Welcome!

ISyE 6644 Simulation

Georgia Tech H. Milton Stewart School of Industrial and Systems Engineering
College of Engineering

By the end of this meeting, students should be able to:

- Gain a clear understanding of the content and purpose of the course.
- Comprehend the basic mathematical and programming knowledge required and be aware of the available bootcamps for refreshing these skills.
- Familiarize themselves with the grading breakdown, the significance of each component, and the importance of time management to meet deadlines.
- Be aware of the opportunity to select from several theory- and applications-oriented topics for their course project.
- Know the regulations regarding the use of notes, calculators, and software during exams.
- Know how to use the Piazza discussion forums effectively for course-related discussions and inquiries.
- Recognize the seriousness of plagiarism and the importance of adhering to the Georgia Tech Student Honor Code.
- Know where to access course materials online and understand the optional textbooks for further reference.
- Be aware of the provisions and accommodations available for students with disabilities or special circumstances.

Content and Purpose of the Course

- Dive into the mechanics of discrete-event simulations to harness their power in tackling complex problems

- Sharpen your statistical skills, investigating intensively concepts such as input analysis, random variate generation, output analysis, and even some sophisticated variance reduction techniques

Mathematical and Programming Knowledge

- Calculus-based probability and statistics

$$\int_a^b f(x)\,dx \approx \sum_{i=1}^{n} f(x_i)\Delta x = \frac{b-a}{n}\sum_{i=1}^{n} f\left(a + \frac{i(b-a)}{n}\right)$$

Definition: If the number of possible values of a RV X is finite or countably infinite, then X is a *discrete* RV. Its *probability mass function* (pmf) is $f(x) \equiv P(X = x)$. Note that $\sum_x f(x) = 1$.

Example: Flip 2 coins. Let X be the number of heads.

$$f(x) = \begin{cases} 1/4 & \text{if } x = 0 \text{ or } 2 \\ 1/2 & \text{if } x = 1 \\ 0 & \text{otherwise} \end{cases} \quad \square$$

Definition: For any RV X (discrete or continuous), the *cumulative distribution function* (cdf) is

$$F(x) \equiv P(X \le x) = \begin{cases} \sum_{y \le x} f(y) & \text{if } X \text{ is discrete} \\ \int_{-\infty}^{x} f(y)\,dy & \text{if } X \text{ is continuous} \end{cases}$$

Note that $\lim_{x \to -\infty} F(x) = 0$ and $\lim_{x \to \infty} F(x) = 1$. In addition, if X is continuous, then $\frac{d}{dx} F(x) = f(x)$.

Mathematical and Programming Knowledge

- "Extensive" computer programming

Welcome Meeting Sample Code.R

Source on Save

```r
n_tosses <- 1e6

set.seed(6644)

# Note that there are many different ways to simulate scenarios such as this
# This is an example for demonstration purposes only

outcomes <- c("H", "T")

# Simulate toss of 1 coin
toss_1 <- sample(x = outcomes, size = n_tosses, replace = TRUE)
barplot(table(toss_1))

# Simulate toss of another coin
toss_2 <- sample(x = outcomes, size = n_tosses, replace = TRUE)
barplot(table(toss_2))


# Find number of heads in the two tosses and examine distribution
sum_tosses <- paste0(toss_1, toss_2)
head(sum_tosses, 10)
barplot(table(sum_tosses))
prop.table(table(sum_tosses))

outcome_mapping <- c("H" = 1, "T" = 0)
```

