

Useful Tips and Tricks for Getting Started with Gurobi

Dan Jeffrey



GUROBI
OPTIMIZATION

The World's Fastest Solver

Welcome to the Webinar

Useful Tips and Tricks for Getting Started with Gurobi



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Speaker Introduction

Dan Jeffrey

- Has twenty years of professional experience in Math Programming and Data Science, working as a technical product expert and as a consultant
- He has architecture and programming expertise with all major computer programming languages, math programming experience with Python, AMPL, and OPL plus programming expertise with the AMPL Solver library.
- Dan is a MIP Fanatic — working as a member of the Gurobi Support Team.



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Agenda

Running Gurobi

Key Documentation

- Modeling basics
- Reference documents and how to use them
- Modeling Videos
- Zendesk Guide

Sample Models

- API examples
- Building block examples
- Online examples
- Optimization Application Demos

Performance

- Generating model files
- Tuning
- Solver logs
- Videos



Running Gurobi

Quick Start:

- Quick Start for install <https://www.gurobi.com/resource/starting-with-gurobi/>

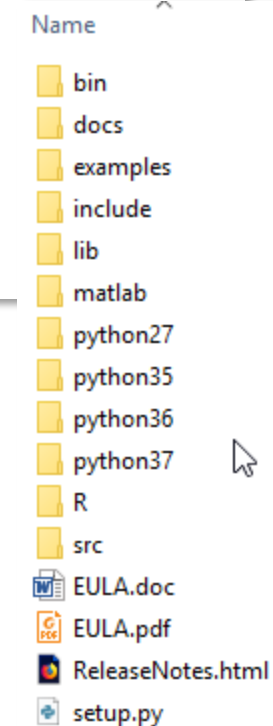
Download Gurobi

- <https://www.gurobi.com/downloads/gurobi-optimizer-eula/>

Install

- Set three environment variables
 - export GRB_VER=811
 - export GUROBI_HOME=/opt/gurobi\${GRB_VER}/linux64
 - export PATH=\${GUROBI_HOME}/bin:\${GUROBI_SERVER_HOME}/bin:"\${PATH}"
 - export LD_LIBRARY_PATH=\${GUROBI_HOME}/lib
 - Windows installer does this for you
- License
 - Install on the correct computer
 - Caution with Compute Server and other license types that are client/server
- Commonly-used Gurobi programs:
 - gurobi.sh or gurobi.bat - interactive shell (Python)
 - gurobi_cl - command line solver
 - grbtune - tuner (more later)
- API-specific installation instructions
 - in Quick Start

```
~$ ls --format=single-column
./
../
EULA.pdf*
R/
ReleaseNotes.html
bin/
docs/
examples/
include/
lib/
matlab/
setup.py
src/
```



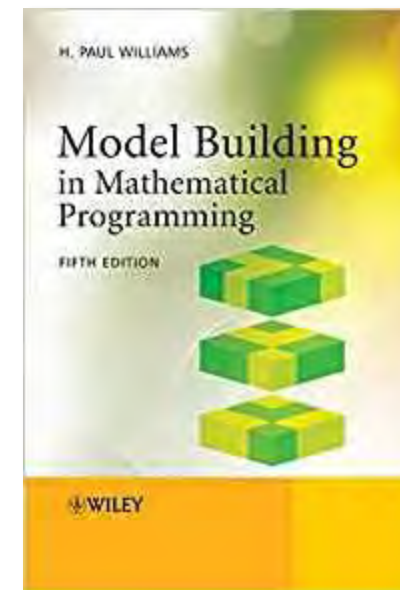
First Steps

Modeling – for those new to math programming

- <https://www.gurobi.com/resource/modeling-basics/>
- Books: <https://www.gurobi.com/resource/books-blogs/>
- Introductory Modeling Videos
 - <https://www.gurobi.com/resource/abremod-getting-started-intro/>
 - <https://www.gurobi.com/resource/abremod-getting-started-main/>
 - <https://www.gurobi.com/resource/abremod-getting-started-end/>

Reference documents and how to use them

- <https://www.gurobi.com/documentation/current/refman/index.html>
- API filter
 - Check your language
 - Filters menu choices, not search though
- Most important Page: API Details
https://www.gurobi.com/documentation/current/refman/py_python_api_details.html
- parameters - esp Parameter Guidelines
<https://www.gurobi.com/documentation/current/refman/parameters.html>
- attributes
<https://www.gurobi.com/documentation/current/refman/attributes.html>



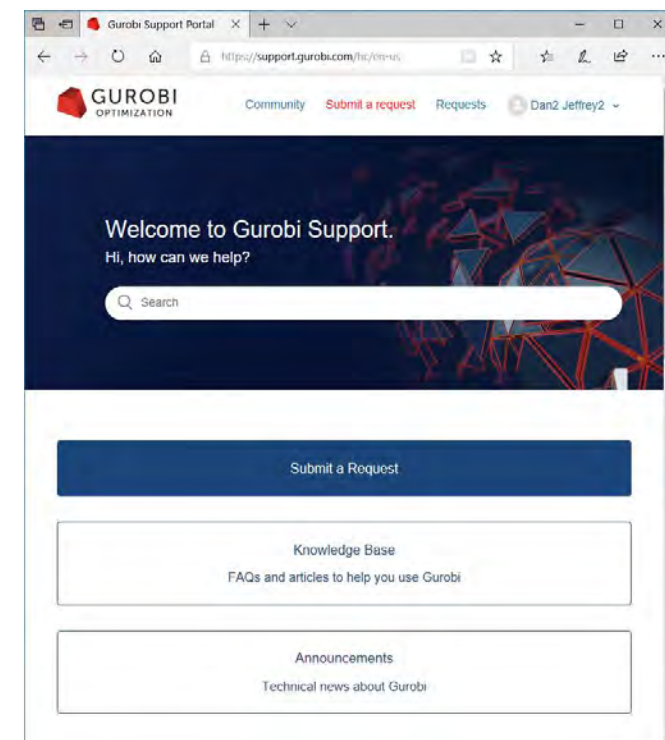
Next Steps

Support Portal

- Knowledge Base
 - <https://support.gurobi.com/hc/en-us/categories/360000840331-Knowledge-Base>
- Community
 - <https://support.gurobi.com/hc/en-us/community/topics>
 - Replaces Google Group
- Submit a ticket

