人工智能前沿研讨会
Symposium on Frontiers of AI at AMSS, Beijing, April 15-16, 2019

时间：2019 年 4 月 15-16 日
地点：北京市海淀区中关村东路恒兴大厦南(四环保福寺桥南)
　　　中国科学院数学与系统科学研究院 <mark>南楼 二层 N204 会议室</mark>
主办：中澳量子信息处理和人工智能联合实验室
组织：李三江（悉尼科技大学）　　张松懋、陆汝钤（中科院数学与系统科学研究院）
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会议日程

四月十五日，星期一

09:00 – 09:10	高小山副院长致开幕辞
09:10 – 10:00	Developing Data-Driven Intelligent Autonomous Systems （刘伟茹，University of Bristol）
10:00 – 10:20	茶 休
10:20 – 11:10	多智能体系统的趋同控制 （张纪峰，AMSS）
11:10 – 12:00	图贝叶斯优化 （杨博，吉林大学）
12:00 – 14:00	午餐（地点：物科宾馆五层自助餐）
14:00 – 14:50	Solving Large Scale Games（安波，南洋理工大学）
14:50 – 15:40	Large-scale Applied Mechanism Design（唐平中，清华大学）
15:40 – 16:00	茶 休
16:00 – 16:50	Decentralized Markov Decision Process: Theory and Its Applications （吴锋，中国科学技术大学）
16:50 – 17:40	一起来玩麻将 （李三江，悉尼科技大学）

四月十六日，星期二

09:00–11:30	"机器学习中的结构化先验"讲习班（李斌，复旦大学）

（所有报告信息、报告人简介见附页）

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四月十五日，星期一

上午 9:10-10:00
报告一　Developing Data-Driven Intelligent Autonomous Systems
报告人：刘伟茹教授，University of Bristol

报告摘要

Multi-Agent Systems (MAS): Intelligent agents are computer systems which have reasoning, decision-making, and acting capabilities, in order to achieve their goals. These systems are well suited for environments that are dynamically changing. This is due to the agents being able to react to, and interact with their environment, in order to make appropriate decisions based on its current state.

The Belief, Desire and Intention (BDI) architecture, is an agent architecture in which agents have their own beliefs, desires and intensions. Based on these, agents are able to respond to the situations that they find themselves in. However, currently within the majority of multi-agent systems, an agent's beliefs are either true or false. This imposes constraints on the agents. Furthermore, current intelligent agents rely on pre-defined plans for their actions. It is often the case that it is not possible to enumerate all plans in advance, due to uncertain and dynamic factors in real-world situations.

We have been conducting research aiming to address these two challenges. First, we have developed a unified belief modelling framework that can capture an agent's heterogeneous beliefs on the one hand, and instantiate the framework with known uncertainty formalisms (probability theory, belief function theory, possibility theory, MDPs) on the other hand. This framework provides a very flexible mechanism to capture and reason with agents' beliefs.

Second, we have also been investigating how to integrate the state-of-the-art planning algorithms and BDI agents. Specifically, we have been looking into how to call First Principles Planners (FPPs), which are online planning algorithms, when an BDI agent runs out of plans to use. The ability for an agent to evolve its planning capabilities overtime has also been studied.

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This talk will cover our major research results achieved. We will use some demos to illustrate how these new results work in real-world applications.

报告人简介：

Weiru Liu holds Chair of Artificial Intelligence (AI) at the University of Bristol, and is the Faculty Research Director for the Engineering Faculty. Her research interests include: data-driven intelligent autonomous systems; cyber-physical systems; large-scale sensor network data analytics, and event modelling, reasoning and correlation in uncertain environments in sensor networks; and information fusion under uncertainty, with a wide range of applications such as security, healthcare, robotics. She has published over 200 peer-reviewed papers mostly in top-tier venues, with several Best Paper Awards. She chaired several international conferences, and was an invited keynote at a few international conferences.

Prior to joining the University of Bristol in 2017, she held the Chair of AI at Queen's University Belfast (QUB), and was the Director of Research for the Knowledge and Data Engineering Cluster for 6 years. She has a sustained track record of securing peer-reviewed, highly competitive funding from a diverse range of funding bodies (over £35.5m as Principal Investigator or Co-Investigator), and was the PI for the £2.3m R&D grant funded by the Allstate Insurance Company (US) and Invest Northern Ireland on detecting fraudulence medical claims. She won an EPSRC Queen's University Belfast Research Impact Award in 2011.

She is a member of UK EPSRC ICT Strategic Advisory Team (SAT); a member of UK Higher Education Research Excellence Framework (REF) 2021 Institutional Environment Pilot Panel; a member of Independent Research Fund Denmark (DFF); and a Co-Director for the Centre for Doctoral Training in Future Autonomous and Robotic Systems: Towards Ubiquity (FARSCOPE-TU) at Bristol, with £5.5M UK EPSRC funding for 2019-2028.

