

翻译对比

原文与翻译对比

原文 (Original)	翻译 (Translation)
COMPSCI4004/COMPSCI5087AI(H/M) COMPSCI4004/COMPSCI5087 AI (H/M) Week 2: Introduction and Foundations Debasis Ganguly 1 1UniversityofGlasgow,Glasgow,UK September 30, 2024 D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)	COMPSCI4004/COMPSCI5087AI(H/M) COMPSCI4004/COMPSCI5087 人工智能 (H/M) 第2周：介绍与基础 Debasis Ganguly 1 1格拉斯哥大学，英国格拉斯哥 2024年9月30日 D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)
COMPSCI4004/COMPSCI5087AI(H/M) Overview Course Introduction What is AI? Why is AI difficult? Agents-Centric view of AI Rationality of Agents Environment Types Agent types D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)	COMPSCI4004/COMPSCI5087AI(H/M) 概述 课程介绍 什么是人工智能 为什么人工智能很难 以代理为中心的人工智能视角 代理的合理性 环境类型 代理类型 D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)
COMPSCI4004/COMPSCI5087AI(H/M) CourseIntroduction Lecturers and Time table ► Lecturers: ► Dr. Debasis Ganguly, Debasis.Ganguly@glasgow.ac.uk (course coordinator). ► Dr. Edmond S. L. Ho, Shu-Lim.Ho@glasgow.ac.uk ► GTAs (for lab support): ► Jie Wang ► Yuxuan Xie ► Lectures: Mondays: 15:00-17:00 at Boyd Orr - Room 412 (LC01) ► Lab sessions: Mondays: 09:00-11:00 (you will be allocated specific 1 hour timeslot) at BOYD ORR 720 ► Open Hours: ► Edmond Ho - Friday 12 noon - 1 PM, SAWB 402, Sir Alwyn Williams Building. ► Debasis Ganguly - Friday 2 PM - 4 PM, M111 Sir Alwyn Williams Building. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)	COMPSCI4004/COMPSCI5087AI(H/M) 课程介绍 讲师和时间表 ► 讲师: ► Debasis Ganguly博士, Debasis.Gangul y@glasgow.ac.uk (课程协调人) ► Edmond S. L. Ho博士, Shu-Lim.Ho@glasgow.ac.uk ► 实验室助教 (提供实验室支持): ► Jie Wang ► Yuxuan Xie ► 讲座: 星期一: 15:00-17:00 在 Boyd Orr - 房间412 (LC01) ► 实验课: 星期一: 09:00-11:00 (您 将被分配特定的一小时时间段) 在BOY D ORR 720 ► 办公时间: ► Edmond Ho - 星期五中午12点至下午1点, SAWB 402, Sir Alwyn Williams Building

<p>COMPSCI4004/COMPSCI5087AI(H/M) CourseIntroduction Course Information ► AI (H and M): Overview of intelligent agent design. ► Fundamental concepts of AI. ► We' ll explain various stages and complexities of an agent-driven model that interacts with an environment and makes sequence of rational decisions. ► Non-examinable materials: ► Recent advancements in AI. ► Responsible AI (explainability, trustworthiness and fairness). ► Labs: ► Labs in Week will be based on the lecture notes covered in Week -1. ► Labs aren' t graded but you should complete the exercises. We will release the solutions the next day. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>► Debasis Ganguly - 星期五 下午2点至4点，M111 Sir Alwyn Williams Building。D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) CourseIntroduction Intended outcomes 1. Demonstrate familiarity with the history of AI, philosophical debates, and understand the potential and limitations of the subject in its current form. 2. Explain the basic components of an intelligent agent, and be able to map these onto other specific subjects such as information retrieval, computer vision, human-computer interaction etc. 3. Discuss basic issues in planning and rational decision making. 4. Explain and apply search-based problem-solving techniques. 5. Formulate and apply Bayesian networks in modelling and planning. 6. Explain and apply utility theory as probabilistic framework for rational decision making. 7. Explain and apply reinforcement learning techniques to learn from rewards and observations. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 课程介绍 课程信息 ► AI (H 和 M): 智能代理设计概览。 ► 人工智能的基本概念。 ► 我们将解释与环 境交互并做出一系列理性决策的代理驱动 模型的各种阶段和复杂性。 ► 非考试内容： ► 人工智能的最新进展。 ► 负责任的人工智能（可解释性、可信度 和公平性）。 ► 实验室： ► 每周的实验 室将基于前一周讲义中涵盖的内容。 ► 实 验室不计分，但你应该完成练习。我们将 在第二天发布答案。