

STA303 人工智能B 课程大纲

(页码按照pdf文件页码标注)

1. 2023秋季学期-----P2
2. 2024秋季学期起-----P9

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	人工智能 B / Artificial Intelligence B
2.	授课院系 Originating Department	统计与数据科学系
3.	课程编号 Course Code	STA303
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业核心课 Major Core Courses
6.	授课学期 Semester	秋季 Fall
7.	授课语言 Teaching Language	中英双语 English & Chinese
8.	授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	魏鸿鑫 Wei Hongxin 统计与数据科学系 Department of Statistics and Data Science hongxin001@e.ntu.edu.sg
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
	32		32		64
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	CS109 计算机程序设计基础 Introduction to Computer Programming CS203 数据结构与算法分析 Data Structures and Algorithm Analysis CS203B 数据结构与算法分析 B Data Structures and Algorithm Analysis B				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite					
14. 其它要求修读本课程的学系 Cross-listing Dept.					

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

<ol style="list-style-type: none"> 1. 理解人工智能的基本概念和发展历史，掌握人工智能领域的核心技术和应用。 2. 掌握智能代理、知识表示和推理、搜索和规划、机器学习、强化学习等主题的基本原理和应用方法。 3. 熟悉智能系统的组成部分和应用场景，了解人工智能在各个领域的应用现状和前景。 4. 掌握一些智能系统开发工具和技术，培养学生的实践能力和团队协作能力。 5. 培养学生理解和分析智能系统的能力，提高学生解决实际问题的能力和创新能力。 6. 培养学生关注人工智能发展的伦理和社会责任意识，引导学生正确使用人工智能技术，为人类社会做出贡献。 <ol style="list-style-type: none"> 1. Understand the basic concepts and developmental history of artificial intelligence, and master the core technologies and applications in the field of artificial intelligence. 2. Master the basic principles and application methods of topics such as intelligent agents, knowledge representation and reasoning, search and planning, machine learning, and reinforcement learning. 3. Be familiar with the components and application scenarios of intelligent systems, and understand the current status and future prospects of artificial intelligence applications in various fields. 4. Master some tools and techniques for developing intelligent systems, and cultivate students' practical skills and teamwork abilities. 5. Cultivate students' ability to comprehend and analyze intelligent systems, enhance their problem-solving and innovation abilities. 6. Cultivate students' awareness of the ethical and social responsibilities involved in the development of artificial intelligence, and guide them to use AI technology properly for the betterment of human society.
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16. 预达学习成果 Learning Outcomes

学习本课程后，学生预期可达到：

1. 理解和掌握人工智能的基本概念和发展历程，了解人工智能的前沿和未来发展趋势。
2. 熟练地运用智能代理、知识表示和推理、搜索和规划、机器学习、强化学习等技术，解决实际问题。
3. 分析和评估智能系统的性能和效果，能够通过数据分析和模型训练优化智能系统的性能。
4. 独立进行小型智能系统的设计和开发，包括需求分析、模型设计、系统实现和测试等全过程。
5. 掌握智能系统的相关工具和技术，包括 Python 编程、机器学习库、智能代理开发工具等。

After completing this course, students are expected to:

1. Understand and master the basic concepts and developmental history of artificial intelligence, and be aware of the cutting-edge research and future development trends of artificial intelligence.
2. Skillfully apply techniques such as intelligent agents, knowledge representation and reasoning, search and planning, machine learning, and reinforcement learning to solve practical problems.
3. Analyze and evaluate the performance and effectiveness of intelligent systems, and be able to optimize their performance through data analysis and model training.
4. Independently design and develop small-scale intelligent systems, including the entire process of requirements analysis, model design, system implementation, and testing.
5. Master the relevant tools and techniques of intelligent systems, including Python programming, machine learning libraries, and intelligent agent development tools.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

Chapter 1: Introduction to AI

- a. Introduction to the course
- b. Overview of the field of AI
- c. History and development of AI
- d. Key concepts and applications of AI

第一章：人工智能概论

- a. 课程介绍
- b. 人工智能领域概述
- c. 人工智能的历史和发展
- d. 人工智能的关键概念和应用

Chapter 2: Intelligent Agents

- a. What are intelligent agents?
- b. Types of agents
- c. Agent architectures
- d. Agent communication and coordination

