

TC3020 Machine Learning

Assignment 3: Artificial Neural Networks

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September 21st, 2021

Abstract

In this assignment, you will implement the feed forward step of an Artificial Neural Network.

1 Description

Overall goal: Implement the feed forward step of the ANN classifier.

You must not employ specialized libraries (sklearn or similar) to produce your solution; it is ok to employ them to compare though.

You have access to a partially implemented source code for an ANN with support for multiple layers and different number of neurons in each of them. Take your time to study the code and understand its structure. There are four main elements:

- A launcher (launcher.py) that creates some instances of the ANN and runs them. It defines some configurations for θ weights to be used with different datasets.
- An ANN class (ann.py) that implements the core aspects of an ANN. **You will be working in this file.**
- A utils script (utils.py) that defines some functions to read the dataset, plot results, etc.

2 Implementation

- Locate the TODO comments in the ann.py file and implement the required functionality.
- Pay attention to the dimensions of the parameters employed in the functions, so that you can be sure your implementation is returning arrays/values with the proper dimensions..
- **Debug as much as you can** to understand the code flow and identify issues.

The launcher.py file defines some values for the weights, so will be simply using them to calculate activations and overall output.

If you don't modify the weight values you shall see the following values as outputs:

2.1 XNOR dataset

```
[[0 0]] predicted as [[0.99995456]]
[[0 1]] predicted as [[4.54803785e-05]]
[[1 0]] predicted as [[4.54803785e-05]]
[[1 1]] predicted as [[0.99995456]]
```

2.2 Blobs dataset

```
[[ 1 -9]] predicted as [[0.83300159 0.05169803 0.15890068]]
[[-4.  7.8]] predicted as [[0.06609078 0.83433916 0.12536189]]
[[-9.  4.5]] predicted as [[0.10053893 0.120974  0.78689376]]
```

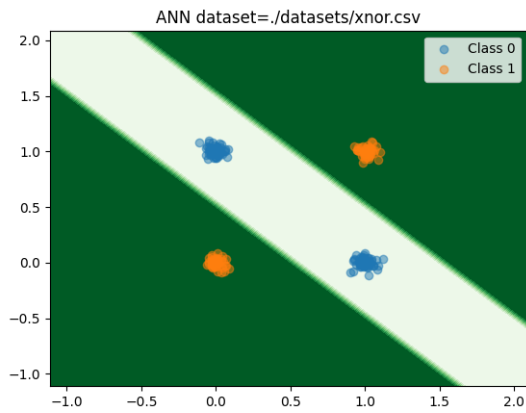
2.3 Moons dataset

```
[[ -0.5  0.5]] predicted as [[9.99988442e-01 1.27034345e-05]]  
[[ 1.  0.5]] predicted as [[9.99993059e-01 8.19801099e-06]]  
[[ 0  0]] predicted as [[5.77226613e-06 9.99993851e-01]]  
[[ 1.5 -0.5]] predicted as [[6.36229133e-06 9.99993249e-01]]
```

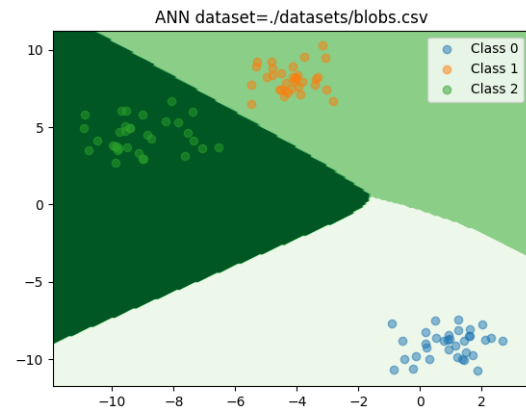
2.4 Circles dataset

```
[[ -0.6 -0.85]] predicted as [[9.99996816e-01 2.99471367e-06]]  
[[ 0.75 -0.06]] predicted as [[1.24458526e-05 9.99986260e-01]]
```

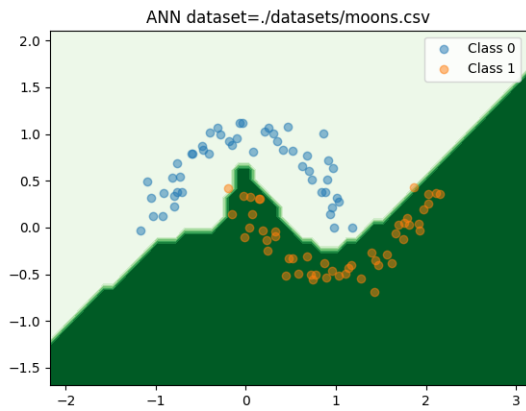
The companion plots would be as shown in Fig. 1.



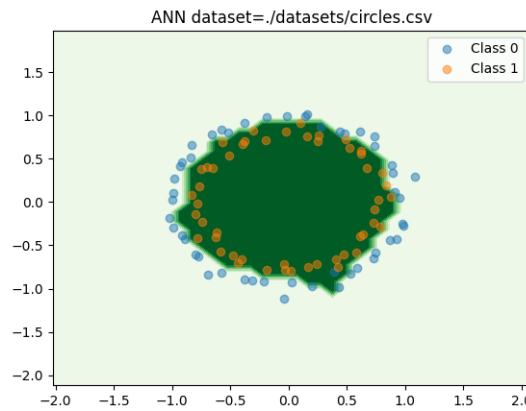
(a) Decision boundary in XNOR dataset



(b) Decision boundary in blobs dataset



(c) Decision boundary in moons dataset



(d) Decision boundary in circles dataset

Figure 1: Expected results for the ANN feed forward implementation

3 Datasets

You are provided with several datasets.

