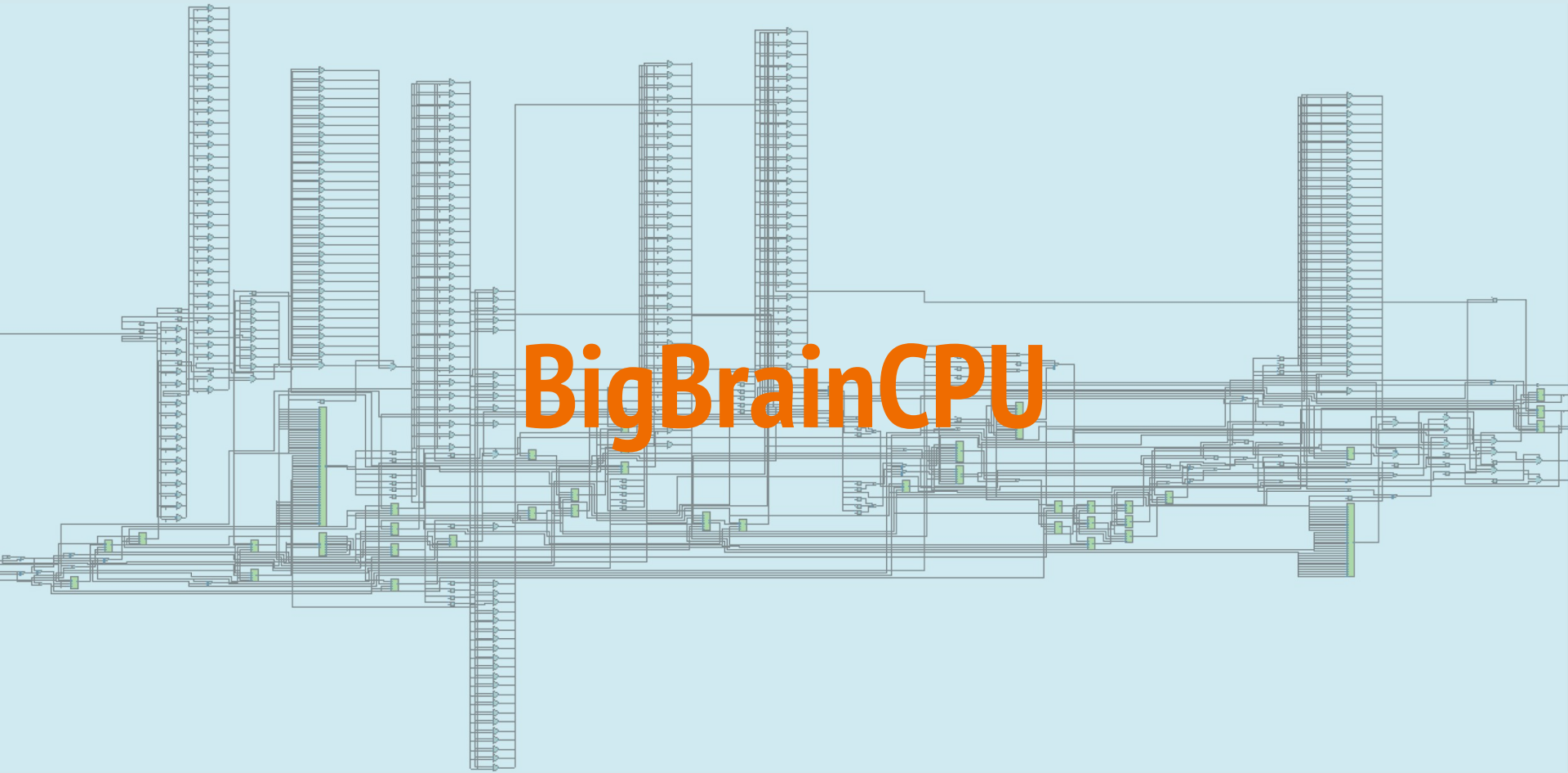

BigBrainCPU

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Advanced Features

Tournament Branch Predictor / BTB	Return Address Stack	Eviction Write Buffer	Prefetcher	L2 Cache
• Local & Global Predictor • Global BHR/PHT • 2-bit State Counters • 32 Entries	• 8 entry stack • RISC-V calls and returns with registers x1 and x5	• Single buffer • Handled dirty and clean evictions	• One Block Lookahead Prefetcher (OBL) • Added to instruction cache • Modified arbiter and cache to support prefetcher	• 2-way set associative with 16 sets • Between arbiter and memory (cache-line adaptor)

Quantitative Results

Tournament Branch Predictor / BTB	Return Address Stack	Eviction Write Buffer	Prefetcher	L2 Cache
Total Branches: 12774 Total JALR: 3079 BTB: 9417 (97.1%) Global: 323 Local: 1862 # of Flushes: 9369 vs. 3357 (35.8%)	Total JALR: 2978 RAS Correct: 1478 Half of the JALR instructions were used to call functions The other half were used to return with 98.6% accuracy	D-Cache stall time • Before: 89182 • *After*: 64187 I-Cache hit cycles • Before: 139546 • *After*: 114550 Other metrics stayed relatively the same	I-Cache Misses • Before: 91 • *After: 78* I-Cache Stall Time • Before: 5183 • *After: 4097* I-Cache Hit Cycles • Before: 113633 • *After: 114550*	I-Cache Stall Time • Before: 4923 • *After: 4087* D-Cache Stall Time • Before: 123837 • *After: 89182* I-Cache Hit Cycles • Before: 173806 • *After: 214868*

Final Reflections

Tournament Branch Predictor / BTB	Return Address Stack	Eviction Write Buffer	Prefetcher	L2 Cache
Parameterized BTB and Predictors *Considerations:* • BTB Size • Mispredictions *Improvements:* • Resolve branch earlier • BHR/Predictor Size	Parameterized RAS Size *Considerations:* • Size *Improvements:* • What to do when stack is full	*Considerations:* • Placement in memory subsystem *Improvements:* • Add more line buffers	*Considerations:* • Priority in memory access • Interference in regular program execution *Improvements:* • FSM -> More Ports • Stride Prefetching	*Considerations:* • Size of L2 Cache • Line Size *Improvements*: • Add more ways • Make line size bigger