

ECE/CS 466 Project_Part 1

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1. What is the performance of running the program, quake, under the default system setup?

Terminal Command: ./sim-outorder -fastfwd 350000000 -max:inst 250000000 quake.ss
< quake.in

Out-of-order performance

Cycles	148193249
IPC	1.6870
CPI	0.5928
Elapsed time/ seconds	140
Inst_rate (insts/ sec)	1785714.2857

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help
sim: ** simulation statistics **
sim_num_insn          250000000 # total number of instructions committed
sim_num.refs           81104979 # total number of loads and stores committed
sim_num.loads          56626333 # total number of loads committed
sim_num.stores          24478646.0000 # total number of stores committed
sim_num.branches        65928024 # total number of branches committed
sim_elapsed_time        140 # total simulation time in seconds
sim_inst_rate          1785714.2857 # simulation speed (in insts/sec)
sim_total_insn          263687144 # total number of instructions executed
sim_total.refs           85620994 # total number of loads and stores executed
sim_total.loads          60049176 # total number of loads executed
sim_total.stores          25571818.0000 # total number of stores executed
sim_total.branches        68912684 # total number of branches executed
sim_cycle               148193249 # total simulation time in cycles
sim_IPC                 1.6870 # instructions per cycle
sim_CPI                 0.5928 # cycles per instruction
sim_exec_BW              1.7793 # total instructions (mis-spec + committed) per cycle
sim_IPB                 3.7920 # instruction per branch
IFQ_count                379237627 # cumulative IFQ occupancy
IFQ_fcount               79908712 # cumulative IFQ full count
ifq_occupancy            2.5591 # avg IFQ occupancy (insn's)
ifq_rate                  1.7793 # avg IFQ dispatch rate (insn/cycle)
ifq_latency                1.4382 # avg IFQ occupant latency (cycle's)
ifq_full                   0.5392 # fraction of time (cycle's) IFQ was full
RUU_count                1517615680 # cumulative RUU occupancy
RUU_fcount               41502815 # cumulative RUU full count
ruu_occupancy             10.2408 # avg RUU occupancy (insn's)
ruu_rate                   1.7793 # avg RUU dispatch rate (insn/cycle)
ruu_latency                 5.7554 # avg RUU occupant latency (cycle's)
ruu_full                    0.2801 # fraction of time (cycle's) RUU was full
LSQ_count                487418024 # cumulative LSQ occupancy
LSQ_fcount               14972254 # cumulative LSQ full count
lsq_occupancy             3.2891 # avg LSQ occupancy (insn's)
lsq_rate                   1.7793 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                 1.8485 # avg LSQ occupant latency (cycle's)
lsq_full                     0.1010 # fraction of time (cycle's) LSQ was full
sim_slip                  2263273292 # total number of slip cycles
avg_sim_slip                9.0531 # the average slip between issue and retirement
```

2. How much is the performance loss if the processor uses in-order execution instead of the default out-of-order execution to run the program?

Terminal Command: ./sim-outorder -fastfwd 350000000 -issue: inorder true -max:inst 2500000000 quake.ss < quake.in

The performance loss: IPC_in_order/ IPC_out_of_order=0.7782/ 1.6870 = 0.4613

in-order performance

Cycles	321272084
IPC	0.7782
CPI	1.2851
Elapsed time/ seconds	133
Inst_rate (insts/sec)	1879699.2481

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help
sim: ** simulation statistics **
sim_num_insn          250000000 # total number of instructions committed
sim_num_refs           81104979 # total number of loads and stores committed
sim_num_loads          56626333 # total number of loads committed
sim_num_stores          24478646.0000 # total number of stores committed
sim_num_branches        65928024 # total number of branches committed
sim_elapsed_time         133 # total simulation time in seconds
sim_inst_rate          1879699.2481 # simulation speed (in insts/sec)
sim_total_insn          251893224 # total number of instructions executed
sim_total_refs           81543049 # total number of loads and stores executed
sim_total_loads          57063838 # total number of loads executed
sim_total_stores          24479211.0000 # total number of stores executed
sim_total_branches        65928031 # total number of branches executed
sim_cycle                321272084 # total simulation time in cycles
sim_IPC                  0.7782 # instructions per cycle
sim_CPI                  1.2851 # cycles per instruction
sim_exec_BW                 0.7840 # total instructions (mis-spec + committed) per cycle
sim_IPB                  3.7920 # instruction per branch
IFQ_count                1117739234 # cumulative IFQ occupancy
IFQ_fcount               264166526 # cumulative IFQ full count
ifq_occupancy             3.4791 # avg IFQ occupancy (insn's)
ifq_rate                  0.7840 # avg IFQ dispatch rate (insn/cycle)
ifq_latency                4.4374 # avg IFQ occupant latency (cycle's)
ifq_full                   0.8223 # fraction of time (cycle's) IFQ was full
RUU_count                870668496 # cumulative RUU occupancy
RUU_fcount                  0 # cumulative RUU full count
ruu_occupancy              2.7101 # avg RUU occupancy (insn's)
ruu_rate                  0.7840 # avg RUU dispatch rate (insn/cycle)
ruu_latency                3.4565 # avg RUU occupant latency (cycle's)
ruu_full                   0.0000 # fraction of time (cycle's) RUU was full
LSQ_count                303813606 # cumulative LSQ occupancy
LSQ_fcount                  0 # cumulative LSQ full count
lsq_occupancy              0.9457 # avg LSQ occupancy (insn's)
lsq_rate                  0.7840 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                1.2061 # avg LSQ occupant latency (cycle's)
lsq_full                   0.0000 # fraction of time (cycle's) LSQ was full
sim_slip                  1503255186 # total number of slip cycles
avg_sim_slip                6.0130 # the average slip between issue and retirement
```

