

RISE QEMU function benchmarks

These are hand-written versions of common memory and string library functions provided by SiFive Inc. For each benchmarked function, we are comparing a “baseline” QEMU against a “latest” QEMU. By default, we look at three versions of the code.

1. the standard library “scalar” implementation of the function
2. the hand-written vector code for VLEN=128 and LMUL=1 (“small vector”)
3. the hand-written vector code for VLEN=1024 and LMUL=8 (“large vector”)

We thus have a total of 6 datasets.

There are four graphs. The first looks at the average number of instructions executed per iteration, and is a sanity check. Although we plot all 6 datasets, only 3 should show on the graph - the “latest” versions of “scalar”, “small vector” and “large vector”, since the version of QEMU should have no impact on the number of instructions being executed. This graph is useful to developers of the vector implementations to see how their code behaves for different sizes of data, but this is outside the scope of this project.

The remaining three graphs capture QEMU performance for each of the three versions of the code. They use the metric of nanoseconds per instruction, to measure the efficiency of QEMU. Each graph shows this metric, plotted against problem size, one line for the “baseline” version of QEMU, the other the “latest” QEMU.

This report is generated entirely automatically using the command

```
./run-all-benchmarks.py
```

This takes less than 20 minutes to run on a 40 thread AMD Threadripper 1950X at 3.4GHz. The code is in the `strmem-benchmarks` directory of the `rise-rvv-tcg-qemu-tooling` repository. It is intended to be portable, but to date has only been tested on Ubuntu 22.04 LTS.

Document details

- Datestamp: 2024-11-06-15-11-46
- User: jeremy

Functions to be benchmarked

Any functions which failed to benchmark are noted.

- memchr
- memcmp

- memcpy
- memmove
- memset
- strcat
- strchr
- strcmp
- strcpy
- strlen (failed)
- strncat
- strncmp (failed)
- strncpy
- strnlen

QEMU versions

- f15f7273ea
- 07d7bd62b2

Tool chain configuration

GCC configuration

```
Using built-in specs. COLLECT_GCC=riscv64-unknown-linux-gnu-gcc COLLECT_LTO_WRAPPER=/home/jeremy/gittrees
/rise-qemu/install/libexec/gcc/riscv64-unknown-linux-gnu/14.1.0/lto-wrapper Target:
riscv64-unknown-linux-gnu Configured with: /home/jeremy/gittrees/rise-qemu/gcc/configure
--target=riscv64-unknown-linux-gnu --prefix=/home/jeremy/gittrees/rise-qemu/install
--with-sysroot=/home/jeremy/gittrees/rise-qemu/install/sysroot --with-pkgversion=gcd0059a1976-dirty
--with-system-zlib --enable-shared --enable-tls --enable-languages=c,c++,fortran --disable-libmudflap
--disable-libssp --disable-libquadmath --disable-lsanitizer --disable-nls --disable-bootstrap
--src=/home/jeremy/gittrees/rise-qemu/gcc --enable-multilib --with-abi=lp64d --with-arch=rv64gc
```

--with-tune= --with-isa-spec=20191213 'CFLAGS_FOR_TARGET=-O2 -mmodel=medany' 'CXXFLAGS_FOR_TARGET=-O2 -mmodel=medany' Thread model: posix Supported LTO compression algorithms: zlib gcc version 14.1.0 (gcd0059a1976-dirty)

Assembler version

GNU assembler version 2.42 (riscv64-unknown-linux-gnu) using BFD version (GNU Binutils) 2.42

Linker version

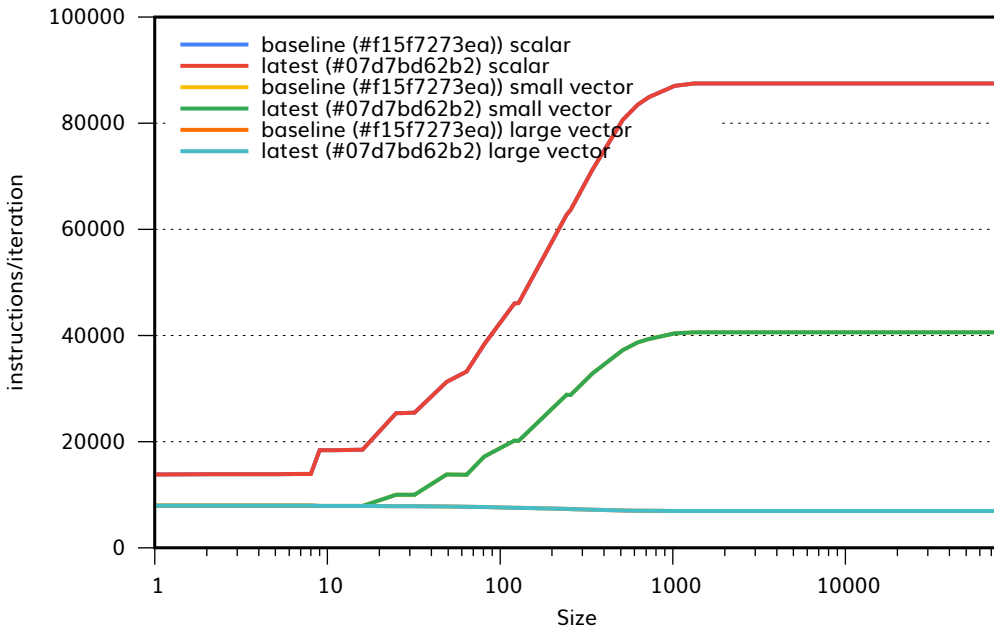
GNU ld (GNU Binutils) 2.42

Glibc version

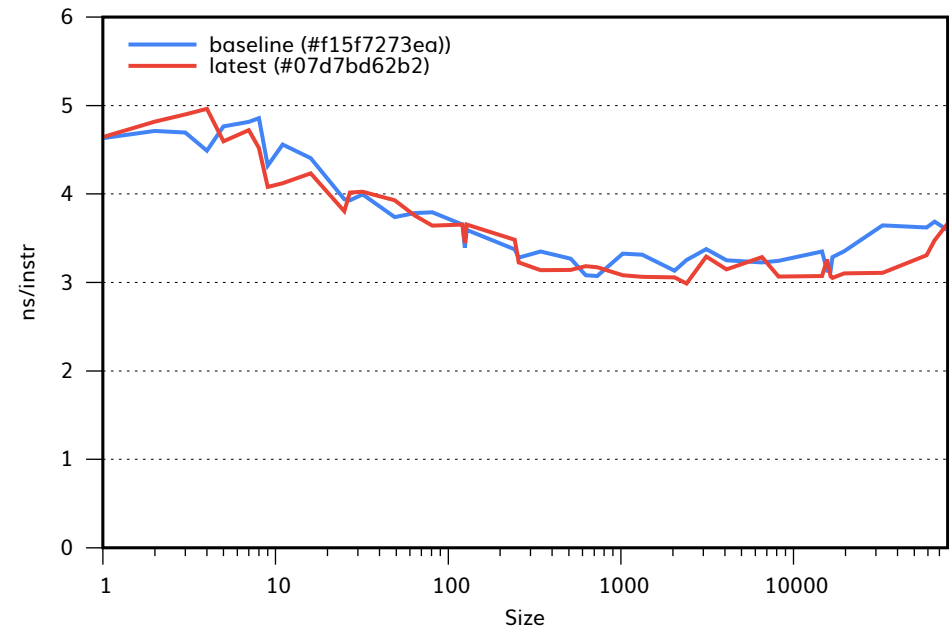
ldd (GNU libc) 2.39 Copyright (C) 2024 Free Software Foundation, Inc. This is free software; see the source for copying conditions. There is NO warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. Written by Roland McGrath and Ulrich Drepper.

