A Career Simulation of Politecnico Students

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ABSTRACT

Nowadays, the simulation environment has a central role to mimic behaviours or discover some hidden patterns. In this report, we explain how to reproduce Politecnico students' career, using some assumptions and a model of student to take the decisions for their career.

Methods

The primary focus on this report is on model of the student. We aim to assess the decision maker based on defined metrics, for a "smart" student object ables to choice the best way depending on the time and the vote received by the exams.

A. Assumption on student background

The simulator uses a parameter to have an idea about the preceding academic level of students, the bachelor vote of the previous career. This parameter is synthetically generated from a uniform distribution, $U \sim [18-30]$. The bachelor vote has a role in the next steps of the simulation, to understand what is the satisfaction level when a student is introduced into the system and participates in the initial session.

B. Improvement theory

In the simulator is implemented a system for which the student tends to improve himself, then an important hypothesis is done to implement the student's commitment to improvement. In the Figure 1 is illustrated a redefined linear function with a different output range. The input domain of the function is defined as the difference between the information taken by the previous exam and the grade obtained by new one. The output has the range among $[0-0.2]$, half value of the maximum function of the Figure 1. This value is used to modify the vote taken, reflecting the student effort to improve their performance. The degree of this improvement depends on the preceding vote taken, and is an indicator of how much the student is able to have an higher vote.

C. Model of the student

First of all, we have to understand which assumptions there are behind the model of the student. In particular, this model has a number between $[0-1]$ given by the sum of 3 main metrics.

The first metric represents the level of inactivity during the study session, operating under the assumption that students with more available time tend to engage in less activity. The metric is randomly generated from a uniform distribution $U \sim [0-0.2]$ The chosen value correspond to 20% of the overall cumulative score, a higher value picked by the uniform distribution correspond to a high level of inactivity.

The second metric is made applying a linear mapping function illustrated in Figure 1. The satisfaction level is given by the information of the preceding exam grade and the new one, in this way, we provide an indication of the student's motivation. The range domain of the function is given using the difference of these 2 votes. Specifically, in the worst-case scenario the maximum value of this difference is 12, considering the maximum of the previous vote and the minimum for the new vote. Additionally, we account also the inverse scenario, for which the new vote represents the maximum and the preceding considered vote is a minimum. The mapping function has a maximum value of 0.40 and constitutes 40% of the overall score.

The third metric, shown in Figure 2, uses a mapping function that takes as input the academic year of the student and produces as output a satisfaction time value. As the previous metric, the mapping function has a maximum value of 0.40. The behavior of the function is characterized by a decreasing trend. When the academic year increases and reaches the $7th$ year, the function returns a constant value 0.26 at which point it stabilizes and maintains a constant output value of 0.26. This output, as the previous metric, corresponds to another 40% of the overall score.

The sum of these three metrics collectively serves as a decision maker to understand if the best choice is to accept or reject a student's exam score. Employing the formula $1-(sumthreemetrics)$, a higher sum indicates a greater level of satisfaction. In practical terms, a higher satisfaction level makes it more likely for the student to reject the exam score, as it suggests they possess a satisfactory level of confidence and preparedness to retake the exam.

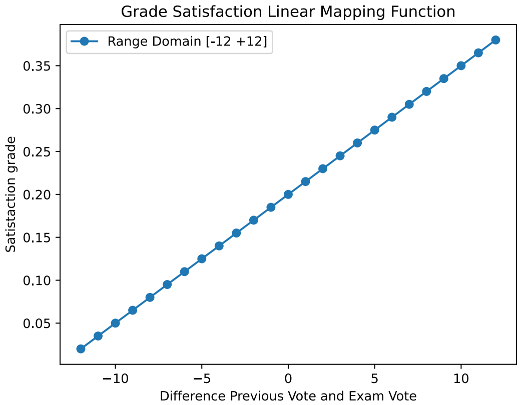

Figure 1: Grade Satisfaction Function

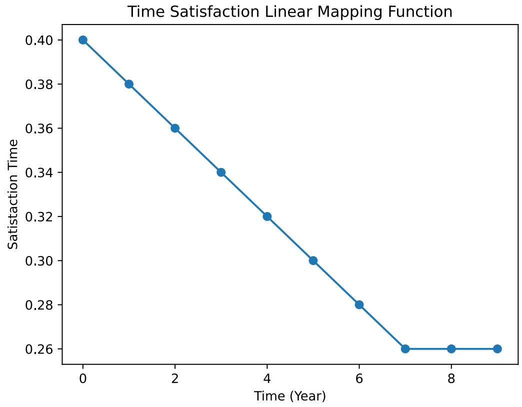

Figure 2: Time Satisfaction Function

Results

The following simulation is run using : $numberCourses = 10$, $numberStudents = 10$, $sessionsPerYear = 3$, $examsPerSession = 3$, $meanExamAttempts = 2$, $passExam = 0.8$, $confidenceInterval = 0.9$, $accuracy = 0.95$, $seed = 12$.
In Figure 3, to complete a MSc in the Politecnico of Turin, a a student employs on average 3 year and 1 session. This result has enough compatibility with real-world expectations.
The number of exams rejected and the corresponding probability of failure are defined respect the graduation time, shown in Figure 4 and 5. It is evident that with an increase in graduation time, there is a discernible trend in which students reject fewer exams. Despite this trend, it is noteworthy that the absolute number of rejections remains relatively high. This suggests that students understand the increasing importance of completing the course promptly and, consequently, prioritize finishing over rejecting fewer grades.
In Figure 6, a noticeable decrease in the final average score is observed. However, it is crucial to acknowledge that this behavior is closely correlated with the underlying assumption that as more time passes, students are increasingly likely to accept every grade they receive.
In Figure 7, we define the final score, taking into account the thesis, its presentation, and additional points. These new variables follow a continuous uniform distribution: $U \sim [0-4]$ for the thesis and $U \sim [0-2]$ for the presentation and extra points. If students achieve a score of more than 112.5, they will graduate with honors ('Lode'). Upon observing the graphs, it is apparent that, to attain a higher final grade, students tend to spend less time. This phenomenon may be attributed to a strong initial academic background, lower probability of failure, and, more importantly, heightened motivation during the graduation period. It is also noteworthy that some students who complete the course later still manage to achieve a good grade, possibly influenced by high satisfaction levels driven by the motivation derived from metrics, considering their previous academic performance.

