GridLAB-D Tutorial Outline

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Overview

This tutorial provides comprehensive instruction on the use and development of GridLAB-D. It is intended for advanced users who wish to study smart-grid systems and develop smart-grid technologies, with particular emphasis on distribution-level technologies. The audience of this tutorial will require

(1) a strong background in engineering analysis, numerical methods and computer programming in C and C++;
(2) intermediate knowledge of power systems, power markets, and building controls; and
(3) basic knowledge of electric utility retail operations, tariff design, and revenue systems.

The entire tutorial is presented in 9 three-hour sessions. Exercises are provided to facilitate understanding and encourage exploration of the system's features and capabilities.

Advance preparation

Before Session 1

1. Download and install GridLAB-D (developers & trunk users see Addendum 1)
2. Setup your favorite editor so it runs GridLAB-D on the active file and displays both standard and error output in an output window (Eclipse users see Addendum 2).

Before Session 3

3. Download and install Matlab and MySQL on your local machine, ensuring that licenses and user access is active (see GridLAB-D Wiki).

Before Session 6

4. Download and install subversion and mingw (see GridLAB-D Wiki).

Session 1 – Introduction and fundamentals (3 hours)

1. History and purpose of GridLAB-D
2. Examples of results obtained with GridLAB-D

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3. Understanding how GridLAB-D works
4. Installing GridLAB-D
5. Running models
6. Modeling language basics
7. Inter-object data exchange
8. Data input and output

Session 2 – Power systems (3 hours)

1. Basic background
2. Using the powerflow module
3. Voltage control
4. Simple load models

Session 3 – Advanced loads and weather (3 hours)

1. Theory behind advanced load models
2. Using advanced load models
3. Direct load control
4. Creating your own weather data

Session 4 – Markets (3 hours)

1. Retail pricing
2. Using the market module
3. Price-based demand response
4. Transactive control

Session 5 – Generation (3 hours)

1. Using the generators module
2. Modeling basics
3. Inverter controls

Session 6 – Reliability analysis (3 hours)

1. Model conversion
2. Scripting
3. Parametric analysis
4. Event generation
5. Reliability metrics

Session 7 – Beginning developers – Classes (3 hours)

1. System architecture

2. Building and validating
3. Time handling
4. Object creation and initialization
5. Object synchronization and notification
6. Properties and units
7. Class design conventions
8. Debugging

Session 8 – Intermediate developers – Modules (3 hours)

1. Module structure
2. Initialization
3. Global variables
4. Class structure
5. Class inheritance
6. Inter-module dependencies
7. Delta-mode support

Session 9 – Advanced developers – Core (3 hours)

1. Core structure
2. Major differences between core and modules
3. Global variables
4. Loader parsing
5. Time control
6. Added properties types
7. Schedule, random variables, and other internal properties
8. Parallelization

Appendix 1 – Installing GridLAB-D

You will need to install the trunk build of GridLAB-D on your system manually because the trunk build does not come with an installer for various platforms. Normally one has to build the system from the source, but pre-built systems are available

Windows

An installer executable built from the trunk code has been provided. Verify your installation by entering the following command in a new command window:

```
C:\>gridlabd --version
GridLAB-D 4.0.0-5549 (trunk) 64-bit WINDOWS RELEASE
```

Note: this basic installation must be upgraded with development extensions in the `GridLAB-D_4.0.0-5549_(trunk)_64-bit_WINDOWS_RELEASE.zip` file before Session 3.

Mac OSX

The trunk system files are stored in the file named `GridLAB-D_4.0.0-5549_(trunk)_64-bit_MACOSX_RELEASE.tar`. (Note: the build number may be different.).

1. Create a folder for GridLAB-D, e.g., `$HOME/gridlabd`, and extract all the files into that folder. This should create the `bin`, `include`, `lib`, and `share` folders.

2. Setup your environment so that PATH environment variable is defined

```
host% export PATH=$HOME/gridlabd/bin:$PATH
```

   (You may want to add this to your profile in `~/.bash_profile`.)

