ML Algorithms from Scratch

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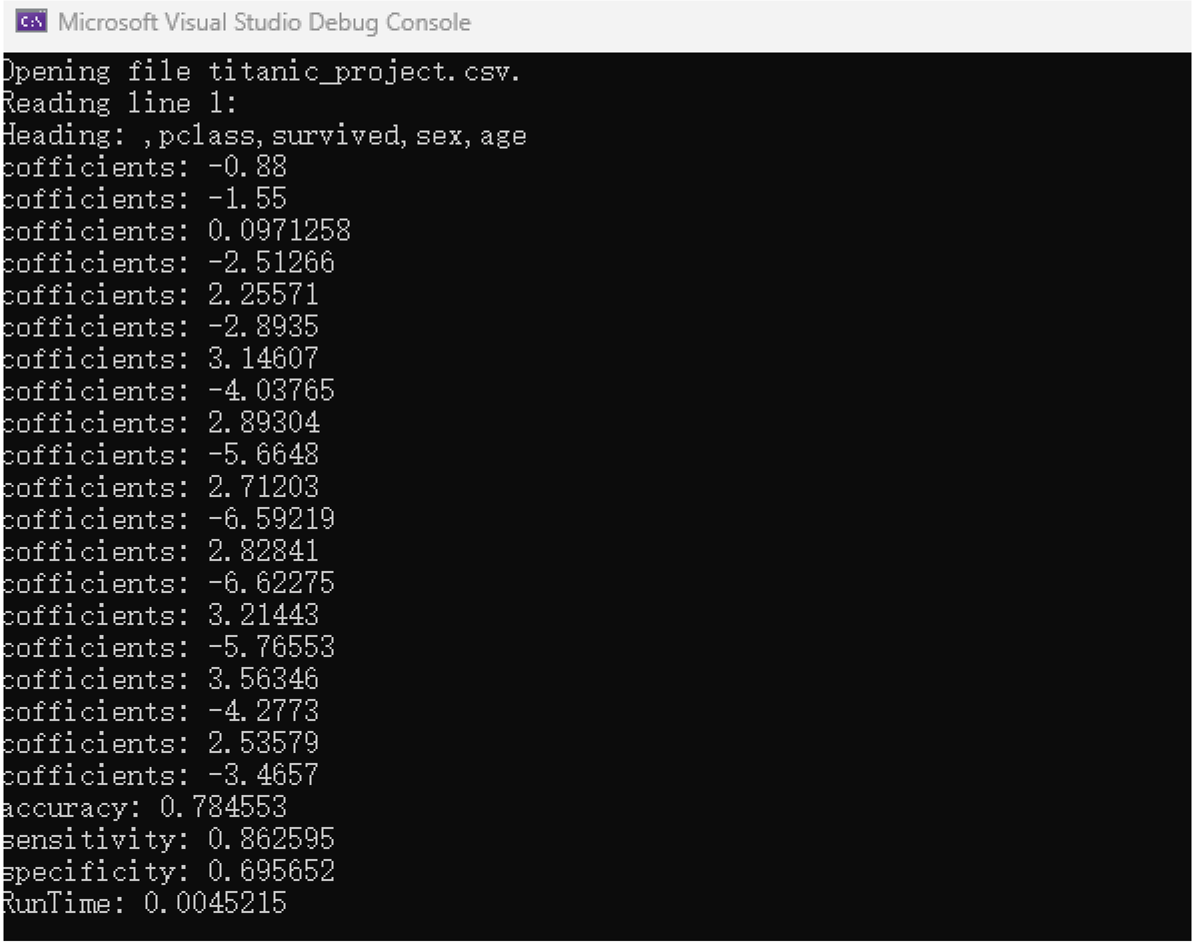
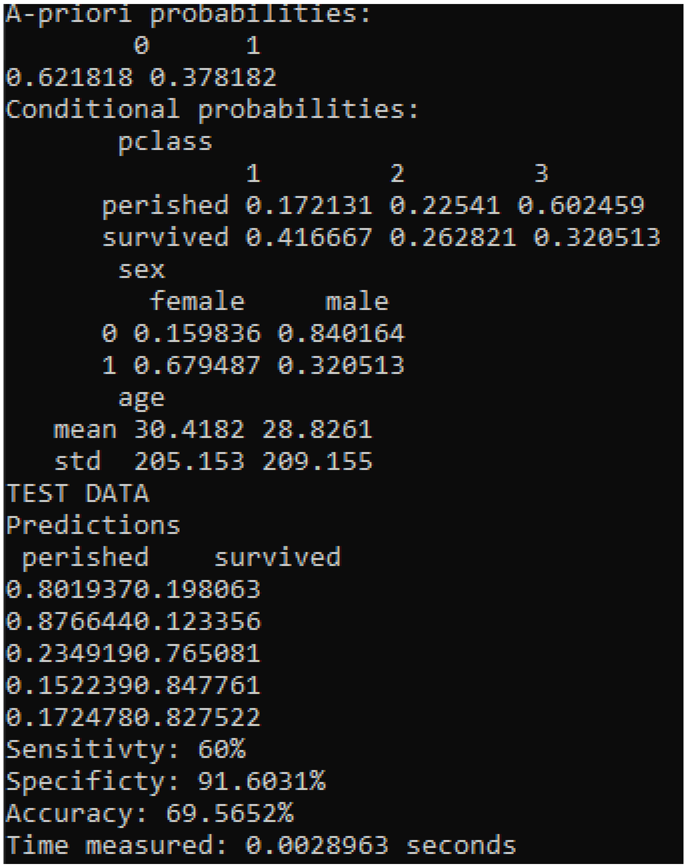
a. Copy/paste runs of your code showing the output (coefficients and metrics), and run times



```
Opening file titanic_project.csv.
Reading line 1:
Heading: ,pclass,survived,sex,age
cofficients: -0.88
cofficients: -1.55
cofficients: 0.0971258
cofficients: -2.51266
cofficients: 2.25571
cofficients: -2.8935
cofficients: 3.14607
cofficients: -4.03765
cofficients: 2.89304
cofficients: -5.6648
cofficients: 2.71203
cofficients: -6.59219
cofficients: 2.82841
cofficients: -6.62275
cofficients: 3.21443
cofficients: -5.76553
cofficients: 3.56346
cofficients: -4.2773
cofficients: 2.53579
cofficients: -3.4657
accuracy: 0.784553
sensitivity: 0.862595
specificity: 0.695652
RunTime: 0.0045215
```

