

Latest Benchmark Results

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Services we provide

- Guide to Software: "**Decision Tree**"
- <http://plato.asu.edu/guide.html>
- Software Archive
- Software Evaluation: "**Benchmarks**"
- Archive of Testproblems
- Web-based Solvers (**1/3 of NEOS**)

Overview of Talk

- **Current and Selected (*) Benchmarks (as of 10-12-20)**
 - **Benchmarks of Continuous Optimization Software**
 - * **Simplex/Barrier QPLIB, [SOCP, SDP, NLP]**
 - **Benchmarks of Discrete Optimization Software**
 - * **MILP, QPLIB, [MISOCP, MINLP]**
- **Observations and Conclusions**

COMBINATORIAL OPTIMIZATION

Concorde-TSP with different LP solvers (12-11-2019)

LINEAR PROGRAMMING

* Benchmark of Simplex LP solvers (11-2-2020)

* Benchmark of Barrier LP solvers (11-2-2020)

Large Network-LP Benchmark (commercial vs free) (11-2-2020)

SEMIDEFINITE/SQL PROGRAMMING

SQL problems from the 7th DIMACS Challenge (8-8-2002)

Several SDP codes on sparse and other SDP problems (6-6-2020)

Infeasible SDP Benchmark (10-12-2020)

Large SOCP Benchmark (9-24-2020)

MISOCP Benchmark (6-14-2020)

PROBLEMS WITH EQUILIBRIUM CONSTRAINTS

MPEC Benchmark (6-3-2020)

MIXED INTEGER LINEAR PROGRAMMING

* MILP Benchmark - MIPLIB2017 (10-2-2020)

MILP cases that are slightly pathological (10-11-2020)

NONLINEAR PROGRAMMING

AMPL-NLP Benchmark (6-3-2020)

MIXED INTEGER QPs and QCPS

Non-commercial convex QP Benchmark (11-1-2019)

* Binary Non-Convex QPLIB Benchmark (10-7-2020)

* Discrete Non-Convex QPLIB Benchmark (non-binary) (10-8-2020)

* Continuous Non-Convex QPLIB Benchmark (10-10-2020)

* Convex Continuous QPLIB Benchmark (9-27-2020)

* Convex Discrete QPLIB Benchmark (10-8-2020)

MIXED INTEGER NONLINEAR PROGRAMMING

MINLP Benchmark (10-16-2020)

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2 Nov 2020 =====
 Benchmark of Simplex LP solvers
 =====
 H. Mittelmann (mittelmann@asu.edu)

This benchmark was run on a Linux-PC (i7-4790K, 4.0GHz, 32GB).

MOSEK-9.2.20 www.mosek.com
 CLP-1.17.6 projects.coin-or.org/Clp
 Google-GLOP LP with Glop
 SOPLEX-5.0.0 soplex.zib.de/
 Gurobi-9.1.0 gurobi.com
 GLPK-4.65 www.gnu.org/software/glpk/glpk.html
 MATLAB-R2020a mathworks.com (dual-simplex)
 COPT-1.4.3 [Cardinal Optimization]
 MindOpt-0.10.0 [alibabaUS]
 HiGHS-1.0.0: HiGHS [ERGO-Code]
 SAS-OR-15.1: SAS (dual-simplex)

Unscaled and scaled shifted (by 10 sec) geometric mean of runtimes

	428	201	836	1105	50.0	3094	926	59.3	84.3	811	432
	8.55	4.01	16.7	22.1	1	61.9	18.5	1.19	1.68	16.2	8.63
solved	38	40	34	36	40	27	32	40	37	33	36
=====											
40 probs	MSK	CLP	GLOP	SPLX	Gurob	GLPK	MATL	COPT	MDOPT	HiGHS	SAS
=====											

2 Nov 2020 =====
 Benchmark of Barrier LP solvers
 =====
 H. Mittelmann (mittelmann@asu.edu)

This benchmark was run on a Linux-PC (i7-4790K, 4GHz, 32GB).

