

Developing an Accurate Method and Algorithm to Identify and Match Tutors with their
Respective Students, According to Intellectual Level and Teaching Style.



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Abstract: Course Stars, LLC is a quality tutoring service focused on helping highschool college students excel in specific college courses, or standardized tests, through the help of experienced tutors (who have taken those specialized courses before). The unique aspect of Course Stars is that our tutors are all specialized in their own college courses and have their strengths in specific standardized testing aspects. The focus of our business project for Course Stars is to create a method for analyzing and matching a specific student in need of tutoring with their respective tutor. This matchmaking will be based on the student's strengths and weaknesses, along with the tutor's teaching style and the student's learning style. Solely focusing on the SAT this semester, we have designed intuitive tests along with an accurate scoring system (developed by trial and error of known SAT scored students). This business project will help with marketing for Course Stars, as we plan to post these tests as a quick measure to instantly get an accurate prediction on what the respective student will receive on the SAT initially, and after matching with a specialized tutor. A quick test can be a lucrative offer on the website to help draw in potential customers. The matchmaking system will also quicken the process of finding the correct tutor while eliminating the possibility that the student leaves the company due to an incorrectly matched tutor. Our business project will serve as a marketing tool and help save Course Stars' management an extra step.

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Report:

Course Stars, is a tutoring company that primarily focuses on college students in need of tutoring. Course Stars offers college graduates, who excelled in the specific programs (accurate to the college and teacher) in which the student needs academic aid. Offering services to mostly students in Illinois, Course Stars has tutors from various schools over the nation, including Harvard University, Benedictine University, Illinois University, Illinois Institute of Technology, The City university of New York, Purdue University, Trinity University, Pomona College, University of Minnesota, Yale University, Vanderbilt University, Grinnell college, Northwestern University, University of Chicago, University of Pennsylvania, Massachusetts Institute of Technology, Drexel University, University at Illinois Urbana-Champaign, and Hope college. Because of the various and vast quantities of educational background the tutors have, Course Stars is able to cover clients coming from a vast extent of colleges. The main issue arises when considering standardized testing. Because all Course Stars tutors have taken the required standardized tests (such as APs, SATs, ACTs, etc.). It is difficult assigning one specific tutor to a customer. This process of matchmaking, usually done by Course Stars management, can prove to be time consuming, and in some cases, cause the client to leave the company due to a tutor who doesn't work well with their teaching style (all tutors have been interviewed and qualified to teach, but some may match better or worse depending on the client's needs and learning methods.

To solve this issue, we decided to create an algorithm to correctly match these two variables based on their styles of learning/teaching, strengths and weaknesses, and cost. To keep the project simple, we limited ourselves to the SAT only. This meant our algorithm would only

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work on students and tutors learning/teaching for the SAT. We first started by analyzing multiple SAT guides and videos online, and organized the SAT into various different sections based on what fundamental concept was required. For SAT Math and Reading subjects, these fundamental concepts were covered:

1. Math

- a. Linear Equations & Inequalities
- b. Systems of Linear functions
- c. Quadratic equations
- d. Rational equations
- e. Exponents
- f. Like terms
- g. Isolation of Variable
- h. Finding 0s
- i. Factoring (Order of Operations)
- j. Radical Expressions
- k. Percents, Ratio, Proportions
- l. Graphs
- m. Geometry + trigonometry
- n. Complex numbers

2. Reading

- a. Comprehension
- b. Stylistic Reading
- c. Finding Evidence

3. English

- a. Grammar
 - i. Subject Verb Agreement
 - ii. Singular collective nouns
 - iii. Prepositional Phrases
 - iv. Clear Pronouns
 - v. Clear Modifiers
 - vi. Homophones
 - vii. Commas + Clauses (separations)
 - viii. Run-ON or Fragments
 - ix. Parallel sentence structure
- b. Style & Tone
 - i. Inferences
 - ii. Add sentence based on correct context

After identifying all the key concepts that need to be included in our practice tests, we were ready to design the tests. Part of our marketing strategy was to keep these tests short so that the student could get their prediction quickly; we needed to combine several sections into the same question in order to shorten the test. Accurately using the subject topics, we were able to design 14 Math questions and 10 Reading questions. Getting these answers would give us information on the client, but not enough. If we wanted to perfectly match them with a tutor, we needed more information, such as their learning style. Because 14 questions wasn't enough to fully encapse the intellect of the client, we added experience questions into the test. Some

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examples were “Have you taken the SAT before?”, “Have you taken Algebra II?”, “Do you often use a calculator?”, “How often do you read for fun?”, “What is your favorite genre?”, etc.

