1. GCC compiler

Input : gcc -Wall --verbose --save-temp -o first-exec first-prog.c

Output :

Using built-in specs.
COLLECT_GCC=gcc
COLLECT_LTO_WRAPPER=/usr/lib/gcc/x86_64-linux-gnu/8/lto-wrapper
OFFLOAD_TARGET_NAMES=nvptx-none
OFFLOAD_TARGET_DEFAULT=1
Target: x86_64-linux-gnu
Configured with: ../src/configure -v --with-pkgversion='Ubuntu 8.3.0-6ubuntu1' --with-bugurl=file:///usr/share/doc/gcc-8/README.Bugs --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++ --prefix=/usr --with-gcc-major-version-only --program-suffix=-8 --program-prefix=x86_64-linux-gnu- --enable-shared --enable-linker-build-id --libexecdir=/usr/lib --without-included-gettext --enable-threads=posix --libdir=/usr/lib --enable-nls --enable-bootstrap --enable-clocale=gnu --enable-libstdcxx-debug --enable-libstdcxx-time=yes --with-default-libstdcxx-abi=new --enable-gnu-unique-object --disable-vtable-verify --enable-libmpx --enable-plugin --enable-default-pie --with-system-zlib --with-target-system-zlib --enable-objc-gc=auto --enable-multiarch --disable-werror --with-arch-32=i686 --with-abi=m64 --with-multilib-list=m32,m64,mx32 --enable-multilib --with-tune=generic --enable-offload-targets=nvptx-none --without-cuda-driver --enable-checking=release --build=x86_64-linux-gnu --host=x86_64-linux-gnu --target=x86_64-linux-gnu
Thread model: posix
gcc version 8.3.0 (Ubuntu 8.3.0-6ubuntu1)
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'first-exec' '-mtune=generic' '-march=x86-64'
 /usr/lib/gcc/x86_64-linux-gnu/8/cc1 -E -quiet -v -imultiarch x86_64-linux-gnu first-prog.c -mtune=generic -march=x86-64 -Wall -fpch-preprocess -fstack-protector-strong -Wformat-security -o first-prog.i
ignoring nonexistent directory "/usr/local/include/x86_64-linux-gnu"
ignoring nonexistent directory "/usr/lib/gcc/x86_64-linux-gnu/8/../../../../x86_64-linux-gnu/include"
#include "..." search starts here:
#include <...> search starts here:
 /usr/lib/gcc/x86_64-linux-gnu/8/include
 /usr/local/include
 /usr/lib/gcc/x86_64-linux-gnu/8/include-fixed
 /usr/include/x86_64-linux-gnu

/usr/include
End of search list.
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'first-exec' '-mtune=generic' '-march=x86-64'

 /usr/lib/gcc/x86_64-linux-gnu/8/cc1 -fpreprocessed first-prog.i -quiet -dumpbase first-prog.c -mtune=generic -march=x86-64 -auxbase first-prog -Wall -version -fstack-protector-strong -Wformat-security -o first-prog.s
GNU C17 (Ubuntu 8.3.0-6ubuntu1) version 8.3.0 (x86_64-linux-gnu)
        compiled by GNU C version 8.3.0, GMP version 6.1.2, MPFR version 4.0.2, MPC version 1.1.0, isl version isl-0.20-GMP

GGC heuristics: --param ggc-min-expand=100 --param ggc-min-heapsize=131072
GNU C17 (Ubuntu 8.3.0-6ubuntu1) version 8.3.0 (x86_64-linux-gnu)
        compiled by GNU C version 8.3.0, GMP version 6.1.2, MPFR version 4.0.2, MPC version 1.1.0, isl version isl-0.20-GMP

GGC heuristics: --param ggc-min-expand=100 --param ggc-min-heapsize=131072
Compiler executable checksum: 1f42e357acaa2189289675afee565401
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'first-exec' '-mtune=generic' '-march=x86-64'
 as -v --64 -o first-prog.o first-prog.s
GNU assembler version 2.32 (x86_64-linux-gnu) using BFD version (GNU Binutils for Ubuntu) 2.32
COMPILER_PATH=/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/:/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/
LIBRARY_PATH=/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/:/usr/lib/gcc/x86_64-linux-gnu/8/../../../../lib/:/lib/x86_64-linux-gnu/:/lib/../lib/:/usr/lib/x86_64-linux-gnu/:/usr/lib/../lib/:/usr/lib/gcc/x86_64-linux-gnu/8/../../../:/lib/:/usr/lib/
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'first-exec' '-mtune=generic' '-march=x86-64'
 /usr/lib/gcc/x86_64-linux-gnu/8/collect2 -plugin /usr/lib/gcc/x86_64-linux-gnu/8/liblto_plugin.so -plugin-opt=/usr/lib/gcc/x86_64-linux-gnu/8/lto-wrapper -plugin-opt=-fresolution=first-prog.res -plugin-opt=-pass-through=-lgcc -plugin-opt=-pass-through=-lgcc_s -plugin-opt=-pass-through=-lc -plugin-opt=-pass-through=-lgcc -plugin-opt=-pass-through=-lgcc_s --build-id --eh-frame-hdr -m elf_x86_64 --hash-style=gnu --as-needed -dynamic-linker /lib64/ld-linux-x86-64.so.2 -pie -z now -z relro -o first-exec /usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/Scrt1.o /usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/crti.o /usr/lib/gcc/x86_64-linux-gnu/8/crtbeginS.o -L/usr/lib/gcc/x86_64-linux-gnu/8 -L/usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu -L/usr/lib/gcc/x86_64-linux-

