real-world decision-making. This course provides a systematic introduction to the practical use of data analysis and machine learning. Topics include data analysis and machine learning fundamentals, tidy data processing, data visualization, supervised learning basics, Bayesian classification and classifier performance evaluation, clustering, decision trees and random forests, recommendation systems, and deep learning methods. By combining theory with hands-on practice, students will develop the skills to apply AI techniques in educational innovation, personalized learning analytics, and data-driven decision support.

3. 课程大纲

1.数据分析和机器学习入门

2.整洁数据

3.数据可视化

4.监督学习入门

5.贝叶斯分类

6.衡量分类器的性能

7.聚类

8.决策树和随机森林

9.推荐系统

10.深度学习

1.Introduction to Data Analysis and Machine Learning

2.Tidy Data

3.Visualization with the Grammar of Graphics

4.Introduction to Supervised Learning

5.Naïve Bayes Classification

6.Measuring the Performance of a Classifier

7.Clustering

8.Decision Trees and Random Forests

9.Recommender Systems

10.Deep Learning

课程二：《脑机接口的人工智能、微电子学与信号处理》

Brain/Machine Interfaces: Artificial Intelligence, Signals, & Circuits

学科方向：信号处理/人工智能

1. 教授介绍

Neal Bangerter

帝国理工学院 生物工程教授

- 博伊西州立大学电气与计算机工程系主任
- 伦敦超高场磁共振成像项目帝国理工学院负责人
- 欧洲工商管理学院 AI 与数字转型教授
- 犹他大学放射科系教授
- 曾任微软战略业务发展经理、麦肯锡高级顾问

Neal Bangerter 于 2018 年加入帝国理工学院，担任生物工程教授，专注于医学成像（特别是 MRI）、人工智能与机器学习、大数据/数据分析以及信号处理。作为伦敦协作超高场扫描仪（LOCUS）项目的帝国理工学院负责人，他领导着由伦敦国王学院、帝国理工学院、伦敦大学学院和癌症研究所共同参与的超高场磁共振成像联合项目。他还是伦敦 EFG 资产管理公司未来领袖小组的人工智能专家，并与帝国人工智能网络和计算、认知与临床神经影像实验室有密切联系。

Bangerter 教授在加州大学伯克利分校获得物理学学士学位，随后在斯坦福大学获得电气工程硕士和博士学位。他曾在威尔科克斯公司担任软件开发工程师，并共同创立了数据可视化软件公司 Visualize。毕业后，他在麦肯锡公司工作，随后在微软担任高级业务开发和战略业务发展经理，其后又在广告技术公司 Reactrix 担任产品管理副总裁。2006 年，他重返学术界，成为斯坦福大学放射学实验室的研究员。目前，Bangerter 教授 的研究兴趣包括开发用于超高磁场强度下的磁共振成像的新型脉冲序列，机器学习在医疗影像和健康护理中的应用，以及数据、人工智能和相关技术在生物科学和其他行业中的前景与局限性。他在设立英国生物银行神经影像研究（一个大规模健康研究项目）方面发挥了重要作用，并与斯坦福大学、牛津大学、剑桥大学、癌症研究所、犹他大学、布莱根杨大学、伦敦国王学院和西门子医疗等机构有积极的研究合作。

Neal Bangerter joined Imperial in February 2018 as Associate Professor of Bioengineering, where he specializes in medical imaging (with a focus on MRI), artificial intelligence and machine learning, big data/data analytics, and signal processing. He is also the Imperial lead of the London Collaborative Ultra-High Field Scanner (LOCUS) project, a joint venture for ultra-high field MR imaging between

King's College London, Imperial, University College London, and the Institute for Cancer Research. He serves on the Future Leaders Panel for EFG Asset Management in London as their Artificial Intelligence expert, and is affiliated with the Imperial Artificial Intelligence Network and the Computation, Cognitive, and Clinical Neuroimaging Laboratory.

