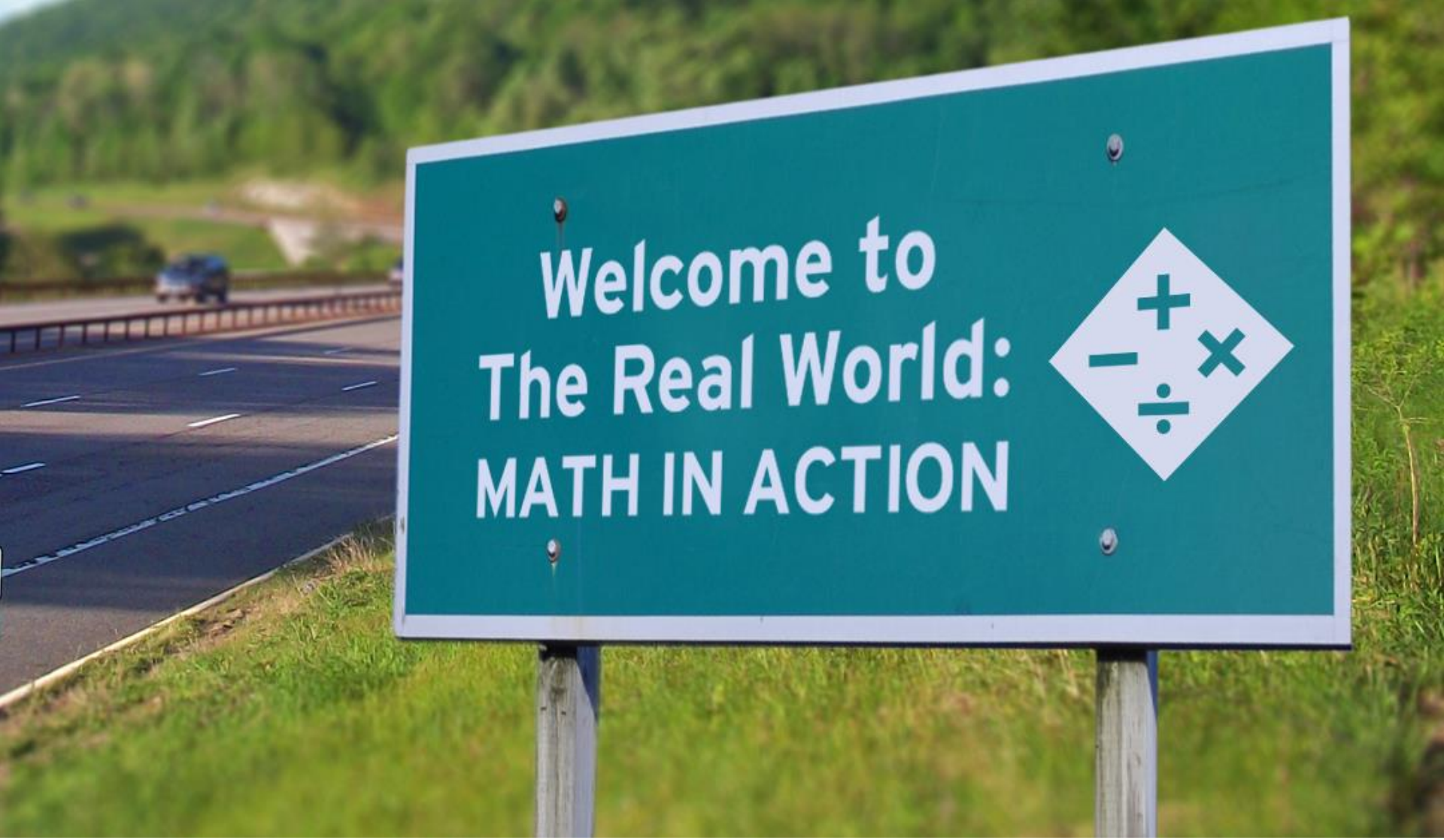


Mathematics @Work

John Poppelaars
ALM Conference July 2017, Rotterdam

BearingPoint®

$$\dot{x_b} = V\,cos\big(\theta(t)\big)$$
$$\dot{y_b} = -V\,\sin\big(\theta(t)\big)$$
$$\dot{\theta_b} = \frac{V}{L}\tan(\delta(t))$$
$$y_a = y_b - L\,sin\big(\theta(t)\big)$$
$$\dot{y_b} \approx -V\theta$$
$$\dot{\theta} \approx \frac{V}{L}\delta(t)$$
$$\dot{y_a} \approx \dot{y_b} - L\dot{\theta} = -V\theta - L\dot{\theta}$$

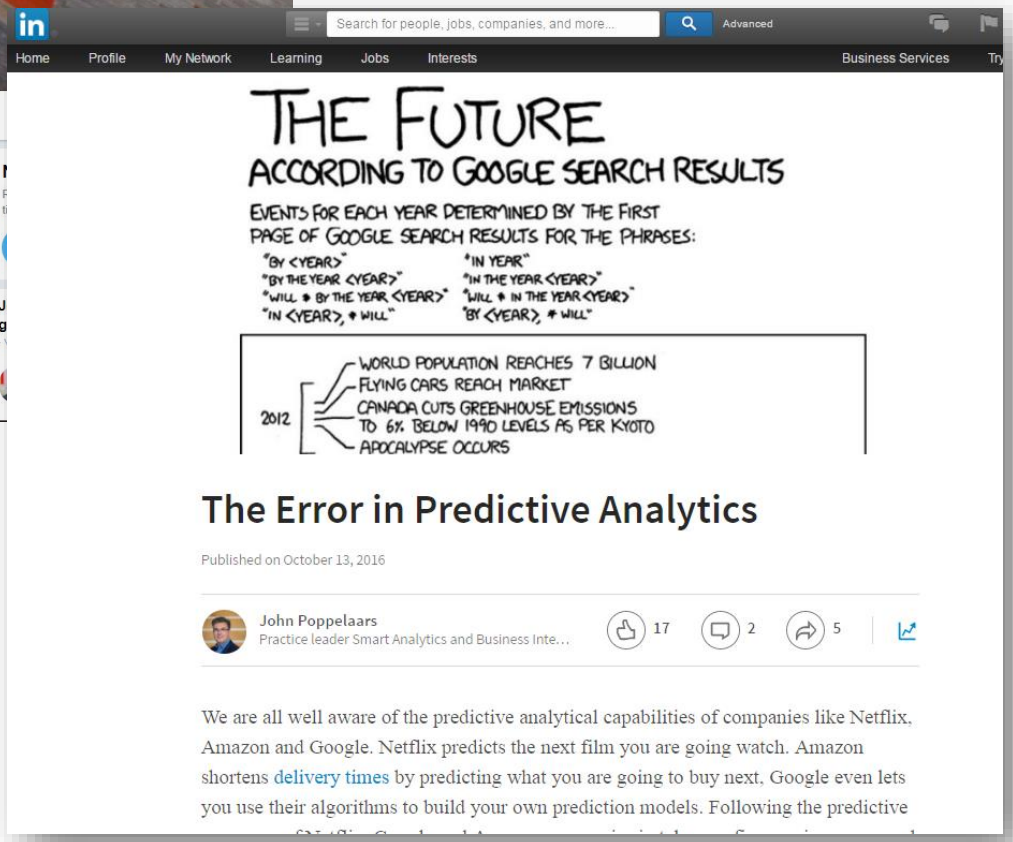
Using math on practical problems is easy…

..even Tom can do it

Who is John?

