

## Introduction

- **Objective:** Improving student motivation, engagement and performance through competitive active learning.
- **Why?:**
  - To motivate students to think outside-the-box.
  - To increase student participation.
- **How?:**
  - By creating an online tool, called Competitive Learning Platform (CLP).



## Research Questions

- Do students feel comfortable and have a positive attitude towards a competitive active learning approach?
- Through competitive active learning, are students encouraged to innovative and try different solutions?
- Does competitive active learning have a significant impact on student performance?
- Does student performance depend on how engaged/active they are in the class?

Class	Subject	Session	# Students	G/UG
CMPE-239	Data & Web Mining	Sp 2017	27	G
CMPE-139	Data & Web Mining	Fa 2017	23	UG
CMPE-255	Data Mining	Fa 2017	34	G
CMPE-255 (01)	Data Mining	Sp 2018	30	G
CMPE-255 (02)	Data Mining	Sp 2018	34	G

Fig1: Classes and Student Distribution in Initial Study

## Assessment Data:

- Conducted survey and obtained student feedback on CLP.
- Both negative and positive questions.
- 10 closed-ended and 4 open-ended questions

## Closed-ended Questions

1 I would prefer to use a competitive learning platform for my homework assignments.	+
2 I found that the leader board function in the CLP discouraged me from trying to improve.	-
3 I thought the CLP system was easy to use.	+
4 I hope I never have to compete in a homework assignment again.	+
5 The CLP leaderboard function motivated me to try my best.	+
6 I found the CLP system unnecessarily complex.	-
7 I would imagine that most people would learn to use the submission system in the CLP quickly.	+
8 I found the information provided by the CLP was insufficient.	-
9 The personal submissions table and graph summary were helpful to gauge my progress.	+
10 I found the personal submissions graph for a given assignment unhelpful.	-

Fig2: Closed-ended questions in the survey

## Introduction

Open-ended Questions				
1	What were the most useful features of the CLP? Why?	+		
2	What were the downsides of using the CLP systems? Why?	-		
3	How, if at all, did you approach solving a CLP homework assignment in a different way than you would have approached a normal homework assignment?	+/-		
4	Did you choose to display leaderboards before submission deadlines? If you could go back to the beginning of the semester and change your choice, would you? Why or why not?	+/-		

Fig 3: Open-ended questions in the survey

Question	5	4	3	2	1	Question	5	4	3	2	1
Q1	75	36	21	10	6	Q6	77	27	12	15	17
Q2	69	30	20	18	11	Q7	91	41	8	5	3
Q3	95	42	7	3	1	Q8	59	38	28	14	9
Q4	60	29	31	19	9	Q9	84	46	11	5	2
Q5	67	43	21	10	7	Q10	89	31	16	8	4

Fig 4: Summary of Response to Closed-ended Questions

- Responses to the open-ended questions are used to perform **sentiment analysis**.
- Submission data containing the history of each submission, including the student ID, time of submission, and the performance result corresponding to the submission are used for **numerical analysis**.

## Competitive Learning Platform (CLP)

- Engages students in active learning through peer contests.
- Developed with an aim to motivate students and promote student engagement.

### Detailed Description:

A practical application in e-commerce applications is to infer sentiment (or polarity) from free form review text submitted for a range of products. For this assignment, you have to implement a k-Nearest Neighbor Classifier to predict the sentiment for 25000 movie reviews provided in the test file (test.dat). *Positive sentiment* is represented by a review rating of +1 and *negative sentiment* is represented by a review rating of -1. In test.dat you are only provided the reviews but no ground truth rating. These data will be used for comparing your predictions. Training data consists of 25000 reviews as well.

Fig 5: Sample Assignment

- Students submit their assignment results in CLP on-line portal.
- Given evaluation score on part of the test data in real time.
- Final accuracy is computed using entire test data.
- Given evaluation score on part of the test data in real time.



