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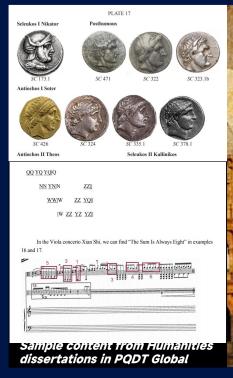




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Louis on Brogerst

#### The wave nature of the electron

Nobel Leasure, Describer 12, 1929 德布罗意的获奖论文

When in 1920 I resumed my studies of theoretical physics which had long been interrupted by discurractances beyond my control. I was far from the idea that my toudies would bring met several years liver to receive at ha high and envised price at that awarded by the Swedith Academy of Sciences each year to a scientist the Nobel Prize for Physica. What at that time draw me towards theoretical physics was not the hope that such a high distinction would ever crown my work; I was attracted to theoretical physics by the mystery informating the structure of matter and the must use of radiations, a mystery which deepened as the strange quantum except introduced by Planck in 1961 in his research on hisk-body radiation condusted to encrease on the whole domain of physics.

To assiss you to understand how my stall at developed, I must first

To savie you to understand how my steller developed, I must fire depict for you the crisis which physics had then been proving through for some twenty yes a.

For a long time physicist had been wondering whether light was composed of small, rapidly moving corposeles. This idea was put fineward by the phicosophets of antiquity and upded by Mewton in the 18th tentory. After Thomas Young's discovery of interference gluenomens and following the admirable work of Augment French, the hypothesis of a granular illustration of light was entirely abundened and the wave theory unantimously adopted. Thus the physicias of last century, sparmed absolutely he idea of an atomic structure of light. Although rejected by optics, the atomic theories began making great healway not only in chemitary, where they provided a simple interpretation of the laws of definite proportions, but also in the physics of matter where they provided a formation of the chemitary where they provided a simple interpretation of the laws of definite proportions, but also in the physics of matter where they made possible and her provides of a large annual or described a definite proportion. Figure 18th and in the physics of the laws of definite proportions of a large annual or decreased of the physics of the laws of the laws of the laws of the provides they were internamental in the choosing of the laws of the provides of the laws of laws of laws of the laws of laws

德布罗意

法国著名理论物理学家

# Recherches sur la théorie des Quanta (关于量子理论的研究)

#### 巴黎大学 1924

- 出身贵族世家
- 半路出家从事物理研究
- · 1924年11月,获得博士学位
- 1929年就赢得了诺贝尔物理学奖
- 造就了5位诺奖得主
- 开辟了好几个物理学界全新的领域

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A New Paradigm for Practical Maliciously Secure Multi-

Language Interfaces

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Fairness in Algorithmic Services

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2010 哥伦比亚大学计算机科学系

2020卡内基梅隆大学计算机科学系

2017威斯康星大学麦迪逊分校计算机系

2018俄亥俄州立大学计算机科学与工程系

2018 西北大学计算机科学系

2018康奈尔大学信息科学系

2018哈佛大学商学院

论文题目	作者	毕业院校	毕业年	执教机构

University of Washington

Stanford University

Stanford University

Stanford University

Cornell University

University of California, Berkeley

University of California, Santa Barbara

University of Maryland, College Park

论文题目	作者	毕业院校	毕业年 度	执教机构

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Zhihao Jia (贾志豪)

Allison Z. Koenecke

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#### On the Angular Distribution in Nuclear Reactions and Coincidence Measurements

Yang, Chen Ning ADD , American Doctoral Dissertations

#### 核反应的角分布与符合测量

摘要/索引

全文PDF

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#### 摘要

Theorems concerning the general form of the angular distribution of products of nuclear reactions and disintegrations are derived. These theorems are based only on the invariance properties of the physical process under space-rotation and under inversion. The following examples are studied in detail: (i) Angular correlation between the electron and the neutrino in β-decay. (ii) Angular correlation between a β-ray and a γ-ray emitted in succession by a nucleus. (iii) Angular correlation between two γ-rays emitted in succession by a nucleus.

#### 索引

学科:	Computational physics; Physics; Nuclear physics and radiation;
标题:	On the Angular Distribution in Nuclear Reactions and Coincidence Measurements
作者:	Yang, Chen Ning
页数:	26
出版日期:	1948
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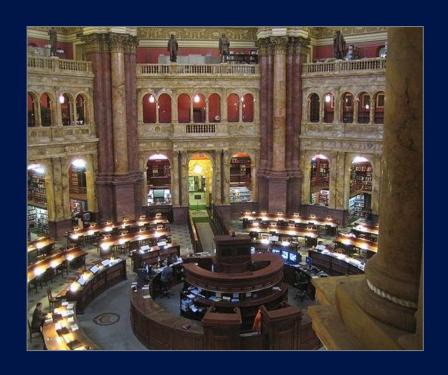
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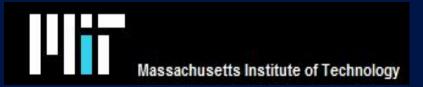
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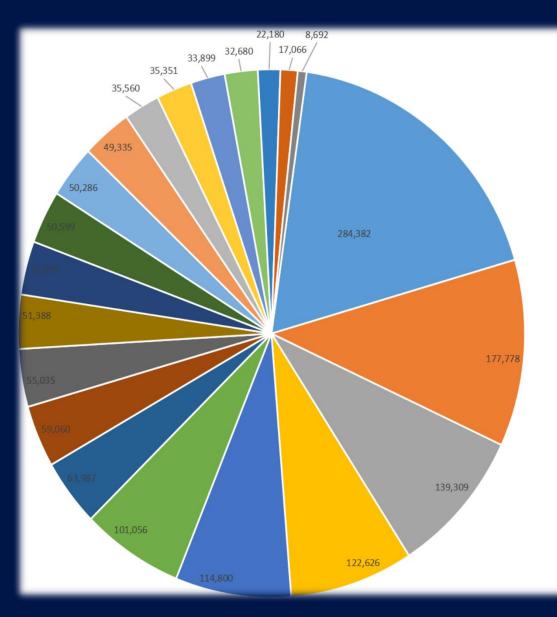


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Meet the recipients of the 2024 ACM A.M. Turing Award, Andrew G. Barto and Richard S. Sutton! They are recognized for developing the conceptual and algorithmic foundations of reinforcement learning. Please join us in congratulating the two recipients! bit.ly/4hpdsbD





2025年3月5日,美国计算机学会(ACM)宣布,将2024年ACMA.M.图 灵奖授予强化学习之父Richard Sutton和他的博士导师Andrew Barto,以表彰他们开发了强化学习(Reinforcement Learning)的概念和算法基础。

近年来,RL结合深度学习取得突破,催生了深度强化学习技术。AlphaGo的成功、ChatGPT的RLHF训练、机器人操控技能学习,以及在网络拥塞控制、芯片设计、全球供应链优化等领域的应用,均展示了其强大潜力。

0:14



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AAI: 9958252, Choy, Kit Shan, (State University of New York at Buffalo), DAI-B 61/01,