3.Based on the simulator running time in Question 1, estimate how long it would take to simulate the program's execution in details from beginning to end using the default configuration.

Terminal Command: ./sim-safe quake.ss < quake.in

The instruction number is 165643487723.

The elapsed time for 250000000 instruction is 140 seconds.

The estimated time in total: (165643487723/250000000)*140 = 92760 seconds.

```
5903: -3.98e+00 -4.62e+00 -6.77e+00
16745: 4.60e-03 5.60e-03 -1.17e-01
Time step 3630
5903: -3.98e+00 -4.62e+00 -6.77e+00
16745: 4.81e-03 1.51e-03 -1.17e-01
Time step 3660
5903: -3.98e+00 -4.62e+00 -6.77e+00
16745: 5.30e-03 1.42e-03 -1.14e-01
Time step 3690
5903: -3.98e+00 -4.62e+00 -6.77e+00
16745: 6.40e-03 4.99e-03 -1.11e-01
Time step 3720
5903: -3.98e+00 -4.62e+00 -6.76e+00
16745: 7.90e-03 1.08e-02 -1.06e-01
Time step 3750
5903: -3.98e+00 -4.62e+00 -6.76e+00
16745: 9.03e-03 1.70e-02 -1.03e-01
Time step 3780
5903: -3.98e+00 -4.62e+00 -6.76e+00
16745: 8.83e-03 2.21e-02 -1.01e-01
Time step 3810
5903: -3.98e+00 -4.62e+00 -6.76e+00
16745: 6.61e-03 2.52e-02 -1.00e-01
Time step 3840
5903: -3.98e+00 -4.62e+00 -6.76e+00
16745: 2.45e-03 2.66e-02 -1.01e-01
quake00: 30169 nodes 151173 elems 3855 timesteps

quake00: Done. Terminating the simulation.

sim: ** simulation statistics **
sim_num_insn          165643487723 # total number of instructions executed
sim_num_refs           78603143990 # total number of loads and stores executed
sim_elapsed_time       5786 # total simulation time in seconds
sim_inst_rate          28628324.8744 # simulation speed (in insts/sec)
ld_text_base           0x00400000 # program text (code) segment base
ld_text_size            132784 # program text (code) size in bytes
ld_data_base           0x10000000 # program initialized data segment base
ld_data_size            16384 # program init'ed `.data' and uninit'ed `.bss' size in bytes
ld_stack_base           0x7fff0000 # program stack segment base (highest address in stack)
ld_stack_size            16384 # program initial stack size
ld_prog_entry           0x00400140 # program entry point (initial PC)
ld_environ_base          0x7fff8000 # program environment base address address
ld_target_big_endian      0 # target executable endian-ness, non-zero if big endian
mem.page_count          10394 # total number of pages allocated
mem.page_mem              41576k # total size of memory pages allocated
mem.ptab_misses         3253141 # total first level page table misses
mem.ptab_accesses        906494435926 # total page table accesses
mem.ptab_miss_rate       0.0000 # first level page table miss rate

ye@ye-Linux:~/Desktop/simplesim-3.0$
```

