

RISC-V with Gem5

Building Gem5 for RISC-V architecture

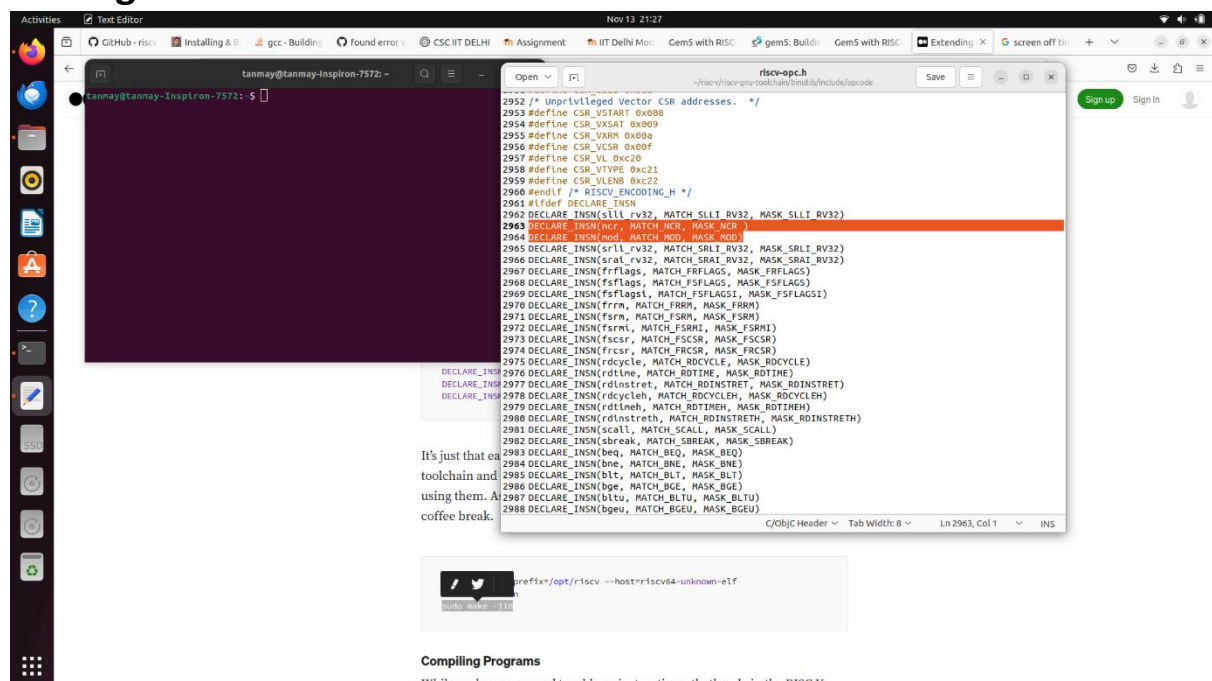
```
1 git clone https://github.com/gem5/gem5
2 scons build /RISC-V/gem5.opt -j 40
-
```

Build riscv-gnu-toolchain

1. Downloaded the prerequisites
2. Cloned riscv-gnu-toolchain
3. Added the installation path to PATH
4. Build the toolchain

```
1 $ git clone https://github.com/riscv/riscv-gnu-toolchain
2 $ ./configure --prefix=/opt/riscv
3 $ sudo make linux
```