memchr performance

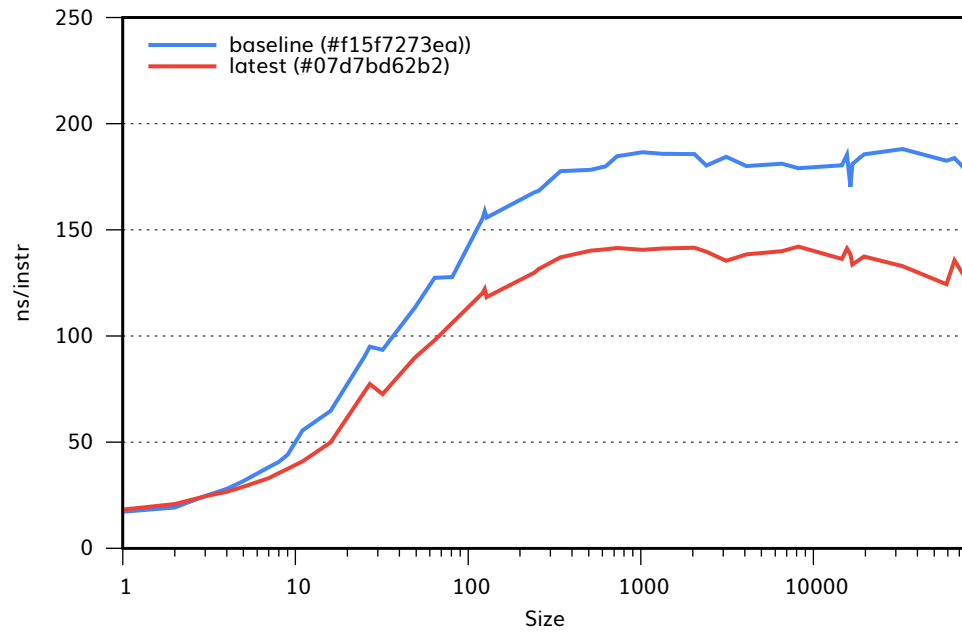
Instruction counts



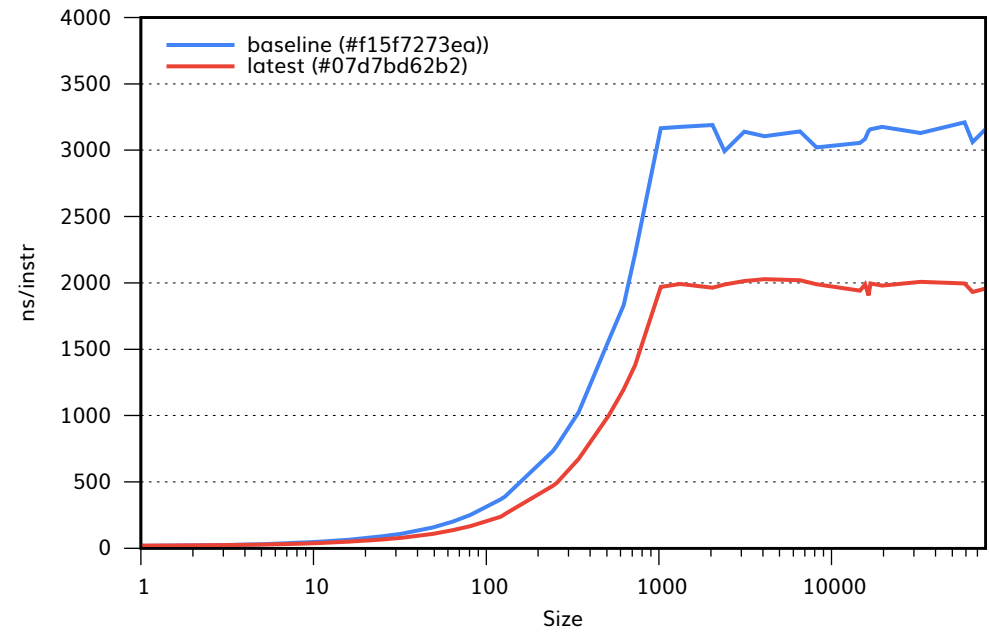
scalar QEMU instruction timings



VLEN=128, LMUL=1 (small vector) QEMU instruction timings

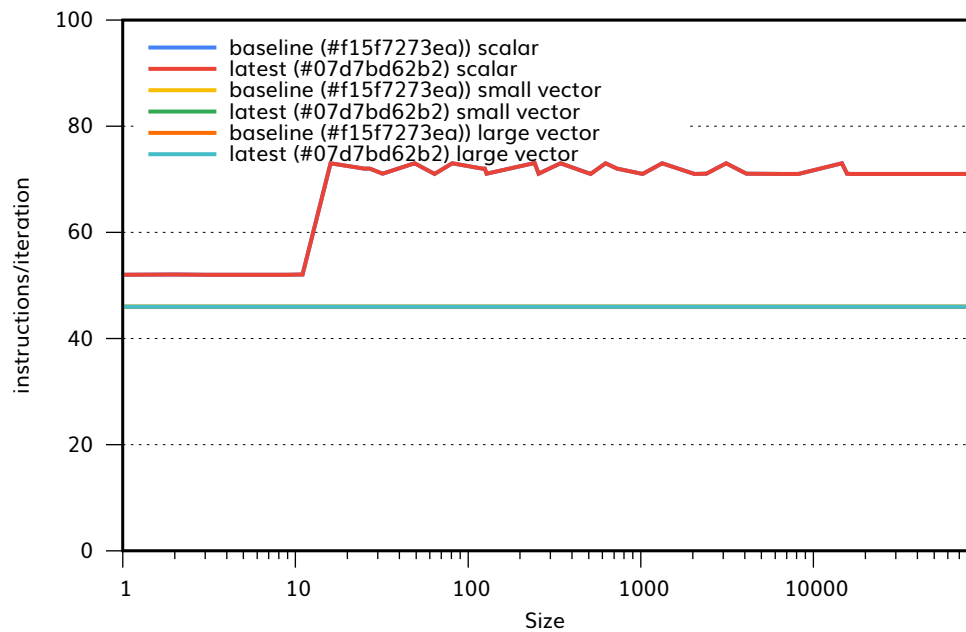


VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

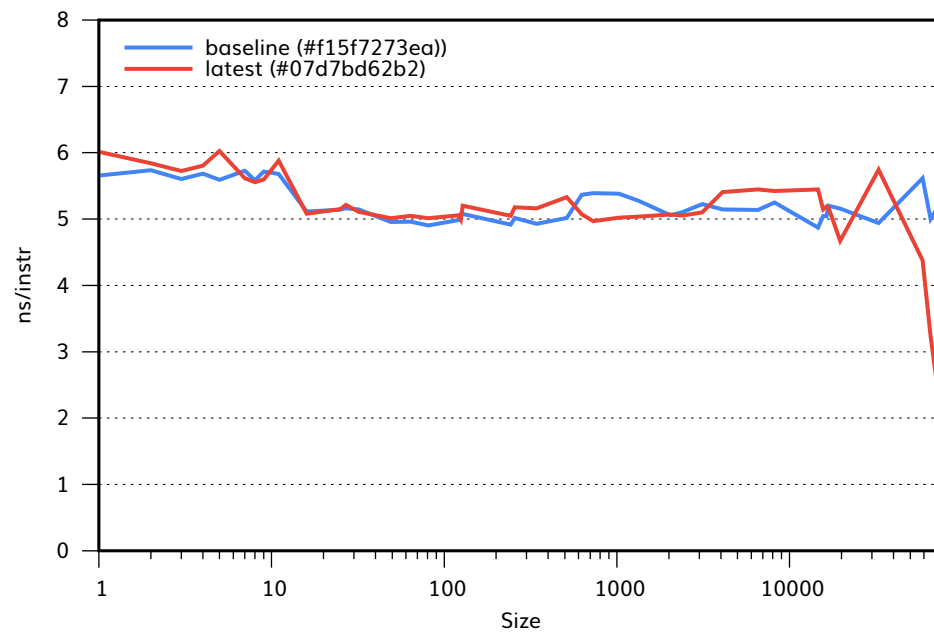


memcmp performance

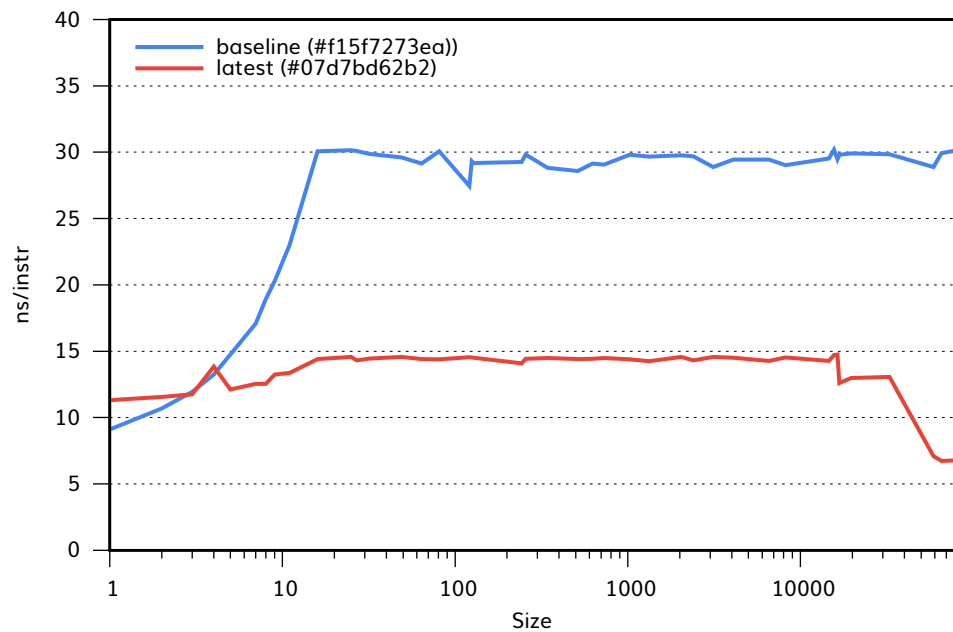
Instruction counts



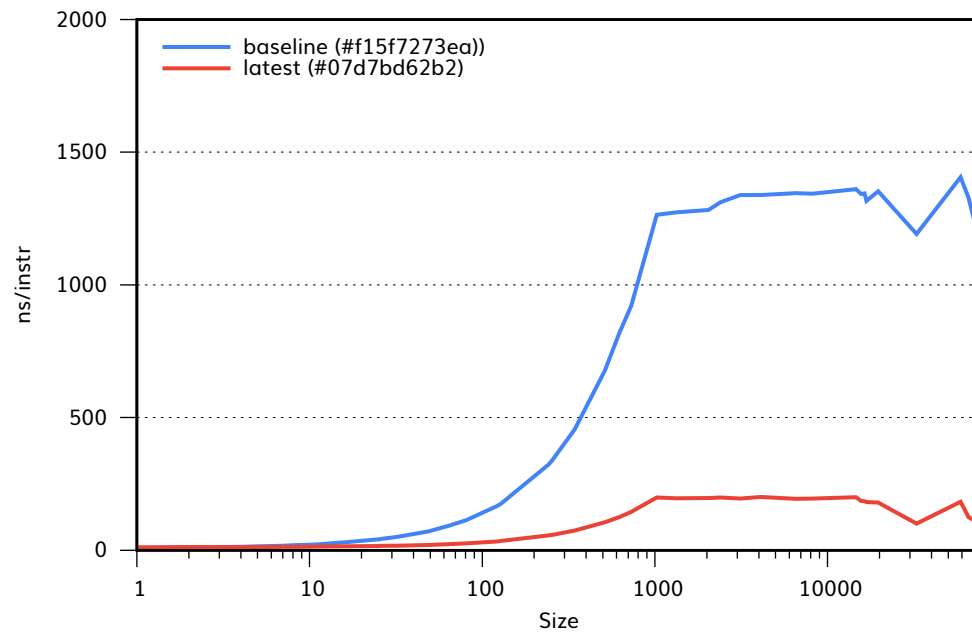
scalar QEMU instruction timings



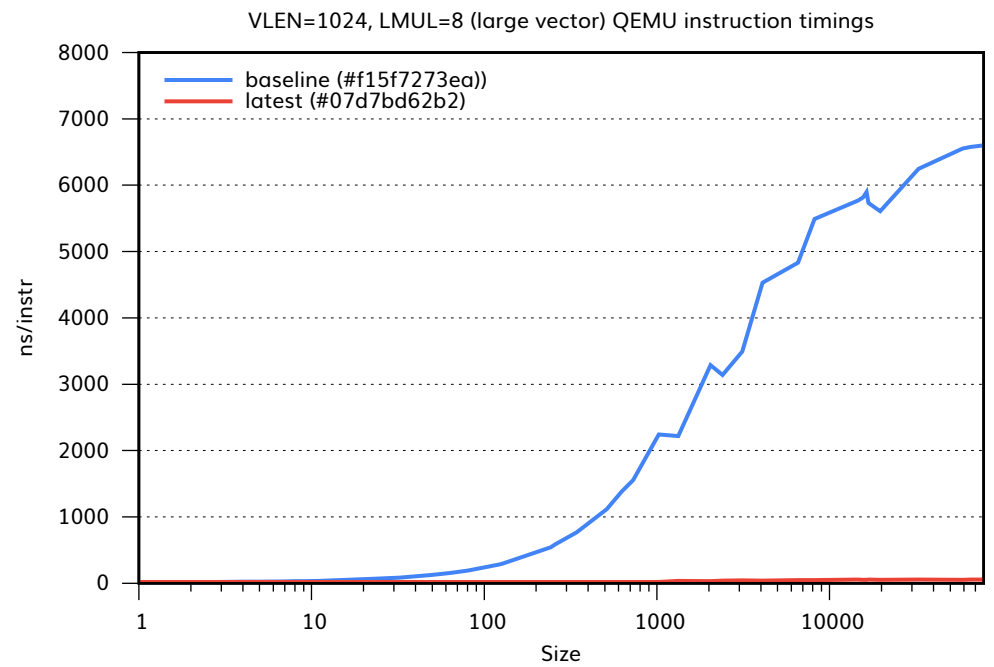
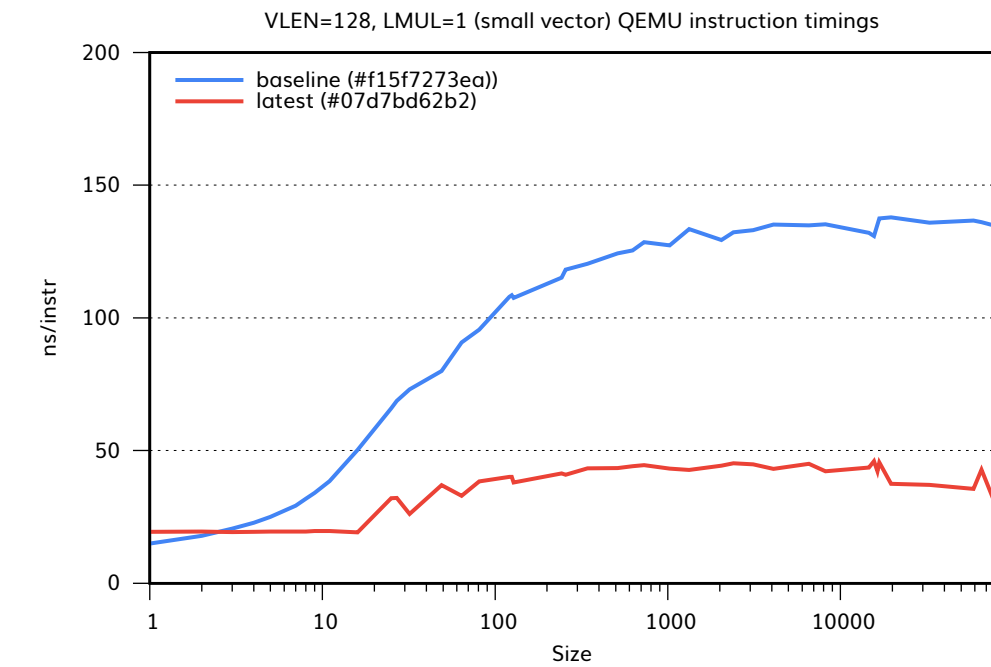
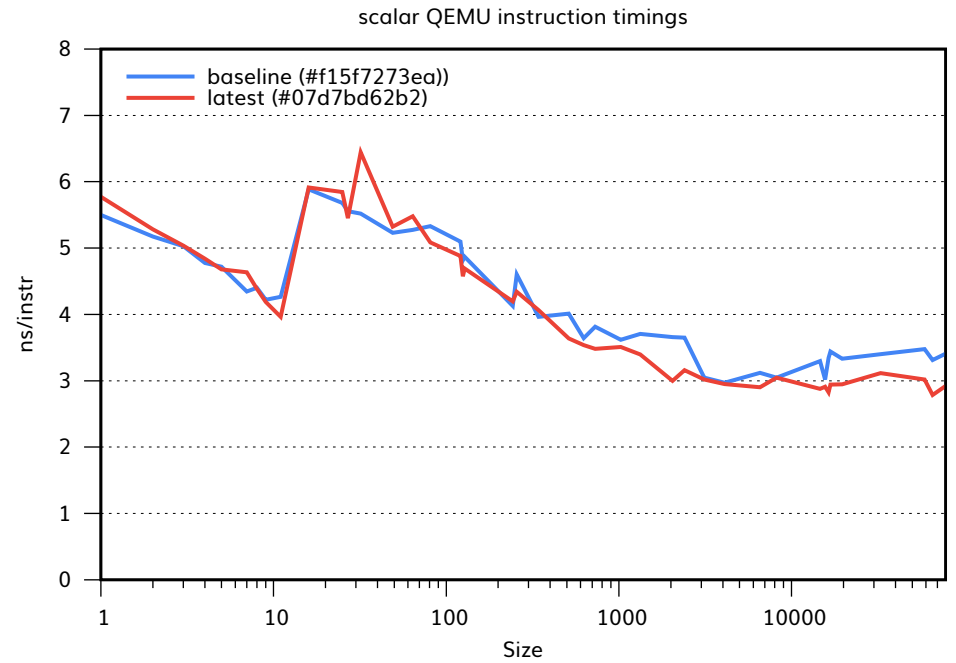
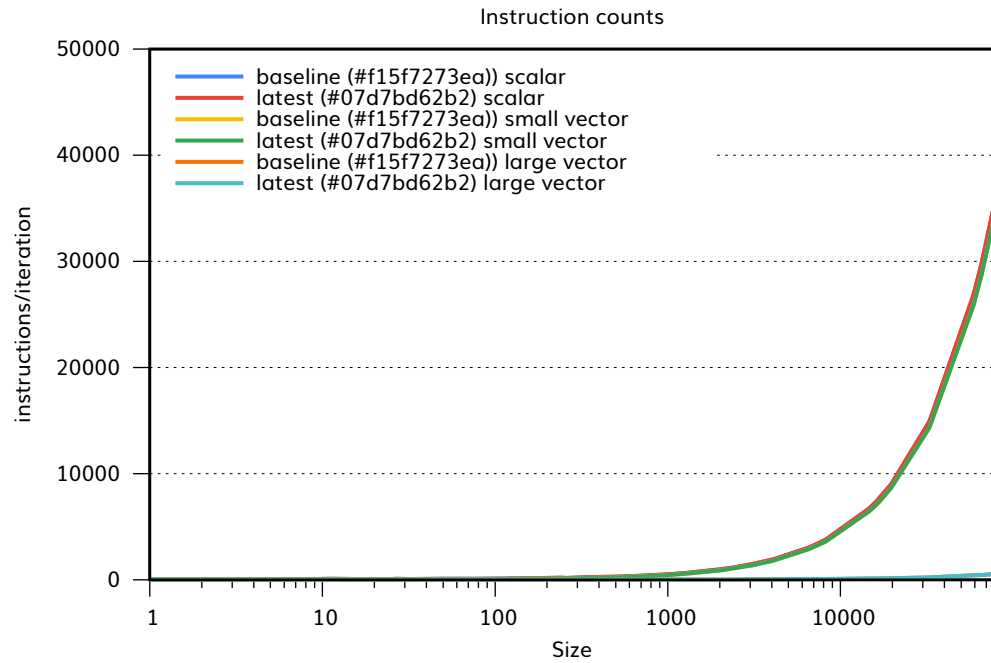
VLEN=128, LMUL=1 (small vector) QEMU instruction timings