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摘要へ

摘要

Conventional uniform acuity machine vision systems limit their attainable visual resources by fixing the acuity. The emergence of the foveal vision system—a new type of vision system strongly analogous to the vertebrate vision, equipped with graded acuity and context sensitive sensor gaze control, promised great improvement in efficiency over the uniform resolution sensors for active vision applications. The foveal systems treat visual resolution as dynamically allocatable resources, it can support simultaneously wide field of view, high localized acuity, and high temporal resolution. The high efficiency of foveal sensor is achieved by minimizing sensor information to relevant data only, and such operations required a crucial visual attention mechanism which optimally directs visual resources. Besides difficulties in manual deriving of such a mechanism, the presence of uncertainties in dynamic environment also prompts for a learning algorithm to achieve and improve the skilled visual attention behavior. The reinforcement learning (RL) approach, together with the visual memory map and hierarchical planning structure is introduced for the construction of gaze control mechanism for the foveal machine vision system. Bottom-up visual information and top-down cognitive knowledge are integrated through the utilization of RL modules, the bottle-neck problems of partial observability and inefficient early learning are properly addressed by various enhancements to the RL algorithms. The proposed RL based visual attention mechanism has significantly improved performance. It can learn strategies for the acquisition of visual information relevant to the task, and it is adaptive to environmental changes because learning is in progress continuously. Intelligence has been distributed throughout functional modules for efficient learning, the modular hierarchy allows flexible expansion and the use of parallel and distributed computation schemes leaves room for parallel implementation.

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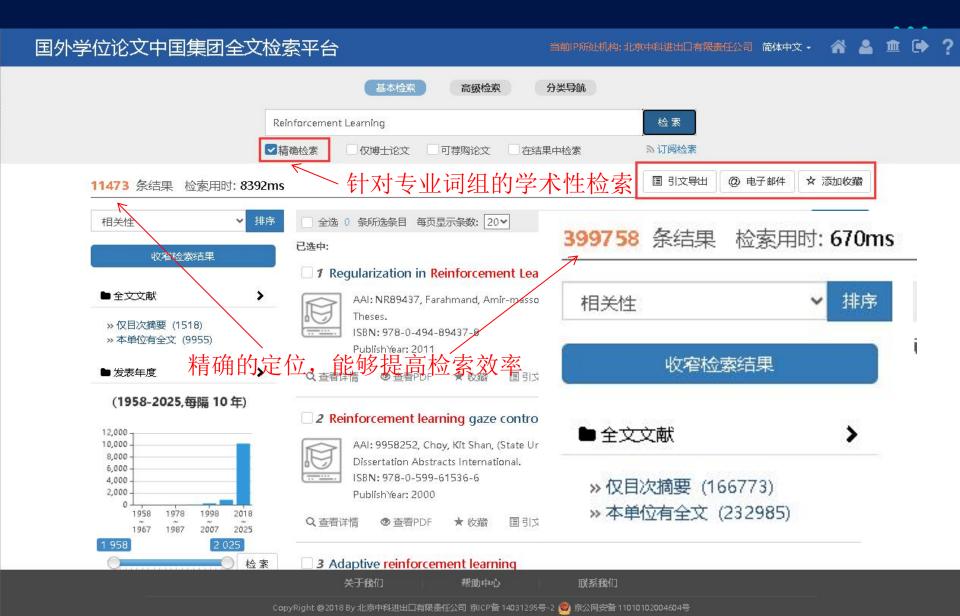
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贝尔物理奖;2000年当选为中国科学院外籍院士;2004年

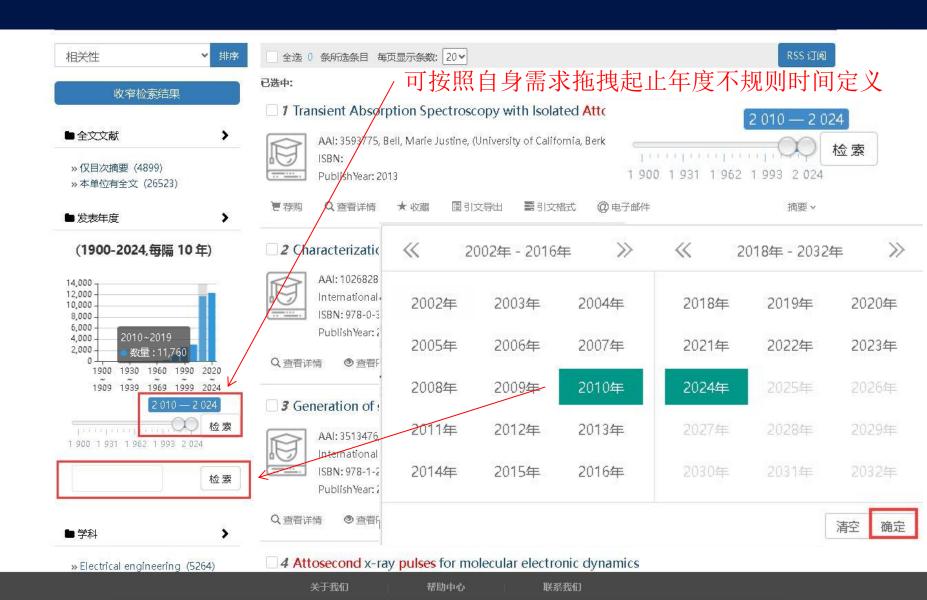
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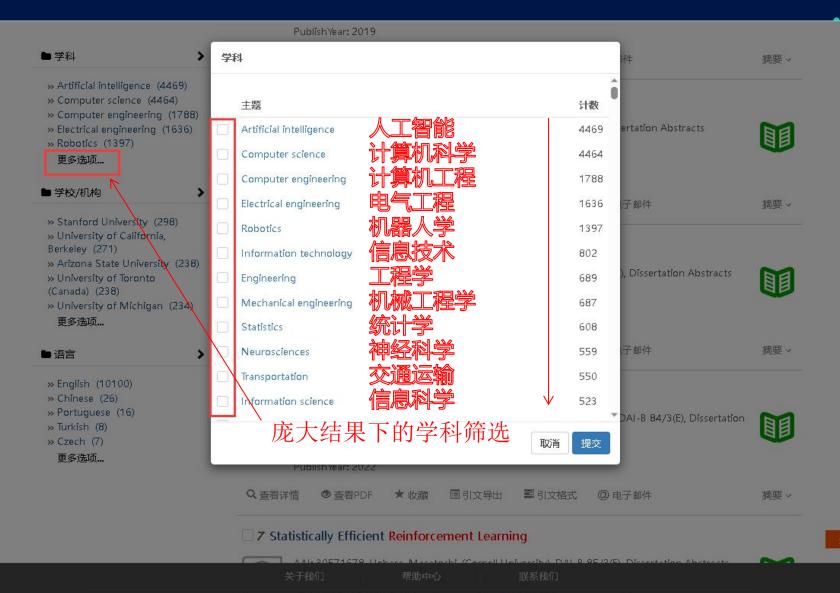


