Math Misery?

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NJPAECET2

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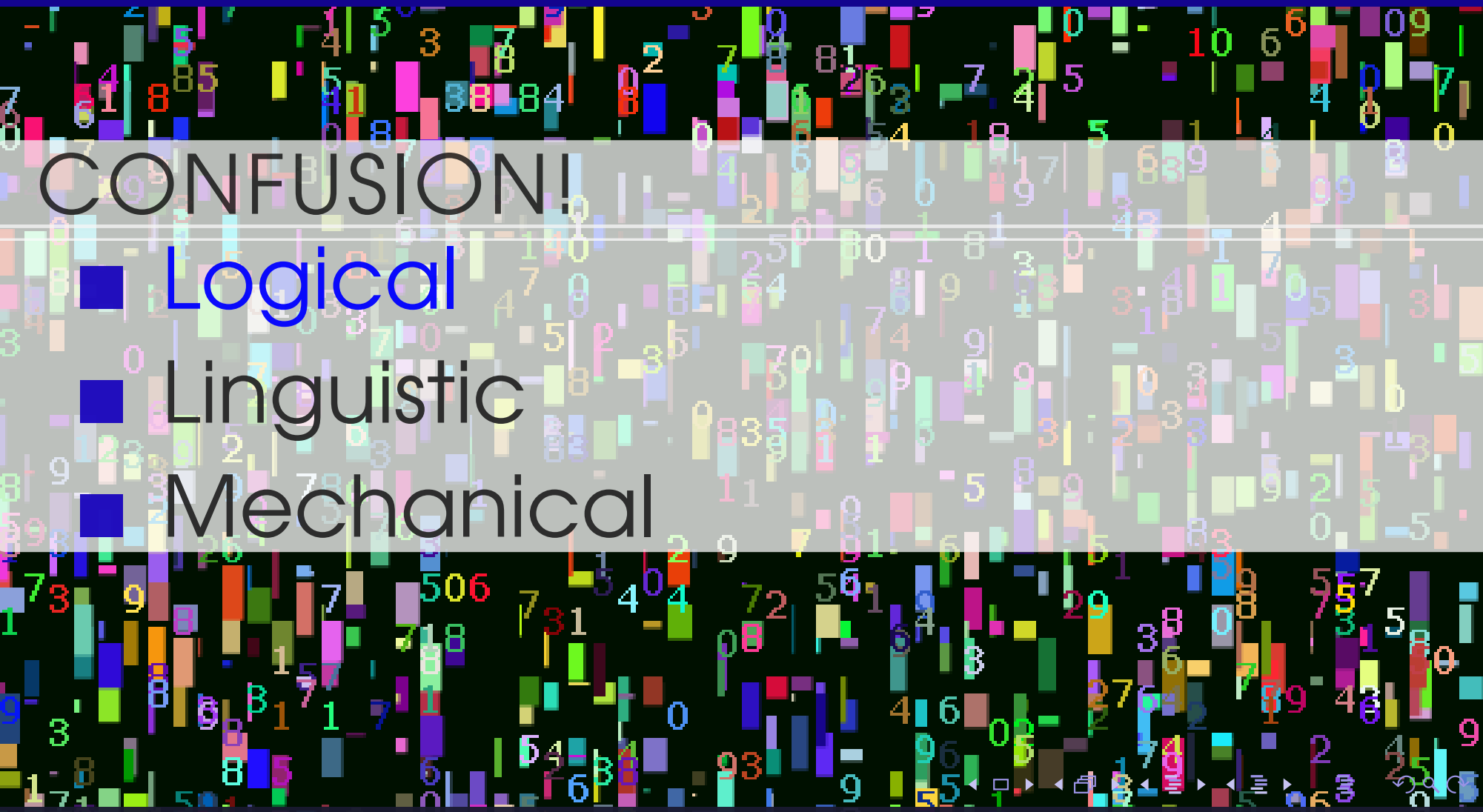
Some Background

- BS Electrical Engineering
- MS, PhD Mathematics
- Education
- Structured Finance
- Gaming / Gambling



CONFUSION!