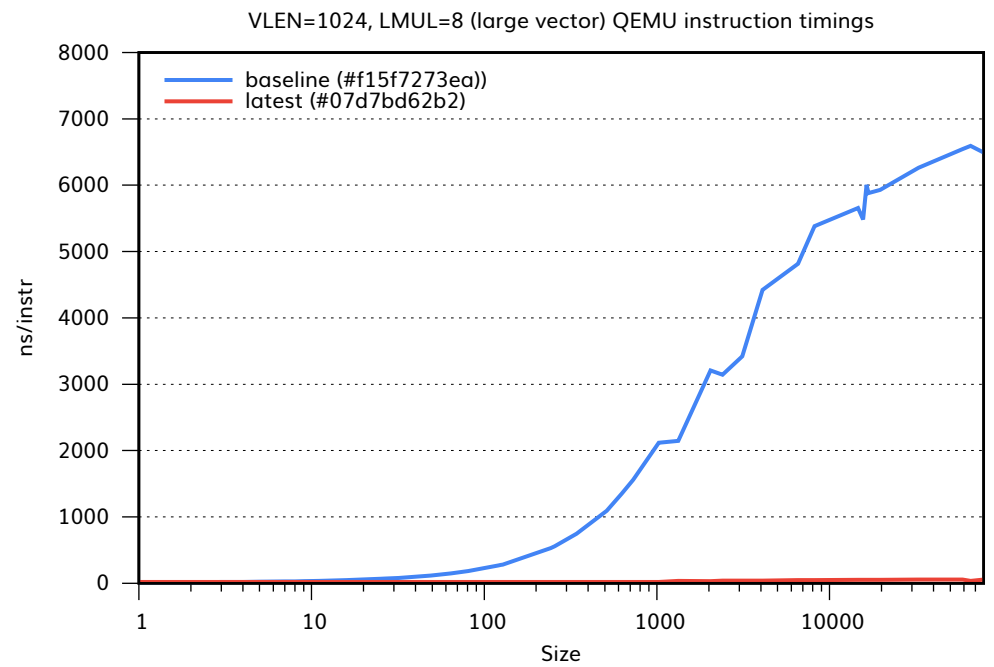
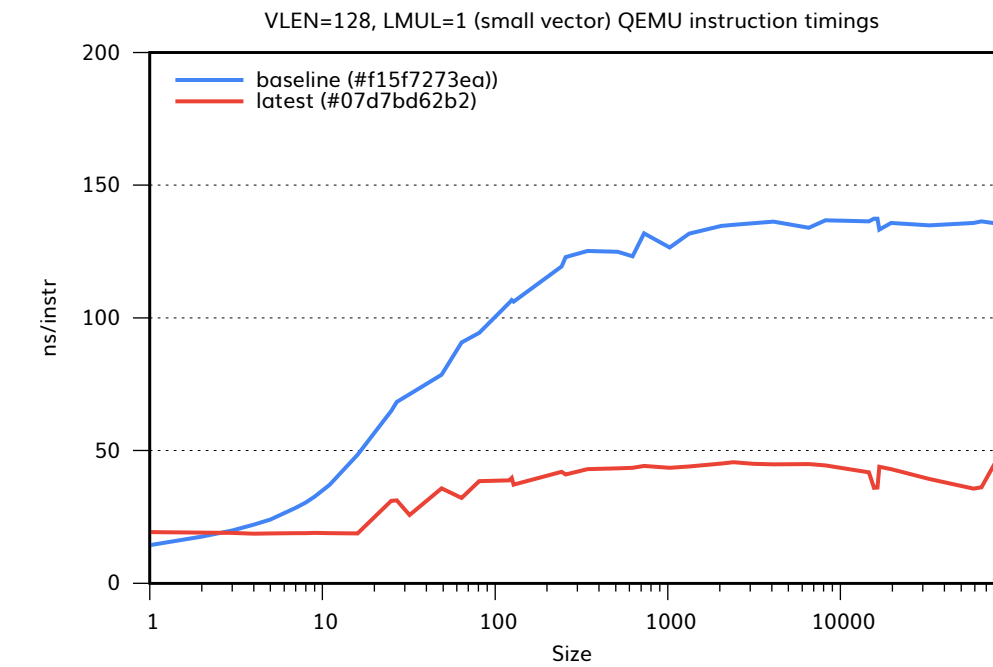
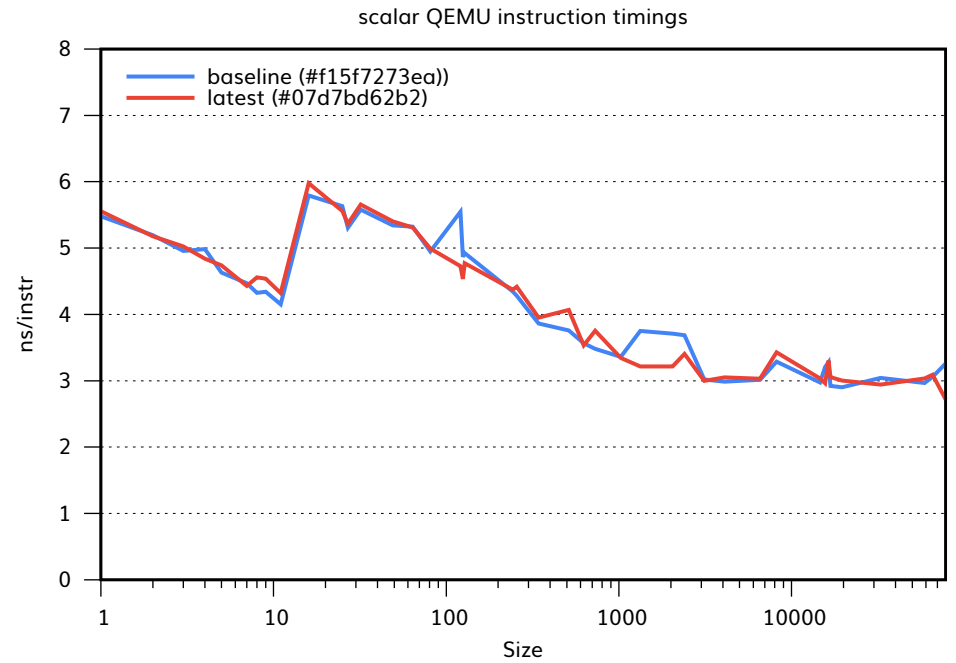
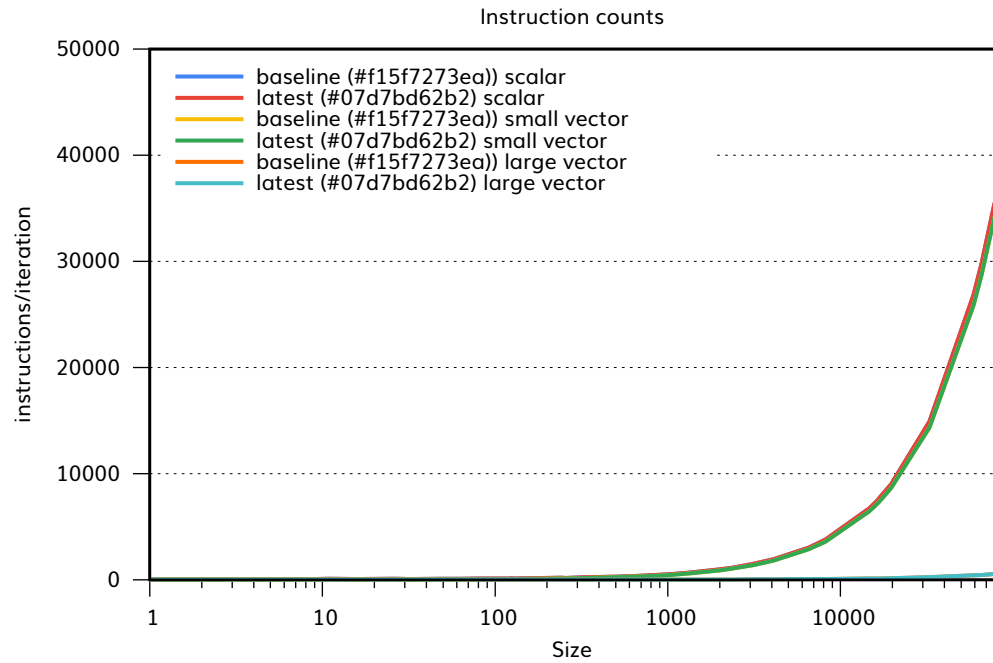
VLEN=1024, LMUL=8 (large vector) QEMU instruction timings