D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Course Introduction Road Map of Weekly Teachings</p> <p>2. Introduction and Foundations</p> <p>3. Deterministic problems - search and optimisation</p> <p>4. Stochastic Problems, Probability and Knowledge Representation</p> <p>5. Decision-making under uncertainty</p> <p>6. Sequential decision-making under uncertainty - MDPs</p> <p>7. Learning from rewards and observations - basic Reinforcement Learning</p> <p>8. Learning from rewards and observations - Reinforcement Learning with linear and non-linear function approximation</p> <p>9. Learning from rewards and observations - improved DQN and policy search (with function approximation)</p> <p>10. Explainable AI/ Artificial General Intelligence (AGI)</p> <p>11. Practical Problem Solving and Revision</p> <p>D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>课程介绍 预期成果</p> <p>1. 展示对人工智能历史、哲学辩论的熟悉程度，并理解该学科当前形式下的潜力和局限性。</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>What is AI? Four Different Viewpoints</p> <p>Thinking Humanly Thinking Rationally</p> <p>Acting Humanly Acting Rationally ►</p> <p>The most popular view-point: Acting Humanly - the Turing Test approach. ►</p> <p>Natural Language Processing: Communication. ►</p> <p>Knowledge Representation: Relations between entities. ►</p> <p>Automated Reasoning: Use the stored information to answer questions and draw new conclusions. ►</p> <p>Machine learning: Adapt to new circumstances and extrapolate patterns. ►</p> <p>Computer vision: Perceive objects and scenes ►</p> <p>Robotics: Manipulate objects. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>解释智能代理的基本组成部分，并能够将这部分映射到其他特定主题，如信息检索、计算机视觉、人机交互等。</p> <p>3. 讨论规划和理性决策中的基本问题。</p> <p>4. 解释并应用基于搜索的问题解决技术。</p> <p>5. 公式化并应用贝叶斯网络进行建模和规划。</p> <p>6. 解释并应用效用理论作为理性决策的概率框架。</p> <p>7. 解释并应用强化学习技术从奖励和观察中学习。</p> <p>D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>What is AI? Mentimeter Go to mentimeter.com; use code '47600586'. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>课程介绍 每周教学路线图</p> <p>2. 引言与基础</p> <p>3. 确定性问题 - 搜索与优化</p> <p>4. 随机问题、概率与知识表示</p> <p>5. 不确定条件下的决策制定</p> <p>6. 不确定条件下顺序决策 - MDPs</p> <p>7.</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M) WhatisAI? Example AI Systems ► IBM' s Deep Blue defeats Garry Kasparov, the world champion in chess in 1997. ► Modern chess engines like Alpha-Zero, StockFish etc. are much better than human players: ≈ 3500 ELO as compared to ≈ 2830 of Magnus Carlsen! D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>从奖励和观察中学习 - 基础强化学习 8. 从奖励和观察中学习 - 使用线性和非线性函数逼近的强化学习 9. 从奖励和观察中学习 - 改进的DQN和策略搜索（使用函数逼近） 10. 可解释的人工智能/通用人工智能 (AGI) 11. 实际问题解决与复习 D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) WhatisAI? Example AI Systems ► IBM' s Watson system competed on Jeopardy! winning the first-place prize of 1 million USD. ► Leverages NLP/Information Retrieval and Knowledge-bases for effective Question Answering. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 什么是人工智能。四种不同的观点 以人类的方式思考 以理性的方式思考 以人类的方式行动 以理性的方式行动 ► 最流行的观点：以人类的方式行动 - 图灵测试方法。 ► 自然语言处理：交流。 ► 知识表示：实体之间的关系。 ► 自动推理：利用存储的信息来回答问题并得出新的结论。 ► 机器学习：适应新环境并推断模式。 ► 计算机视觉：感知物体和场景。 ► 机器人技术：操控物体。</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) WhatisAI? Example AI Systems ► Open AI' s Chat-GPT is large language model (LLM) that is able to converse with humans or other LLMs. ► Leverages: ► Pre-training on large volumes of text data ► Represents context of words (tokens) as high dimensional vectors. ► A step towards Artificial General Intelligence. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Why is AI difficult? Why is AI difficult ► AI has been successfully applied for specific tasks, achieving super or comparable human performance. ► Examples: Game playing (Chess/ Atari games), question answering (Chat-GPT), self-driving cars etc. ► But are the machines really “intelligent” ? ► What is the definition of “intelligence” ? “A very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings...” ► We have progressed well on the aspects colored as blue. ► What about other more general tasks, such as the ones shown in red? D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>什么是人工智能。Mentimeter 请访问 mentimeter.com; 使用代码 ‘4760 0586’ 。