JOKE BREAK

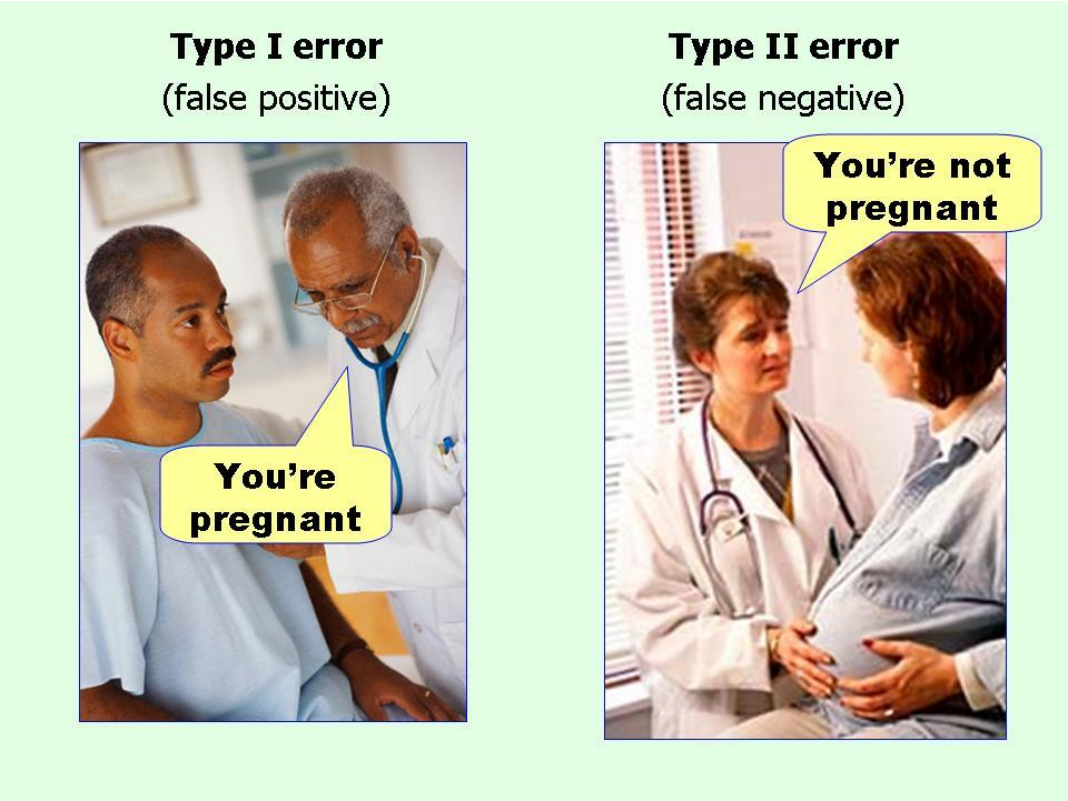
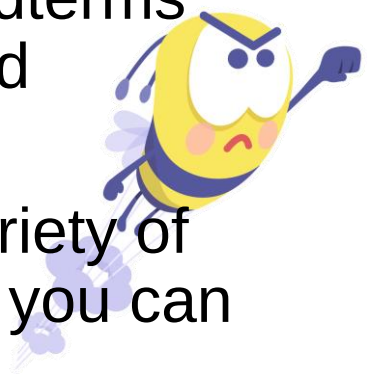


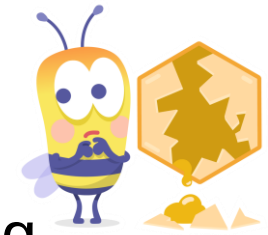
Image borrowed from
https://effectsizefaq.files.wordpress.com/2010/05/type-i-and-type-ii-errors.jpg

Grading Breakdown and Time Management

- Assignments are due on Canvas before their respective deadlines to ensure fairness to all, and to help you develop excellent time management skills. If you do happen to submit a bit late, there's a deduction of 10x%, where x is the number of days late, capped at 3 days.
- Showcase your understanding through two midterms and a final exam, filled with multiple-choice and true/false questions.
- An exciting project that you can pick from a variety of theory and application topics, and good news, you can collaborate in small groups!



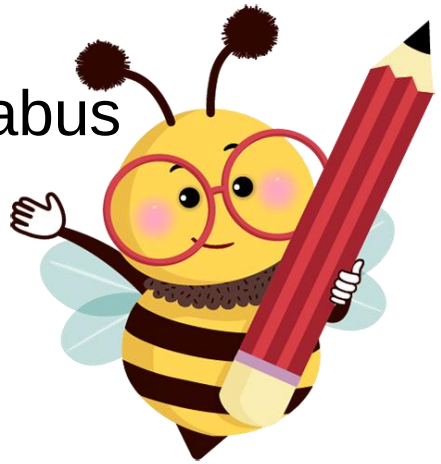
Grading Breakdown and Time Management



- We're all here to learn and grow, so focus on doing your best and the grades will follow.
- We've got a grading structure that includes a bit of everything - homework, exams, the project, and even bonus opportunities to boost your score.
- Remember to check the schedule regularly for homework, project, and exam due dates, as they may change.
- This course is designed to challenge you, but also to support you every step of the way. So, let's dive in, stay on track, and make the most of this learning adventure!

