CMake Build system generator

CONCEPTS

CMake does not build anything itself: it generates files for a native tool (Make, Ninja, Visual Studio), which then compiles. Keep the build tree out of the source tree.

CMakeLists.txt project description
↓ configure
Build tree cache + generated files
↓ --build
Binaries via Make/Ninja
↓ ctest / --install
Tests, install results, prefix

Configure once, then build, test and install from the same tree

Cache variables (-D) persist in build/CMakeCache.txt, so later runs reuse them. Use --fresh or delete the build dir to reset.

CONFIGURE

cmake -S *<src>* **-B** *<build>*
Configure source into build dir

cmake -B build -G "*<generator>*"
Choose generator (Ninja, Unix Makefiles)

cmake -B build -D*<VAR>*=*<value>*
Set a cache entry

cmake -B build -DCMAKE_BUILD_TYPE=*<type>*
Debug, Release, RelWithDebInfo

cmake -B build --fresh
Drop the cache and reconfigure

cmake -B build --toolchain *<file>*
Use a toolchain file (cross-compile)

-DCMAKE_EXPORT_COMPILE_COMMANDS=ON
Write compile_commands.json

BUILD

cmake --build *<dir>*
Build everything

cmake --build *<dir>* **-j** *<N>*
Build with N parallel jobs

BUILD (cont.)

cmake --build *<dir>* **-t** *<target>*
Build one target

cmake --build *<dir>* **--clean-first**
Clean, then build

cmake --build *<dir>* **--config** *<cfg>*
Choose config (multi-config generators)

cmake --build *<dir>* **-v**
Show full compiler commands

INSTALL AND TEST

cmake --install *<dir>*
Install the project

cmake --install *<dir>* **--prefix** *<dir>*
Override the install prefix

ctest --test-dir *<dir>*
Run all tests

ctest --test-dir *<dir>* **--output-on-failure**
Show output of failing tests

ctest -R *<regex>*
Run tests whose name matches

ctest -E *<regex>*
Exclude matching tests

ctest -j *<N>*
Run tests in parallel

ctest --rerun-failed
Run only tests that failed last time

PRESETS

cmake --list-presets
List configure presets

cmake --preset *<name>*
Configure with a preset

cmake --workflow --preset *<name>*
Run configure, build, test in sequence

Presets live in CMakePresets.json (shared, committed) and CMakeUserPresets.json (personal, usually git-ignored).

INSPECT AND DEBUG

cmake -L -N *<dir>*
List cache variables, no reconfigure

cmake --debug-find
Show how find_package searches

CMAKELISTS.TXT

cmake_minimum_required(VERSION *<x.y>***)**
Declare the minimum CMake version

project(*<name>* **VERSION** *<x.y>* **LANGUAGES CXX)**
Name the project

add_executable(*<tgt>* *<sources>***)**
Define an executable target

add_library(*<tgt>* **STATIC|SHARED** *<sources>***)**
Define a library target

target_link_libraries(*<tgt>* **PRIVATE** *<lib>***)**
Link a dependency

target_include_directories(*<tgt>* **PUBLIC** *<dir>***)**
Add include paths

target_compile_features(*<tgt>* **PUBLIC cxx_std_17)**
Require a language standard

find_package(*<Pkg>* **REQUIRED)**
Locate an installed package

add_subdirectory(*<dir>***)**
Include a nested CMakeLists.txt

enable_testing()
Turn on ctest support

add_test(NAME *<t>* **COMMAND** *<exe>***)**
Register a test

install(TARGETS *<tgt>* **DESTINATION bin)**
Install a target

Prefer target_* commands over global ones (include_directories, add_definitions). Use ${VAR} to read a variable and $<...> for generator expressions evaluated at build time.