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Why is AI difficult? Bongard Problems ► Invented by the Russian computer scientist Mikhail Moiseevich Bongard. ► Popularized by Douglas Hofstadter in his Pulitzer prizewinner - Godel, Escher and Bach. Task ► Explain (in language), why the images on the left differ from those on the right. ► Test the abstract thinking capacity. Large figures vs. Small figures Small figure represents vs. No small figure represents D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>什么是人工智能。示例人工智能系统 ► IBM 的深蓝在 1997 年击败了世界象棋冠军加里·卡斯帕罗夫。► 现代象棋引擎如 Alpha-Zero、StockFish 等比人类玩家表现更好：约为 3500 ELO，而马格努斯·卡尔森约为 2830 ELO。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Why is AI difficult? Characteristics of (Human) Intelligence ► Different levels of abstraction. ► What combinations of attributes to use to define an object. ► Some are more fine-grained (e.g., number of corners, lines etc.) than others (e.g., convexity). ► Moving back and forth between these representations to define how are objects similar and how are they dissimilar, specific to task. ► Left: BP denotes an abstract property for the understanding of numbers 3 and 4. More fine-grained concepts of corners, lines, wedges don't work. Right: An abstract concept of density is required. D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>什么是人工智能。示例人工智能系统 ► IBM的沃森系统参加了《危险边缘》比赛，并赢得了100万美元的一等奖。► 利用自然语言处理/信息检索和知识库进行有效的问答。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Why is AI difficult? What is possible today (2024)? ► Drives safely along a curving mountain road? ► Drives safely along University Avenue in the first week of the semester? ► Buys a week's worth of groceries online? ► Plays a decent game of Bridge/Go/Chess? ► Discover and prove a new mathematical theorem? ► Design and execute a research program in molecular biology? ► Write an intentionally funny story? ► Give competent legal advice in a specialized area of law? ► Converses successfully with another person for an hour? ► Perform a complex surgical operation? ► Unload any dishwasher and put everything away? ► Play a decent game of table tennis? ► Explain your feeling and emotion to others? ► Learn, adapt and develop over several decades? ► Learn a new motor skill from a few examples? D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>什么是人工智能。示例人工智能系统 ► Open AI的Chat-GPT是一个大型语言模型 (LLM)，能够与人类或其他LLM进行对话。</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M) Why is AI difficult? Types of Learning in AI</p> <p>► Unsupervised learning (learning without teacher) ► Example: Discover patterns within the data. ► Figure out which data is similar to what and different from others. ► Supervised Learning. ► Multi-class classification: Is this movie review positive, neutral, or negative? ► Multi-label classification: More than one class can be present in an instance, e.g., objects within an image. ► Update model parameter based on the examples. ► This course will cover the very basics. Covered at more depth in the ML course. ► Reinforcement Learning ► Learning to be adaptive within an environment. ► Example: You want to find out your way out of maze. D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>► 利用：► 在大量文本数据上的预训练</p> <p>► 将词（标记）的上下文表示为高维向量。</p> <p>► 朝向通用人工智能迈出的一步。 D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) Agents-Centric view of AI Key question: How should we study, design and build intelligent agents that behave rationally? ► What is an agent? ► An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators (includes humans, robots, chatbots, thermostats). D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 为什么AI很难。为什么AI很难 ► AI已经在特定任务上成功应用，达到了超越或与人相当的表现。 ► 例子：游戏（国际象棋/雅达利游戏）、问答（Chat-GPT）、自动驾驶汽车等。 ►</p> <p>但是机器真的“智能”吗？ ►</p> <p>“智能”的定义是什么？ “一种非常普遍的心理能力，它包括但不限于推理、计划、解决问题、抽象思考、理解复杂概念、快速学习以及从经验中学习的能力。它不仅仅是书本知识、狭隘的学术技能或应试技巧。