QUOPS:

Quantum algorithms for modern Optimization and Sampling

Simon Apers
(Université Paris Cité, CNRS, IRIF)

December 2022

QUOPS:

- funded via ANR JCJC
- duration: 48 months
- funding: €201.063
- CE 47 – Technologies quantiques – Axis E.6

QUOPS project

- **Principal investigator:**

  Simon Apers

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central question:

WHAT WILL QUANTUM COMPUTERS BE USEFUL FOR?

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design of QUANTUM ALGORITHMS
(and classical benchmarks)

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$\downarrow$

design of QUANTUM ALGORITHMS
(and classical benchmarks)

for/using
optimization, Markov chains, graph theory

- **Research collaborators:**

QUOPS project

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Frédéric Magniez
(CNRS)

expertise:
quantum and
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QUOPS project

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expertise:
quantum and streaming/distributed algorithms

Adrian Vladu (CNRS)

expertise:
combinatorial optimization, machine learning

Elie Bermot

expertise:
quantum machine learning

PhD student
(start in April ’22)

QUOPS project

goal:

design of new quantum algorithms for

QUOPS project

goal:

design of new quantum algorithms for

optimization (WP1)

QUOPS project

goal:

design of new quantum algorithms for

optimization (WP1)

and

sampling (WP2)

QUOPS project

goal:

design of new quantum algorithms for

optimization (WP1)

and

sampling (WP2)

by using

“modern” discrete $\leftrightarrow$ continuous methods

QUOPS project

"modern" **discrete** $\leftrightarrow$ **continuous** methods:

QUOPS project

“modern” **discrete** $\leftrightarrow$ **continuous** methods:

recent breakthroughs (e.g., max flow) combine

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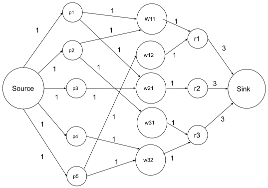
“modern” **discrete** $\leftrightarrow$ **continuous** methods:

recent breakthroughs (e.g., max flow) combine

discrete methods
(graphs)

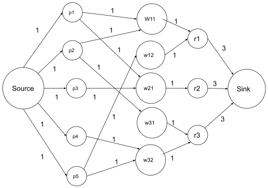


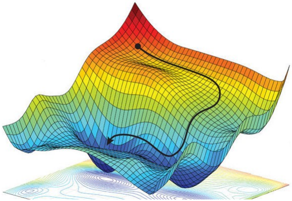
QUOPS project

“modern” **discrete** $\leftrightarrow$ **continuous** methods:

recent breakthroughs (e.g., max flow) combine

discrete methods (graphs) with continuous methods (convex optimization)





prior work:

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• quantum speedups for
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minimum (s-t) cut (CCC'21)

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- quantum walks for sampling (ESA'19, STACS'21)

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first results:

QUOPS project

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first results:

- quantum walks and electric flows (arXiv:2211.16379)

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minimum (s-t) cut (CCC'21)

• quantum walks for sampling (ESA'19, STACS'21)

first results:

• quantum walks and electric flows (arXiv:2211.16379)

• quantum speedups for
interior point methods and linear programming (ongoing)