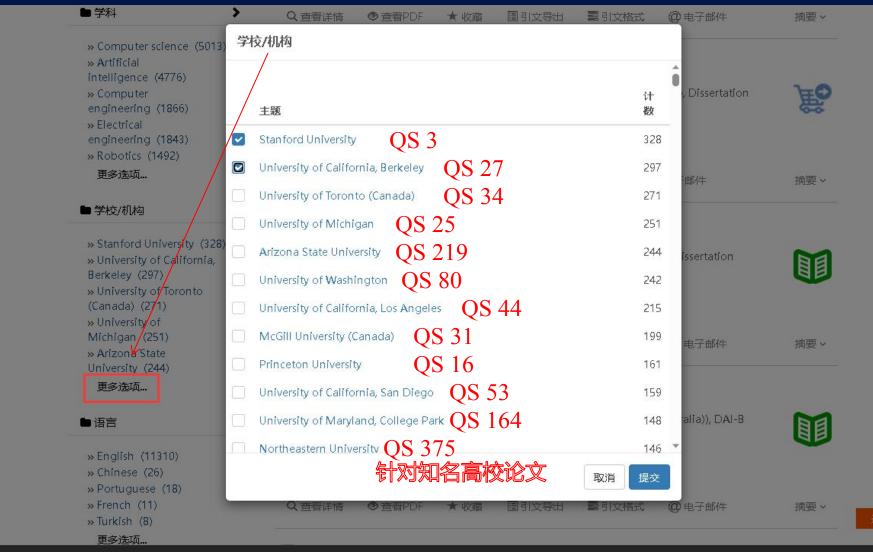
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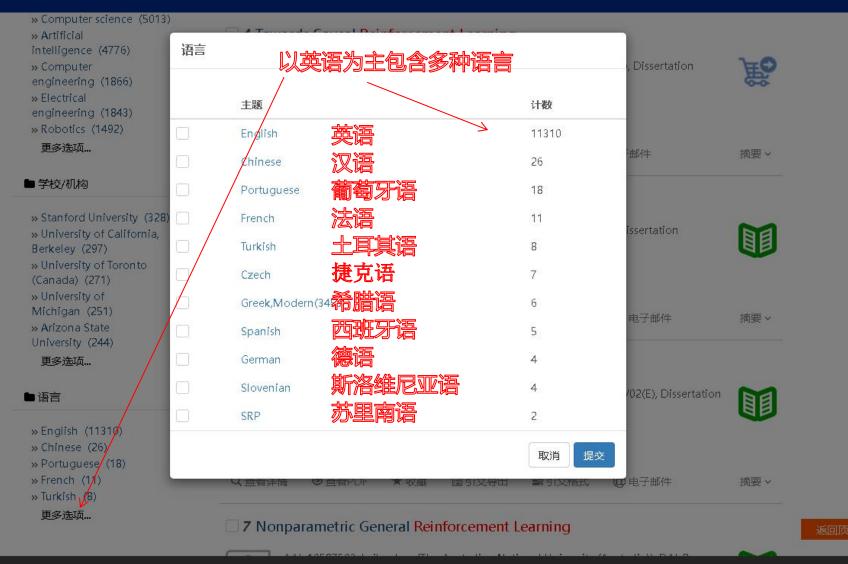






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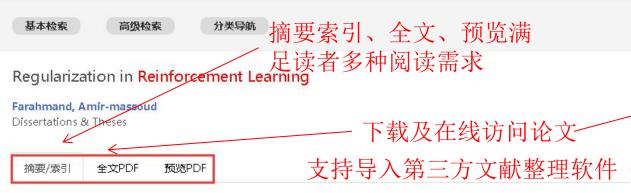
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This thesis studies the reinforcement learning and planning problems that are modeled by a discounted Markov Decision Process (MDP) with a large state space and finite action space. We follow the value-based approach in which a function approximator is used to estimate the optimal value function. The choice of function approximator, however, is nontrivial, as it depends on both the number of data samples and the MDP itself. The goal of this work is to introduce flexible and statistically-efficient algorithms that find close to optimal policies for these problems without much prior information about them. The recurring theme of this thesis is the application of the regularization technique to design value function estimators that choose their estimates from rich function spaces. We introduce regularization-based Approximate Value/Policy Iteration algorithms, analyze their statistical properties, and provide upper bounds on the performance loss of the resulted policy compared to the optimal one. The error bounds show the dependence of the performance loss on the number of samples, the capacity of the function space to which the estimated value function belongs, and some intrinsic properties of the MDP itself. Remarkably, the dependence on the number of samples in the task of policy evaluation is minimax optimal. We also address the problem of automatic parameter-tuning of reinforcement learning/planning algorithms and introduce a complexity regularization-based model selection algorithm. We prove that the algorithm enjoys an oracle-like property and it may be used to achieve adaptivity: the performance is almost as good as the performance of the unknown best parameters. Our two other contributions are used to analyze the aforementioned algorithms. First, we analyze the rate of convergence of the estimation error in regularized least-squares regression when the data is exponentially β-mixing. We prove that up to a logarithmic factor, the convergence rate is the same as the optimal

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摘要

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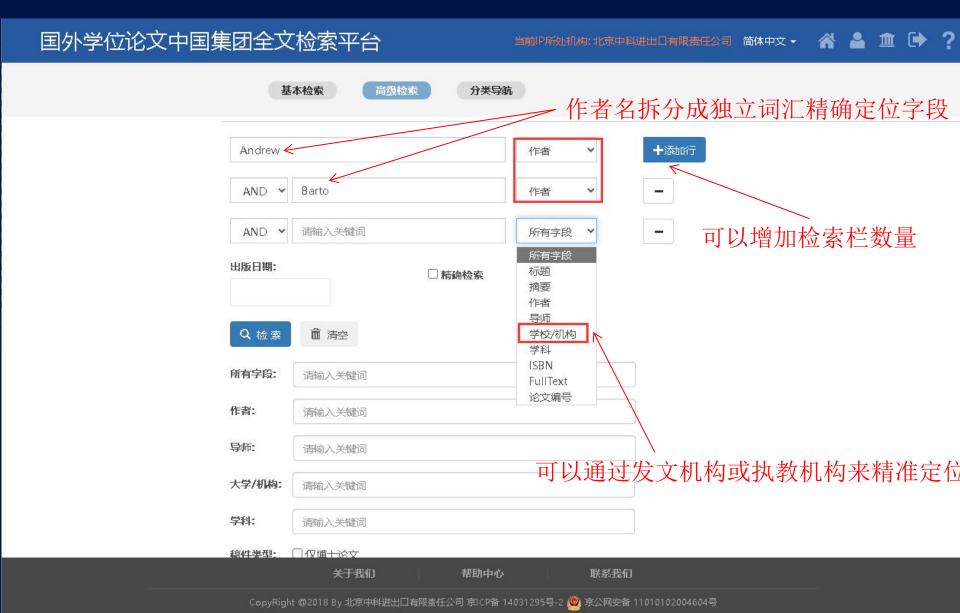
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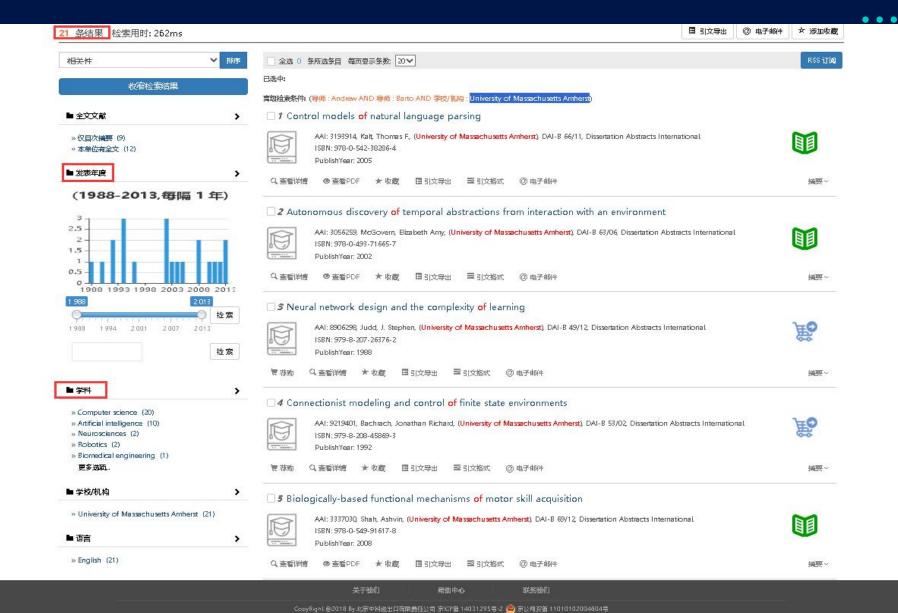
安德鲁·巴托(Andrew G. Barto, 1948-),曾任马萨诸塞大学阿默斯特分 校信息与计算机科学系教授。他于1977 年加入该校, 先后担任博士后研究员、副 教授、教授,曾任系主任。巴托获得密歇 根大学数学学士、计算机与通信科学硕士 及博士学位,马萨诸塞大学神经科学终身 成就奖、IJCAI卓越研究奖和IEEE神经网 络学会先驱奖; 电气电子工程师协会 (IEEE)会士、美国科学促进协会 (AAAS)的会士。