Fig 6: Competition Leaderboard, Class Score Distribution & Personal submissions

## Competitive Learning Platform (CLP)

### Components of Particular CLP Dashboard:

- leaderboard with the top three current scorers in the class plus their best score and rank,
  - a graph displaying the class score distribution,
  - a graph displaying the trend of personal submissions, and
  - a table containing all the submissions of the student and corresponding scores.
- CLP provides an option to not display the competition leaderboard to reduce potential stress.
  - If not chosen, can attempt to improve their own scores, without competing with peers.
  - CLP system open for entire duration of the assignment.
  - 5 submissions per day.
  - Extra credit points awarded to the students with top 3 scores.

## Experimental Results

- **Do students feel comfortable and have a positive attitude towards a competitive active learning approach, or do they feel that it is demotivating?**

- Mean sentiment of most students is positive.

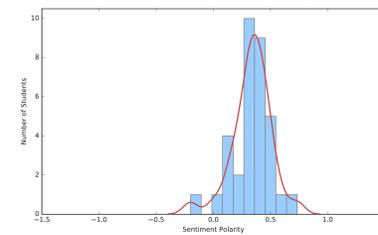


Fig 7: Sentiments of the Students (CMPE 255)

- CMPE-139 has the most students with negative sentiments, as it was an under-graduate course but followed the majority of the content of the equivalent graduate course.

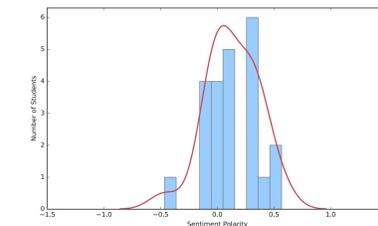


Fig 8: Sentiments of the Students (CMPE 139)

- 107 students opted for the CLP leaderboard and only 2 of them wished to change their decision.
- Positive sentiment of students towards the competitive leaderboard feature of the CLP system.

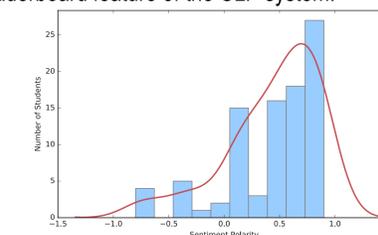


Fig 9: Sentiments for Q4 (Chose to display)

## Experimental Results

- **Through competitive active learning, are students encouraged to innovative and try different solutions?**

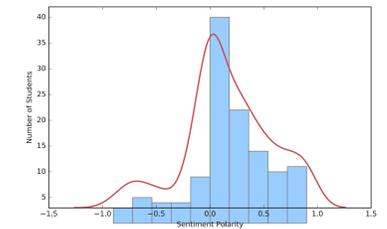


Fig 10: Sentiments for Q3 (Innovative Thinking)

- Encourage thinking outside-the-box.
- Majority of students saw competitive assignments as a positive addition to the course curriculum.
- **Does competitive active learning have a significant impact on student performance?**

Class	Best Score	Improvement	Grade
Homework-1	0.419347 (33)	0.627656 (33)	0.314100 (33)
Homework-2	0.321742 (38)	0.576598 (38)	0.274715 (38)
Homework-3	0.334773 (37)	0.578663 (37)	0.358696 (37)

Fig 11: Average Submission Correlation for CMPE 255

- Aid student performance by encouraging them to engage more in learning activities.
- As a student engages more, they will perform better.
- Pearson correlation coefficient between the average number of submissions and student best scores, score improvement, and grades.
- The number of submissions is a strong indicator of performance improvement over the life of the assignment, denoting strong student engagement in the course.

- **Does student performance depend on how engaged/active they are in the class?**

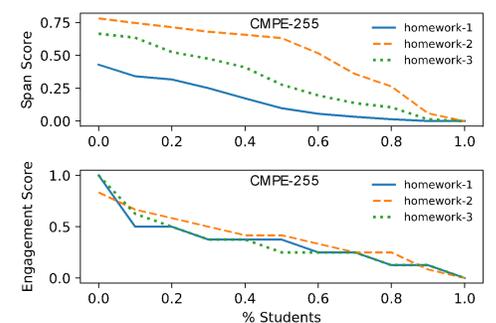


Fig 12: Submission Span Score and Daily Engagement Distributions)

**Engagement Score** = # days submitted / total days  
**Span Score** = (last day – first day) / total days

- High engagement score values indicate continued student engagement.
- High submission span score values indicate higher improvement in score and thus increased performance.