What can Machine Learning do on course evaluation?

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BREIF INTRODUCTION:

In our campus learning life, most of the hard working students are taking serious care of their grades. And acquiring a fully understand of the course will be important to decide if the student will succeed.

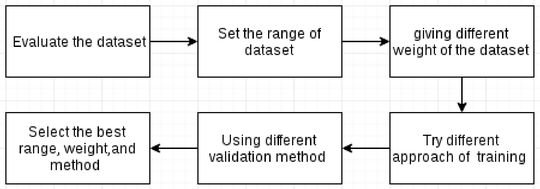
Though listening to the former students' advice will be an acceptable way, the advice from them will be subjective.
Therefore We believe that well-designed machine learning methods with training sets can be better in giving students a complete overview of the course , and also help students gain confidence by helping them predict their grades

OUR GOAL:

Our project is designated to help students predict their grade and give a clear understanding of the courses hard-level by using **machine learning technique** both in a large scope and in person.

Also, by given the basic education idea, we want to find out students attitudes toward the whole class by finding the potential lazy student

METHOD:



First, we want to evaluate the dataset with different statistical technique. We want to find the possible setback, or difference, or variance of the different feature of the exam.
Second, we want to train the set with different range of data, since our project is focus on its functionality to students, different student has a different progress of course, we need a method to select different range on the training set by the grade giving by student and get best fitting result.
Third, In the feature, some homework might not affect the grade of totally at all for its irrelevantly. And we only extract the most -important feature of the student
Forth, we need to try different method by take a deep analyze of the graph, and comparing the result by using different validation method. For example, we need to explore the fundamental difference between svm, knn or linear regression, we will try to find the best -fitting method for the course
Fifth, multiple- fold validation is an important way to test the data, however how many fold to choose might be an important work to work on.Also, choosing the test, valid, and train data set

ANALYSIS RESULT:

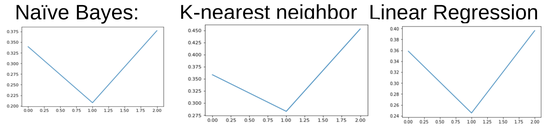
exam prediction:

We are using 12 homework grade to predict the overall final/midterm grade, which is four class composed of 4 labels "1, 2,3,4" represent for 4 types of grade based on students grade's standard deviation,

label = 1	if grade>mean+std
label = 2	If mean+std>grade>mean
label = 3	if mean>grade>mean-std
label = 4	if mean<grade-std

Prediction with different method :

Naïve Bayes: K-nearest neighbor Linear Regression



These 3 graph represent for 3 different method (KNN,NB,and linear regression) , three vertices in the graph represent for the First, Second, and Final midterm result,

K-NN : predict with nearest data-set in distance

in this case, it will predict the student with other student that has a similar homework score which already occur in the training data

Naïve-Bayes: assume that each homework singly account a percent of the prediction without considering the interactions with each other

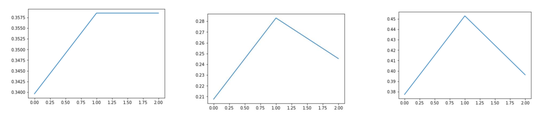
Linear Regression: assume that the prediction of the exam can be examined by using a specific weight of each-homework, by adding 4-multiple threshold- labels will be predict by using Y=F(X).

Analysis result:

second midterm has least clear relationship(linear or non-linear) with MP grade meaning that there is a great randomness in second midterm's grade.
And so we believe that second midterm poorly reflect students' daily hard-work!