Passion for data, mathematics and decision making

BearingPoint®



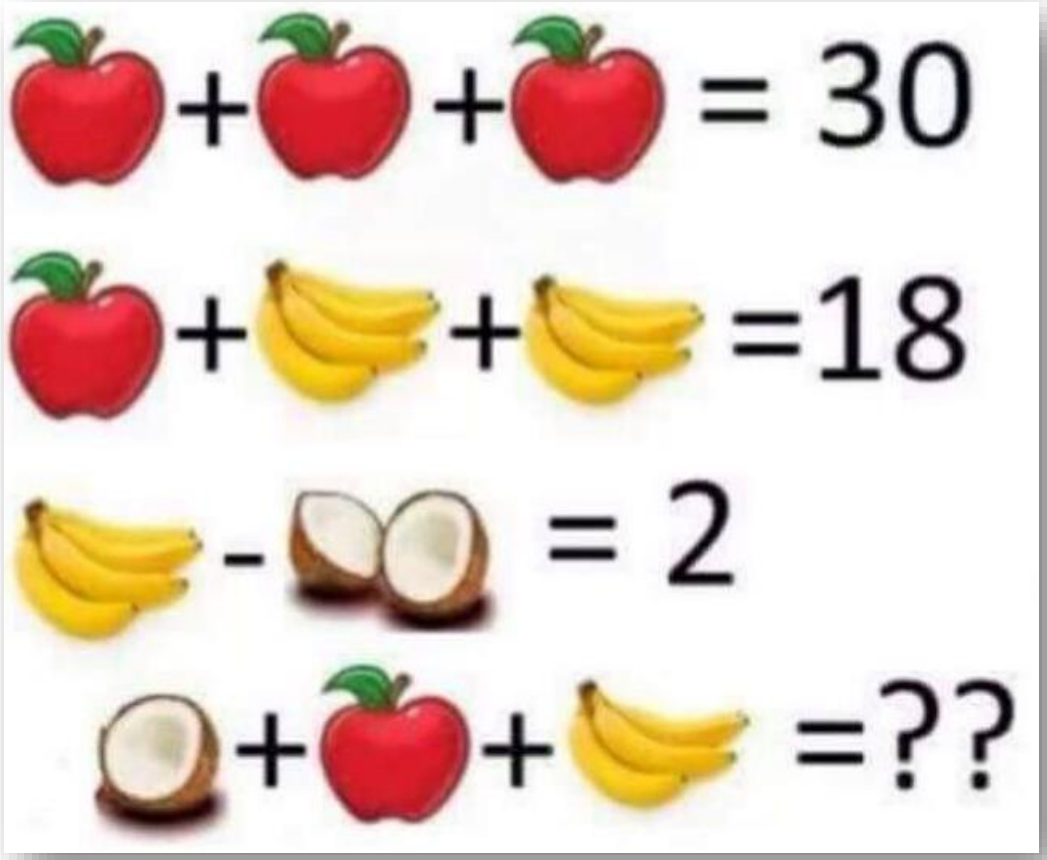
https://www.linkedin.com/today/author/johnpoppelaars

