G4SEE lecture preparation guideline

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Contents

- 1) Installing Docker on your computer
- 2) Downloading the G4SEE Docker image
- 3) Starting a G4SEE Docker container
- 4) Running a G4SEE simulation inside a G4SEE Docker container
- [optional] Displaying visualization/GUI
- [optional] Building G4SEE from source
- User support – Links & Contact
1) Installing Docker

Docker is an easy-to-install, cross-platform application that enables you to build, share and run containerized applications in loosely isolated environments called Docker containers. It’s an ideal tool for sharing and running the G4SEE toolkit without building Geant4 or G4SEE from source!

Docker installation steps

- Docker Desktop for Linux
- Docker Desktop for Windows
- Docker Desktop for Mac
2) Downloading G4SEE Docker image

- A Docker container uses a custom and isolated filesystem, provided by a container image. Such an image contains everything needed to run the G4SEE application: Linux (Debian 11) environment, Python3.10, all dependencies incl. Geant4, scripts, compiled executables, source code, etc.

<table>
<thead>
<tr>
<th>To download image using <code>docker pull</code> via CLI</th>
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</thead>
<tbody>
<tr>
<td><strong>G4SEE v0.5 release</strong> with Geant4 v11.0.3 (current release):</td>
</tr>
<tr>
<td>$ docker pull gitlab-registry.cern.ch/g4see/g4see:v0.5_G4-11.0.3</td>
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<tr>
<td><strong>or</strong></td>
</tr>
<tr>
<td><strong>G4SEE v0.5.1 release</strong> with Geant4 v11.0.3 (next release):</td>
</tr>
<tr>
<td>$ docker pull gitlab-registry.cern.ch/g4see/g4see:v0.5.1_G4-11.0.3</td>
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</table>

CLI = Command Line Interface
3) Starting a G4SEE Docker container

- A **container** is a lightweight, runnable instance of an image. You can create, start, stop or delete a container. Everyone gets the same G4SEE container that works in the same way and has the same content inside.

- Sharing a folder (using docker’s `-v` argument) between the host machine and the container is recommended, e.g. to share macro and output files.

To start a container using `docker run` via CLI

```
$ docker run -it -h g4see -v /host/path/to/shared_folder:/home \
  gitlab-registry.cern.ch/g4see/g4see:v0.5_G4-11.0.3
```

Use a **real, absolute path of host machine** you want to access also from the container!

After next release, replace `v0.5` with `v0.5.1`!
4) Running a G4SEE simulation

- In the container, copy example macros and create a new folder for outputs.
- Let’s run a short example simulation with G4SEE to test it!
- After a successful multi-threaded run, merge the histogram files together!

To run a simulation inside the container via CLI

```
root@g4see:/home# cp -r $G4SEE_SRC/examples /home
root@g4see:/home# mkdir output
root@g4see:/home# g4see -h
root@g4see:/home# g4see examples/SRAM_example.mac -o output/
root@g4see:/home# mergeHistograms output/
```

Merged histogram files in home dir.: 

```
root@g4see:/home# ls
Edep_0_histogram.out
Edep_1_histogram.out
Ekin_0_histogram.out
Ekin_1_histogram.out
Ekin_2_histogram.out
```

To quit a container press Ctrl+d keys, to detach it instead press Ctrl+p and Ctrl+q. To attach again a detached (but running) container use **docker attach** command.
You might need to install the X Window System on your host machine to forward any visualization or GUI display: Xming (Win) or XQuartz (Mac)

To start a container via CLI with visualization/GUI forwarding

On Linux hosts (For Windows and Mac hosts, find steps here):

```bash
$ export DISPLAY=:0.0
$ xhost +local:docker
$ docker run -it -h g4see -e DISPLAY=$DISPLAY \
  -v /tmp/.X11-unix:/tmp/.X11-unix \
  -v /host/path/to/shared_folder:/home \
  gitlab-registry.cern.ch/g4see/g4see:v0.5_G4-11.0.3
```

Depending on your display settings, the `0.0` value might be different for you.

After next release, replace `v0.5` with `v0.5.1`!
Building G4SEE from source
[optional, NOT recommended]

- **Building** without Docker, however using Docker is the recommended option
- Dependencies: **Geant4** (>=10.7.0), **CMake** (>=3.17), **Python** (>=3.8)

To clone and build G4SEE toolkit via CLI on Linux

Clone recursively the G4SEE GitLab repositories:

```
$ git clone --recursive https://gitlab.cern.ch/g4see/g4see.git
$ cd g4see
```

In the main repo’s root dir., build the app with your Geant4:

```
$ mkdir build && cd build
$ export G4LIB=<Geant4_install_path>/lib64/Geant4-<version>/
$ cmake -DGeant4_DIR=$G4LIB ..
$ make -j <jobs>
$ sudo make install
```

(the last step is optional)
User support – Links & Contact

- G4SEE Website: https://g4see.web.cern.ch
- G4SEE Documentation: https://g4see-docs.web.cern.ch
- G4SEE User Forum: https://g4see-forum.web.cern.ch
- G4SEE Main GitLab repository: https://gitlab.cern.ch/g4see/g4see

- G4SEE Developers’ email: g4see.toolkit@cern.ch
  Contact us for additional help, or if you have any questions about G4SEE!