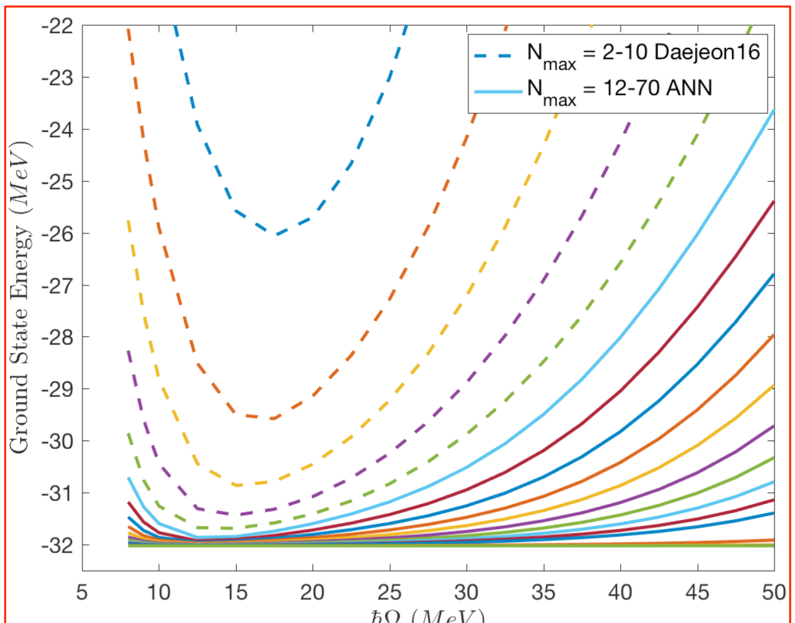
Deep Learning for Nuclear Binding Energy and Radius

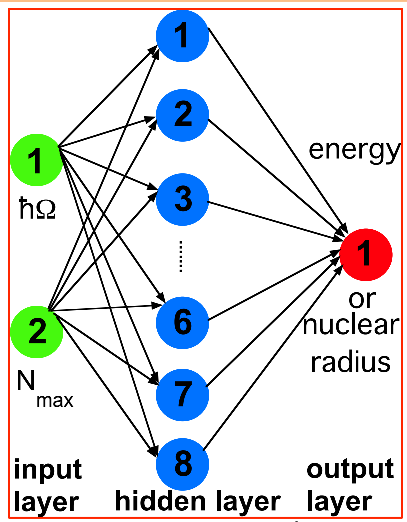
Scientific Achievement

- Development of an artificial neural network (ANN) for extending the application range of the *ab initio* No-Core Shell Model (NCSM)
- Demonstrated predictive power of ANNs for converged solutions of weakly converging simulations of the nuclear radius
- Provided a new paradigm for matching Deep Learning with results from high performance computing simulations

Significance and Impact

- Guides experimental programs at DOE's rare isotope facilities
- Extends the predictive power of *ab initio* nuclear theory beyond the reach of current high performance computing simulations
- Establishes foundation for deep learning tools in nuclear theory useful for a wide range of applications





Architecture of neural network (**above**) used successfully to extrapolate the ^{6}**Li** ground state energy from modest basis spaces (dashed line sequence) to extreme basis spaces (solid line sequence) achieving independence of basis parameters (flat line in **left figure**).

Research Details

- Predict properties of nuclei based on *ab initio* structure calculations in achievable basis spaces
- Develop artificial neural networks that extend the reach of high performance computing simulations of nuclei
- Produce accurate predictions of nuclear properties with quantified uncertainties using fundamental inter-nucleon interactions

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NUCLEI Nuclear Computational Low-Energy Initiative

Ref: Best Paper Award: G. A. Negoita, et al., in COMPUTATION TOOLS 2018, Barcelona, Spain, February 18–22, 2018http://www.thinkmind.org/index.php?view=article&articleid=computation_tools_2018_1_40_80017

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