- Logical
- Linguistic
- Mechanical

Logic

logic = legalism of mathematics

Mathematics

Mathematical theorems are non-negotiable

Mathematics

If f is differentiable at x
Then f is continuous at x

Mathematics

What happens if f isn't differentiable at x?

Social

“Social theorems” are negotiable

Social

Clean your room $\rightarrow$ Get pizza

Social

What happens if the room isn't cleaned?

Social

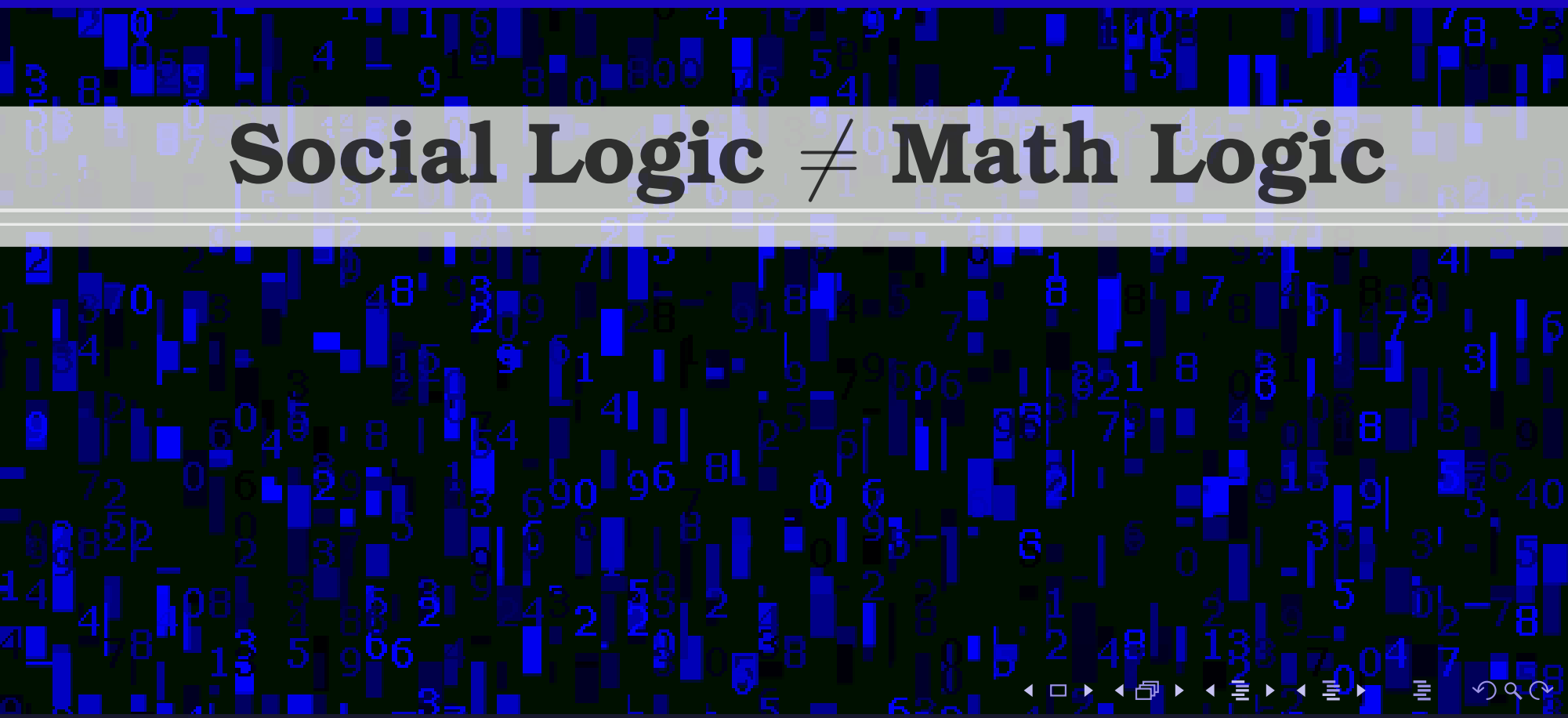
Pizza is still possible!

