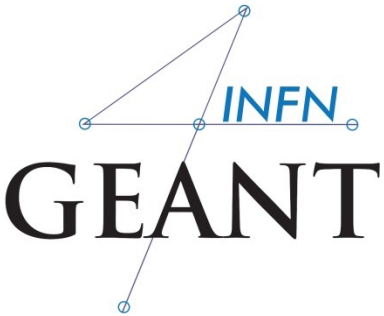


Building a GEANT4 application

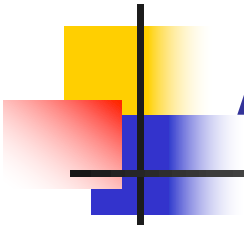
GAP Cirrone

INFN – Laboratori Nazionali del Sud

cirrone@lns.infn.it

A lot of material by J. Pipek

Vienna (A), April 2024



Application build checklist

1. Properly organize your code into directories
2. Prepare a **`CMakeLists.txt`** file
3. Create a build directory and run `CMake`
4. Compile (make) the application
5. Run the application

1) Structure of an application

Official basic/B1 example:

```
2,4K  4 Dic 14:48 CMakeLists.txt
475B  4 Dic 14:48 GNUmakefile
2,8K  4 Dic 14:48 History
7,5K  4 Dic 14:48 README
4,0K  4 Dic 14:48 exampleB1.cc
226B  4 Dic 14:48 exampleB1.in
 35K  4 Dic 14:48 exampleB1.out
272B  4 Dic 14:49 include
338B  4 Di
553B  4 Dic 14:48 run1.mac
448B  4 Dic 14:48 run2.mac
272B  4 Dic 14:49 src
3,8K  4 Dic 14:48 vis.mac
```

Macro file containing the commands

The text file **`CMakeLists.txt`** is the CMake script containing commands which describe how to build the exampleB1 application

contains **`main()`** for the application

Header files

```
2,2K  4 Dic 14:48 B1ActionInitialization.hh
2,4K  4 Dic 14:48 B1DetectorConstruction.hh
2,4K  4 Dic 14:48 B1EventAction.hh
2,7K  4 Dic 14:48 B1PrimaryGeneratorAction.hh
                  unAction.hh
                  teppingAction.hh
```

Note: Recommended, not enforced!

Source files

```
2,9K  4 Dic 14:48 B1ActionInitialization.cc
7,7K  4 Dic 14:48 B1DetectorConstruction.cc
2,6K  4 Dic 14:48 B1EventAction.cc
4,3K  4 Dic 14:48 B1PrimaryGeneratorAction.cc
5,8K  4 Dic 14:48 B1RunAction.cc
3,2K  4 Dic 14:48 B1SteppingAction.cc
```

2) CMake

- **`CMake`** is a build configuration tool
  - it takes *configuration file* (`CMakeLists.txt`)
  - it finds all dependencies (in our case, Geant4)
    - there might be others, e.g. ROOT, MySql, …
  - creates **`Makefile`** to run the compilation itself
- You have to write this `CMakeLists.txt` file
  - take inspiration in examples directories
  - be sure to set the name of your application correctly
  - specify all auxiliary files you need

Note: It is possible but **discouraged** to base build on GNU `make` instead of **`CMake`**.

CMakeList.txt – an example

File structure

1) Cmake minimum version and **project name**
2) Find and configure G4
3) Configure the project to use G4 and B1 headers
4) List the **sources**
5) Define and link the **executable**
6) Copy any macro files to the build directory

```
cmake_minimum_required(VERSION 2.6 FATAL_ERROR)
project(B1)
option(WITH_GEANT4_UIVIS "Build example with Geant4 UI and Vis
drivers" ON)
if(WITH_GEANT4_UIVIS)
  find_package(Geant4 REQUIRED ui_all vis_all)
else()
  find_package(Geant4 REQUIRED)
endif()

include(${Geant4_USE_FILE})
include_directories(${PROJECT_SOURCE_DIR}/include)

file(GLOB sources ${PROJECT_SOURCE_DIR}/src/*.cc)
file(GLOB headers ${PROJECT_SOURCE_DIR}/include/*.hh)

add_executable(exampleB1 exampleB1.cc ${sources} ${headers})
target_link_libraries(exampleB1 ${Geant4_LIBRARIES})

set(EXAMPLEB1_SCRIPTS
  exampleB1.in
  exampleB1.out
  init_vis.mac
  run1.mac
  run2.mac
  vis.mac
  )

foreach(_script ${EXAMPLEB1_SCRIPTS})
  configure_file(
    ${PROJECT_SOURCE_DIR}/${_script}
    ${PROJECT_BINARY_DIR}/${_script}
    COPYONLY
    )
```

3) Build directory & CMake

- If modifying the Geant4 examples, copy them to your **$HOME** first:

```
cp -r /usr/local/geant4/geant4.v11.2.0/examples/basic/B1 ~
```

