

Gate Level Event-Driven Simulation using GPGPUs with CUDA

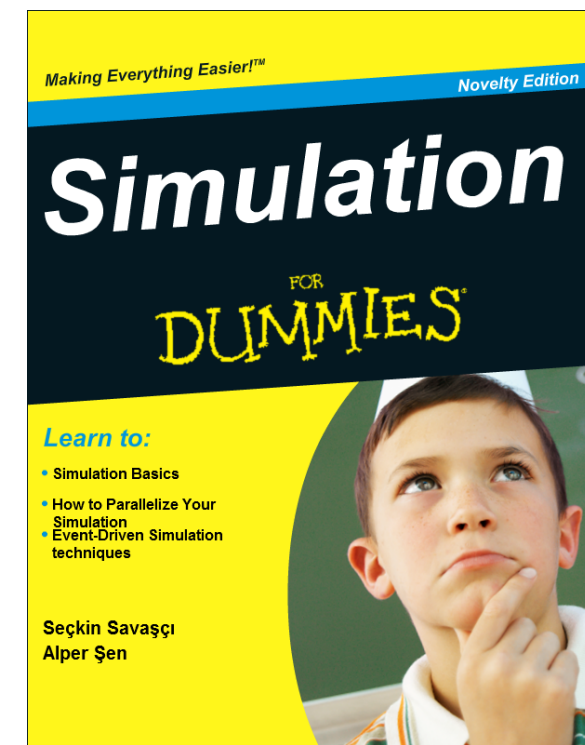
Seçkin Savaşçı, Alper Şen
{seckin.savasci, alper.sen}@boun.edu.tr



WHY DO WE NEED SIMULATION?

More than half of the effort in the design phase goes for verification and validation of the design! Performance for gate level netlist simulation is extremely low; typically it takes **days** to validate a particular design. But netlist simulation performance is quite significant since short times-to-market limit the coverage that can be achieved in verification. Thus, faster verification methods are needed to improve coverage.