3. Open a new shell and check your installation by issuing the command:

```
host% gridlabd --version
GridLAB-D 4.0.0-5549 (trunk) 64-bit MACOSX RELEASE
```

Appendix 2 – Using Eclipse to run GridLAB-D

If you have not already done so and wish to use Eclipse as your primary GridLAB-D editor, you may install it from `http://www.eclipse.org/`. Install the C/C++ IDE.

Mac OSX Users: For your convenience the Eclipse files are provided in the `Tools/Eclipse/Mac` folder. If you have trouble starting Eclipse you may need to upgrade your Java support with the other packages provided in that folder.

Step 1 – Create a file type association for GLM files

Open **Eclipse->Preferences** and add an editor file type association for GLM files:
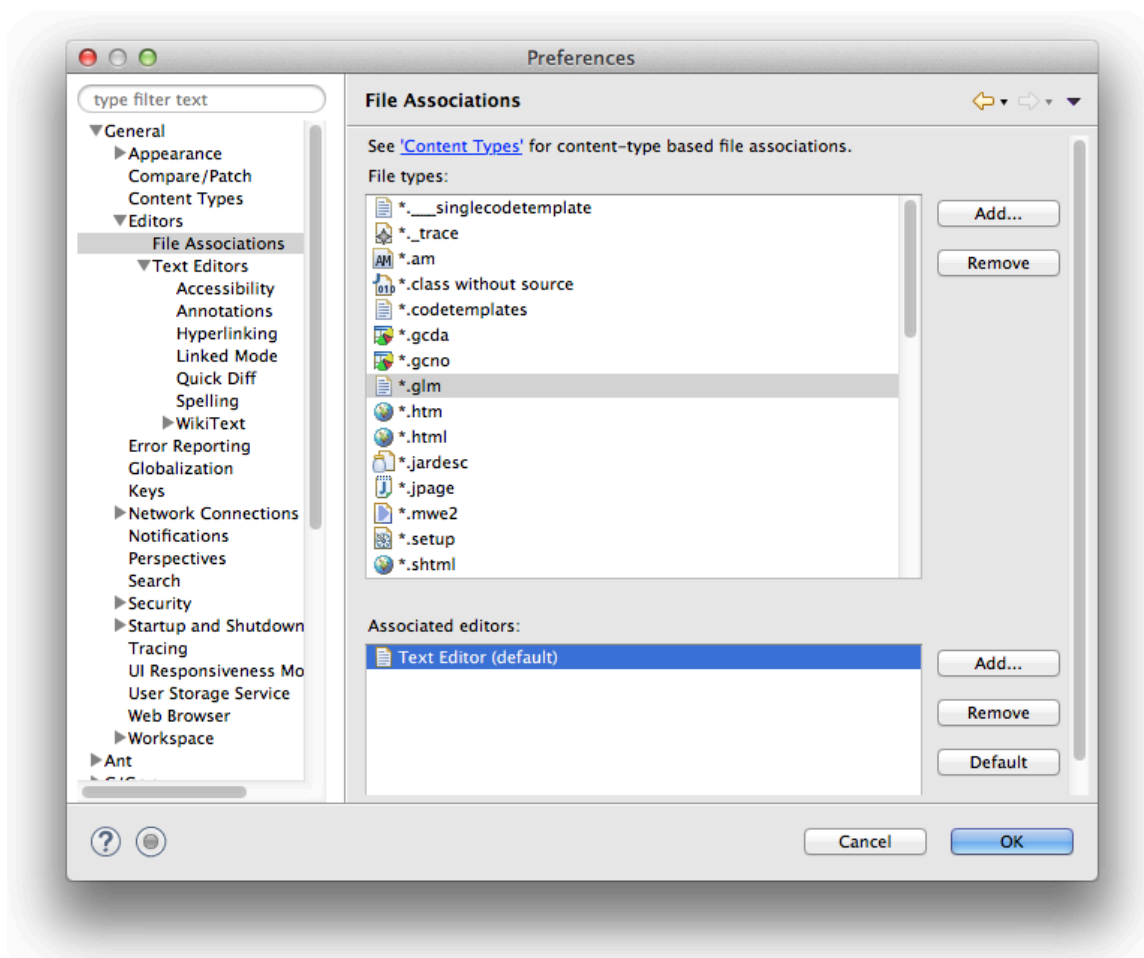
## *Step 2 – Create an external tool configuration for GridLAB-D*

Select **Run->External Tools->External Tools Configuration** and click the "New Launch Configuration" icon (upper left of explorer pane), enter the following values, click "Apply" and "Close".

