**Naïve Bayes Learning and Learning the KNN Classifier**

**Task 1 Programming and Evaluation on A Small Dataset :**

Given a university’s football game data for the last two seasons, please construct Naïve Bayes classification models to predict game results on games, and evaluate the model performance. Data

* + Each data object (or called instance) is a game. We have three attributes: (1) “Is Home/Away?”, a 2-value attribute (“Home”, “Away”), (2) “Is Opponent in AP Top 25 at Preseason?”, a 2-value attribute (“In”, “Out”), (3) “Media”, a 5-value attribute (“1-NBC”, “2- ESPN”, “3-FOX”, “4-ABC”, “5-CBS”). The label “Win/Lose” is binary (“Win”, “Lose”).
* Training set
  + 24 games. Please use game ID 1-24 to construct classification models.
* Testing set
  + 12 games. Please use your classification models to predict labels of game ID 25-36 and evaluate the performance of the classification models.
* Predictive labels
  + Suppose “Win” is the positive label and “Lose” is the negative label. Keep it in mind when you use Precision and Recall to evaluate the models.

Q1: Programming (**you can implement from scratch, use open-sourced code, or use machine learning platforms**)**:** Use **Naïve Bayes and KNN** to predict labels of instances in the testing set (12 games) based on the training set (24 games). Calculate Accuracy, Precision, Recall, and F1 score on the testing result. This posting discusses the four measurements: https://blog.exsilio.com/all/accuracy-precision-recall-f1-score-interpretation-of-performance-measures/

Q2: Write down the prediction labels of the 12 testing games in the PDF.

Training Data:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ID | Date | Opponent | Is\_Home\_or\_Away | Is\_Opponent\_in\_AP25\_Preseason | Media | Label |
| 1 | 9/5/15 | Texas | Home | Out | 1-NBC | Win |
| 2 | 9/12/15 | Virginia | Away | Out | 4-ABC | Win |
| 3 | 9/19/15 | GeorgiaTech | Home | In | 1-NBC | Win |
| 4 | 9/26/15 | UMass | Home | Out | 1-NBC | Win |
| 5 | 10/3/15 | Clemson | Away | In | 4-ABC | Lose |
| 6 | 10/10/15 | Navy | Home | Out | 1-NBC | Win |
| 7 | 10/17/15 | USC | Home | In | 1-NBC | Win |
| 8 | 10/31/15 | Temple | Away | Out | 4-ABC | Win |
| 9 | 11/7/15 | PITT | Away | Out | 4-ABC | Win |
| 10 | 11/14/15 | WakeForest | Home | Out | 1-NBC | Win |
| 11 | 11/21/15 | BostonCollege | Away | Out | 1-NBC | Win |
| 12 | 11/28/15 | Stanford | Away | In | 3-FOX | Lose |
| 13 | 9/4/16 | Texas | Away | Out | 4-ABC | Lose |
| 14 | 9/10/16 | Nevada | Home | Out | 1-NBC | Win |
| 15 | 9/17/16 | MichiganState | Home | Out | 1-NBC | Lose |
| 16 | 9/24/16 | Duke | Home | Out | 1-NBC | Lose |
| 17 | 10/1/16 | Syracuse | Home | Out | 2-ESPN | Win |
| 18 | 10/8/16 | NorthCarolinaState | Away | Out | 4-ABC | Lose |
| 19 | 10/15/16 | Stanford | Home | In | 1-NBC | Lose |
| 20 | 10/29/16 | MiamiFlorida | Home | Out | 1-NBC | Win |
| 21 | 11/5/16 | Navy | Home | Out | 5-CBS | Lose |
| 22 | 11/12/16 | Army | Home | Out | 1-NBC | Win |
| 23 | 11/19/16 | VirginiaTech | Home | In | 1-NBC | Lose |
| 24 | 11/26/16 | USC | Away | In | 4-ABC | Lose |

Testing Data

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ID | Date | Opponent | Is\_Home\_or\_Away | Is\_Opponent\_in\_AP25\_Preseason | Media | Label |
| 25 | 9/2/17 | Temple | Home | Out | 1-NBC | Win |
| 26 | 9/9/17 | Georgia | Home | In | 1-NBC | Lose |
| 27 | 9/16/17 | BostonCollege | Away | Out | 2-ESPN | Win |
| 28 | 9/23/17 | MichiganState | Away | Out | 3-FOX | Win |
| 29 | 9/30/17 | MiamiOhio | Home | Out | 1-NBC | Win |
| 30 | 10/7/17 | NorthCarolina | Away | Out | 4-ABC | Win |
| 31 | 10/21/17 | USC | Home | In | 1-NBC | Win |
| 32 | 10/28/17 | NorthCarolinaState | Home | Out | 1-NBC | Win |
| 33 | 11/4/17 | WakeForest | Home | Out | 1-NBC | Win |
| 34 | 11/11/17 | MiamiFlorida | Away | In | 4-ABC | Lose |
| 35 | 11/18/17 | Navy | Home | Out | 1-NBC | Win |
| 36 | 11/25/17 | Stanford | Away | In | 4-ABC | Lose |

**Task 2 Programming and Evaluation on A Large Dataset (Titanic):**

Q1: Test your **naïve Bayesian** classification on the **Titanic** dataset. Report the average Accuracy, Precision, Recall, and F1 score of your five-fold cross validation. The five-folds of the Titanic data are split randomly. What do you observe and learn by applying Bayesian learning to small datasets and larger datasets?

Q2: **Implement KNN classification from scratch**, and evaluate how K impacts the overall accuracy of kNN on the dataset. Plot the accuracies of kNN over k, and identify the best K. You can read sample code and try to implement by yourself. Below are some sample implementations from Github for your fast references:

<https://github.com/sagarmk/Knn-from-scratch>

<https://github.com/senavs/knn-from-scratch>

<https://github.com/mavaladezt/kNN-from-Scratch>

<https://github.com/tugot17/KNN-Algorithm-From-Scratch>

<https://github.com/varmichelle/KNN>

**Task 3:**

According to your algorithm analysis, which machine learning model performs better, Naïve Baysian or KNN on the small dataset (football game)and the large dataset (Titanic)?

Additional Questions:

* Approximately how many hours did you spend on this assignment?
* Which aspects of this assignment did you find most challenging? Were there any significant stumbling blocks?
* Which aspects of this assignment did you like? Is there anything you would have changed?

**Please submit a PDF report. In your report, please answer each question with your explanations, plots, results in brief. DO NOT paste your code or snapshot into the PDF. At the end of your PDF, please include a website address (e.g., Github, Dropbox, OneDrive, GoogleDrive) that can allow the TA to read your code.**