Course Project

- Milestones
  - Project Topic & Team Selection (5 points)
    - Assignment/Quiz in Canvas; everyone must submit
  - Project Progress Report (5 points)
    - Assignment in Canvas; only one group member must submit
  - Final Report (90 points)
    - Assignment in Canvas; only one group member must submit
- Project Topics to be published per the syllabus



Exams: Notes, Calculators, and Software Oh My!

- Notes
  - Exam 1 = 1 sheet; Exam 2 = 2 sheets; Exam 3 = 3 sheets
  - Put whatever you don't want to memorize on them!
- Calculators
  - Any reasonable calculator; see Piazza Exam post for more details
- Software
  - No use of Excel or Arena allowed

Exams: Notes, Calculators, and Software Oh My!

- Syllabus has information about what topics you can expect to see on exams

- The practice exams are good indicators of what you can expect to see

Be Involved!

- Piazza
  - One of the most powerful tools at your disposal
  - More than just a platform for announcements and course updates
  - Interactive and collaborative learning space
  - If used effectively, can greatly enhance your learning experience
  - Post questions, engage in thought-provoking discussion, and share insights about the course material
  - A community of knowledge seekers
  - See the Piazza post on Piazza (it's turtles all the way down!)
- Even though this is largely asynchronous, you should be checking your email and Piazza once per day for any updates and announcements

