Grid Optimization (GO) Competition
Platform Interaction and Entry Submission

STEPHEN ELBERT

Webinar 2
February 21, 2019, 12:00 pm ET
Preparing to Submit—your environment

- Download available datasets
  - Sandbox (easy starting point)
  - Challenge 1 Original Datasets 1 & 2
  - Trial 1, 2 and Final datasets will not be available ahead of time

- Create Code 1
  - Runs with 10 (Real-time) or 45 (Offline) minute time limit
  - Creates solution1.txt (base case)

- Create Code 2
  - Longer time limit
  - Creates solution2.txt (contingency solution)

- Score solution files with [https://github.com/GOC ompetition/Evaluation](https://github.com/GOC ompetition/Evaluation)

- Code invocation syntax on Languages page
  [https://gocompetition.energy.gov/languages](https://gocompetition.energy.gov/languages)
Preparing to Submit as Entrant

► Account Registration
  ■ Individuals
  ■ Team
    ○ GitHub username
    ○ Install SSH Key
    ○ Create repo with Code1, Code2, and submission.conf (if relevant; versioning, MPI)

► Eligibility, Documents for ARPA-E, and Platform Access
  ■ Registration Approval (via ARPA-E) → Sandbox submission
  ■ Sandbox qualification → Challenge 1 submission
Setting the GitHub SSH Key

- Your team will be assigned an SSH key on the Team account page
  - Enter just the username, not http://github.com/username
  - The username is not case sensitive but the entry on the team page is because of the SSH Key
  - SSH (Secure Shell) keys are an access credential that are used in the SSH protocol
  - SSH keys are an authentication method used to gain access to an encrypted connection between systems
  - Allows the GO Competition platform to securely connect and download a team’s submission code
  - [https://gocompetition.energy.gov/github-and-go-competition](https://gocompetition.energy.gov/github-and-go-competition)

- Copy the team’s SSH key (you can use the convenient copy button)
- Log in to your team’s account on GitHub
- Go to Settings under your Public Profile icon
  - Icon is in the top-right navigation menu and “Settings” is in the drop-down list
- Go to “SSH and GPG keys” in the left menu bar or [https://github.com/settings/keys](https://github.com/settings/keys)
- Click on the “New SSH key” green button located at the top right of the SSH keys page
  - Create a title for your key (for example, GO Competition SSH key)
  - Paste the SSH text from the GO Competition Portal Team page into the Key text box
  - Click “Add SSH key” button
- Your new key is added to your SSH Key list and you are ready to test a GO Competition submission
GitHub SSH Key Diagram

This webinar is being recorded for instructional purposes

February 21, 2019
Software Environment

Languages
https://gocompetition.energy.gov/languages
- Input Parameters
- Submission.conf
- C/C++
- GAMS
- Julia/JuMP
- Java/Scala
- Python
- MATLAB/MATPOWER
- Linux binary executables

Solver Libraries
https://gocompetition.energy.gov/available-solvers
- CPLEX
- CVX
- GAMS
- Gurobi
- Ipopt
- MATLAB/MATPOWER
- Mosek
- PowerWorld
- Siemens PSS®E

See website for current versions and restrictions
If you need something not currently provided, contact arpacomp@pnnl.gov
Challenge specific
- Problem Definition
- Input Files and Format
- Output Files and Format
- Evaluation
- Scoring
- Leaderboard

Background
- Inspiration
- Timeline
- Prizes
- About

Stay in Touch
- FAQs
- Forum
- News
- Definitions

General References
- Getting Started
- Available Solvers
- Languages
- Evaluation Platform Information
- GitHub
- How to
  - Register
  - Create a Team
  - Make a Submission
- Rules

Items in red: check website frequently for updates!
Login

NOTICE

**WARNING**

This is a Department of Energy (DOE) computer system. DOE computer systems are provided for the processing of official U.S. Government information only. All data contained within DOE computer systems is owned by the DOE, and may be audited, intercepted, recorded, read, copied, or captured in any manner and disclosed in any manner, by authorized personnel. THERE IS NO RIGHT OF PRIVACY IN THIS SYSTEM. System personnel may disclose any potential evidence of crime found on DOE computer systems to appropriate authorities. USE OF THIS SYSTEM BY ANY USER, AUTHORIZED OR UNAUTHORIZED, CONSTITUTES CONSENT TO THIS AUDITING, INTERCEPTION, RECORDING, READING, COPYING, CAPTURING, and DISCLOSURE OF COMPUTER ACTIVITY.

**WARNING**

Username or e-mail address *

You may login with either your assigned username or your e-mail address.