SIMULATION 101

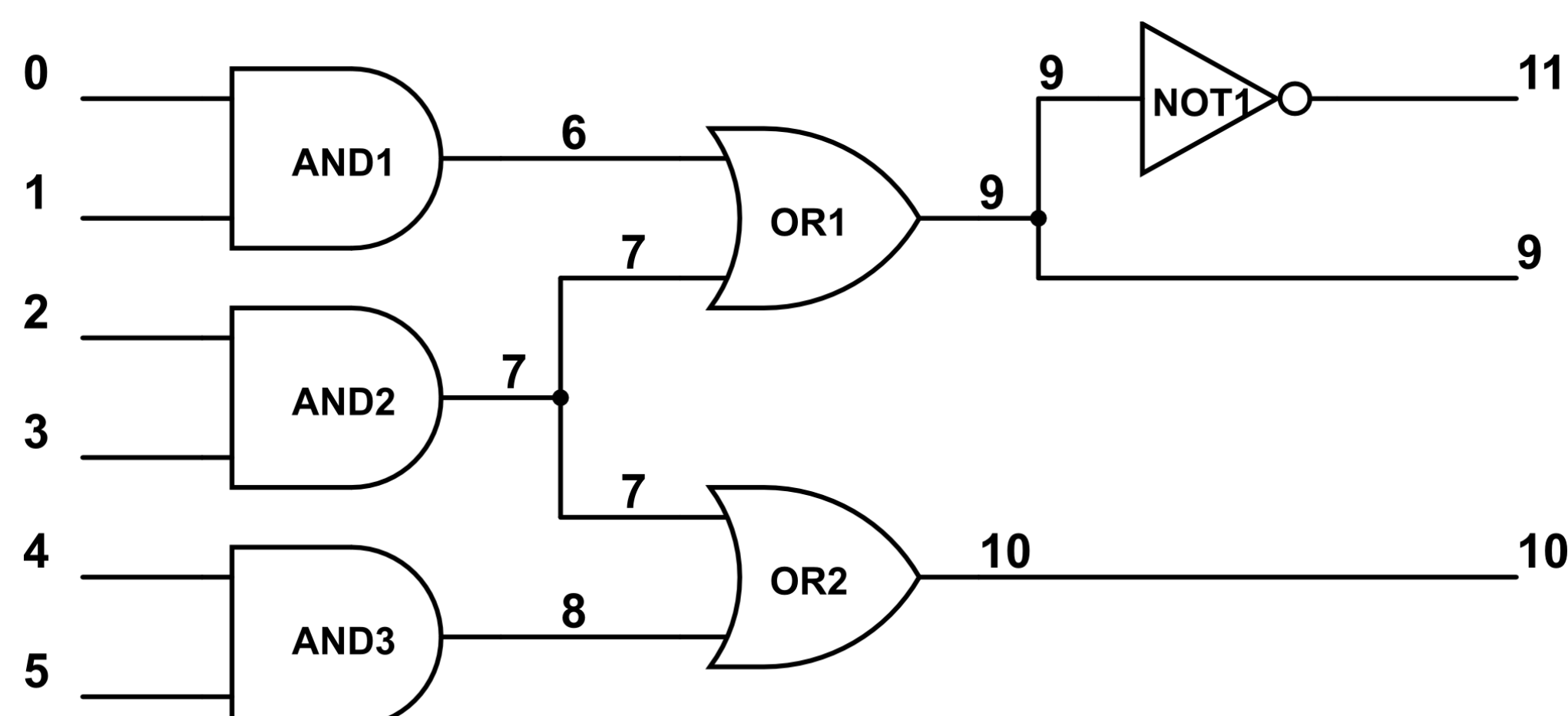


Simulation at a glance

1. get the inputs
2. process the inputs
3. get the outputs

Simulation Types

