Subject Information Guide

Complex Networks: theory and analysis

Semester 2, 2014

Administration and contact details

Host Department	**School of Mathematical and Geospatial Sciences**
Host Institution	**RMIT University**
Name of lecturer	**Dr Stephen Davis**
Phone number	**03 9925 2278**
Email Address	**stephen.davis@rmit.edu.au**
Homepage	**http://www.rmit.edu.au/browse;ID=ke7g19jela4**
Name of Honours coordinator	**Dr Stephen Davis**
Phone number	**03 9925 2278**
Email Address	**stephen.davis@rmit.edu.au**

Subject details

Handbook entry URL	**http://www.rmit.edu.au/browse;ID=BH010**
Subject homepage URL	**http://www.rmit.edu.au/browse;ID=BH010**
Honours student hand-out URL	**http://www.rmit.edu.au/browse;ID=BH010**
Start date:	**30th July**
End date:	**8th October**
Contact hours per week:	**2**
Lecture day and time:	**Wednesday 10 am - 12 pm**
Description of electronic access arrangements for students (for example, WebCT)	**NA**

Subject content

1. Subject content description

This course is designed for Honours students of both mathematics and statistics, and will examine the recent advances over the last two decades in understanding the structure of complex networks. There will be an emphasis on the analytical techniques used to classify and

characterise networks and students will be asked to analyse real networks themselves. Hence the assessment of this course will involve writing code to import network data and implement the techniques encountered in the lectures in a programming environment such as Mat Lab or, preferably, R (http://www.r-project.org/). *Students should be comfortable with programming or be prepared to learn how to use R.* The course will also begin with a short, focused study of graph theory as the mathematical basis for network science.

2. Week-by-week topic overview

Week 1: Graph definitions; paths and circuits; connectedness and components; betweenness and closeness; diameter, radius, centrality; adjacency matrix; path matrix; Laplacian matrix.

Week 2: Clustering coefficient; cyclic coefficient; spectral properties of graphs; types of graphs; types of networks.

Week 3: Topological structure of networks; degree sequence; degree distribution; entropy and energy; the Gini coefficient.

Week 4: *k*-regular networks; binary tree network; proximity graphs; bipartite graphs.

Week 5: Small-world networks; the Watts-Strogatz procedure; properties of small-world networks.

Week 6: Scale-free networks; network growth models; the rich get richer; the good get richer; properties of scale-free networks.

Week 7: Random networks; Erdos-Renyi (ER) algorithm; Gilbert, ER and anchored random networks; properties of random networks.

Week 8: Subgraphs and motifs.

Week 9: Community detection.

Week 10: Spatial networks; bond percolation; site percolation; long-range percolation; properties of spatial networks.

3. Assumed prerequisite knowledge and capabilities

As stated in the subject content description, the assessment of this course will involve writing code to import network data and implement the techniques encountered in the lectures in a programming environment such as Mat Lab or, preferably, R (http://www.r-project.org/). *Students should be comfortable with programming or be prepared to learn how to use R.*

4. Learning outcomes and objectives

Advanced knowledge of the modern techniques used to analyse the structure and function of complex networks. An appreciation of the range of fields within which complex networks have arisen and been studied, and the common research approaches and methods that have been developed. The technical abilities to characterise and classify networks derived from real data.

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject
Problem Solving - You will have the ability to apply knowledge and skill to characterise, analyse and solve a wide range of problems.	**S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence** **S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas** **A2: to adapt knowledge and skills in diverse contexts**

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

Insert texts, printed notes and/or software required

6. Assessment

Exam/assignment/classwork breakdown					
Exam	**60 %**	**Assignment**	**40 %**	**Class work**	**0 %**
Assignment due dates		**9th September**	**7th October**	Click here to enter a date.	Click here to enter a date.
Approximate exam date				**Take home exam: 27-31 October**	

Institution Honours program details

Weight of subject in total honours assessment at host department	**12.5%**
Thesis/subject split at host department	**25% thesis/75% course work**
Honours grade ranges at host department:	
H1	**80-100 %**
H2a	**75-79 %**
H2b	**70-74 %**
H3	**65-69 %**