Password *

The password field is case sensitive.

Log in
At this point you should have generated, signed, and uploaded all the proper forms and they have been approved by ARPA-E.

**STEVE ELBERT**

**ARPA-E REGISTRATION FORMS**

**INSTRUCTIONS:**
Click the **Edit** box above and review your website My Account page for any missing required information before you proceed with any registration steps below.

**YOUR AVAILABLE FORMS:**
Team Member - Download and sign this form, and then make an electronic image (via scan or photograph) in PDF format. Send this form to your Team Leader.

*Generate and Download Entrant Registration:* [PDF](#)

Team Leader - download and sign this form, and then make an electronic image (via scan or photograph) in PDF format. Collect all of your team member's signed PDF forms. **Merge all member's forms into one single PDF file. This will be your Team Registration packet. Upload it to the GO Competition website.**

*Generate and Download Team Registration (Team Lead Only):* [PDF](#)

Team Leader - download, fill-in change team information, and sign this form if you are **making any changes to your team's official registration after you have been approved by ARPA-E.** Changes can be in team members, team name, anonymous or prize settings, etc. Once you have filled out the form appropriately, **upload the Team Change Form PLUS an updated Team Registration packet** to ARPA-E for change approval.

*Generate and Download Team Change Form (Team Lead Only):* [PDF](#)

**YOU MUST RETURN YOUR SIGNED FORMS TO PARTICIPATE IN CHALLENGE 1:**
Upload your signed and scanned forms. You may not make any submissions until the signed forms are received and approved by ARPA-E.

**VIEW FORM STATUS:**
You can view the status of your uploaded forms.
ALL citizenships must be given on penalty of disqualification
Go to Competition/Sandbox
https://fog-dev.pnl.gov/challenges/sandbox

The Sandbox provides Entrants the opportunity to become familiar with the competition platform: formats for input and output files, algorithm submission, evaluation, and scoring. The links on this page provide information about the original Beta datasets that have been converted to Challenge 1 format and are accessible through the Sandbox submission. See Challenge 1 for full descriptions of the formulation, file formats, evaluation and scoring.

Please be aware that the problem description, input and output formats, datasets, evaluation, and scoring change for each Challenge of the competition, generally becoming more difficult.

There are no prizes associated with use of the Sandbox; it is for testing purposes only.

Click on the Submit button.
If you don’t see the blue Submit button, you have not been approved to submit!
Creating a Submission (Sandbox)

- Enter a submission name
- Enter any notes associated with this submission
- Enter your team’s GitHub Repository name
- Enter your team’s GitHub Repository branch (master is default)
- Select a language environment (CPP, Executable, GAMS, Java/Scala, Julia, MATLAB, Python)
- Select a dataset
  - Challenge 1: IEEE 14 Bus (1 scenario)
  - C1_OD1_RT_N01_s01
  - C1_OD1_RT_N03_s01
- Select scoring division
  - Only Division 1 for Sandbox
- Click Blue Submit button

This webinar is being recorded for instructional purposes
Submission Results page (upon submission)

- Submission ID (30-1550532323) is used to track the submission
- The Red Terminate button does just that! (but not for T1, T2, Final)
- Submission Information box
- Technical Details box
- Filesize box (no info until done)
- Results Link box: where to get results
- Results log
  - Select which division results to view
  - Sometimes there is a slight delay in communicating with the back end
Submission Results page (upon completion)

30-1550533563

Submission Results Filesize
Division 1 results file size: 2.1K

Submission Results Link
Division 1 results available [here].

Submission Results

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Status</th>
<th>Status Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019 Feb 18</td>
<td>Score</td>
<td>Details for division 1 scenario 1 of model Network_S1_IEEE14-1 (output1) at <a href="https://dnr2.pnnl.gov/reposcomp/v1/30-1550533563_1_output1.tar.gz">https://dnr2.pnnl.gov/reposcomp/v1/30-1550533563_1_output1.tar.gz</a>. Archive filesize is 2.3K.</td>
</tr>
<tr>
<td>2019 Feb 18</td>
<td>Score</td>
<td>Network model score for division 1, Network_S1_IEEE14-1: 522366.46</td>
</tr>
<tr>
<td>2019 Feb 15</td>
<td>Scoring</td>
<td>Division 1 dataset score: 522366.46</td>
</tr>
<tr>
<td>2019 Feb 15</td>
<td>Score</td>
<td>Scenario score for division 1, scenario 1 of model Network_S1_IEEE14-1 (output1): 522366.46</td>
</tr>
<tr>
<td>2019 Feb 15</td>
<td>Evaluation</td>
<td>Run complete for division 1, model Network_S1_IEEE14-1, scenario 1 (output1).</td>
</tr>
<tr>
<td>2019 Feb 15</td>
<td>Evaluation</td>
<td>Executing network model Network_S1_IEEE14-1 scenario 1 (output1)</td>
</tr>
<tr>
<td>2019 Feb 15</td>
<td>Received</td>
<td>Submission received. Waiting for compute node assignment.</td>
</tr>
<tr>
<td>2019 Feb 15</td>
<td>Cloning</td>
<td>Attempting to clone github repository OOCOMPetition/Pt1Core/master.</td>
</tr>
</tbody>
</table>