JOKE BREAK

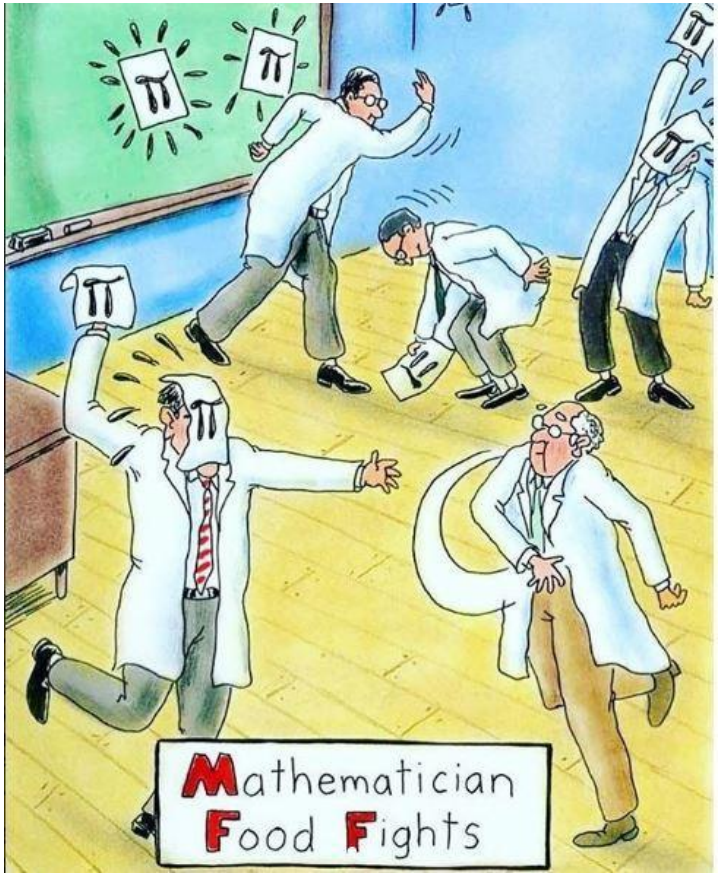


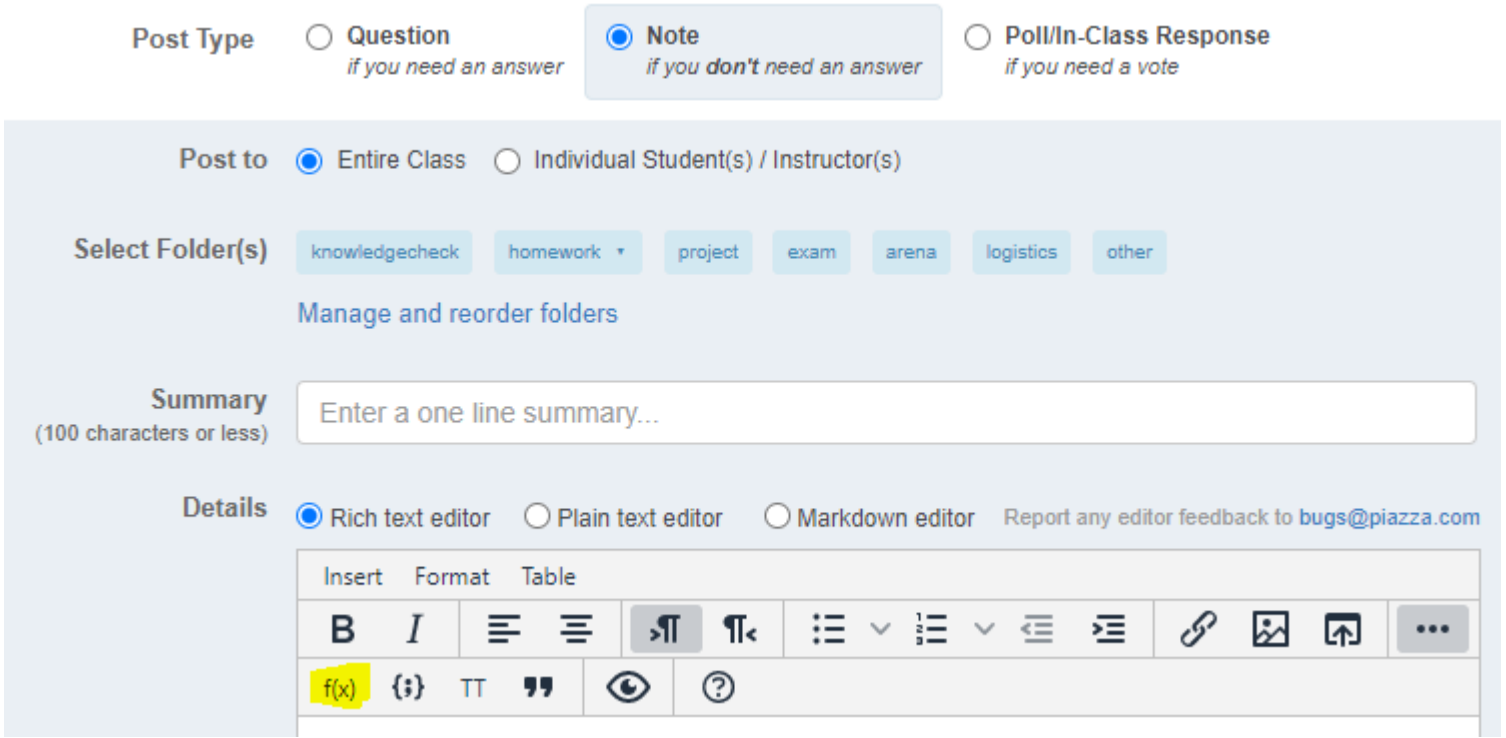
Image borrowed from
https://www.piday.org/wp-content/uploads/photo-gallery/imported_from_media_libray/4.jpg?bwg=1562342583

Asking Questions

- Make a good faith effort
  - Include your best answer or understanding about what you are asking about
  - The more effort you put into asking the question, the more learning will take place and will provide a better foundation for discussion that will benefit every student in the course
- Try to answer questions (even if you aren't sure!)
  - Answering and engaging with your peers can be extremely useful
  - If you're not 100% sure, then do some additional research
  - You can even do this and NOT post on Piazza to help yourself engage with topics (but I encourage you to add responses!)
  - If you post a question and figure it out, then answer your own question (do NOT post "Nevermind I figured it out")

Asking Questions

- Learn how to use LaTeX in Piazza posts either typing it in directly (using $$ delimiters) or by using the LaTeX Equation Editor in Piazza.