Note: values shown are for Mac OSX. On Windows the location should be "C:\Program Files\GridLAB-D\bin\gridlabd.exe". Windows users should also enter the environment variables from Step 2 of Appendix 1 on the "Environment" tab.
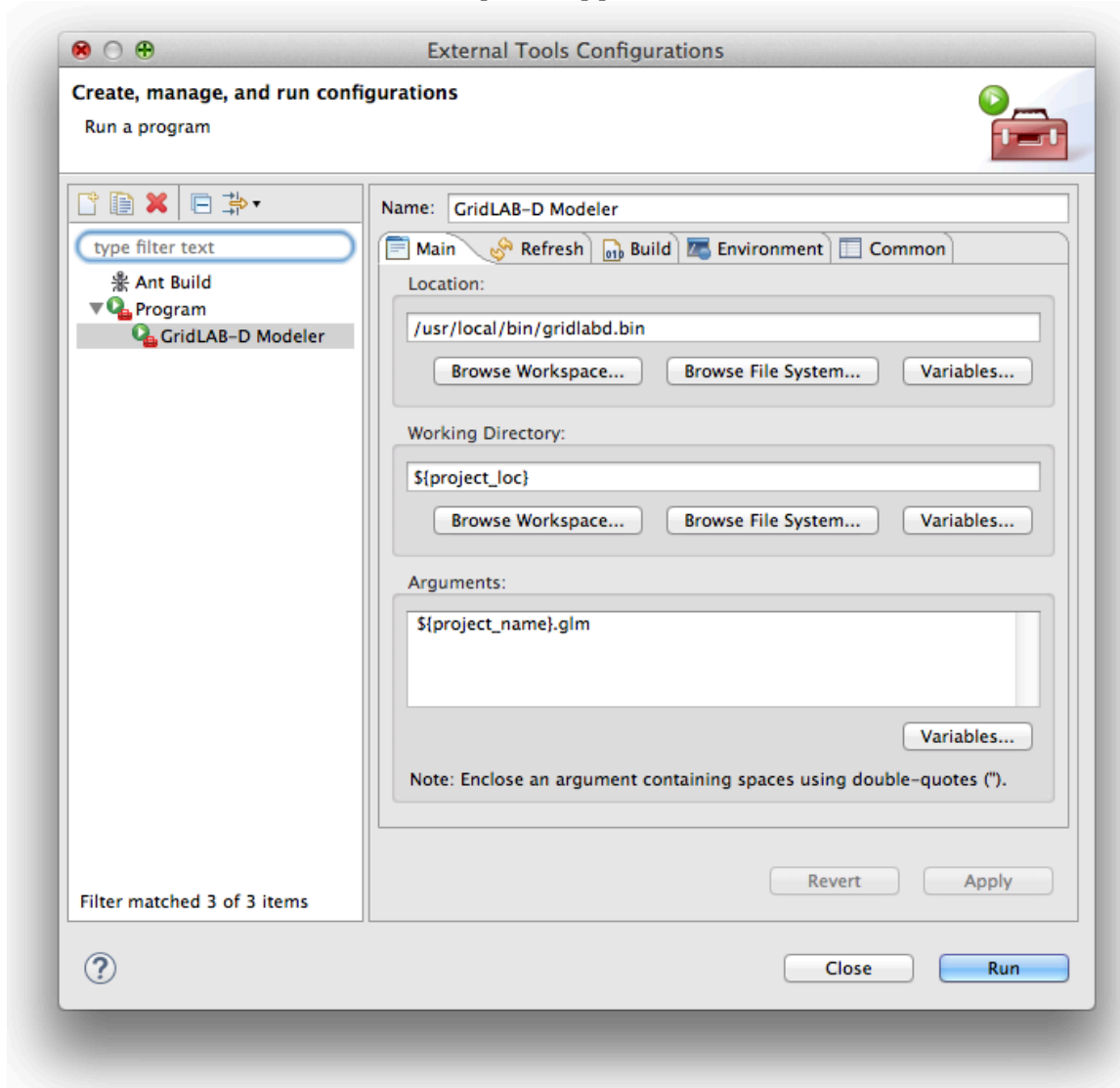
Step 3 – Create a project for your work