These questions, although don’t require calculations or analysis, can provide lots of useful qualitative information, combined with the relative ease of the questions. The more information with the least amount of questions is the goal.

For a scoring system, we first created the range from 400 to 1500. 400 being no questions answered correctly and 1500 even if every question is answered correctly (with the maximum math section SAT being a 780). This is a marketing strategy, as we still want top-excelling students to purchase tutoring from CourseStars. Doing the calculations and scoring for the math section, here are the results.

Question number	Points worth	Reason - See report
1 (QA)	20/10/0	1A
2 (QA)	20/10/0	1A
3 (QA)	20/10/0	1B
4 (QA)	20/10	2A
5 (QA)	20/10	2A
6 (QA)	20/10	2B
7 (QA)	20/10/0	1A
8 (QA)	20/10/0	3A
9 (QA)	20/10/0	3B
10 (QA)	20/10	3B
11 (QA)	20/10	3B
12 (QN)	40/0	1C
13 (QN)	40/0	1C
14 (QN)	40/0	1C
15 (QN)	40/0	1C
16 (QN)	40/0	1C
17 (QN)	40/0	1C
18 (QN)	40/0	1C
19 (QN)	40/0	1C
20 (QN)	40/0	1C
21 (QN)	40/0	1C
22 (QN)	40/0	1C
23 (QN)	40/0	1C
24 (QN)	40/0	1C
25 (QN)	40/0	1C

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Each question, along with the available points and type of response is included in the table above. For the question numbers, QA stands for a qualitative question and response, while QN stands for a quantitative question and response. Although qualitative questions don't have correct answers, we awarded more points to the answers which would help an SAT test taker perform better. This had to be predicted and calculated as it is not guaranteed, so we included a margin of error. For the points of each question, the answers are divided by slashes ["/"]. Depending on the answer given, the participant would be awarded a different value of points. The most correct/best answer is at the far left, and progressing to the right are answers that give less of a chance for the participant's success on the SAT. Reasonings:

1A - These questions ask about how well they performed on a previous examination or test. They provide useful information as basing a good estimate of future scores can utilize grades from old classes, which cover the subjects of the SAT.

1B - Similar to 1A in style, yet use previous SAT test scores to determine the grade. Although an important question, 1B is not weighted heavily because old test scores aren't the best determination of future ones, as seen in our test subjects.

1C - Question for quantitative information, only one answer is correct.

2A - A yes or no question, centered around qualitative, personal experience

2B - A yes or no question, centered around how a test-taker will approach questions and give us more information on the type of learner the student is (ex. visual).

3A - These questions ask for overall experience, rather than performance. Although experience is not a great factor for predicting scores, it can be used to reach marginal error.

3B - These questions are another aspect to figure out how a student might approach a problem, but looking at the technical and personal side rather than the learning style of the student.

The 14 [QN] math questions can be found below:

Question 1: What is the Linear equation (and what do the variable mean) ($y=mx+b$)

Question 2: $y=5x-9$. Does the point $(-2, -19)$ lie on this graph?

Question 3: $y=5x-9$. $(a,0)$ What is the value of a

Question 4: Identify $y=5x-9$ on a graph

Question 5: $5y+4x=16$ $2y-2x=7$; find the point of intersection

Question 6: Find the zeros of this expression: x^2-6x+9

Question 7: Find the zeros of this expression: $4x^2-3x+8$

Question 8: $(64/a^{27})^{-2/3}$ Simplify.

Question 9: $5x/2x^2+7x$ Simplify.

Question 10: When is a rational function undefined? (Denominator = 0)

Question 11: $(0,2)$, $(1,2.2)$, $(2, 2.42)$, $(3, 2.662)$ What function is his ($y=2(1.1)^x$, $y=1.1x+2$)

Question 12: If $\sin(x)=3/5$, what is $\tan(x)$? |

Question 13: Evaluate. $(3+i)(3-i)$

Question 14: If two legs of a triangle are 6in and 9in, what is the measure of the hypotenuse?

These questions are purposely kept short and simpler, while covering the main concepts and topics to allow the test to be taken in a shorter period of time.