上午 10:20 – 11:10

报告二 多智能体系统的趋同控制

报告人：张纪峰教授 中国科学院数学与系统科学研究院

报告摘要：

随着网络化、智能化的快速发展，集信息传输、信息处理和控制决策于一体的多智能体系统的分布式估计与控制目前已成为系统控制界的热点。本报告将简单介绍我们研究小组近年来在多智能体系统的趋同控制方面取得的一些成果，包括量测噪声情形下的趋同协议的设计及趋同的充分必要条件，基于小容量信道的趋同控制设计与闭环系统性能分析，以及多智能体系统的可趋同性与智能体之间的通信拓扑、各智能体的动力学特性和容许控制集之间的关系等。

报告人简介：

张纪峰，1985 年本科毕业于山东大学数学系，1991 年博士毕业于中国科学院系统所，现为中国科学院数学与系统科学研究院系统所所长。

研究方向为随机系统、有限信息系统、多自主体系统的分析与控制等。1997 年获国家杰出青年基金资助，2009 年获全国优秀博士学位论文指导教师荣誉证书，2010 年和 2015 年先后两次获国家自然科学二等奖，2014 年当选为美国电气与电子工程师协会会士(IEEE Fellow)，2016 年当选为国际自动控制联合会会士(IFAC Fellow)和国际系统与控制科学院院士，2018 年当选为欧洲科学与艺术院院士。

先后担任国务院学位委员会系统科学评议组召集人、国际自动控制联合会学术委员会副主席、中国系统工程学会副理事长、中国自动化学会副理事长，是科普期刊《系统与控制纵横》的创刊主编，《系统科学与数学》、《中国科学：信息科学》、《系统工程理论与实践》、IEEE Trans. on Automatic Control、SIAM J. on Control and Optimization、IEEE Control Systems Letters 等的主编、副主编、编委；中国控制会议、中国系统科学大会、全球智能控制与自动化(WCICA)、第 20 届国际自动控制联合会(IFAC)世界大会等多个系统控制领域重要学术会议的副主席、程序委员会主席、副主席。

上午 11:10 – 12:00

报告三 图贝叶斯优化

报告人：杨博 教授，吉林大学计算机科学与技术学院

报告人简介：

杨博，吉林大学计算机科学与技术学院教授，博士生导师，符号计算与知识工程教育部重点实验室主任，主要从事数据挖掘和知识工程方面的理论和应用研究。

报告摘要：

现实世界中的复杂系统大都可以抽象地表示为网络，节点表示子系统，链接表示子系统之间的相互作用。由于网络的拓扑结构决定了复杂系统的功能和动力学特性，因此在解决不同领域的实际问题时人们常常会面临一个共同的问题：什么样的网络结构是我们期望的？例如，人们想知道什么样的晶体结构能产生高温超导现象，什么样的社会接触结构能最小化流行病的传播范围，什么样的路网结构最能改善交通拥堵现象，什么样的深度网络结构具有最佳的分类或回归性能。诸如此类的问题还可以列举很多，但这些表面上没有关联的问题实质上都可以归结为网络结构优化问题：设计出能产生最优网络功能或动力学特性的网络结构。针对这些问题，本报告介绍我们在这方面的工作，如何将贝叶斯优化框架从欧式空间拓展到属性网络空间，构造出贝叶斯图优化工具，有效处理多峰、评估代价高昂、评估存在噪声、黑箱目标函数的网络结构优化问题。

下午　2:00 – 2:50

报告四　Solving Large Scale Games

报告人：安波 副教授， 南洋理工大学计算机科学与工程学院

报告人简介：

Bo An is an Associate Professor with the School of Computer Science and Engineering, Nanyang Technological University, Singapore. He received the Ph.D degree in Computer Science from the University of Massachusetts, Amherst. His current research interests include artificial intelligence, multiagent systems, game theory, reinforcement learning, and optimization. His research results have been successfully applied to many domains including infrastructure security and e-commerce. Dr. An was the recipient of the 2010 IFAAMAS Victor Lesser Distinguished Dissertation Award, an Operational Excellence Award from the Commander, First Coast Guard District of the United States, the 2012 INFORMS Daniel H. Wagner Prize for Excellence in Operations Research Practice, and 2018 Nanyang Research Award (Young Investigator). His publications won the Best Innovative Application Paper Award at AAMAS’12 and the Innovative Application Award at IAAI’16. He was invited to give Early Career Spotlight talk at IJCAI’17. He led the team HogRider which won the 2017 Microsoft Collaborative AI Challenge. He was named to IEEE Intelligent Systems' "AI's 10 to Watch" list for 2018. He was invited to be an Advisory Committee member of IJCAI’18. He is a member of the editorial board of JAIR and the Associate Editor of JAAMAS, IEEE Intelligent Systems, and ACM TIST. He was elected to the board of directors of IFAAMAS and senior member of AAAI.