The barrier methods were tested of:

MOSEK-9.2.21 www.mosek.com
 MATLAB-R2020a mathworks.com (interior-point, NO CROSSOVER!)
 Gurobi-9.1.0 gurobi.com
 CLP-1.17.6 projects.coin-or.org/Clp
 SAS-OR-15.1 SAS
 Tulip-0.5.1 [Tulip at Github]
 COPT-1.4.3 [Cardinal Optimization]

Unscaled (w/o first 5) and scaled shifted (by 10 sec) geometric mean of runtimes

	33.8	514	16.3	786	106	558	36.9
45 probs	2.36	30.7	1	47.4	5.26	36.2	2.39
solved	44	34	45	37	43	35	45
=====							
problem	MOSEK	MATLAB	Gurobi	CLP	SAS	TULIP	COPT
=====							

10 Oct 2020

```

=====
Continuous Non-Convex QPLIB Benchmark
=====
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```

Logfiles at plato.asu.edu/ftp/cnconv_logs/

```

Baron-20.4.14    BARON
ANTIGONE-1.1    ANTIGONE
SCIP-7.0.0      SCIP/SOPLEX
COUENNE-0.5     COUENNE [projects.coin-or.org/Couenne]
MINOTAUR-0.2.1  MINOTAUR
Octeract-1.07.29 OCTERACT
Gurobi-9.0.3    GUROBI

```

The above solvers were run on an Intel Xeon E5-4657L (48 cores, 512GB) on the continuous non-convex problems (102 total) from QPLIB. Times given are elapsed times in seconds. Time limit 3hrs. Only those instances are shown for which at least one solver succeeded. Shifted and scaled geometric mean of runtimes:

mean	1.59	1.83	4.39	4.63	3.55	2.47	1
solved	29	25	8	6	12	16	28*
=====							
prob#	ANTIGONE	BARON	COUENNE	MINOTAUR	SCIP	OCTERACT	GUROBI

27 Sep 2020

```
=====  
Convex Continuous QPLIB Benchmark  
=====  
H. Mittelmann (mittelmann@asu.edu)
```

Logfiles at plato.asu.edu/ftp/cconvex_logs/

```
MOSEK-9.2.24    MOSEK  
KNITRO-12.2    KNITRO  
IPOPT-3.13.0   [Ipoprt at Github]  
Gurobi-9.0.3   GUROBI
```

The above solvers were run on a 3 GHz Intel i7-5960X (8 cores, 48GB) on the 32 continuous convex problems from QPLIB. Times given are elapsed times in seconds; time limit 2hrs, 8 threads
Shifted and scaled geometric mean of runtimes:

```
mean      1    1.56    3.64    1.31  
solved    29    30     28     30  
=====
```

prob#	MOSEK	KNITRO	IPOPT	Gurobi
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```
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```

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- Observations and Conclusions

2 Oct 2020

```
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The MIPLIB2017 Benchmark Instances
=====
H. Mittelmann (mittelmann@asu.edu)
```

The following codes were run with a limit of 2 hours on the MIPLIB2017 benchmark set on two platforms.

1 thread: Intel i7-4790K, 4 cores, 32GB, 4GHz;
8 threads: Intel i7-5960X, 8 cores, 48GB, 3Ghz;

CBC-2.10.5: projects.coin-or.org/Cbc
GLPK-4.65: www.gnu.org/software/glpk/glpk.html
LP_SOLVE-5.5.2: lpsolve.sourceforge.net/
MATLAB-2020a: MATLAB (intlinprog)
SAS-OR-15.1: SAS
(F)SCIP/spx]-7.0.0: FiberSCIP (SCIP+SOPLEX on 1 thread)
Gurobi-9.0.3: Gurobi

2 Oct 2020

```
=====
The MIPLIB2017 Benchmark Instances
=====
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```

The third line lists the number of problems (240 total) solved.

