



### **Department of Physics**

## The Basic Idea

The primary goal of a physicist is to collect observations about the world around us and understand those observations by finding a mathematical representation of the data. That is, to find a function that describes the data and allows the results of future experiments to be Initial guess predicted. Occasionally the mathematical form of this function is simple (e.g. Coulomb's Law, Hooke's Law) but more often it is complicated and difficult or impossible to Run Network know *a priori*. Although recognizing the pattern in a set of data might be next to impossible for a human, a  $C_i^{t+1} = C_i^t - \alpha \nabla_i (\text{Error})$ Update parameters to improve output computer is ideally suited for this task, and the question arises: alculate gradien

**Can a computer be taught to find the mathematical** expression that describes a set of data?

## Network Functions

A function is nothing more than an ordered set of fundamental operations that map some inputs to an output. Suppose the ability to take inputs, apply some fundamental operations, and produce and output were encapsulated in a *node*.



 $h(x) = C_1 e^x + C_2 \ln(x) + C_3 x + C_4$ 

Then, any analytical function can be formed by a network of these nodes connected in the right way.



# **TEACHING COMPUTERS TO BE PHYSICISTS—MACHINE LEARNING WITH NETWORK FUNCTIONS**

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is a universal approximator.





