

A design space exploration for a flexible eFPGA-based neuromorphic processing core

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Neuromorphic computing is a rapidly evolving field of research. Earlier research focused on replicating biologically accurate computational dynamics [1], whereas contemporary research adopts a brain-inspired yet practical approach to algorithm design. This shift promoted neuromorphic computing designs built with flexibility in mind. This flexibility is demonstrated by improved performance metrics in successive hardware iterations, largely due to their increased design flexibility[2]. Instead of adopting a micro-kernel or a general-purpose processor design common in neuromorphic hardware, we explored the use of embedded field-programmable gate arrays (eFPGAs) for flexible neuromorphic computing [3]. We designed an eFPGA fabric to accelerate neuromorphic workloads, incorporated an event-activated clock network for event-based workloads, designed logic elements that enabled higher-frequency computations, and a hard in-fabric macro inspired by neuromorphic design principles to handle memory and computation. We synthesized the design using the open-source SKY130 process and benchmarked its performance against a comparable ASIC accelerator. Our results demonstrate that the eFPGA achieves comparable ASIC performance in power, latency, and throughput while outperforming similar open-source eFPGA implementations[3]. Figure 1 shows a block diagram of the designed FPGA, where configurable logic blocks (CLBs) contain the designed logic elements, compute & register-file blocks (CRF) contain the main acceleration macros, and the edge blocks represent the termination of the FPGA.

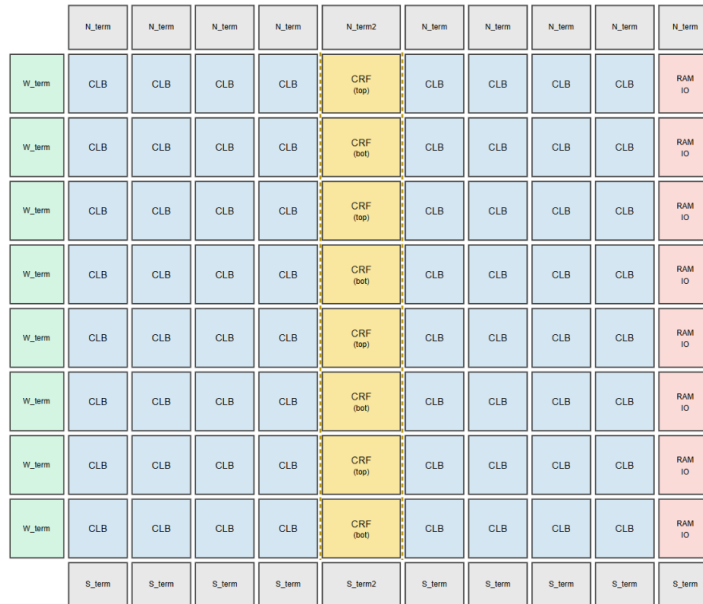


Figure 1: eFPGA block diagram showing the different blocks designed in [3].

- [1] D. R. Muir and S. Sheik, The road to commercial success for neuromorphic technologies, Nat. Commun., vol. 16, Article 3586, 2025.
- [2] D. Kudithipudi et al., Neuromorphic computing at scale, Nat., vol. 637, no. 8047, pp. 801–812, 2025.
- [3] B. Elshinnawey, Exploring eFPGAs For Flexible Neuromorphic Computing, Univ. Twente, 2026, <https://purl.utwente.nl/essays/109510>.