GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2025-2026

Networks in Socio-Economic Systems (F000920)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2025-2026

A (semester 2)	English	Gent	lecture
			seminar

Lecturers in academic year 2025-2026

Correa da Rocha, Luis Enrique	EB21	lecturer-in-charge

Offered in the following programmes in 2025-2026	crdts	offering
Master of Science in Business Engineering(main subject Data Analytics)	6	A
Master of Science in Business Engineering(main subject Finance)	6	A
Master of Science in Business Engineering(main subject Operations Management)	6	A
Master of Science in Economics	6	A
Master of Science in Economics (Double Degree)	6	A
Master of Science in Physics and Astronomy	6	A
Exchange programme in Economics and Business Administration	6	A

Teaching languages

English

Keywords

complex systems; complexity; complex networks; social networks; human behaviour; socio-economic systems; data science; data analytics; modelling; agent-based.

Position of the course

This methodological and interdisciplinary course introduces fundamental and state-of-the-art network science tools, and aims to guide students in the application of network modelling and network analytics to real-world data to study socio-economic problems from a system's perspective, e.g. social and communication networks, interbank lending, trade and transportation networks, innovation, collaboration, opinions, migration, mobility, among others.

Contents

The course covers a spectrum of network data modelling and analytic quantitative techniques relevant to study socio-economic systems. The course is divided in three parts.

Part 1. Fundamentals of Network Science.

This part introduces elementary mathematical and computational network methods and concepts such as network modelling, data representation, and network visualisation. It also introduces elementary algorithms to extract information from network data, e.g. node degree, clustering, motifs, paths, centrality, core-periphery, assortativeness.

Part 2. Processes on Networks.

This part introduces techniques to model dynamic processes on networks, as for example diffusion of information (e.g. opinions, rumours), epidemics, network attacks, failures and cascades.

Part 3. Advanced Network Analytics.

This part introduces advanced analytic methods, e.g. community detection, temporal networks, and network sampling.

Initial competences

A strong quantitative mindset, mathematical knowledge of probability and statistics, including probability distributions/histograms, p-values, matrices, vectors, differential equations, computer literacy (i.e. use of Windows, MacOS, or Linux), and familiarity (basic to medium level) with one computer programming language (e.g. Python, R, C/C++, Matlab, Java, or Scilab). Willingness to learn Python (basic to medium level) is fundamental since the labs use Python. Consult the course-leader for clarifications about the expected technical background.

Final competences

1 Identify and critically analyse socio-economic problems from a system's perspective.
2 Select network methods for a particular network data analytics task.
3 Implement a network data analysis project using network tools in Python.
4 Manage collaborative data analysis projects
5 Presenting professional and convincing data analytics reports.
6 Reflecting on own learning process and that of peers.

Conditions for credit contract

Access to this course unit via a credit contract is unrestricted: the student takes into consideration the conditions mentioned in 'Starting Competences'

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Extra information on the teaching methods

Enquiry-based learning. Teaching and learning are student-centred and based on social constructivism. Lectures and workshops include group work, and workshops include guided self-study. Journal club, discussions, peer-assessment

Study material

Type: Handbook

Name: Networks: An Introduction. Oxford University Press
Indicative price: € 65
Optional: yes
Language : English
Author : Mark Newman
ISBN : 978-0-19880-509-0
Number of Pages : 780
Online Available : Yes
Available in the Library : Yes
Available through Student Association : No
Usability and Lifetime within the Course Unit : regularly
Usability and Lifetime within the Study Programme : one-time
Usability and Lifetime after the Study Programme : occasionally
Additional information: This is one of the recommended textbook for ambitious students

Type: Handbook

Name: Introduction to Scientific Programming in Python. SpringerOpen
Indicative price: Free or paid by faculty
Optional: no
Language : English
Author : Joakim Sundnes
ISBN : 978-3-03050-356-7
Number of Pages : 157
Online Available : Yes
Available in the Library : No
Available through Student Association : No
Usability and Lifetime within the Course Unit : regularly
Usability and Lifetime within the Study Programme : regularly
Usability and Lifetime after the Study Programme : regularly
Additional information: Freely available online

Type: Handbook

Name: A First Course on Network Science. Cambridge University Press
Indicative price: € 45
Optional: yes
Language : English
Author : F Menczer, S Fortunato, C A Davis
ISBN : 978-1-10847-113-8
Number of Pages : 300
Online Available : No
Available in the Library : Yes
Available through Student Association : No
Usability and Lifetime within the Course Unit : regularly
Usability and Lifetime within the Study Programme : one-time
Usability and Lifetime after the Study Programme : occasionally
Additional information: The textbook is not mandatory but highly recommended.

Type: Slides

Name: Lecture slides
Indicative price: Free or paid by faculty
Optional: no
Language : English
Number of Slides : 12
Available on Ufora : Yes
Online Available : Yes
Available in the Library : No
Available through Student Association : No
Additional information: Slides available before the Lecture. Slides cannot be shared without prior approval by the course leader.

Type: Other

Name: Python notebooks
Indicative price: Free or paid by faculty
Optional: no
Additional information: Python notebooks available before the Lab. They cannot be shared without prior approval by the course leader.

References

- F Menczer, S Fortunato, C A Davis (2020). A First Course on Network Science. Cambridge University Press
- A-L Barabasi (2016). Network Science. Cambridge University Press, UK. ISBN 1107076269
- MO Jackson (2010). Social and Economic Networks. Princeton University Press, USA. ISBN 0691148201
- D Easley and J Kleinberg (2010). Networks, Crowds, and Markets: Reasoning about a Highly Connected World. Cambridge University Press, UK. ISBN 0521195330
-J Sundness (2020). Introduction to Scientific Programming in Python. SpringerOpen

Course content-related study coaching

Individual and group support via appointment.

Assessment moments

continuous assessment

Examination methods in case of periodic assessment during the first examination period

Examination methods in case of periodic assessment during the second examination period

Examination methods in case of permanent assessment

Oral assessment, Peer and/or self assessment, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is not possible

Extra information on the examination methods

a. 1st summative assessment after the 1st part of the course (around week 7)
b. 2nd summative assessment after the 3rd part of the course (around week 12)
c. 3rd summative assessment after the 3rd part of the course (around week 13)
Further information can be found on Ufora.

Calculation of the examination mark

Final mark = a*0.5 + b*0.4 + c*0.1
- The pass mark is 10 for all assessments.
- Active participation in the group project and presentation is mandatory. If not, individual marks can be reduced.
- Deadlines must be respected. If not, marks can be reduced.

Facilities for Working Students

Lab attendance is not mandatory. Online feedback.