1. **Straightforward** : Simulate all sequentially!
2. **Parallel** : Simulate parallel if you can!
3. **Event-Driven** : Simulate parts if needed!



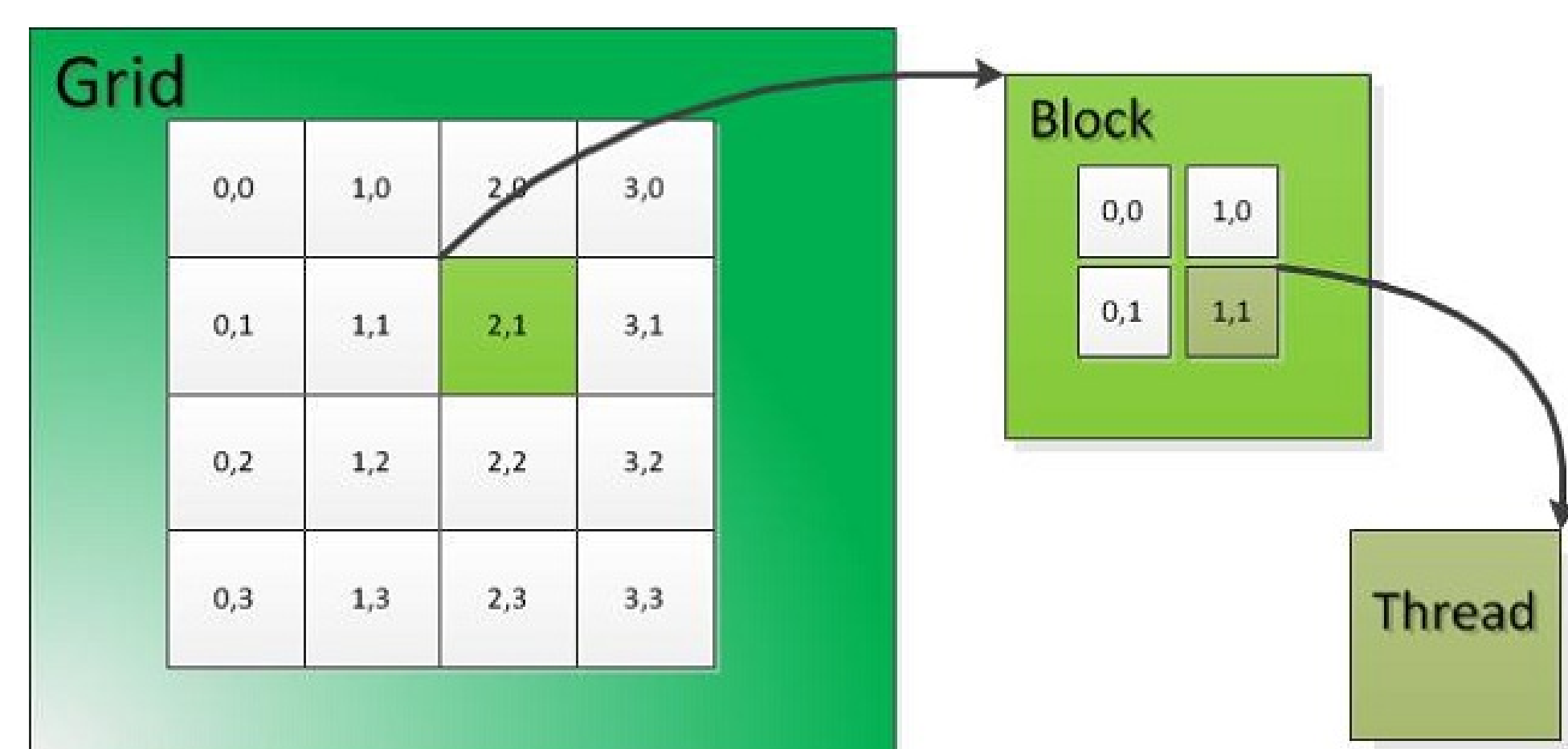
WHY CUDA?