Python

- Installing Gurobi into Python
 - setup.py
 - Anaconda
- Python modeling tutorials:
 - <https://www.gurobi.com/resource/python-i-webinar/>
 - <https://www.gurobi.com/resource/python-ii-webinar/>
 - <https://www.gurobi.com/resource/python-iii-webinar/>



Sample Models

Product Examples

- $\$GUROBI_HOME/examples/<your\ favorite\ language>$
- API examples
- Building block examples
- Don't miss /build
- Example Tour

<https://www.gurobi.com/documentation/current/examples/examples.html>

Online examples

- Product samples indexed
<https://www.gurobi.com/resource/functional-code-examples/>
- Modeling examples
<https://www.gurobi.com/resource/modeling-examples/>
- Modeling library
<https://github.com/Gurobi/modeling-examples>

Optimization Application Demos

<http://demos.gurobi.com>

Video: <https://www.gurobi.com/resource/gurobi-optimization-application-demos/>

```
R/  
build/  
c/  
c#/  
c++/  
data/  
java/  
matlab/  
python/  
vb/
```

examples/build:

```
DOTNETCore2  
projects2015  
projects2017  
C_examples_2015.sln  
C_examples_2017.sln  
C++_examples_2015.sln  
C++_examples_2017.sln  
CS_examples_2015.sln  
CS_examples_2017.sln  
runjava.bat  
runpython.bat  
VB_examples_2015.sln  
VB_examples_2017.sln
```

```
~$ ls --format=s  
DOTNETCore2  
Makefile  
diet_c
```

```
callback.py  
custom.py  
dense.py  
diet.py  
diet2.py  
diet3.py  
diet3a.py  
diet4.py  
dietmodel.py  
facility.py  
feasopt.py  
fixanddive.py  
genconstr.py  
gurobi.log  
lp.py  
lpmethod.py  
lpmod.py  
mip1.py  
mip2.py  
multiobj.py  
netflow.py  
params.py  
piecewise.py  
poolsearch.py  
portfolio.py  
qcp.py  
qp.py  
sensitivity.py  
sos.py  
sudoku.py  
tsp.py  
tune.py  
workforce1.py  
workforce2.py  
workforce3.py  
workforce4.py  
workforce5.py
```

Performance

Videos

- <https://www.gurobi.com/resource/improving-the-performance-of-the-gurobi-optimizer/>
- <https://www.gurobi.com/resource/intro-to-tuning-webinar/>
- <https://www.gurobi.com/resource/parameter-setting/>

Solver logs

- <https://www.gurobi.com/documentation/8.1/refman/logging.html>

Tuning

- grbtune
- Gurobi support for maintenance customers
- Video: <https://www.gurobi.com/resource/automatic-tuning-tool/>

Generating model files

- `model.write("filename.mps")`
or
- <https://support.gurobi.com/hc/en-us/articles/360030716132-Upload-Files-for-Testing-Tuning-and-Benchmarking>

```
Gurobi Optimizer version 8.1.0 build v8.1.0rc1 (linux64)
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Read MPS format model from file glass4.mps
Reading time = 0.02 seconds
glass4: 396 rows, 322 columns, 1815 nonzeros
Optimize a model with 396 rows, 322 columns and 1815 nonzeros
Variable types: 20 continuous, 302 integer (0 binary)
Coefficient statistics:
  Matrix range [1e+00, 8e+06]
  Objective range [1e+00, 1e+06]
  Bounds range [1e+00, 8e+02]
  RHS range [1e+00, 8e+06]
Presolve removed 4 rows and 5 columns
Presolve time: 0.01s
Presolved: 392 rows, 317 columns, 1815 nonzeros
Variable types: 19 continuous, 298 integer (298 binary)
Found heuristic solution: objective 3.133356e+09

Root relaxation: objective 8.000024e+08, 72 iterations, 0.00 seconds

  Nodes | Current Node | Objective Bounds | Work
Expl Unexpl | Obj Depth IntInf | Incumbent BestBd Gap | It/Node Time
-----|-----|-----|-----|-----|-----|-----|-----|-----|-----
  0  0 8.0000e+08  0 72 3.1334e+09 8.0000e+08 74.5% - 0s
H  0  0          2.400019e+09 8.0000e+08 66.7% - 0s
  0  0 8.0000e+08  0 72 2.4000e+09 8.0000e+08 66.7% - 0s
H  0  0          2.066683e+09 8.0000e+08 61.3% - 0s
  0  0 8.0000e+08  0 72 2.0667e+09 8.0000e+08 61.3% - 0s
  0  0 8.0000e+08  0 72 2.0667e+09 8.0000e+08 61.3% - 0s
  0  2 8.0000e+08  0 72 2.0667e+09 8.0000e+08 61.3% - 0s
```

Thank You – Questions?



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