2024 Data Mining

HW3

Task introduction

- Anomaly Detection
  - TA use the Letter Image Data features and select 6 letters to form the training set, and randomly add some other 4 letters as outliers in testing set.
  - Implement machine/deep learning model to do anomaly detection.
  - All package is available (sklearn, keras, pytorch etc.).
  - Do not use any pretrained model & Do not use any extra data for training, but it is acceptable to use such data for validation purposes.

- Requirement
  - Upload your submission to Kaggle
  - Submit a report and your source code to E3

- Deadine is 6/21 23:59, no late submission

Dataset

UCI Letter Image Recognition Data Set.

- training.csv
  - Randomly sampled 6 letters(each label is 700) from Letter Image Recognition Data Set.
  - link

- test_X.csv
  - Randomly sample 600 from previous letters, and randomly select 400 other letters.
  - Please use the features to assign weight values to indicate whether each letter is an outlier or not.
  - link

Training Data

lettr	x-box	y-box	width	high	onpix	x-bar	y-bar	x2bar	y2bar	xybar	x2ybr	xy2br	x-ege	xegvy	y-ege	yegvx
B	4	8	6	6	5	9	7	4	6	10	5	6	2	8	6	10
B	1	0	1	0	0	7	7	6	4	7	6	7	1	8	5	9
B	4	8	6	6	8	8	6	4	3	6	7	7	6	11	8	9
B	4	7	6	5	5	8	6	5	6	9	6	7	3	8	7	9
B	9	14	7	8	5	6	8	5	7	10	6	8	6	6	7	9
B	4	7	6	5	5	7	8	5	5	9	6	6	3	7	6	7
B	4	7	5	5	6	8	7	6	6	6	6	6	2	8	6	9
B	4	7	5	5	4	8	6	4	6	9	5	6	2	8	6	10
B	5	10	6	8	7	9	7	3	5	7	6	8	7	8	6	9
B	4	9	4	7	4	6	7	9	7	7	6	7	2	8	9	10
B	3	7	5	5	5	8	8	4	5	7	5	6	4	8	5	8
B	4	10	6	8	7	8	7	4	7	6	6	6	8	8	6	10
B	6	9	8	7	7	7	8	6	5	6	5	6	4	9	7	6
B	4	10	5	8	7	6	8	8	5	7	5	7	2	8	7	9
B	2	3	4	2	2	8	7	3	5	10	5	6	2	8	4	9
B	6	9	8	7	6	10	6	3	7	10	3	7	6	6	7	11
B	6	8	8	7	9	7	6	5	5	8	6	8	7	7	9	6
B	4	10	6	7	7	8	7	6	5	7	6	6	6	8	6	10
B	3	6	4	4	5	7	7	6	5	7	6	6	2	8	6	10
B	7	11	9	8	8	10	6	3	6	10	3	7	5	7	6	11
B	4	9	6	6	6	6	8	7	4	7	5	6	4	8	5	6
B	4	9	4	7	5	8	8	8	6	7	5	7	2	8	7	9
B	3	7	3	5	3	6	8	8	6	7	5	7	2	8	9	10
B	2	6	4	4	3	8	8	5	7	7	6	6	2	8	6	9

All features are given.

Testing Data

x-box	y-box	width	high	onpix	x-bar	y-bar	x2bar	y2bar	xybar	x2ybr	xy2br	x-ege	xegvy	y-ege	yegvx
3	11	4	8	2	1	13	5	4	12	10	7	0	8	3	6
4	10	5	7	3	5	10	9	4	7	4	8	3	7	6	11
5	9	6	5	3	10	3	4	6	12	4	10	3	8	7	10
4	6	6	6	6	6	9	5	3	6	4	8	7	8	4	9
4	6	6	4	4	10	6	7	5	6	7	4	8	5	2	5
4	5	4	8	2	1	14	5	4	12	10	6	0	8	2	6
4	6	4	4	3	7	6	9	7	7	7	7	2	8	8	9
4	9	5	7	4	7	7	3	12	9	6	8	0	8	8	8
8	12	8	6	4	10	6	3	9	9	2	5	4	6	4	10
4	10	5	8	4	6	10	6	5	9	7	3	2	10	4	7
6	7	8	5	5	7	8	2	7	10	5	9	4	7	3	7
7	9	8	4	3	5	9	3	4	13	9	9	5	8	0	8
7	12	6	6	3	8	9	7	5	14	4	4	4	10	4	7
5	10	7	8	4	7	7	3	11	11	6	8	1	8	7	8
3	8	3	6	3	7	7	12	1	6	6	8	5	8	0	8
4	9	6	6	7	9	6	4	4	6	7	7	7	9	8	6
2	8	3	6	2	2	11	4	5	11	10	8	0	8	2	7
2	4	4	3	2	6	7	2	7	11	7	9	2	8	4	8
6	10	9	7	7	8	7	5	6	9	5	6	3	7	7	10
3	4	4	6	3	6	9	9	8	7	5	7	2	8	9	10

No lettr attribute, use it to predict it is outlier or not!