4.If all the other parameters are kept the same, how much is the performance improvements when the pipeline bandwidth increases from 4 to 8? Usually when the pipeline bandwidth increases, the capacity of other hardware components should also increase to have a balanced design. Which component should double its size first, RUU, LSQ, integer ALU, integer multiplier, floating-point ALU, or floating-point multiplier? Use experimental results to support your claim.

	bandwidth =4	bandwidth =8
Cycles	148193249	133647851
IPC	1.6870	1.8706
CPI	0.5928	0.5346
Elapsed time/ seconds	140	141
Inst_rate (insts/ sec)	1785714.2857	1773049.6525

Speedup: $1.8706/1.6870 = 1.1088$.

Increase other hardware components

	RUU	LSQ	Integer ALU	Integer multiplier	Floating-point ALU	Floating-point multiplier
Cycles	127176612	134663504	132920925	133647851	133647851	133647851
IPC	1.9658	1.8565	1.8808	1.8706	1.8706	1.8706
CPI	0.5087	0.5387	0.5317	0.5346	0.5346	0.5346
Elapsed time/ seconds	146	144	144	142	143	140

The RUU should double its size first. Because when we increased the hardware components RUU, the changes of the value of IPC is biggest.

Bandwidth:8

Terminal Command: ./sim-outorder -fetch:ifqsize 8 -decode:width 8 -issue:width 8 -commit:width 8 —fastfwd 350000000 -max:inst 250000000 quake.ss < quake.in