Dr. Bangerter received a Bachelor's degree in Physics from U.C. Berkeley, and received his Master's and Ph.D. degrees in Electrical Engineering from Stanford University. He spent several years as a software developer for metrology company Wilcox Associates prior to graduate school, and co-founded data visualization software company Visualize. He returned to academia in 2006 as a researcher in Stanford's Radiological Sciences Laboratory. His current academic interests include the development of novel pulse sequences for magnetic resonance imaging at ultra-high magnetic field strengths, the application of machine learning to a variety of problems in medical imaging and healthcare, and the promises and limitations of data, artificial intelligence, and related technologies in the biosciences, healthcare, and other industries.

He was instrumental in setting up the U.K. Biobank Neuroimaging study (a massive big-data health research effort), and has active research collaborations with groups at Stanford University, Oxford, Cambridge, the Institute for Cancer Research, University of Utah, Brigham Young University, Kings College London, and Siemens Healthcare.

2. 课程介绍

在本课程中，学生将被引入脑机接口（Brain/Machine Interfaces）领域，并学习人工智能（AI）和机器学习（ML）如何革新我们解读大脑信号的能力。课程首先将讲解实现人脑与电子、机械系统交互的基础技术，随后深入探讨各类人工智能、机器学习及信号处理方法如何帮助我们理解来自大脑的信号。前几次课程将介绍学生理解该领域所需的基础概念，主题包括：信号处理入门、脑机接口中的人工智能技术基础系列讲座、基础电子电路、微电子学与集成电路。

此外，学生还将学习人脑与神经系统的基本原理，了解神经系统如何利用电信号在体内的感觉与运动通路上传递信息。随后，课程将回顾脑机接口中涉及的各种技术，包括：非侵入式技术（EEG 脑电图、EMG 肌电图、MEG 脑磁图以及基于成像的方法）；半侵入式技术（ECoG 皮层电图）；侵入式技术（植入式电极系统）。在这些部分中，我们将重点讲解用于分析不同类型神经信号的各种人工智能/机器学习算法与信号处理方法。最后，课程将概述脑机接口领域的前沿研究与最新应用，介绍这些技术目前正在探索的广泛应用场景。

In this course, students will be introduced to the exciting field of Brain/Machine Interfaces and will learn how the fields of Artificial Intelligence and Machine Learning are revolutionizing our ability to interpret signals from the brain. We will first study the basic technologies that make interfacing the human brain with electronic and mechanical systems possible, and will then delve into how various artificial intelligence/machine learning and other signal processing techniques are allowing us to interpret signals we receive from the brain. The first several

lectures will cover basic foundational concepts that the students will require to understand the field. Topics will include an introduction to signal processing, an in-depth series of lectures on the basics of artificial intelligence techniques for brain/machine interfaces, basic electronic circuits, microelectronics and integrated circuits. Students will also learn fundamentals of the human brain and nervous system, and how the nervous system uses electrical signals to communicate over the sensory and motor pathways in the body.

We will then review the various technologies involved in brain/machine interfaces. These will include lecture material and readings on the non-invasive technologies (EEG, EMG, MEG, and imaging-based techniques), semi-invasive technologies (ECoG), and invasive technologies (implanted electrode systems). We will focus heavily in all of these lectures on the various artificial intelligence/machine learning and other signal processing techniques used to analyze neurological signals of different types. Finally, we will review the current state-of-the-art in brain/machine interfaces, introduce the broad set of applications being explored for these technologies.

3. 课程大纲

1. 脑机接口概述

2. 人工智能与机器学习导论

3. 脑机接口中的信号处理导论

4. 脑机接口的神经科学基础导论

5. 脑机接口的高级人工智能与机器学习

6. 基于成像与代谢的脑机接口类型

7. 基于电位的脑机接口技术

8. 脑机接口的硬件、电路与系统

9. 有效科研计划书写作与论文结构

10. 脑机接口的未来展望与人工智能的作用

1. Applications of brain/machine interfaces

2. Introduction to basic signals, systems, and signal processing

3. Basic electronic circuits, microelectronics, and integrated circuits

4. Basics of the human brain and human nervous system

5. Neurological signals and Non-invasive brain/machine interfaces

6. Measuring electrical signals from the brain: electroencephalography (EEG), magnetoencephalography (MEG)

7. Measuring electrical signals from skeletal muscle: electromyography (EMG)

8. Semi-invasive brain/machine interfaces: electrocorticography (ECoG)

9. Invasive brain/machine interfaces: implanted electrodes

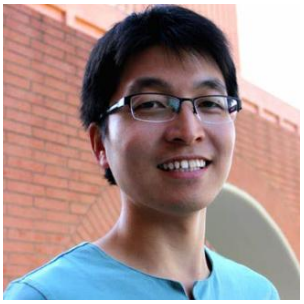
10. Signal processing and machine learning techniques for biomedical signals

