EE789 Assignment 3

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Q1.

(a) Implementation of floating point divider-

Module is defined as:

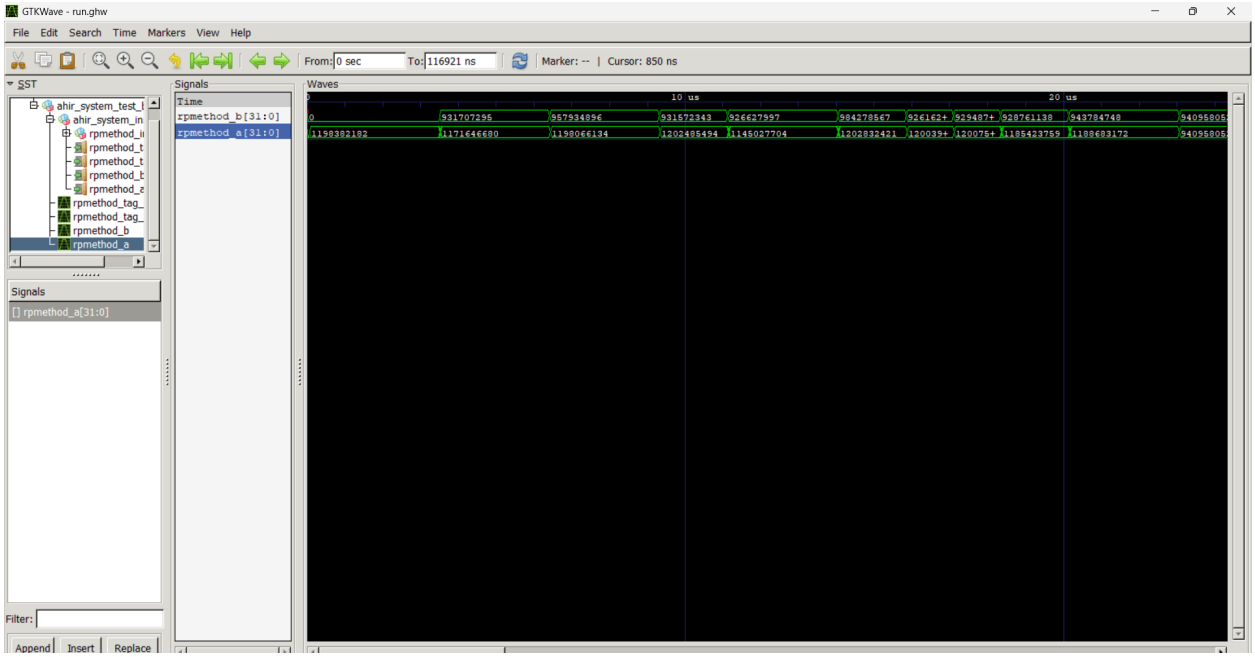
$module [rpmethod]
$in (a: $float<8,23>)
$out (b: $float<8,23>)
$is

```
analyze vhdl/ahir_system_global_package.vhdl
analyze /release/vhdl/GhdlLink.vhdl
analyze vhdl/ahir_system_test_bench.vhdl
analyze vhdl/ahir_system.vhdl
elaborate ahir_system_test_bench
root@18908ed95c02:/host/ass_3/q1# tmux
```

