

网络科学与计算课程大纲

1、2020 春季学期 -- 2021 春季学期.....	P1
2、2022 春季学期起.....	P5

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	网络科学与计算 Network Science and Computing				
2.	授课院系 Originating Department	统计与数据科学系 Department of Statistics and Data Science				
3.	课程编号 Course Code	STA404				
4.	课程学分 Credit Value	3				
5.	课程类别 Course Type	专业选修课 Major Elective Courses				
6.	授课学期 Semester	春季 Spring 【2020 春季学期 -- 2021 春季学期】				
7.	授课语言 Teaching Language	中英双语 Chinese and English				
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)	马一方 助理教授 Assistant Professor Yifang Ma 统计与数据科学系 Department of Statistics and Data Science				
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	48				48

Credit Hours

--	--	--	--	--

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	概率论与数理统计 (MA212) Probability and Statistics (MA212)
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	社交网络分析、数据可视化及应用 Social Network Analysis, Data Visualization and Application
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

本课程通过大量实际案例引导学生充分了解网络科学的起源、需要解决的实际问题和方法。培养学生网络科学与数据科学的思维模式，结合编程实践，达到解决实际数据问题的目的。

The course aims to guide students to fully understand the emerging science of complex networks, the related methods and their applications. Develop the concept of network science and data science and the capability to solve real problems by utilizing related network analysis software or programming.

16. 预达学习成果 Learning Outcomes

通过本课程的学习，学生预期可达到：

- 熟悉社会网络、交通网络、生物网络、科学引文网络等真实数据的结构，各项网络指标特征以及演化规律
- 通过编程实践，学会运用网络科学工具分析实际数据，解释实际数据中所观测到的现象
- 了解网络科学与数据科学前沿，提高数据科学的建模和分析能力

On successful completion of the course, students should be able to:

- Be familiar with the structure, characteristics and the dynamic patterns of the real networked data, such as social network, transportation network, biological network and citation network, etc.
- Learn how to analyze real data by software or programming, and explain complex phenomena at larger scales.
- Understand the frontiers of network science and data science, improve the capability of data analysis and modeling.

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.)

第 1 章 简介 (4 学时)

复杂系统与网络科学, 网络科学的兴起, 社会以及科学影响力

Chapter 1 Introduction (2 hours)

Complex system and network science, the emergence of network science, the societal and scientific impact

第 2 章 图论 (6 学时)

图与网络, 度、平均度、度分布, 邻接矩阵, 加权网络、网络路径与最短距离、连通性、聚类系数

Chapter 2 Graph theory (4 hours)

Graphs and networks, degree, average degree, degree distribution, adjacency matrix, weighted network, paths and distances, connectedness, clustering coefficient

第 3 章 随机网络 (6 学时)

随机网络模型, 随机网络度分布, 小世界模型

Chapter 3 Random networks (6 hours)

Random network model, degree distribution, small worlds

第 4 章 无标度网络 (4 学时)

幂律分布与无标度网络, 无标度网络的性质, 无标度网络的生成

Chapter 4 Scale free network

Power laws and scale free networks, scale free properties, network generating

第 5 章 Barabási-Albert (BA) 模型 (6 学时)

网络增长与优先连接, BA 模型, 度增长, 度分布, 非线性优先连接, 网络直径与聚类系数

Chapter 5 Barabási-Albert (BA) model (6 hours)

Growth and preferential attachment, BA model, degree dynamics, degree distribution, Non-linear preferential attachment, diameter and clustering coefficient

第 6 章 网络演化 (4 学时)

Bianconi-Barabási 模型, Fitness, 玻色-爱因斯坦凝聚, 网络演化

Chapter 6 Evolving networks

Bianconi-Barabási model, measuring fitness, Bose-Einstein condensation, evolving networks

第 7 章 度相关性 (4 学时)

Assortativity, 度相关性的度量, 性质及其应用

Chapter 7 Degree correlations (4 hours)

Assortativity, measuring degree correlations, properties and applications

第 8 章 网络鲁棒性 (4 学时)

简介, 渗流理论, 无标度网络的鲁棒性, 网络攻击, 级联失效及建模

Chapter 8 Network robustness (4 hours)

Introduction, percolation theory, robustness of scale free networks, attack tolerance, cascading failures and modeling

第 9 章 社区结构 (6 学时)

社区结构简介, 层级聚类, 模块性, 重叠社区划分, 应用

Chapter 9 Communities (4 hours)

Basics of communities, hierarchical clustering, modularity, overlapping communities, applications

第 10 章 传播 (4 学时)

简介, 疾病传播与网络传播模型, 接触网络, 免疫, 疾病传播预测

Chapter 10 Spreading (4 hours)

Introduction, epidemic modeling and network epidemics, contact networks, immunization, epidemic prediction

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

Textbook:

Toroczkai, Zoltán. Network Science, Network Science, Albert-László Barabási, Cambridge U. Press, 2016, 456 p, \$59.99, ISBN 978-1-107-07626-6[J]. Physics Today, 2017, 70(4):55-56.