报告摘要：

In January 2017 CMU's Libratus system beat a team of four top-10 headsup no-limit specialist professionals, which was the first time an AI had beaten top human players in this game. Libratus's success is purely based on algorithms for solving large scale games and has nothing to do with deep learning! Over the last few years, algorithms for solving large scale games have also been applied to scheduling security resources in many significant domains including airports, federal air marshals service, coast guard, and wildlife conservation organizations. Game theory has also been applied in many other AI problems such as sustainability, ad-word auction, and e-commerce. This talk will discuss key techniques behind these success and their potential applications in other domains.

下午 2:50 – 3:40

报告五 Large-scale Applied Mechanism Design

报告人：唐平中 副教授，清华大学

报告摘要：

In this talk, I will introduce three research projects at the interface of AI and economics, all within the framework of mechanism design at nationwide scales. The first project aims to design markets for water right, while the second and third aim to design mechanisms that maximize revenue for nationwide mobile applications. The results are a set of mechanisms that satisfy both computation and economics constraints.

报告人简介：

Pingzhong Tang is a Tenured associate professor and head of the Computational economics lab at IIIS (aka. Yao class), Tsinghua University. Before joining Tsinghua, he was a postdoc at computer science department of CMU. He obtained PhD degree at HKUST. He has been visiting scientist at Stanford University, Harvard University, University of California at Berkeley and Microsoft research Asia. Dr. Tang's research is to apply computational methodologies to design, analyze and implement economic mechanisms, as well as use economic insights and paradigms to regulate computer protocol design. Some of his research results have been applied in major internet companies such as Baidu, DiDi and Alibaba. His PhD thesis work on computer-aided theorem discovery in economics has been included in various textbooks. He has been a member of Microsoft research Star-track program, China National Youth-1000 program, National teaching excellence award in computer science Alibaba initiative research program, an invitee of the IJCAI early career spotlight talk and a member of MIT TR35 China.

下午 4:00—4:50

报告六 Decentralized Markov Decision Process: Theory and Its Applications

报告人：吴锋 副教授，中国科学技术大学计算机科学与技术学院

报告摘要:

A fundamental challenge in artificial intelligence is how to achieve intelligent coordination of a group of decision makers in spite of stochasticity and limited information. Decentralized Markov decision process offers a normative framework for optimizing decisions under uncertainty. But due to computation complexity barriers (i.e., NEXP-hard), developing effective algorithms for this model is a serious challenge in AI. In this talk I will introduce our recent progress on developing novel theory and techniques based on simulation for solving this model, which can scale to very large problems and are among the leading algorithms in the literature. Additionally, we successfully applied these methods to real-world applications such as robot soccer, search and rescue, etc.

报告人简介:

Feng Wu is an Associate Professor in the School of Computer Science and Technology, University of Science and Technology of China (USTC). He received his B.E and Ph.D. both from USTC in 2006 and 2011 respectively. Before joining USTC, he is a Research Fellow worked with Prof. Nick Jennings at University of Southampton, UK. His research interests include planning under uncertainty, multi-agent systems, reinforcement learning, and robotics. He has published over 40 refereed papers on these topics in prestigious journals and conferences such as AIJ, IJCAI, AAAI, NIPS, AAMAS, and UAI. He is a recipient of the President's Special Award of Chinese Academy of Sciences (CAS) in 2011, Outstanding Dissertation Award of CAS in 2012. He won the first place in the RoboCup competitions 3 times and the best application paper award in AAMAS 2015. More information about his research can be found: http://staff.ustc.edu.cn/~wufeng02/.

下午 4:50—5:40
报告七 一起来玩麻将
李三江 教授 悉尼科技大学量子软件与信息中心

摘要：
Mahjong is a very popular tile-based game commonly played by four players. Each player begins with a hand of 13 tiles and, in turn, players draw and discard (i.e., change) tiles until they complete a legal hand using a 14th tile. In this paper, we initiate a mathematical and AI study of the Mahjong game and try to answer two fundamental questions: how bad is a hand of 14 tiles? and which tile should I discard? We define and characterise the notion of deficiency and present an optimal policy to discard a tile in order to increase the chance of completing a legal hand within k tile changes for each $k \geq 1$.
相关论文见：https://arxiv.org/abs/1903.03294

