Resource-Efficient Logarithmic Number Scale Arithmetic for SPN Inference on FPGAs

\[ \text{LNS} \]
Approach

- SPNs are nets for **machine learning**
  - Very small values ($< 10^{-50}$) are relevant
  - Numeric range of values: $[0, 1]$

- Logarithmic number system (LNS) operators
  - *Custom & parameterized*
  - Replacing double precision floating point operators

- **Automatically generate** accelerator designs
  - *Fully spatial, fully pipelined*
  - For SPN *Inference*
Results

- **Outperforms CPU & GPU** for most examples (14 of 16)
  - 4.7x vs. GPU, 11.4x vs. CPU

- **Saves Resources** vs. FP-baseline
  - Up to 50% of Slices (Geo.-mean 14.6%)
  - Up to 38% of DSPs (Geo.-mean 10.8%)

- **Almost identical** throughput (-1.1% on average)

- **Identical** error margin (10^{-6} in logscale)

- Allows mapping of **bigger** and **more relevant** SPNs to FPGAs