- XNOR problem. This is similar to the example seen in class. As it is a simple, it will help you to perform a quick test of your implementation. Shown in Fig 2a.

- Blobs: Three separable clouds of data, shown in Fig. 2b.
- Moons: Two intertwined moon-shaped sets of data, shown in Fig. 2c.
- Circles: Two data classes nested in circles, shown in Fig. 2d.

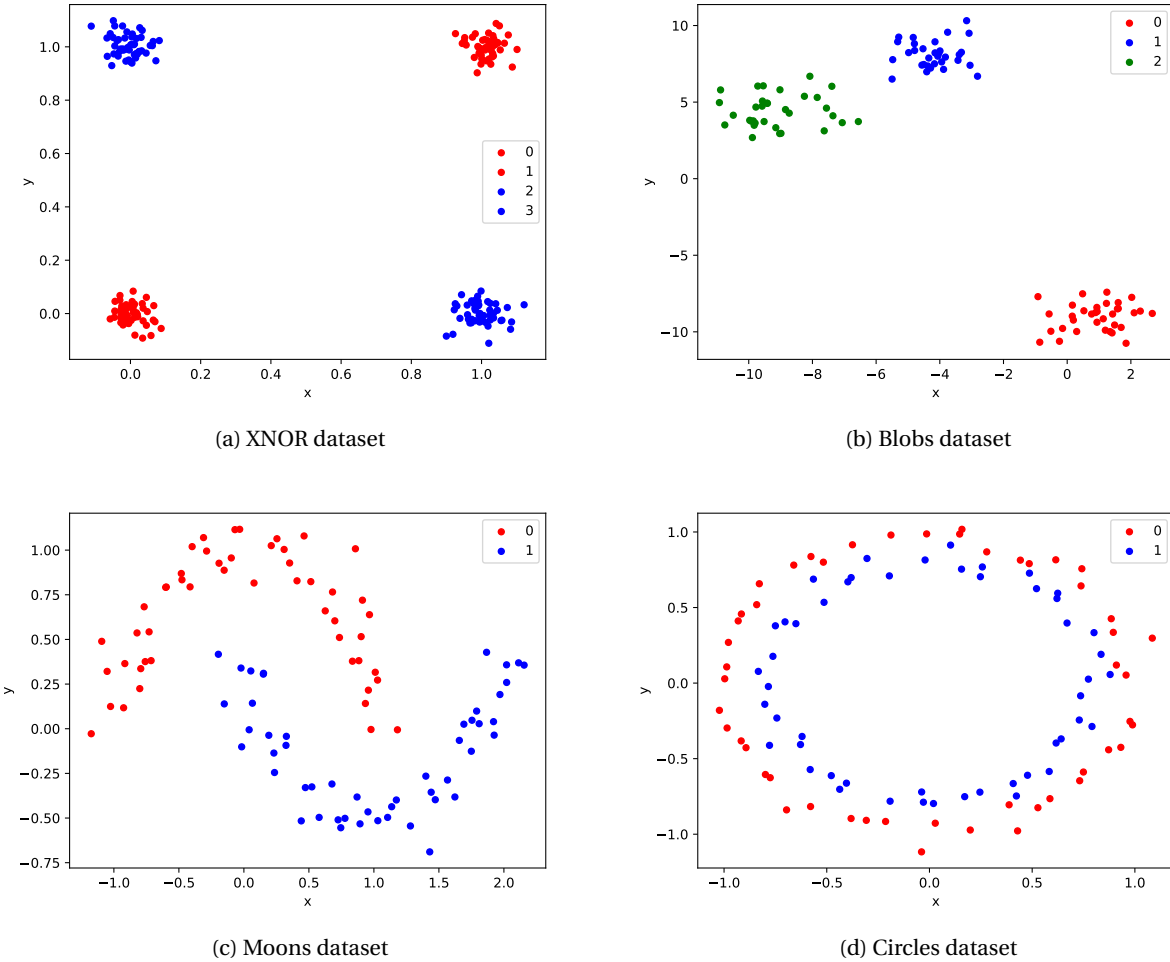


Figure 2: Datasets

4 Further work

Prepare a short report (3 text pages top, could be more with cover, figures), where you present your findings during your implementation. For this assignment, it is sufficient to show that you obtained the same shapes as in the provided plots.

5 Notes

- Your code should be ready to be run by just executing the `launcher.py` script.
- Include everything (even datasets) in your submitted code so that it can be executed straightforwardly.
- **It will be penalized if your code can't be run directly.**

6 Deliverables

- Your implementation as a zip file with the source code.
 - Name your file as A1_A2_A3-HW-02.zip where A1, A2, A3 are the reg number (matrícula) of students.
 - Include the names of team members and student numbers as comments.
- Your report as a PDF.

A single submission per team is enough, there is no need for submitting more than once.