NTNU

Kunnskap for en bedre verden

AI for Norway’s technological future

- how can NTNU benefit in the coming years from collaborating with CERN in the area of AI

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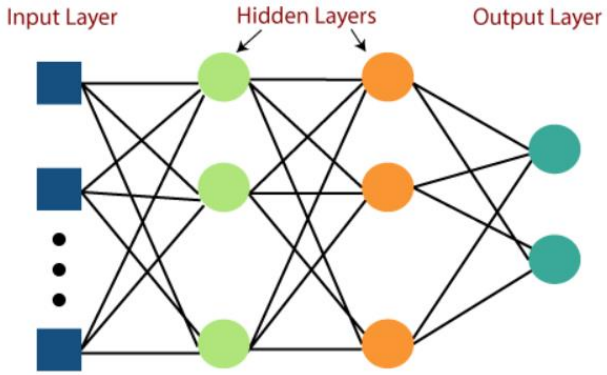
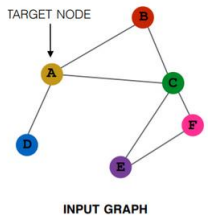
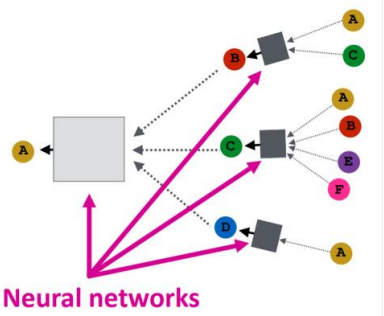
NTNU

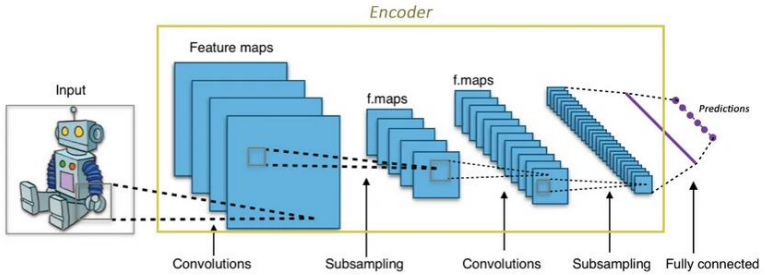
AI in the CERN experiments

- «Traditional» Deep Learning in use at CERN for some years:
  - Feed-forward-architectures
  - Convolutional neural networks
  - Graph neural networks

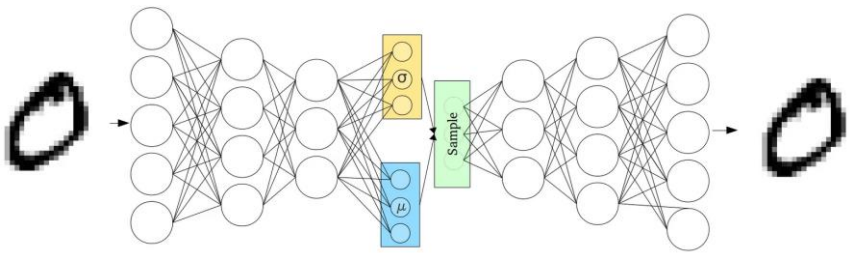


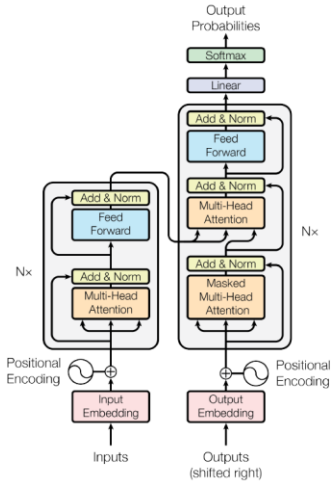






- More advanced architectures during the later years:
  - Generative Adversarial Networks
  - Variational Autoencoders
  - Transformers (backbone of Chat-GPT)
  - Normalizing Flows
  - Diffusion Models





- Even though there are applications of Deep Learning also in the accelerator sector, the main drivers are the largest LHC experiments:
  - Feed-forward, convolutional networks and graph networks for complex analyses of large amounts of data
  - Transformer architecture reformulated to solve classification problems in physics analyses
  - Generative models (GAN, VAE, Normalizing Flows and Diffusion models) used to simulate large amounts of data
  - Implementations of Deep Learning on very fast hardware architectures (GPU, FPGA, ASIC) for online applications with extreme speed requirements (e. g. first-level trigger)

Knowledge transfer for future technological applications in Norway

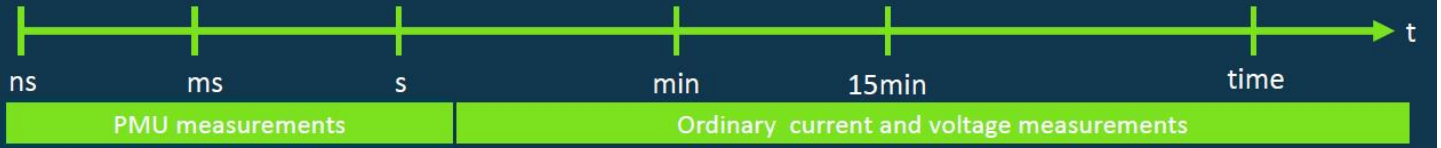
- Generative models for industrial simulation, industrial design, digital twins, …
- Fast, energy-efficient FPGA-implemented models for condition monitoring and decision support
- But also more traditional Deep Learning for process- and product optimization, predictive maintenance, quality control, condition monitoring, computer vision, classification, regression,….

Potential case: fast condition monitoring of Norwegian electrical grid

Power production from hydropower plants will be replaced by power from sun and wind power plants, power plants that are connected to the grid through power electronics, this gives the power grid new characteristic, and the grid needs to be monitored in a new way.

To enable the green shift in a safe way, the power grid needs to be monitored at millisecond level.

The PMU (Phasor Measurement Unit) is a component that can measure conditions in the network at the millisecond level



Statnett

Det grønne taktskiftet

Potential case: AI-assisted optimization of aluminium production line (generative models, hybrid models)