C-C-C

- Conditional: $X \rightarrow Y$
- Converse: $Y \rightarrow X$
- Contrapositive: $\sim Y \rightarrow \sim X$

Mixed Worlds

Social Logic ≠ Math Logic



Math & Pizza

Clean room $\leftrightarrow$ Get pizza

Contracts

Logic is contractual

Truth Table

p	q	$p \rightarrow q$	
F	**F**	**T**	
F	**T**	**T**	
T	**F**	**F**	**(broken contract!)**
T	**T**	**T**	

Missing In Math Ed

We need to teach more logic and fewer rules

Assumptions

I'll see you in the middle of the week

Assumptions

How many numbers are between one and ten?

Assumptions

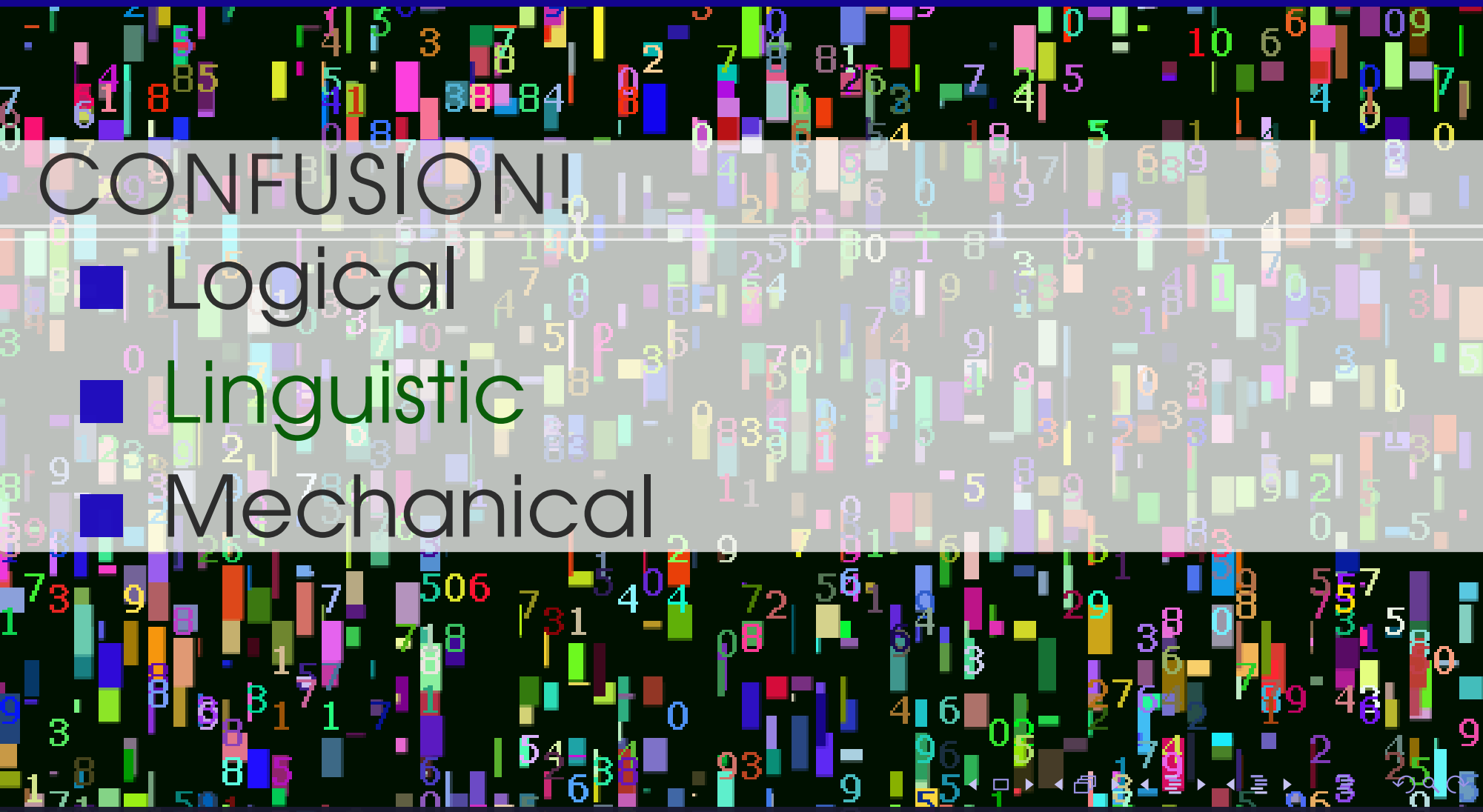
“Overassume”, “Underassume”