课程三：《人工智能：大模型推理、多智能体协作与智能决策算法》

Algorithms for Modern AI

学科方向：生成式 AI 与大模型

1. 教授介绍



Haifeng Xu

芝加哥大学 计算机科学教授

- 芝加哥大学 SIGMA 智能研究实验室负责人
- 2020 年获得谷歌学院研究奖
- 2019 年获得 ACM SIGecom 最佳论文奖，荣誉奖
- the Games journal 特邀编辑
- 2022 年 IDEAL 数据经济学特别会议组织者之一
- 中科大华罗庚精英项目成员

Haifeng Xu 是芝加哥大学计算机科学系助理教授，领导机器代理战略智能（SIGMA）实验室。他研究数据和机器学习的经济学，包括为多代理决策设计学习算法，以及为数据和 ML 算法设计市场。海峰定期在领先的机器学习和计算经济学会议上发表论文，并担任 ICML、EC、AAAI、IJCA 等顶级会议的领域主席或高级程序委员会委员。

他的研究获得了多个奖项，包括 AI2050 Early Career fellow、IJCAI Early Career Spotlight、Google Faculty Research Award、ACM SIGecom Dissertation Award（荣誉奖）、IFAAMAS Distinguished Dissertation Award（亚军）以及多个最佳论文奖；他的工作得到了多个机构的慷慨支持，包括 NSF、ARO、ONR、Schmidt Science 和 Google Research。

Haifeng Xu is an assistant professor in the Department of Computer Science at UChicago, where he directs the Strategic Intelligence for Machine Agents (SIGMA) lab . He studies the economics of data and machine learning, including designing learning algorithms for multi-agent decision making and designing markets for data

and ML algorithms. Haifeng publishes regularly at leading machine learning and computational economics conferences, and serves as area chair or senior program committee for premier venues such as ICML, EC, AAAI, IJCA, etc.

His research has been recognized by multiple awards, including the AI2050 Early Career fellow, IJCAI Early Career Spotlight, Google Faculty Research Award, ACM SIGecom Dissertation Award (honorable mention), IFAAMAS Distinguished Dissertation Award (runner-up), and multiple best paper awards; his works have been generously supported by varied agencies including NSF, ARO, ONR, Schmidt Science, and Google Research.

2. 课程介绍

本课程专注于人工智能前沿知识与核心技术。从经典机器学习基础讲起，帮助学生理解深度神经网络的架构与运行机制，深入剖析反向传播和随机梯度下降等关键算法。同时，系统讲解多智能体系统、马尔可夫决策过程，以及强化学习在大语言模型中的应用。还会介绍蒙特卡洛树搜索算法和语言模型智能体设计。最后解析 AI 平台市场算法，让学生从技术和市场两方面把握人工智能领域。

This course focuses on the cutting - edge knowledge and core technologies of artificial intelligence. Starting from the basics of classical machine learning, it helps students understand the architecture and operation mechanisms of deep neural networks, and deeply analyzes key algorithms like backpropagation and stochastic gradient descent. Meanwhile, it systematically explains multi - agent systems, Markov decision processes, and the application of reinforcement learning in large language models. It also introduces the Monte Carlo tree search algorithm and the design of language model agents. Finally, it analyzes the market algorithms of AI platforms, enabling students to grasp the field of artificial intelligence from both technical and market aspects.

