

Embedded System Testing
Project Work

Saurabh Jawahar Kakade

sk2354@nau.edu

1. Dynamic Analysis:

- Proved the program with the possible and reasonable inputs in such a way to expose or uncover the subtle bugs in the code.
- Using fuzzer to pass the inputs to the executable makes the analysis as dynamic as possible. Providing inputs by use of fuzzers like afl,libfuzzer,default fuzzer helps the testers to improve the code coverage and also to enter the new paths in the code that cannot be reached when tested using manually written inputs.
- Command: `./testfile -fuzz -min_log_level 1 -timeout 2`

Output:

```
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
ERROR: Exceeded set input limit. Set or expand DEEPSTATE_SIZE to write more bytes.
ERROR: Abandoned: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
TRACE: Running: a_b from test_deepstate.cpp(86)
TRACE: Passed: a_b
INFO: Done fuzzing! Ran 146 tests (73 tests/second) with 0 failed/56 passed/90 abandoned tests
user@89d58f49eba2:~/deepstate$
```

2. Static analysis:

First, the basic idea of static analysis is that it analyzes source code without running the code. This has advantages, but also serious disadvantages, when compared to dynamic analysis or testing.

Commands: `cppcheck test_deepstate.cpp`

Output:

```
Checking /home/user/deepstate/examples/TakeOver.cpp ...
48/67 files checked 71% done
Checking /home/user/deepstate/sparsepp/examples/emplace.cc ...
Checking /home/user/deepstate/sparsepp/examples/emplace.cc: SPP_NO_CXX11_RVALUE_REFERENCES...
49/67 files checked 73% done
Checking /home/user/deepstate/sparsepp/examples/hash_std.cc ...
50/67 files checked 74% done
Checking /home/user/deepstate/sparsepp/examples/insert_rvalue.cc ...
51/67 files checked 76% done
Checking /home/user/deepstate/sparsepp/examples/movable.cc ...
52/67 files checked 77% done
Checking /home/user/deepstate/sparsepp/examples/piecewise.cc ...
53/67 files checked 79% done
Checking /home/user/deepstate/sparsepp/examples/serialize_file.cc ...
54/67 files checked 80% done
Checking /home/user/deepstate/sparsepp/examples/serialize_large.cc ...
55/67 files checked 82% done
Checking /home/user/deepstate/sparsepp/examples/serialize_stream.cc ...
56/67 files checked 83% done
Checking /home/user/deepstate/sparsepp/examples/test.cc ...
57/67 files checked 85% done
Checking /home/user/deepstate/sparsepp/tests/perftest1.cc ...
58/67 files checked 86% done
Checking /home/user/deepstate/sparsepp/tests/spp_alloc_test.cc ...
59/67 files checked 88% done
Checking /home/user/deepstate/sparsepp/tests/spp_bitset_test.cc ...
[/home/user/deepstate/sparsepp/tests/spp_bitset_test.cc:290]: (error) Invalid number of character '{' when no macros are defined.
60/67 files checked 89% done
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc ...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: BSD;DGUX;HAVE_GETPAGESIZE;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: CLSIZE;NBPB;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: DARWIN; DARWIN;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: EXEC_PAGESIZE;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: MAP_ANON;MAP_ANONYMOUS;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: MREMAP;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: NBPC;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: NBPB;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: NDEB;SPP_DEBUG;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: NEED_GLOBAL_LOCK_INIT;SPP_EXCLUDE_IMPLEMENTATION...
Checking /home/user/deepstate/sparsepp/tests/spp_relative_include_test.cc: PAGESIZE;SPP_EXCLUDE_IMPLEMENTATION...
61/67 files checked 91% done
Checking /home/user/deepstate/sparsepp/tests/spp_test.cc ...
Checking /home/user/deepstate/sparsepp/tests/spp_test.cc: SPP_NO_CXX11_HDR_INITIALIZER_LIST...
Checking /home/user/deepstate/sparsepp/tests/spp_test.cc: SPP_NO_CXX11_RVALUE_REFERENCES...
Checking /home/user/deepstate/sparsepp/tests/spp_test.cc: SPP_NO_CXX11_VARIADIC_TEMPLATES...
Checking /home/user/deepstate/sparsepp/tests/spp_test.cc: _MSC_VER...
Checking /home/user/deepstate/sparsepp/tests/spp_test.cc: __MINGW32__...
62/67 files checked 92% done
Checking /home/user/deepstate/src/lib/DeepState.c ...
Checking /home/user/deepstate/src/lib/DeepState.c: DEEPSTATE_TAKEOVER_RAND...
Checking /home/user/deepstate/src/lib/DeepState.c: __cpp_exceptions...
63/67 files checked 94% done
Checking /home/user/deepstate/src/lib/Log.c ...
64/67 files checked 95% done
Checking /home/user/deepstate/src/lib/Option.c ...
65/67 files checked 97% done
Checking /home/user/deepstate/src/lib/Stream.c ...
66/67 files checked 98% done
Checking /home/user/deepstate/test_deepstate.cpp ...
67/67 files checked 100% done