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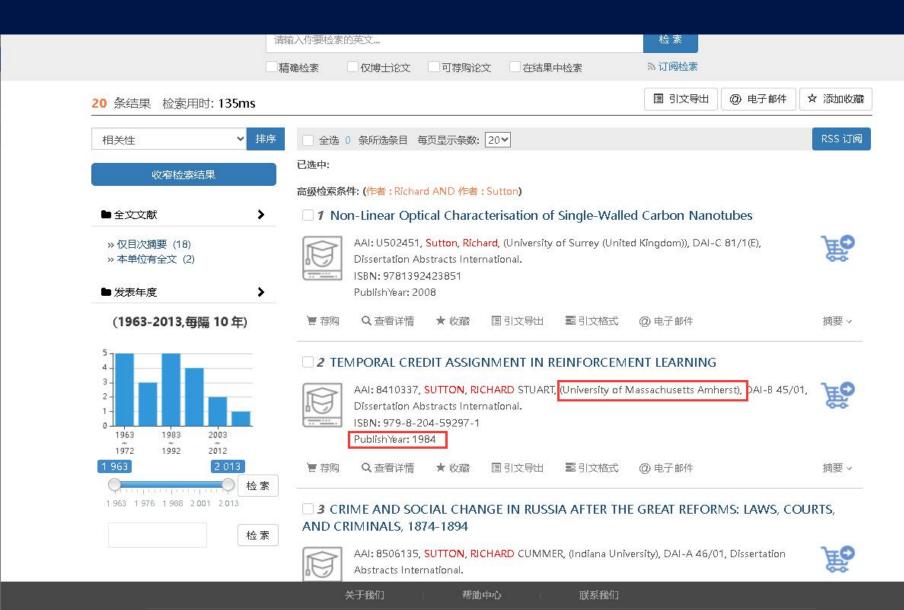
process that, in incorporating a Bayesian model for evolving uncertainty about unknown process parameters, takes the form of a Markov decision process defined over a set of "hyperstates" whose cardinality grows exponentially with the planning horizon. I develop computational procedures that retain the full Bayesian formulation, but sidestep intractability by utilizing techniques from reinforcement learning theory (specifically, Monte-Carlo simulation and the adoption of parameterized function approximators). By pursuing an approach that is grounded in a complete Bayesian world model, I develop algorithms that produce policies that exhibit performance gains over simple heuristics. Moreover, in contrast to many heuristics, the justification or legitimacy of the policies follows directly from the fact that they are clearly motivated by a complete characterization of the underlying decision problem to be solved. This dissertation's contributions include a reinforcement learning algorithm for estimating Gittins indices for multi-armed bandit problems, a Monte-Carlo gradient-based algorithm for approximating solutions to general problems of optimal learning, a gradient-based scheme for improving optimal learning policies instantiated as finite-state stochastic automata, and an investigation of diffusion processes as analytical models for evolving uncertainty.

### 索引

学科:	Statistics; Operations research; Artificial intelligence; Computer science;			
标题:	Optimal learning: Computational procedures for Bayes -adaptive Markov decision processes			
作者:	Duff, Michael O'Gordon			
页数:	247			
出版日期:	2002			
学校代码:	0118			
大学/机构:	University of Massachusetts Amherst			
来源:	DAI-B 63/01, Dissertation Abstracts International			
大学所在地:	United States Massachusetts			
ISBN:	978-0-493-52573-0 可治心地压杀 子 女次 巴 发状 肋 大盐			
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理查德·萨顿(Richard S. Sutton)是美国计算 机科学家,是Deepmind的研究科学家,阿尔伯 塔大学计算机学教授。萨顿与安德鲁•巴托的合作 始于 1978 年, 当时在马萨诸塞大学阿默斯特分校 巴托是萨顿的博士生导师和博士后导师,在马萨诸 塞大学阿默斯特分校获得了计算机与信息科学的硕 士学位和博士学位。Sutton 曾获得国际神经网络 学会颁发的总统奖,国际人工智能联合会议 (IJCAI) 卓越研究奖、加拿大人工智能协会终身 成就奖,以及马萨诸塞大学阿默斯特分校杰出研究 成就奖。他是英国皇家学会会士、人工智能促进会 (AAAI)会士及加拿大皇家学会会士。