3. 课程大纲

1.背景和经典机器学习

2.深度神经网络

3.反向传播和随机梯度下降

4.多智能代理系统

5.Markov 决策过程

6.强化学习和对 LLM 的应用

7. LLM 的策划问题，思想链

8. 蒙特卡洛树搜索

9.语言模型代理设计

10. A1 平台的市场算法

1. Background and Classic Machine Learning

2. Deep Neural Networks

3. Backpropagation and Stochastic Gradient Descent

4. Multi-Agent System (adversarial search + game theory)

5. Markov Decision Processes

6. Reinforcement learning and application to LLMs

7. Reasoning issue of LLMs, Chain of Thought

8. Monte Carlo Tree Search

9. Language Model Agent Design

10. Market algorithms for Al platforms

课程四：《电子工程：物联网与无人机阵列网络通信系统设计》

Wireless Communications System Design

学科方向： 智能无人系统

1. 教授介绍

Danijela Cabric

加州大学洛杉矶分校 电子工程终身教授

- 加州大学洛杉矶分校电路和嵌入式系统项目主任
- 2018-2019 IEEE Com Soc 美国电气和电子工程师协会通讯领域杰出科学家
- 美国 IEEE 网络信号和信息处理期刊副主编
- 著名通讯硬件制造商 MaxLinear 公司首席科学顾问

Danijela Cabric 教授是加州大学洛杉矶分校电子与计算机工程系的教授。她于 2001 年获得加州大学洛杉矶分校的电子工程专业硕士学位，随后于 2007 年获得加州大学伯克利分校的电子工程专业博士学位。她的研究方向是无线通信系统设计，无线通信的机器学习，传感与安全与性能分析，嵌入式平台和软件定义无线电的实验。2020 年，Cabric 教授因其“对频谱感知和认知无线电系统的理论和实践的贡献”而当选电气和电子工程师协会(IEEE)院士。教授的学术成就闻名国际，在顶级学术期刊所发表论文的总引用量近两万次。

Danijela Cabric is a Professor in the Department of Electrical Engineering, University of California, Los Angeles. She gained her master degree in University

of California, Los Angeles in 2001 and her PhD in University of California, Berkeley in 2007. Her research interests are wireless communications system design, machine learning for wireless communications, sensing and security and performance analysis and experiments on embedded platforms and software defined radios.

In 2020, Professor Cabric was elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) for her "contributions to theory and practice of spectrum sensing and cognitive radio systems." Her academic achievements are internationally renowned, with an astounding total citation count of 20,000.

2. 课程介绍

课程将重点介绍一种自上而下的无线通信系统设计方法,从分析和实践的角度建立对核心物理和网络层功能的基本理解。学生们将学习无线系统数字通信和信号处理的知识;实用的检测和估计算法应用于发射机-接收机线路设计中;研究基于 OFDM、扩频和多天线的现代无线电设计以及无线协议和网络技术。同时学生们将研究现有和新出现的无线系统, 包括 2G 到 6G 网络、WiFi 和物联网。

The course will focus on a top-down approach to the design of wireless communication systems to build a fundamental understanding of core physics and network layer functions from an analytical and practical perspective. Students will learn about digital communication and signal processing in wireless systems; Practical detection and estimation algorithms are used in transmitter - receiver circuit design. Modern radio design based on OFDM, spread spectrum and multi-antenna as well as wireless protocols and network technologies are studied. Students will also study existing and emerging wireless systems, including 2G to 6G networks, WiFi and the Internet of Things.

3. 课程大纲

1.数字通信: 信号空间、发射器和接收器结构

2.无线信号处理: 调制/解调、估计/检测

3.无线信道建模、链路预算

4.多载波调制（OFDM）

5.信道估计、均衡、同步

6.多天线通信、MIMO

7.波束成形、大规模多输入多输出

8.无线传感和定位

9.设计实例: 物联网、WiFi、超宽带通信

10.设计实例 5G 蜂窝和毫米波网络

1. Digital Communications Fundamentals: Signal Space, Transmitter and Receiver Structure

2. Signal Processing Fundamentals for Wireless:

3. Modulation and Demodulation, Estimation and Detection

4. Wireless Channel Modeling, Link Budget

5. Multicarrier Modulation (OFDM)

6. Channel Estimation, Equalization, Synchronization

7. Multiple Antenna Communications, Beamforming, Massive MIMO

8. Wireless Sensing and Localization

9. Design examples: Internet of Things, WiFi

10. Design Examples: 5G Cellular, Cognitive Radio Communications