Neural Network - First Examples

Introduction

In these examples we consider a simple neural network, which has to recognize the figures and their characteristics. Every figure has three attributes, represented by three bits.

1. A figure can be a **circle** `[1]` or a **square** `[0]`
2. A figure can be **empty** `[0]` or **full** `[1]`
3. A figure can be **black and white** `[1]` or **colored** `[0]`

Single attribute correlated with the output (1 to 1)

For the first example, the neural network has to recognize when a figure is a circle, empty/full or color don't matter. Obviously, only one attribute matters to decide the output, but the neural network doesn't know that. In fact, in the network we only have one hidden layer, except the base one with the input data.

FIGURE	INPUT			OUTPUT
	CIRCLE	EMPTY	BLACK-WHITE	
	0	0	1	0
	0	1	1	0
	1	0	1	1
	1	1	1	1

Double attributes correlated with the output (2 to 1)

For the second example, the neural network has to recognize when a figure is an empty circle or a full square, color doesn't matter. Now, the output is provided by the combination of two attributes, this cause the need for a second hidden layer, where the inputs are combined.

FIGURE	INPUT			OUTPUT
	CIRCLE	EMPTY	BLACK-WHITE	
	0	0	1	0
	0	1	1	1
	1	0	1	1
	1	1	1	0

Multiple attributes correlated with two outputs (5 to 2)

For the third example, we introduce two extra attributes:
4. A figure can have an **hole** `[1]` or **not** `[0]`
5. A figure can have **stripes** `[1]` or **not** `[0]`

Now the neural network has to recognize two different situation, described by two different outputs (2 bits); one for a colored circle with an hole and the stripes, one for a square without the hole. In this example the output is provided by the combination of five attributes for two outputs, this cause the need for four hidden layers, for a better performance.

FIGURE	OUTPUT					OUTPUT	
	CIRCLE	EMPTY	BW	HOLE	STRIPES		
	0	0	1	1	0	0	0
	0	1	0	0	0	0	1
	0	0	1	1	1	0	0
	0	1	1	0	0	0	1
	1	0	0	1	0	0	0
	1	1	0	0	0	0	0
	1	0	1	0	0	0	0
	1	1	0	1	1	1	0