相反，它反映了更广泛和深入的理解周围环境的能力。” ►</p> <p>我们在蓝色标注的方面取得了很好的进展</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M) Agents-CentricviewofAI Agent function The agent function (as implemented by the agent program) maps from prior/build-in knowledge, π, and percepts, P, to actions A, i.e., $: P, \pi$ \rightarrow ► Percepts, P: Perceptual inputs, percepts, and sequence/history as reported by the sensors. ► Actuators and actions, A: What ever means the agent has to influence the environment via its actuators (visual, physical, audio, computer commands, etc.) D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>► 那么对于其他更一般的任务，比如用红 色标出的任务。D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) Agents-CentricviewofAI Agent function (Contd.) ► Prior knowledge, π: Any hard coded constraints or knowledge about the environment (e.g. if temperature < -40 degrees is not good). ► Function, f: ► An abstract, external characterization of the agent by mathematical function which can be represented by mathematical object such as look-up table, continuous or discrete function. ► Implemented as agent program and runs on physical device. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 为什么AI很难。邦加德问题 ► 由俄罗斯计 算机科学家米哈伊尔· 莫伊谢耶维奇· 邦 加德发明。 ► 由道格拉斯· 霍夫施塔特在 他的普利策获奖作品《哥德尔、埃舍尔 、巴赫》中推广。任务 ► 用语言解释为什 么左边的图像与右边的不同。 ► 测试抽象思维能力。大图形对比小图形 小图形存在对比没有小图形 D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agents-CentricviewofAI PEAS model</p> <p>► It is useful to ‘think’ about any AI task as PEAS model. ► Performance measure: - Defines what “good behaviour” is in specific context. ► Environment: specification of the physical (or virtual) environment the agent is expected to operate in. ► Actuators: The types and physical properties of the actuators available to the agent. Limits what the agent can do. ► Sensors: The types and physical properties of the sensors available to the agent. Limits what the agent can know about the environment. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>为什么AI很难。(人类)智能的特点 ► 不同层次的抽象。 ► 使用哪些属性组合来定义一个对象。 ► 有些属性更加细致（例如，角的数量、线条等），而另一些则较为宽泛（例如，凸性）。 ► 在这些表示之间来回切换，以根据特定任务定义对象之间的相似性和差异性。</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agents-CentricviewofAI PEAS view of existing AI models ► Performance measure: Maze finding Minimize #steps taken, or time spent in the maze. ► Environment: Size of the maze, start, goal, paths and obstacles. ► Actuators: Movement through grid - virtually or physically. ► Sensors: Reacting to obstacle - virtually or physically. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>► 左：BP 表示理解数字3和4的抽象属性。更细化的概念如角、线、楔形不起作用。右：需要一个密度的抽象概念。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agents-CentricviewofAI PEAS view of existing AI models ► Performance measure: Maximize - correctness, relevance, or Minimize - Chat-GPT reading effort, misinformation of the answer. ► Environment: The virtual space of all possible answers (quantized in terms of tokens). ► Actuators: Generating token conditioned on the input and what' s generated before. ► Sensors: The API interface that gets user' s text.</p> <p>D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>为什么AI很难。今天（2024年）可能实现什么。 ► 沿着蜿蜒的山路安全驾驶。 ► 在学期的第一周沿着大学大道安全驾驶。 ► 在网上购买一周所需的杂货。 ► 下一盘不错的桥牌/围棋/国际象棋。 ► 发现并证明一个新的数学定理。 ► 设计并执行一项分子生物学研究计划。 ► 写一篇有意图的搞笑故事。 ► 在法律的专门领域提供称职的法律建议。 ► 与另一个人成功交谈一个小时。 ► 执行复杂的外科手术。 ► 卸载洗碗机并将所有东西归位。 ► 打一场不错的乒乓球。 ► 向他人解释你的感受和情绪。 ► 在几十年间学习、适应和发展。 ► 从几个例子中学习新的运动技能。 D</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agents-CentricviewofAI PEAS view of existing AI models ► Performance measure: Maximize - safety, or Minimize - time to reach destination (performance Self-Driving Cars measures can be conflicting with each other!). ► Environment: The surface on which the car is driven, the obstacles, road corners etc. ► Actuators: Brake, accelerator, gear. ► Sensors: Sequences of images captured, or other physical sensors like wetness of the road etc. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>RationalityofAgents An agent should behave rationally ► What is rational behaviour? What does it mean to do thing ‘the right way’ ? ► Objective answer: Consider the consequences (the ‘P’ of the PEAS model) of an agent’ s behaviour. ► For each possible percept (sequence), P, rational agent selects an action (sequence) which is expected to maximize its performance measure given the evidence provided by the percept (sequence) so far and whatever prior/built-in knowledge the agent has. