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

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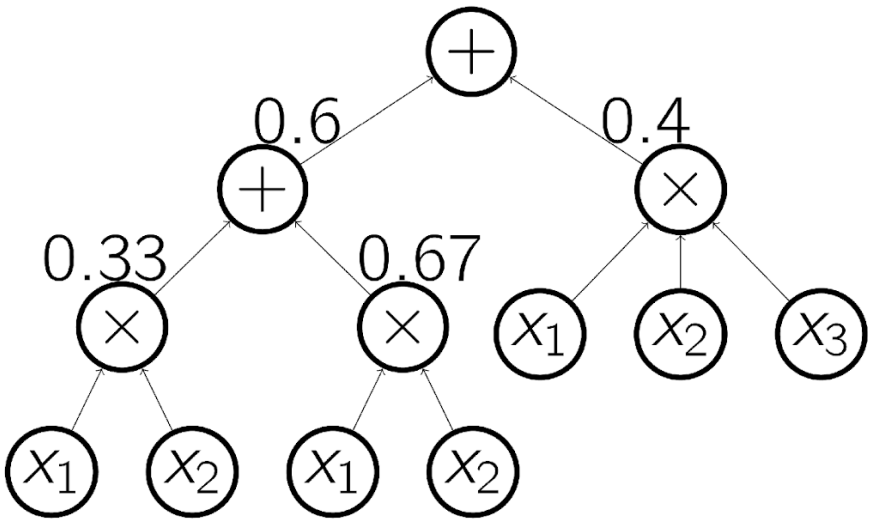
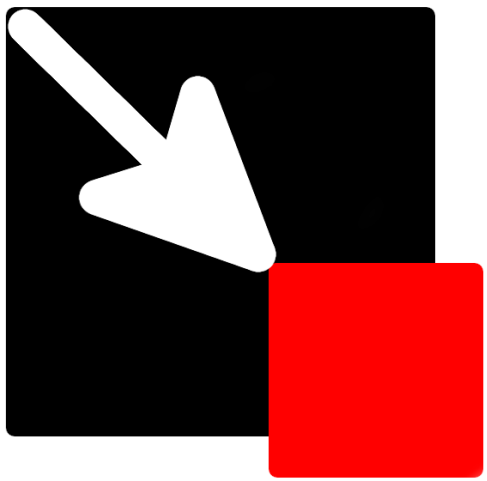


+ = 

LNS

Embedded Systems & Applications

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