Testbench_hw success-

```
root@18908ed95c02: /host/ass_3/q1
=0 data= 0702bc2c8008c1
/release/vhdl/ahir.vhdl:17787:41:@22465ns:(assertion note): RPIPE StoreGroup0 Req -rb 0-bufPipe requester
=0 data= 0702bc2c8008c1
/release/vhdl/ahir.vhdl:17780:41:@22485ns:(assertion note): WPIPE LoadGroup0-RxGen-rb-4-bufPipe requester
=0 data= 0808c4
/release/vhdl/ahir.vhdl:17780:41:@22485ns:(assertion note): WPIPE LoadGroup0-RxGen-rb-3-bufPipe requester
=0 data= 0608c4
/release/vhdl/ahir.vhdl:17787:41:@22495ns:(assertion note): RPIPE LoadGroup0-RxGen-rb-3-bufPipe requester
=0 data= 0608c4
/release/vhdl/ahir.vhdl:17787:41:@22505ns:(assertion note): RPIPE LoadGroup0-RxGen-rb-4-bufPipe requester
=0 data= 0808c4
/release/vhdl/ahir.vhdl:17780:41:@22525ns:(assertion note): WPIPE ApFloatMul_group_2-imux-rxBuf-1-bufPipe
 requester=0 data= 46d9dda43815e164
/release/vhdl/ahir.vhdl:17787:41:@22525ns:(assertion note): RPIPE ApFloatMul_group_2-imux-rxBuf-1-bufPipe
 requester=0 data= 46d9dda43815e164
/release/vhdl/ahir.vhdl:17780:41:@22615ns:(assertion note): WPIPE ApFloatSub_group_6-imux-rxBuf-2-bufPipe
 requester=0 data= 400000003f7f1ba3
/release/vhdl/ahir.vhdl:17787:41:@22615ns:(assertion note): RPIPE ApFloatSub_group_6-imux-rxBuf-2-bufPipe
 requester=0 data= 400000003f7f1ba3
/release/vhdl/ahir.vhdl:17780:41:@22725ns:(assertion note): WPIPE ApFloatMul_group_2-imux-rxBuf-0-bufPipe
 requester=0 data= 3815e1643f80722e
/release/vhdl/ahir.vhdl:17787:41:@22725ns:(assertion note): RPIPE ApFloatMul_group_2-imux-rxBuf-0-bufPipe
 requester=0 data= 3815e1643f80722e
/release/vhdl/ahir.vhdl:17780:41:@22825ns:(assertion note): WPIPE LoadGroup0-RxGen-rb-2-bufPipe requester
=0 data= 0408e6
/release/vhdl/ahir.vhdl:17780:41:@22825ns:(assertion note): WPIPE LoadGroup0-RxGen-rb-1-bufPipe requester
=0 data= 0208e6
/release/vhdl/ahir.vhdl:17787:41:@22835ns:(assertion note): RPIPE LoadGroup0-RxGen-rb-1-bufPipe requester
=0 data= 0208e6
/release/vhdl/ahir.vhdl:17787:41:@22845ns:(assertion note): RPIPE LoadGroup0-RxGen-rb-2-bufPipe requester
=0 data= 0408e6
/release/vhdl/ahir.vhdl:17780:41:@22865ns:(assertion note): WPIPE ApFloatSub_group_6-imux-rxBuf-0-bufPipe
 requester=0 data= 3815e16438166717
/release/vhdl/ahir.vhdl:17787:41:@22865ns:(assertion note): RPIPE ApFloatSub_group_6-imux-rxBuf-0-bufPipe
 requester=0 data= 3815e16438166717
/release/vhdl/ahir.vhdl:17780:41:@22875ns:(assertion note): WPIPE ApFloatSub_group_6-imux-rxBuf-1-bufPipe
 requester=0 data= 381667173815e164
/release/vhdl/ahir.vhdl:17787:41:@22875ns:(assertion note): RPIPE ApFloatSub_group_6-imux-rxBuf-1-bufPipe
 requester=0 data= 381667173815e164
/release/vhdl/ahir.vhdl:17780:41:@22995ns:(assertion note): WPIPE LoadGroup0-RxGen-rb-0-bufPipe requester
=0 data= 0008f7
/release/vhdl/ahir.vhdl:17787:41:@23005ns:(assertion note): RPIPE LoadGroup0-RxGen-rb-0-bufPipe requester
=0 data= 0008f7
/release/vhdl/ahir.vhdl:17780:41:@23045ns:(assertion note): WPIPE rpmethod_out_buffer-bufPipe requester=0
 data= ?3815e164
/release/vhdl/ahir.vhdl:17787:41:@23055ns:(assertion note): RPIPE rpmethod_out_buffer-bufPipe requester=0
 data= ?3815e164
root@18908ed95c02:/host/ass_3/q1# ./testbench_hw --wave=run.ghw
All done: Success :-)
root@18908ed95c02:/host/ass_3/q1#
[0] 0:./ahir_system_test_bench*                                                    "18908ed95c02" 17:22 06-Nov-22
```

gtk wave -



(b) accuracy of better than 10−6

Tolerance taken in sample.aa

$constant t: $float<8,23> := _f1.0e-6

verify the tolerance in teshbench.c

```
        if (abs(z - 1.0/x) > 0.000001)
        {
            fprintf(stderr, "Error: 1 / %.8f = %.8f, expected %.8f.\n", x,z,1.0/x);
            _err_ = 1;
        }
    }
```