第二章：智能代理

- a. 什么是智能代理？
- b. 代理的类型
- c. 代理架构
- d. 代理通信和协调

Chapter 3: Knowledge Representation and Reasoning

- a. Knowledge representation languages and techniques
- b. Inference and reasoning
- c. Ontologies and semantic networks
- d. Expert systems and knowledge-based systems

第三章：知识表示和推理

- a. 知识表示语言和技术
- b. 推理和推理
- c. 本体和语义网络
- d. 专家系统和基于知识的系统

Chapter 4: Search and Optimization

- a. Search algorithms and strategies
- b. Heuristic search
- c. Constraint satisfaction problems
- d. Optimization techniques

第四章：搜索和优化

- a. 搜索算法和策略
- b. 启发式搜索
- c. 约束满足问题
- d. 优化技术

Chapter 5: Machine Learning

- a. Introduction to machine learning
- b. Types of machine learning algorithms
- c. Supervised and unsupervised learning
- d. Decision trees and ensemble learning

第五章：机器学习

- a. 机器学习简介
- b. 机器学习算法的类型
- c. 监督和无监督学习
- d. 决策树和集成学习

Chapter 6: Neural Networks

- a. Introduction to neural networks

- b. Single-layer and multi-layer neural networks
- c. Backpropagation algorithm
- d. Convolutional neural networks

第六章：神经网络

- a. 神经网络简介
- b. 单层和多层神经网络
- c. 反向传播算法
- d. 卷积神经网络

Chapter 7: Reinforcement Learning

- a. Introduction to reinforcement learning
- b. Markov decision processes
- c. Q-learning algorithm
- d. Applications of reinforcement learning

第七章：强化学习

- a. 强化学习简介
- b. 马尔可夫决策过程
- c. Q-learning 算法
- d. 强化学习的应用

Chapter 8: Planning and Decision Making

- a. Introduction to planning and decision making
- b. Goal formulation and problem solving
- c. Decision trees and decision making under uncertainty
- d. Multi-agent decision making

第八章：规划和决策

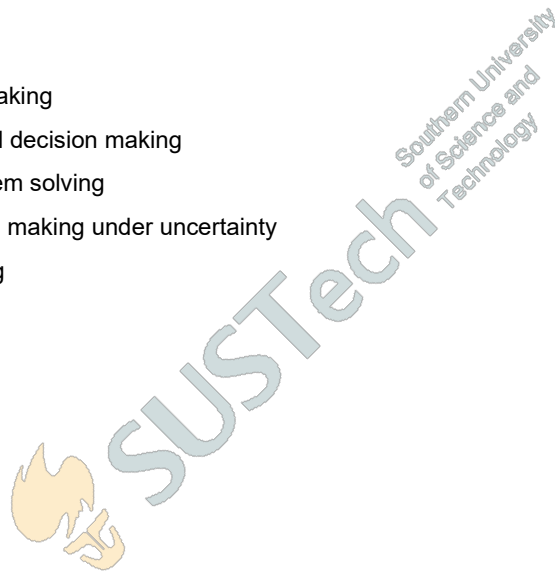
- a. 规划和决策简介
- b. 目标制定和问题解决
- c. 决策树和不确定决策
- d. 多智能体决策

Chapter 9: Robotics

- a. Introduction to robotics
- b. Robot kinematics and dynamics
- c. Robot control and navigation
- d. Applications of robotics

第九章：机器人技术

- a. 机器人技术简介
- b. 机器人运动学和动力学
- c. 机器人控制和导航



d. 机器人技术的应用

Chapter 10: Computer Vision

- a. Introduction to computer vision
- b. Image formation and processing
- c. Feature extraction and object recognition
- d. Applications of computer vision

第十章：计算机视觉

- a. 计算机视觉简介
- b. 图像形成和处理
- c. 特征提取和物体识别
- d. 计算机视觉的应用

Chapter 11: AI Ethics and Social Implications

- a. Introduction to AI ethics
- b. Ethical considerations in AI development and use
- c. Social implications of AI
- d. Bias and fairness in AI systems

第十一章：人工智能伦理和社会影响

- a. 人工智能伦理简介
- b. 人工智能开发和使用中的道德考虑
- c. 人工智能的社会影响
- d. 人工智能系统的偏见和公平性

Chapter 12: Advanced Topics in AI

Advanced topics in AI based on students' interests and the latest research trends

第十二章：人工智能前沿课题

根据学生兴趣和最新研究趋势的人工智能前沿课题

18. 教材及其它参考资料 Textbook and Supplementary Readings

教材：Artificial Intelligence: A Modern Approach (中文版：人工智能：一种现代的方法)

参考资料：Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016.

