CCA Project

Neural Networks performance for generating standard random distributions

Lokmane ABBAS TURKI (lokmane.abbas_turki@sorbonne-universite.fr)
Supervised by Aurélien GRENARD (aurelien.grenard10@gmail.com)

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Introduction Since the advent of von Neumann's architecture, simulation has been widely articulated around the use of libraries. As a result, large companies usually find themselves with software, inherited from decades of development, suited to old/outdated cluster solutions. Changing the existing software solutions is hard because of the many evolving hardware options. The hardware uncertainty remains real even when using cloud computing since cloud providers themselves suggest using their chips, essentially for inference like TPUs by Google or Inferentia by AWS. AI allows for resolving hardware uncertainty by replacing an entire simulation code or parts of it with inference systems. The maintenance cost of these inference systems is reduced when compared to libraries that produce the same data.

This project is about performance comparison of libraries and neural networks for generating standard law distribution like Poisson distribution [1], non-central chi-squared distribution [2], compound Poisson, and so on.

Work to be done Students will be guided on how random numbers of some distribution are generated and will have the neural networks that mimic the targetted distributions at their disposal. Students will be asked first to compute the performance of generating standard distributions using different options proposed in libraries and references. Computing the performance will involve the parallelization of the different random generation options on CPUs and GPUs using OpenMP, Numba JIT, and cuRAND [3]. The second part of the project is dedicated to the computation of the performance of random number generation using neural networks during the inference phase on CPUs and GPUs.

References

[1] S. J. A. MALHAM and A. WIESE (2013): Chi-square simulation of the CIR process and the Heston model. *IJTAF,* Vol. 16, No. 03.

[2] G. PAGÈS (2018): *Numerical Probability: An Introduction with Applications to Finance*, Springer Universitext.

[3] NVIDIA (2023): *cuRAND Library*, https://docs.nvidia.com/cuda/curand/index.html.