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help
sim: ** simulation statistics **
sim_num_insn          250000001 # total number of instructions committed
sim_num_refs            81104979 # total number of loads and stores committed
sim_num_loads           56626333 # total number of loads committed
sim_num_stores          24478646.0000 # total number of stores committed
sim_num_branches        65928024 # total number of branches committed
sim_elapsed_time         141 # total simulation time in seconds
sim_inst_rate            1773049.6525 # simulation speed (in insts/sec)
sim_total_insn          265867518 # total number of instructions executed
sim_total_refs           85619511 # total number of loads and stores executed
sim_total_loads          60047786 # total number of loads executed
sim_total_stores         25571725.0000 # total number of stores executed
sim_total_branches       70003245 # total number of branches executed
sim_cycle                133647851 # total simulation time in cycles
sim_IPC                  1.8706 # instructions per cycle
sim_CPI                  0.5346 # cycles per instruction
sim_exec_BW               1.9893 # total instructions (mis-spec + committed) per cycle
sim_IPB                  3.7920 # instruction per branch
IFQ_count                657804619 # cumulative IFQ occupancy
IFQ_fcount               63017453 # cumulative IFQ full count
ifq_occupancy             4.9219 # avg IFQ occupancy (insn's)
ifq_rate                  1.9893 # avg IFQ dispatch rate (insn/cycle)
ifq_latency                2.4742 # avg IFQ occupant latency (cycle's)
ifq_full                   0.4715 # fraction of time (cycle's) IFQ was full
RUU_count                 1496773735 # cumulative RUU occupancy
RUU_fcount                64799727 # cumulative RUU full count
ruu_occupancy              11.1994 # avg RUU occupancy (insn's)
ruu_rate                   1.9893 # avg RUU dispatch rate (insn/cycle)
ruu_latency                 5.6298 # avg RUU occupant latency (cycle's)
ruu_full                    0.4849 # fraction of time (cycle's) RUU was full
LSQ_count                 469444041 # cumulative LSQ occupancy
LSQ_fcount                16127229 # cumulative LSQ full count
lsq_occupancy              3.5125 # avg LSQ occupancy (insn's)
lsq_rate                   1.9893 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                 1.7657 # avg LSQ occupant latency (cycle's)
lsq_full                     0.1207 # fraction of time (cycle's) LSQ was full
sim_slip                   2223004454 # total number of slip cycles
avg_sim_slip                8.8920 # the average slip between issue and retirement
bpred_bimod.lookups        72552625 # total number of bpred lookups
bpred_bimod.updates         65928022 # total number of updates
bpred_bimod.addr_hits       64762569 # total number of address-predicted hits
bpred_bimod.dir_hits        64762636 # total number of direction-predicted hits (includes add
r-hits)
bpred_bimod.misses          1165386 # total number of misses
```

RUU:

Terminal Command: ./sim-outorder -fetch:ifqsize 8 -decode:width 8 -issue:width 8 -commit:width 8 -ruu:size 32 —fastfwd 350000000 -max:inst 250000000 quake.ss < quake.in

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help
sim: ** simulation statistics **
sim_num_insn          250000003 # total number of instructions committed
sim_num.refs           81104979 # total number of loads and stores committed
sim_num.loads          56626333 # total number of loads committed
sim_num.stores          24478646.0000 # total number of stores committed
sim_num.branches        65928025 # total number of branches committed
sim_elapsed_time        146 # total simulation time in seconds
sim_inst_rate           1712328.7877 # simulation speed (in insts/sec)
sim_total_insn          268773863 # total number of instructions executed
sim_total.refs           87436470 # total number of loads and stores executed
sim_total.loads          61501579 # total number of loads executed
sim_total.stores          25934891.0000 # total number of stores executed
sim_total.branches        70365827 # total number of branches executed
sim_cycle               127176612 # total simulation time in cycles
sim_IPC                 1.9658 # instructions per cycle
sim_CPI                 0.5087 # cycles per instruction
sim_exec_BW              2.1134 # total instructions (mis-spec + committed) per cycle
sim_IPB                 3.7920 # instruction per branch
IFQ_count                593403106 # cumulative IFQ occupancy
IFQ_fcount               53665416 # cumulative IFQ full count
ifq_occupancy            4.6660 # avg IFQ occupancy (insn's)
ifq_rate                  2.1134 # avg IFQ dispatch rate (insn/cycle)
ifq_latency                2.2078 # avg IFQ occupant latency (cycle's)
ifq_full                   0.4220 # fraction of time (cycle's) IFQ was full
RUU_count                1790008191 # cumulative RUU occupancy
RUU_fcount               9017555 # cumulative RUU full count
ruu_occupancy             14.0750 # avg RUU occupancy (insn's)
ruu_rate                  2.1134 # avg RUU dispatch rate (insn/cycle)
ruu_latency                6.6599 # avg RUU occupant latency (cycle's)
ruu_full                   0.0709 # fraction of time (cycle's) RUU was full
LSQ_count                561284038 # cumulative LSQ occupancy
LSQ_fcount               46510046 # cumulative LSQ full count
lsq_occupancy             4.4134 # avg LSQ occupancy (insn's)
lsq_rate                  2.1134 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                2.0883 # avg LSQ occupant latency (cycle's)
lsq_full                   0.3657 # fraction of time (cycle's) LSQ was full
sim_slip                  2558259104 # total number of slip cycles
avg_sim_slip              10.2330 # the average slip between issue and retirement
bpred_bimod.lookups        73279029 # total number of bpred lookups
bpred_bimod.updates         65928020 # total number of updates
bpred_bimod.addr_hits       64762567 # total number of address-predicted hits
bpred_bimod.dir_hits        64762634 # total number of direction-predicted hits (includes add
r-hits)
bpred_bimod.misses          1165386 # total number of misses
bpred_bimod.jr_hits          2911911 # total number of address-predicted hits for JR's
bpred_bimod.jr_seen          2911916 # total number of JR's seen
bpred_bimod.jr_non_ras_hits.PP 363636 # total number of address-predicted hits for non
-RAS JR's
bpred_bimod.jr_non_ras_seen.PP 363637 # total number of non-RAS JR's seen
bpred_bimod.bpred_addr_rate   0.9823 # branch address-prediction rate (i.e., addr-hits/upda
tes)
bpred_bimod.bpred_dir_rate    0.9922 # branch direction-prediction rate (i.e., all hits/ups
tes)
```

LSQ:

Terminal Command: ./sim-outorder -fetch:ifqsize 8 -decode:width 8 -issue:width 8 -commit:width 8 -lsq:size 16—fastfwd 350000000 -max:inst 250000000 quake.ss < quake.in

