

# Build a Geant4 application

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# Application build process

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- 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**

# Application source structure in Geant4

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 Dic 14:48 init_vis.mac
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
2,5K  4 Dic 14:48 B1RunAction.hh
2,4K  4 Dic 14:48 B1SteppingAction.hh
```

## 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
```

# CMake (again)

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- CMake is a build configuration tool
  - it takes configuration file (**CMakeLists.txt**)
  - it finds all dependencies (in our case, **Geant4**)
  - creates Makefile to run the compilation itself
- You have to write this **CMakeLists.txt** file

# CMakeLists.txt

```
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)
```

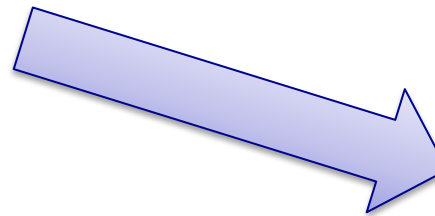
```
add_executable(exampleB1 exampleB1.cc ${sources} ${headers})
target_link_libraries(exampleB1 ${Geant4_LIBRARIES})
```

```
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
  )
endforeach()
```

## 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



# Build directory and CMake

- 1) If modifying the Geant4 examples, copy them to your \$HOME first:

```
cp -r /usr/local/geant4/geant4.11.0.1/examples/basic/B1 ~
```

- 2) 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:


```
cmake
-DGeant4_DIR=/usr/local/geant4/geant4.11.0.1-install/lib64/Geant4-11.0-1/
~/B1/
```

Path to Geant4

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
```

# Compilation

- In the build directory, run **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
```

```
make -j2
```

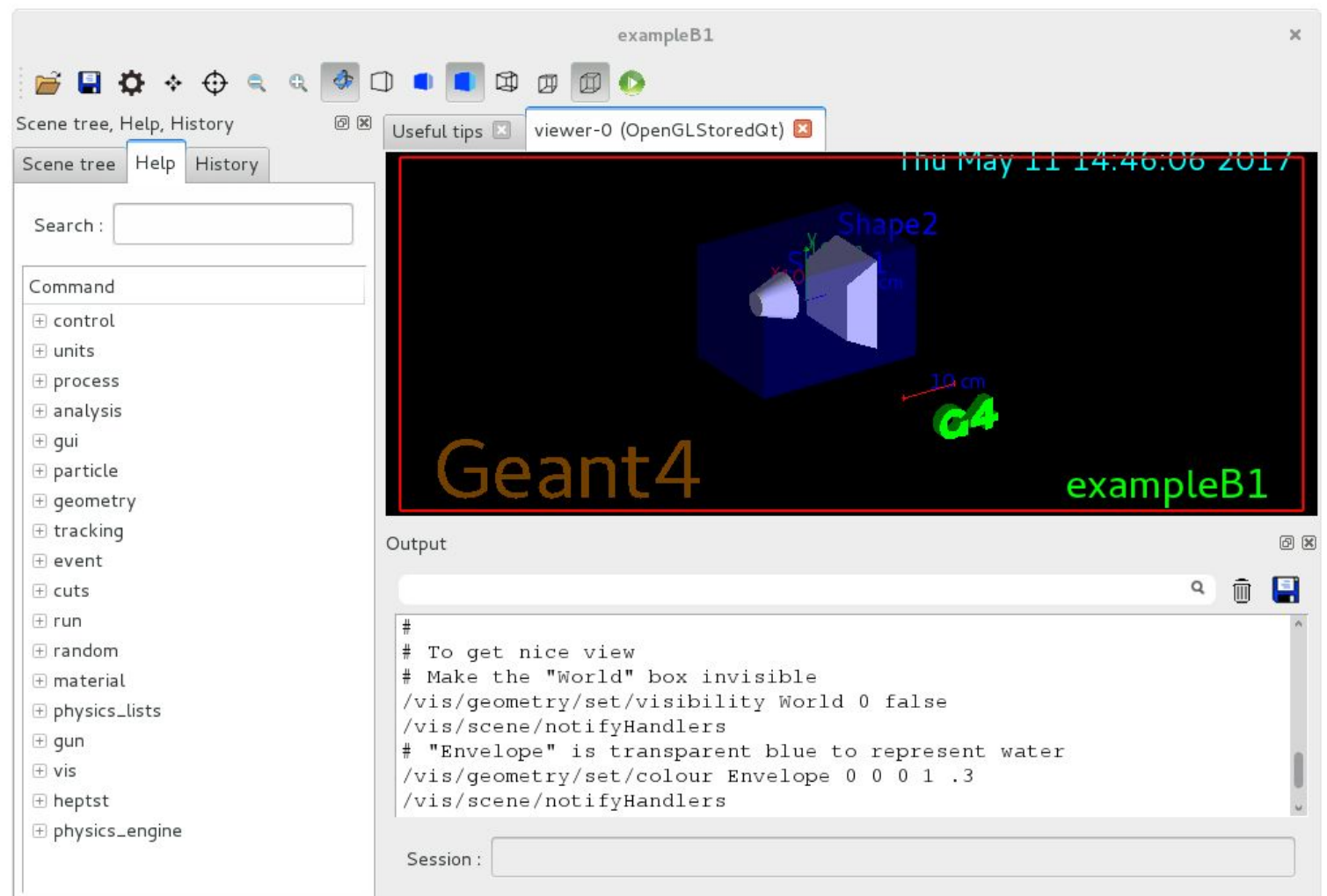


# Run the application - GUI

- Just type the name of your application, including the `./` identifier of current directory (e.g. **`./exampleB1`**)

`./exampleB1`

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



# Task 0

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- **Task 0a Geant4 Basics**

Exercise 0.1: Find and understand the Geant4 environment file

Exercise 0.2: Check your Geant4 environment

Exercise 0.3 : compile and run the basic example B1