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>为什么AI很难。AI中的学习类型 ► 无监督学习（没有教师的学习） ► 例如：在数据中发现模式。 ► 确定哪些数据与哪些相似，哪些不同。 ► 监督学习。 ► 多类分类：这条电影评论是正面的、中立的还是负面的。 ► 多标签分类：一个实例中可以存在多个类别，例如，图像中的对象。 ► 根据示例更新模型参数。 ► 本课程将涵盖非常基础的内容。在机器学习课程中会更深入地讲解。 ► 强化学习 ► 学习如何适应环境。 ► 例如：你想找到走出迷宫的方法。D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>RationalityofAgents Rationality in the vacuum world EAS of the vacuum world AI task ► E: two rooms (no prior knowledge about the prior likelihood of the dirt distribution). ► A: Left, Right, Suck ► S: Correctly identify if room is clean. Which ‘P’ leads to rationality? 1. +1 for sucking up portion of dirt. 2. +1 for each clear square observed. 3. +1 for each clear square; -0.1 for taking an action due to battery usage. D.Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>以代理为中心的AI视角 关键问题：我们应该如何研究、设计和构建行为理性的智能代理？ ► 什么是代理</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Rationality of Agents Rationality in the vacuum world Rule of Thumb Choose performance measure (P) on the basis of: ► Objective view-point: What is required in the environment. ► Subjective view-point: NOT on how an agent should behave. ► Which agents are rational? 1. Cleans square if dirty, otherwise moves to the other square over period of 1000 time steps (say checks every 10 min). 2. Cleans floors moving back and forth continuously for an hour and then goes to sleep for the day waking up after 23 hours. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>► 代理是指任何可以通过传感器感知其环境并通过执行器对该环境采取行动的事物（包括人类、机器人、聊天机器人、恒温器）。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Rationality of Agents What IS Rationality and what it IS NOT? Rationality IS NOT omniscient ► An agent can't know the precise outcome of the action in the environment. ► It can only estimate the outcome based on previous percepts. Rationality DOES NOT imply success ► Being rational does not imply success in solving the task. ► Example: Think about uncertain environments. Rationality CAN LEAD to exploration, learning and autonomy ► Example: An irrational maze-finder can just continue to move back and forth; but then it doesn't learn the possible ways out of the maze. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>以代理为中心的人工智能视角 代理功能 代理功能（由代理程序实现）将先前/内置的知识π和感知P映射到动作A，即：$P, \pi \rightarrow A$ ► 感知，P：由传感器报告的感知输入、感知以及序列/历史。 ► 执行器与动作，A：代理通过其执行器影响环境的任何方式（视觉、物理、音频、计算机命令等）。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Environment Types Fully observable vs. partially observable ► Fully observable: Access to all relevant information via the sensors. ► Partially observable: If an agent acts based on noisy or broken sensors - or sensors simply do not capture the relevant information. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>以代理为中心的人工智能视角 代理功能（续） ► 先前知识，π：关于环境的任何硬编码约束或知识（例如，如果温度< -40度是不好的）</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>EnvironmentTypes Deterministic vs. Stochastic ▶ Deterministic: The next state of the environment is fully captured by current state and the action to be carried out. ▶ Stochastic: Can not determine the next state based on current state and action due to randomness (or unknowns) in the environment. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>▶ 函数, f: ▶ 通过数学函数对代理进行抽象的外部描述，该函数可以由查找表、连续或离散函数等数学对象表示。▶ 实现为代理程序并在物理设备上运行。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>EnvironmentTypes Static vs. Dynamic ▶ Static: The environment never changes. ▶ Dynamic: The environment changes while we decide what to do, time matters! ▶ Example: Ice melts (at certain rate) on the frozen lake environment. ▶ Example: Dirt accumulates with certain probability in the vacuum world environment. ▶ Semi-Static: The world is the same, but the performance score changes. ▶ Example: Performance measure changed to maximizing battery life as opposed to just the room cleanliness in the vacuum world. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>以代理为中心的人工智能视角 PEAS模型</p> <p>▶ 将任何人工智能任务视为PEAS模型是有用的。▶ 性能度量：- 在特定上下文中定义什么是“良好行为”。▶ 环境：指定代理预期操作的物理（或虚拟）环境。▶ 执行器：代理可用执行器的类型及其物理特性。限制了代理能够做什么。▶ 传感器：代理可用传感器的类型及其物理特性。限制了代理能够了解环境的程度。D</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>EnvironmentTypes More environment types Discrete vs. Continuous ►</p> <p>Discrete: State of the environment are determined among set of discrete possibilities (e.g. chess), discrete actions (e.g. move left or right), discrete percepts (e.g. dirty, not dirty)</p> <p>► Continuous: The world has infinitely many states (e.g. temperature), actions are continuous, percepts are continuous (human vision). Episodic vs. Sequential ► Episodic: Single actions based on current percept only, e.g., vacuum world. ► Sequential: Current action influences all future decisions, e.g., chess, maze finder. Single agent vs. multi-aDg.eGanngtulyenvirCoOMn PmSCel4n00t4s/COMPSCI5087AI(H/M)</p> <p>Multiple agents can cooperate or compete to fulfill individual or group goals.</p>	<p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agenttypes Tabular (Rule-based) Agents ► pre-configured look-up table of state transitions. ► Keeps the entire percept sequence in memory. ► Feasible to define for small-scaled task such as vacuuming two rooms. [A, clean] (cid:55)→ Right ...</p> <p>D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>[A, clean], [A, clean], [A, Dirty] (cid:55)→ Suck ► Not feasible where the state space is large. ► Can you define set of specific rules for an AI agent to play chess?</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>以代理为中心的人工智能视角</p> <p>PEAS视角下的现有AI模型 ►</p> <p>性能指标：迷宫寻路 最小化在迷宫中行走的步数或花费的时间。 ► 环境：迷宫的大小、起点、终点、路径和障碍物。 ► 执行器：通过网格移动——虚拟或物理方式。 ► 传感器：对障碍物作出反应——虚拟或物理方式。 D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agenttypes Reflex-based Agents ►</p> <p>TheactionisNOTafunctionof historicalperceptsbutdepends ONLYonthe currentpercept (state). ►</p> <p>Whathappensifweonlyhavea ‘dirt’ sensor,andno ‘location’ sensor? ► Whatdowedoifthe stateisclean? Ifwedon’ t movewegetstuck. ► Ifwemovethenhowcan wefigureoutthe direction? Movingleft from ‘A’ willcausean infiniteloop! ► Ifstatus== ‘Dirty’ then ‘Suck’ ► Doesrandomizingactions ► Iflocation== ‘A’ thenreturn ‘Right’ solvethis? ► Iflocation== ‘B’ thenreturn ‘Left’</p> <p>D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>以代理为中心的人工智能视角</p> <p>PEAS视角下的现有AI模型 ► 性能指标：最大化——正确性、相关性，或最小化——Chat-GPT阅读努力、答案中的错误信息。 ► 环境：所有可能答案的虚拟空间（以标记为单位量化）。 ► 执行器：根据输入及之前生成的内容生成标记。 ► 传感器：获取用户文本的API接口。D</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agenttypes Model-based Agents ►</p> <p>Reflex-based agent: Doesn’ t keep track of how the environment changes with an action; ► e.g., Sucking dirt may introduce new state where room is neither completely clean, nor completely dirty. ► model-based agent learns mapping between the actions and consequences. ► Can reflex-based agent for 2 room environment also work on 4 room one? What about model-based agent? D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M) Agenttypes Goal-based Agents ► For some problems the goal state(s) is (are) known. ► There are 2 goal states for the vacuum world - two clean rooms with the agent in any one of them. ► A rational agent should then perform actions that result in states that are ‘closer’ to the goal state. ► We need then an evaluation function over states to measure this closeness. ► For the vacuum world, how do we compute how far are we from the goal? D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 以代理为中心的AI视角 PEAS视角下的现有AI模型 ► 性能指标： 最大化安全性，或最小化到达目的地的时 间（性能指标之间可能存在冲突）。► 环 境：汽车行驶的表面、障碍物、道路弯道 等。► 执行器：刹车、油门、档位。► 传感器：捕获的图像序列，或其他物理传 感器如路面湿度等。D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>► Move towards the goal that’s ‘closer’ from the current state. ► Reach trade-off (Utility-based agents). ► Try to maximize the performance as much as possible. COMPSCI4004/COMPSCI5087AI(H/M) Agenttypes Limitations of Goal-based Agents ► What should an agent do when there are: ► Multiple goals? ► Conflicting goals? ► Ill-specified goals (e.g., ‘user satisfaction’ for conversational agent)? D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 代理的理性行为 代理应表现出理性行为 ► 什么是理性行为。