Conclusion

We can assert that the implementation of the Career Simulation for Politecnico students faithfully reproduces results that are consistent with reality. However, to achieve even more accurate results, additional information could be considered. For instance, factors such as the difficulty of exams, the time of day they are conducted (morning or afternoon, potentially influencing student preparation), and the format of the exam (written or oral) could be taken into account. Additionally, gaining insights into how students attain higher scores—examining the reasons and difficulties within each course—would provide a more comprehensive understanding of their academic performance.

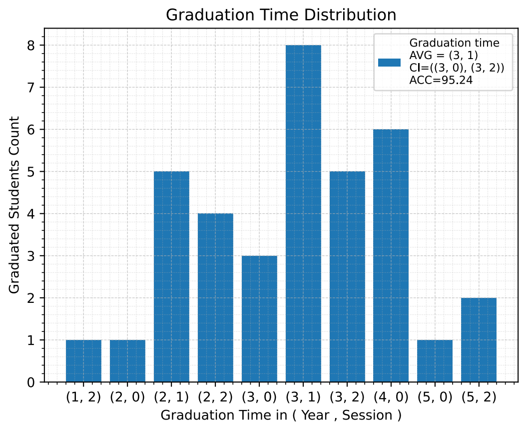

Figure 3: Graduation Time Distribution.

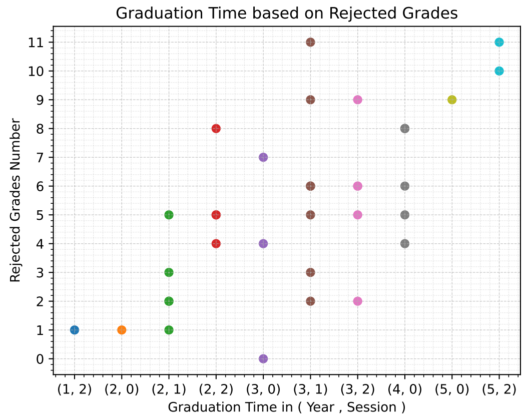

Figure 4: Graduation Time based on Rejected Grades

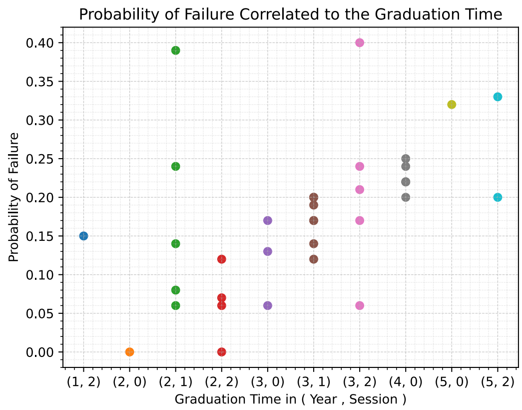

Figure 5: Probability of Failure Correlated to the Graduation Time

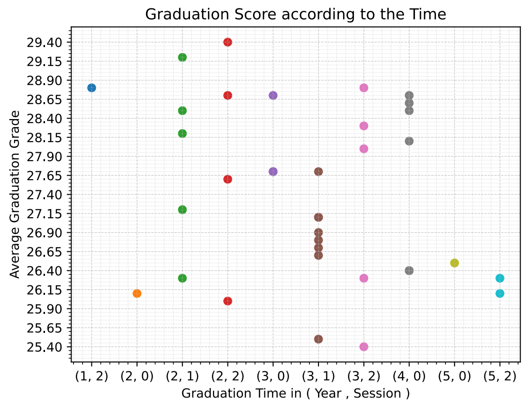

Figure 6: Graduation Score according to the Time

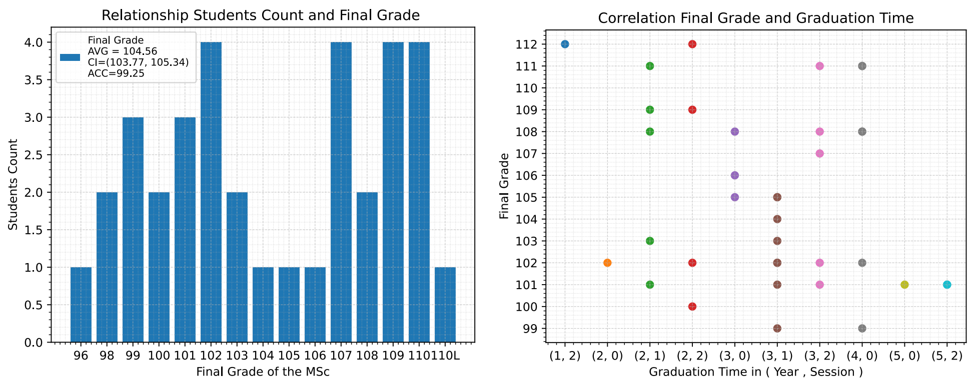

Figure 7: Relationship among Number of Graduated Students, Graduation Time and Final Grade