CUDA[1] stands for Compute Unified Device Architecture. It is a parallel programming platform and a programming model created by NVIDIA. It enables programmers to develop programs using massively parallel architecture of GPUs.

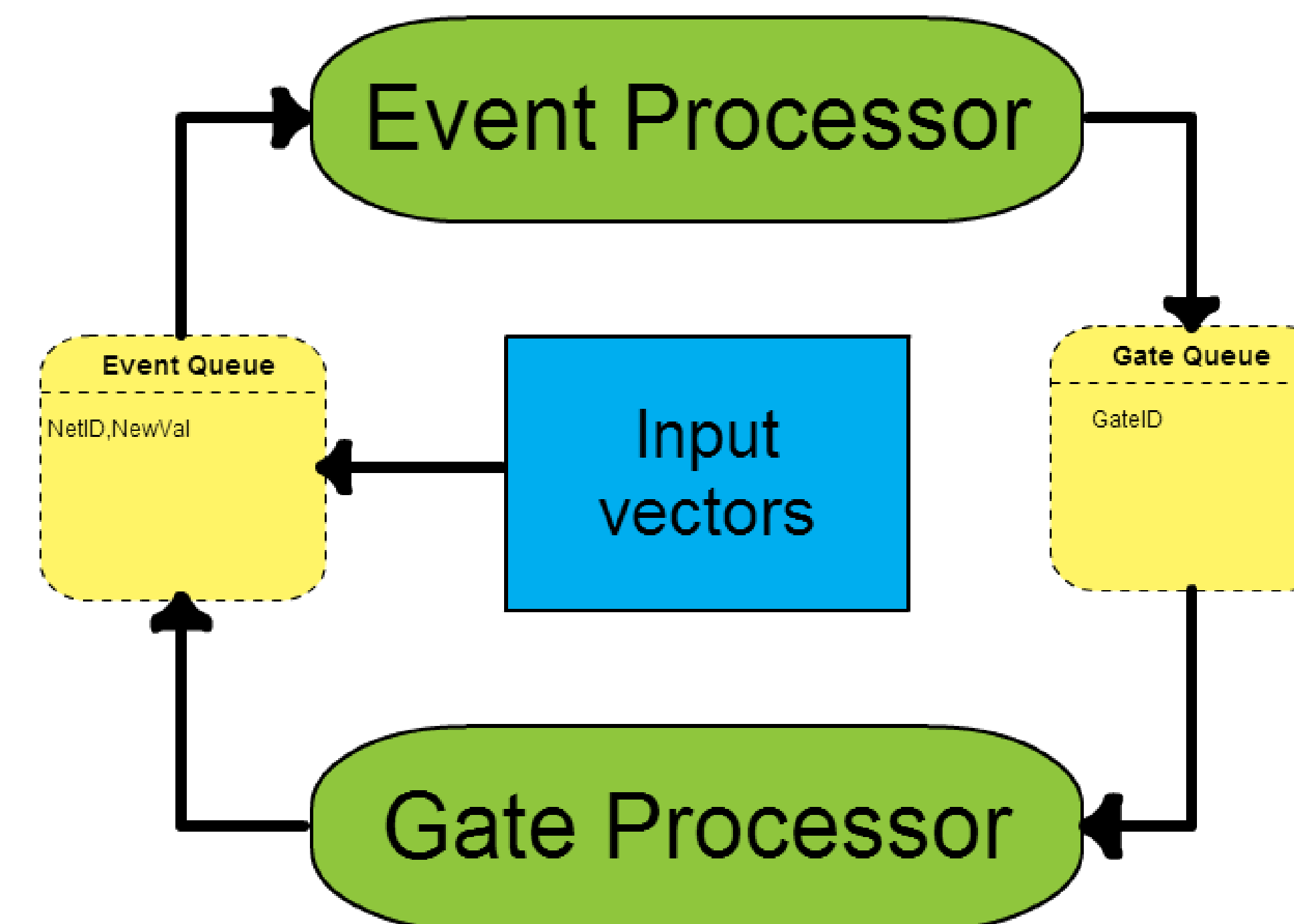
- + Easy to learn
- + C + some gpu related calls
- + Easily wrappable for C++
- Architecture dependent
- NVIDIA only
- Host-Device distance

