進階機器學習 Advanced Machine Learning

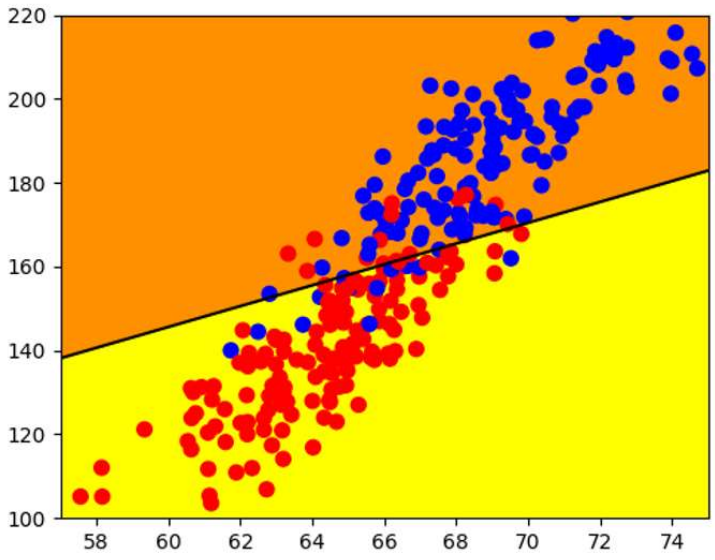
Homework #1
Due 2025 Mar 12 11:00PM

(一) Use the following code to generate a total of 100 two-class two-dimensional data:

```
from sklearn import datasets

circles_data, circles_data_labels = datasets.make_circles(n_samples=100, factor=0.1, noise=0.1)
```

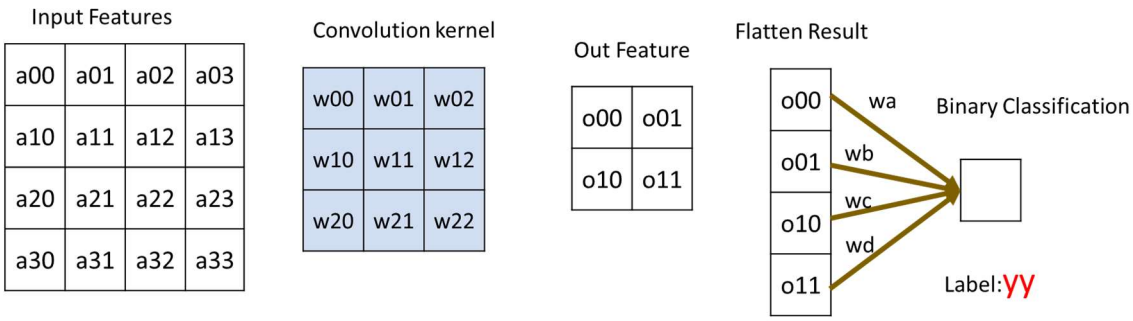
- Divide the above data into 70% training data and 30% testing data sets. Use pytorch to train a neural network which can only consist of full-connected layers which can classify the data. The class of the data is given in the *circles_data_labels* variable.
- Draw all 100 data on the screen as shown in the following figure. You should also draw different background colors for those feature spaces which will be classified into different classes by the proposed neural network.



(二) Consider an input feature map of size 4x4, which passes through a convolutional layer with a 3x3 kernel. The activation function applied in the convolutional layer is the *sigmoid* function. The convolution results are then flattened and multiplied by the corresponding weights. These products are summed, and the result is passed through another *sigmoid* activation function to yield the final classification output. Assume the correct label is *yy*, and the loss function used is *cross-entropy*. Write the detailed steps involved in deriving

1. the gradient of the loss with respect to the weight *w00*

2. the gradient of the loss with respect to the input feature *a21*, as shown in the figure below.



Note:

- Write your program using jupyter notebook. Submit your ipynb file to the cyberspace assigned by TA before the deadline. ***We won't accept the late submission***.
- You can refer the pytorch programming to the following webpage:
  https://hackmd.io/@lido2370/S1aX6e1nN?type=view
  You can also search for more references by your own.