# Progress on SNN Model and Neuromorphic System Research

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# Content

- Research Introduction
- Research progress
  - Completed
  - On-going
  - To-do
- Schedule

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# Research Introduction

- Dynamic Quantization
    - Dynamically adjust the precision based on the network's current state and computational requirements

    - Significantly reduce energy consumption and memory usage without notably compromising accuracy

    - Implemented by using algorithms that monitor the activity of neurons and adjust precision levels accordingly

3.141592653     ⟶     3.1415

32 bit     ⟶     8 bit

Figure: Examples of quantization process

# Research Introduction

- Dynamic Pruning
  - **Pruning:**
    - Removes synapses/neurons to reduce model size.
    - ➔ (+) Smaller models, potential for better generalization.
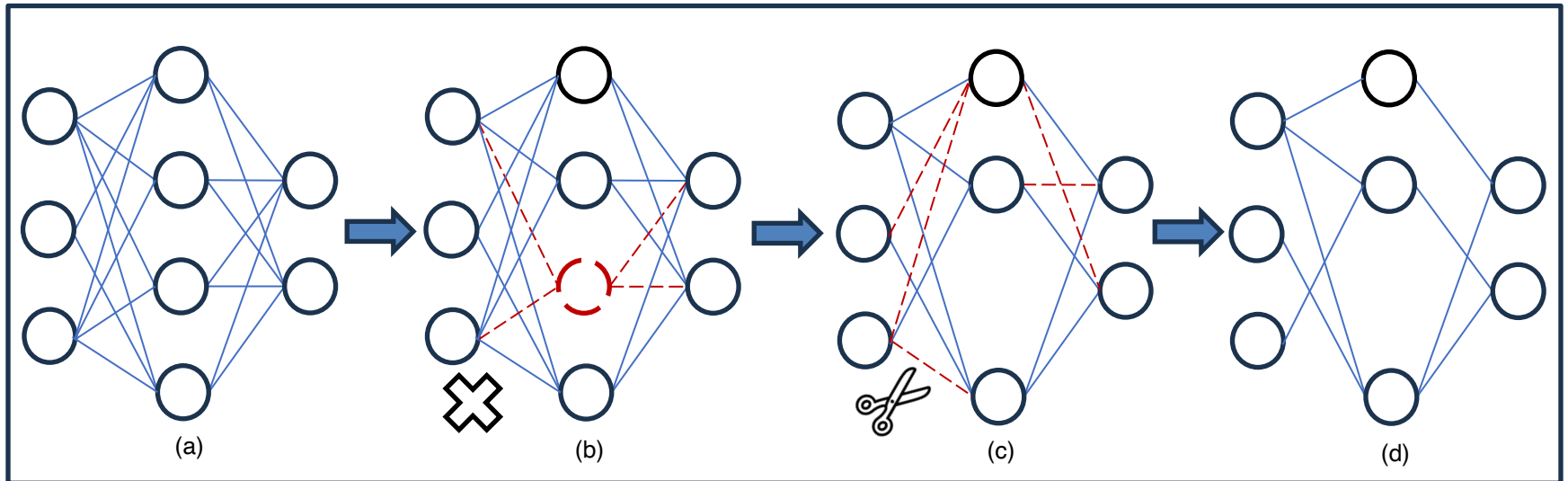    - ➔ (−) Loss of network robustness, requires retraining

Figure: Pruning Examples in Neural Networks: Neurons Pruning (b) & Synapses Pruning (d)

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# Research progress – Completed

- **Tutorial:**
  - Ran the 'DN-SoC: FPGA Implementation of Doanh Neuromorphic System-on-Chip' tutorial by a previous master's student

- **Power Estimation:**
  - Conducted power estimation for the SNN model

- **SNN Size Change:**
  - Changed model size from [784, 48, 10] to [784, 128, 10]
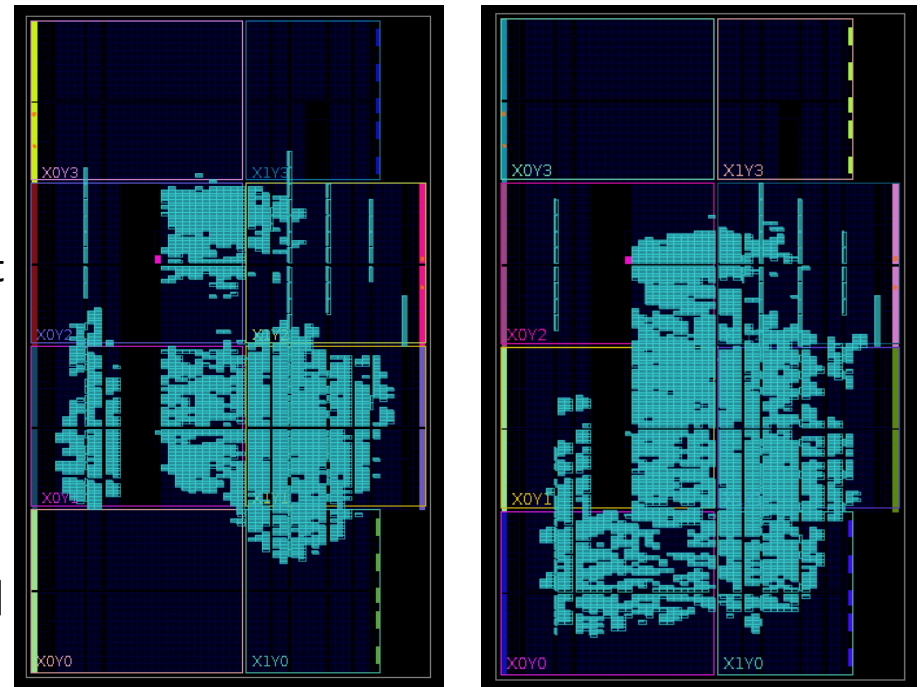  - Compared results: Area, Timing (Max Frequency), Power Estimation



