



## *NETWORKS goes to school 2023*

### *Networks & Algorithms*

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Why do we study networks? Because we interact! At every moment of the day we interact with our surroundings, we send messages to our friends, news and gossip go viral, during the whole day the cells in our body interact with each other, our house has electricity which is produced somewhere far away. Networks are everywhere! Think of a network as a collection of objects which are connected. Our brain is a network consisting of neurons connected by axons, societies are formed through social networks where two people are connected if they know each other. We encounter networks everywhere and as we interact we allow networks to evolve.

And algorithms? Mobile phones, ATMs, modern cars, televisions, and e-readers: none of them would work without software. The heart of software is formed by algorithms: step-by-step procedures to perform given tasks. Algorithms can be executed by computers, but also by persons. Moreover, algorithms and networks can be combined, think of navigation apps for example. They calculate optimal routes from one location to another in a second upon demand, and they can also find optimal routes considering random effects like traffic or bad weather.

To understand how networks work, and also to construct efficient and good algorithms we rely on mathematics. Do you want to broaden your mathematics knowledge, work on some wonderful mathematics, and get a glimpse into state-of-the-art mathematical research? Then this masterclass is for you!

During this two-day masterclass, you will discover and work on the mathematics behind networks and algorithms. You will get familiar with graphs, which are used by mathematicians to represent networks, and study their properties. You will also learn what algorithms are, how they work, and will construct algorithms to find the shortest routes in a given network! Below you can find the exact program of the masterclass on the mathematics behind networks and algorithms.

The masterclass will be offered twice, one in Eindhoven and one in Amsterdam. You can choose to join the masterclass that is more convenient for you.

Tuesday 28<sup>th</sup> of February (Eindhoven University of Technology)

### Community detection in networks

- 09.30 - 10.00** Arrival and registration
- 10.00 - 10.15** General introduction
- 10.15 - 11.00** Crash course on graph theory and networks
- 11.00 - 11.15** Short break
- 11.15 - 12.30** Lecture: Martijn Gösgens (TU Eindhoven)
- 12.30 - 13.30** Lunch (two groups of students visit [Lehmer's dance](#), one at 12:40 and one at 13:05)
- 13.30 - 14:30** Exercise session & Discussion
- 14.30 - 16.00** Visit [IMAGINARY](#) (either with the whole group or in two groups)
- 16.30 - 16.30** Discussion, questions, group photo.

Thursday 2<sup>nd</sup> of March (Eindhoven University of Technology)

### Algorithms and shortest paths in networks

- 09.30 - 10.00** Arrival and registration
- 10.00 - 10.15** General introduction
- 10.15 - 11.00** Crash course on algorithms and networks
- 11.00 - 11.15** Short break
- 11.15 - 12.30** Lecture: Nikki Levering (University of Amsterdam)
- 12.30 - 13.30** Lunch (provided by us)
- 13.30 - 14:30** Exercise session & Discussion
- 14.30 - 16.00** Visit [IMAGINARY](#) (either with the whole group or in two groups)
- 16.30 - 16.30** Discussion, questions, group photo.

Tuesday 4<sup>th</sup> of April (University of Amsterdam)

### Community detection in networks

- 09.30 - 10.00** Arrival and registration
- 10.00 - 10.15** General introduction
- 10.15 - 11.00** Crash course on graph theory and networks
- 11.00 - 11.15** Short break
- 11.15 - 12.30** Lecture: Martijn Gösgens (TU Eindhoven)
- 12.30 - 13.30** Lunch (provided by us)
- 13.30 - 14:30** Exercise session
- 14.30 - 14:45** Short break
- 14.45 - 15.45** Discussion, exercises and simulations
- 15.45 - 16.30** Discussion, questions, group photo.

Thursday 6<sup>th</sup> of April (University of Amsterdam)

### Algorithms and shortest paths in networks

- 09.30 - 10.00** Arrival and registration
- 10.00 - 10.15** General introduction
- 10.15 - 11.00** Crash course on algorithms
- 11.00 - 11.15** Short break
- 11.15 - 12.30** Lecture: Nikki Levering (University of Amsterdam)
- 12.30 - 13.30** Lunch (provided by us)
- 13.30 - 14:30** Exercise session
- 14.30 - 14:45** Short break
- 14.45 - 15.45** Discussion, exercises and simulations
- 15.45 - 16.30** Discussion, questions, group photo.