From bottom up; order variable
Cloning—check correctness
Error if proper codes not found
Evaluation start; complete

Scenario Score: 522,366.46
Good score is 14,677.02
Network model score (same)
Dataset score (same)
(each) Scenario details link

Solution files
DetailedSolution.csv results
Results link
Summary score.csv
Messages.txt
Output* (each scenario)
    - Messages.log
    - DetailedSolution.csv
    - Log files
    - Solution_size.txt
    - Evaluation log (feasibility.err)
## Results tar file contents

- **Output1, Output2, …**
- **30-1550533563_SM1_messages.txt**

```
30-1550533563_DIV1: Executing network model Network_S1_IEEE14-1 scenario 1 (output 1)
30-1550533563_DIV1: Run complete for division 1, model Network_S1_IEEE14-1, scenario 1 (output1).
30-1550533563_DIV1: Scenario score for division 1, scenario 1 of model Network_S1_IEEE14-1 (output1) : 522366.46
30-1550533563_DIV1: Network model score for division 1, Network_S1_IEEE14-1 : 522366.46
30-1550533563_DIV1: Division 1 dataset score : 522366.46
```

- **30-1550533563_SM1_Score.csv**

```
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Score</th>
<th>Objective</th>
<th>Cost</th>
<th>Penalty</th>
<th>Max_Obj_Viol</th>
<th>Max_Non_Obj_Viol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network_S1_IEEE14-1 Scenario 1</td>
<td>522366.4628</td>
<td>522366.4628</td>
<td>150936.791</td>
<td>371429.6718</td>
<td>0.209133375</td>
<td>0</td>
</tr>
<tr>
<td>Network model score for Network_S1_IEEE14-1</td>
<td>522366.4628</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score for Dataset Challenge_1_IEEE14_1_Scenario</td>
<td>522366.4628</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

### Infeasibility
- **FALSE**
- **Missing/Bad Solution**
  - **FALSE**
- **Slack Objective**
  - **12614621.2**
- **Evaluation Duration (sec)**
  - **0.016803026**
- **Code1 (sec)**
  - **0.12890699**
- **Code2 (sec)**
  - **0.038966285**
Tar/output1 contents

- 30-1550533563_messages.log
  - Mon Feb 18 15:46:08 PST 2019 Evaluation Executing network model Network_S1_IEEE14-1 scenario 1 (output 1)

- 30-1550533563_SM1_Network_S1_IEEE14-1_1_DetailedSolution.csv

- feasibility.err (Evaluation log)

- MyPython1.log

- MyPython2.log

- solution_size.txt
  - solution1.txt 535
  - solution2.txt 600
### Interpreting Results: DetailedSolution.csv

<table>
<thead>
<tr>
<th>ctg</th>
<th>infeas</th>
<th>pen</th>
<th>cost</th>
<th>obj</th>
<th>vmax-idx</th>
<th>vmax-val</th>
<th>vmin-idx</th>
<th>vmin-val</th>
<th>bmax-idx</th>
<th>bmax-val</th>
<th>bmin-idx</th>
<th>bmin-val</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>195205.9857</td>
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<td>346142.7768</td>
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<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>LINE-6-12-BL</td>
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<td>176223.6861</td>
<td>0</td>
<td>522366.4628</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>pbal-idx</th>
<th>pbal-val</th>
<th>qbal-idx</th>
<th>qbal-val</th>
<th>pgmax-idx</th>
<th>pgmax-val</th>
<th>pgmin-idx</th>
<th>pgmin-val</th>
<th>qgmax-idx</th>
<th>qgmax-val</th>
<th>qgmin-idx</th>
<th>qgmin-val</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.193396284</td>
<td>6</td>
<td>0.020487062</td>
<td>(3, '1')</td>
<td>0</td>
<td>(3, '1')</td>
<td>0</td>
<td>(3, '1')</td>
<td>0</td>
<td>(3, '1')</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0.194654075</td>
<td>2</td>
<td>0.056978264</td>
<td>0</td>
<td>0</td>
<td>(3, '1')</td>
<td>0</td>
<td>(3, '1')</td>
<td>0</td>
<td>(3, '1')</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>qvg1-idx</th>
<th>qvg1-val</th>
<th>qvg2-idx</th>
<th>qvg2-val</th>
<th>lineomax-idx</th>