b. Analyze the results of your algorithms on the Titanic data

In the logistic regression, accuracy 0.784553 means that the model is correctly predicting the outcome 78.46% of the time. Sensitivity 0.862595 means that it identifies 86.26% of the positive cases in this dataset. Specificity 0.695652 shows that it identifies 69.57% of the negative cases in this dataset. Total run time of the logistic regression in 10 echoes is 0.0045215.



```
A-priori probabilities:
        0      1
0.621818 0.378182
Conditional probabilities:
       pclass
                1        2        3
      perished 0.172131 0.22541 0.602459
      survived 0.416667 0.262821 0.320513
       sex
         female     male
      0 0.159836 0.840164
      1 0.679487 0.320513
       age
   mean 30.4182 28.8261
   std  205.153 209.155
TEST DATA
Predictions
 perished    survived
0.8019370.198063
0.8766440.123356
0.2349190.765081
0.1522390.847761
0.1724780.827522
Sensitivty: 60%
Specificty: 91.6031%
Accuracy: 69.5652%
Time measured: 0.0028963 seconds
```

In my Naive Bayes model I got an accuracy of 69.5652 percent. This is not the best possible accuracy but overall, 70 percent accuracy is good. This means that 70 percent of the predictions are correct. The sensitivity is 60%. That shows that it can identify 60 percent of the survived cases accurately. The Specificity is 91.6 percent. This is a very good value and means that it can accurately identify 91.6% of the perished values in the data set.The total run time of the model was 0.0015 seconds which is very fast.

c. Write two paragraphs comparing and contrasting generative classifiers versus discriminative classifiers. Cite any sources you use.

Generative classifiers are based on modeling the probability distribution of the data for each class. If a new observation is given to the generative classifiers, it will predict the class that is most likely to have generated a new observation. Naive Bayes is a good example of generative classifiers. It directly estimates parameters for P(Y) and P(X|Y). The strengths of generative classifiers are hard to overfit because they model the probability distribution of the data. The weaknesses of generative classifiers require more data to train the probability distribution for each class.

Discriminative classifiers model the input features to predict the possible classes. It means that if a dataset has specific features, discriminative classifiers can identify other data with those features to predict the possible classes. Logistic regression is one of discriminative classifiers. It directly estimates the parameters of P(Y|X). Discriminative classifiers are capable of handling complex decision boundaries, making them flexible in predicting the possible classes. However, the bad points for discriminative classifiers are easier to overfit if the dataset has limited data.

Citation:
Yıldırım, Soner. “Generative vs Discriminative Classifiers in Machine Learning.” Medium, Towards Data Science, 14 Nov. 2020, https://towardsdatascience.com/generative-vs-discriminative-classifiers-in-machine-learning-9ee265be859e#:~:text=Logistic%20regression%2C%20SVM%2C%20and%20tree,are%20examples%20of%20discriminative%20classifiers.

d. Google this phrase: reproducible research in machine learning. Using 2-3 sources, at least one of which should be academic, write a couple of paragraphs of what this means, why it is important, and how reproducibility can be implemented. Cite your sources using any format.

Reproducible research in machine learning ensures that the algorithm can be executed multiple times on the same dataset, producing identical or comparable results. It is essential for ensuring the validity and reliability of research in machine learning, as it permits other researchers to test, identify and correct potential errors and biases, and develop more sophisticated research based on the findings. According to “*Reproducible Research for Scientific Computing: Tools and Strategies for Changing the Culture*” in this article, it described the concept of reproducibility in scientific research and highlighted the importance of reproducible research in machine learning. It also provides many examples of reproducible research in different fields, including genomics and astrophysics. The author believed that we need to strengthen the standards and guidelines for reproducibility and improve their implementation. For the implementation, we can use github or R notebooks to display code documentation and testing tracking.

Citation:
LeVeque, Randall J., Ian M. Mitchell, and Victoria Stodden. "Reproducible research for scientific computing: Tools and strategies for changing the culture." Computing in Science & Engineering 14.04 (2012): 13-17.
Heil, B.J., Hoffman, M.M., Markowetz, F. et al. Reproducibility standards for machine learning in the life sciences. Nat Methods 18, 1132–1135 (2021). https://doi.org/10.1038/s41592-021-01256-7.