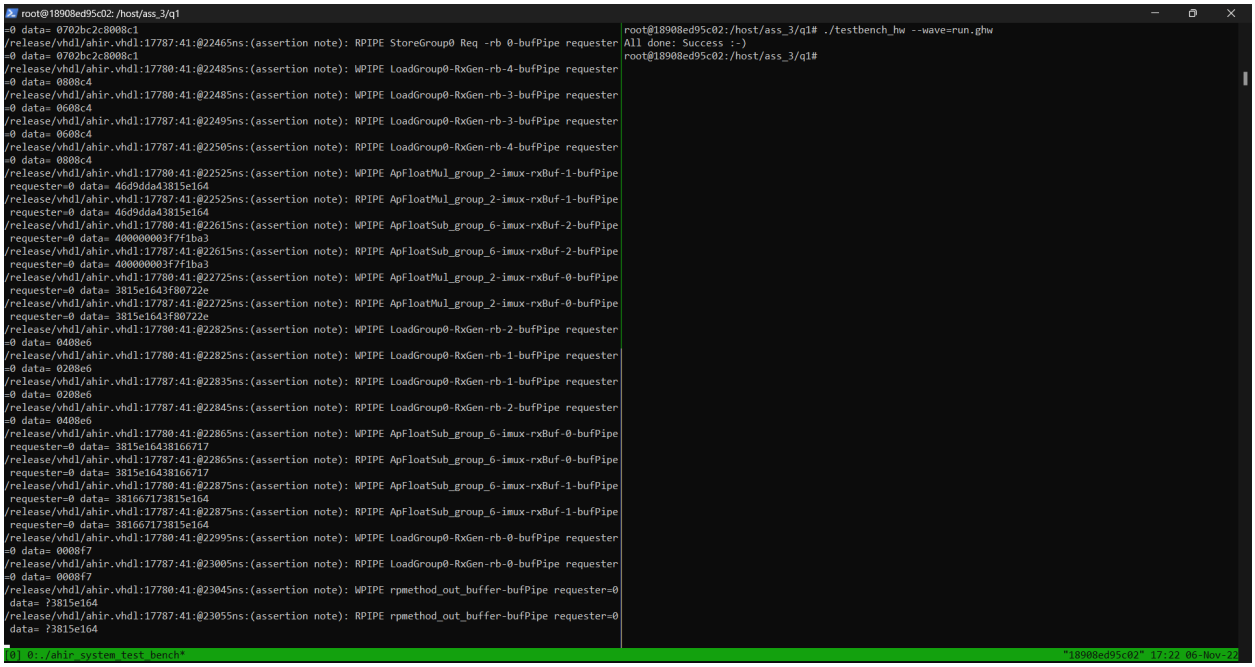
(c) clock cycles does your divider take to produce the result - 291 clock cycles

Since the Newton Raphson method converges in O(logN)*F(N) and the maximum order of a float (or the value of exponent) can be 128, we can say that algorithm converges with a cap of 128*c clock cycles (note that this is the maximum, can only be achieved in a rare and exceptional case) where c is the number of clock cycles taken to complete one convergence of the NR method.

Q2.

```
analyze vhdl/ahir_system_global_package.vhdl
analyze /release/vhdl/GhdlLink.vhdl
analyze vhdl/ahir_system_test_bench.vhdl
analyze vhdl/ahir_system.vhdl
elaborate ahir_system_test_bench
root@18908ed95c02:/host/ass_3/q2#
```

Testbench_hw success-



For the second part we are supposed to find the solution of 16 linear equations using the given A and B matrix. We use gaussian elimination for the same and use the q1 code for divider.