Artificial Neural Networks (ANNs) Artificial Intelligence +1

# How do I decide the number of nodes in a hidden layer of a neural network?

I want to recognize handwritten English alphabets and digits.
Each input has about 726 features.I will be using a three layer model.
What should be the number of neurons in the hidden layer to start with?

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## 4 Answers

Kaushik Kasi, (Data Science && Bitcoin) Enthusiast
Written Apr 8, 2015

There is *no hard-and-fast rule* for this.

The number of hidden nodes you should have is based on a complex relationship between

1. Number of input and output nodes
2. Amount of training data available
3. Complexity of the function that is trying to be learned
4. The training algorithm

Source: (comp.ai.neural-nets FAQ, Part 3 of 7: GeneralizationSection - How many hidden units should I use? )

To minimize the error and have a trained network that generalizes well, you need to pick an optimal number of hidden layers, as well as nodes in each hidden layer.

- *Too few nodes* will lead to high error for your system as the predictive factors might be too complex for a small number of nodes to capture
- *Too many nodes* will overfit to your training data and not generalize well

I could find some general advice on this page (comp.ai.neural-nets FAQ, Part 3 of 7: GeneralizationSection - How many hidden units should I use? )

- The number of hidden nodes in each layer should be somewhere between the size of the input and output layer, potentially the mean.
- The number of hidden nodes shouldn't need to exceed twice the number of input nodes, as you are probably grossly overfitting at this point.

One paper details how a researcher used some dimensionality reduction on the training images and found that 17 was an optimal number of hidden nodes. While it might be specific to his problem, you can check it out here for ideas:(Effects of the number of hidden nodes used in a structured-based neural network on the reliability of image classification )

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Michal Illich, founder of Wikidi
Written Apr 8, 2015

If you insist on three layer model (1 hidden layer) then I would start with 88 (geometric mean of input and output layer sizes - just a quick rule of thumb).

But you will get MUCH better results if you use
- convolutional neural networks
- or autoencoders

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Ambarish Jash, Engineer at Google
Written Apr 8, 2015

My suggestion is use Rectified linear as the activation.
Use 400 neurons in the hidden layer with dropout regularization.
Use softmax as output.

This should give you reasonably good answers.

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Birbal Srivastava, Masters Deep Learning Techniques, National University of Singapore
Written Feb 9

There is no hard and fast rule. You just have to keep trying with different number of layers to see which one works best.

In neural networks, model architecture is an art that you can master with some experience and domain knowledge. Like for simple problems a single layer might work but for more complex e.g highly nonlinear problems you will have to try going for deeper layers.

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