

## Series 2b

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### MLP

We choose to build our Multilayer Perceptron (MLP) using Python and the pytorch library. We build this part of the project as follow :

- In the file `utils.py` we build two classes : a MLP class which represent our Multilayer Perceptron and a `OurDataset` class which we use to build our data set. In this file, there is also a function `train_model` which we use to train our MLP.
- In the file `hidden_neuron_selection.py`, we try to optimize the number of neuron in the hidden layer.
- Then, once we have chosen our architecture, we try to find the best learning rate. This is what we do in the file `learning_rate_selection.py`
- In the file `iteration_selection.py` we try to choose the best number of epochs to build our model.
- Finally, in the file `test.py`, we try to build the best model and we compute its accuracy on the test set.

First, let's focus on the architecture of our MLP. We want to find which number of neuron provide the best result. To do it we try the value 10, 25, 40, 55, 70, 85, 100, 115. So we train these different models using a learning rate of 0.01, and 15 epochs on the training set. After each epoch, we compute the accuracy of the model on the validation set. This gives the following observations :

	10	25	40	55	70	85	100	115
Best accuracy	0.93311	0.95983	0.9665	0.96933	0.97344	0.97677	0.97727	0.977166
Mean accuracy	0.92295	0.95256	0.95897	0.96456	0.96733	0.96924	0.97057	0.970466

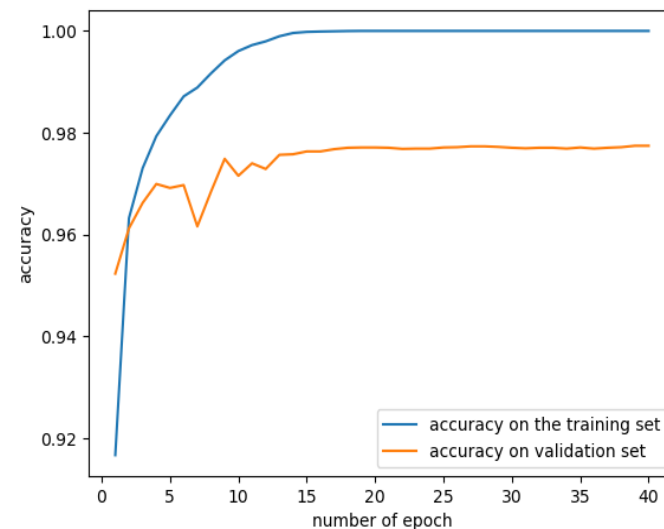
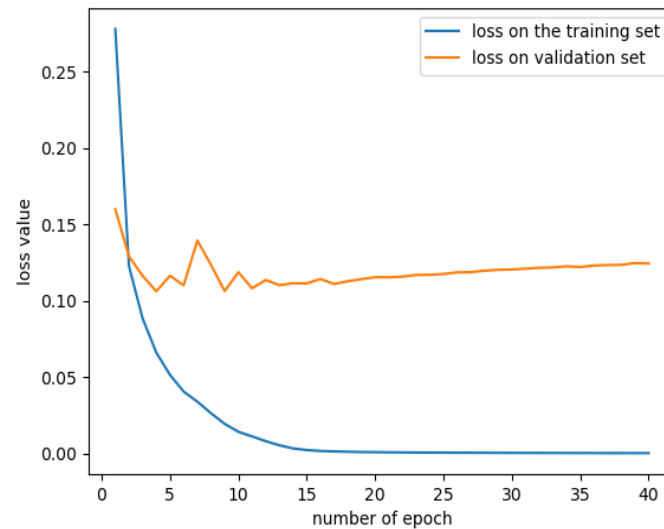
We can observe that the model with 100 neurons provide the best output.

Then, we try to find the best learning rate for our model. We test the value 0.001, 0.005, 0.01, 0.015 using the same parameters as before but instead of 15 we will use 25 epochs. (To be sure that all models have enough iterations to converges to a minimum if it converges). We evaluate our model with these parameters after each epoch on the validation set and we get :

	0.001	0.005	0.01	0.05	0.1
Best accuracy	0.97122	0.97588	0.97661	0.955	0.80738
Mean accuracy	0.95776	0.97112	0.97254	0.9442	0.72297

We can observe that the model with a learning rate of 0.01 provide the best accuracy.

After that, we want to find a good number of epoch to build our model. So, we run our neural network, using 100 neurons in the hidden layer, a learning rate of 0.01 and 40 epochs. And then, we plot the computed accuracy and loss on the train and on the validations set :



We can observe that we are not in a case of overfitting. But after about 20 epochs, the model accuracy does not increase anymore. So we think that 20 is an interesting number of epoch.

Finally, we build our MLP using 100 neurons, a learning rate of 0.01 and 20 epochs. We pick the model which has the best accuracy on the validation set and we test it on the test set. We make this process five times and the best accuracy we were able to obtain is 0.9777222.