University of Amsterdam
Faculty of Science
Korteweg-de Vries Institute
P.O. Box 94248
1090 GE Amsterdam

Telephone: 020-525 6694

www.thenetworkcenter.nl
email: info@thenetworkcenter.nl

# Programme of the 9th NETWORKS Training week

# 28 October – 1 November 2019, Asperen

## Monday, 28 October

12:00-12:30 Arrival
12:30-13:30 Lunch
13:30-14:30 Research presentations

- Solon Pissis (CWI)
  *Reverse-Safe Data Structures for Text Indexing*
- Henk Alkema (TU/e)

14:30-15:00 Break
15:00-16:00 Jaap en Mark
*Let's discuss: Machine Learning and Artificial Intelligence,* contest
16:00-16:15 Break
16:15-16:45 Intro of new PhD students (7 min each)

- Pierfrancesco Dionigi (UL)
- Diego Goldsztajn (TU/e)
- Michelle Sweering (CWI)
- Daoyi Wang (UL)

16:45-17:00 Open problem session
17:00-18:00 Research session: work in small group
18:30 Dinner

## Tuesday, 29 October

07:30-09:00 Breakfast
09:00-10.15 Mini-course: Stella Kapodistria
10:15-10:45 Break
10:45-12:00 Mini-course: Jesper Nederlof
12:00-13:30 Lunch
13:30-14:30 Research presentations

- Nikki Levering (UvA)
  *Functional form based optimization for invasive species management*
- Jaap Storm (VU)
  *A diffusion-based analysis of a multi-class road traffic network*

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## Tuesday, 29 October, continued

14:30-15:00 Break

15:00-16:00 Research presentations

- Luca Avena (UL)
- Mark de Berg (TU/e)
  *Throughput and Packet Displacements of Dynamic Broadcasting Algorithms*

16:00-18:00 Research session: work in small group

18:30u Dinner

## Wednesday, 30 October

07:30-09:00 Breakfast

09:00-10:15 Mini-course: Stella Kapodistria

10:15-10.45 Break

10:45-12:00 Mini-course: Jesper Nederlof

12:00-13:30 Lunch

13:30-14:30 Research presentations

- Rowel Gundlach (TU/e)
- Jaron Sanders (TU/e)
  *Markov chains for error accumulation in quantum circuits*

14:30-14:45 Break

14:45-15:45 Research presentations

- Mark van der Boor (TU/e)
  *Load balancing with little communication*
- Birgit Sollie (VU)
  *Parameter Estimation for Multivariate Population Processes: a Saddlepoint approach*

15:00-16:45 Research session: work in small groups

16:45-21:00 Social event and dinner

## Thursday, 31 October

07:30-09:00 Breakfast

09:00-10:15 Mini-course: Stella Kapodistria

10:15-10:45 Break

10:45-12:00 Mini-course: Jesper Nederlof

12:00-13:30u Lunch

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## Thursday, 31 October, continued

13:30-14:30 Research presentations

- Roel Lambers (TU/e)
- Celine Swennenhuis (TU/e)
  *Parameterized Complexity of Partial Scheduling*

14:30-15:00 Break

15:00-16:00 Research presentations

- Jop Briët (CWI)
  *Quantum algorithms are not quantum games*
- Fabian Stroh (UvA)

16:00-18:00 Research session: work in small groups

18:30 Dinner

## Friday, 1 November

07:30-09:00 Breakfast

09:00-10.15 Mini-course: Stella Kapodistria

10.15-10:45 Break

10:45-11:45 Mini-course: Jesper Nederlof

11:45-12:15 Jaap en Mark
*Let's discuss: Machine Learning and Artificial Intelligence*, closing session

12:15-13:00 Lunch

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## Abstracts

### Solon Pissis (CWI): Reverse-Safe Data Structures for Text Indexing

We introduce the notion of reverse-safe data structures. These are data structures that prevent the reconstruction of the data they encode. A data structure D is called z-reverse-safe when there exist at least z datasets with the same set of answers as the ones stored by D.
The main challenge is to ensure that D stores as many answers to useful queries as possible, is constructed efficiently, and has size close to the size of the original dataset it encodes. Given a text of length n and an integer z, we propose an algorithm which constructs a z-reverse-safe data structure that has size O(n) and answers pattern matching queries of length at most d optimally, where d is maximal for any z-reverse-safe data structure. The construction algorithm takes O(n^ω log n) time, where ω is the matrix multiplication exponent.

### Jop Briet: Quantum algorithms are not quantum games

At first sight, quantum algorithms and the model of nonlocal games--abstractions of experiments to demonstrate the physical reality of quantum entanglement--don't seem to have more in common than just having something quantum in them. But common connections with Grothendieck's inequality and characterizations in terms of similar-looking tensor norms suggest these two areas of quantum information theory might be closely connected. In 2012, Pisier even asked if the two relevant tensor norms are equivalent, which would in a sense imply that the distinction between quantum algorithms and games is superficial. This talk is about the recent resolution of this question in the negative, supporting the first impression that quantum algorithms and nonlocal games are indeed quite different after all.
Based on joint work with Carlos Palazuelos

### Jaap Storm: A diffusion-based analysis of a multi-class road traffic network

In traffic flow theory, an important class of models are the kinematic wave models. These model traffic with a conservation law in combination with the fundamental diagram, which describes the functional relation between the vehicle density and velocity. This has been a very fruitful branch of research, but most of the models are deterministic. Since traffic flow is significantly determined by various human factors, it has been argued that, in order to accurately describe and predict evolution of traffic densities, a good stochastic model is necessary.
In this talk I will present a stochastic model for the vehicle densities in a road traffic network used by multiple types of vehicles, which is completely consistent with the deterministic kinematic wave models. The models is tractable, in that the vehicle density process can be approximated by an appropriate Gaussian process. This Gaussian approximation can also be used to evaluate the travel time distribution. I will present our results and illustrate their usefulness with a number of relevant numerical experiments.

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**Jaron Sanders: Markov chains for error accumulation in quantum circuits**

We study a model for the accumulation of errors in multi-qubit quantum computations, as well as a model describing continuous errors accumulating in a single qubit. By modeling the error process in a quantum computation using two coupled Markov chains, we are able to capture a weak form of time-dependency between errors in the past and future. By subsequently using techniques from the field of discrete probability theory, we calculate the probability that error measures such as the fidelity and trace distance exceed a threshold analytically. The formulae cover fairly generic error distributions, cover multi-qubit scenarios, and are applicable to e.g. the randomized benchmarking protocol. To combat the numerical challenge that may occur when evaluating our expressions, we additionally provide an analytical bound on the error probabilities that is of lower numerical complexity, and we also discuss a state space reduction that occurs for stabilizer circuits. Finally, taking inspiration from the field of operations research, we illustrate how our expressions can be used to e.g. decide how many gates one can apply before too many errors accumulate with high probability, and how one can lower the rate of error accumulation in existing circuits through simulated annealing.
A preprint is available on https://arxiv.org/abs/1909.04432.

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