OO-TNB

MannaPack
THANKS
A
Million
Liberian Children
FOR CARING
YOUR LOVE

Problems need to be solved every day and everywhere, even on Facebook

This one is easy, even though there has been a lot of debate about it

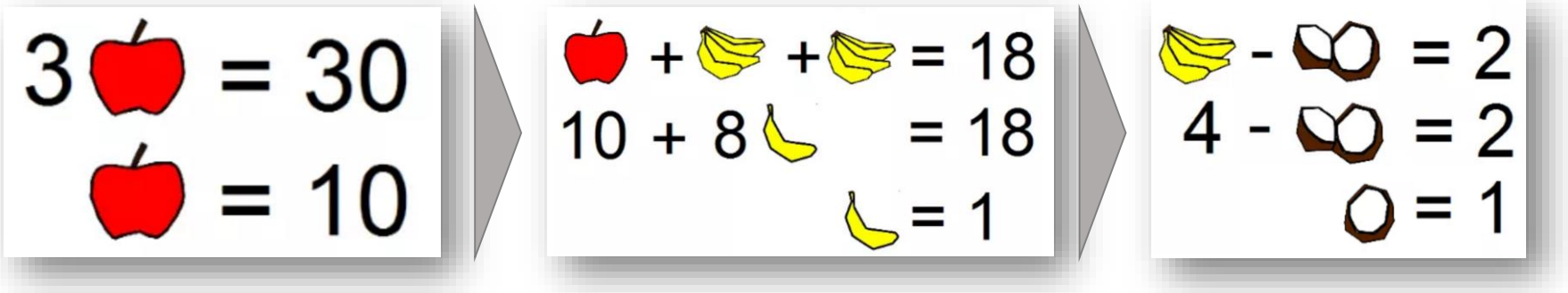


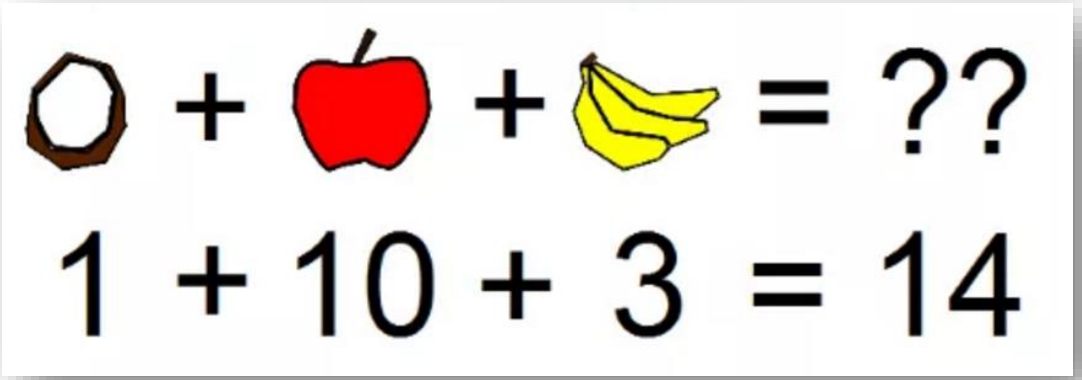
We know this

Spoiler

Spoiler

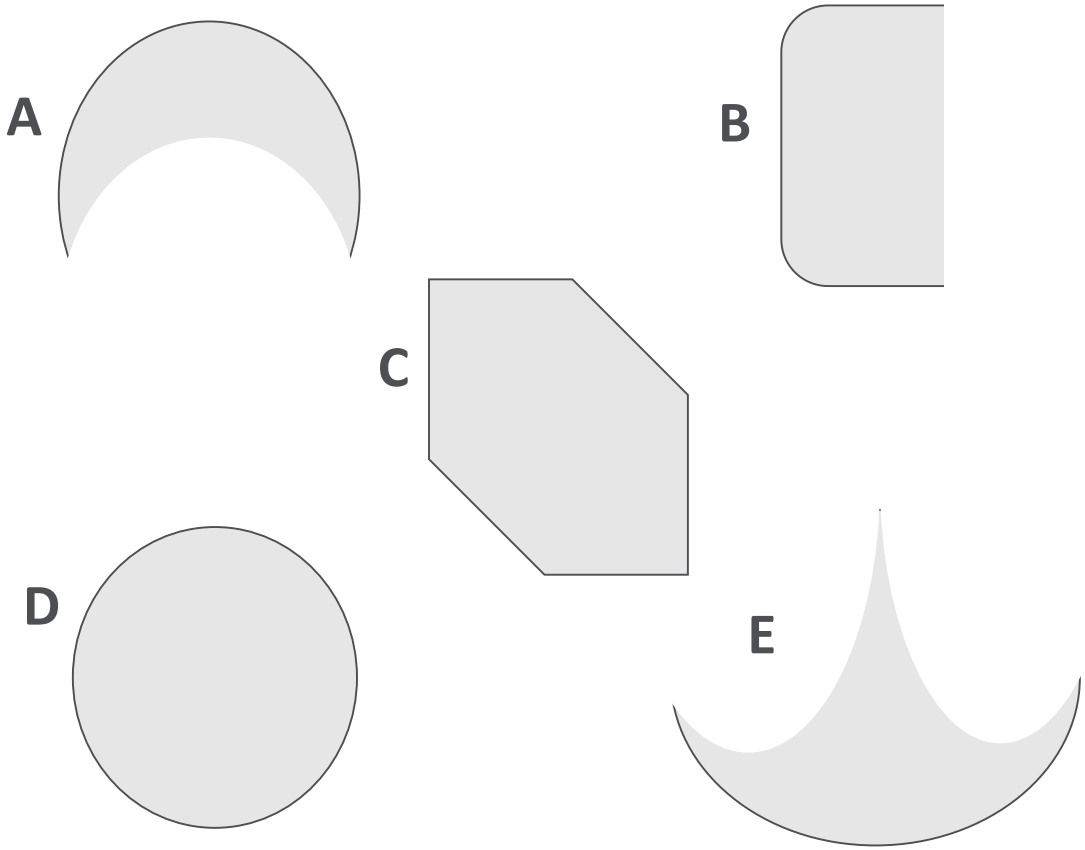
Some basic algebra does the trick





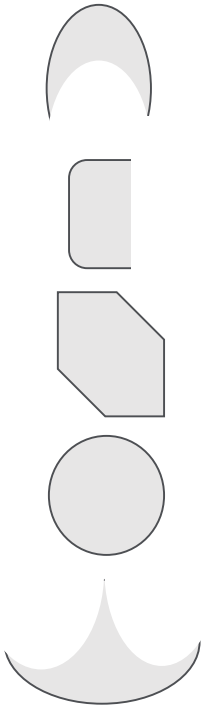
What about this one?

Which one doesn't belong with the others?



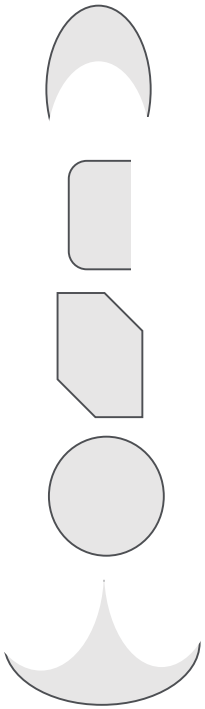
- From : Roger von Oegh. A Wack to the side of the Head (1983)

