

Pathological Tasks

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Sommario

1 Introduction

The problems discussed below were first proposed by Hochreiter and Schmidhuber [1] as examples of difficult problems because they require learning long term correlations and have been commonly used as benchmark tasks since.

2 Addition problem

The problem consists in performing an addition between two real numbers x_i and x_j in $[-1.1]$ belonging to a sequence of randomly generated numbers. The difficulty in this problem is that such numbers can be arbitrarily distant in the input sequence, so the learning net must exhibit a long term memory. More specifically the input is a sequence of pairs; each pair is composed of a real number and a marker which can be in $\{1, 0\}$. The marker is used to select the two numbers in the sequence to add. The prediction is the last value in the output sequence, the target is $\frac{x_i+x_j}{2}$. The prediction y is considered correct if $|y - \frac{x_i+x_j}{2}| < 0.04$.

Sequences have random length, say L , between the minimal sequence length T and $T + \frac{T}{10}$, the position of the first marker is sampled in first $\frac{L}{10}$ positions, the last marker is instead sampled in $[\frac{4L}{10}, \frac{5L}{10}]$

3 Multiplication problem

The problem is very similar to the addition problem, here we select two numbers in the input sequences of real numbers in $[0, 1]$ and we need to predict the product.

4 Temporal order problem

The input sequences are composed T randomly chosen symbols in $\{a, b, c, d\}$ except for two randomly selected positions where the symbols is chosen in $\{x, y\}$. The task is to predict the relative order of the two special symbols, that is $\{xx, xy, yx, yy\}$. A variant of the task is to use three special symbols instead of two. Again, the difficulty of the problem is the possibly distance from the special symbols whose relative order is to be detected.

5 Random permutation problem

Riferimenti bibliografici

- [1] Sepp Hochreiter and Jürgen Schmidhuber. Long short-term memory, 1995.