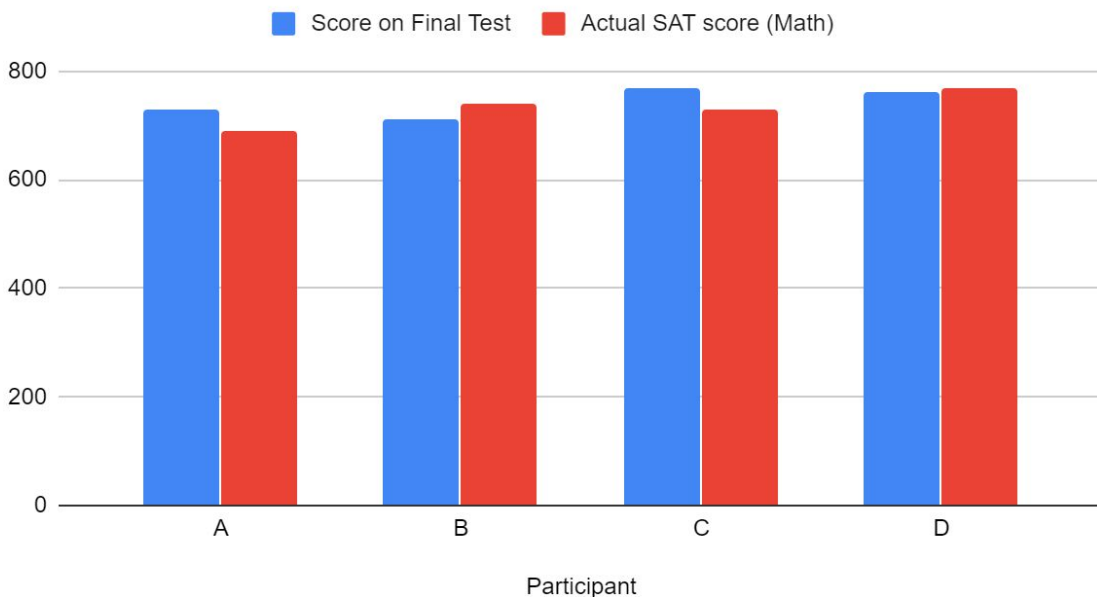
The scoring and test questions were modified based on a various number of test subjects who took our example test. We had 4 volunteers from various skill levels take the test and recorded data on them. (Names not listed). Due to the environment and the volunteers allotted to us, most of our participants were among the top scoring students in the nation. This could be considered a limitation of our test. Also, because of the tweaking and modifying process, we had the volunteers take different tests multiple times which might have resulted in an increase.

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Participant	Time	Score on Final Test	Actual SAT score (Math)
A	17:56	730	690
B	14:12	710	740
C	18:09	770	730
D	22:43	760	770

Other limitations existed, such as the participant taking the SAT a long time ago; their actual score wasn't an accurate representation of their skill level. Overall, after our final modifications, we reached a marginal error of %11.428 (within 40 points of their actual score). It is important to note that on all of our tests, our participants did very well on QN questions with all participants scoring 13/14 or higher; higher than expected. This may challenge our weighting scale and potentially call for modification. In reality, the final test scores would be slightly higher, but we capped the max score to be 780 for marketing purposes (see above). (Example tests with reasoning behind questions listed in sources).

Comparison of Scores from Example and Actual Tests



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Now with the finished tests, we created a marketing strategy to effectively implement our work, and hopefully draw clients toward Course Stars. Our main system of marketing would revolve around featuring the test on the Course Stars' website. Many people who are about to take the SAT are nervous about the score they might get and may feel like they haven't prepared enough, or vice versa. Offering a quick (within 20min) SAT pretest to predict what score the client might get can be lucrative to many students. After the test is finished, Course Stars can reach out to them. For free, we will show them their predicted scores. Then, we'll recommend a tutor for them based on their skill sets and weaknesses (but they will not be able to see the responses and what their weaknesses are). Course Stars will also offer a free 5-min online session to go over the test results and see if they would want to get tutored. Our project will save Course Stars' time and bring in potential customers (see Abstract for summary).

I would like to thank my coworker in this project, Aryan Gandhi, who has completed the reading tests and reading aspect of the SAT, and Jill Ko, my mentor throughout this internship. I've had a wonderful experience working at Course Stars.

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