Assumptions

$$\frac{3}{x+2} > 1 \implies 3 > x + 2?$$

Missing in Math Ed

We don't stress *context* enough



English Is A Disaster!

food	good
pear	hear
hear	rear
rear	bear
dough	rough
read	read

Definitions

Colloquial

Students define: continuous

- never-ending
- it goes on forever
- always "on"
- repeating (periodicially)

Colloquial

Students define: infinity

- never-ending
- it goes on forever
- it contains everything
- it's the biggest number

Overused Vocabulary

as in English, context dependent

- χ^2 test
- χ^2 distribution
- χ^2 statistic

Overused Symbolism

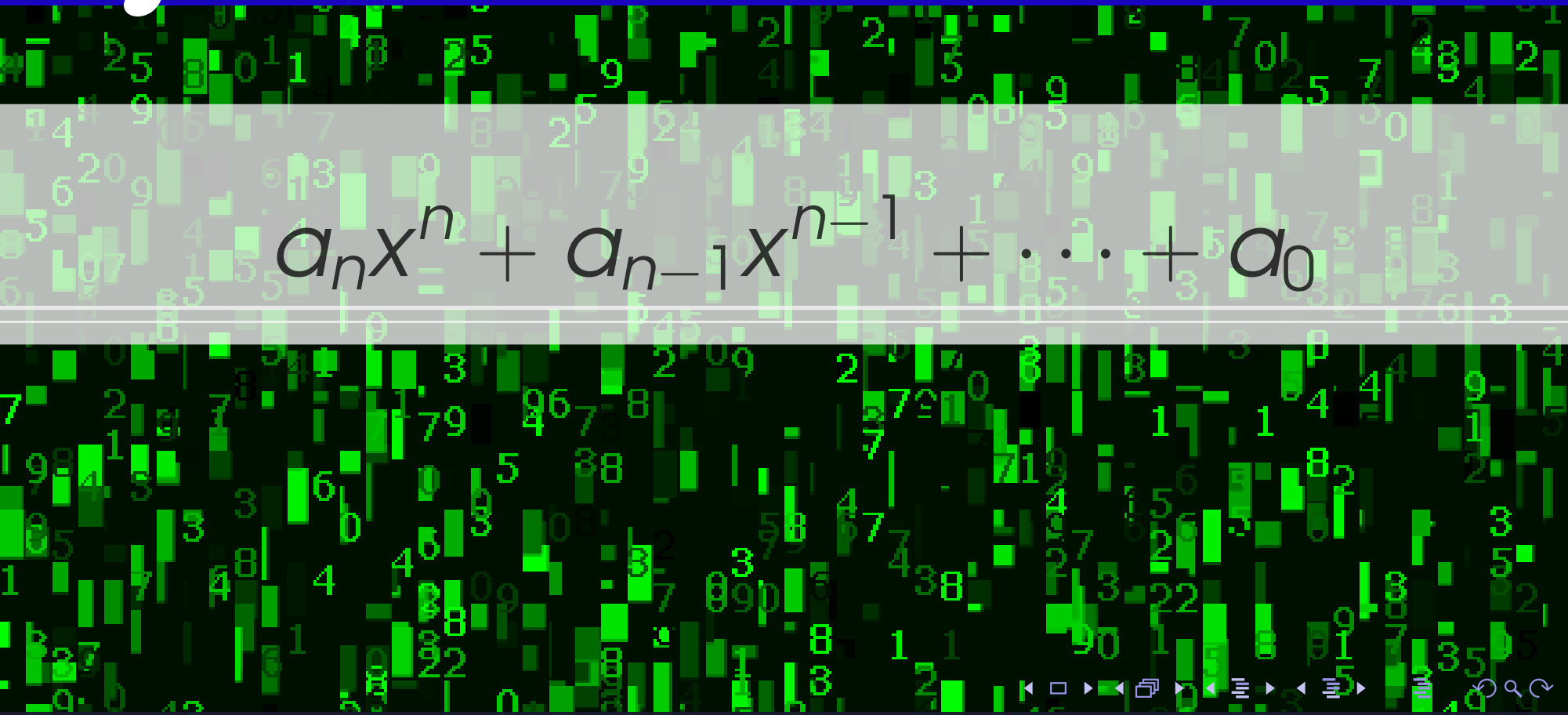
- σ (standard deviation)
- σ (permutation map)
- σ-field
- σ-algebra
- σ vs Σ