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		出勤率 100%得满分，每缺席一次扣

			0.5 分
课堂表现 Class Performance			
小测验 Quiz			
课程项目 Projects	25		要求学生完成一个智能系统的开发项目，包括需求分析、系统设计、编码实现、测试和文档编写等环节。项目成果和过程文档将被评估。
平时作业 Assignments	40		包括理论和实践两部分。理论作业要求学生掌握课程知识，实践作业要求学生运用所学知识完成编程任务
期中考试 Mid-Term Test			
期末考试 Final Exam			
期末报告 Final Presentation	25		
其它（可根据需要 改写以上评估方式） Others (The above may be modified as necessary)			

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading
 B. 二级记分制（通过/不通过） Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

课程详述

COURSE SPECIFICATION

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5.	课程类别 Course Type	专业核心课 Major Core Courses
6.	授课学期 Semester	秋季 Fall
7.	授课语言 Teaching Language	中英双语 English & Chinese 
8.	授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	孔芳 Kong Fang 统计与数据科学系 Department of Statistics and Data Science fangkong@sjtu.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
学时数 Credit Hours	32		32		64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	CS109 计算机程序设计基础 Introduction to Computer Programming CS203 数据结构与算法分析 Data Structures and Algorithm Analysis CS203B 数据结构与算法分析 B Data Structures and Algorithm Analysis B
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13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	
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14. 其它要求修读本课程的学系 Cross-listing Dept.	
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教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

1. 理解人工智能的基本概念和发展历史，掌握人工智能领域的核心技术和应用。
 2. 掌握智能代理、知识表示和推理、搜索和规划、机器学习、强化学习等主题的基本原理和应用方法。
 3. 熟悉智能系统的组成部分和应用场景，了解人工智能在各个领域的应用现状和前景。
 4. 掌握一些智能系统开发工具和技术，培养学生的实践能力和团队协作能力。
 5. 培养学生理解和分析智能系统的能力，提高学生解决实际问题的能力和创新能力。
 6. 培养学生关注人工智能发展的伦理和社会责任意识，引导学生正确使用人工智能技术，为人类社会做出贡献。
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1. Understand the basic concepts and developmental history of artificial intelligence, and master the core technologies and applications in the field of artificial intelligence.
 2. Master the basic principles and application methods of topics such as intelligent agents, knowledge representation and reasoning, search and planning, machine learning, and reinforcement learning.
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2. 熟练地运用智能代理、知识表示和推理、搜索和规划、机器学习、强化学习等技术，解决实际问题。
3. 分析和评估智能系统的性能和效果，能够通过数据分析和模型训练优化智能系统的性能。
4. 独立进行小型智能系统的设计和开发，包括需求分析、模型设计、系统实现和测试等全过程。
5. 掌握智能系统的相关工具和技术，包括 Python 编程、机器学习库、智能代理开发工具等

After completing this course, students are expected to:

1. Understand and master the basic concepts and developmental history of artificial intelligence, and be aware of the cutting-edge research and future development trends of artificial intelligence.
2. Skillfully apply techniques such as intelligent agents, knowledge representation and reasoning, search and planning, machine learning, and reinforcement learning to solve practical problems.
3. Analyze and evaluate the performance and effectiveness of intelligent systems, and be able to optimize their performance through data analysis and model training.
4. Independently design and develop small-scale intelligent systems, including the entire process of requirements analysis, model design, system implementation, and testing.
5. Master the relevant tools and techniques of intelligent systems, including Python programming, machine learning libraries, and intelligent agent development tools.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

Chapter 1: Introduction to AI

- a. Introduction to the course
- b. Overview of the field of AI
- c. History and development of AI
- d. Key concepts and applications of AI



第一章:人工智能概论

- a. 课程介绍
- b. 人工智能领域概述
- c. 人工智能的历史和发展
- d. 人工智能的关键概念和应用

Chapter 2: Intelligent Agents

- a. Agents and environments
- b. The concept of rationality
- c. The nature of environments
- d. The structure of agents

第二章:智能化智能体

- a. 智能体和环境
- b. 理性的概念
- c. 环境的本质
- d. 智能体的结构

Chapter 3: Search

- a. Introduction to search problems
- b. Uninformed search methods (Depth-First Search, Breadth-First Search, Uniform-Cost Search)
- c. Informed search methods (Heuristics, Greedy Search, A* Search, Graph Search)

