**I. Pen-and-paper**

1. Forward Propagation:

This part objective is to transform the input no output , for achieving this we apply recursively these functions

Applying forward propagation to the data given in the assignment, the following activation and net input vectors were obtained:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| (input) |  |  |  |  |  |  |
| 1 | 6 | 0.999988 | 3.76157 | 0.99892 | 0 | 0 |
| 1 | 1 | 0.761594 | 3.76157 | 0.99892 | 0 | 0 |
| 1 | 6 | 0.999988 |  | | | |
| 1 |  | | | | | |
| 1 |

Back Propagation:

After performing forward propagation, the stochastic gradient descent is applied in order get new weights and biases that better perform according to the loss function

The derivative needed to calculate SGD can be obtained using the chain rule:

Calculating the

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | |  |  | |  |
| 0 | 0 | 0.00216 | 0 | 0 | 1 | 0 | 0.999988 |
| 0 | 0 | 0 | 0.00216 | 0 | 0 | 1 | 0.761594 |
|  |  |  |  |  |  |  | 0.999988 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | |  |  | |  |
| -1 | 1 | 0 | -1 | 1 | 0 | 0.99892 |
| 1 | 0 | 1 | 1 | 0 | 1 | 0.99892 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | | |  |  | | |  |
| 1 | 1 |  | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 0.419974 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 |  | 0 | 0 | 0 | 1 | 1 |
|  |  |  |  |  |  |  |  |  | 1 |
|  |  |  |  |  |  |  |  |  | 1 |

Updates:

Now we have all the data needed to update the weights and biases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | |  | |  |  |
| -0.9989 | -0.9989 | 0.09989 | 0.09989 | -1 | 0.1 |
| 0.9989 | 0.9989 | -0.09989 | -0.09989 | 1 | -0.1 |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | |  | | | | |  |  |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | |  | | |  |  |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |

1. This exercise is similar to the previous one, so the data calculated can be reused. The only results that were changed were:

Forward Propagation:

Back Propagrtion:

By applying this formulas we got:

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | |  |
| -2 | 0.25 | -0.25 | -0.5 |
| 0 | -0.25 | 0.25 | 0.5 |

Updates:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | |  | |  |  |
| -0.4995 | -0. 4995 | 0.04995 | 0.04995 | -0.5 | 0.05 |
| 0. 4995 | 0. 4995 | -0.04995 | -0.04995 | 0.5 | -0.05 |

**II. Programming and critical analysis**

1. Answer 5
2. Answer 6
3. Answer 7
4. Answer 8

**III. APPENDIX**

Paste your programming code here using Consolas 9pt or 10pt.

Use **highlighting** or colored text to facilitate the analysis by your faculty hosts.

**END**