Networks: Models, Algorithms and Applications

Programme course

6 credits

Nätverk: modeller, algoritmer och tillämpningar

TSKS11

Valid from: 2017 Spring semester

Determined by
Board of Studies for Electrical
Engineering, Physics and Mathematics

Date determined
2017-01-25

Replaced by
TSKS22

Main field of study

Computer Science and Engineering, Electrical Engineering

Course level

First cycle

Advancement level

G2X

Course offered for

- Mathematics, Master's Programme
- Mathematics
- Computer Science and Engineering, M Sc in Engineering
- Industrial Engineering and Management - International, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Information Technology, M Sc in Engineering
- Computer Science and Software Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Communication Systems, Master's programme

Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites

Linear algebra. Basic knowledge and understanding of probability theory/statistics. Programming skills.

Intended learning outcomes

After the course the students should

- with adequate terminology, in a well-structured manner and logically coherent, be able to describe and conduct simpler calculations that relate to graph representations of networks, metrics, centrality (Google PageRank, Katz, hub/authority, betweenness), structural balance, Laplace operator, random walks, spreading of information over networks, diffusion, cascades, models for and properties of random graphs, community detection, small-world phenomena, searchability and reachability, collaborative filtering on bipartite graphs (recommendation systems), power laws and information cascades
- be able to describe, apply, and implement in a conventional programming language, and show engineering understanding of the theory and models used in the course
- be able to report work in written form, using adequate language, terminology, structure and typography

Course content

Graph representations of networks. Metrics and characteristics. Basic algorithms. Strong and weak ties. Positive and negative relations, structural balance. Web-networks. Link analysis and "page rank". Basic game theory. Information cascades. Information diffusion over networks. World-is-small phenomena. Recommendation systems. Preference aggregation and voting schemes.

Teaching and working methods

12 lectures, 8 tutorials and a series of computer laborations. Inclass examination of some computer laboratory work, and individual written reporting of some tasks.

Examination

LAB4	Laboratory work	2 credits	U, G
TEN2	Written examination	4 credits	U, 3, 4, 5

The exam (TEN2) is normally written, but the course director can decide to use oral examination, as complement to or as replacement for a written exam, in case there are few students taking the exam, or in other special cases.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Courses in computer, information and communication networks, Internet and web technology, social networks, graph theory, machine learning and network analysis.

Department

Institutionen för systemteknik

Director of Studies or equivalent

Klas Nordberg

Examiner

Erik G. Larsson

Course website and other links

http://www.commsys.isy.liu.se/sv/student/kurser/TSKS11

Education components

Preliminary scheduled hours: 56 h
Recommended self-study hours: 104 h

Course literature

Additional literature

Books

A. Barabasi, *Network Science*
D. Easley, J. Kleinberg, *Networks, Crowds and Markets*
M. Chiang, *Networked Life*

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.