Attributes Description

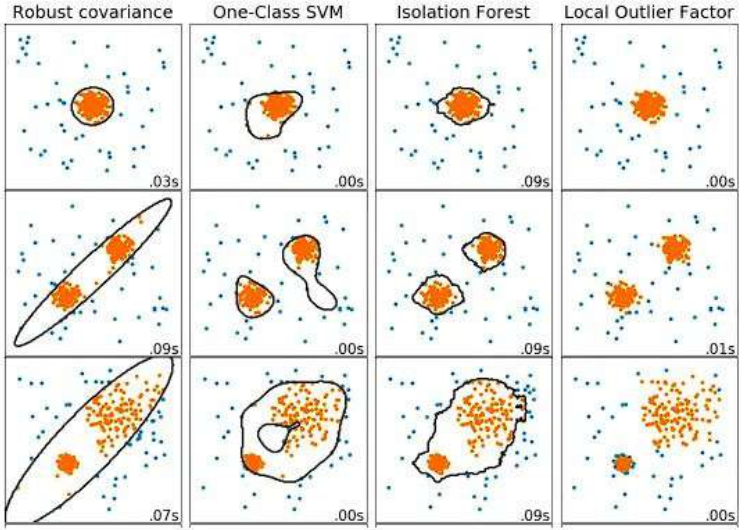
- lettr capital letter (26 values from A to Z)
- x-box horizontal position of box (integer)
- y-box vertical position of box (integer)
- width width of box (integer)
- high height of box (integer)
- onpix total # on pixels (integer)
- x-bar mean x of on pixels in box (integer)
- y-bar mean y of on pixels in box (integer)

Attributes Description

- x2bar mean x variance (integer)
- y2bar mean y variance (integer)
- xybar mean x y correlation (integer)
- x2ybr mean of x * x * y (integer)
- xy2br mean of x * y * y (integer)
- x-ege mean edge count left to right (integer)
- xegvy correlation of x-ege with y (integer)
- y-ege mean edge count bottom to top (integer)
- yegvx correlation of y-ege with x (integer)

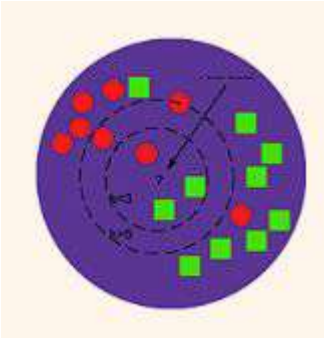
Method 1 - SVM

- Use OneClass SVM to learn a decision boundary.
- Find the suitable kernel space and parameters to fit the data.
- Convert the result of classification to the self-defined value.



Overview of outlier detection methods

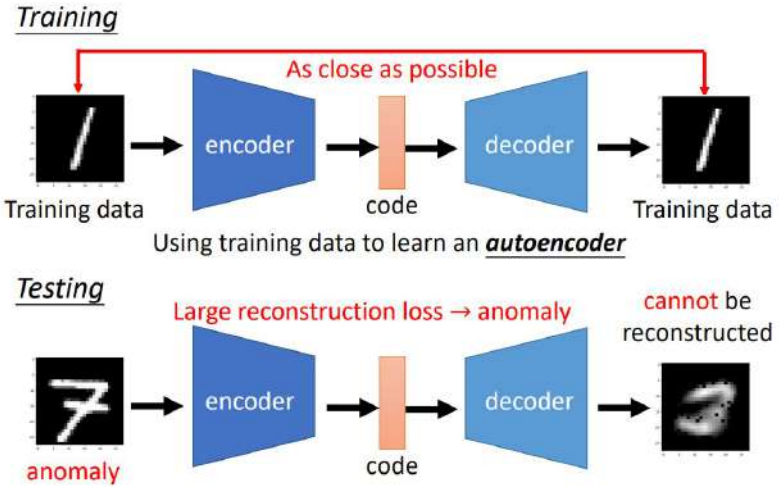
Method 2 - KNN



- Assume that there are n clusters in training data.
- Assume that n is a small value
- Using K-means to calculate the n centroids of training data. Then use these n centroids to cluster the testing data.
- In the same cluster, the distance between inliers to centroid must smaller than the distance between outliers to centroid.
- We can take the distance to centroids as the weight value for prediction.

Method 3 - Autoencoder

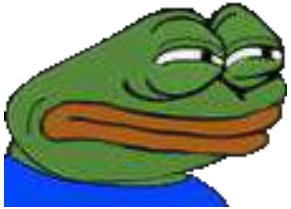
- Using training data to train a AE or VAE
- Because the outliers cannot be reconstructed well, the MSE of outliers must greater than inliers.
- We can take the reconstruction loss as the weight value for prediction.



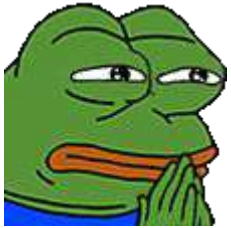
Methed 4 - Any reasonable way you can think

The key point is to make objects within the same group as similar as possible, and keeping those in different groups to be as dissimilar as possible.

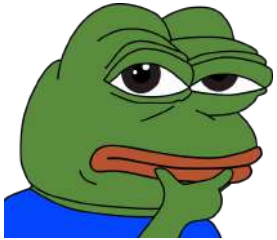
HW3? No way!



