Complex Network Systems

Overview and logistics

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Winter

Objective

Understand how complex systems are designed and what their design properties are

Create own dataset or use an existing one for analysis

Use the universal language for describing complex data

Understand the impact

[First successful real-time prediction of a pandemic](#)

Content

- Graphs

- Structural metrics

- Centrality metrics

- Degree distribution and power law

- Network models

- Diffusion

- Game of life

NetworkX

- # Meetings on Wednesdays

- # Attendance is not required

- # All slides will be available on ILIAS

Exercise	Date	Topic
Exercise 1	6-11-19	Overview, logistics and graphs
Exercise 2	13-11-19	Introduction to NetworkX
Exercise 3	20-11-19	Structural metrics
Exercise 4	27-11-19	Centrality metrics
Exercise 5	4-12-19	Katz centrality and PageRank
Exercise 6	11-12-19	Degree distribution and power law
Exercise 7	18-12-19	Network models
Exercise 8	15-1-20	Diffusion
Exercise 9	22-1-20	Game of life
Exercise 10	29-1-20	Reserved
Exercise 11	5-2-20	Reserved

Student

PROJECT

Objective

Analyse the structure and dynamics of
a complex network of your choice

Individual work

- Each student works on their own project and chooses their own topic
  - It is fine if topics overlap

- Expectation
  - Satisfy *all* requirements
  - Respect *all* guidelines
  - Creativity of data representation
  - Thoroughness of data analysis

Requirements

- Requirements
  - Graph construction and visualisation
  - Analysis of structural metrics
  - Construction and analysis of graph structures
  - Construction and analysis of network modularity
  - Analysis of centrality metrics
  - Analysis of degree distribution and power law
  - Construction and analysis of network models
  - Implementation of graph-construction algorithms
- Detailed requirements of a topic introduced at the corresponding meeting

Deliverables

- Project description

- Implementation

- Report

- Presentation

Project description

- Description should be between 1000 and 2000 characters

- Describe the network of your choice
  - Topic
  - Whether it is your own data set or existing one
  - The size and order of the network
  - Types of nodes
  - Types of edges
  - …

Implementation

- Network data in a CSV file (or other appropriate format)

- Python program(s) for the network analysis

- Separate python program for each algorithm

Report

- LaTeX template
  - Available on ILIAS

- Mandatory sections
  - Introduction
  - Network analysis
  - Discussion and conclusion

- Max 40 pages

Submissions

- Project description
  - Text form
  - ILIAS

- Report
  - .pdf file
  - ILIAS

- Implementation
  - Everything in a single folder compressed in a .zip file
  - my email

Naming convention

- Implementation
  - CSV file: *networkName_dataset.csv*
  - Main python program: *network_analysis.py*
  - Python program per algorithm: *algorithmName_algorithm.py*
  - .zip file: *Lastname_implementation.zip*
  - email subject: *[CNS] Lastname implementation submission*

- Report
  - *Lastname_report.pdf*

Presentation

- Presentation in front of the class

- Schedule will be announced in due course

- Be prepared
  - 20 minutes for presentation
  - 5 minutes for Q&A

Important dates

Item	Deadline (end of day)
Project description	November 7, 2019
Implementation	February 3, 2020
Report	February 3, 2020

Questions?