Imperial College London

COURSEWORK

IMPERIAL COLLEGE LONDON

DEPARTMENT OF COMPUTING

Splay Trees Exploration

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Date: November 1, 2023

1 Studying Microarchitecture Effects

1.1 Instructions per Clock Cycle vs RUU Size

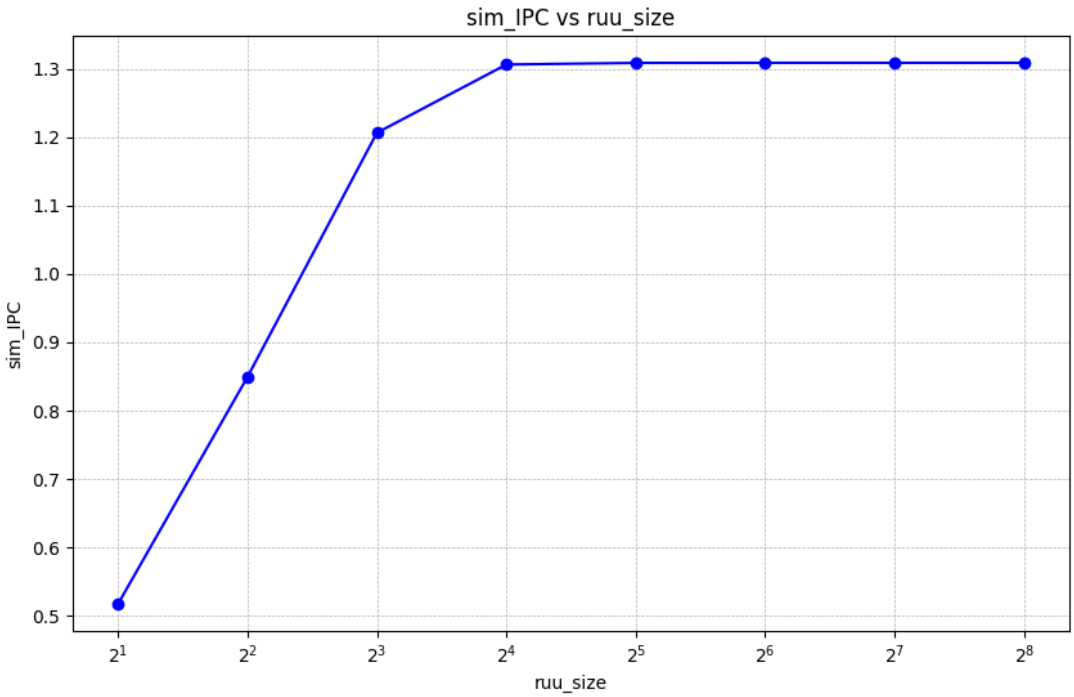

Figure 1: Instructions per Clock Cycle vs RUU Size

For smaller RUU sizes (i16), there is a clear trend of increasing IPC with a larger RUU size. With a smaller RUU, the CPU is likely getting bottle-necked, as the RUU gets full & cannot hold all of the issued instructions, leading to stalls in instruction execution. This increase in IPC tapers of significantly past a RUU size of 16, from 8 to 16 there is a smaller relative increase, and after 16 the curve plateaus. As RUU size increases past this point, there is enough space in the RUU to handle all of the in-flight instructions, and other factors become limiting, such as fetching instructions, or memory latency. The IPC plateaus are around 1.3 instructions per clock cycle - diminishing returns in increasing the RUU size past 16.

1.2 Total Energy Consumed vs RUU Size

Initially, there is an energy saving in increasing the RUU size, up to 16, suggesting greater energy-efficiency. As the RUU size increases, the time the RUU is full decreases significantly, leading to fewer stalls & decreasing execution time, hence decreasing energy-consumption. This is shown in the IPC & execution BW metrics, which increase (more work done per energy consumed). After an RUU size of 16, the energy consumption increases as RUU size increases. As seen previously, past RUU size 16, there is a diminishing return in performance benefits, accompanied by an increase in energy consumption (hence, paying heavily in energy use for slightly better performance). After RUU of 16, the time RUU is full decreases significantly, and the RUU is no longer a bottleneck. Although, after an RUU size of 32, the LSQ full time increases, suggesting that the LSQ then becomes a bottleneck,

