A Framework For Computational Thinking For The Transition To A Super Smart Society

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Universidad de Chile

Computational Thinking

Why?

What?

How to teach it?

Computational Thinking

Why?

What?

How to teach it?

Imagine the future

Source: The Government of Japan

Super Smart Society

Your smartphone talks to you and make suggestions

Your smartphone takes the initiative

Your Smartphone learns autonomously

A second App in your smartphone also takes the initiative but has another opinion

Both Apps take the extra initiative to talk each other and discuss their arguments

You have 10 different Apps with different personalities

Welcome to a new fascinating world: the Super Smart Society

Time to include Computational Thinking in the curriculum?

Common Core v/s NGSS

Mathematical Practices	Scientific and Engineering Practices
1. Make sense of problems and persevere in solving them	1. Ask questions and define problems
2. Reason abstractly and quantitatively	2. Develop and use models
3. Construct viable arguments and critique the reasoning of others	3. Plan and carry out investigations
4. Model with mathematics	4. Analyze and interpret data
5. Use appropriate tools strategically	5. Use mathematics and computational thinking
6. Attend to precision	6. Construct explanations and design solutions
7. Look for and make use of structure	7. Engage in argument from evidence
8. Looking for and expressing regularity in repeated reasoning	8. Obtain, evaluate, and communicate information

Computational Thinking

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Computational Thinking

Decompose in elementary machines

Computational modeling

Machine Learning

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Computational Thinking is the thought processes involved in formulating a problem and expressing its solution(s) in such a way that a computer – human or machine – can effectively carry out

- Jeannette Wing, Director of the Data Sciences Institute at Columbia University

https://www.youtube.com/watch?v=YVEUOHw3Qb8 at min 17:15

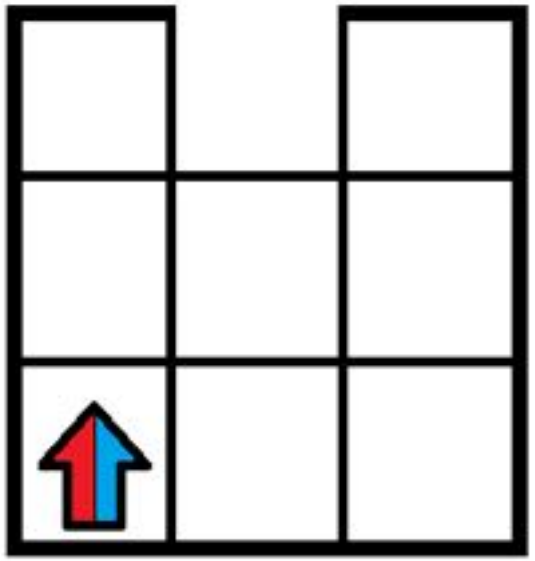
Let us calculate, without further ado, to see who is right

- Leibnitz

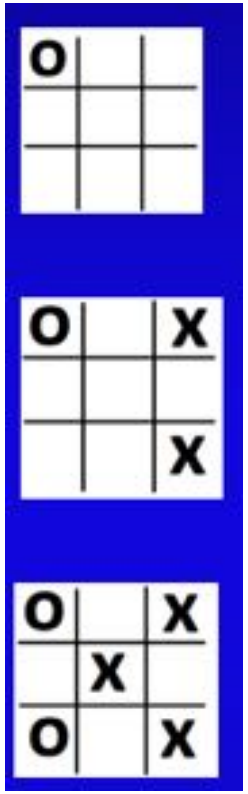
Four species calculating machine - an apparatus that was able to conduct the four basic arithmetic operations **mechanically**