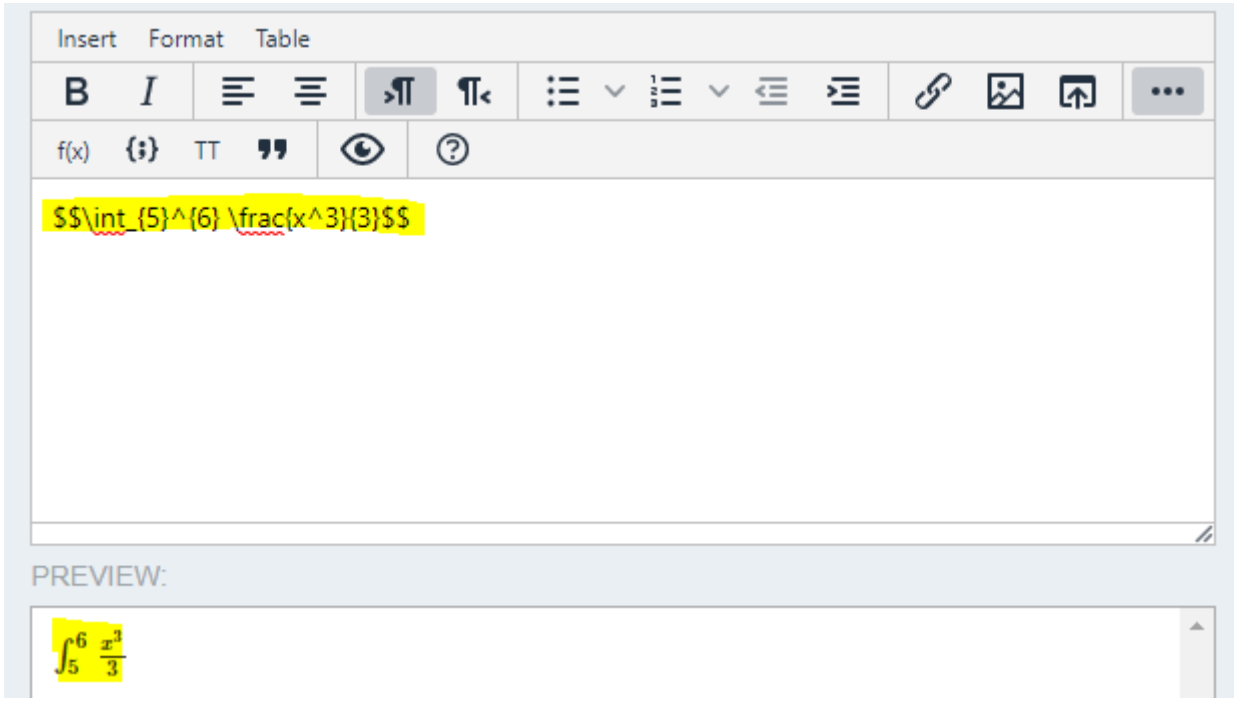


Asking Questions

- Learn how to use LaTeX in Piazza posts either typing it in directly (using $$ delimiters) or by using the LaTeX Equation Editor in Piazza.

Asking Questions

- Learn how to use LaTeX in Piazza posts either typing it in directly (using $$ delimiters) or by using the LaTeX Equation Editor in Piazza.



Office Hours

- Twice per week
  - Monday will be for recently released homework to provide tips and solution strategies
  - Wednesday will be to review recently due homework to review solutions
- Exam Prep Sessions

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					Homework 1 Released	
	Homework 1 Tips				Homework 1 Due Homework 2 Released	
	Homework 2 Tips Homework 1 Late Penalty Complete		Homework 1 Solution Review			

