## How does the "Mileage" extra credit system work?

The intention is to trick you into spreading your work out over multiple days, instead of doing all of your homework the day before it is due.

1. Your "mileage" increases every time you attempt a CAPA question. All mileage credit is recorded at the time of each CAPA submission. Whenever you attempt a question and get it wrong, your mileage credit increases by a small amount that depends on how many tries you are permitted and also on how many tries you have attempted so far:

$$
\text { Credit for a "No" }=\frac{1+(\text { Tries Permitted })-(\text { This Try } \#)}{(\text { Tries Permitted })(\text { Tries Permitted }+1)} \times(\text { Problem Value })
$$

Whenever you get a CAPA question correct, you get all the remaining value for that question.
So, for example, consider a case where you are permitted 5 tries for a homework problem, and you are working on a problem that is worth 10 points. If you get it wrong twice before finally getting it right, then:

Your credit for the first "No" in CAPA is: 1.667 points
Your credit for the second "No" in CAPA is: 1.333 points
Your credit for the first "Yes" in CAPA is: $10-1.667-1.333=7$ points
Your total credit for this problem: 10 points, divided into 3 time stamps.
According to this formula, if you use all your tries on incorrect answers, you always get total credit equal to $50 \%$ of the point value. So, for the above example, if you had five "No" attempts, then the total value would be $1.667+1.333+1.0+0.667+0.333=5$ points total (out of 10 possible)
2. The time and value of each submission is normalized. The resulting times range from 0 to 1 , and the resulting scores are a simple fraction of the total possible points for that assignment. Here is what the data might look like for 5 different students for any given assignment:


Four of these students earned a $100 \%$ on their assignment; the "purple" student only got a $68 \%$. But you can see that the student represented by the magenta line did none of the work until the last minute, which is what I am trying to discourage.
3. Each plot is integrated numerically using 100 trapezoids. Integrals can range from about 0.0 for the magenta student to about 1.0 for the blue student. The area for the purple student is about 0.25 , and is colored for you here. Note that this $25 \%$ is a lot less than their homework score of $68 \%$ !
4. The integral is converted into "miles" using this formula: Miles $=1666.7 \times$ (integral) -333.3 . This results in a value ranging from -333.3 to +1333.3 . This result is then truncated into the range 0 to 1000 miles. In the example image, the blue student would have 1000 miles, the red student would have 500 miles, the green student would have about 350 miles, the purple student would have about 85 miles, and the magenta student would have 0 miles.
5. If your mileage for any assignment reaches or exceeds 500 miles, then you earn one full "reward" for that assignment. Otherwise, you earn a fractional reward of (earned miles)/500. So, the green student earned about $(350 / 500)=0.70$ rewards. Once earned, rewards cannot be lost. There is a maximum number of rewards permitted per student per semester:

General Physics: Maximum of $M=13$ rewards for 14 assignments.
Applied Mechanics: Maximum of $M=11$ rewards for 12 assignments.
Fluid Mechanics: Maximum of $M=9$ rewards for 10 assignments.
Math Methods: Maximum of $M=13$ rewards for 14 assignments.
Electric Circuits: Maximum of $M=10$ rewards for 11 assignments.
6. The value of any reward is applied to your grade after any other curves. This is a very big deal.
7. How big is a "reward"? It depends on the class statistics at the end of the semester. If the final score distribution for a class turns out to be $A \pm S$ (for example, $65 \pm 12$ ), including homework, exams, and everything, then each reward has a value of $S /(3 M)$ which is added directly to your score without recalculating $A$ or $S$. So, in the case where you earn $M$ rewards (the maximum), your grade will be increased by $S / 3$. Using the given example of $65 \pm 12$, this would add 4 percent to your final grade.
8. In Dr. Pogo's gradebook, the difference between any two adjacent letter grades (like C+ and B-) is defined as $S / 3$. So, earning $M$ rewards is guaranteed to move you up to the next " $\pm$ " letter grade (unless you're already getting an A grade anyway). However, since there is no such thing as a D+, or an $\mathrm{E}-$, it's harder to interpret the impact for those earning a D or E grade, because you might be getting a "D-", but that looks the same as a "D".

If you earn fewer than $M$ rewards, you still have a pretty good chance of moving up a letter grade, just for doing your homework earlier than the last minute. For example, suppose you are getting a B+ in Math Methods, where 13 rewards are possible, and you have earned 9 of these possible rewards. Then your grade will increase to an A- if you are in the top (9/13) of the B+ range.

