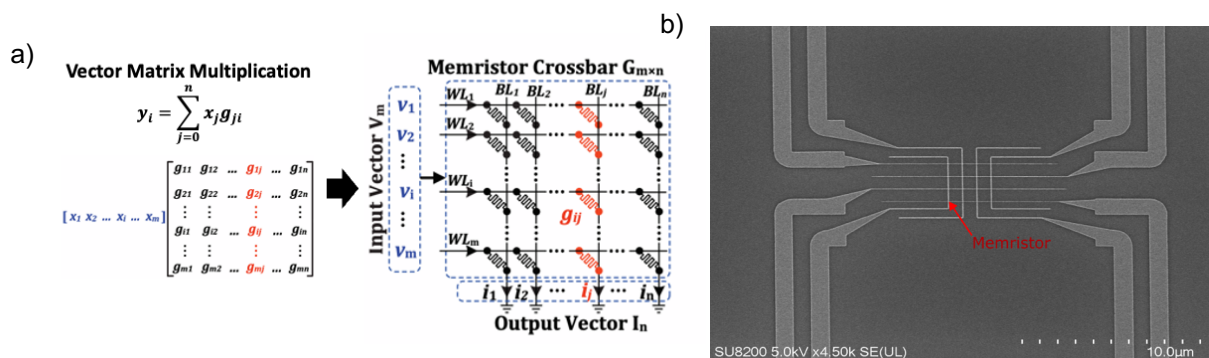


# Semester Thesis

## Implementation and Benchmarking of Memristor Crossbar Array Computations for Neuromorphic Systems

### Short Description

Memristors are tunable resistance elements that can be used as analog memory and for computation. Recently, they emerged as compelling technology for neuromorphic computing where they act as artificial synapses. Arranged in crossbar arrays, these memristors form a grid that can efficiently process information in parallel, analog to the neural network in the brain. One prominent example is the vector-matrix multiplication, a central mathematical operation in machine learning/artificial intelligence. In memristor crossbar arrays this operation can be done very efficiently in a single step by simply applying a vector of voltages at the input of the array and reading out the current (Figure a). To profit from the advantages of this crossbar array arrangement, the goal of this thesis is to implement the programming and readout of crossbar arrays as well as crossbar vector-matrix multiplications in our lab and to test your implementation on our fabricated arrays.



a) Vector-matrix multiplication on memristor crossbar arrays. b) Fabricated 4x4 crossbar array.

### Type of Work

In this thesis you will:

- Write a Python code to extend our measurement software for the reading and writing of weights to and from a memristor crossbar array.
- Perform measurements on our crossbar arrays to benchmark the reading and writing of weights.
- Write a Python script to implement the hardware vector-matrix multiplication.
- Benchmark the vector-matrix multiplication.

The exact scope of the thesis can be tailored to your interests and skills.

### Prerequisites

We are looking for a candidate with a general interest in coding and electrical characterization in our lab. Previous experience in writing code in Python is beneficial.

### Contact Details:

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