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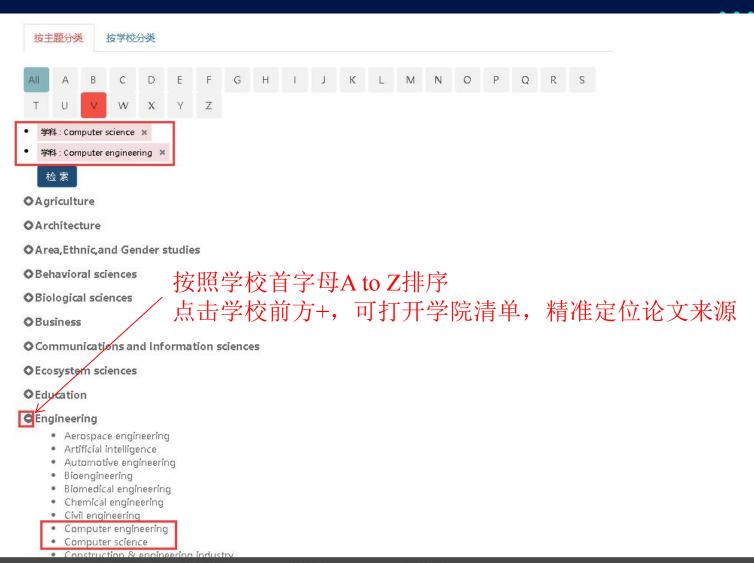
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- · Atomic physics
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- Computational physics
- · Condensed matter physics
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- · High temperature physics
- · Inorganic chemistry
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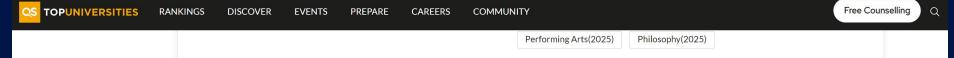
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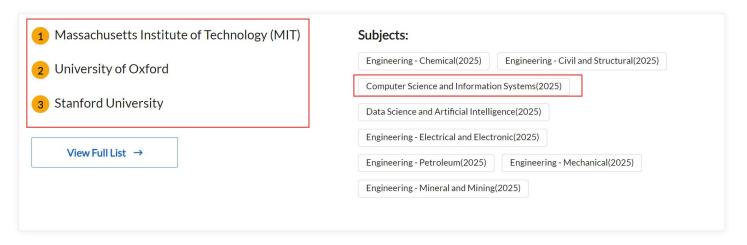
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计算机科学	1			斯坦	富大学12所独	立科研机构基本概况
기 무00년 수	1	中文名称	英文简称	成立时间	人员规模	主要研究領域
生命科学	1	爱德华兹实验室	1	1951年	47	量子电子学、半导体激光、皮(可)秒脉冲技术、光学显微镜 光纤、超电导材料及其微波应用软件等。
统计学	1	海森物理实验室	HEPL	1951年	28	天体物理学及相对论、 基于人造卫星的工程科学、 加速器物理 放电子激光等。
物理学	1	斯坦福国际问题研究中				国际问题及挑战。公共政策等交叉学科研究:亚太地区发展。
地球科学	2	心	SIIS	T.	295	卫生保健、国际安全、欧美研究、跨文化教育等。
化学	2	斯坦福语言和信息研究 中心	CSLI	1983年	93	信息、计算机和认知科学领域的交叉研究:计算机科学、语言辑学、哲学、心理学、教育学等。
数学	2	杰贝里高级材料研究实 验室	GLAM	1999年	36	高级材料研究:数据记录与存储材料、计算机材料、电子材料 材料、材料物理、合成物、光学物理等。
		斯坦福社会定量研究所	SIQSS	1998年	21	使用定量研究方法研究社会学领域问题: 信息技术对社会的影 育及其社会效应、对人口普查结果的分析。
		斯坦福人文研究中心	SHC	1980年	35	人文、历史、哲学、人类学等交叉研究中的热点问题。
		斯坦福 Bio - X研究中心	Bio - X	1998年	273	生物科学同物理学、化学、工程学、医学等学科的交叉研究:算机、结构生物学、生物物理、生物化学、生物医学工程、学、纳米等。
		全球气候与能源项目	GCEP	2003年	25	氢、可再生能原、清洁能源、减少二氧化碳排放的新技术、 系统、高级核能源、地理工程等。
		斯坦福经济政策研究所	SIEPR	1982年	54	世界经济政策问题及其影响:企业、政府、财政、货币、劳能源、环境、科技等问题。
		卡福里粒子天体物理学与宇宙论研究所	KIPAC	2003年	34	重力透镜化、银河星系群、盖然性数据分析方法、一般相对的 Brane 世界模式、黑洞物理学等。
		斯坦福教学改革研究中	SCII	2002年	56	促进教学和学习的基础和应用技术研究: 提升初学者学习能力、

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2002年

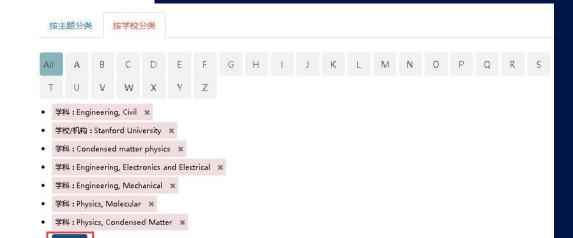
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### Starrordshire University (United Kingdom)

### Stanford University

- . Biology, Molecular
- · Biology, Neuroscience
- · Biology, Cell
- Anthropology, Cultural
- · History, Latin American
- Education, Teacher Training
- Mathematics
- Quantum physics
- Philosophy
- Education, Educational Psychology
- Psychology, Cognitive
- Education, Technology of
- Biology, Genetics
- Business Administration, Entrepreneurship
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- Geophysics
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- Early childhood education
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- Engineering, Civil
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- Biology, Ecology
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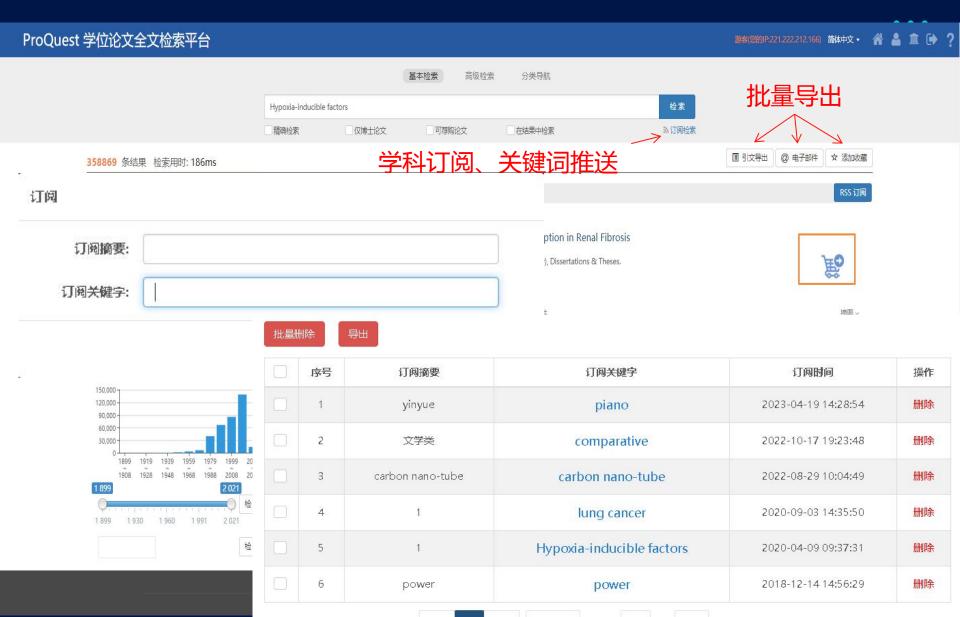
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7	基本检索	volcanic eruptions	2023-04-25 07:00:33	删除
8	基本检索	volcanic eruptions	2023-04-25 06:58:34	删除
9	基本检索	volcanic eruptions,仅目次摘要	2023-04-25 06:56:37	删除
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开题前,通过(PQDT学位论文)等数据库,针对性收集了全球(博硕士学位论文)等 类型文献,阅读了课题相关(前沿的、经典的、重要的、综述性)文献内容,通过文献 检索和分析,梳理研究脉络,从(分布式机器学习)等过往研究课题,到(联邦机器学 习-边缘计算)等最新课题,了解(生成式 ▲ 与多模态学习、量子机器学习、边缘计算 与物联网安全)等是国内本学科的热点研究方向,当前主要的研究机构有(麻省理工大 学、斯坦福大学、加州大学伯克利分校、卡内基梅隆大学(CMU))等,代表性的研究 学者有(杨强(香港科技大学)、Peter Kairouz(谷歌研究院)、Jure Leskovec (斯坦福大学)、Michael Jordan (加州大学伯克利分校))等,当前主要发文高校 有(麻省理工大学、斯坦福大学、加州大学伯克利分校)等。该课题的相关问题和应用 领域主要有(核心技术领域 —— 分布式机器学习、联邦学习、边缘计算