Let’s take some votes



Shape	Score
A	
B	
C	
D	
E	

The answer

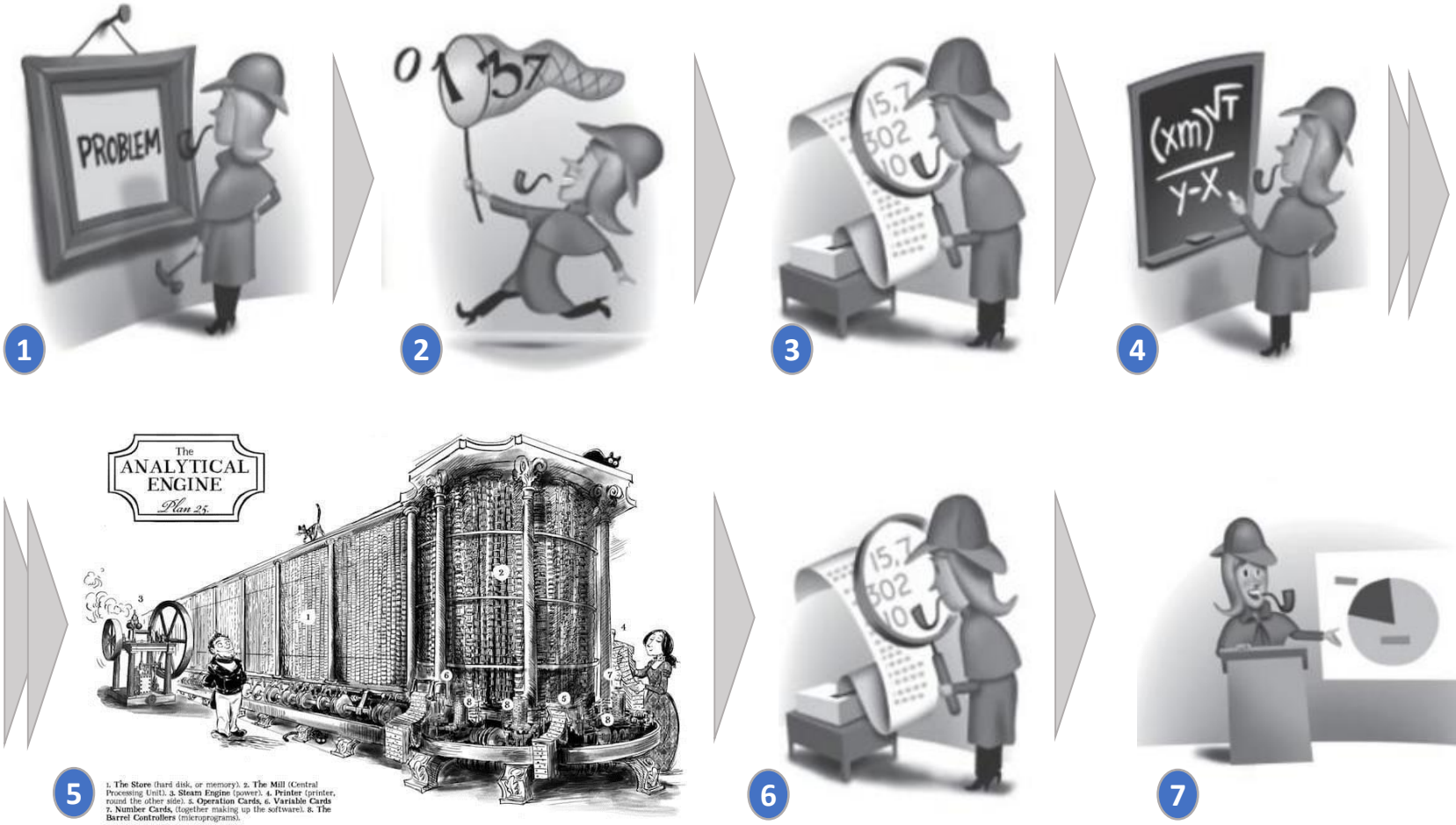


- Correct! It's the only one with part of the shape internal to the rest of the shape
- Correct! It's the only one with straight and curved sides
- Correct! It's the only one with all straight lines
- Correct! It's the only one with no corners (or points of discontinuity for mathematicians)
- Correct! It's the only one that depicts a non-Euclidian triangle projected into Euclidian space

There is no right or wrong answer

Which one is best depends on the circumstances.

Solving a practical problem…



…requires a structured process

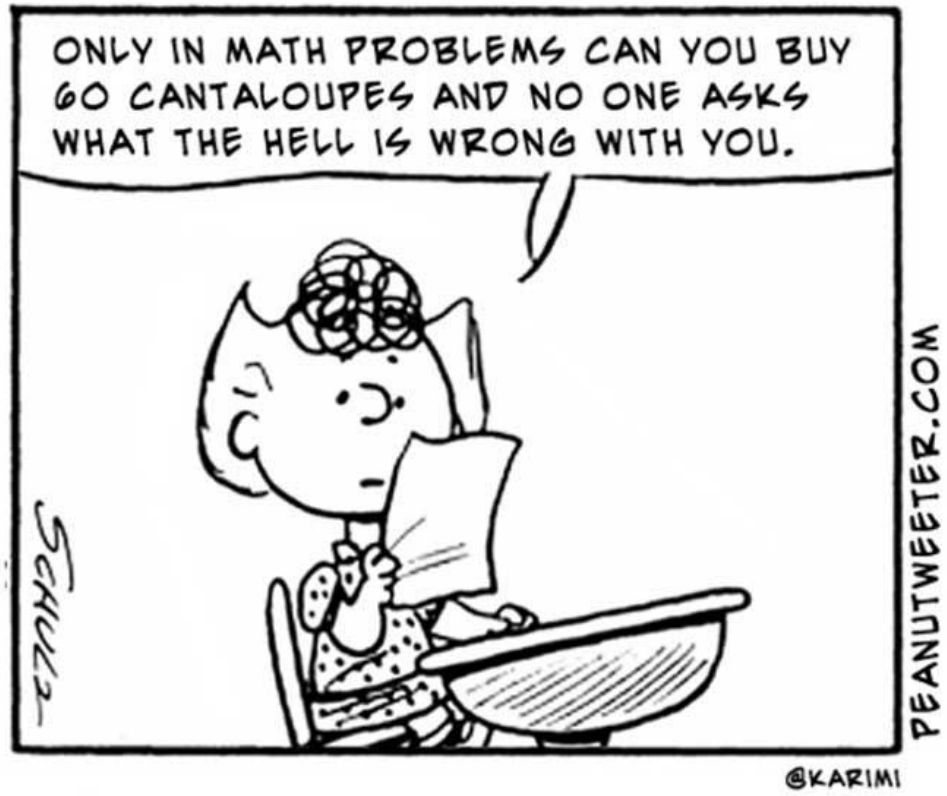
Source Cartoons : Keeping up with the Quants, Tom Davenport
Analytical Engine http://blog.hackerearth.com/charles-babbage-computer-history-computer-programming

The harsh reality of math consulting

1990

Theory vs Practice

Real life problems differ a lot from text book problems

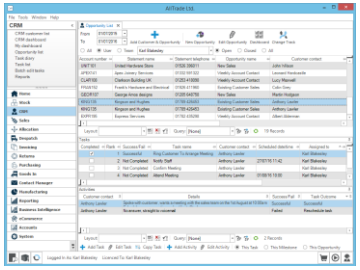


- You need to find out what is relevant and what not
- Need to identify what data you require
- Have to create multiple math models and find a way to solve them
- Model needs to be simple enough to be of practical use, complex enough to be able to solve the problem
- Many times there is no wrong or right answer
- It takes a lot of discussions, posing and testing hypothesis, and making mistakes.

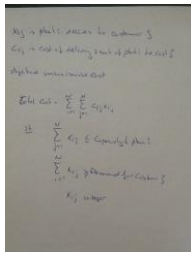
Things have changed

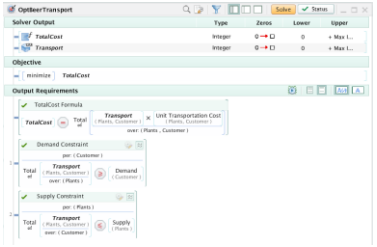
Much more data, faster computers and better software