(information) Too many #ifdef configurations - cppcheck only checks 12 configurations. Use --force to check all configurations. For more details, use --enable-information.
user@89d58f49eba2:~/deepstate$
```

```
user@89d58f49eba2:~/deepstate$ cppcheck ./testfile
Checking testfile ...
[testfile:1]: (error) The code contains unhandled character(s) (character code=152). Neither unicode nor extended ascii is supported.
user@89d58f49eba2:~/deepstate$ cppcheck ~/deepstate/
Checking /home/user/deepstate/TestSorts.cpp ...
1/67 files checked 1% done
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c ...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: INT_1788; INTEGRITY...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: MPRAS; MPRAS...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: SCO_SV; SCO_SV; sco_sv...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: SDCC; SDCC_VERSION_MAJOR...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: SDCC; SDCC_VERSION_MAJOR; SDCC_VERSION_MAJOR...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: SIMULATE_VERSION_TWEAK...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: WIN32; WIN32; WIN32...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: XENIX; XENIX; XENIX...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: AIX; AIX; AIX; aix; aix...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: BEOS; BEOS; BeOS...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdC/CMakeCCompilerId.c: CRAYC...
2/67 files checked 2% done
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp ...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: INT_1788; INTEGRITY...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: MPRAS; MPRAS...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: SCO_SV; SCO_SV; sco_sv...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: SIMULATE_VERSION_TWEAK...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: WIN32; WIN32; WIN32...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: XENIX; XENIX; XENIX...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: AIX; AIX; AIX; aix; aix...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: BEOS; BEOS; BeOS...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: CRAYC...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: MSC_BUILD; MSC_VER...
Checking /home/user/deepstate/build/CMakeFiles/3.15.5/CompilerIdCXX/CMakeCXXCompilerId.cpp: MSC_FULL_VER; MSC_VER...
3/67 files checked 4% done
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c ...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: MPRAS; MPRAS...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: SCO_SV; SCO_SV; sco_sv...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: SDCC; SDCC_VERSION_MAJOR...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: SDCC; SDCC_VERSION_MAJOR; SDCC_VERSION_MAJOR...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: SIMULATE_VERSION_PATCH...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: SIMULATE_VERSION_PATCH; SIMULATE_VERSION_TWEAK...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: WIN32; WIN32; WIN32...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: XENIX; XENIX; XENIX...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: AIX; AIX; AIX; aix; aix...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: BEOS; BEOS; BeOS...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdC/CMakeCCompilerId.c: COMPILER_VERSION; SGI_COMPILER_VERSION...
4/67 files checked 5% done
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp ...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: MPRAS; MPRAS...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: SCO_SV; SCO_SV; sco_sv...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: SIMULATE_VERSION_PATCH...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: SIMULATE_VERSION_PATCH; SIMULATE_VERSION_TWEAK...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: WIN32; WIN32; WIN32...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: XENIX; XENIX; XENIX...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: AIX; AIX; AIX; aix; aix...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: BEOS; BEOS; BeOS...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: COMPILER_VERSION; SGI_COMPILER_VERSION...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: COMPILER_VERSION; SGI_COMPILER_VERSION; SGI_COMPILER_VERSION...
Checking /home/user/deepstate/build_afl/CMakeFiles/3.10.2/CompilerIdCXX/CMakeCXXCompilerId.cpp: CRAYC...
5/67 files checked 7% done
Checking /home/user/deepstate/build_afl/CMakeFiles/feature_tests.c ...
Checking /home/user/deepstate/build_afl/CMakeFiles/feature_tests.c: __STDC_VERSION__...
```