做事情 “正确的方式” 意味着什么。► 客观答案：考虑代理行为 的结果（PEAS模型中的 ‘P’ ）。</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) Agenttypes Limitations of Goal-based Agents ► Move towards the goal ► What should an agent do that’s ‘closer’ from the when there are: current state. ► Multiple goals? ► Reach trade-off ► Conflicting goals? ► (Utility-based agents). Ill-specified goals (e.g., ► ‘user satisfaction’ for Try to maximize the conversational agent)? performance as much as possible. D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>► 对于每个可能的感知（序列），P，理 性代理会选择 一个动作（序列），该动作 预期能够根据迄今为止由感知（序列）提 供的证据以及代理拥有的任何先验/内置知 识来最大化其性能度量。D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M) Agenttypes Utility-based Agents ▶ A little bit of dirt in the other room with enough battery remaining to be recharged is a better goal than with a fully dead battery and two clean rooms. ▶ Need a trade-off: which is what we do by defining a utility function. ▶ A rational agent should then perform actions that result in states that maximize utility. ▶ For the vacuum world, what is a good utility function? ▶ $u(\text{state}) = 0.9 \times \text{cleanliness} + 0.1 \times \text{charge}$? D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 代理的合理性 真空世界中的合理性 真空世界的EAS AI任务 ▶ E: 两个房间（关于 灰尘分布的先验可能性没有先验知识） 。 ▶ A: 左移、右移、吸尘 ▶ S: 正确识别房间是否干净。 哪个‘P’导致了合理性。 1. 吸入部分灰尘得+1分。 2. 观察到每块干净区域得+1分。 3. 每块干净 区域得+1分；因使用电池而采取行动扣-0. 1分。 D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) Agenttypes Generalized Learning Agent (Motivation) ▶ Can the most capable agents that we have looked thus far, viz. goal-based and utility-based agents that has been designed to perform well in the first environment also do well in the second? ▶ Why or why not (consider the following)? ▶ Environments are stochastic. ▶ State distribution is different. ▶ What needs to be changed? D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M) 代理的合理性 真空世界中的合理性 经验法则 根据以下原则选择性能度量（P）： ▶ 客观视角：环境中需要什么</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M) Agenttypes Generalized Learning Agent (Design) ▶ Performance Element: Selects actions - similar to static agent as we have seen so far. ▶ Learning Element: Finds improvements. ▶ Critic Element: Feedback from the environment which affects ‘Learning Element’ . ▶ Problem Generator: Choose sub-optimal paths to explore more about the environment to discover better actions in the long run. D. Ganguly COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>▶ 主观视角：不是关于代理应该如何行为。 ▶ 哪些代理是理性的。 1. 如果脏了就清 理，否则在1000个时间步长内（比如说每 10分钟检查一次）移动到另一个方格。 2. 连续来回移动清洁地板一个小时后，然后 休息一天，在23小时后醒来。</p>

<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agenttypes Generalized Learning Agent (back to the example) ►</p> <p>Performance Element: Utility function that minimizes the risk of falling down into hole and maximizes the chance of getting the reward. ►</p> <p>Learning Element: Discover that two adjacent holes are more risky than single one (this was not hard-coded into the utility function). ►</p> <p>Critic Element: Gives high negative reward when an agent actually falls into hole. ►</p> <p>Problem Generator: The agent needs to fall into holes (some risk taking ability) to improve its learning of maneuvering techniques around holes. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agenttypes Summary Now you know about: ► PEAS - Performance, Environment, Actuators, Sensors. ►</p> <p>Agent types - Journey from Reflex-based agents to Utility-based agents. ►</p> <p>Learning Agents - the most capable one. To Do: ► Go through the lecture notes and try out the exercises from Chapter 2 of the AIMA book. ►</p> <p>Attend Week 3' s lab and carry out the exercises. D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理的理性</p> <p>什么是理性以及什么不是理性。</p> <p>理性并不意味着全知全能 ► 代理无法知道其行动在环境中的确切结果。 ►</p> <p>它只能根据之前的感知来估计结果。</p> <p>理性并不意味着成功 ► 理性并不意味着在解决任务时一定会成功。 ►</p> <p>例如：考虑不确定的环境。</p> <p>理性可以导致探索、学习和自主 ► 例如：一个非理性的迷宫寻找者可能会一直来回移动；但这样它就不会学到走出迷宫的可能路径。</p>
