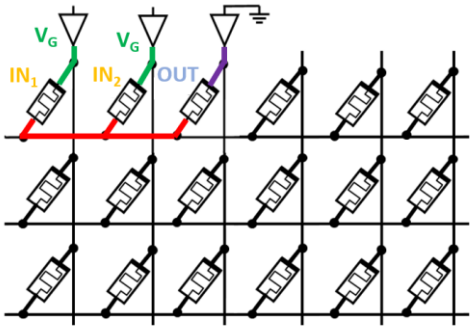
ASIC² ARCHITECTURES SYSTEMS INTELLIGENT COMPUTING INTEGRATED CIRCUITS

Simulations of Large-scale Memristive Crossbars using Xyce

Recently, several different memristive technologies (ReRAM, CBRAM, PCM and STT-MRAM) have emerged as promising candidates for digital and analog in-memory computation. Since large-scale crossbars are still not available commercially, simulations are used to evaluate these computation methods. While simulations of a few devices is possible using simple SPICE tools, simulations of large-scale crossbars is very time consuming without some sort of computation acceleration. Furthermore, a design tool to build and quickly analyze the results of such large-scale simulations is missing.



The Xyce Parallel Electronic Simulator is a SPICE-compatible circuit simulator, developed at Sandia National Laboratories. As a mature platform for large-scale parallel circuit simulation, Xyce supports standard capabilities available from commercial simulators, in addition to a variety of devices and models. Xyce is designed and written from the ground up to support large-scale parallel computing architectures. Xyce supports a canonical set of compact models. Verilog-A models may be processed into Xyce-compatible C++ code using the ADMS model compiler with the Xyce/ADMS back-end.

In this project you will use the Xyce simulator to write and simulate accurate memristive models. Then, you will build a tool to control Xyce from Python, in order to simulate large crossbar arrays. Finally, you will use the tool to evaluate in-memory computation methods in large-scale memristive crossbars.

Project Schedule:

- Learn about memristors and modeling of memristive devices.
- Learn about the Xyce simulator.
- Explore available memristor models available to use in Xyce.
- Develop a python tool to simulate memristive crossbars in Xyce.
- Learn about different in-memory computation methods using memristors.
- Use the tool to evaluate the performance, power and energy consumption of in-memory computation methods using memristitve crossbars.

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Prerequisite:

- "Introduction to VLSI" or "Advanced Circuits and Architectures with Memristors" courses
- Programming in Python
- C/C++ is a plus

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