QuAS: Quantum Application Score

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QuAS: Quantum Application Score

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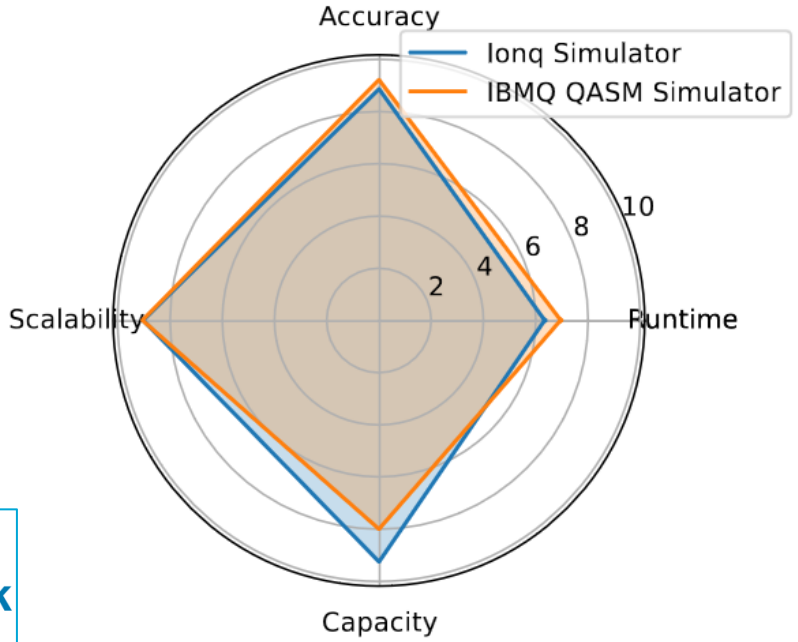
QPack Scores

- Application based benchmark
- Performance metric
- 7 test problems - QAOA & VQE
- Gate-based quantum computers
- Vendor agnostic



QPack: Quantum Approximate Optimization Algorithms as benchmark for quantum computers

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QPack Scores: Quantitative performance metrics for application-oriented quantum computer benchmarking

Huub Donkers, *Quantum & Computer Engineering*
Koen Mesman, *QBlox*
Zaid Al-Ars, *Quantum & Computer Engineering*
Matthias Möller, *Numerical Analysis, DIAM*

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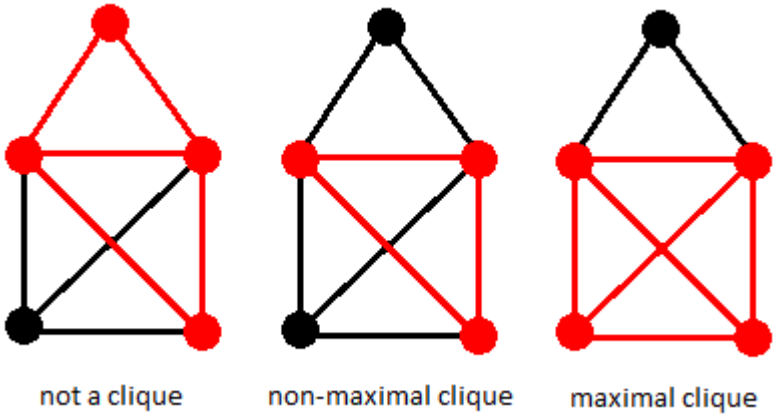
Hardware-agnostic Max-Clique (Q-Score)

- Implemented Q-score on annealing devices
- Max-Clique in Q-score framework
- Find the largest clique: complete subgraph in graph
- Natively solvable on **photonic**, **annealing** and **gate-based** quantum hardware
- First quantum metric evaluation for all three quantum paradigms, as well as classical devices



Q-score Max-Clique: The First Quantum Metric Evaluation on Multiple Computational Paradigms

Ward van der Schoot[1], Robert Wezeman[1], Niels M. P. Neumann[1], Frank Phillipson[1,2], and Rob Kooij[1,3]

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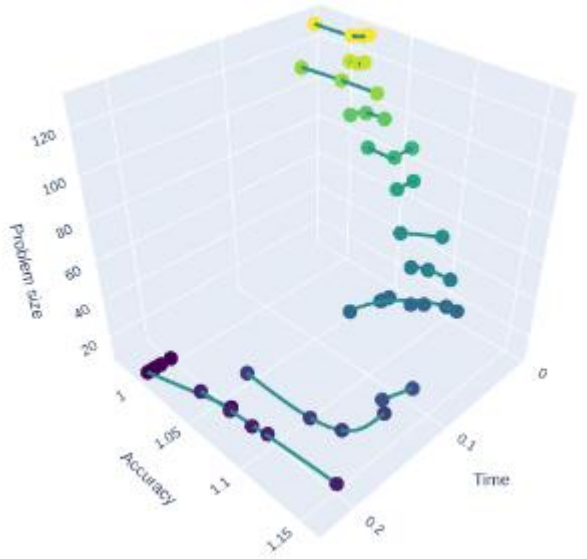
QuAS: Quantum Application Score - aim