个人简介：
李三江，男，1975 年 2 月生于陕西渭南。2001 年获四川大学基础数学博士学位，师从刘应明院士、罗懋康教授。现为澳大利亚悉尼科技大学教授。主要研究方向为人工智能理论，具体研究内容涉及知识表示与推理、时空推理、模糊推理、约束求解等。自 2001 年以来他与合作者系统深入地研究了空间推理的定性方法，并在空间关系建模和空间约束求解等方面取得重要成果。这些成果主要发表在人工智能领域重要国际刊物和顶级国际会议，其中包括 Artificial Intelligence Journal 多篇。2004 年获德国洪堡基金会资助到德国弗赖堡大学访问（任洪堡学者），2006 年获首届微软青年教授奖，2008 年获中创软件人才奖，2009 年获澳大利亚 ARC Future Fellow 奖，2010 年获悉尼科技大学 ECR Research Excellence Award。

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四月十六日，星期二

上午 9:00--11:30： "机器学习中的结构化先验" 讲习班

主讲人：李斌 教授，复旦大学计算机科学技术学院

个人简介：李斌，复旦大学计算机科学技术学院青年研究员、博士生导师，上海高校特聘教授（东方学者）。2009 年获复旦大学理学博士学位，2017 年回复旦大学任教，期间先后担任法国南巴黎电信学院（TELECOM SudParis）博士后、悉尼科技大学（UTS）讲师、澳大利亚联邦科学与工业研究组织（CSIRO）高级研究员。研究领域涉及统计机器学习、贝叶斯非参数方法、人工智能、大数据分析；发表论文 50 余篇，包括 ICML、NIPS、IJCAI 等机器学习与人工智能领域一流国际会议论文 20 余篇，IEEE TKDE、IEEE TCYB 等 SCI 期刊论文 10 余篇。

上午 9:00 – 09:40

《机器学习中的结构化先验（1）：原理与应用》（40 分钟）

贝叶斯模型由两个重要部分组成：用于拟合模型的'似然'与定义模型假设空间的'先验'。当使用最大后验概率估计时，似然与先验分别等价于损失函数与正则化项。目前众多性能优异的机器（深度）学习模型大多由数据驱动，即通过最小化海量数据上的经验损失来训练模型，'先验'则仅仅用于约束模型参数，这在很大程度上低估了'先验'的作用。认知科学研究发现，知识在人脑中的组织是结构化的，这为研究类脑学习机制指引了一个探索方向——结构化先验。报告第一部分将介绍结构化先验的研究动机与基本原理、以及我们基于经典贝叶斯非参数先验（中国餐馆过程、印度自助餐过程、蒙德里安过程）从复杂数据中发现与学习其隐含的结构化知识的若干应用。

上午 09:40 --09:55 茶休

上午 09:55 –10:35

《机器学习中的结构化先验（2）：随机划分过程》（40 分钟）

在贝叶斯模型中，当隐变量为一个具有无限维参数的数据结构时，其先验不再是一个概率分布，而是一个随机过程。然而，现有随机过程的种类非常有限，缺乏具有足够表达能力的随机过程生成某些复杂的数据结构，例如对于空间的'划分'。已有方法仅使用与坐标轴平行的超平面对空间进行划分，这种'格子'形式的先验具有诸多局限性，例如难以有效表达维度间的依赖关系、对于稀疏数据区域的划分效率较低等。为此，我们首次提出了使用任意超平面与矩形框对空间划分的随机过程，分别称为'空间二分树过程'与'矩形框过程'，突破了以往空间划分的先验仅可以是'格子'的限制，分别解决了以上两个局限性。报告第二部分将介绍我们提出的两个新型随机划分过程的定义与数学性质、及其在关系建模与决策树上的应用。

上午 10:35 --10:50 茶休

上午 10:50 --11:30

《机器学习中的结构化先验（3）：可学习深度先验》 （40 分钟）

在认知心理学中，'知觉组织'研究人如何从视觉信息中组织基本视觉元素形成一个完整的物体。由于物体具有任意形状，随机划分过程已经无法胜任其先验，这对知觉组织建模提出了一个巨大的挑战——如何定义一个可以生成任意形状的先验？为此，我们转而探索无固定样式的结构化先验，通过神经网络强大的非线性映射能力，把以往所见一切物体的形状都记忆在神经网络的参数中，故称为'可学习深度先验'。报告第三部分将介绍我们基于可学习深度先验提出的空间混合模型。其中，混合模型的成分对应于图像中的物体，每个像素属于不同物体的先验由神经网络生成的'截断折棍过程'定义。由于神经网络记忆了物体形状，因此像素的先验之间具有空间依赖性，从而倾向于形成一个'印象'中的物体形状，这与人类推断遮挡或模糊物体时的做法不谋而合。