Data



Model





Calculation

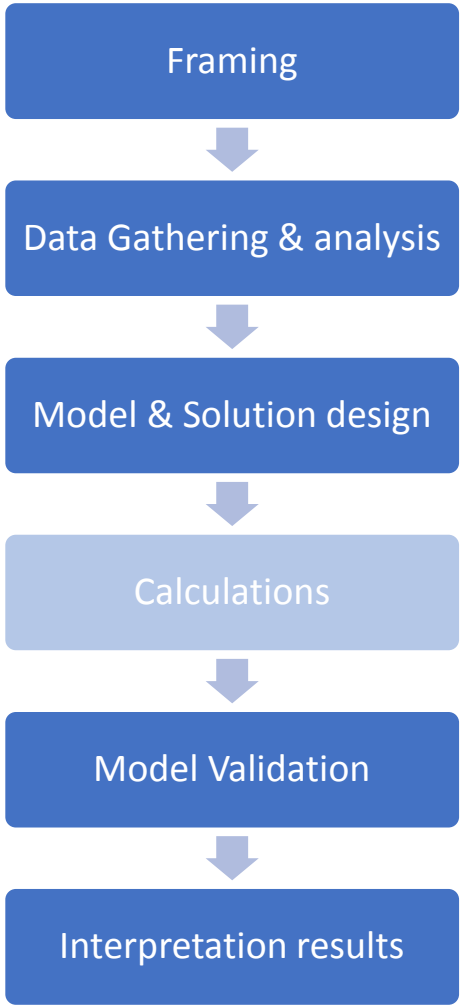
Effort

Several weeks

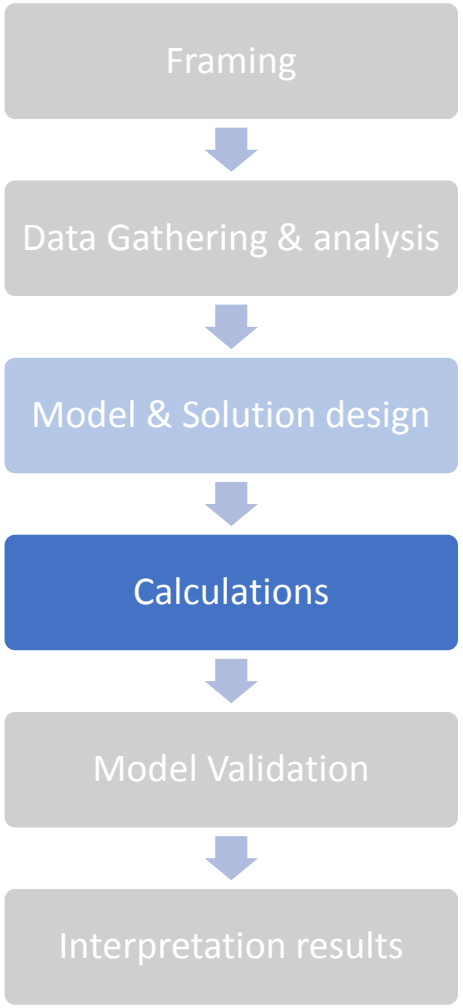
Within days

1990 | 2017

Required Practical Math Skills



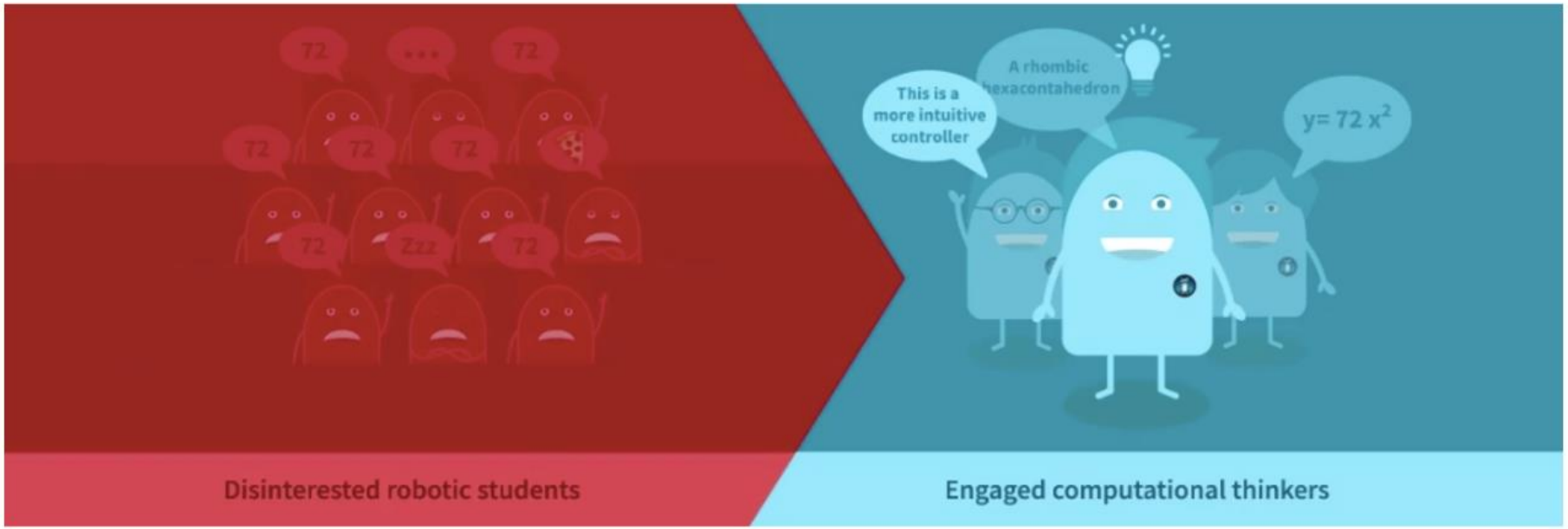
Math Curriculum



A computer is much better at what we learn in math class, also in practice computers will do this work anyway

Let's Fix Maths Education

Solve Today's Classroom Crisis with Computer-Based Maths



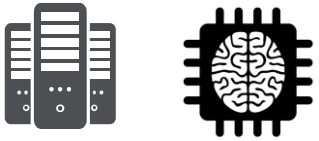
Embed computers in math class and teach problem solving with real life problems