Mathematics

Abuse of notation

- Wrong if student does it
- Abuse of notation if done by mathematician

Symbolic Overload



Missing In Math Ed

- Not enough emphasis on *reading* mathematics
- Hyperfocus on "right" and "wrong"

What We Should Do

- Parsing symbolism is hard
- $\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{t} e^{-\frac{x^2}{2}}\,dx$ is a dense statement
- Pretend it is a page of text

A/An vs The

Give me *a* fork for my steak.
Give me *the* fork for my steak.

A/An vs The

Find *a* solution for $x^2 - 1 = 0$

Find *the* solution *set* for $x^2 - 1 = 0$

0, ∅, Non-existence

Solve for x in $x + 3 = 3$

- $x = 0$
- "It's nothing!"
- "There's no solution!"

The Dodo Bird

(sometimes) zero = non-existence

- The dodo bird is extinct
- There are zero dodo birds in existence

Degrees Celsius

(sometimes) zero $\neq$ non-existence

- Water freezes at zero degrees Celsius.
- Water freezes at a temperature that does not exist???

The Bankers

Zero is a number

- **Banker 1**: We have a number of bidders.
- **Banker 2**: Really? How many?
- **Banker 1**: Zero.

Missing In (Math) Ed

- Collaboration with Language Arts
- Emphasis on language and math reading comprehension

CONFUSION!

- Logical
- Linguistic
- Mechanical

Rules!

Is $0^1 = 0$? or is it $1^0 = 0$? or is it $0^1 = 1$? or is it $1^0 = 1$?

Path To Math Misery

- "Point-getting" → memorization
- Memorization done at expense of understanding
- Lack of understanding → math misery

Penmanship!

50Mϵ E$\chi\forall$mρles

- $6, \sigma, \delta$
- $O, o, 0, \theta, \Theta, \emptyset$
- $z, Z, 2$
- $I, l, 1, 7$

Penmanship!

- Hard to "do" math, if one is confused by one's own handwriting
- Emphasize numbers along with ABCs

Fractions!

Too many types, too many rules

Mixed fractions $1\frac{2}{3}$

Improper fractions $\frac{3}{2}$

Proper fractions $\frac{2}{3}$

Fractions!

