



# NN-FPGA Controller

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- The NN-FPGA controller implies building of a cost efficient neural network by using customizable blocks designed in the Matlab Simulink and Xilinx System Generator.
- Implementing neural network in reconfigurable architecture like FPGA is the best way to calculate weights and network topologies.
- Network parameters are mapped into a hardware structure that improves the performance and the efficiency.



# FPGA Memory

- The size of the implemented NN is limited by the block RAM capacity of the FPGA board.
- The size of a NN is the amount of neurons synaptic weights available.
- Number of synaptic weight connections available for FPGA board:

$$N_{sw} = \frac{(\text{FPGA Block RAM Size})(\# \text{ of Block RAMs})}{\text{Size of Synaptic Weights}}$$



# NN Efficiency

- To ensure effective utilization of FPGA board resources, a high efficient NN should be built.
- Network efficiency is the percentage of processing elements operating in parallel.

$$\text{Eff} = \frac{\text{\#of neurons in the smallest layer}}{\text{\#of neurons in the largest layer}} \times 100\%$$

- Maximum network efficiency is achieved when the network layers have the same number of neurons.
- Thus, to increase the efficiency, neurons in the largest layer are multiplexed in groups.



# NN Hardware Architecture

- The network blocks will be built in Simulink environment, and use basic Xilinx blocks.
- Control block manages the control signals of the neurons.
- The winner neuron is the neuron with the weight vector that closely matches the input.