Open **File->New Project**, select **General/Project**, and click "Next". Specify the project name and your preferred location for your project files. Then click "Finish".
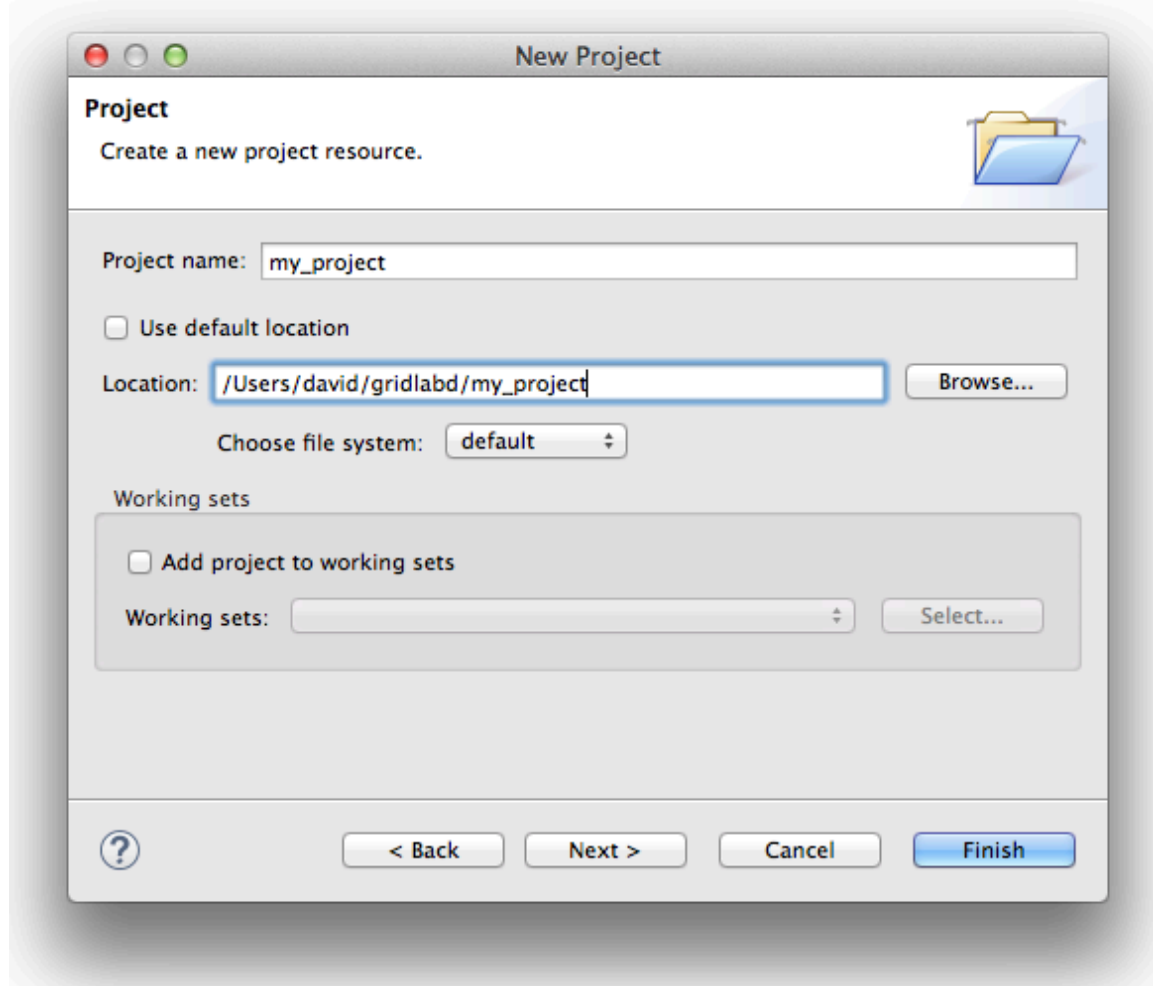
Step 4 – Create your GLM file

