moduleqnc
quantum & neuromorphic computing

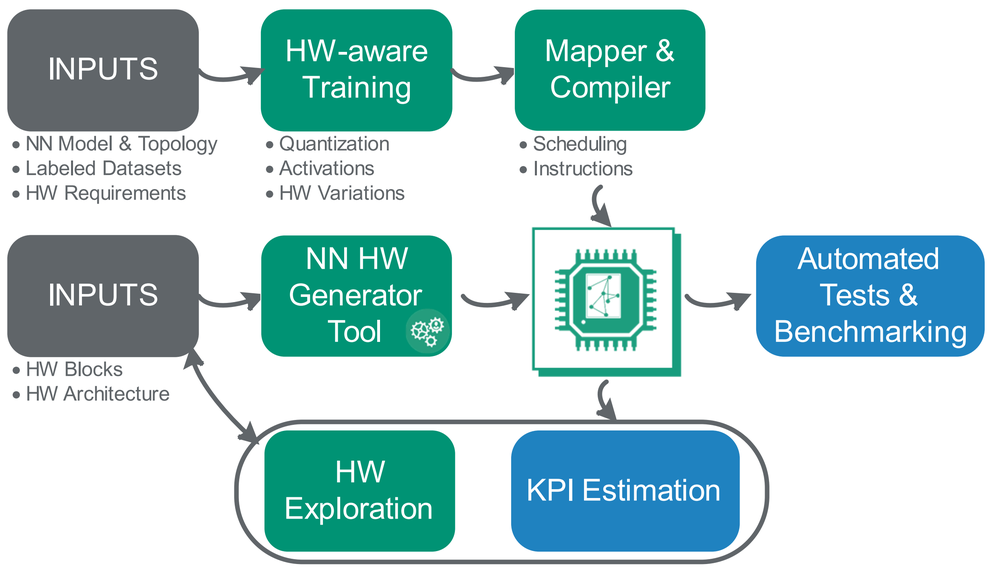
Developing Neural Networks for bio-inspired Hardware

Neuromorphic Topology Design and Parameter Training

1 Deep Learning for Neuromorphic Hardware

The development of Neural Networks (NNs) for neuromorphic hardware (HW) accelerators requires special care, as generic NNs do not map well to non-GPU HW.

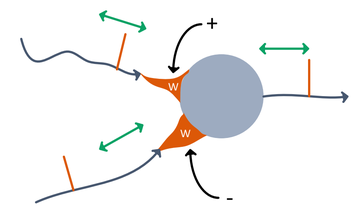
The **FMD** provides a Neuromorphic Computing Tool Chain inspired by the classical Deep Learning workflow to develop and deploy NNs on mixed-signal HW accelerators:



2 Training Beyond Backpropagation

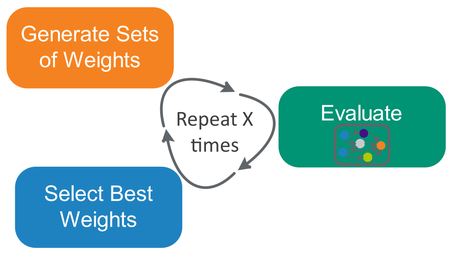
Bio-inspired learning rules for parameter training promise to make NNs more robust to signal & HW noise as well as more energy efficient during training and inference.

Local Learning:



- „What fires together, wires together“
- Observed in Neuroscience

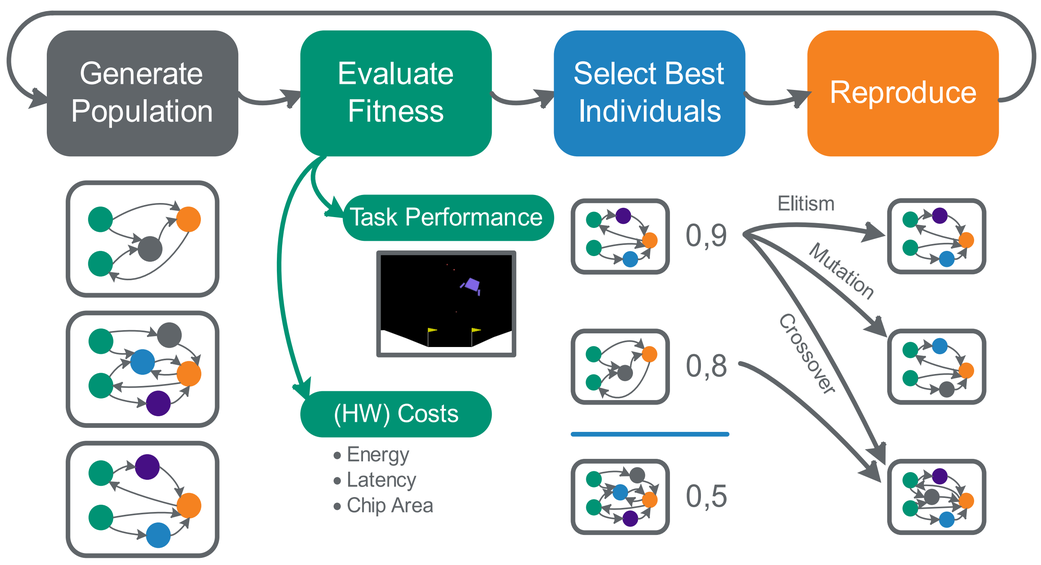
Evolutionary Training:



- Optimize weights w/o gradients
- Can also be used to find new plasticity rules

3 Neuroevolution

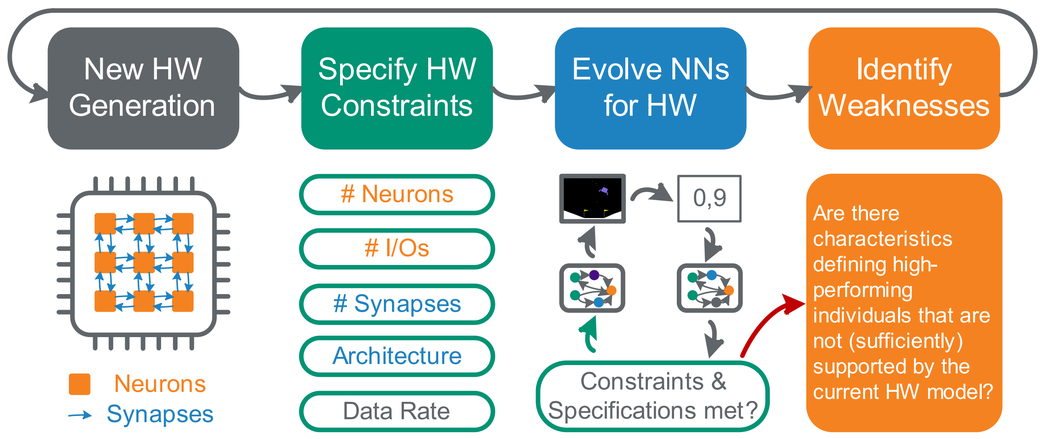
Network topology and parameters can be optimized simultaneously through neuroevolution.
This is approach differs fundamentally from Neural Architecture Search & Deep Learning, as **layer abstraction and gradient-based optimization are not required**.



- Fitness measure derived from target use case & KPIs
- Suitable for non-differentiable tasks
- Finds the most efficient & compact solution for your embedded application

4 Hardware/Software Co-Design

Co-Designing NNs with current & next HW generations allows us to meet your target requirements in the most cost-effective way.



5 Enabling Application-driven Solutions

We are ready to tackle for your application with NNs that:

- consider hardware resource limits
- find the best trade-off between
  - **accuracy,**
  - **robustness,**
  - **latency,**
  - **efficiency**
- grow into the neuromorphic target hardware

Get in touch to learn more about the FMD approach to neuromorphic systems!

For inquiries, email us at experts@module-qnc.de

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