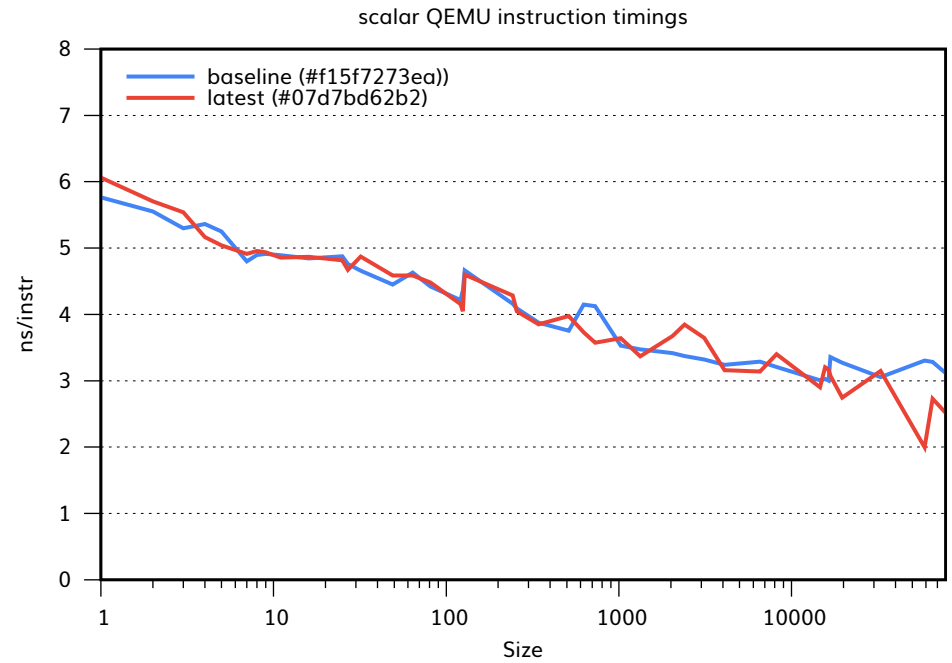
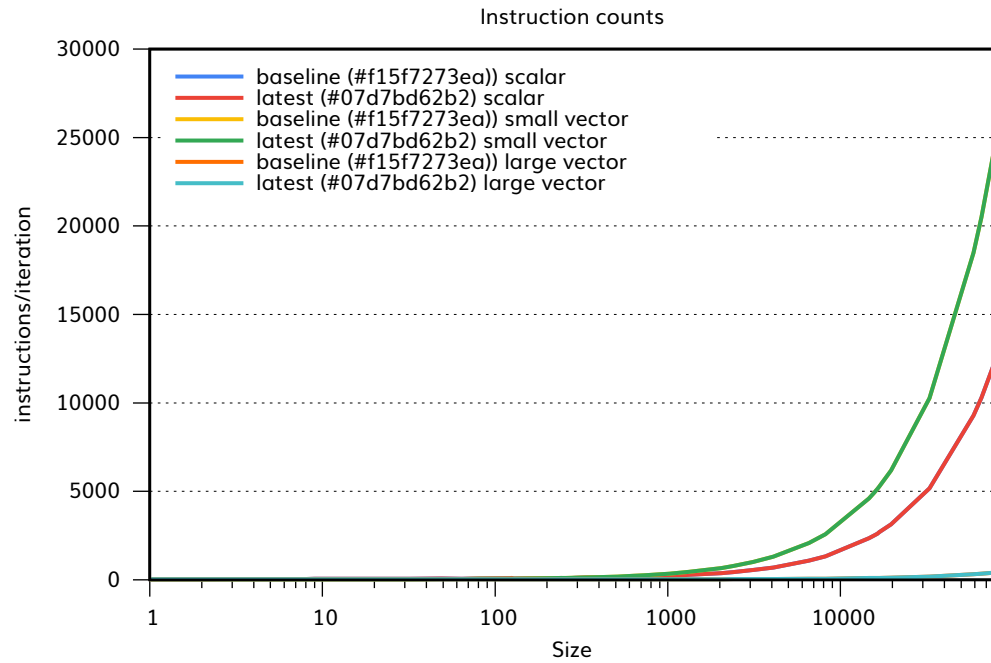
memcpy performance