<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>Agenttypes Anonymous Feedback for Continuous Monitoring D.Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>	<p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>环境类型 完全可观测 vs. 部分可观测 ►</p> <p>完全可观测：通过传感器可以访问所有相关信息。 ►</p> <p>部分可观测：如果代理基于有噪声或损坏的传感器行动——或者传感器根本无法捕捉到相关信息。 D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>环境类型 确定性 vs. 随机性 ▶ 确定性：环境的下一个状态完全由当前状态和即将执行的动作决定。▶ 随机性：由于环境中的随机因素（或未知因素），不能根据当前状态和动作确定下一个状态。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>环境类型 静态 vs. 动态 ▶</p> <p>静态：环境永远不会改变。▶ 动态：在我们决定如何行动时，环境会发生变化，时间是一个重要因素。</p>
	<p>▶ 示例：冰在结冰的湖面上以一定的速度融化。▶ 示例：灰尘以一定的概率在真空世界环境中积累。▶ 半静态：世界保持不变，但性能得分发生变化。▶ 示例：性能指标从仅关注房间清洁度转变为最大化电池寿命。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>环境类型 更多环境类型 离散与连续 ▶ 离散：环境状态是从一组离散的可能性中确定的（例如国际象棋），动作是离散的（例如向左或向右移动），感知也是离散的（例如脏、不脏）。▶ 连续：世界有无限多个状态（例如温度），动作是连续的，感知也是连续的（如人类视觉）。</p> <p>片段式与序列式 ▶ 片段式：仅基于当前感知采取单一行动，例如真空世界。▶ 序列式：当前行动影响所有未来的决策，例如..</p> <p>.</p>

	<p>, 国际象棋, 迷宫寻路。单智能体与多智能体。在COMPSCI4004/COMPSCI5087人工智能（荣誉/硕士）课程中，多个智能体可以合作或竞争以实现个人或团队目标。COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>智能体类型 表格型（基于规则的）智能体</p> <p>► 预先配置的状态转换查找表。►</p> <p>将整个感知序列保存在内存中。► 对于小规模任务如清扫两个房间是可行的定义方式。[A, 清洁] (cid:55)→ 右移。D.</p> <p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>[A, 清洁], [A, 清洁], [A, 脏] (cid:55)→ 吸尘 ► 当状态空间很大时不可行。► 你能为一个下国际象棋的人工智能智能体定义一套具体的规则吗？COMPSCI4004/COMPSCI5087AI(H/M) 智能体类型</p> <p>反射型智能体 ► 动作不是历史感知的函数，而是仅依赖于当前感知（状态）。► 如果我们只有“脏污”传感器而没有“位置”传感器会发生什么？► 如果状态是清洁的我们应该怎么做。如果我们不动就会卡住。►</p> <p>如果我们移动了，那么如何确定方向？</p>
	<p>从‘A’向左移动会导致无限循环。►</p> <p>如果状态==‘脏’则执行‘吸尘’►</p> <p>执行随机动作►</p> <p>如果位置==‘A’则返回‘右’</p> <p>解决这个问题。►</p> <p>如果位置==‘B’则返回‘左’ D.</p> <p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 基于模型的代理 ► 基于反射的代理：不跟踪环境如何随动作变化；► 例如，吸尘可能会引入一个新的状态，在这个状态下房间既不是完全干净也不是完全脏。► 基于模型的代理学习动作与后果之间的映射。► 对于两房间环境有效的基于反射的代理是否也能适用于四房间环境？</p> <p>基于模型的代理呢？D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 目标导向型代理 ▶</p> <p>对于某些问题，目标状态是已知的。▶ 在真空世界中两个目标状态——两个干净的房间，且代理位于其中任何一个房间内。▶ 理性的代理应该执行那些能够使状态更接近目标状态的动作。</p>
	<p>▶ 我们需要一个评估函数来衡量状态之间的这种接近程度。▶ 对于真空世界，我们如何计算距离目标还有多远。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>▶ 朝向从当前状态来看更“近”的目标移动。▶ 达成折衷（基于效用的代理）。▶ 尽可能最大化性能。COMPSCI4004/COMPSCI5087AI(H/M) 代理类型</p> <p>目标导向代理的局限性 ▶</p> <p>当存在以下情况时，代理应该做什么：▶ 多个目标。▶ 冲突的目标。▶ 不明确的目标（例如，对话代理中的“用户满意度”）。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 目标导向代理的局限性 ▶</p> <p>朝向目标移动 ▶ 当存在以下情况时，代理应该做什么：从当前状态来看更“近”的目标。▶ 多个目标。▶ 达成折衷 ▶ 冲突的目标。（基于效用的代理） 不明确的目标（例如，对话代理中的“用户满意度”）。▶ 尽可能最大化性能</p>
	<p>D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 基于效用的代理 ▶ 在另一个房间有一点灰尘，但电池剩余电量足够充电，这比电池完全耗尽且两个房间都干净的情况要好。▶ 需要权衡：这就是我们通过定义一个效用函数来做的事情。▶ 理性的代理应该执行那些能够使状态效用最大化的动作。▶ 对于吸尘器世界来说，一个好的效用函数是什么？▶ $u(\text{状态}) = 0.9 \times \text{清洁度} + 0.1 \times \text{电量}$。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 通用学习代理（动机） ▶ 我们迄今为止所研究的能力最强的代理，即目标导向型和基于效用的代理，在第一个环境中表现良好，它们是否也能在第二个环境中表现出色？ ▶</p> <p>为什么可以或不可以（考虑以下几点）。 ▶ 环境是随机的。 ▶ 状态分布不同。 ▶ 需要做哪些改变。 D</p>
	<p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 通用学习代理（设计） ▶</p> <p>执行元素：选择动作 -</p> <p>类似于我们迄今为止所见的静态代理。 ▶</p> <p>学习元素：寻找改进方法。 ▶ 评价元素：来自环境的反馈，影响“学习元素”。 ▶</p> <p>问题生成器：选择次优路径以进一步探索环境，从而在长期内发现更好的行动。D.</p> <p>Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 通用学习代理（回到示例） ▶</p> <p>执行元素：效用函数旨在最小化掉入洞中的风险并最大化获得奖励的机会。 ▶ 学习元素：发现两个相邻的洞比单个洞更危险（这一点并未被硬编码到效用函数中）。 ▶ 评价元素：当代理实际上掉入洞中时，给出较高的负奖励。</p>
	<p>▶ 问题生成器：代理需要掉入洞中（具备一定的风险承担能力），以提高其在洞周围操控技巧的学习。D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>

	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型总结 现在你已经了解了： ►</p> <p>PEAS - 性能、环境、执行器、传感器。 ►</p> <p>代理类型 - 从基于反射的代理到基于效用的代理的发展历程。 ► 学习型代理 -</p> <p>最有能力的一种。 待办事项： ► 阅读讲义笔记，并尝试完成《人工智能：一种现代方法》第二章中的练习题。 ►</p> <p>参加第三周的实验课并完成相关练习。 D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>
	<p>COMPSCI4004/COMPSCI5087AI(H/M)</p> <p>代理类型 匿名反馈用于持续监控 D. Ganguly</p> <p>COMPSCI4004/COMPSCI5087AI(H/M)</p>