第三章:搜索

- a. 搜索问题介绍
- b. 无信息的搜索策略 (深度优先搜索、广度优先搜索、代价一致搜索)
- c. 有信息的搜索策略 (启发函数、贪心搜索、A*搜索、图搜索)



Chapter 4: Constraint Satisfaction Problems (CSPs)

- a. Introduction to CSPs
- b. backtracking search
- c. Speed-ups
- d. Local Search

第四章: 约束满足问题

- a. 约束满足问题介绍
- b. 回溯搜索
- c. 加速求解方法

d. 局部搜索

Chapter 5: Adversarial Search

- a. Game
- b. Optimization Decisions in Games
- c. Alpha-beta Pruning
- d. Incomplete Real-time Decisions

第五章：对抗搜索

- a. 博弈
- b. 博弈中的优化决策
- c. Alpha-beta 剪枝
- d. 不完整的实时决策

Chapter 6: Machine Learning

- a. Introduction to machine learning
- b. Types of machine learning algorithms
- c. Supervised and unsupervised learning
- d. Decision trees and ensemble learning

第六章：机器学习

- a. 机器学习简介
- b. 机器学习算法的类型
- c. 监督和无监督学习
- d. 决策树和集成学习

Chapter 7: Neural Networks

- a. Introduction to neural networks
- b. Single-layer and multi-layer neural networks
- c. Backpropagation algorithm



d. Convolutional neural networks

第七章:神经网络

- a. 神经网络简介
- b. 单层和多层神经网络
- c. 反向传播算法
- d. 卷积神经网络

Chapter 8: Markov Decision Problems (MDPs)

- a. Markov property
- b. Introduction to MDP
- c. Value iteration
- d. Policy iteration

第八章:马尔可夫决策过程

- a. 马尔可夫性质
- b. 马尔可夫决策过程介绍
- c. 价值迭代方法
- d. 策略迭代方法



Chapter 9: Reinforcement Learning

- a. Passive reinforcement learning
- b. Active reinforcement learning
- c. Approximate reinforcement learning
- d. Applications of reinforcement learning

第九章:强化学习

- a. 被动强化学习
- b. 主动强化学习
- c. 近似强化学习

d. 强化学习的应用

Chapter 10: Uncertain Knowledge and Reasoning

- a. Uncertainty
- b. Bayes networks
- c. Inference in bayes networks
- d. Making simple decisions

第十章：不确定知识与推理

- a. 不确定性
- b. 贝叶斯网络
- c. 贝叶斯网络中的推理
- d. 制定简单决策

Chapter 11: AI Ethics and Social Implications

- a. Introduction to AI ethics
- b. Ethical considerations in AI development and use
- c. Social implications of AI
- d. Bias and fairness in AI systems

第十一章：人工智能伦理和社会影响

- a. 人工智能伦理简介
- b. 人工智能开发和使用中的道德考虑
- c. 人工智能的社会影响
- d. 人工智能系统的偏见和公平性

Chapter 12: Advanced Topics in AI

Advanced topics in AI based on students' interests and the latest research trends

第十二章:人工智能前沿课题

根据学生兴趣和最新研究趋势的人工智能前沿课题



18. 教材及其它参考资料 **Textbook and Supplementary Readings**

教材: Artificial Intelligence: A Modern Approach (中文版:人工智能:一种现代的方法)

参考资料: Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning. MIT Press, 2016.

CS 188 Introduction to Artificial Intelligence by UC Berkeley

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		5		出勤率 100%得满分, 每缺席一次扣 0.5 分
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		25		要求学生完成一个智能系统的开发项目, 包括需求分析、系统设计、编码实现、测试和文档编写等环节。项目成果和过程文档将被评估。
平时作业 Assignments		40		包括理论和实践两部分。理论作业要求学生掌握课程知识, 实践作业要求学生运用所学知识完成编程任务
期中考试 Mid-Term Test				
期末考试 Final Exam		30		
期末报告 Final Presentation				
其它 (可根据需要 改写以上评估方式) Others (The above may be modified as necessary)				

20. 记分方式 **GRADING SYSTEM**

A. 十三级等级制 **Letter Grading**

B. 二级记分制 (通过/不通过) **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过

This Course has been approved by the following person or committee of authority

教学负责人签字：
日期：