http://computerbasedmath.org/

ATARI

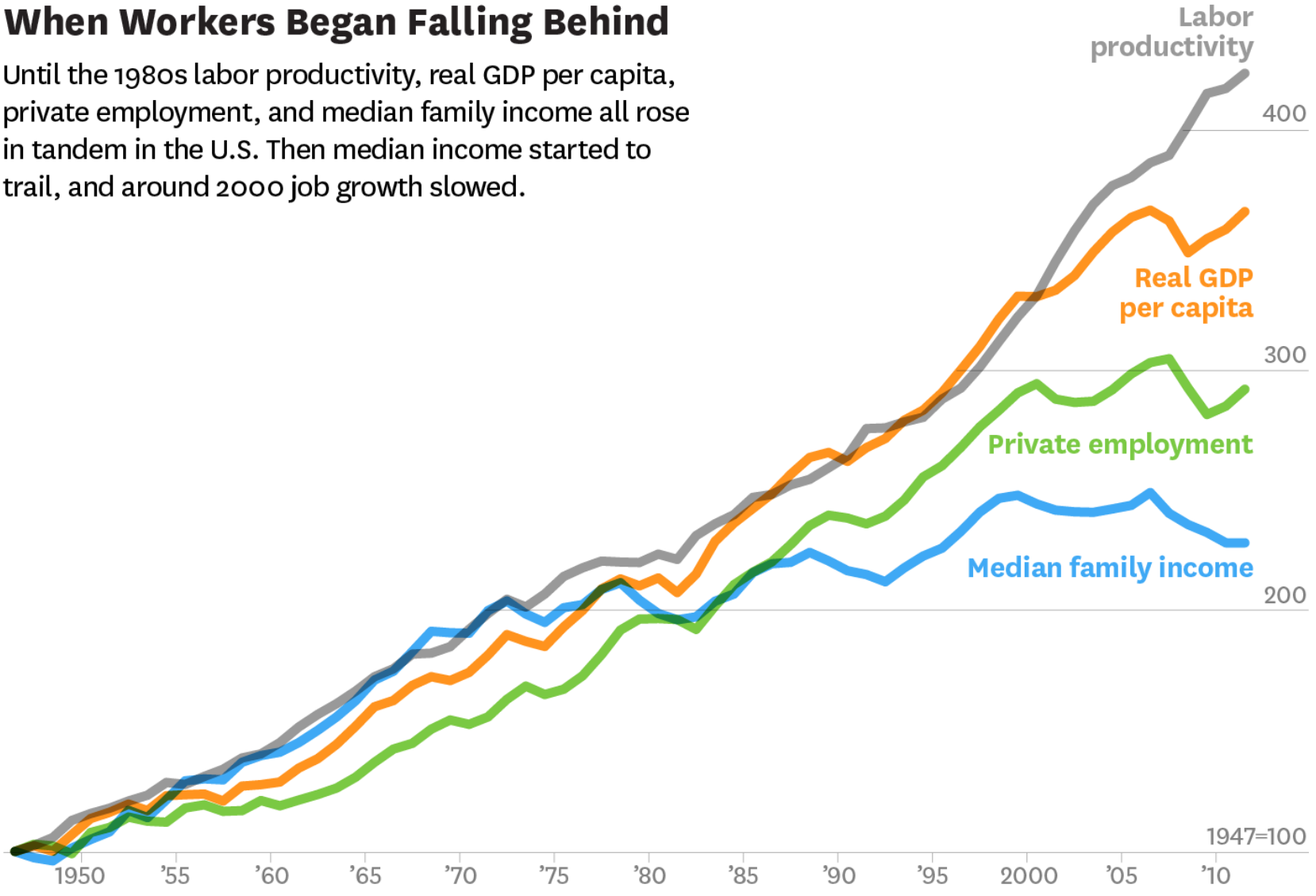
Math is changing the world

To change the world, you need both physical and mental power. We seem to be losing control over both

	<1800	>1800, <1990 Industrial revolution	>1990 2nd Machine Age
Physical Power	 Muscle power, animals	 Steam, combustion and electric Engines	 Combustion and electric Engines
Mental Power	 Human	 Human	 Computers, big data, IoT and AI?

When Workers Began Falling Behind

Until the 1980s labor productivity, real GDP per capita, private employment, and median family income all rose in tandem in the U.S. Then median income started to trail, and around 2000 job growth slowed.



SOURCE FEDERAL RESERVE BANK OF ST. LOUIS; ERIK BRYNJOLFSSON AND ANDREW MCAFEE
FROM "THE GREAT DECOUPLING," JUNE 2015

© HBR.ORG

Is it time to fold?

ENGINEERING

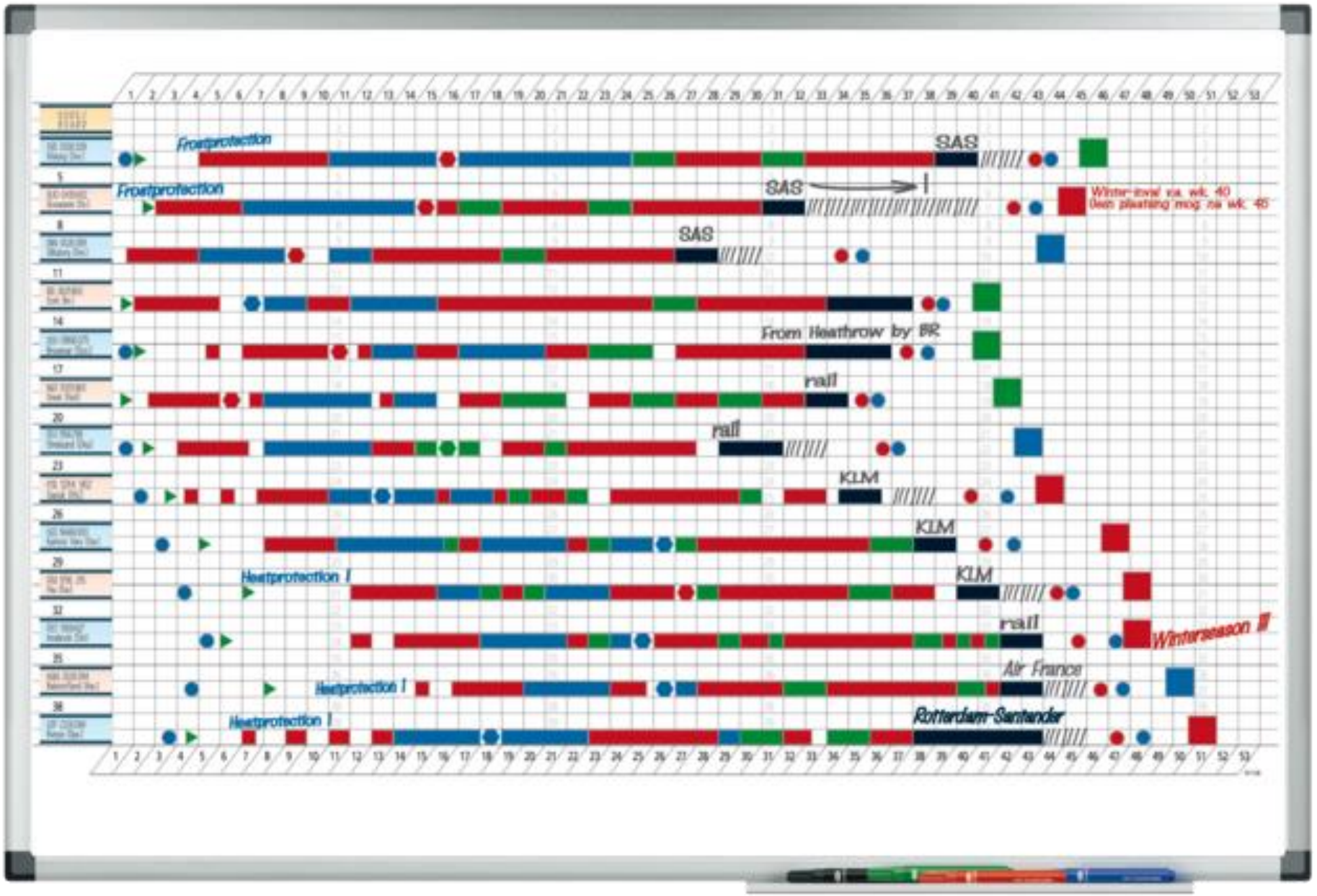
Time to Fold, Humans: Poker-Playing AI Beats Pros at Texas Hold'em

