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CE 452

Simulating the ARM Cortex-A76

My selected processor was the ARM Cortex-A76. This core is designed for use in both mobile devices as well as in the datacenter. Comparable chips include the Qualcomm Snapdragon 855 (which is an implementation using the cores) and Ampere Altra, which features ARM Neoverse N1 cores, a slightly upgraded server variant of the Cortex-A76. These implementations are notable as they span both the mobile and server markets.

The 4-way superscalar core features many modern capabilities, including out-of-order and speculative execution. The core is designed on a 7nm process and first appeared in 2018. It is designed to run at 3.0 GHz. In order to benchmark it, I applied the following configuration parameters to sim-outorder:

flag	value(s)	Source/Justification
fetch:ifqsize	16	WikiChip
bpred	2lev	Real Cortex-A76 has a tournament style branch predictor, which is a variant of two-level branch prediction
bpred:2lev	1 1024 8 0	The branch predictor has 6k entries in actuality, with 8-way set associativity. However, like many of the values for flags, sim-outorder only accepts powers of 2.
decode:width	4	WikiChip
issue:width	8	WikiChip
ruu:size	128	WikiChip
lsq:size	64	WikiChip
cache:dl1	dl1:256:64:4:l	WikiChip
cache:dl1lat	4	7-CPU
cache:dl2	ul2:1024:64:8:l	WikiChip
cache:dl2lat	11	7-CPU
cache:il1	il1:256:64:4:l	WikiChip
cache:il1lat	4	7-CPU
cache:il2	dl2	WikiChip
cache:il2lat	11	7-CPU
mem:lat	61 61	7-CPU (11 cycles + 140ns @ 2.84 GHz)

tlb:itlb	itlb:1:4096:32:l	WikiChip
tlb:dtlb	dtlb:1:4096:32:l	WikiChip
tlb:lat	3	7-CPU
fastfwd	1	Necessary to get sim to work.
bpred:ras	32	ChatGPT query
bpred:btb	1024 4	WikiChip

As you can see from the table, there were many approximations necessary, namely in rounding to powers of 2 as well as modeling the closest behavior the branch predictors provided could model. I was grateful to see that 7-CPU had good data for latency behavior, as well as an extensive block-diagram provided by WikiChip.

Benchmark Results

I've included in this report two tables on the following pages. One with common metrics and another with rates from various components of the core. Note that I was unable to get vortex to work at all, and will update when I have it working.

Although only two charts are provided, I have much more extensive data collection (as well as configuration information) available in the various sheets of this spreadsheet.

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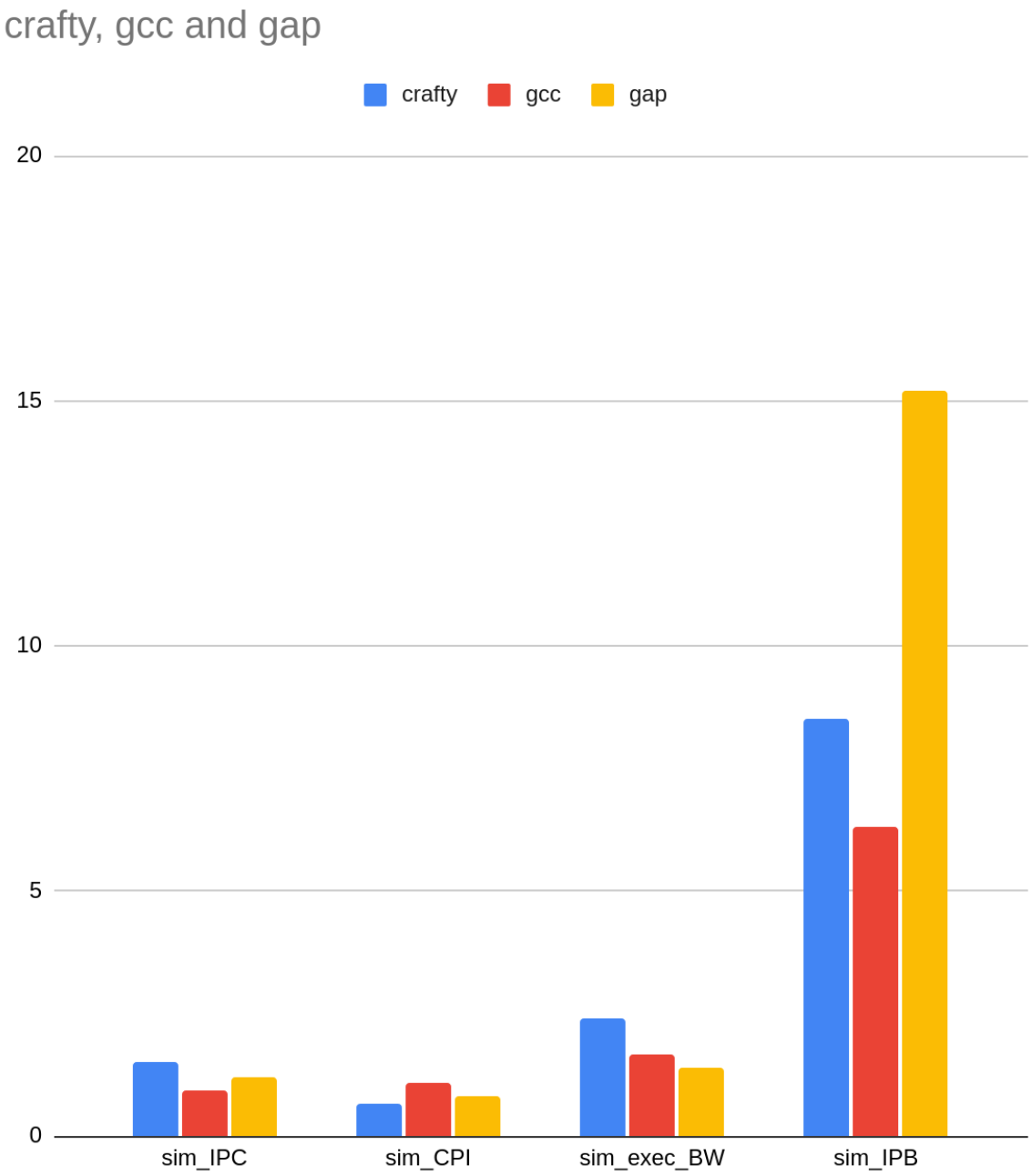

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