Photonic quantum **mem**ristor ne**two**rks

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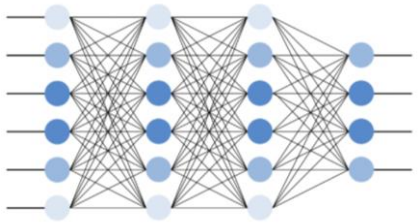
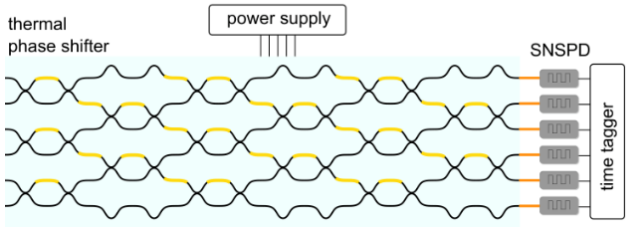


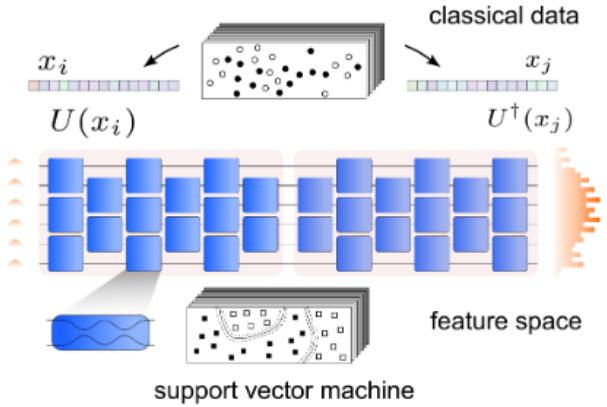
Artificial neural networks are a highly versatile machine learning model.
The learning process requires **nonlinearities**.

Integrated tunable photonic circuits implement arbitrary unitary operations on Fock states.
They ensure stability and scalability.

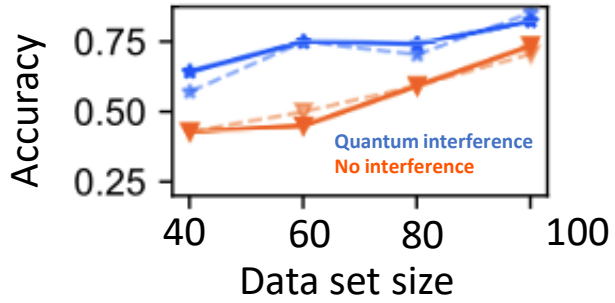


Can we implement nonlinear behaviours through photonics?

Nonlinearity through encoding



Nonlinearly classifiable data are mapped onto a feature space and then separated through a hyperplane. This map is performed through the unitary evolution of 2-indistinguishable photon states.



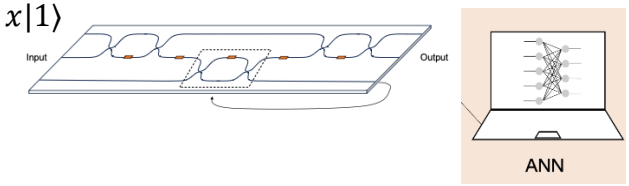
This feature map allows to achieve high classification accuracy

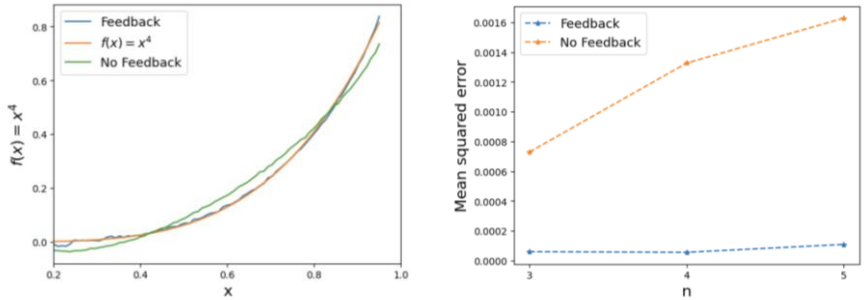
Nonlinearity through feedback loop

x

$\sqrt{x}|0\rangle + \sqrt{1-x}|1\rangle$

$f(x) = x^n$?





The feedback loop enhances the nonlinearity

Conclusions and outlook

- Scale to a larger platforms, with **more nonlinear nodes.**
- **Real world-oriented tasks** (e.g. image recognition)
- Tasks with **no classical counterpart** (Entanglement detection, quantum correlation set characterization)