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help

sim: ** simulation statistics **
sim_num_insn          250000006 # total number of instructions committed
sim_num_refs           81104979 # total number of loads and stores committed
sim_num_loads          56626333 # total number of loads committed
sim_num_stores          24478646.0000 # total number of stores committed
sim_num_branches        65928026 # total number of branches committed
sim_elapsed_time        144 # total simulation time in seconds
sim_inst_rate           1736111.1528 # simulation speed (in insts/sec)
sim_total_insn          265576971 # total number of instructions executed
sim_total_refs          85619511 # total number of loads and stores executed
sim_total_loads         60047786 # total number of loads executed
sim_total_stores         25571725.0000 # total number of stores executed
sim_total_branches       69930609 # total number of branches executed
sim_cycle               134663504 # total simulation time in cycles
sim_IPC                 1.8565 # instructions per cycle
sim_CPI                 0.5387 # cycles per instruction
sim_exec_BW              1.9722 # total instructions (mis-spec + committed) per cycle
sim_IPB                 3.7920 # instruction per branch
IFQ_count                664750403 # cumulative IFQ occupancy
IFQ_fcount               64389864 # cumulative IFQ full count
ifq_occupancy            4.9364 # avg IFQ occupancy (insn's)
ifq_rate                  1.9722 # avg IFQ dispatch rate (insn/cycle)
ifq_latency                2.5030 # avg IFQ occupant latency (cycle's)
ifq_full                   0.4782 # fraction of time (cycle's) IFQ was full
RUU_count                1571317584 # cumulative RUU occupancy
RUU_fcount               82170133 # cumulative RUU full count
ruu_occupancy             11.6685 # avg RUU occupancy (insn's)
ruu_rate                  1.9722 # avg RUU dispatch rate (insn/cycle)
ruu_latency                5.9166 # avg RUU occupant latency (cycle's)
ruu_full                   0.6102 # fraction of time (cycle's) RUU was full
LSQ_count                505888089 # cumulative LSQ occupancy
LSQ_fcount               0 # cumulative LSQ full count
lsq_occupancy             3.7567 # avg LSQ occupancy (insn's)
lsq_rate                  1.9722 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                1.9049 # avg LSQ occupant latency (cycle's)
lsq_full                   0.0000 # fraction of time (cycle's) LSQ was full
sim_slip                  2335158459 # total number of slip cycles
avg_sim_slip              9.3406 # the average slip between issue and retirement
bpred_bimod.lookups        72552625 # total number of bpred lookups
bpred_bimod.updates        65928023 # total number of updates
bpred_bimod.addr_hits      64762570 # total number of address-predicted hits
bpred_bimod.dir_hits       64762637 # total number of direction-predicted hits (includes add
r-hits)
bpred_bimod.misses         1165386 # total number of misses
bpred_bimod.jr_hits        2911911 # total number of address-predicted hits for JR's
bpred_bimod.jr_seen         2911916 # total number of JR's seen
bpred_bimod.jr_non_ras_hits.PP 363636 # total number of address-predicted hits for non
-RAS JR's
bpred_bimod.jr_non_ras_seen.PP 363637 # total number of non-RAS JR's seen
bpred_bimod.bpred_addr_rate 0.9823 # branch address-prediction rate (i.e., addr-hits/upda
tes)
bpred_bimod.bpred_dir_rate 0.9823 # branch direction-prediction rate (i.e., all-hits/upda
```

ALU:

Terminal Command: ./sim-outorder -fetch:ifqsize 8 -decode:width 8 -issue:width 8 -commit:width 8 -res:alu 8 —fastfwd 350000000 -max:inst 250000000 quake.ss < quake.in

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help

sim: ** simulation statistics **
sim_num_insn          250000002 # total number of instructions committed
sim_num_refs           81104979 # total number of loads and stores committed
sim_num_loads          56626333 # total number of loads committed
sim_num_stores          24478646.0000 # total number of stores committed
sim_num_branches        65928024 # total number of branches committed
sim_elapsed_time        143 # total simulation time in seconds
sim_inst_rate           1748251.7622 # simulation speed (in insts/sec)
sim_total_insn          265869271 # total number of instructions executed
sim_total_refs          85621233 # total number of loads and stores executed
sim_total_loads         60049508 # total number of loads executed
sim_total_stores         25571725.0000 # total number of stores executed
sim_total_branches       70003245 # total number of branches executed
sim_cycle               132920925 # total simulation time in cycles
sim_IPC                 1.8808 # instructions per cycle
sim_CPI                 0.5317 # cycles per instruction
sim_exec_BW              2.0002 # total instructions (mis-spec + committed) per cycle
sim_IPB                 3.7920 # instruction per branch
IFQ_count                652708442 # cumulative IFQ occupancy
IFQ_fcount               62289331 # cumulative IFQ full count
ifq_occupancy            4.9105 # avg IFQ occupancy (insn's)
ifq_rate                  2.0002 # avg IFQ dispatch rate (insn/cycle)
ifq_latency               2.4550 # avg IFQ occupant latency (cycle's)
ifq_full                   0.4686 # fraction of time (cycle's) IFQ was full
RUU_count                1481017399 # cumulative RUU occupancy
RUU_fcount               63770911 # cumulative RUU full count
ruu_occupancy             11.1421 # avg RUU occupancy (insn's)
ruu_rate                  2.0002 # avg RUU dispatch rate (insn/cycle)
ruu_latency                5.5705 # avg RUU occupant latency (cycle's)
ruu_full                   0.4798 # fraction of time (cycle's) RUU was full
LSQ_count                465091762 # cumulative LSQ occupancy
LSQ_fcount               16208057 # cumulative LSQ full count
lsq_occupancy             3.4990 # avg LSQ occupancy (insn's)
lsq_rate                  2.0002 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                1.7493 # avg LSQ occupant latency (cycle's)
lsq_full                   0.1219 # fraction of time (cycle's) LSQ was full
sim_slip                  2206226602 # total number of slip cycles
avg_sim_slip              8.8249 # the average slip between issue and retirement
bpred_bimod.lookups       72553189 # total number of bpred lookups
bpred_bimod.updates        65928022 # total number of updates
bpred_bimod.addr_hits      64762569 # total number of address-predicted hits
bpred_bimod.dir_hits       64762636 # total number of direction-predicted hits (includes add
r-hits)
bpred_bimod.misses         1165386 # total number of misses
bpred_bimod.jr_hits        2911911 # total number of address-predicted hits for JR's
bpred_bimod.jr_seen         2911916 # total number of JR's seen
bpred_bimod.jr_non_ras_hits.PP 363636 # total number of address-predicted hits for non
-RAS JR's
bpred_bimod.jr_non_ras_seen.PP 363637 # total number of non-RAS JR's seen
bpred_bimod.bpred_addr_rate 0.9823 # branch address-prediction rate (i.e., addr-hits/upda
tes)
bpred_bimod.bpred_dir_rate 0.9823 # branch direction-prediction rate (i.e., all-hits/upda
```