1 thr	CBC	GLPK	LP_SOL	MATLAB	SAS	SCIP	Gurobi
unscal	2107	5032	5335	3301	743	1100	260
scaled	8.10'	19.4	20.5	12.7	2.86	4.23	1
solved	89	23	20	63	147	125	205

8 thr	CBC	SAS	FSCIP	Gurobi
unscal	1723	580	1065	151
scaled	11.4	3.85	7.06	1
solved	98	157	138	219

7 Oct 2020

```

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Binary Non-Convex QPLIB Benchmark
=====
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```

Logiles at plato.asu.edu/ftp/qplib_logs/

```

Baron-20.14.4      BARON
(F)SCIP-7.0.0      (Fiber)SCIP-SOPLEX (only open source code included)
ANTIGONE-1.1       ANTIGONE
MINOTAUR-0.2.1     MINOTAUR
OCTERACT-1.07.29  OCTERACT
Gurobi-9.0.3       Gurobi

```

The above solvers were run on a 3 GHz Intel i7-5960X (8 cores, 48GB) on the binary nonconvex problems (128 total) from QPLIB. Times given are elapsed times in seconds. Mipgap is zero, time limit 1hr; 8 threads, except SCIP&Minotaur. Only those instances are shown for which at least one solver succeeded. Shifted and scaled geometric mean of runtimes:

mean	16	53	65	87	21	1	45
solved	42	26	23	7	36	81	34
=====							
prob#	BARON	SCIP	ANTIGONE	MINOTAUR	OCTERACT	GUROBI	FSCIP

```

8 Oct 2020      =====
Discrete Non-Convex QPLIB Benchmark (non-binary)
=====
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```

Logfiles at plato.asu.edu/ftp/nonbinary_logs/

```

Baron-20.4.14    BARON
ANTIGONE-1.1     ANTIGONE
SCIP-7.0.0       SCIP/SOPLEX
COUENNE-0.5      projects.coin-or.org/Couenne
MINOTAUR-0.2.1   MINOTAUR
OCTERACT-1.07.29 OCTERACT
Gurobi-9.0.3     Gurobi

```

The above solvers were run on an Intel Xeon E5-4657L (48 cores, 512GB) on the discrete non-convex problems (160 total) with not only binary variables from QPLIB. Times given are elapsed times in seconds. Time limit 3hrs. Only those instances are shown for which at least one solver succeeded. Shifted and scaled geometric mean of runtimes:

mean	17.2	14.3	7.31	37.5	43.0	11.9	31.8	1
solved	29	31	32	8	4	30	8	65
=====								
prob#	ANTIGONE	BARON	FSCIP	COUENNE	MINOTAUR	SCIP	OCTERACT	GUROBI

8 Oct 2020

=====
Convex Discrete QPLIB Benchmark
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Logiles at plato.asu.edu/ftp/convex_logs/

MOSEK-9.2.18	MOSEK
KNITRO-12.2	KNITRO
Baron-20.4.14	BARON
Bonmin-1.8.7	BONMIN (with CBC and Ipopt)
SCIP-7.0.0	SCIP with SOPLEX-5.0.0
ANTIGONE-1.1	ANTIGONE
MINOTAUR-0.2.1	MINOTAUR
Gurobi-9.0.3	Gurobi
Shot-1.0	SHOT with CBC
OCTERACT-1.07.29	OCTERACT

The above solvers were run on a 3 GHz Intel i7-5960X (8 cores, 48GB) on the 31 discrete convex problems from QPLIB. Times given are elapsed times in seconds. Mipgap zero, time limit 2hrs, 8 threads; SCIP, Minotaur 1 thread
Shifted and scaled geometric mean of runtimes:

mean	13.2	19.8	7.99	19.3	15.5	50.8	32.0	1	59.5	36.3
solved	11	9	16	10	11	2	11	25	1	7

=====
prob# MOSEK KNITRO BARON BONMIN SCIP ANTIGONE MINOTAUR GUROBI SHOT OCTERACT

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"TOP PERFORMERS"

LP-Simplex:	COPT, MindOpt, Gurobi
LP-Barrier:	Gurobi, MOSEK, SAS
Network-LP:	SAS, Gurobi, COPT
MILP:	Gurobi, SAS, (F)SCIP
SOCP:	MOSEK, Gurobi
MISOCP:	Gurobi, MOSEK, SCIP
nonc BQCP:	Gurobi, BARON, FSCIP
nonc DQCP:	Gurobi, FSCIP, BARON
nonc CQCP:	Gurobi, ANTIGONE, BARON
conv DQCP:	Gurobi, BARON, MOSEK
conv CQCP:	MOSEK, Gurobi, KNITRO
MINLP:	BARON, SCIP

Thank you!

slides at: <http://plato.asu.edu/talks/>

Expect updates soon!