Figure: Implemented design of the two different sized SNN models

# Research progress – Completed

- **Papers Read**

  – "A 0.086-mm2 12.7-pJ/SOP 64k-Synapse 256-Neuron Online-Learning Digital Spiking Neuromorphic Processor in 28-nm CMOS" **by** C. Frenkel, M. Lefebvre, J. -D. Legat and D. Bol
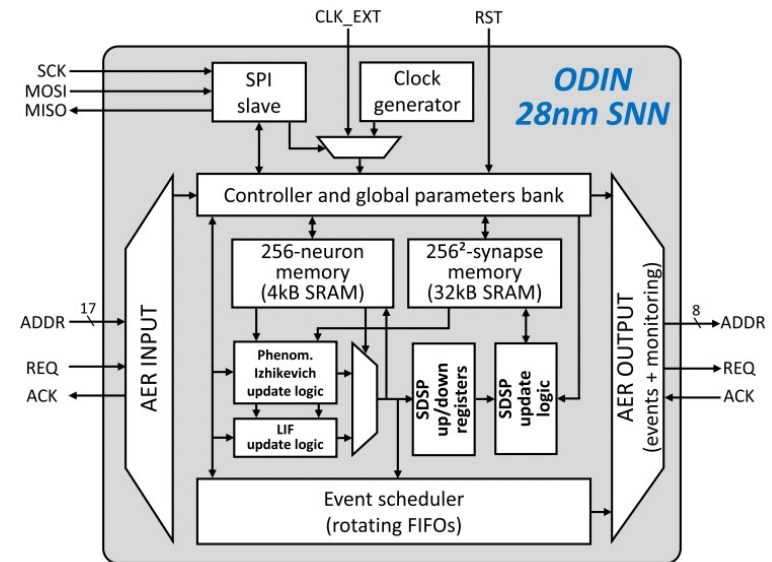


Figure: Block diagram of the ODIN online-learning digital spiking neuromorphic processor

# Research progress – On-going

- **Testing SNN on MNIST:**
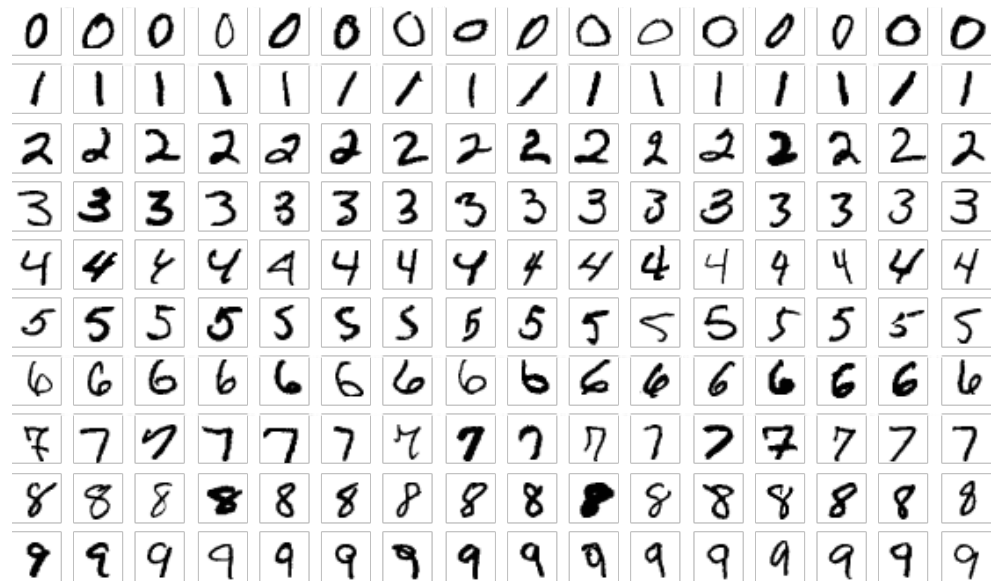  - Current focus on testing the SNN model with the MNIST dataset



Figure: MNIST Dataset

# Research progress – To-do

- **White Paper:**
    - Plan to write a white paper explaining the SNN model size comparison ([784, 48, 10] vs. [784, 128, 10])
    - Aim to improve research paper writing skills

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# Schedule

| Time<br>Task | Oct. 2024 | Nov. 2024 | ... | |
|---|---|---|---|---|
| Testing SNN power estimation | → | | | |
| Running tested SNN tutorials on the MNIST Dataset | → | | | |
| Writing white paper | → | | | |
| | | | | |

# Thank you for your attention