MUL:

Terminal Command: ./sim-outorder -fetch:ifqsize 8 -decode:width 8 -issue:width 8 -commit:width 8 -res:imult 2 —fastfwd 350000000 -max:inst 250000000 quake.ss < quake.in

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help
sim: ** simulation statistics **
sim_num_insn          250000001 # total number of instructions committed
sim_num_refs           81104979 # total number of loads and stores committed
sim_num_loads          56626333 # total number of loads committed
sim_num_stores          24478646.0000 # total number of stores committed
sim_num_branches        65928024 # total number of branches committed
sim_elapsed_time        142 # total simulation time in seconds
sim_inst_rate           1760563.3873 # simulation speed (in insts/sec)
sim_total_insn          265867518 # total number of instructions executed
sim_total.refs          85619511 # total number of loads and stores executed
sim_total.loads          60047786 # total number of loads executed
sim_total.stores         25571725.0000 # total number of stores executed
sim_total.branches       70003245 # total number of branches executed
sim_cycle               133647851 # total simulation time in cycles
sim_IPC                 1.8706 # instructions per cycle
sim_CPI                 0.5346 # cycles per instruction
sim_exec_BW              1.9893 # total instructions (mis-spec + committed) per cycle
sim_IPB                 3.7920 # instruction per branch
IFQ_count                657804619 # cumulative IFQ occupancy
IFQ_fcount               63017453 # cumulative IFQ full count
ifq_occupancy            4.9219 # avg IFQ occupancy (insn's)
ifq_rate                  1.9893 # avg IFQ dispatch rate (insn/cycle)
ifq_latency               2.4742 # avg IFQ occupant latency (cycle's)
ifq_full                   0.4715 # fraction of time (cycle's) IFQ was full
RUU_count                1496773735 # cumulative RUU occupancy
RUU_fcount               64799727 # cumulative RUU full count
ruu_occupancy             11.1994 # avg RUU occupancy (insn's)
ruu_rate                  1.9893 # avg RUU dispatch rate (insn/cycle)
ruu_latency                5.6298 # avg RUU occupant latency (cycle's)
ruu_full                   0.4849 # fraction of time (cycle's) RUU was full
LSQ_count                469444041 # cumulative LSQ occupancy
LSQ_fcount               16127229 # cumulative LSQ full count
lsq_occupancy             3.5125 # avg LSQ occupancy (insn's)
lsq_rate                  1.9893 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                1.7657 # avg LSQ occupant latency (cycle's)
lsq_full                   0.1207 # fraction of time (cycle's) LSQ was full
sim_slip                  2223004454 # total number of slip cycles
avg_sim_slip              8.8920 # the average slip between issue and retirement
bpred_bimod.lookups       72552625 # total number of bpred lookups
bpred_bimod.updates        65928022 # total number of updates
bpred_bimod.addr_hits      64762569 # total number of address-predicted hits
bpred_bimod.dir_hits       64762636 # total number of direction-predicted hits (includes add
r-hits)
bpred_bimod.misses         1165386 # total number of misses
bpred_bimod.jr_hits        2911911 # total number of address-predicted hits for JR's
bpred_bimod.jr_seen         2911916 # total number of JR's seen
bpred_bimod.jr_non_ras_hits.PP 363636 # total number of address-predicted hits for non
-RAS JR's
bpred_bimod.jr_non_ras_seen.PP 363637 # total number of non-RAS JR's seen
bpred_bimod.bpred_addr_rate 0.9823 # branch address-prediction rate (i.e., addr-hits/upda
tes)
bpred_bimod.bpred_dir_rate 0.9823 # branch direction-prediction rate (i.e., all-hits/upda
tes)
```

FPALU:

Terminal Command: ./sim-outorder -fetch:ifqsize 8 -decode:width 8 -issue:width 8 -commit:width 8 -res:fpalu 8 —fastfwd 350000000 -max:inst 250000000 quake.ss < quake.in

