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1. $\because LL(\mathbf{w}) = \sum_{i=1}^{N} y_i \mathbf{w}^T \mathbf{x}_i - \log(1 + \exp(\mathbf{w}^T \mathbf{x}_i))$

$$\therefore \frac{\partial LL(\mathbf{w})}{\partial \mathbf{w}} = \sum_{i=1}^{N} y_i \mathbf{x}_i - \frac{\mathbf{x}_i \exp(\mathbf{w}^T \mathbf{x}_i)}{1 + \exp(\mathbf{w}^T \mathbf{x}_i)}$$

4. Logistic regression on breast cancer Wisconsin dataset

4.1. Algorithm:

4.1.1. Load data from “sklearn.datasets”.

4.1.2. Apply [0, 1]-normalization on inputs (x).

4.1.3. Generate an index with the size of the data, then randomly shuffle the index.

4.1.4. Use the first 1/3 index of data as testing dataset and the last 2/3 index of data as training dataset.

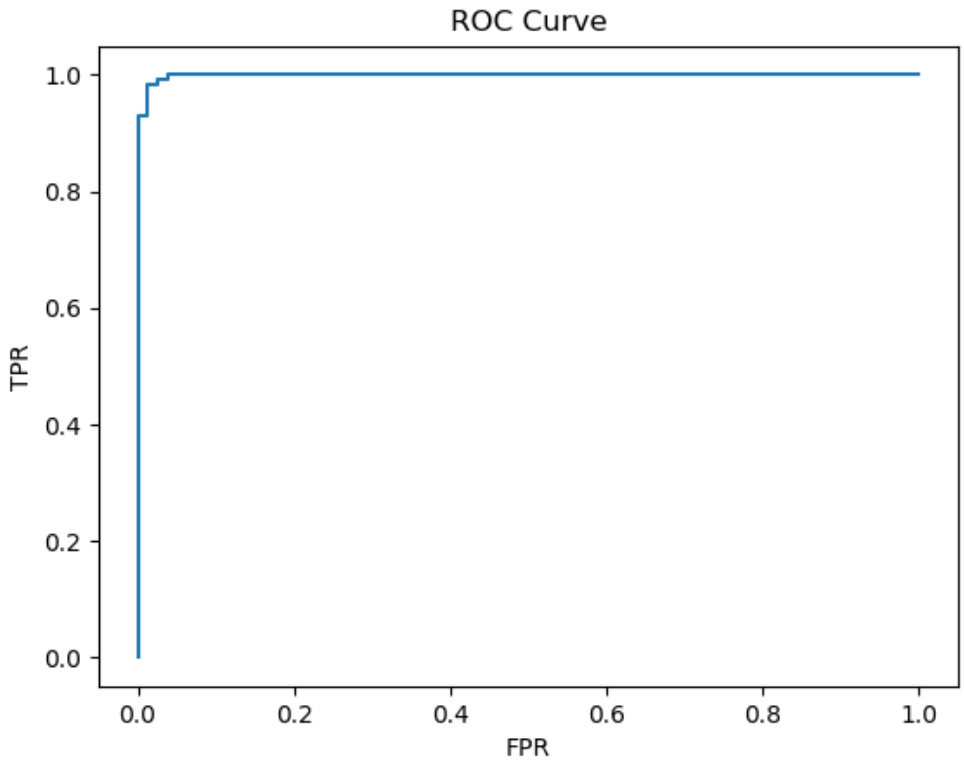
4.1.5. Train the model with $\alpha = 0.1$ and $\|\nabla E(\mathbf{w}_k)\| \leq 0.07$ as the termination rule

4.1.6. Predict the probabilities for the testing dataset.

4.1.7. Calculate the accuracy of the prediction with the threshold 50%.

4.1.8. Draw the ROC curve.

4.2. Result:



Accuracy: 98.41%