The feat represents a leap forward in developing artificial intelligence that can learn with incomplete information

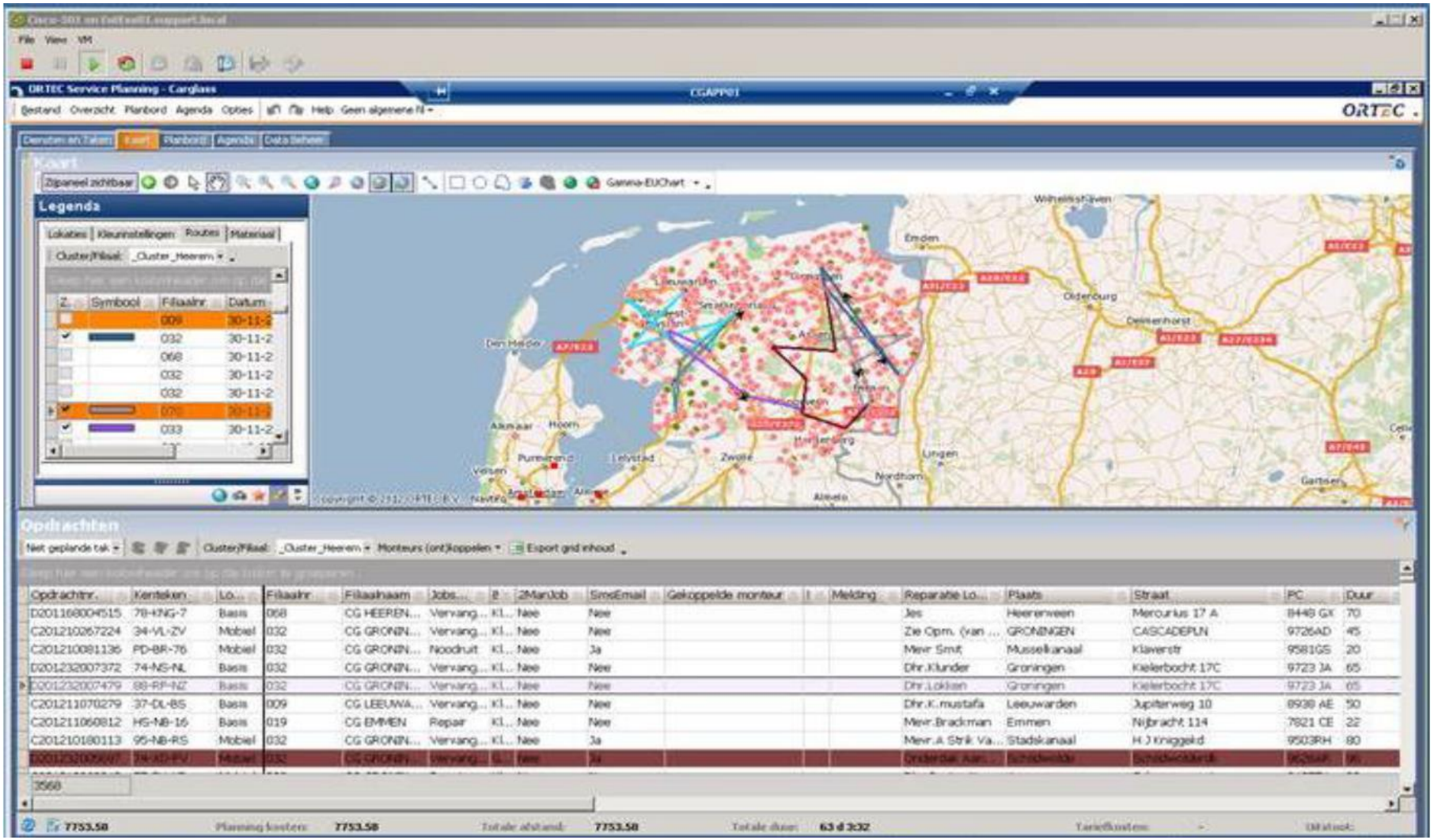
By Catherine Caruso on March 2, 2017

https://www.scientificamerican.com/article/time-to-fold-humans-poker-playing-ai-beats-pros-at-texas-hold-rsquo-em/