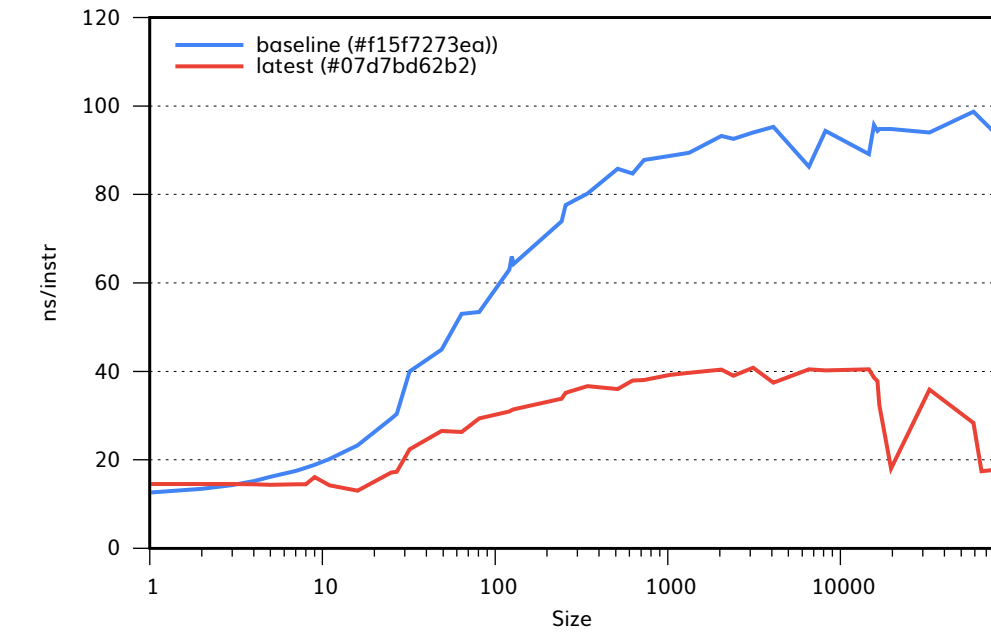
memmove performance



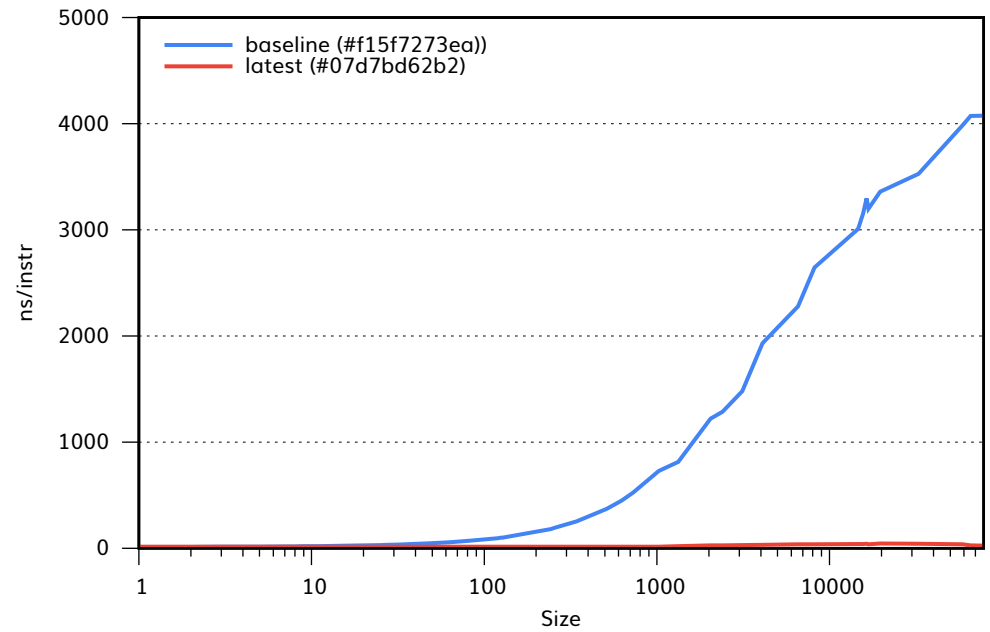
memset performance



VLEN=128, LMUL=1 (small vector) QEMU instruction timings

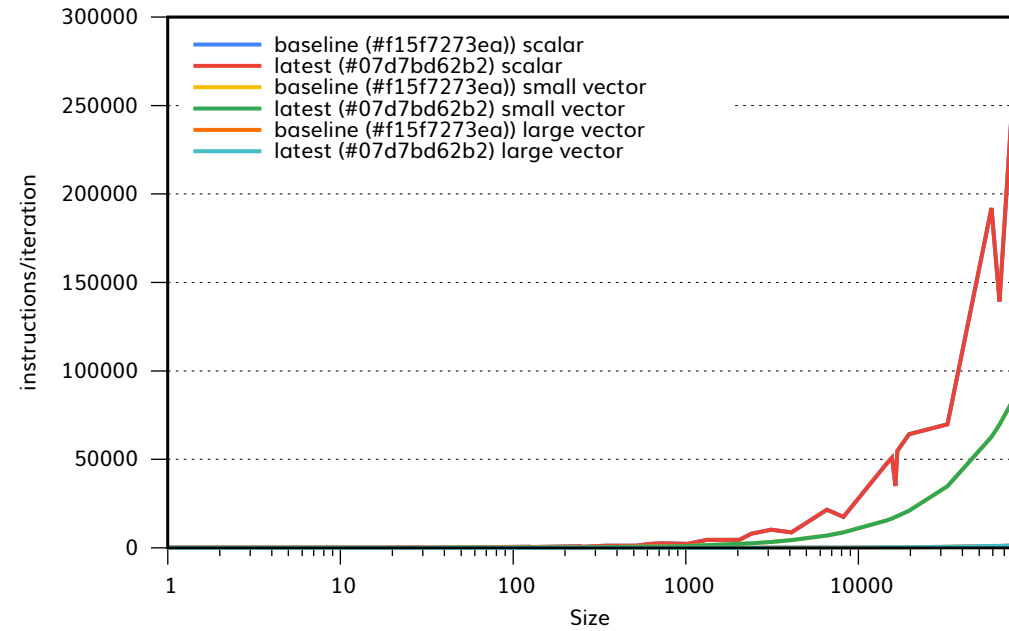


VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

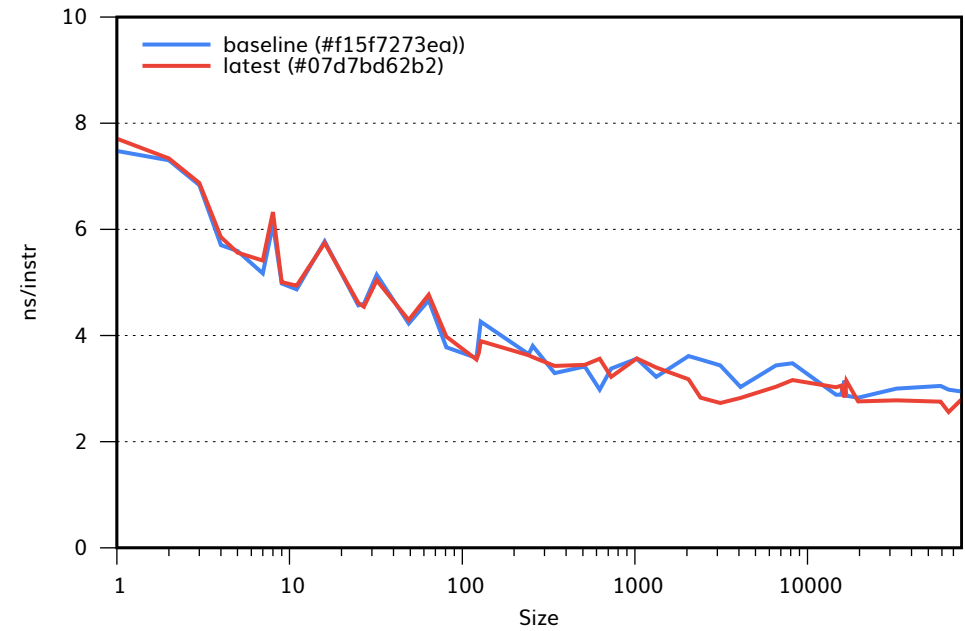


strcat performance

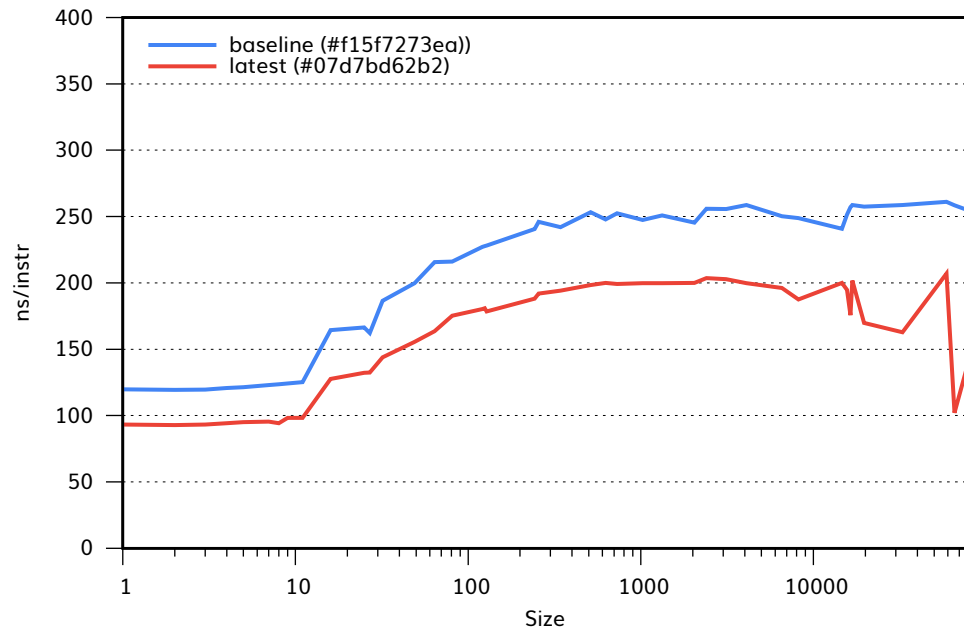
Instruction counts



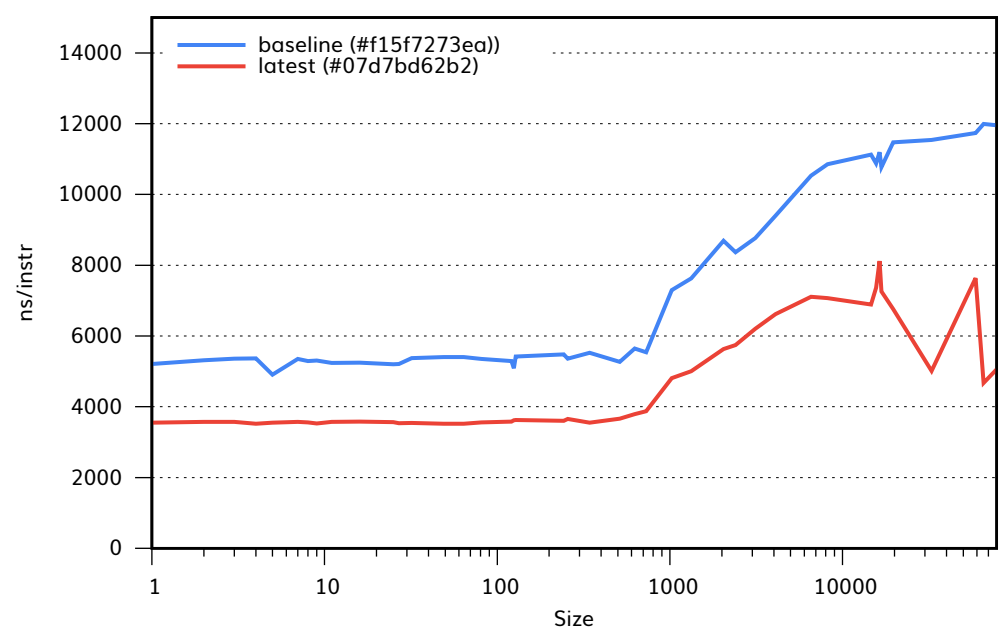
scalar QEMU instruction timings



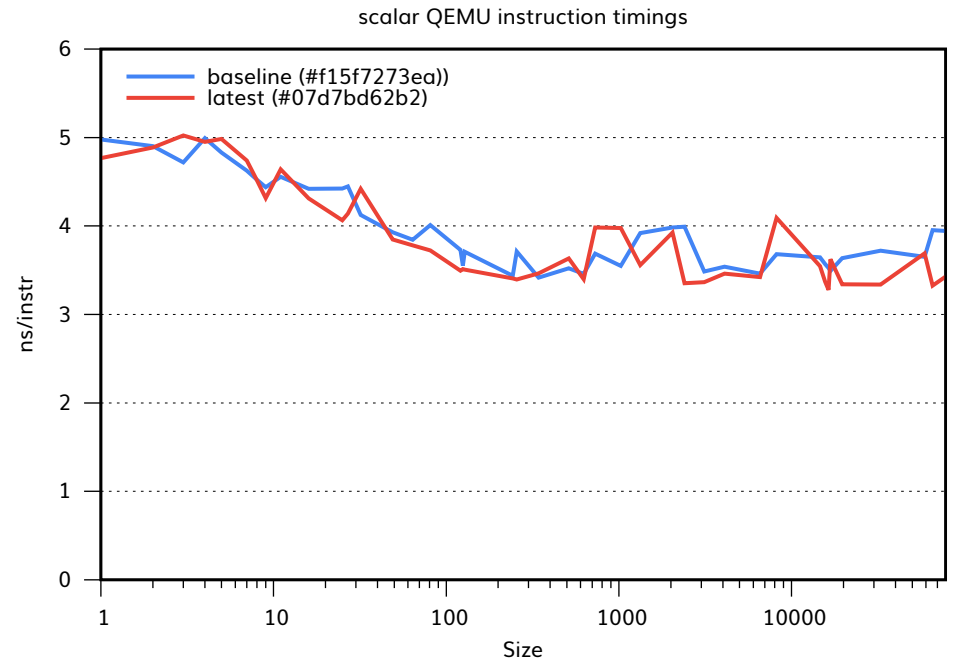
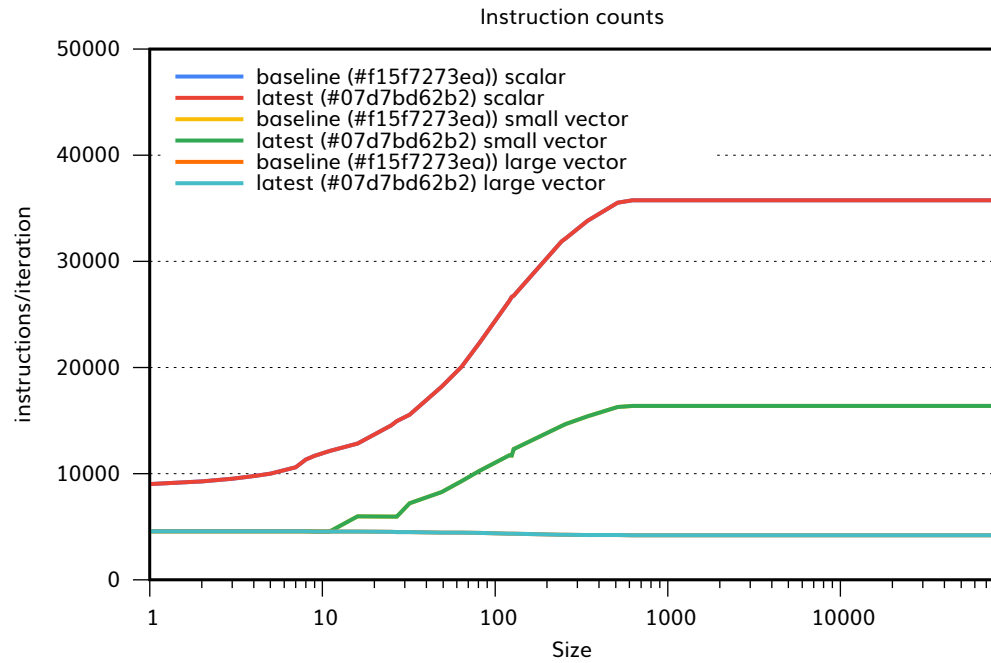
VLEN=128, LMUL=1 (small vector) QEMU instruction timings



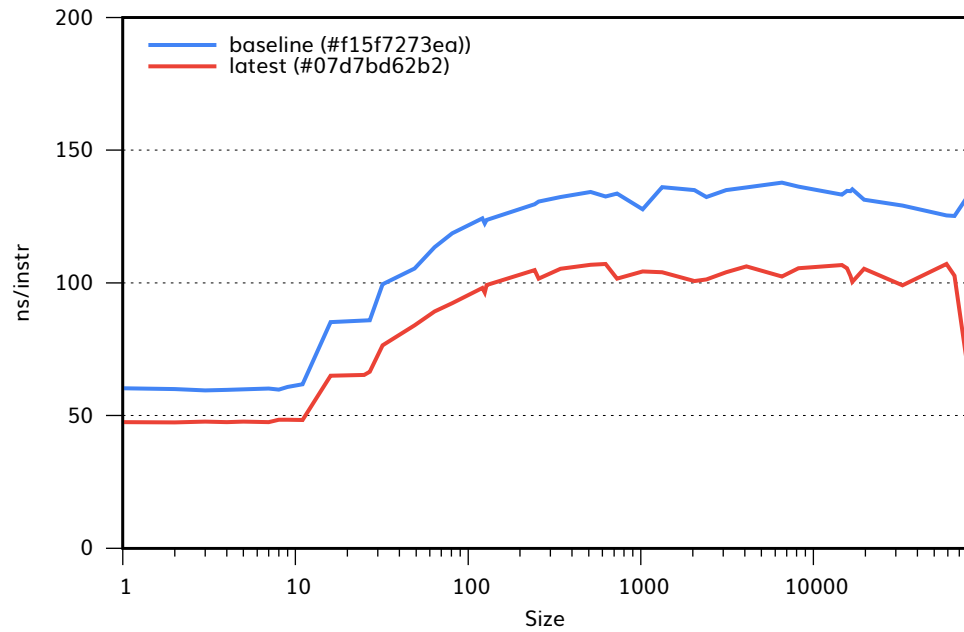
VLEN=1024, LMUL=8 (large vector) QEMU instruction timings



