Performance Analysis of Undefined Behavior Optimizations

Wednesday 1st March, 2023

Abstract

State-of-the-art compilers, such as Clang/LLVM, use undefined behavior to issue optimizations. In this poster session, we present the impact of undefined behavior optimizations for a diverse set of application categories. We use Phoronix to test the impact in the form of total execution time, FPS, transactions per second, etc. The results can be used by application developers who may choose to disable certain such optimizations because they buy low performance benefits or they are considered too dangerous.

1 Context and Motivation

The ISO C Standard [2] provides a definition of undefined behavior that gives absolute freedom to compiler implementation when erroneous program constructs, erroneous data or indeterminately-valued objects are encountered. This allows Clang/LLVM to treat undefined behavior in various ways while still being standard conformant.

This allows the compiler implementation to use the definition of undefined behavior to issue optimizations. However, the impact of such optimizations is not clear. Some application categories might benefit from the advantages of undefined behavior optimizations while other might not.

In this context we take a set of application categories and assess the performance impact of undefined behavior optimizations. The categories are the following: webservers, circuit simulators, telephony, finance, GUI, software defined radio, speech, compression, texture compression, audio encoding, databases, chess, password cracking, cryptography, security, parallel processing, image processing, bioinformatics, simulation, video encoding, neural networks, HPC and compiler build speed.

These categories are the result of a fine grained analysis of the benchmarks provided by Phoronix Test Suite [1]. We use this benchmark framework as it provides support for a wide range of applications and a fast and mature interface for running the benchmarks.

We test the appplication categories against different undefined behavior optimization flags such as: -fwrapv, -fno-strict-aliasing, -fstrict-enums, etc.

References

[1] Phoronix test suite. `https://www.phoronix-test-suite.com/`, last visited Wednesday 1st March, 2023.

[2] Programming languages — C. Standard, International Organization for Standardization, Dec 1990.