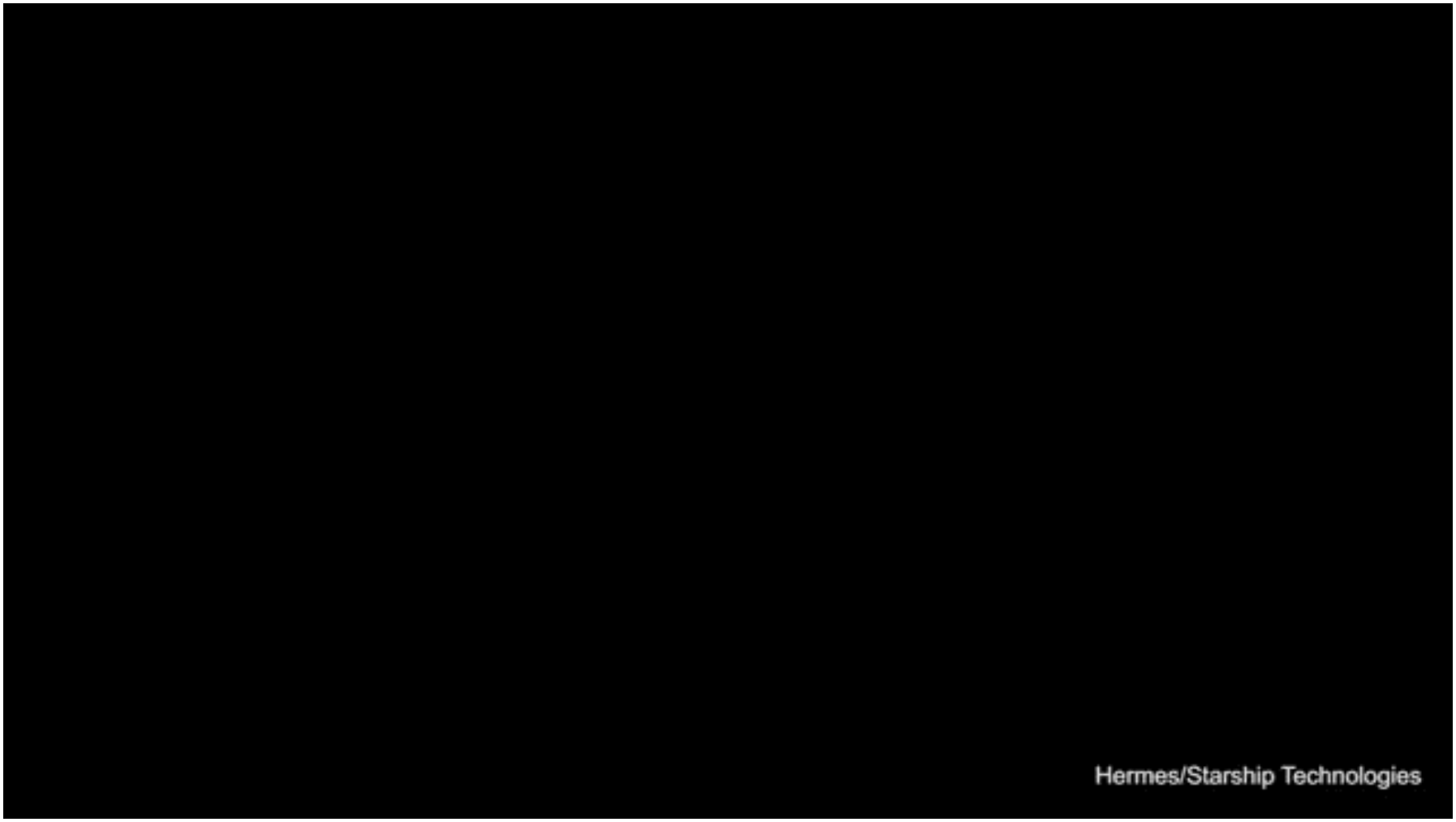
Planning in 1990



Planning in 2010

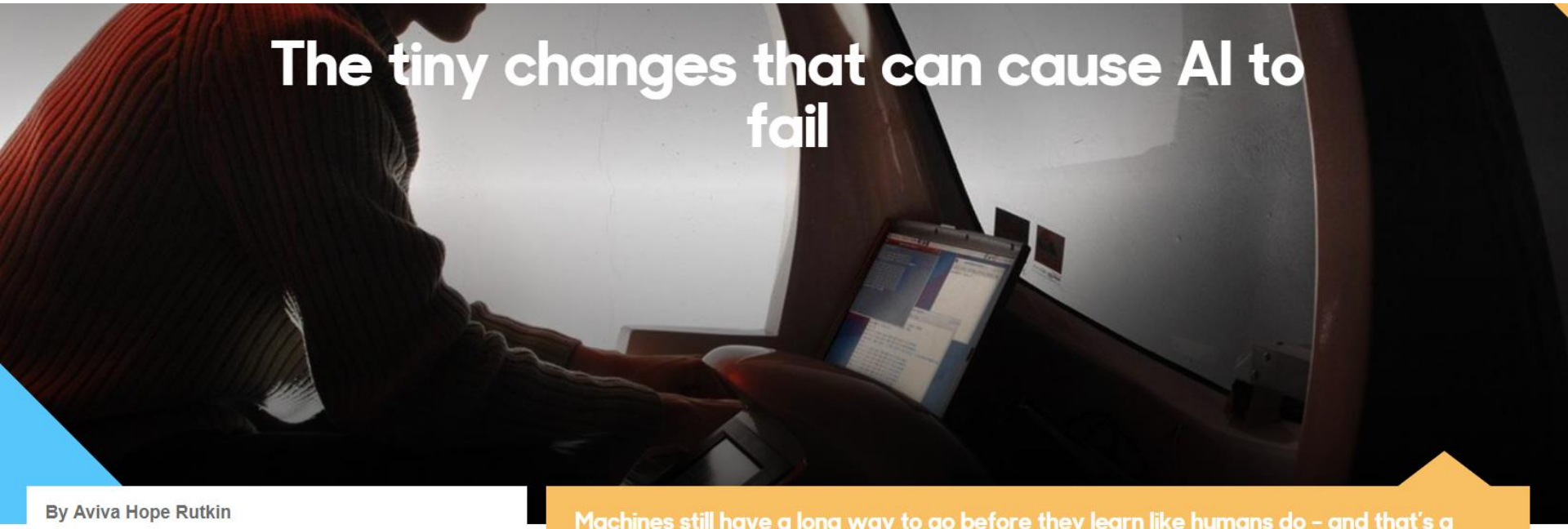


No Planning in 2030?



Computers are good at calculation
and exploiting patterns,
predictable work is at risk

Although powerful, AI isn't infallible

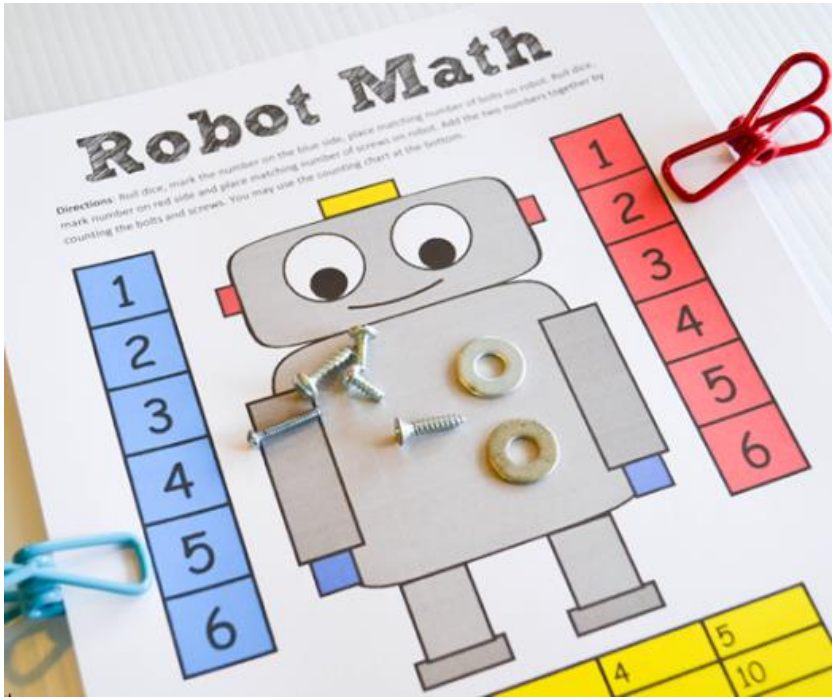


This requires us(ers) to be alert and critical

http://www.bbc.com/future/story/20170410-how-to-fool-artificial-intelligence

There will be a lot of areas where humans will continue to outperform machines, among these[1] :

- Interpersonal and social contacts
- Creativity
- Entrepreneurship
- **Problem framing and problem solving**



We need to adapt math teaching for that

[1] The Second Machine age, McAfee & Brynjolfsson

Questions?