If your project already contains files, they will be listed in the project explorer pane. To create a GLM file, open **New->File**, select **General/File**, and click "Next". Select the project, enter the GLM file name. Use the project name as the main GLM file. Then click "Finish".
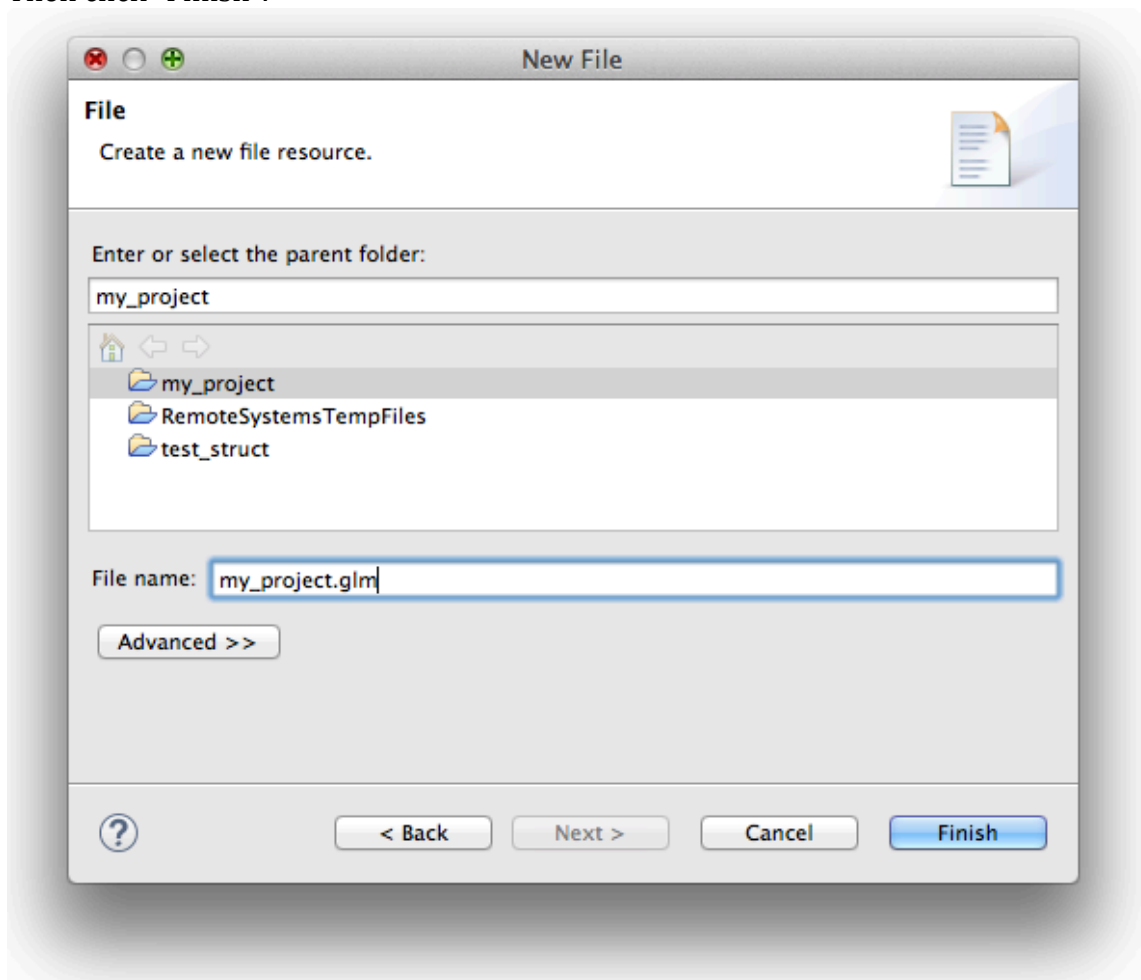
Step 5 – Run your simulation

Open **Run->External Tools->GridLAB-D Modeler** and select the Console pane to view the output. You can also click the "Run GridLAB-D Modeler" icon   on the toolbar to start GridLAB-D.

Warnings and errors are displayed first in the output. Then the standard output is displayed. You can use the file name and line number to locate any issues.

By default the run configuration uses the project name as the GLM file name. You can change that using the **External Tools Configuration** dialog in Step 2.