HiGHS Newsletter 25.0

This newsletter announces the upcoming second HiGHS workshop, discusses GPU accelerated optimization, and introduces the three new members of the team.

The second HiGHS workshop

The second HiGHS workshop will take place in Edinburgh on 26-27 June, following EURO in Leeds on 23-25 June. Confirmed participants include Huangfu Qi (COPT) and Oscar Dowson (JuMP). HiGHS would not exist without Qi, and Oscar has been a very important guide and supporter of the project. Some of the industrial participants in the first workshop will be returning, and registration is via workshop25.highs.dev.

GPU-accelerated optimization

Primal-dual linear programming (PDLP) is an emerging solution technique for LPs that has created increasing excitement since its initial CPU implementation appeared (Applegate, et al - 2021). Its overwhelming computational cost is a matrix-vector product using the LP constraint matrix, so it is suitable for acceleration using GPUs. Such an implementation (cuPDLP-C) appeared in early 2024, and, since it's MIT licensed, its CPU variant was soon integrated within HiGHS. Since the release of HiGHS v1.10.0 in March 2025, it has been possible to run cuPDLP-C on NVIDIA GPUs. The genuine excitement about a novel high-performance solver for LPs reached its peak on March 18 2025, when Jensen Huang announced that NVIDIA's cuOpt would be made available as open source. cuOpt contains NVIDIA's implementation of PDLP, as well as a heuristic MIP solver that runs on a GPU, but uses the HiGHS MIP solver on a CPU to achieve proven optimality.

However, questions have been raised (for example by Rothberg in a recent Gurobi webinar) about the accuracy of the solutions obtained by PDLP. As a first order method, the linear convergence of PDLP means that finding high-accuracy solutions is relatively more expensive than when using an interior point method. PDLP also terminates when optimality criteria relative to the magnitudes of the costs and RHS values of the LP are satisfied. Hence, when these contain large values, it is possible for absolute optimality criteria to be far from satisfied. Julian Hall has been carrying out experiments to study the accuracy and speed of cuPDLP-C relative to the HiGHS interior point solver (IPX) using the Mittelmann benchmark LP problems. For one of these (L2CTA3D) cuPDLP-C terminates with a claim of optimality almost immediately. Although the relative optimality criteria are satisfied, the absolute errors are of order 100, which may render the solution meaningless. PDLP is also not robust: for an LP with two variables, one simple constraint, and one redundant inequality (constructed to study the effect of large RHS values) cuPDLP-C diverges.

In one published comparison, PDLP was run on a cutting-edge GPU and its performance then assessed relative to a commercial interior point solver running using one thread on a modest CPU, so a reasonable and equitable testing environment is important. Since the best GPUs are very expensive, Julian felt that for HiGHS users, a performance comparison on more modest hardware was appropriate. Using an NVIDIA RTX 5000 Ada GPU and an i7-13700HX CPU on a £3k laptop, he tested with the 48 Mittelmann LP instances, using a time limit of 15,000 seconds. Julian found that IPX solved 39 instances, whereas cuPDLP-C "solved" 41 and was 1.6 times faster. There was a very wide range in the relative solution times using the two methods. However, when cuPDLP-C claimed optimality, in 8 cases (including L2CTA3D) the violation of absolute optimality tolerances was at least of order one. The conclusion is that PDLP can solve some LP problems significantly faster than interior point or simplex, and a few HiGHS users have already reported this, but it's the exception rather than the rule, and the accuracy of the claimed solution must be assessed. HiGHS v1.11.0 will do this internally and return measures allowing users to make their own judgement. The HiGHS team has also started to develop its own PDLP implementation. This will replace cuPDLP-C in HiGHS, and provide an environment for research.

New members of the HiGHS team

Mark Turner

From Melbourne, Australia, Mark Turner has a BSc and MSc majoring in Discrete Mathematics and Operations Research from The University of Melbourne, and a PhD supervised by Thorsten Koch from Technische Universität Berlin. From 2020 to 2025 Mark was a part of the SCIP development team at Zuse Institute Berlin, and joined the HiGHS team as a MIP developer in May 2025.

Ben Champion

From Thousand Oaks, California, USA, Ben Champion has a BA and MMath from the University of Cambridge and a decade of experience in the financial industry. Since September 2024, Ben is working to enhance the HiGHS mixed integer solver for energy system models, as part of a PhD at the University of Edinburgh funded by Kraken Technologies Ltd.

Yanyu Zhou

Born in Yongzhou, China, Yanyu Zhou completed a bachelor's degree at Jinan University in Shenzhen. Following this, Yanyu pursued an engineering degree (equivalent to a master's) at ENSTA Paris in France. In September 2024, she began a PhD at the University of Edinburgh under the supervision of Julian Hall, focusing on first-order algorithms for large-scale linear programming.