CUDA 101

- CUDA version 5.0 , currently being developed for full C++ support
- Have helper libraries like Thrust[2], CUBLAS[3]
- Atomic operations for integer and float
- Multiple GPU support
- Same naming : cudaMalloc(), cudaMemcpy()
- OpenGL integration
- Several Built-in Memory types: Global, shared, texture
- function<<< blocks, threads >>>(args...)



SIMULATION DIAGRAM



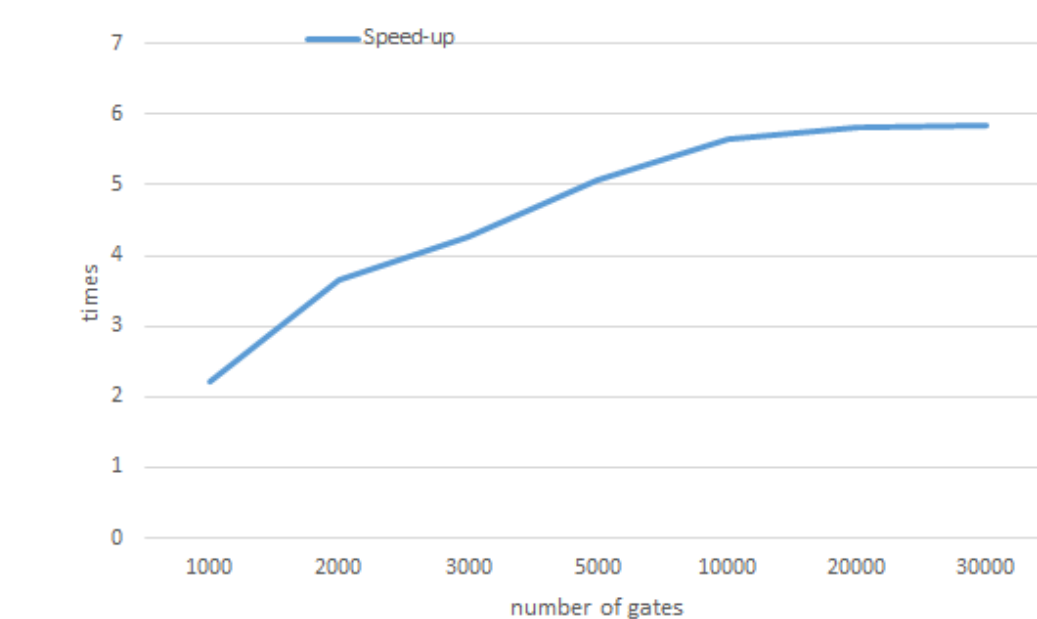
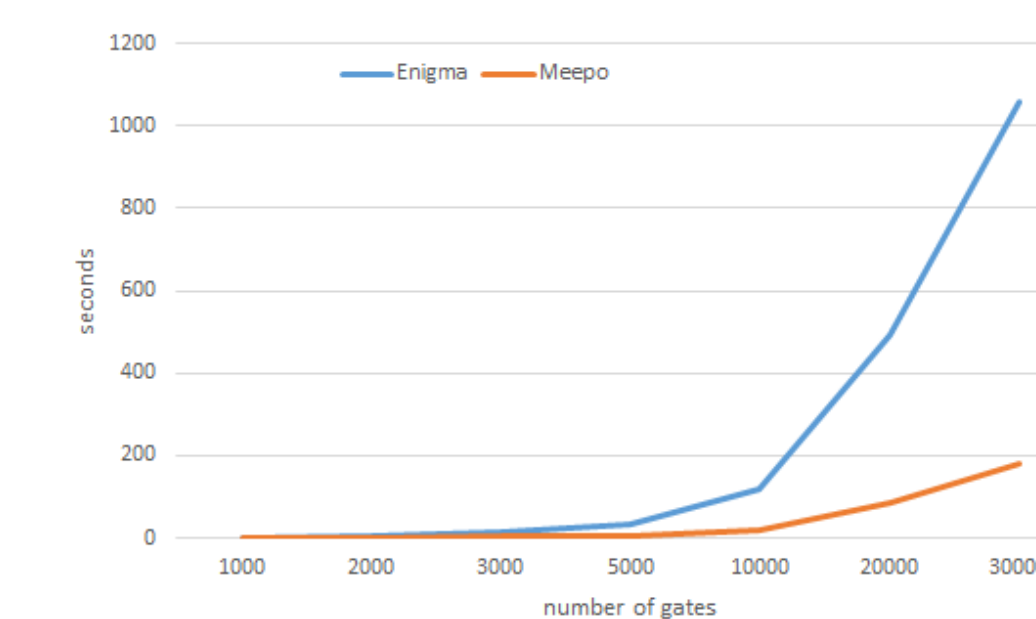
CONTRIBUTIONS

- **Circuit Generator**
A random circuit generator for our own circuit format
- **Run Generator**
A random run generator that feeds the simulation with inputs in each timestep
- **Sequential Event-Driven Circuit Simulator(Enigma)**
A sequential circuit simulator written in C++
- **Parallel Event-Driven Circuit Simulator(Meepo)**
Our project goal, parallelized version of Enigma simulator, with the help of CUDA

RESULTS

Results demonstrates up to 6x speed-up in simulation. These results are obtained by simulating several circuits with random structures for one hundred input vectors.

Gates	Enigma(sec)	Meepo(sec)	Speed-up
1000	2.08	0.943	2.206
2000	6.053	1.658	3.651
3000	12.438	2.915	4.267
5000	32.246	6.363	5.068
10000	118.059	20.907	5.647
20000	493.285	85	5.803
30000	1060.34	181.785	5.833



REFERENCES

- 1 : to get started, please visit developer.nvidia.com/cuda
- 2 : Thrust library aims to provide c++ stl capabilities for CUDA, see thrust.github.com
- 3 : CUBLAS is a port of famous scientif package BLAS, see developer.nvidia.com/cublas