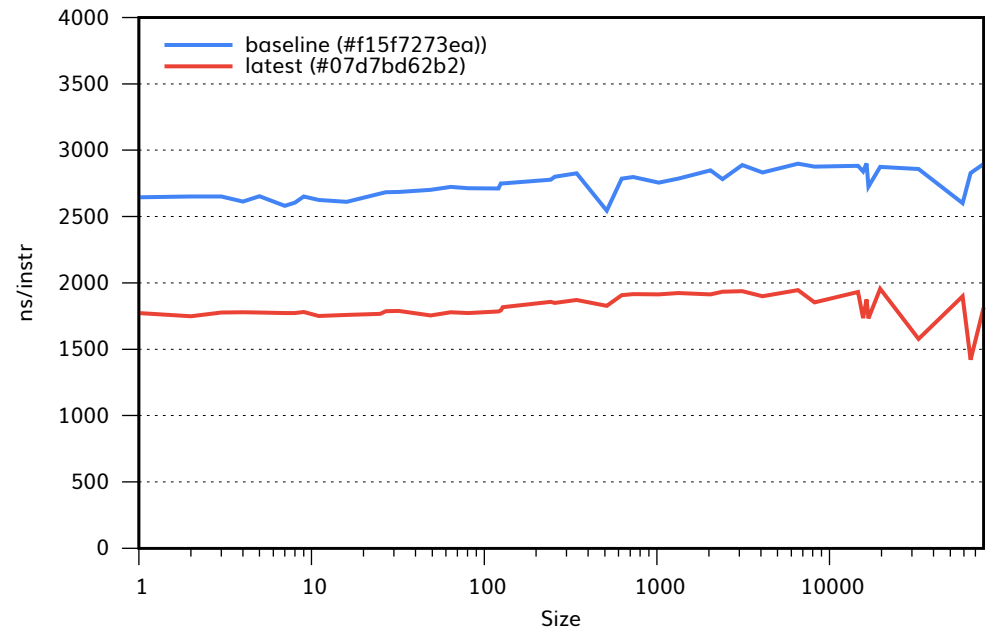
strchr performance



VLEN=128, LMUL=1 (small vector) QEMU instruction timings

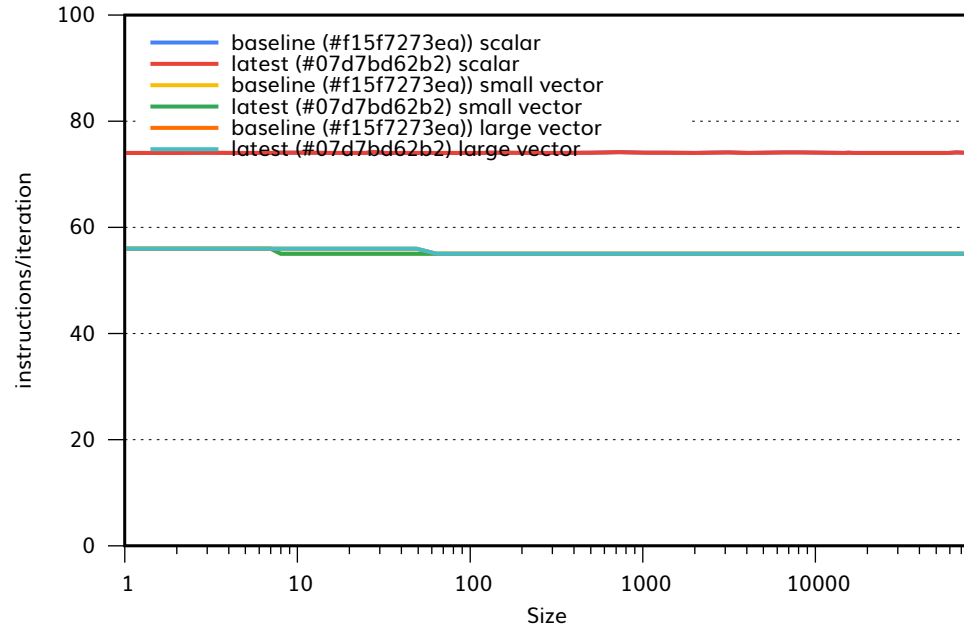


VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

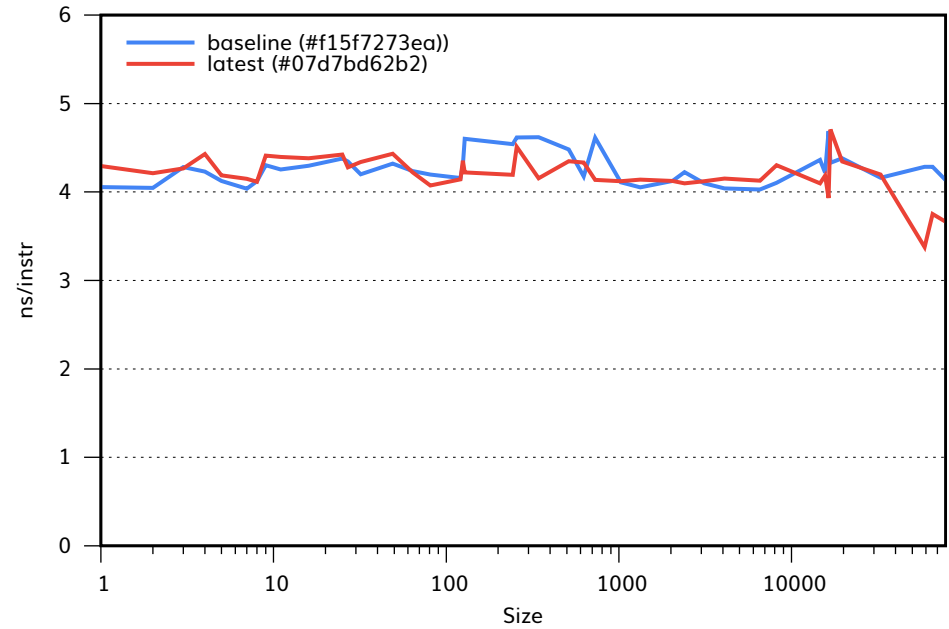


strcmp performance

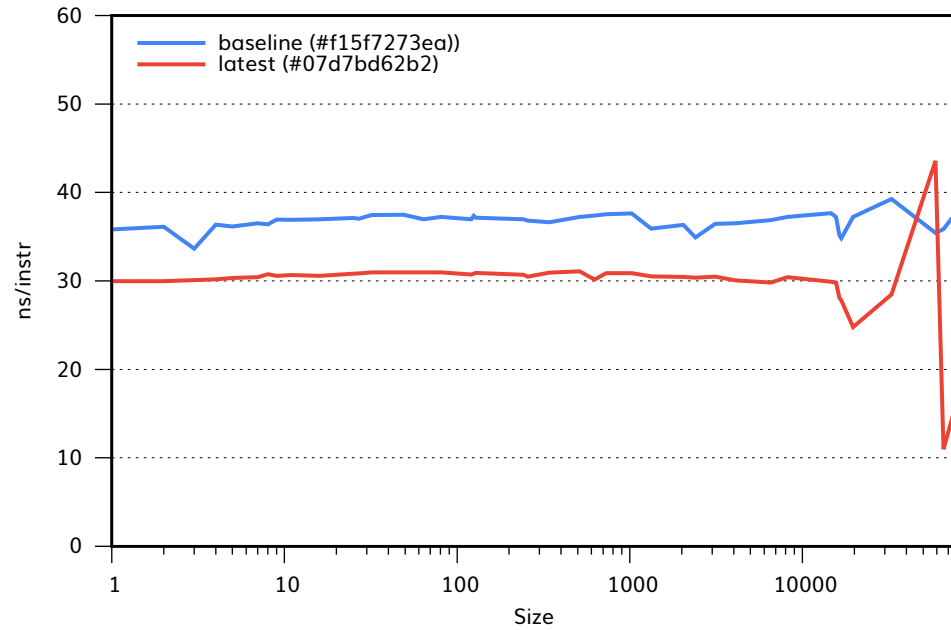
Instruction counts



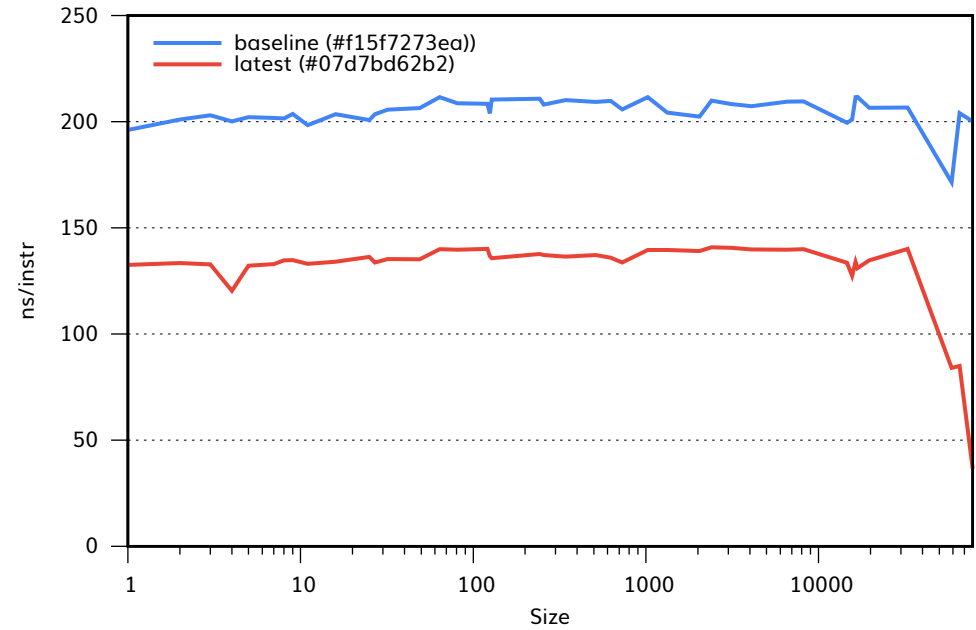
scalar QEMU instruction timings



VLEN=128, LMUL=1 (small vector) QEMU instruction timings

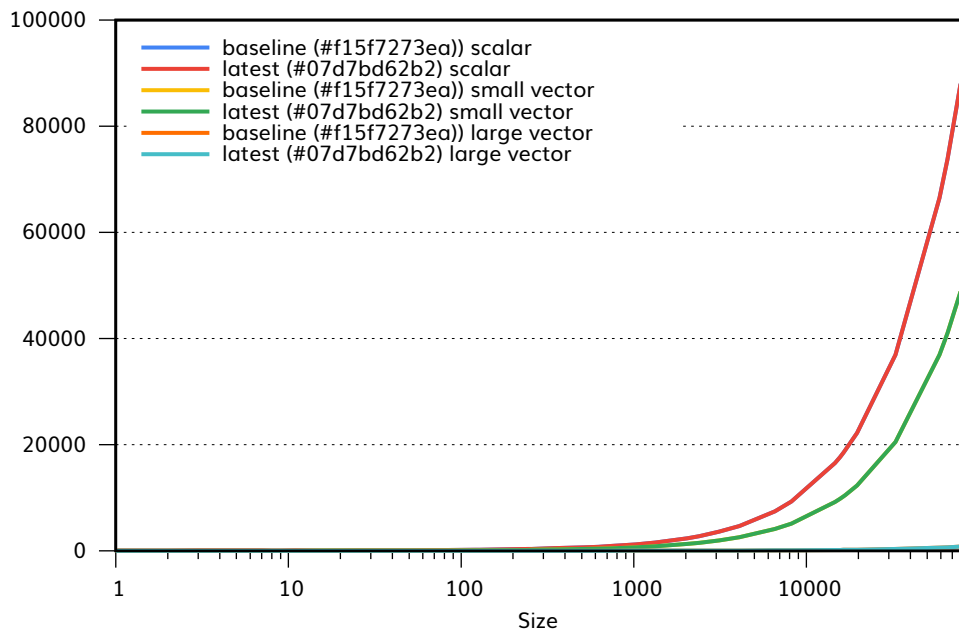


VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

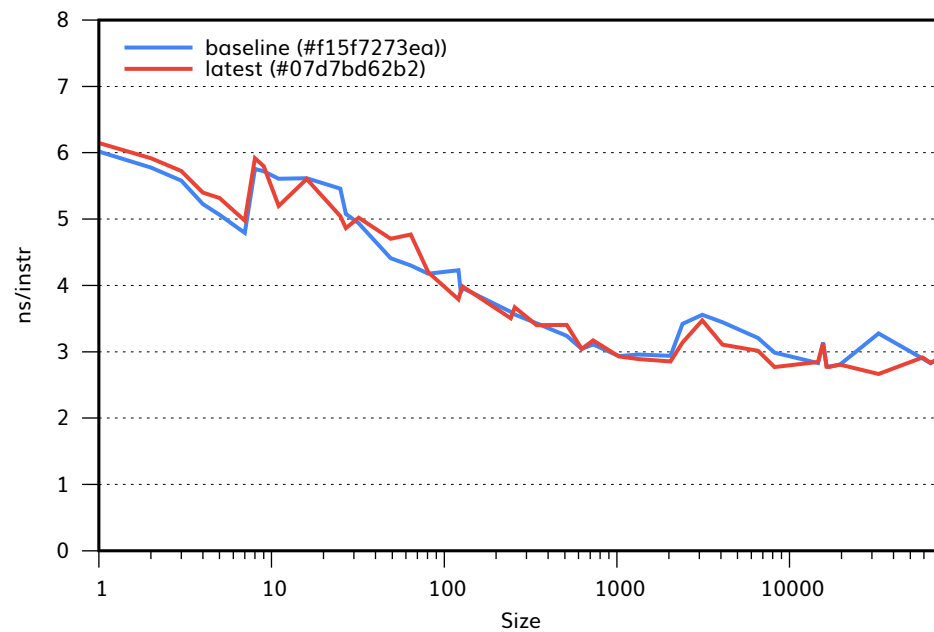


strcpy performance