```
ye@ye-Linux: ~/Desktop/simpleSim-3.0
File Edit View Search Terminal Help
quake.ss: Reading elements.
sim: ** starting performance simulation **

sim: ** simulation statistics **
sim_num_insn          250000001 # total number of instructions committed
sim_num_refs           81104979 # total number of loads and stores committed
sim_num_loads          56626333 # total number of loads committed
sim_num_stores          24478646.0000 # total number of stores committed
sim_num_branches        65928024 # total number of branches committed
sim_elapsed_time        143 # total simulation time in seconds
sim_inst_rate          1748251.7552 # simulation speed (in insts/sec)
sim_total_insn          265867518 # total number of instructions executed
sim_total.refs          85619511 # total number of loads and stores executed
sim_total.loads          60047786 # total number of loads executed
sim_total.stores          25571725.0000 # total number of stores executed
sim_total.branches        70003245 # total number of branches executed
sim_cycle               133647851 # total simulation time in cycles
sim_IPC                 1.8706 # instructions per cycle
sim_CPI                 0.5346 # cycles per instruction
sim_exec_BW              1.9893 # total instructions (mis-spec + committed) per cycle
sim_IPB                 3.7920 # instruction per branch
IFQ_count               657804619 # cumulative IFQ occupancy
IFQ_fcount              63017453 # cumulative IFQ full count
ifq_occupancy            4.9219 # avg IFQ occupancy (insn's)
ifq_rate                 1.9893 # avg IFQ dispatch rate (insn/cycle)
ifq_latency              2.4742 # avg IFQ occupant latency (cycle's)
ifq_full                  0.4715 # fraction of time (cycle's) IFQ was full
RUU_count               1496773735 # cumulative RUU occupancy
RUU_fcount              64799727 # cumulative RUU full count
ruu_occupancy            11.1994 # avg RUU occupancy (insn's)
ruu_rate                 1.9893 # avg RUU dispatch rate (insn/cycle)
ruu_latency              5.6298 # avg RUU occupant latency (cycle's)
ruu_full                  0.4849 # fraction of time (cycle's) RUU was full
LSQ_count               469444041 # cumulative LSQ occupancy
LSQ_fcount              16127229 # cumulative LSQ full count
lsq_occupancy            3.5125 # avg LSQ occupancy (insn's)
lsq_rate                 1.9893 # avg LSQ dispatch rate (insn/cycle)
lsq_latency              1.7657 # avg LSQ occupant latency (cycle's)
lsq_full                  0.1207 # fraction of time (cycle's) LSQ was full
sim_slip                 2223004454 # total number of slip cycles
avg_sim_slip             8.8920 # the average slip between issue and retirement
bpred_bimod.lookups      72552625 # total number of bpred lookups
bpred_bimod.updates       65928022 # total number of updates
bpred_bimod.addr_hits     64762569 # total number of address-predicted hits
bpred_bimod.dir_hits      64762636 # total number of direction-predicted hits (includes add
r-hits)
bpred_bimod.misses        1165386 # total number of misses
bpred_bimod.jr_hits        2911911 # total number of address-predicted hits for JR's
bpred_bimod.jr_seen        2911916 # total number of JR's seen
bpred_bimod.jr_non_ras_hits.PP 363636 # total number of address-predicted hits for non
-RAS JR's
bpred_bimod.jr_non_ras_seen.PP 363637 # total number of non-RAS JR's seen
bpred_bimod.bpred_addr_rate 0.9823 # branch address-prediction rate (i.e., addr-hits/upda
+es)
```

FPMUL:

Terminal Command: ./sim-outorder -fetch:ifqsize 8 -decode:width 8 -issue:width 8 -commit:width 8 -res:fpmult 2 —fastfwd 350000000 -max:inst 2500000000 quake.ss < quake.in