- User-tailored scoring metric
  - Hardware
  - Problem
  - KPI
- Hardware Agnostic
- Single but subdivisible score
- Clear representation of trade-offs
- Scalable



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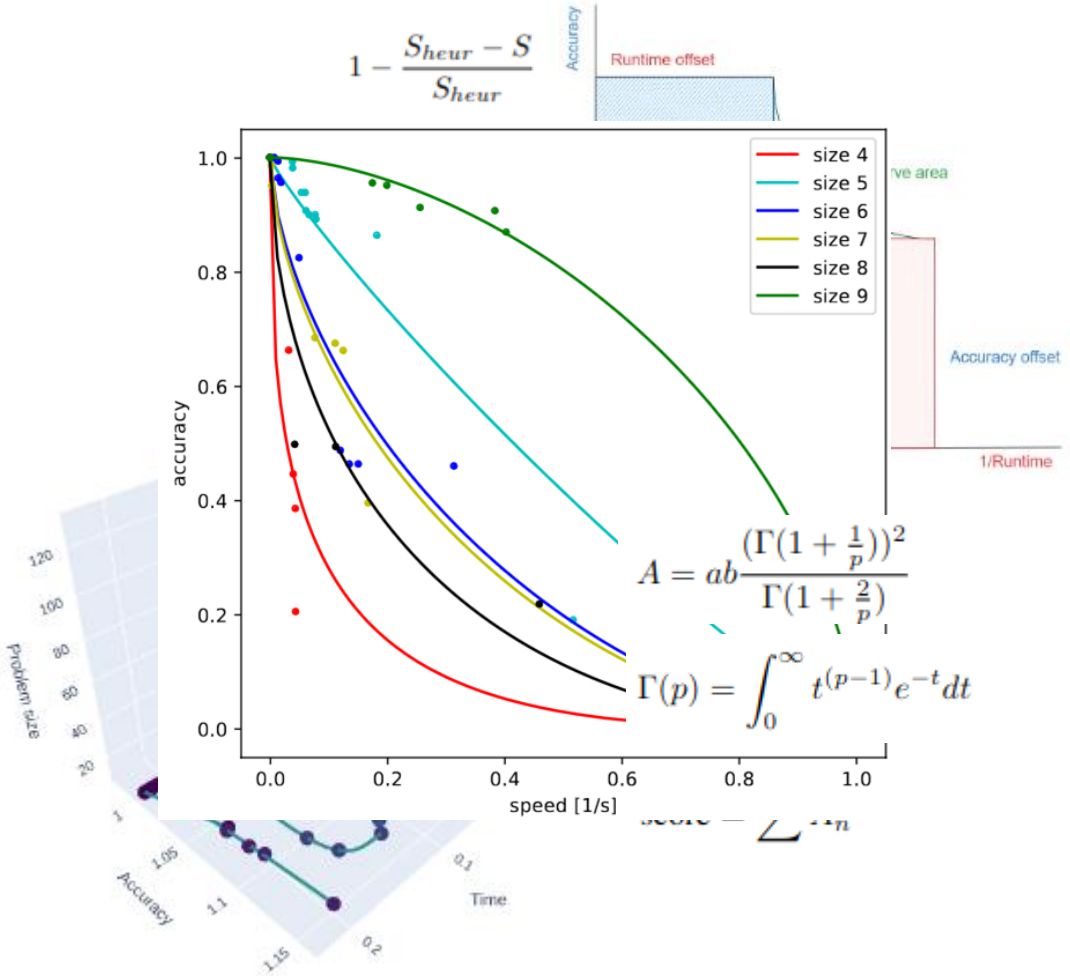
Method

- Determine Pareto front
- Scale using accuracy and runtime offset
- Fit to Lame curve (Lp-norm)
- Sum of Area scores
- Heuristic as reference



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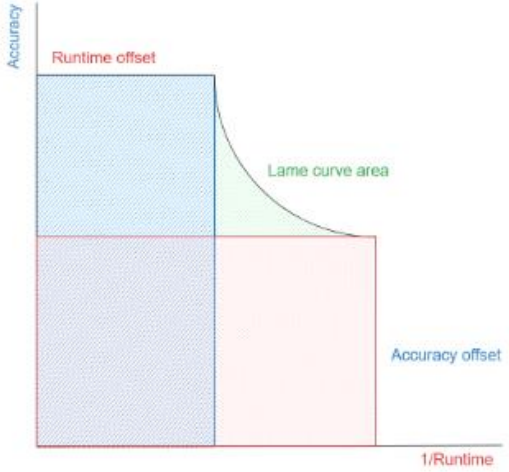
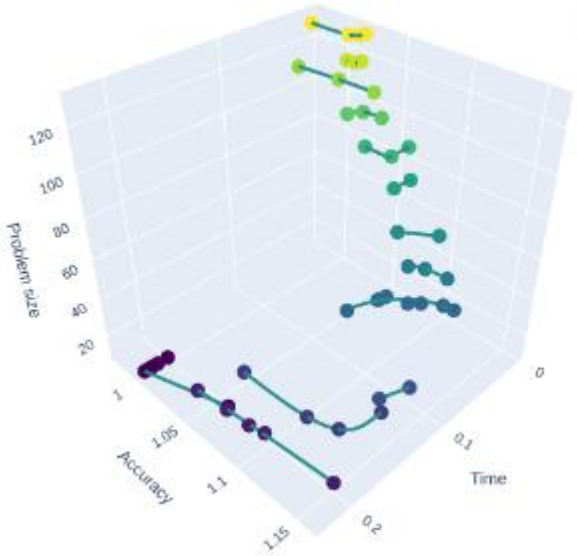
Method