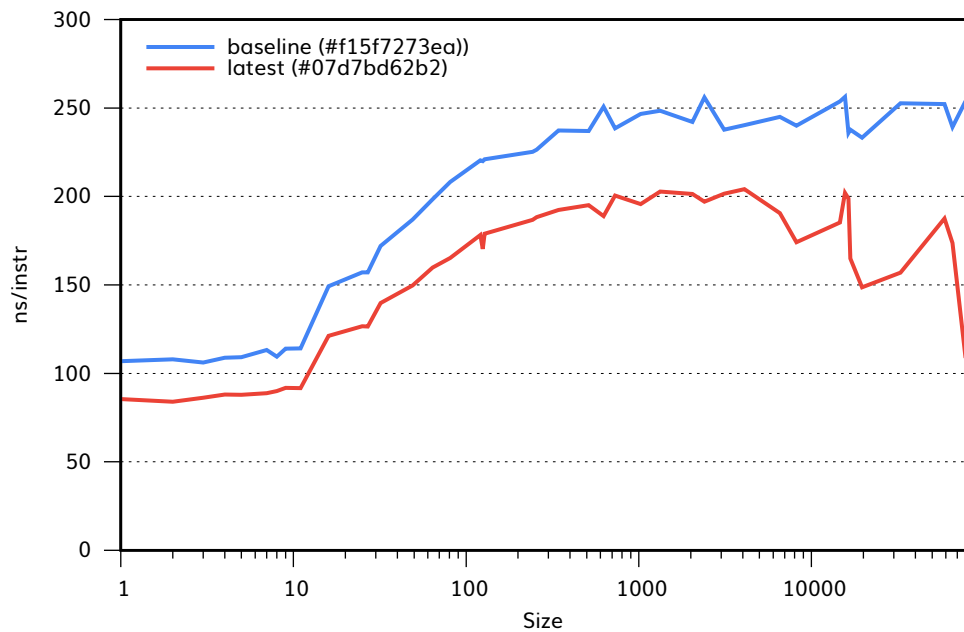
Instruction counts



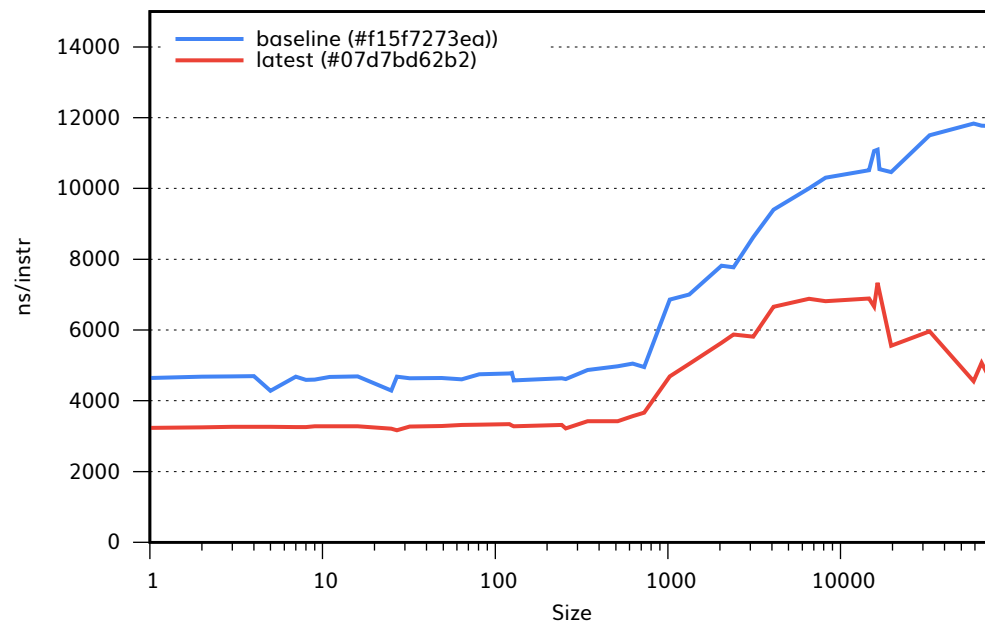
scalar QEMU instruction timings



VLEN=128, LMUL=1 (small vector) QEMU instruction timings

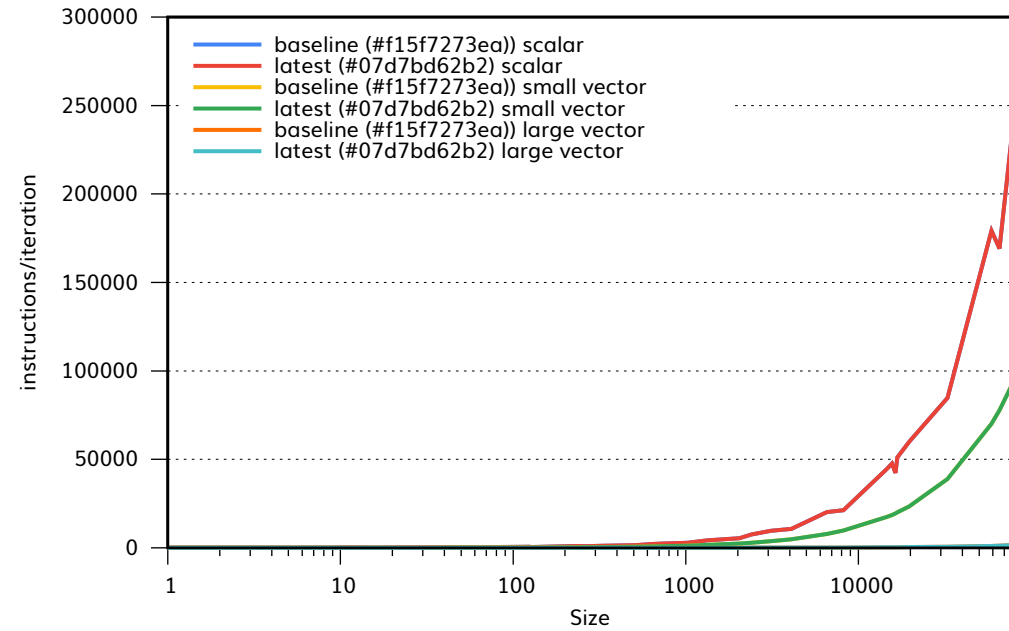


VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

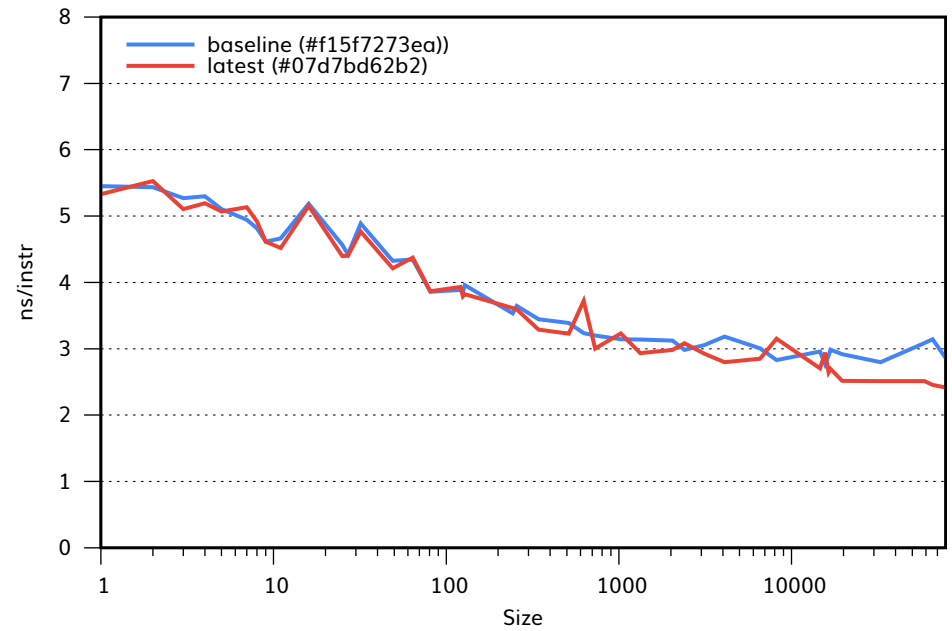


strncat performance

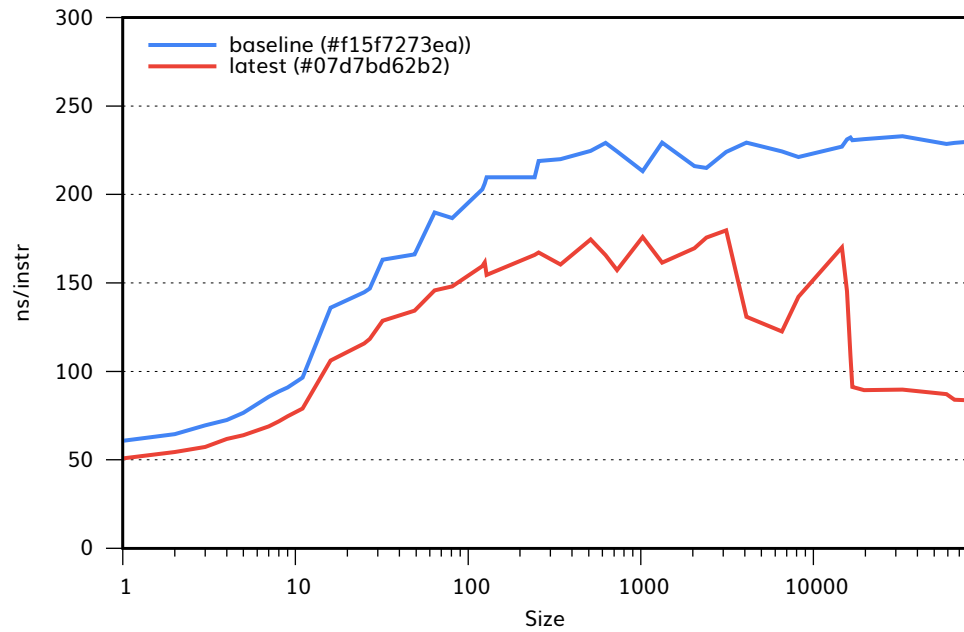
Instruction counts



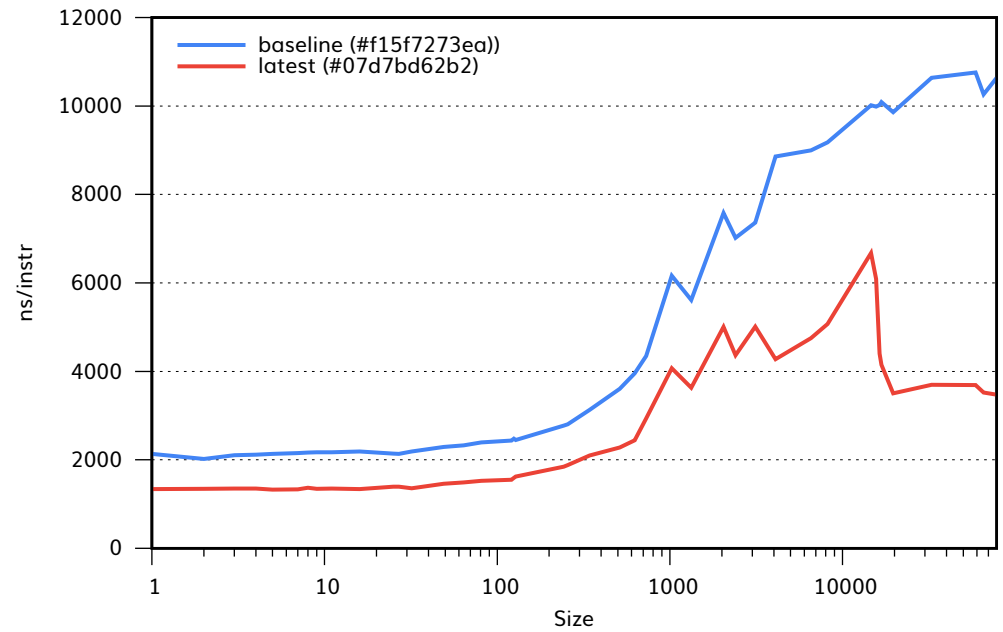
scalar QEMU instruction timings



VLEN=128, LMUL=1 (small vector) QEMU instruction timings

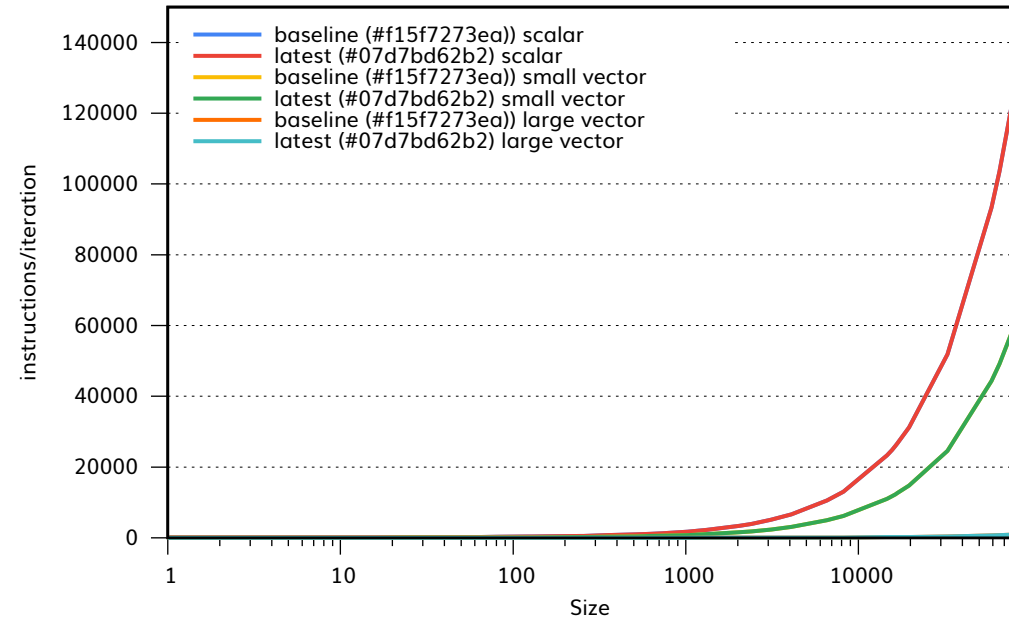


VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

