Report from

"ML in Hardware, and in Experiment Control and Design"

Chair: Alberto Nannarelli

Workshop on Perspectives and Applications of Deep Learning for Accelerated Scientific Discovery in Physics

Panelists

- Andreas Salzburger (CERN)
- Stefania Xella (KU/Physics)
- Alessandra Camplani (KU/Physics)
- Oswin Krause (KU/DIKU)
- Alberto Nannarelli (DTU/Compute)

Hardware Platforms for Data Processing

Motivation

Efficient computation and data storage and impact on performance and energy consumption.
Need to address relatively large dynamic ranges: meters to microns.

Proposal

Adapt number format to the specific algorithm to reduce data storage, increase memory bandwidth, and reduce energy consumption.

Discussion

- What is the best platform: CPU, GPU, FPGA, ASIC?
- FPGAs allow the necessary flexibility, but latest models are optimized for standard formats (i.e., single precision).
- The "accelerator paradigm" (get data from memory, process, and store back in memory) is emerging as the winner.

Hardware Platforms for Data Processing (cont.)

Discussion (cont.)

- FPGA-based accelerators can be reconfigured on-the-fly to adapt the processing to the workload.
- Software needed for bit-accurate simulations of hardware and automatic generation of code synthesizable on the selected platform.
- ML, e.g., speech recognition, is moving from the Cloud to the Device thanks to powerfull computing platforms.

Conclusions

FPGAs seem the way to go for flexibilty, performance and cost.
ASICs, unless off-the-shelf, require long development times and high costs.

Autoencoder (ANN) to Reduce the Amount of Saved Data

Motivation

Huge amount of data is saved for later processing.
Finding a "safe" way of reducing such data is desirable.

Proposal

Use an Autoencoder, Artificial Neural Network for unsupervised learning, which is documented to work well for anomalies detection.

Discussion

During the discussion it emerged that even with good training (example with faces) the decoding of data may lead to weird results.
Target accuracy has an impact on results.

Conclusion

It is not safe: may lose important data.
Better to find other ways to reduce data size.
It can be tested in "trigger" to flag events with high error for later analysis.

AI for System Design

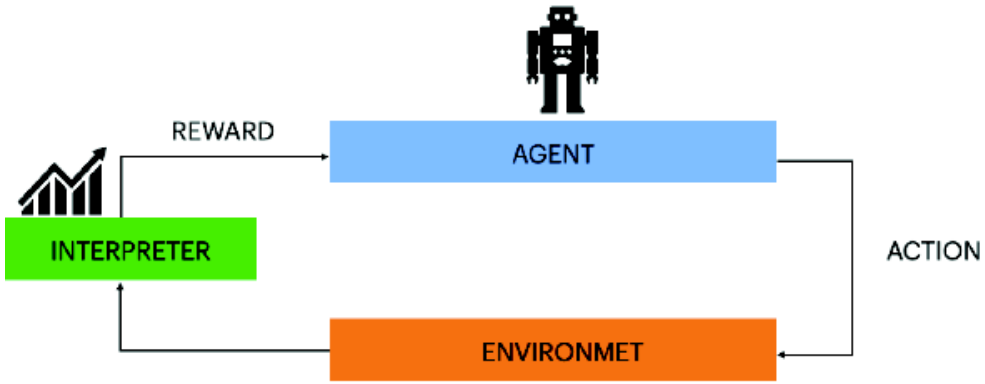
Motivation

Huge design space for complex systems.

Several parameters/dimensions/constraints to consider. High design costs.

Proposal

Use an AI Agent to find an optimal set of parameters



Discussion

Ambitious goal.

Probably, not feasible for large experiments requiring several iterations.

To be tested for pilot (small) cases. Suggestion: use Evolution Strategy methods.