No restrictions?



Let me think...



Ah, ha!

Compactness & Separation

Kaggle Submission

id	outliers
0	3.865861106
1	1.564198455
2	1.427000115
3	1.1940908
4	2.475497267
5	-0.0849644

- Kaggle link
- Display team name : <student ID>
  - team name error : -5%
- Submission format
  - A 1001*2 .csv file, index start from 0. Outliers are any weight values that you define.(MSE, F1Loss, distance etc.)
  - Column name must be id and outliers.
  - sample submission
- There are one simple baseline and one strong baseline, beat them to get the higher score.

Kaggle Submission

- You can submit at most 5 times each day.
- The scoring metric is auc score.
- You can choose 2 of the submissions to be considered for the private leaderboard, or will otherwise default to the best public scoring submissions.

Report Submission

Answer the following 3 questions:

1. Explain your implementation which get the best performance in detail.
2. Explain the rationale for using auc score instead of F1 score for binary classification in this homework.
3. Discuss the difference between semi-supervised learning and unsupervised learning.

Please answer the question in detail !

Grading policy

- Kaggle (70%)
  - Basic score:
    Over strong baseline : 55
    Over simple bassline : 40
    Under simple baseline : 25
  - Ranking score:
    15-(15/N)*(ranking-1), N=numbers of people
  - Final Kaggle score depend on 30% public leaderboard 70% private leaderboard

- Source code and report (30%)
  - 10% for each quesiton

E3 Submission

Submit your source code and report to E3 before 6/21 23:59.

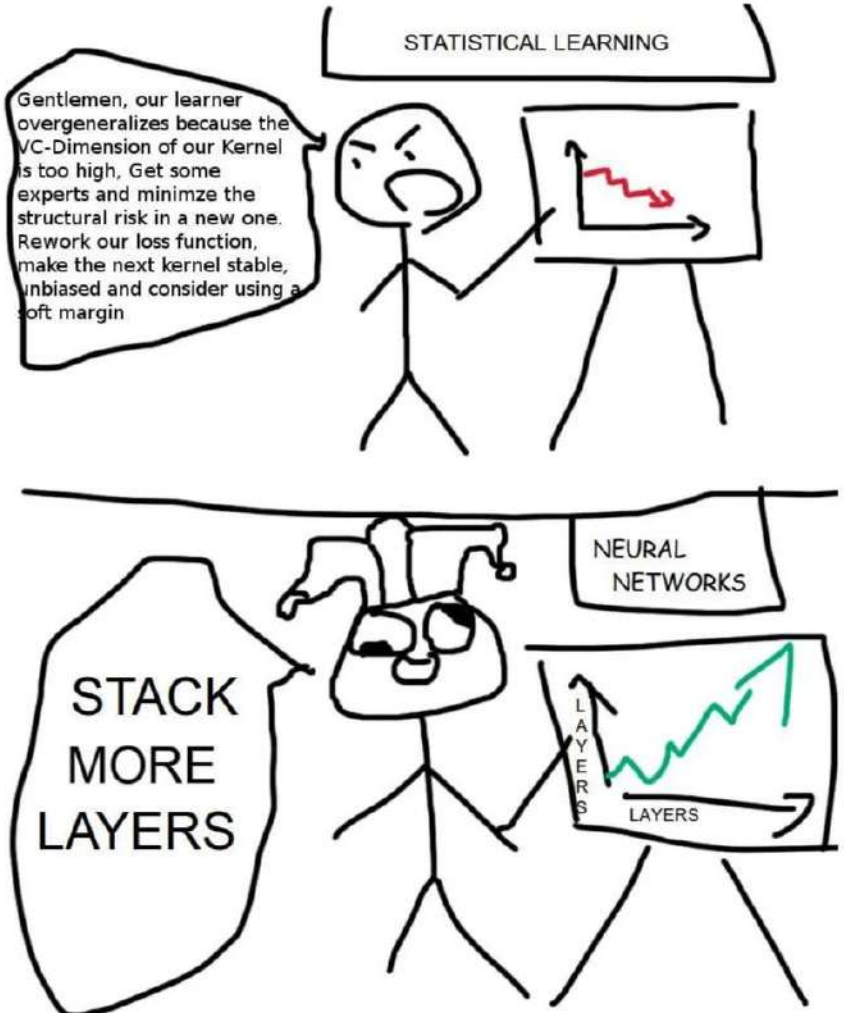
No late submission !

- Format
  - source code : HW3_<student ID>.py or HW3_<student ID>.ipynb
  - report : HW3_<student ID>.pdf

If you have any question about HW3, please feel free to contact with TA: GUAN-YI HO

through email joy861106.cs11@nycu.edu.tw

Take Easy


STATISTICAL LEARNING
Gentlemen, our learner overgeneralizes because the VC-Dimension of our Kernel is too high, Get some experts and minimze the structural risk in a new one. Rework our loss function, make the next kernel stable, unbiased and consider using a soft margin
NEURAL NETWORKS
STACK MORE LAYERS
LAYERS
LAYERS