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- ── 前沿探索:量<del>了</del>计算、具身智能、环境科学、伦理学 )等。

# 毕业论文写作(开题)



- 选题来源:如果是纵向项目可以参考国家或者省属课题,比如大家熟知的973、863、自然基金等。
- 选题分类:基础性研究、应用性研究、综合性研究、其他(论文属于哪一类选择哪一个分类即可)
- 选题依据(开题的研究意义、国内外研究现状及发展趋势)
- 在国内外研究现状这里,如果提及该领域目前还存在的问题时, 注意需要客观描述事实,不能加以评论否定别人的研究。
- 研究方案(包括:研究内容、方法及技术路线,创新点,研究基础和条件,预期成果)
- 在继承前人的经验总结和现有研究成果的基础上,结合自己的方法,重点在实践方面提炼出自己的观念......

# 毕业论文写作(语言)



- 多用动词和名词,少用形容词。很多人论文中容易出现特别、非常、更加,这些形容词无法做到准确和客观,尽量少用。
- 借鉴权威期刊中相关的学科术语,在论文中合理运用,语言要准确和凝练。
- 在学习及写作时不断实现认知水平、思维方式的升维,从而在看待问题的方法、深度、精确度方面有本质提升,在人类广阔的知识世界某个边缘小点有突破性发现,提升论文整体的学术性。

# 毕业论文写作(创新性)



- 探索未知的新领域: 领域内未解决的空白问题、争议性议题或新兴 趋势, 避免重复已有研究。
- 论文选题的新高度:要追踪学术前沿,学术发展方向、处于关键地位、对理论和实践都能产生重大影响的问题。
- 观察问题的新视角:如跨文化比较、微观行为分析,重新定义传统问题,提出更精准的研究维度。
- 成果应用的新价值:理论延伸:是否在既有理论框架下增加新变量,理论整合:是否融合不同理论,形成更具解释力的分析框架。

# 毕业论文写作(综合)



- 理论性:引经据典、运用理论专业和最新学术成果
- 科学性:以事实为依据;遵循事物发展规律;措辞要严谨,语义 要确定,结构要完整,逻辑要严密。
- 实践性:实践价值与现实意义。
- 专业性
- 创新性
- 系统性:知识框架、理论框架、方法框架等。
- 可读性:条理清晰、文字流畅、语言简洁、逻辑严密、图表明晰、分析合理。

# 毕业论文写作(架构)

• • •

- 题名: 简短精炼 恰如其分
- 摘要:目的,意义,方法,结论,成果等
- 关键词:一般3-8个
- 绪论:课题背景、意义,国内外研究现状等
- 图表:数据真实可靠,内容展现清晰,排版美观大方
- 结论:准确、精炼,提出设想、尚待解决问题等
- 辅文:参考文献年限不应太久远,中外文都应引用
- 文献引注
- 单位制注明
- 致谢





### **Empirical Analyses in Finance and Macroeconomics**

A dissertation presented

by

Yueran Ma

to

The Department of Economics

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in the subject of

Business Economics

Harvard University

Cambridge, Massachusetts

April 2018

# 摘要与目录



Dissertation Advisors: Professor Andrei Shleifer Author:

Yueran Ma

Professor Edward Glaeser

**Empirical Analyses in Finance and Macroeconomics** 

### Abstract

This thesis has three essays which are empirical studies at the intersection of finance and macroeconomics. The topics include low interest rates and financial markets, debt contracts and corporate borrowing constraints, and expectations in finance and macro. The essays hope to provide empirical evidence, using diverse approaches, to better understand the connections as well as differences between classic theories and economic activities in practice.

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# 鸣谢与引言(绪论)



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It is a great fortune to have a career dedicated to understanding the world. This is made possible by the support and inspiration from numerous people, to whom I will always be grateful for. My indebtedness goes much beyond this short acknowledgement.

I am deeply indebted to my dissertation committee Andrei Shleifer, Ed Glaeser, Sam Hanson, and Alp Simsek for their invaluable guidance, tracing back to my sophomore year in college. Andrei's insights into economic activities are truly exceptional and inspiring. He asks the most fundamental questions and conveys the most powerful messages, which I shall continue to learn in the decades to come. Ed is an extraordinary force of nature that guided me through all my adventures, and pushed me to climb higher, sail farther, and dive deeper. Sam is one of a kind in his perceptive humor; his back-to-back line edits through my paper drafts are also unforgettable. Learning from Alp's classes since college has had a far-reaching impact on my research path, and he has been an incredible mentor along the way; his encouragement and support are precious.

My research would not be possible without the generous help and valuable feedback from John Beshears, John Campbell, Emmanuel Farhi, Fritz Foley, Robin Greenwood, Victoria Ivashina, Kristin Mugford, David Scharfstein, Jeremy Stein, and Adi Sunderam. Conversations with them taught me countless things. For the opportunity to start the academic journey at Harvard, I am also thankful to Shing-Tung Yau, who spotted me at his high school math competition in China nine years ago and invested in my ventures.

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### Introduction

This thesis has three essays which are empirical studies at the intersection of finance and macroeconomics. The topics include low interest rates and financial markets, debt contracts and corporate borrowing constraints, and expectations in finance and macro. The essays hope to provide empirical evidence, using diverse approaches, to better understand the connections as well as differences between classic theories and economic activities in practice.

The first essay is "Low Interest Rates and Risk Taking: Evidence from Individual Investment Decisions," joint with Chen Lian and Carmen Wang. In this research, we demonstrate that individuals "reach for yield," that is, have a greater appetite for risk taking when interest rates are low. Using randomized investment experiments holding fixed risk premia and risks, we show low interest rates lead to significantly higher allocations to risky assets, among MTurk subjects and HBS MBAs. This effect also displays non-linearity, and becomes increasingly pronounced as interest rates decrease below historical norms. The behavior is not easily explained by conventional portfolio choice theory or institutional frictions. We then propose and provide evidence for mechanisms related to investor psychology, including reference dependence and salience. We also present results using observational data on household investment decisions.