<th>lineomax-val</th>
<th>linedmax-idx</th>
<th>linedmax-val</th>
<th>xfmromax-idx</th>
<th>xfmromax-val</th>
<th>xfrmrdmax-idx</th>
<th>xfrmrdmax-val</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>(1, 5, 'BL')</td>
<td>0.209133</td>
<td>(1, 5, 'BL')</td>
<td>0.201754</td>
<td>(4, 9, 'BL')</td>
<td>0</td>
<td>(4, 9, 'BL')</td>
<td>0</td>
<td>(4, 9, 'BL')</td>
<td>0</td>
</tr>
<tr>
<td>(3, '1')</td>
<td>0</td>
<td>(1, 5, 'BL')</td>
<td>0.031053</td>
<td>(1, 5, 'BL')</td>
<td>0.030476</td>
<td>(4, 9, 'BL')</td>
<td>0</td>
<td>(4, 9, 'BL')</td>
<td>0</td>
<td>(4, 9, 'BL')</td>
<td>0</td>
</tr>
</tbody>
</table>

Column header definitions are defined on the Evaluation page

Evaluation Log

Attempting to open /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//inputfiles.ini
Attempting to open /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//inputfiles.ini
Attempting to open /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//inputfiles.ini
Attempting to open /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//inputfiles.ini

Scoring Method: 1
Model: /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1/
Scenario: /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//scenario_1
Output: /export/submission-manager/submission-manager-tmp//GOCompetition/30-1550533563_1//output1
RAW: /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//scenario_1/case.raw
ROP: /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//scenario_1/case.rop
CON: /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//scenario_1/case.con
INL: /export/submission-manager/data//Challenge_1_IEEE14_1_Scenario/Network_S1_IEEE14-1//scenario_1/case.inl

read data time: 0
buses: 14
loads: 11
fixed_shunts: 1
generators: 5
nontransformer_branches: 17
transformers: 3
areas: 1
switched_shunts: 0
generator inl records: 5
generator dispatch records: 5
active power dispatch records: 5
piecewise linear cost functions: 5
contingencies: 1
set data scalars: 0.000000
set data bus params: 0.000035
set data load params: 0.000538
set data fxsh params: 0.000304
num gen in service: 5, out of service: 0
ctg eval log
ctg done ctg to go t elapsed t per ctg t to go
0 1 1.50e-05 na na
eval ctg time: 0
eval total time: 0
obj: 522366.462823
cost: 150936.791022
penalty: 371429.671801
max_obj_viol: 0.209133
max_nonobj_viol: 0.000000
infeas: 0

Slack
Objective: 126164621.202038
Solutions generated: True
Objective: 522366.462823
Cost: 150936.791022
Penalty: 371429.671801
Infeasibility: 0
Max Obj Violation: 0.209133
Max non-Obj Violation: 0.000000

Eval runtime: 0.016803
Code 1 runtime: 0.128907
Code 2 runtime: 0.038966285
Score: 522366.462823
List all submissions by all team members

Ask for C1 submission access

Team Submission Results

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Submission</th>
<th>Source</th>
<th>Repository</th>
<th>Language</th>
<th>Dataset</th>
<th>Status</th>
<th>Division</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019 Feb 18 15:46:03</td>
<td>Example submission (30-1450533563) submission no. 1</td>
<td>Sandbox</td>
<td>FirstCase</td>
<td>Python</td>
<td>Challenge 1: IEEE 14 Bus (1 scenario)</td>
<td>Score</td>
<td>1</td>
<td>822366.46</td>
</tr>
</tbody>
</table>
Challenge 1 Submission

- Complete a successful Sandbox run
  - Generate valid solution files
- Request link on Team page
- Access to Challenge 1 submissions
  - Submit button visible
- Develop algorithm on Sandbox version of OD1 datasets
  - C1_OD1_RT_N01_s01 = Network_01 scenario 1
  - C1_OD1_RT_N03_s01 = Network_03 scenario 1
- Unless code exploits Div 3, 4, only use Div 1, 2 for development
- Trial 1, 2 and Final all 4 Divisions run
- Only ONE submission for T1, T2, Final
Questions?

GRID OPTIMIZATION (GO) COMPETITION