gnu/8/../../../../lib -L/lib/x86_64-linux-gnu -L/lib/../lib -L/usr/lib/x86_64-linux-gnu -L/usr/lib/../lib -L/usr/lib/gcc/x86_64-linux-gnu/8/../../.. first-prog.o -lgcc --push-state --as-needed -lgcc_s --pop-state -lc -lgcc --push-state --as-needed -lgcc_s --pop-state /usr/lib/gcc/x86_64-linux-gnu/8/crtendS.o /usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/crtn.o COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'first-exec' '-mtune=generic' '-march=x86-64'

Components of GCC compiler

1. Preprocessor

This phase includes:
- Removal of comments
- Expansion of Macros
- Expansion of Included Files

/usr/lib/gcc/x86_64-linux-gnu/8/cc1 -E -quiet -v -imultiarch x86_64-linux-gnu first-prog.c -mtune=generic -march=x86-64 -Wall -fpch-preprocess -fstack-protector-strong -Wformat-security -o first-prog.i

File generated after this step : first-prog.i

2. Compiler

It translates the high level language code(.i file) to low level language assembly code(.s file).

/usr/lib/gcc/x86_64-linux-gnu/8/cc1 -fpreprocessed first-prog.i -quiet -dumpbase first-prog.c -mtune=generic -march=x86-64 -auxbase first-prog -Wall -version -fstack-protector-strong -Wformat-security -o first-prog.s

File generated after this step : first-prog.s

3. Assembler

It translates the assembly language code to machine language code(.o file)

as -v --64 -o first-prog.o first-prog.s

File generated after this step : first-prog.o

4. Loader/Linker

It builds an executable file from collection of object files.

File generated after this step : first-exec

5. Executable File : ./first-exec

Loads an executable file into memory and starts it(first-exec).

2. G++ Compiler

Input : g++ -Wall --verbose --save-temp -o second-exec second-prog.cpp

Output :

Using built-in specs.
COLLECT_GCC=g++
COLLECT_LTO_WRAPPER=/usr/lib/gcc/x86_64-linux-gnu/8/lto-wrapper
OFFLOAD_TARGET_NAMES=nvptx-none
OFFLOAD_TARGET_DEFAULT=1
Target: x86_64-linux-gnu
Configured with: ../src/configure -v --with-pkgversion='Ubuntu 8.3.0-6ubuntu1' --with-bugurl=file:///usr/share/doc/gcc-8/README.Bugs --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++ --prefix=/usr --with-gcc-major-version-only --program-suffix=-8 --program-prefix=x86_64-linux-gnu- --enable-shared --enable-linker-build-id --libexecdir=/usr/lib --without-included-gettext --enable-threads=posix --libdir=/usr/lib --enable-nls --enable-bootstrap --enable-clocale=gnu --enable-libstdcxx-debug --enable-libstdcxx-time=yes --with-default-libstdcxx-abi=new --enable-gnu-unique-object --disable-vtable-verify --enable-libmpx --enable-plugin --enable-default-pie --with-system-zlib --with-target-system-zlib --enable-objc-gc=auto --enable-multiarch --disable-werror --with-arch-32=i686 --with-abi=m64 --with-multilib-list=m32,m64,mx32 --enable-multilib --with-tune=generic --enable-offload-targets=nvptx-none --without-cuda-driver --enable-checking=release --build=x86_64-linux-gnu --host=x86_64-linux-gnu --target=x86_64-linux-gnu
Thread model: posix
gcc version 8.3.0 (Ubuntu 8.3.0-6ubuntu1)
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'second-exec' '-shared-libgcc' '-mtune=generic' '-march=x86-64'

/usr/lib/gcc/x86_64-linux-gnu/8/cc1plus -E -quiet -v -imultiarch x86_64-linux-gnu -D_GNU_SOURCE second-prog.cpp -mtune=generic -march=x86-64 -Wall -fpch-preprocess -fstack-protector-strong -Wformat-security -o second-prog.ii
ignoring duplicate directory "/usr/include/x86_64-linux-gnu/c++/8"
ignoring nonexistent directory "/usr/local/include/x86_64-linux-gnu"
ignoring nonexistent directory "/usr/lib/gcc/x86_64-linux-gnu/8/../../../../x86_64-linux-gnu/include"
#include "..." search starts here:
#include <...> search starts here:
 /usr/include/c++/8
 /usr/include/x86_64-linux-gnu/c++/8
 /usr/include/c++/8/backward
 /usr/lib/gcc/x86_64-linux-gnu/8/include
 /usr/local/include
 /usr/lib/gcc/x86_64-linux-gnu/8/include-fixed
 /usr/include/x86_64-linux-gnu
 /usr/include
End of search list.
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'second-exec' '-shared-libgcc' '-mtune=generic' '-march=x86-64'
 /usr/lib/gcc/x86_64-linux-gnu/8/cc1plus -fpreprocessed second-prog.ii -quiet -dumpbase second-prog.cpp -mtune=generic -march=x86-64 -auxbase second-prog -Wall -version -fstack-protector-strong -Wformat-security -o second-prog.s
GNU C++14 (Ubuntu 8.3.0-6ubuntu1) version 8.3.0 (x86_64-linux-gnu)
        compiled by GNU C version 8.3.0, GMP version 6.1.2, MPFR version 4.0.2, MPC version 1.1.0, isl version isl-0.20-GMP