The second essay is "Anatomy of Corporate Borrowing Constraints," joint with Chen Lian. A common perspective in macro-finance analyses links firms' borrowing constraints to the liquidation value of physical assets firms pledge as collateral. We empirically investigate borrowing by non-financial firms in the US. We find that 20% of corporate debt by value is collateralized by specific physical assets ("asset-based lending" in creditor parlance),



### Table 1.1: Demographics of Benchmark Experiment Samples

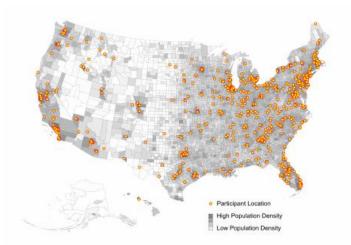
Panels A, B, C tabulate demographics for Experiments B1, B2, B3 respectively. In the Low condition, the risk-free rate is 1%; in the High condition, the risk-free rate is 5%. The mean excess returns of the risky asset is 5% in both conditions. The final three columns show repetitively: the difference in the percentage of participants in a certain category, the f-statistic associated with the difference, and the p-value from the Mann-Whitney-Wilcoxon test against the null that the distribution of characteristics across the two conditions are the same. For the MBA sample, we do not collect age because of homogeneity, and do not collect wealth as it might be sensitive information. Risk tolerance is measured through a question that asks participants to choose their favorite lottery from six options increasing in risks and expected payoffs. We group risk tolerance into low, medium, and high based on the lottery chosen.

Panel A. Experiment B1: MTurk, Hypothetical

		Low		High			Low - High	
		N	%	N	%	%	[t]	U test (p)
Gender	Male	82	40.0	102	52.3	-123	[-248]	0.01
	Female	123	60.0	93	47.7	12.3	[2.48]	
Education	Graduate school	38	18.5	30	15.4	3.2	[0.84]	0.99
	College	112	54.6	118	60.5	-5.9	[-1.19]	
	High school	53	25.9	45	23.1	2.7	[0.62]	
Age	Below 30	103	50.2	98	50.3	-0.0	[-0.00]	0.97
	30-40	63	30.7	56	28.7	2.0	[0.44]	
	40-50	16	7.8	25	12.8	-5.0	[-1.65]	
	Above 50	23	11.2	16	8.2	3.0	[1.02]	
Risk tolerance	High	32	15.6	35	18.0	-2.3	[-0.62]	
	Medium	67	32.7	64	32.8	-0.1	[-0.03]	0.54
	Low	106	51.7	96	49.2	2.5	[0.49]	
Financial wealth (ex. housing)	200K+	10	4.9	17	8.7	-3.8	[-1.52]	
	50K-200K	56	27.3	56	28.7	-1.4	[-0.31]	
	10K-50K	57	27.8	43	22.1	5.7	[1.33]	0.65
	0-10K	59	28.8	51	26.2	2.6	[0.59]	
	In debt	23	11.2	28	14.4	-3.1	[-0.94]	
Investing experience	Extensive	7	3.4	6	3.1	0.3	[0.19]	0.69
	Some	61	29.8	60	30.8	-1.0	[-0.22]	
	Limited	88	42.9	75	38.5	4.5	[0.91]	
	No	49	23.9	54	27.7	-3.8	[-0.86]	
Total		2	05	1	95			





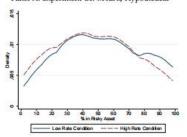


Note: This plot shows the geographic distribution of MTurk participants in the benchmark experiments (Experiments B1 and B2). The dots indicate participant locations. The background shade is colored based on log population density in each county.

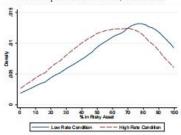
Figure 1.1: Geographic Distribution of MTurk Participants



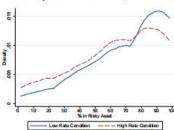
Panel A. Experiment B1: MTurk, Hypothetical



Panel B. Experiment B2: MTurk, Incentivized

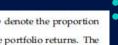


Panel C. Experiment B3: HBS MBA, Incentivized



Note: Density plots of allocations to the risky asset in the benchmark experiments. Panels A, B, and C present plots for Experiments B1, B2, and B3 respectively. The solid line is the distribution of allocations to the risky asset in the low interest rate condition, and the dashed line is that in the high interest rate condition.

Figure 1.2: Distribution of Allocations to the Risky Asset in Benchmark Experiments



 $r_f + x$ , where x is the excess returns with mean  $\mu = \mathbb{E}x > 0$ . Let  $\phi$  denote the proportion of wealth allocated to the risky asset, and  $1+r_p=1+r_f+\phi x$  the portfolio returns. The investor chooses optimal  $\phi^* \in [0,1]$  to maximize expected utility:

$$\phi^* = \arg \max_{\phi \in [0,1]} \mathbb{E}u \left(w \left(1 + r_p\right)\right) \tag{1.2}$$

We start with the case of mean-variance analysis, the widely used approximation to the general portfolio choice problem, and then discuss the general case.

Mean-Variance Analysis. Conventional portfolio choice analysis often uses the meanvariance approximation, in which case the investor trades off the average returns and variance of the portfolio, and obtains

$$\phi_{mv}^{\bullet} \triangleq \arg \max_{\phi \in [0,1]} \mathbb{E}r_p - \frac{\gamma}{2} Var(r_p) = \min \left(\frac{\mathbb{E}x}{\gamma Var(x)}, 1\right),$$
 (13)

where  $\gamma = \frac{-uu''(u)}{u'(w)}$  denotes the coefficient of relative risk aversion.

When we hold fixed the distribution of the excess returns x, the risk-return trade-off stays the same in mean-variance analysis, and investment decisions should not change with the level of the risk-free rate rf.9

General Case. The optimal mean-variance portfolio allocation  $\phi_{nm}^*$  in Equation (1.3) is a second-order approximation to the optimal allocation to the risky asset  $\phi^*$  defined in Equation (1.2). Now we analyze the general case which also takes into account the potential impact of higher order terms. We consider how the optimal allocation to the risky asset  $\phi^*$ changes with the risk-free rate  $r_f$  for a given distribution of the excess returns x.

Proposition 1. We assume the investor's utility function u is twice differentiable and strictly

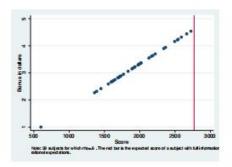
For our incentivized experiments, would wealth outside the experiment affect predictions of the conventional portfolio choice analysis? We make three observations. First, if the investor's outside wealth w, has a non-stochastic return  $r_o$ , we can just redefine the utility function  $\bar{u}$  (w (1 +  $r_o$ )) = u ( $w_o$  (1 +  $r_o$ ) + w (1 +  $r_o$ ) and the same analysis applies. Second, even if the return on outside wealth is stochastic, as long as it is independent of the returns in the experiment, we can show that the optimal allocation based on mean-variance analysis (a second-order approximation to the problem in (1.2)) still should not change with respect to the interest rate. Finally, as Barberis et al. (2006) point out, narrow framing (which refers to investors' tendency to consider investment problems in isolation, rather than mingling them with other risks) is key to explaining many phenomena, including the lack of risk neutrality to modest risks which holds in our experiments. To the extent that investors frame narrowly, the analysis here also applies directly.