```
ye@ye-Linux: ~/Desktop/simplesim-3.0
File Edit View Search Terminal Help
quake00: Reading nodes.
quake00: Reading elements.
sim: ** starting performance simulation **

sim: ** simulation statistics **
sim_num_insn          250000001 # total number of instructions committed
sim_num_refs           81104979 # total number of loads and stores committed
sim_num_loads          56626333 # total number of loads committed
sim_num_stores          24478646.0000 # total number of stores committed
sim_num_branches        65928024 # total number of branches committed
sim_elapsed_time        140 # total simulation time in seconds
sim_inst_rate          1785714.2929 # simulation speed (in insts/sec)
sim_total_insn          265867518 # total number of instructions executed
sim_total_refs          85619511 # total number of loads and stores executed
sim_total_loads         60047786 # total number of loads executed
sim_total_stores         25571725.0000 # total number of stores executed
sim_total_branches       70003245 # total number of branches executed
sim_cycle               133647851 # total simulation time in cycles
sim_IPC                 1.8706 # instructions per cycle
sim_CPI                 0.5346 # cycles per instruction
sim_exec_BW              1.9893 # total instructions (mis-spec + committed) per cycle
sim_IPB                 3.7920 # instruction per branch
IFQ_count               657804619 # cumulative IFQ occupancy
IFQ_fcount              63017453 # cumulative IFQ full count
ifq_occupancy            4.9219 # avg IFQ occupancy (insn's)
ifq_rate                 1.9893 # avg IFQ dispatch rate (insn/cycle)
ifq_latency              2.4742 # avg IFQ occupant latency (cycle's)
ifq_full                  0.4715 # fraction of time (cycle's) IFQ was full
RUU_count               1496773735 # cumulative RUU occupancy
RUU_fcount              64799727 # cumulative RUU full count
ruu_occupancy             11.1994 # avg RUU occupancy (insn's)
ruu_rate                  1.9893 # avg RUU dispatch rate (insn/cycle)
ruu_latency                5.6298 # avg RUU occupant latency (cycle's)
ruu_full                  0.4849 # fraction of time (cycle's) RUU was full
LSQ_count               469444041 # cumulative LSQ occupancy
LSQ_fcount              16127229 # cumulative LSQ full count
lsq_occupancy             3.5125 # avg LSQ occupancy (insn's)
lsq_rate                   1.9893 # avg LSQ dispatch rate (insn/cycle)
lsq_latency                 1.7657 # avg LSQ occupant latency (cycle's)
lsq_full                  0.1207 # fraction of time (cycle's) LSQ was full
sim_slip                  2223004454 # total number of slip cycles
avg_sim_slip              8.8920 # the average slip between issue and retirement
bpred_bimod.lookups        72552625 # total number of bpred lookups
bpred_bimod.updates        65928022 # total number of updates
bpred_bimod.addr_hits       64762569 # total number of address-predicted hits
bpred_bimod.dir_hits        64762636 # total number of direction-predicted hits (includes add
r-hits)
bpred_bimod.misses          1165386 # total number of misses
bpred_bimod.jr_hits          2911911 # total number of address-predicted hits for JR's
bpred_bimod.jr_seen          2911916 # total number of JR's seen
bpred_bimod.jr_non_ras_hits.PP 363636 # total number of address-predicted hits for non
-RAS JR's
bpred_bimod.jr_non_ras_seen.PP 363637 # total number of non-RAS JR's seen
```