- Score always increases for larger problem instances
- Scaling and offset give insights
- p-norm describes KPI trade-off





$$A = ab\frac{(\Gamma(1+\frac{1}{p}))^2}{\Gamma(1+\frac{2}{p})}$$

$$\text{score} = \sum^{n} A_n$$

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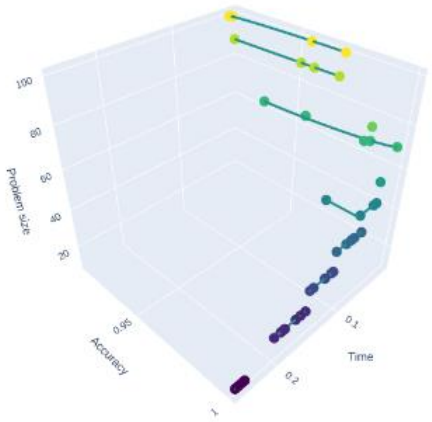
QuAS scores

Tested implementations: **D-Wave**, IBM, Quantum Inspire and Rigetti



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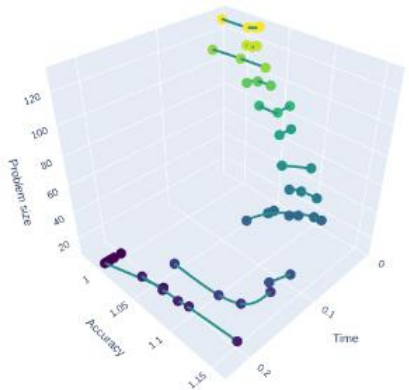
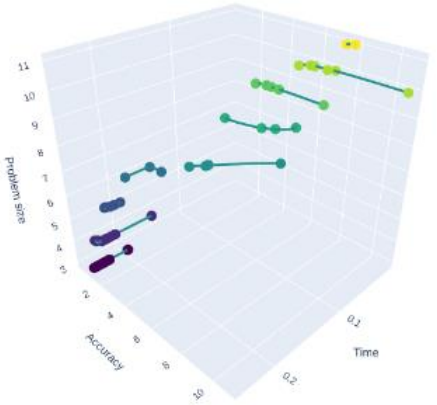


Max-Cut



Traveling Salesperson

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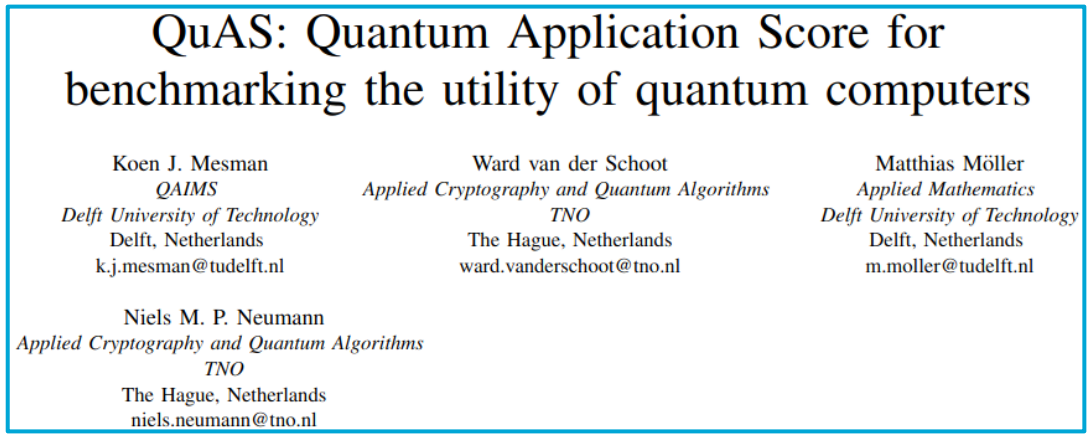
Conclusion

- User-tailored scoring metric
  - KPI's
  - Applications
  - Weight-scaling
- Hardware & resource Agnostic
  - Gate based quantum
  - Quantum annealers
  - classical computers
- Comparable, insightful score
- Scalable



QuAS: Quantum Application Score for benchmarking the utility of quantum computers

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