Exam Relationship :

First-midterm Second-midterm Final-exam



We believe that no matter what exam it is, most of the exams don't represent a strong confidence on linear relationship, which means **that student that study hard on homework, will have a high chance not be able to get a good grade on the exam**, rather than, **most of the students get similar grade may have similar result no matter what the grade is!**

DEEP LEARNING EXPLORATION

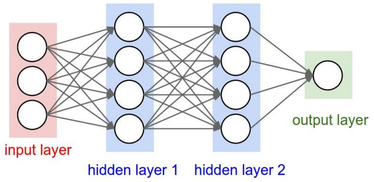
Background:

As we know, Deep learning nowadays are widely used for its swiftness in making complex relationships. Since the prediction rate for classical machine learning method is lower than we expected, we believe that Deep-learning method can develop better model , find the possible correlation between homework and student's mid term grade.

Architecture:

Neural networks are consisting of different layers. Each layer preforms an operation of multiplying with weights and addition with biases. Tune the weights and bias properly can have model learn the features.

5 layers with varying dimensions, producing the output layer of 4 classes. The label should be "1,2,3,4" which is same as previous machine learning method



Training time	Accuracy
1000	0.41
5000	0.46
10000	0.79

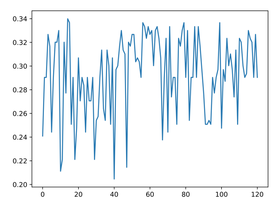
Observation:

We can see that the accuracy from deep learning do get lots more higher than normal machine learning technique, Our best guess is because homework 's grade do have a deeper convolutional relationship with the final exam.

MPs correlation with Finals

We want to analysis which homework matter the most with the final exam. since it is deep learning, we do not worry about what exactly is the relationship(mostly convolutional) ,

Therefore, we decide to only take two of the features , by taking randomly for more than hundred of time, we believe that we could find the most/least important homework related to exam grade

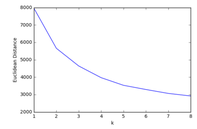


X axis represent for different combination of homework, Yaxis represent for the predict accuracy, as we can see, the prediction are tend to be more stable on the right side, which is mostly composed of homework that later in the semester

The highest point occur at the middle, however, accuracy rate is not the only thing we are looking for here, we want to see how the Accuracy fluctuate as homework feature changes. With Higher fluctuation , comes more unstable relationship, Therefore , we believe that **homework in the second half semester influence students grade more.**

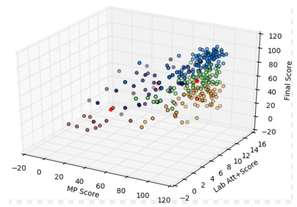
UNSUPERVISED LEARNING

Use K-means clustering method to partition students into different kinds. We used MP score, lab attendance and score, and exam score as three features. As we increases the k, the Euclidean distance between data and cluster points will change as figure below.



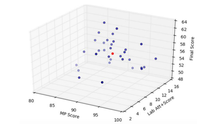
When k = 1 & 5, the decrease of distance slows down.
It indicates when 5 is the best value.
(k=1 is not considered)

K=5, 3D Scatter plot of features. Different colors means students are in different label and red point is the center point. We concentrate on the students whose mps and labs are high but exams are low.



mp	78.22	90.74	78.24	88.71	90.72
lab	9.32	12	12.29	3.2	13.04
exam	65.78	54.81	54.94	71.47	67.90

The table records five center scores, the second data set is our focus.



We use k(3)-means clustering on those student again to partition 32 students who have very high MP and lab scores but extremely low exam scores. We believe they have bad learning attitude.
As we know, mp can work as partners, which means a student can do nothing but get whole credit. We believe this policy will drive some students to become lazy and have bad learning attitude.

CONCLUSIONS

Upon the above researching, Though the prediction rate is still lower than we thought because of many highly unstable factor .For example, student's attitude toward the course may not be the same throughout the course, also homework scores may not only depend on hard-working , too . We still found many interesting result that we have never seen/ known before from anyone about this course. **We strongly contend that Machine learning methods can not only help course coordinators and associated educators design the course exams ,homework with better ranking mechanism, but also let student acquire a more-round view of the course**. Both of them , we believe, are very important on students ' success in college.

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