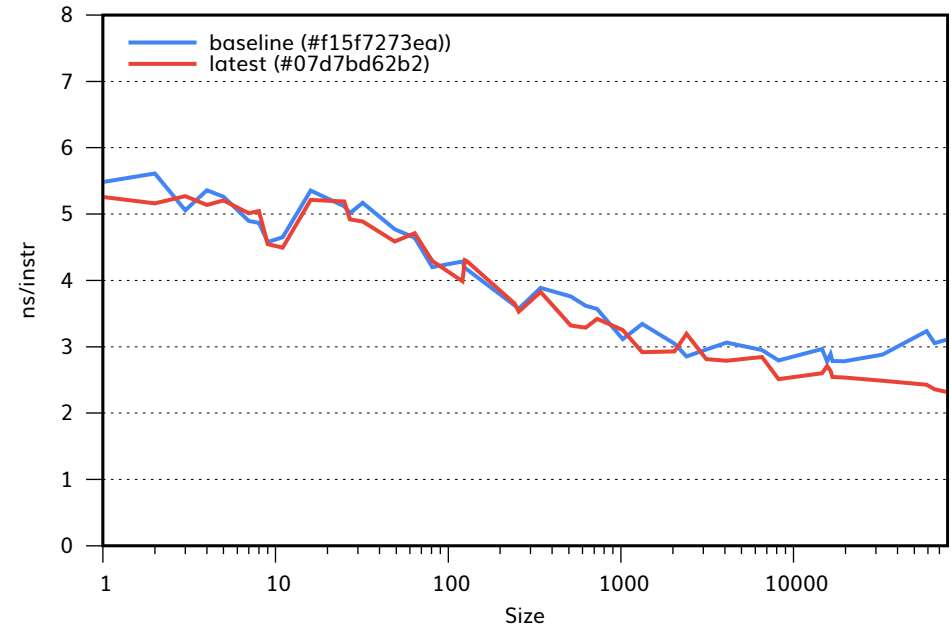


strncpy performance

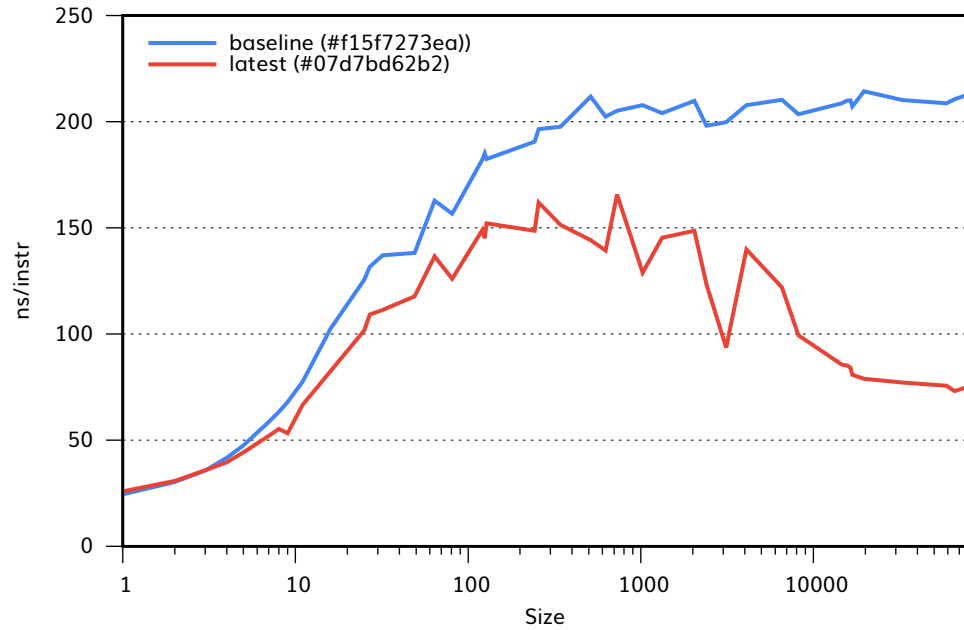
Instruction counts



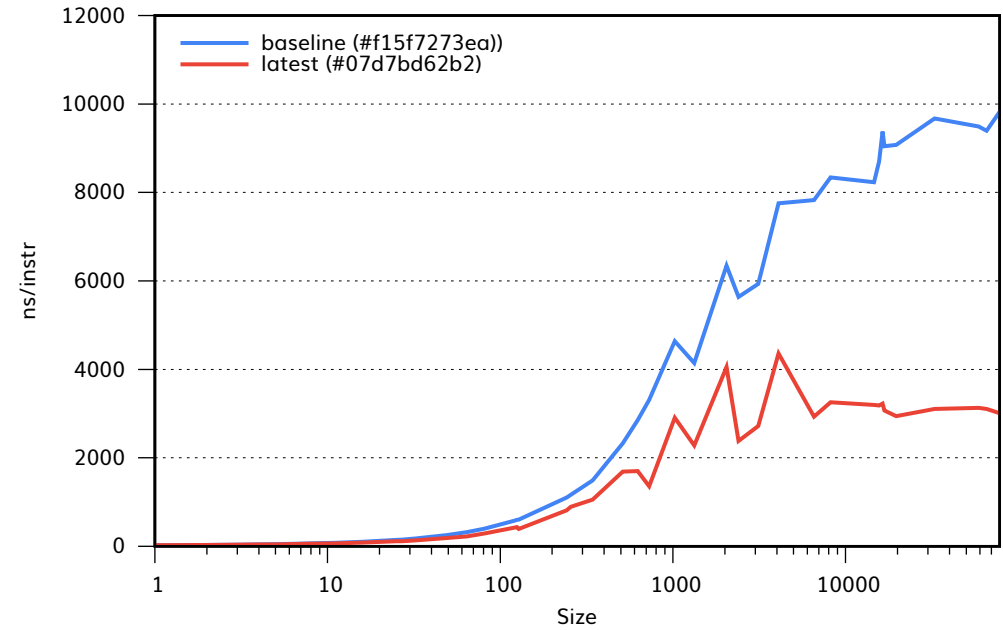
scalar QEMU instruction timings



VLEN=128, LMUL=1 (small vector) QEMU instruction timings

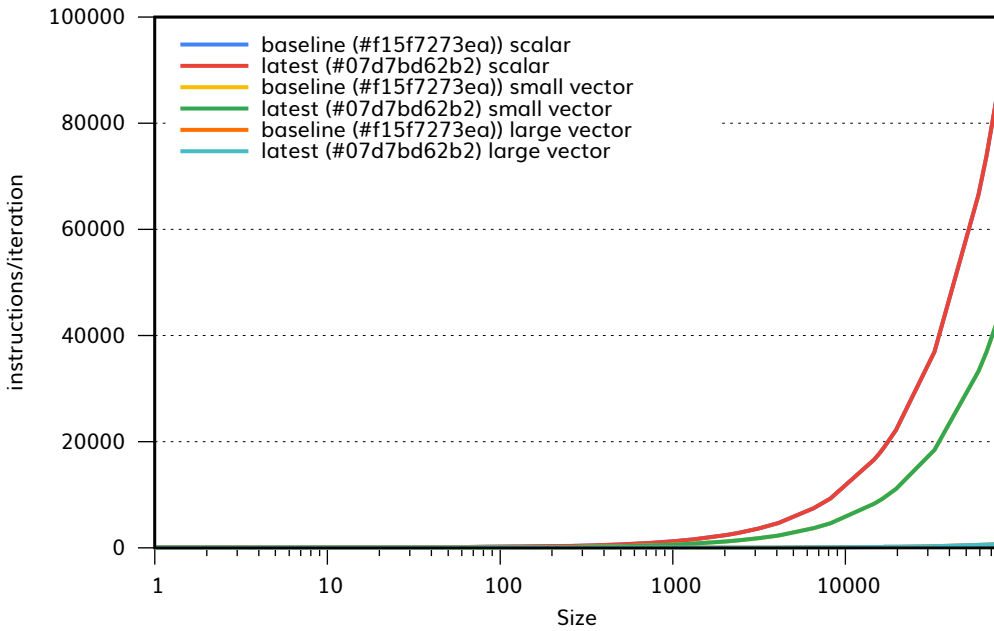


VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

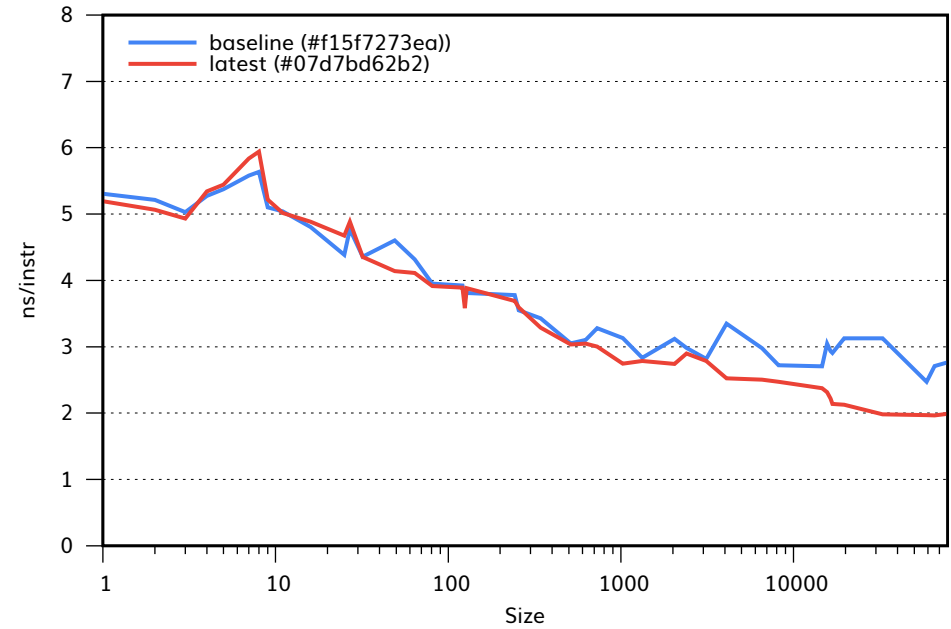


strnlen performance

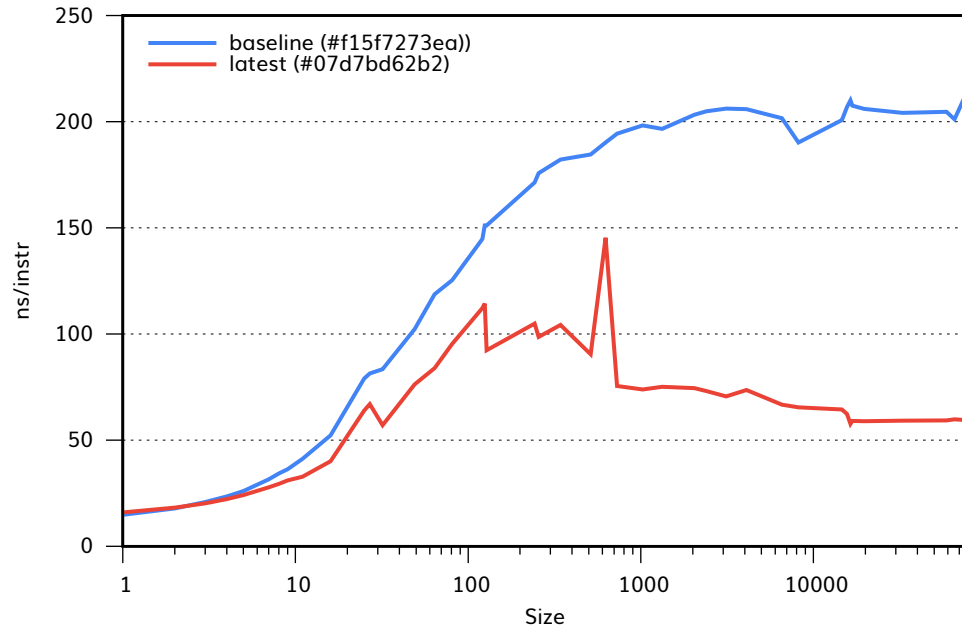
Instruction counts



scalar QEMU instruction timings



VLEN=128, LMUL=1 (small vector) QEMU instruction timings



VLEN=1024, LMUL=8 (large vector) QEMU instruction timings