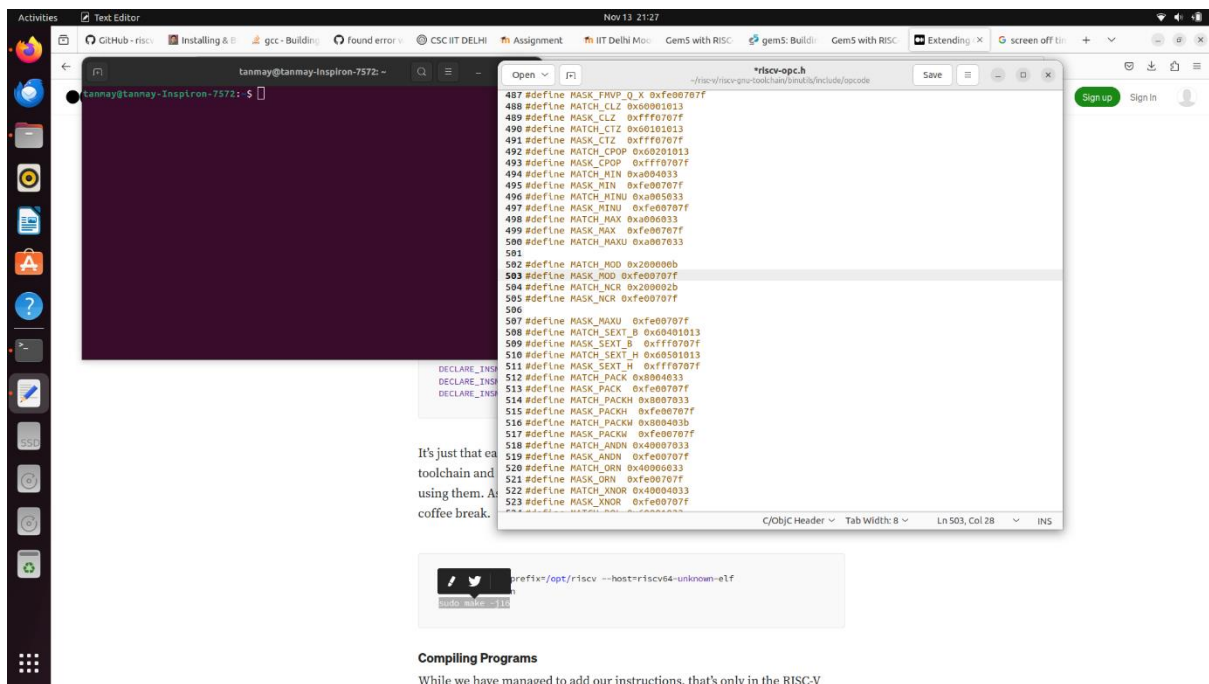
Adding Custom Instructions



It's just that each toolchain and using them. At coffee break.