JOKE BREAK

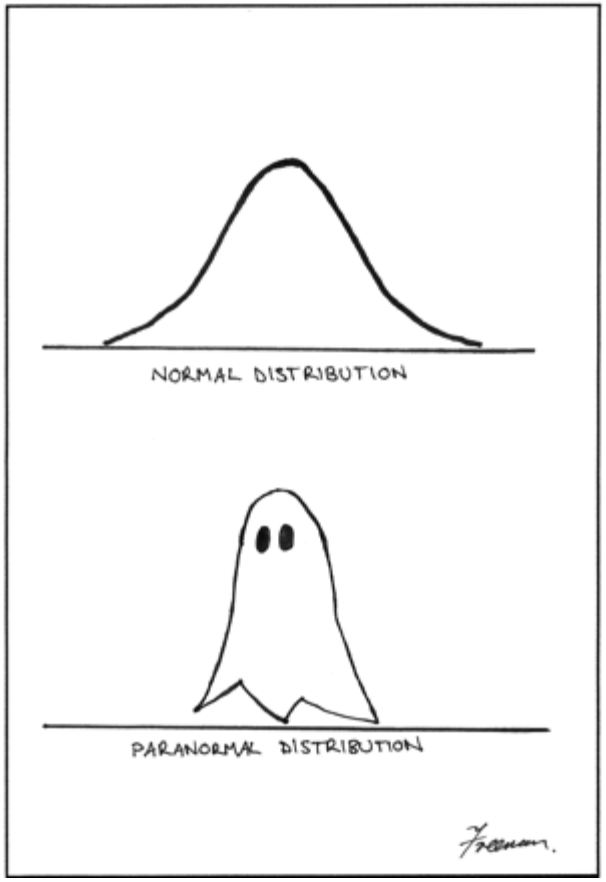


Image borrowed from
https://jech.bmj.com/sites/default/files/highwire/jech/60/1/6/embed/graphic-1.gif

Academy Integrity and Honesty

- A serious matter; approach with a positive and proactive mindset
- We have noticed an increase in violations particularly with the project component of the course
- Copying and pasting code or changing variable names isn't the kind of creativity we're striving for
- It's important to remember that citing sources isn't just about adding a footnote or a reference list. If you've copied large portions of content, even with citation, it's like taking a shortcut on our intellectual journey.
- Giving credit where it's due is a cornerstone of academic integrity. It's about respecting the intellectual property of others, but it's also about respecting your own capacity to generate original ideas and solutions.
- Academic integrity is not just about rules or avoiding penalties. It's about being true to ourselves, being fair to others, and honoring the spirit of learning.

Don’t be in such a hurry!

- You're preparing a delicious stew in a slow cooker. You assemble the ingredients, carefully place them into the cooker, and then you wait. It's not a quick, fast-food type of meal. It takes time for the flavors to meld and the ingredients to soften. The result, though, is a rich, savory dish that is far more delicious because it had time to simmer and marinate!

- This graduate level course is not a sprint; it's more like a slow-cooked meal. The lectures, readings, and course materials we provide are like the ingredients for your intellectual stew. They need time to marinate in your mind. You can't rush through the material and expect to fully understand the complexity and depth of the topics we're covering.

Image borrowed from
https://www.pinterest.com/pin/341218109251198584/

Don’t be in such a hurry!

- One of the best ways to let things marinate is to try to work through the course materials independently at first. Just like you wouldn't keep opening the slow cooker to check on the stew, resist the urge to immediately seek help when you encounter a difficult concept. Instead, spend some time wrestling with it, turning it over in your mind, and trying out different approaches. You'll be surprised at how often the answer comes to you when you give it time.

- It's okay to get stuck and let things simmer. Just like a slow cooker transforms tough, raw ingredients into something soft and palatable, the process of wrestling with tough concepts will transform them into something you understand and can work with. Remember, it's in the slow, careful simmering that the most complex flavors are developed. Similarly, it's in the quiet contemplation and personal struggle with difficult ideas that deep learning and understanding occurs.

Image borrowed from
https://www.pinterest.com/pin/341218109251198584/

Course Materials

- Canvas
  - Links to all lectures, slides, other resources
- Piazza
  - Module Additional Notes
  - Lively discussion
- Textbooks
  - The Law text has a lot of the simulation theory
  - The Kelton text expands more on the Arena material (and can provide further details behind some of the models that Professor Goldsman uses)
  - Professor Goldsman's probability text is a good reference and contains more details and proofs
- Arena
  - Piazza post to be published with details on installing locally or using GT virtual labs

In conclusion

- Embrace the joy of learning! This is more than just a course, it's a journey, so make sure you enjoy every step along the way.
- Dive deep into knowledge! Let's not just skim the surface. Get into the heart of the concepts and explore all they have to offer.
- Become a code maestro! Try implementing some of the concepts in code yourself. Not only will this solidify your understanding, but it'll also give you a practical edge.
- Unravel mysteries through proofs! Challenge yourself to attempt some of the proofs and share your logic with other students. It's a great way to learn and foster a sense of community.
- Be the question master! Ask questions whenever you're in doubt. Remember, the only silly question is the one that's never asked.
- Turn into a knowledge hero! Don't hesitate to answer and enlighten when you know the answer. It's a great way to reinforce your understanding and help others.
- Keep the faith, never stop believing in your abilities! Learning is a journey with ups and downs, but with persistence, the sky's the limit.
- Beat the clock! Keep on top of your assignments and submit your homework on time. Remember, late submissions can impact your grades, so let's stay ahead of the game!