How Neural Nets Work

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Abstract:

There is presently great interest in the abilities of neural networks to mimic "qualitative reasoning" by manipulating

neural incodings of

symbols. Less work has been performed on using neural networks to process floating point numbers and it is sometimes

stated

that neural networks are somehow inherently inaccu(cid:173) rate and therefore best suited for "fuzzy" qualitative

reasoning. Nevertheless, the potential speed

of massively parallel operations make neural net "number crunching" an interesting topic to explore. In this paper we

discuss some

of our work in which we demonstrate that for certain applications neural networks can achieve significantly higher

numerical accuracy than

more conventional tech(cid:173) niques. In particular, prediction of future values of a chaotic time series can be

performed with exceptionally

high accuracy. We analyze how a neural net is able to do this , and in the process show that

a large class of functions from Rn. ~ Rffl may be accurately approximated by a backpropagation neural net with just

two "hidden" layers. The network uses this functional approximation to perform either interpolation (signal processing

applications) or extrapolation (symbol processing

applicationsJ. Neural nets therefore use quite familiar meth(cid:173) ods to perform. their tasks. The geometrical

viewpoint advocated here seems to

be a useful approach to analyzing neural network operation and relates neural networks to well studied topics in

functional approximation.