Love and/or Hate Math?

Amotz Bar-Noy

Department of Computer and Information Science
Brooklyn College
Some answers to “Why Math?”

When not knowing Math can cost you money!

https://www.youtube.com/watch?v=BbX44YSsQ2I

Visualize The Problem (The Simpsons):

https://www.youtube.com/watch?v=6Jq_9ghf-jI
Some answers to “What Is Math?”

Math as a game!?
https://www.youtube.com/watch?v=F92IdQobZiU&feature=youtu.be

The “map” of Mathematics:
https://www.youtube.com/watch?v=OmJ-4B-mS-Y&t=425s
Math and Dates

Find your age:

- Select a number between 1 to 9.
- Multiply by 2.
- Add 5.
- Multiply by 50.
- Add 1772.
- Subtract your birthday year.
- Add 1 if you already had your birthday
  * Or if it is today – congratulations!
- Omit first appearance of selected number if it is in your number.
- You are left with your age!!!
Find your age:

- **Manipulating the selected number:**
  - Selected number: $d \in \{1, 2, \ldots, 9\}$.
  - Age: $k < 100$.
  - After four math operations your number is:
    \[ n = ((2d + 5) \cdot 50) + 1772 = 2022 + 100d \]
  - Since $d$ is a digit: $n = 2d22$.
  - $2d22$ becomes 2022 after omitting the digit $d$.

- **Age plus birthday year:**
  - $k + (2022 - k) = 2022$ if birthday after today.
  - $k + (2023 - k) = 2023$ if birthday before today.
Math and Dates

Calculating the day of the Week for any date until 2099:

www.youtube.com/watch?v=UsStBxY9STw&list=PLDZcGqoKA84HZHcTVK2CxxNResu-2y76ML&index=6&t=0s

The birthday “paradox”

https://youtu.be/KtT_cgMzHx8
Think Before You Answer!

Can you solve this in five seconds?

- A bat and a ball cost $11.
- The bat costs $10 more than the ball.
- How much does the ball cost?

The problem, the solution, and some discussion:

www.youtube.com/watch?v=mjZoLfEhc8&list=PL1-lK8m-ellDit1dLRadlsnuCFQVu&index=80&t=0s

Why so many people give the wrong answer?

https://www.youtube.com/watch?v=i-aCSFD3xro&feature=youtu.be
Problem:

- $A$ and $B$ stand in a line with other people.
- $A$ is the fifth person from right, $B$ is the fifth person from left, and there are three people between them.
- How many people in the line?
Beyond the Trivial Solution

Problem:
- A and B stand in a line with other people.
- A is the fifth person from right, B is the fifth person from left, and there are three people between them.
- How many people in the line?

The trivial (?) solution: 13

XXXXXBXXXXAXXXX
Beyond the Trivial Solution

**Problem:**
- $A$ and $B$ stand in a line with other people.
- $A$ is the fifth person from right, $B$ is the fifth person from left, and there are three people between them.
- How many people in the line?

**The trivial (?) solution:** 13

$$XXXXBXXXXAXXXX$$

**The hidden (?) solution:** 5

$$AXXXB$$

**Visualization**

www.youtube.com/watch?v=YuGPE8F0h_4&list=PL1-lK8m-e1LDit1dLRadlsvuCFQVbkgVI&index=23&t=0s
Thinking Out of the Box

5 apples to 4 children and 18 horses to 3 children.

https://www.youtube.com/watch?v=JixXbESBaLs

https://www.youtube.com/watch?v=mfPAKd3eDwk

Covering 9 dots with 4 lines and even with 3 lines

https://www.youtube.com/watch?v=jvUD_v_f9qQ

https://www.youtube.com/watch?v=zs-UtzMstps

4 triangles with 6 matches and 7 triangles with 9 matches

https://www.youtube.com/watch?v=s1yy4RUviNw&feature=youtu.be

https://www.youtube.com/watch?v=PtNNqc_oLyI

A parking lot sequence with a missing number

https://www.youtube.com/watch?v=bwM2-jp3XgA
Find the “Shortest” way!

Trains, Birds, and Flies
- [https://www.youtube.com/watch?v=kKMBjlIwU2k](https://www.youtube.com/watch?v=kKMBjlIwU2k)
- [https://www.youtube.com/watch?v=-DkXXOGtVDU](https://www.youtube.com/watch?v=-DkXXOGtVDU)

Two poles and a cable
- [https://www.youtube.com/watch?v=l_ffdarcJiQ&feature=youtu.be](https://www.youtube.com/watch?v=l_ffdarcJiQ&feature=youtu.be)

A table, a cat, and a turtle
- [https://www.youtube.com/watch?v=BPRueCu3fXU&feature=youtu.be](https://www.youtube.com/watch?v=BPRueCu3fXU&feature=youtu.be)
Math and Art: Plotting Sequences

Amazing Graphs on Numberphile

- Part I: https://www.youtube.com/watch?v=pAMgUB51XZA&list=PLt5AfwLFPxWLkoPqhxvuA8183hh1rBnGM&index=2&t=0s

- Part II: https://www.youtube.com/watch?v=o8c4uYnnNnc&list=PLt5AfwLFPxWLkoPqhxvuA8183hh1rBnGM&index=3&t=0s

- Part III: https://www.youtube.com/watch?v=j0o-pMIR8uk&list=PLt5AfwLFPxWLkoPqhxvuA8183hh1rBnGM&index=4&t=0s

- Part IV: https://www.youtube.com/watch?v=4x2kdLFUSvM&list=PLt5AfwLFPxWLkoPqhxvuA8183hh1rBnGM&index=5&t=0s
How many marbles are in the jar?

https://www.youtube.com/watch?v=WZtCC-h2pQU&t=174s

The concept

https://www.youtube.com/watch?v=Zv80ibV-0FM
Do we understand what is “Average”?

The Will Rogers Phenomenon

“When the Okies left Oklahoma and moved to California, they raised the average intelligence level in both states.”

Example with numbers

Let \( S = \{1, 2, 3\} \) and let \( H = \{4, 5, 6, 7\} \).

The arithmetic averages of both sets are \( a_S = 2 \) and \( a_H = 5.5 \).

Move 4 from \( H \) to \( S \) so now \( S' = \{1, 2, 3, 4\} \) and \( H' = \{5, 6, 7\} \).

The arithmetic averages of \( S' \) and \( H' \) are \( a_{S'} = 2.5 \) and \( a_{H'} = 6 \).

It follows that \( a_{S'} > a_S \) and \( a_{H'} > a_H \).
Do we understand what is “Average”? 

Example with people

- Let $S$ be the set of all sick people in the world and let $a_S$ be their life expectancy. Let $H$ be the set of all healthy people in the world and let $a_H$ be their life expectancy.

- New diagnostic methods move people from $H$ to $S$. Let $M$ be the set of all people in the world who moved from $H$ to $S$ and let $a_M$ be their life expectancy. Let $S' = S \cup M$ and let $H' = H \setminus M$.

- Naturally, $a_M > a_S$ and $a_M < a_H$. As a result, $a_{S'} > a_S$ and $a_{H'} > a_H$.

- But the life expectancy of people in the world remains the same! New diagnostic methods by themselves do not influence life expectancy!

Resources

- https://www.youtube.com/watch?v=J4NtCsrwq2E