Confusion for students when there are no numbers

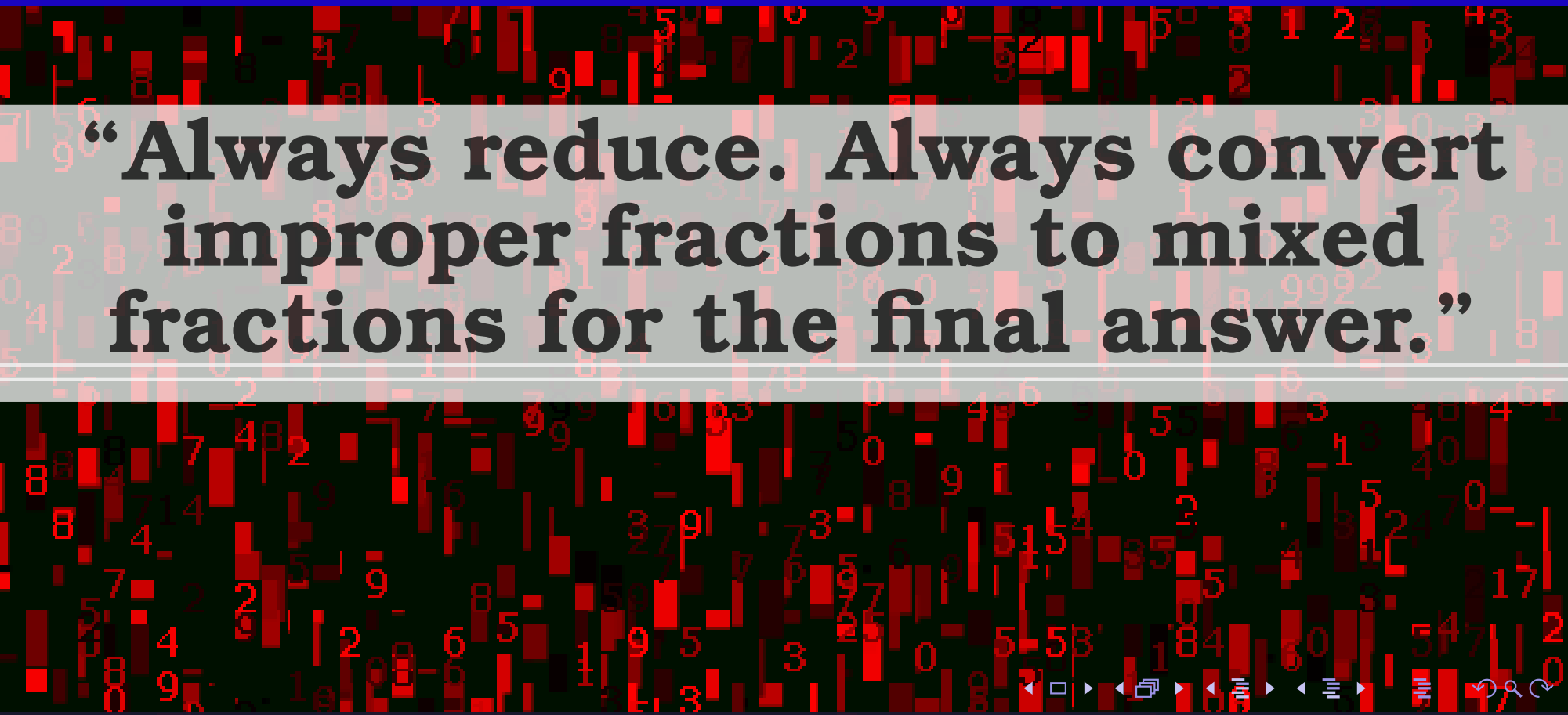
$$\frac{a}{b} + \frac{c}{d}$$

Fractions!

"Convert improper fractions to mixed fractions when adding or subtracting, but don't when multiplying or dividing"

Fractions!

Fractions!



Fractions!

Fractions!

Fractions!

All Jumbled

Too many rules = Zero rules

- Cross multiply to add / subtract?
- What do I change and flip?
- Greatest least common multiple of the dividend?

The Coup De Grâce

"x is the independent variable because it has two legs. y is the dependent variable because it has one leg and needs x's support to stand."

Thank you!

KEEP IN TOUCH!

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- Catch the blog at mathmisery.com