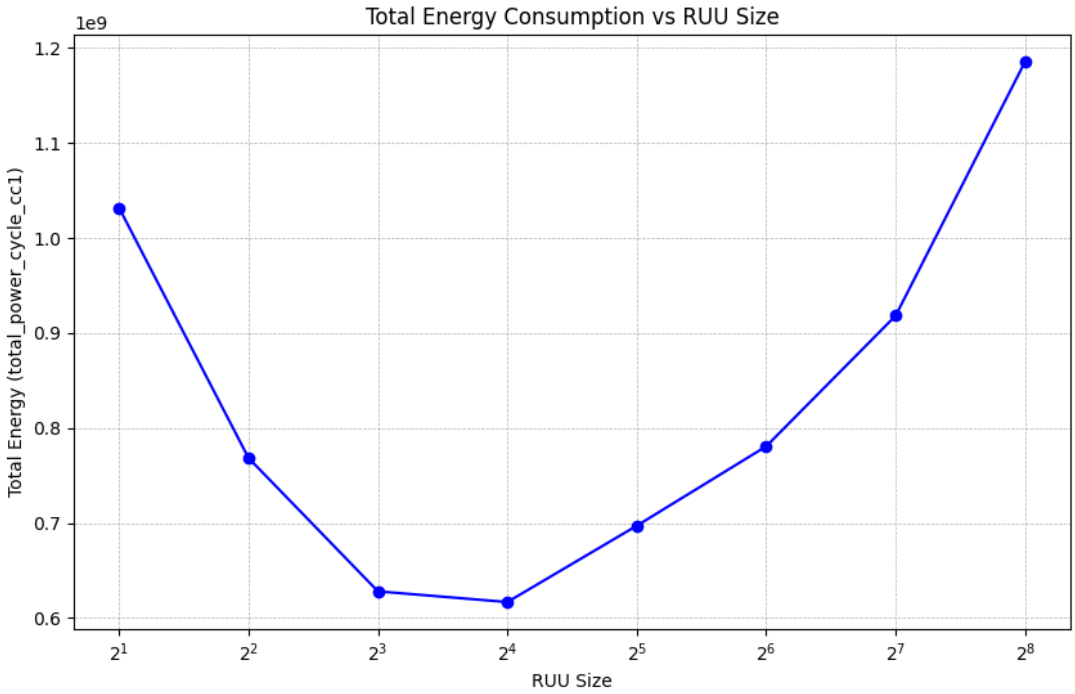

Figure 2: Total Energy Consumption vs RUU Size

causing the increase in energy due to the increased waiting times & pipeline stalls due to memory accesses.

1.3 Interaction between LSQ & RUU Size

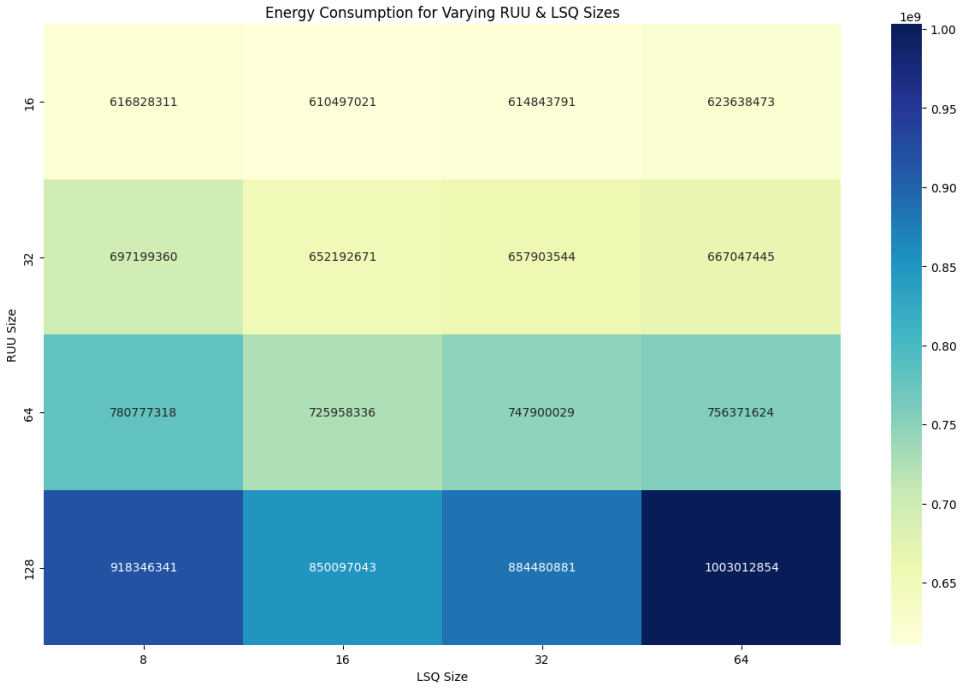

Figure 3: Energy Consumption for Varying RUU & LSQ Sizes