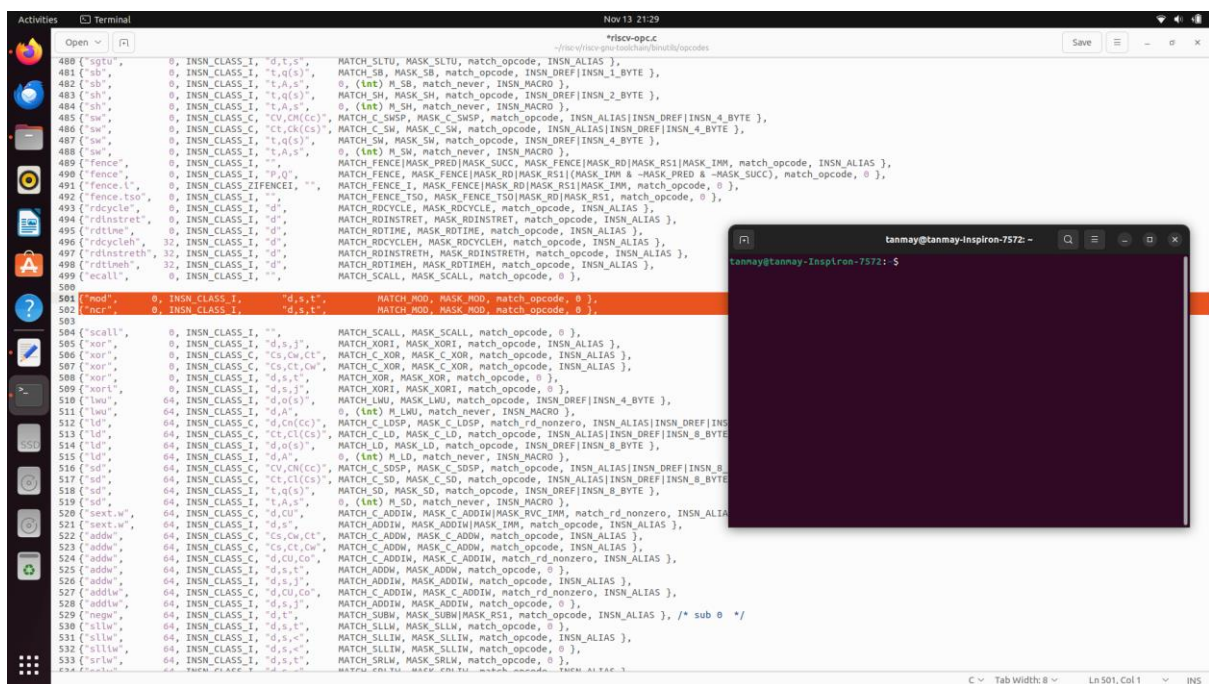
Compiling Programs

While we have managed to add our instructions, that's only in the RISC-V



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Rebuild the toolchain

- 1 `./configure --prefix=/opt/riscv --host=riscv64-unknown-elf`
- 2 `sudo make clean`
- 3 `sudo make -j16`

```

Activities  Terminal  Nov 13 22:18
tanmay@tanmay-inspiron-7572: ~/riscv/riscv-gnu-toolchain

tanmay@tanmay-inspiron-7572: ~
/usr/bin/install -c -m 644 .././gcc/gcc/value-query.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/value-query.h
/usr/bin/install -c -m 644 .././gcc/gcc/value-range.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/value-range.h
/usr/bin/install -c -m 644 .././gcc/gcc/value-range-pretty-print.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/value-range-pretty-print.h
/usr/bin/install -c -m 644 .././gcc/gcc/value-range-storage.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/value-range-storage.h
/usr/bin/install -c -m 644 .././gcc/gcc/value-relation.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/value-relation.h
/usr/bin/install -c -m 644 .././gcc/gcc/varasm.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/varasm.h
/usr/bin/install -c -m 644 .././gcc/gcc/vec.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/vec.h
/usr/bin/install -c -m 644 .././gcc/gcc/vec-pern-indices.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/vec-pern-indices.h
/usr/bin/install -c -m 644 .././gcc/gcc/vector-builder.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/vector-builder.h
/usr/bin/install -c -m 644 version.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/version.h
/usr/bin/install -c -m 644 .././gcc/gcc/vmsdbg.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/vmsdbg.h
/usr/bin/install -c -m 644 .././gcc/gcc/vr-values.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/vr-values.h
/usr/bin/install -c -m 644 .././gcc/gcc/vtable-verify.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/vtable-verify.h
/usr/bin/install -c -m 644 .././gcc/gcc/wide-int-bitmask.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/wide-int-bitmask.h
/usr/bin/install -c -m 644 .././gcc/gcc/wide-int.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/wide-int.h
/usr/bin/install -c -m 644 .././gcc/gcc/wide-int-print.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/wide-int-print.h
/usr/bin/install -c -m 644 .././gcc/gcc/xcoff.h /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/xcoff.h
/usr/bin/install -c -m 644 b-header-vars /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/plugin/include/b-header-vars
for file in collect2 .; do \
  if [ "x$file" != "x." ]; then \
    rm -f /opt/riscv/libexec/gcc/riscv64-unknown-elf/13.2.0/$file; \
    /usr/bin/install -c $file /opt/riscv/libexec/gcc/riscv64-unknown-elf/13.2.0/$file; \
  else true; fi; \
done
rm -f /opt/riscv/lib/gcc/riscv64-unknown-elf/13.2.0/specs
if test "" != "yes" ; then \
  if [ -f gcov ] ; \
  then \
    rm -f /opt/riscv/bin/riscv64-unknown-elf-gcov; \
    /usr/bin/install -c gcov /opt/riscv/bin/riscv64-unknown-elf-gcov; \
  fi; \
fi
if test "" != "yes" ; then \
  if [ -f gcov-tool ] ; \
  then \
    rm -f /opt/riscv/bin/riscv64-unknown-elf-gcov-tool; \
    /usr/bin/install -c \
    gcov-tool /opt/riscv/bin/riscv64-unknown-elf-gcov-tool; \
  fi; \
fi
if test "" != "yes" ; then \
  if [ -f gcov-dump ] ; \
  then \
    rm -f /opt/riscv/bin/riscv64-unknown-elf-gcov-dump; \
    /usr/bin/install -c \
    gcov-dump /opt/riscv/bin/riscv64-unknown-elf-gcov-dump; \
  fi; \
fi
make[3]: Leaving directory '/home/tanmay/riscv-riscv-gnu-toolchain/build-gcc-newlib-stage2/gcc'
make[2]: Leaving directory '/home/tanmay/riscv-riscv-gnu-toolchain/build-gcc-newlib-stage2'
make[1]: Leaving directory '/home/tanmay/riscv-riscv-gnu-toolchain/build-gcc-newlib-stage2'
mkdir -p stamp/ && touch stamp/build-gcc-newlib-stage2
tanmay@tanmay-inspiron-7572: ~/riscv/riscv-gnu-toolchain

```

Adding logic for nCr in decoder.isa

Location for decoder.isa is src/arch/{isa}/decoder.isa

```

1  0x07: decode FUNCT3 {
2      format ROp {
3          0x0: decode FUNCT7 {
4              0x1: ncr({{
5                  uint64_t n = Rs1_sd;
6                  uint64_t r = Rs2_sd;
7                  r = r > (n-r) ? r : (n-r);
8                  uint64_t c = 1, fact = 1;
9                  for (uint64_t i = n; i > r; i--) {
10                     c = c * i;
11                     fact = fact * (n - i + 1);
12                 }
13                 Rd = c / fact;
14             }});
15         }
16     }
17 }
18

```

Program-

```
1  #include <stdint.h>
2  #include <stdio.h>
3
4  int main(void) {
5      int64_t a = 3, b=5, n=7, sum=0;
6      for (uint32_t i = 0; i <= n; i++) {
7          uint32_t cn=n, cr=r;
8          cr = cr > (cn-cr) ? cr : (cn-cr);
9          uint64_t c = 1, fact = 1;
10         for (uint64_t j = cn; j > cr; j--) {
11             c = c * j;
12             fact = fact * (n - j + 1);
13         }
14         int64_t comb= c/fact
15
16         int powa = 1;
17         for (uint32_t j = 1; j <= i; j++)
18             y *= a;
19
20         int powb = 1;
21         for (uint32_t j = 1; j <= i; j++)
22             y *= b;
23
24         int64_t result = comb * powa * powb;
25         sum += result;
26         printf("%ld\t", result);
27     }
28     printf("\n%d\n", sum);
29
30     return 0;
31 }
```

Issues: Getting errors while simulating the code in gem5