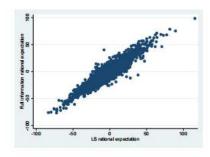
Note Screen shot of the prediction task. The green dots indicate past realizations of the statistical process. In each round  $I_t$  participants are asked to make predictions about two future realizations  $F_t x_{t+1}$  and  $F_t x_{t+2}$ . They can drag the mouse to indicate  $F_t x_{t+1}$  in the purple bar and indicate  $F_t x_{t+2}$  in the red bar. Their predictions are shown as yellow dots. The grey dot is the prediction of  $x_{t+1}$  from the previous round  $F_{t-1} x_{t+1}$ ; participants can see it but cannot change it. After they have made their predictions, participants click "Make Predictions" and move on to the next round. The total score is displayed on the top left corner, and the score associated with each of the past prediction (if the actual is realized) is displayed at the bottom.

Figure 3.1: Prediction Screen



Note: Each point on this figure corresponds to one participant in one condition of the baseline experiment (Experiment 1, with  $\rho = .6$ ). On the x-axis, we report the score obtained, and on the y-axis, the payment in \$5, which is equal to the score divided by 600. The vertical red line on the right represents the expected payment of a (full information) rational participant for which  $F_1x_{2+1} = E_1x_{2+1} = px_2$ .

Figure 3.2: Payment and scores in the Baseline Experiment



Note: Each point on this figure corresponds to one participant in one testing round. On the x-axis, we report the LS expectations of  $x_1$  using three lags  $x_{k-1}, x_{k-2}, x_{k-3}$  and coefficients estimated using OLS and all information available until date t-1. On the y-axis, we report the FI expectation given by  $\rho x_{k-1}$ . We only focus on participants for which  $\rho \geq 0$  and  $\rho < 1$ . Regressing y on x leads to an  $R^2 = .84$  and a slope coefficient of .86.

Figure 3.3: Full Information vs Least Square Expectations

### 3.5 Empirical Results

### 3.5.1 Measuring rational expectations

To estimate our econometric specification, we need to compute the rational expectation of the agent, which we generically denote  $E_{t-k}x_t$ . We use two different measures, which we describe here. The first measure assumes that the agent knows the data-generating process. This corresponds to the full information rational expectation used in most economic models. We thus define rational expectation about  $x_t$  conditional on information available at date t-k as:

$$E_{t-1}^{FI}x_t = \rho^k x_t$$

This definition of full information rational expectations will be our baseline, and for simplicity we will use it in most of our regressions.

The participant does not, however, know the data-generating process, so in practice the participant will try to infer it using the data. In robustness checks, we use a definition based

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# 结论与参考文献

### 3.6 Conclusion

In this paper, we run a large scale experiment to investigate how people form forecasts of a variable when faced with past realizations of that variable. At both the individual and the aggregate levels, find strong evidence of extrapolative bias and of forecast stickiness. We calibrate a simple model that nests rational expectations, in which both biases can coexist. Extrapolation turns out to be quantitatively the most important bias. Interestingly, we find our parameters to be relatively independent of the process statistical characteristics. Stickiness is stronger when agents are reminded in a more salient manner of their past forecasts. Apart from this, we find that context elements and framing of the experiment do not affect significantly our estimations. We also find that agents do not improve the quality of their forecasts over time.



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### Appendix A

# Appendix to Chapter 1



### A.1 Proofs

### A.1.1 Proof of Proposition 1

Consider first the problem without the constraint  $0 \le \phi \le 1$ . Let  $h(\phi) = \mathbb{E}u\left(w\left(1+r_p\right)\right)$ . We have  $\frac{\partial^2 h(\phi)}{\partial \phi^2} = \mathbb{E}\left[x^2u''\left(\bar{w}\right)\right] < 0$  because u is strictly concave. As a result,  $h(\phi)$  is strictly concave and twice differentiable. Define  $\phi_1^* = \arg\max_{\phi} \mathbb{E}u\left(w\left(1+r_p\right)\right) = \arg\max_{\phi} h\left(\phi\right)$ , i.e. the optimal allocation to the risky asset in the unconstrained problem. Because  $h\left(\phi\right)$  is strictly concave and twice differentiable,  $\phi_1^*$  is fully characterized by the first order condition:

$$\mathbb{E}\left[xu'\left(w\left(1+r_f\right)+\phi_1^*wx\right)\right]=0.$$

Therefore,

$$\frac{\partial \phi_1^*}{\partial r_f} = -\frac{\mathbb{E}\left[xu''\left(w\left(1+r_f\right)+\phi_1^*wx\right)\right]}{\mathbb{E}\left[x^2u''\left(w\left(1+r_f\right)+\phi_1^*wx\right)\right]} = -\frac{\mathbb{E}\left[xu''\left(\bar{w}\right)\right]}{\mathbb{E}\left[x^2u''\left(\bar{w}\right)\right]} = \frac{\mathbb{E}\left[xu''\left(\bar{w}\right)A\left(\bar{w}\right)\right]}{\mathbb{E}\left[x^2u''\left(\bar{w}\right)\right]},$$

where  $\bar{w} = (1 + r_f) w + \phi_1^* x w$  is the investor's final wealth, and  $A(\bar{w}) = \frac{-u''(\bar{w})}{u'(\bar{w})}$  denotes the coefficient of absolute risk aversion.

Since u is strictly concave,  $\frac{\mathbb{E}[xu'(\bar{w})A(\bar{w})]}{\mathbb{E}[x^2u''(\bar{w})]}$  has the same sign as  $-\mathbb{E}[xu'(\bar{w})A(\bar{w})]$ . Note

# Q&A

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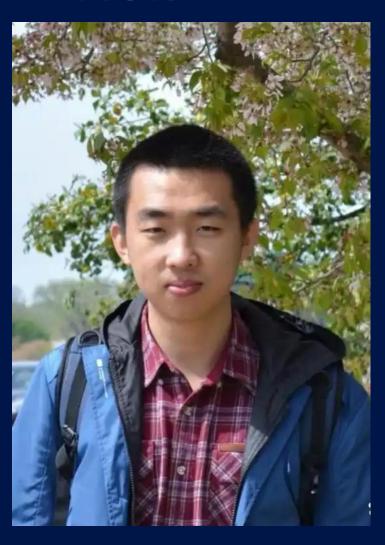
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- 3. PQDT 学位论文数据库可以通过\_\_\_\_\_对检索结果进行筛选(多选)
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- **❷** D. 论文语言

# 互动操作



### 2025年斯隆研究奖计算机方向得主

2009 年,他以 NOI 国家集训队选手的身份被保送至清华大学,进入由图灵奖得主姚期智教授亲自主持的"姚班"继续深造

他曾作为本科生<mark>交换生赴麻省理工学院</mark>(MIT)学习,并先后两次进入微软亚洲研究院(MSRA)不同的研究组实习,与世界顶级计算机科学家共事。

本科毕业后,他前往斯坦福大学攻读博士学位,在计算机系统和机器学习交叉领域 开展了一系列具有深远影响的研究工作。

2020年毕业Stanford University 博士毕业后,他选择加入卡内基梅隆大学

(Carnegie Mellon University)担任助理教授,主要研究计算机系统与编译器如何高效支持机器学习,尤其是大语言模型和生成式人工智能的优化。他的研究极大地推动了这一领域的进步,使 AI 计算更加高效和可扩展。

# Thank You

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