- Create a **build directory***, where the compiled application will be put:

```
mkdir -p ~/B1-build
cd ~/B1-build
```

***Note:** It is possible (though not recommended) to compile **inside** source directory.

Run CMake

- In the **build** directory you just created, run **CMake**

Path to Geant4

```
cmake -DGeant4_DIR=/usr/local/geant4/geant4.10.05.p01-install/lib64/Geant4-10.5.1/ ~/B1/
```

Path to source

```
-- The C compiler identification is GNU 4.8.5
-- The CXX compiler identification is GNU 4.8.5
-- Check for working C compiler: /usr/bin/cc
-- Check for working C compiler: /usr/bin/cc -- works
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done
-- Detecting C compile features
-- Detecting C compile features - done
-- Check for working CXX compiler: /usr/bin/c++
-- Check for working CXX compiler: /usr/bin/c++ -- works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Configuring done
-- Generating done
-- Build files have been written to: /path/to/build/directory
```

4) Compilation

- In the build directory, run `make`

```
make
```

(and don't get a cup of coffee)

  - You have only a couple of files, it should be ready in a minute or two
  - An **executable** with the name of your application is created (e.g. exampleB1) in build directory
  - **Macros** and other auxiliary files are copied into build directory

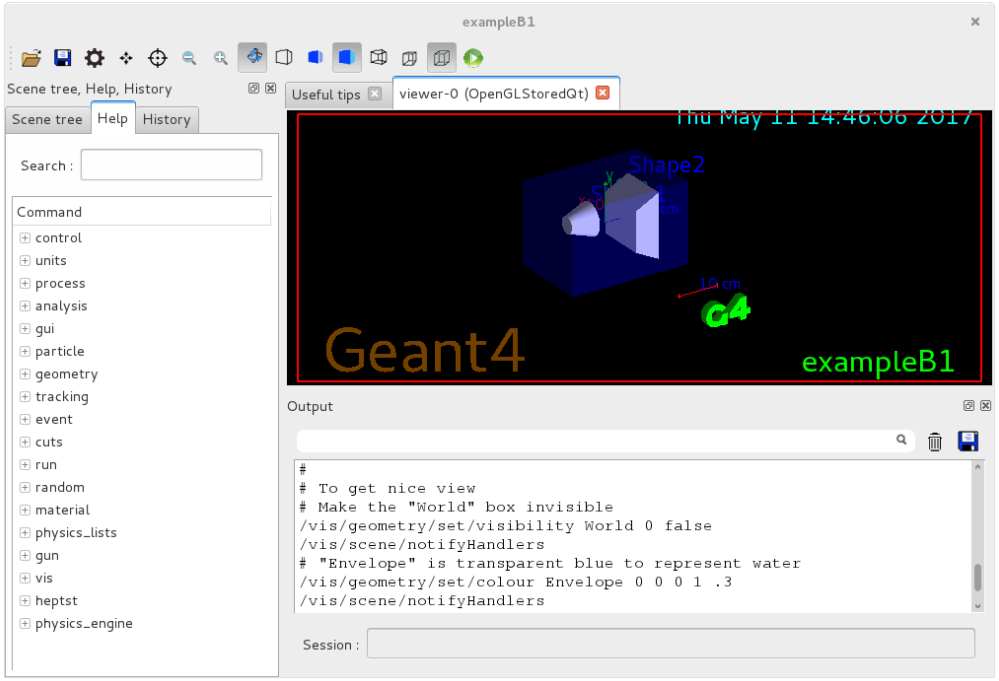
```
Scanning dependencies of target exampleB1
[ 12%] Building CXX object CMakeFiles/exampleB1.dir/exampleB1.cc.o
[ 25%] Building CXX object CMakeFiles/exampleB1.dir/src/B1RunAction.cc.o
[ 37%] Building CXX object CMakeFiles/exampleB1.dir/src/B1SteppingAction.cc.o
[ 50%] Building CXX object CMakeFiles/exampleB1.dir/src/B1DetectorConstruction.cc.o
[ 62%] Building CXX object CMakeFiles/exampleB1.dir/src/B1PrimaryGeneratorAction.cc.o
[ 75%] Building CXX object CMakeFiles/exampleB1.dir/src/B1EventAction.cc.o
[ 87%] Building CXX object CMakeFiles/exampleB1.dir/src/B1ActionInitialization.cc.o
[100%] Linking CXX executable exampleB1
[100%] Built target exampleB1
```

5) Running the application - GUI

- Just type the *name of your application*, including the `./` identifier of current directory (e.g. `./exampleB1`)
- By default, **graphical user interface** is started*

```
./exampleB1
```

```
Available UI session types: [ Qt, GAG, tcsh, csh ]
```



***Note:** Depends on your application main(), Geant4 configuration, etc.

Conclusions

Building an application is easy ☺