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				
课堂表现 Class Performance		10		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		15		
期中考试 Mid-Term Test		25		
期末考试 Final Exam		50		
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)				

SUSTech
Southern University of Science and Technology

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

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	网络科学与计算 Network Science and Computing
2.	授课院系 Originating Department	统计与数据科学系 Department of Statistics and Data Science
3.	课程编号 Course Code	STA404
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业选修课 Major Elective Courses
6.	授课学期 Semester	春季 Spring 【2022 春季学期起】
7.	授课语言 Teaching Language	中英双语 Chinese and English
8.	授课教师、所属学系、联系方式 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	马一方 助理教授 Assistant Professor Yifang Ma 统计与数据科学系 Department of Statistics and Data Science
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
	48				48
学时数 Credit Hours					
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	概率论与数理统计 (MA212) Probability and Statistics (MA212)				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	社交网络分析、数据可视化及应用 Social Network Analysis, Data Visualization and Application				
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

本课程通过大量实际案例引导学生充分了解网络科学的起源、需要解决的实际问题和解决方法。培养学生网络科学与数据科学的思维模式，结合编程实践，达到解决实际数据问题的目的。

The course aims to guide students to fully understand the emerging science of complex networks, the related methods and their applications. Develop the concept of network science and data science and the capability to solve real problems by utilizing related network analysis software or programming.

16. 预达学习成果 Learning Outcomes

通过本课程的学习，学生预期可达到：

- 熟悉社会网络、交通网络、生物网络、科学引文网络等真实数据的结构、各项网络指标特征以及演化规律
- 通过编程实践，学会运用网络科学工具分析实际数据，解释实际数据中所观测到的现象
- 了解网络科学与数据科学前沿，提高数据科学的建模和分析能力

On successful completion of the course, students should be able to:

- Be familiar with the structure, characteristics and the dynamic patterns of the real networked data, such as social network, transportation network, biological network and citation network, etc.
- Learn how to analyze real data by software or programming, and explain complex phenomena at larger scales.
- Understand the frontiers of network science and data science, improve the capability of data analysis and modeling.

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.)

第 1 章 简介 (4 学时)

复杂系统与网络科学, 网络科学的兴起, 社会以及科学影响力

Chapter 1 Introduction (2 hours)

Complex system and network science, the emergence of network science, the societal and scientific impact

第 2 章 图论 (6 学时)

图与网络, 度、平均度、度分布, 邻接矩阵, 加权网络、网络路径与最短距离、连通性、聚类系数

Chapter 2 Graph theory (4 hours)

Graphs and networks, degree, average degree, degree distribution, adjacency matrix, weighted network, paths and distances, connectedness, clustering coefficient

第 3 章 随机网络 (6 学时)

随机网络模型, 随机网络度分布, 小世界模型

Chapter 3 Random networks (6 hours)

Random network model, degree distribution, small worlds

第 4 章 无标度网络 (4 学时)

幂律分布与无标度网络, 无标度网络的性质, 无标度网络的生成

Chapter 4 Scale free network

Power laws and scale free networks, scale free properties, network generating

第 5 章 Barabási-Albert (BA) 模型 (6 学时)

网络增长与优先连接, BA 模型, 度增长, 度分布, 非线性优先连接, 网络直径与聚类系数

Chapter 5 Barabási-Albert (BA) model (6 hours)

Growth and preferential attachment, BA model, degree dynamics, degree distribution, Non-linear preferential attachment, diameter and clustering coefficient

第 6 章 网络演化 (4 学时)

Bianconi-Barabási 模型, Fitness, 网络演化

Chapter 6 Evolving networks

Bianconi-Barabási model, measuring fitness, evolving networks

第 7 章 度相关性 (4 学时)

Assortativity, 度相关性的度量, 性质及其应用

Chapter 7 Degree correlations (4 hours)

Assortativity, measuring degree correlations, properties and applications

第 8 章 网络鲁棒性 (4 学时)

简介, 渗流理论, 无标度网络的鲁棒性, 网络攻击, 级联失效及建模

Chapter 8 Network robustness (4 hours)

Introduction, percolation theory, robustness of scale free networks, attack tolerance, cascading failures and modeling

第 9 章 社区结构 (6 学时)

社区结构简介, 层级聚类, 模块性, 重叠社区划分, 应用

Chapter 9 Communities (4 hours)

Basics of communities, hierarchical clustering, modularity, overlapping communities, applications

第 10 章 传播 (4 学时)

简介, 疾病传播与网络传播模型, 接触网络, 免疫, 疾病传播预测

Chapter 10 Spreading (4 hours)

Introduction, epidemic modeling and network epidemics, contact networks, immunization, epidemic prediction

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

Textbook:

Network Science, Albert-László Barabási, Cambridge U. Press, 2016, 456 p, \$59.99, ISBN 978-1-107-07626-6[J].

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		
课堂表现 Class Performance				
小测验 Quiz				
课程项目 Projects		20		
平时作业 Assignments		30		
期中考试 Mid-Term Test		20		
期末考试 Final Exam				
期末报告 Final Presentation		20		
其它（可根据需要 改写以上评估方式） Others (The above may be modified as necessary)				

Southern University
of Science and
Technology

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