GGC heuristics: --param ggc-min-expand=100 --param ggc-min-heapsize=131072
GNU C++14 (Ubuntu 8.3.0-6ubuntu1) version 8.3.0 (x86_64-linux-gnu)
        compiled by GNU C version 8.3.0, GMP version 6.1.2, MPFR version 4.0.2, MPC version 1.1.0, isl version isl-0.20-GMP

GGC heuristics: --param ggc-min-expand=100 --param ggc-min-heapsize=131072
Compiler executable checksum: 1110442b7b958f151ae10a1cb5af9032
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'second-exec' '-shared-libgcc' '-mtune=generic' '-march=x86-64'
 as -v --64 -o second-prog.o second-prog.s
GNU assembler version 2.32 (x86_64-linux-gnu) using BFD version (GNU Binutils for Ubuntu) 2.32
COMPILER_PATH=/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/:/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/

LIBRARY_PATH=/usr/lib/gcc/x86_64-linux-gnu/8/:/usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/:/usr/lib/gcc/x86_64-linux-gnu/8/../../../../lib/:/lib/x86_64-linux-gnu/:/lib/../lib/:/usr/lib/x86_64-linux-gnu/:/usr/lib/../lib/:/usr/lib/gcc/x86_64-linux-gnu/8/../../../:/lib/:/usr/lib/
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'second-exec' '-shared-libgcc' '-mtune=generic' '-march=x86-64'
 /usr/lib/gcc/x86_64-linux-gnu/8/collect2 -plugin /usr/lib/gcc/x86_64-linux-gnu/8/liblto_plugin.so -plugin-opt=/usr/lib/gcc/x86_64-linux-gnu/8/lto-wrapper -plugin-opt=-fresolution=second-prog.res -plugin-opt=-pass-through=-lgcc_s -plugin-opt=-pass-through=-lgcc -plugin-opt=-pass-through=-lc -plugin-opt=-pass-through=-lgcc_s -plugin-opt=-pass-through=-lgcc --build-id --eh-frame-hdr -m elf_x86_64 --hash-style=gnu --as-needed -dynamic-linker /lib64/ld-linux-x86-64.so.2 -pie -z now -z relro -o second-exec /usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/Scrt1.o /usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/crti.o /usr/lib/gcc/x86_64-linux-gnu/8/crtbeginS.o -L/usr/lib/gcc/x86_64-linux-gnu/8 -L/usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu -L/usr/lib/gcc/x86_64-linux-gnu/8/../../../../lib -L/lib/x86_64-linux-gnu -L/lib/../lib -L/usr/lib/x86_64-linux-gnu -L/usr/lib/../lib -L/usr/lib/gcc/x86_64-linux-gnu/8/../../.. second-prog.o -lstdc++ -lm -lgcc_s -lgcc -lc -lgcc_s -lgcc /usr/lib/gcc/x86_64-linux-gnu/8/crtendS.o /usr/lib/gcc/x86_64-linux-gnu/8/../../../x86_64-linux-gnu/crtn.o
COLLECT_GCC_OPTIONS='-Wall' '-v' '-save-temps' '-o' 'second-exec' '-shared-libgcc' '-mtune=generic' '-march=x86-64'

Components of G++ compiler

1. Preprocessor

This phase includes:
- Removal of comments
- Expansion of Macros
- Expansion of Included Files

 /usr/lib/gcc/x86_64-linux-gnu/8/cc1plus -E -quiet -v -imultiarch x86_64-linux-gnu -D_GNU_SOURCE second-prog.cpp -mtune=generic -march=x86-64 -Wall -fpch-preprocess -fstack-protector-strong -Wformat-security -o second-prog.ii

File generated after this step : second-prog.ii

2. Compiler

It translates the high level language code(.i file) to low level language assembly code(.s file).

/usr/lib/gcc/x86_64-linux-gnu/8/cc1plus -fpreprocessed second-prog.ii -quiet -dumpbase second-prog.cpp -mtune=generic -march=x86-64 -auxbase second-prog -Wall -version -fstack-protector-strong -Wformat-security -o second-prog.s
File generated after this step : second-prog.s

3. Assembler

It translates the assembly language code to machine language code(.o file)

as -v --64 -o second-prog.o second-prog.s

File generated after this step : second-prog.o

4. Loader/Linker

It builds an executable file from collection of object files.

File generated after this step : second-exec

5. Executable File : ./second-exec

Loads an executable file into memory and starts it(second-exec).