

The Eye of Mathematics

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A long time ago, in a “place” far, far
away...

- Students saw patterns.
- Students made abstractions of those patterns.
- Students extended the abstraction of those patterns in search of knowledge.
- Students developed an appreciation for the effectiveness of math in our world.

At the present time, in a “place” not so far away...

- Students see patterns.
- Students ask Google for a quick formula for the pattern.
- Students press buttons and write down something, then forget.
- Students question the relevance of math in our world.

What happened?

- Math is (generally) poorly taught in schools.
- Math is not well understood by many who use it.
- Math is not part of popular culture like business, sports, entertainment, gaming.
- Statements like “I’m not good at math” and “I hate math” have become socially acceptable positive things to say.
- Math is perceived as rules upon rules upon rules... and devoid of any creativity.
- Most college students see math as a distraction from the tech curriculum and job they seek.
- Math is tough to teach because it’s hard to learn... so we make it easier with “shallow” tech math courses.

What happened? (Specifically in the tech math courses I teach...)

- Evaluations are “given x produce y ” metric: $x \rightarrow y$
- $x \rightarrow y$ students tend to succeed.
- $x \rightarrow z$ students tend to fail.
- Very little evaluation weight is placed on the logical thought process, “ \rightarrow ”, involved.
- Students memorize a solution algorithm “ \rightarrow ” for each type of question
- Students “succeed” in their first semester math course, then seem to know nothing later on!

What does the Eye of Mathematics propose?

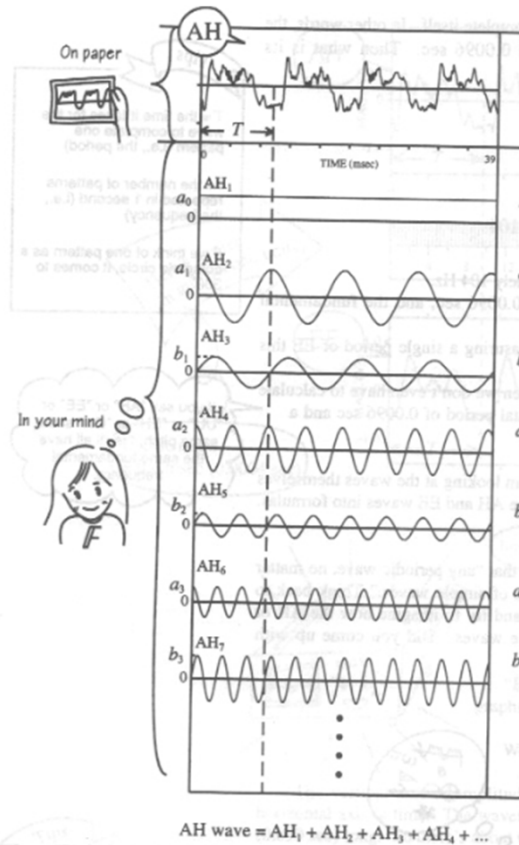
- Math must be understood.
- Evaluate the communication of the thought process “ \rightarrow ” used.
- Evaluate the effectiveness of the process in solving the problem and how it can be extended to solve other types of problems.
- $x \rightarrow y$ students may fail!
- $x \rightarrow z$ students may succeed!

How are we going to evaluate this? (by the numbers...)

- 2+2 hrs per week
- 24 quizzes (see sample...)
- 10 group exercises/presentations (see sample...)
- 20 homework
- 2 tests
- 1 text: Who is Fourier?

Who is Fourier?

- Read the book



KEY PAGE

To find the velocity of an object at a specific instant when its velocity is changing over time, calculate the velocity for the interval Δt seconds following the instant (t seconds) in question.

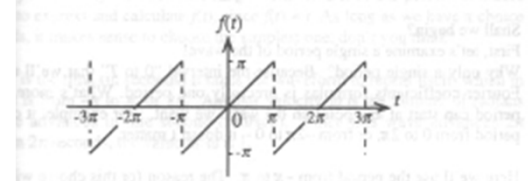
$$\frac{\Delta y}{\Delta t} = \frac{f(t + \Delta t) - f(t)}{\Delta t}$$

Then bring Δt as close as possible to 0.

$$\frac{dy}{dt} = \lim_{\Delta t \rightarrow 0} \frac{\Delta y}{\Delta t}$$

$$= \lim_{\Delta t \rightarrow 0} \frac{f(t + \Delta t) - f(t)}{\Delta t}$$

Decorative elements include a key, a padlock, a lightbulb, and a hand holding a pen.



with a waveform that resembles the teeth of a saw. Here we shall the calculations required for the Fourier coefficients of a sawtooth in a wave that consists of straight lines really be expressed as the sum of cosine waves, which consist of smooth curves? That's our riddle. We shall see...

marking on our calculations, let us review several crucial lessons studies so far. First, a reminder of what we learned at the very about the Fourier series:

Any complicated wave, if it repeats itself, can be expressed as the sum of sine and cosine waves.

series formula

$$f(t) = a_0 + \sum_{n=1}^{\infty} (a_n \cos n\omega t + b_n \sin n\omega t)$$

reminder about Fourier coefficients:

omplicated wave consists of the sum of several simple waves, and we can determine the quantity of each of these waves.

efficients formulas

$$a_0 = \frac{1}{T} \int_0^T f(t) dt$$

$$a_n = \frac{2}{T} \int_0^T f(t) \cos n\omega t dt$$

$$b_n = \frac{2}{T} \int_0^T f(t) \sin n\omega t dt$$

What are the goals of the Eye of Mathematics?

- Revisit math on a “guided tour”, from first principles, and challenge the FEAR of math.
- Understand the relationships between math, the “mind’s eye”, and nature.
- Literacy in the written language of math.
- Students with higher levels of confidence and self-esteem as technical professionals in a workplace where knowledge of math is an undisputed asset.
- Realization that math can be learned by ANYONE that has patience, perseverance, and the right approach.

What are some necessary conditions for the Eye of Mathematics?

- Openness, transparency, and adaptability; this is a new course and constant feedback from faculty and students will be required to improve it.
- A constant examination of the pedagogy itself; students and instructors openly seek and explore innovations in the learning of mathematics.

What will continue to drive the Eye of Mathematics and sustain it in our crazy/changing world?

- Math is a prerequisite to technical participation in our modern economy.
- Mathematical reasoning is NOT subject to technical obsolescence.
- Despite efforts in primary/secondary mathematics education, math skills are still declining.

Break Point...

Questions? Comments?

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Where is the Eye of Math now?

- The Eye of Mathematics **1**, Fall 2017.
- Critical Performance: “...students will have demonstrated the ability to **derive and manipulate** primitive mathematical abstractions from patterns observed in physical phenomena, by means of the language of mathematics, in order to acquire deeper insights about the physical world.”

Where is the Eye of Math now?

- The Eye of Mathematics **2**, Winter 2018.
- Critical Performance: “...students will have demonstrated the ability to **combine and transform** more complex mathematical abstractions, by means of the language of mathematics, in order to arrive confidently at a series of powerful and succinct mathematical expressions for the physical world.”

What is the force that binds them?

- Learning outcome #1: “Solve basic mathematical problems using foundational mathematical representations, algorithms, and tools...”
- Learning outcome #2: “Creatively translate worded descriptions to and from mathematical expressions using foundational mathematics as a written language...”

Use the force...

- Use the “language of mathematics” to **derive mathematical abstractions** from the patterns observed in these physical objects.
- **Manipulate the mathematical abstractions** to describe a new object; similar to the original.

Questions? Comments? Hospitality Suite?

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