# Feedforward Neural Networks as Radial Basis Function Networks

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## Introduction

In this assignment, a mapping was created from articulated arm joint angles to arm position in the x dimension. This was accomplished using a radial basis function network.

Radial basis function networks allow network responses to be constructed out of weighted sums of arbitrary functions. Although an arbitrary activation function is not biologically plausible, some activation functions can be constructed of several layers of neurons with biologically realistic sigmoid activation functions. In this assignment, Gaussian activation functions were approximated using two layers of neurons with sigmoid activation functions. The first layer, called the alpha layer, consists of perceptrons with hyperbolic tangent activation functions. The hyperbolic tangent function is a sigmoid function with a range of -1 to 1. The second layer, called the beta layer, sums the outputs of the alpha layer using weights of -1 and 1. These weights are selected so that the each beta node has a maximum at one point that slopes off in all directions. By appropriately biasing these nodes, the output closely resembles a Gaussian radial basis function. Once the beta nodes are trained, the third layer is a single node with linear activation function, just as in a normal radial basis function network. The weights of this output (gamma layer) node can be set algebraically with the pseudoinverse, or biologically by random perturbations. In this assignment, the algebraic method was used while tuning the alpha and beta layers, and then a biologically plausible algorithm was created.

## Alpha Layer Bias Selection

## Beta Layer Bias Selection

## Gamma Node Bias Selection by Random Perturbations

## Conclusions