Vehicles & robots

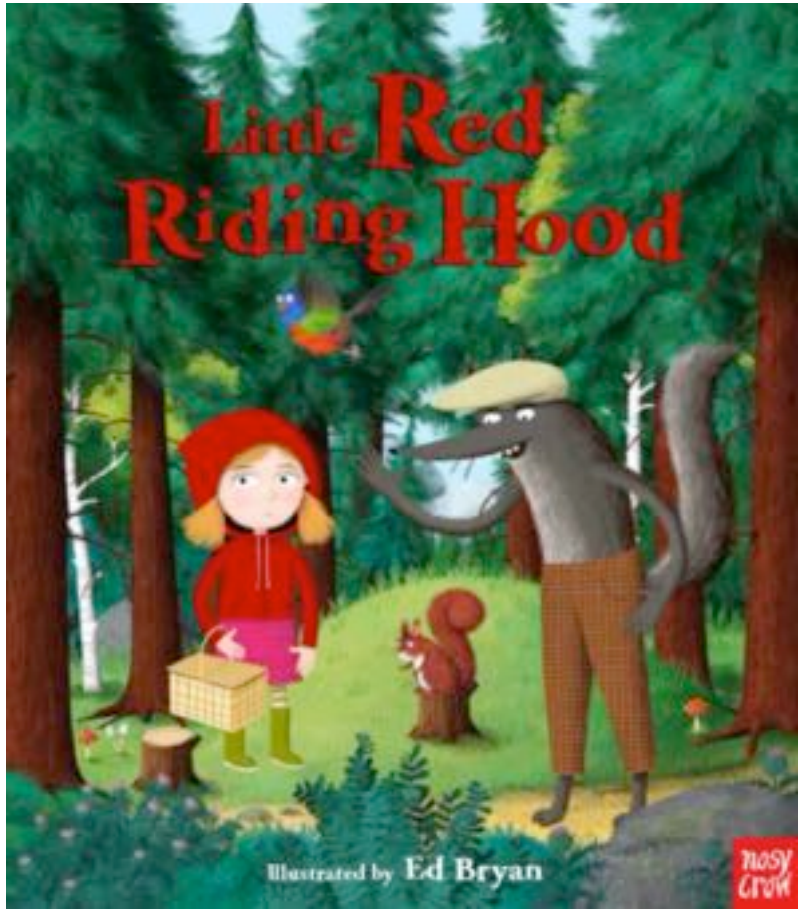
Games



What RULES (code) are neede?



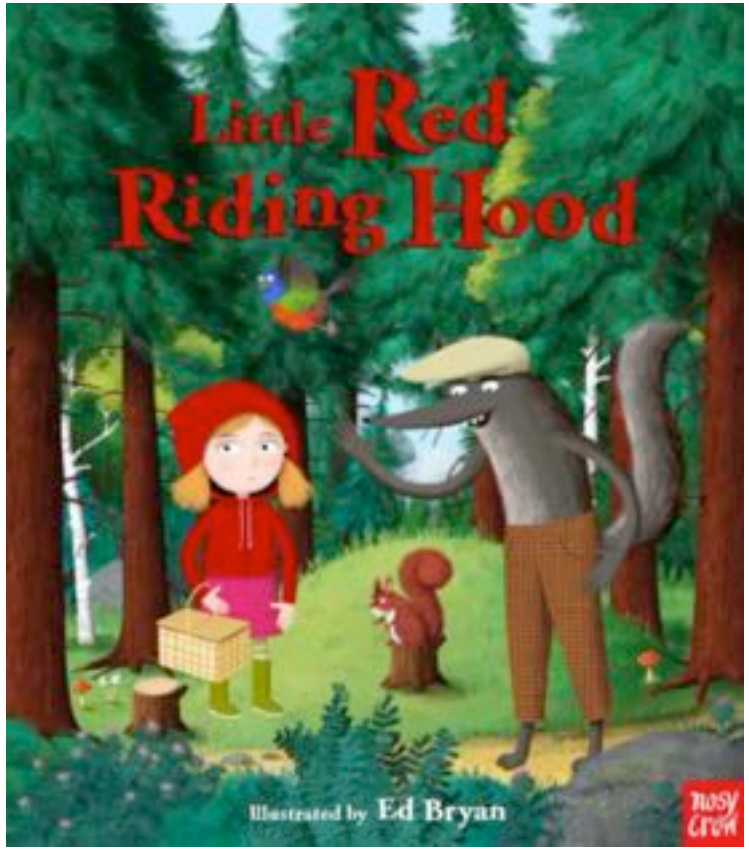
Digital Humanities

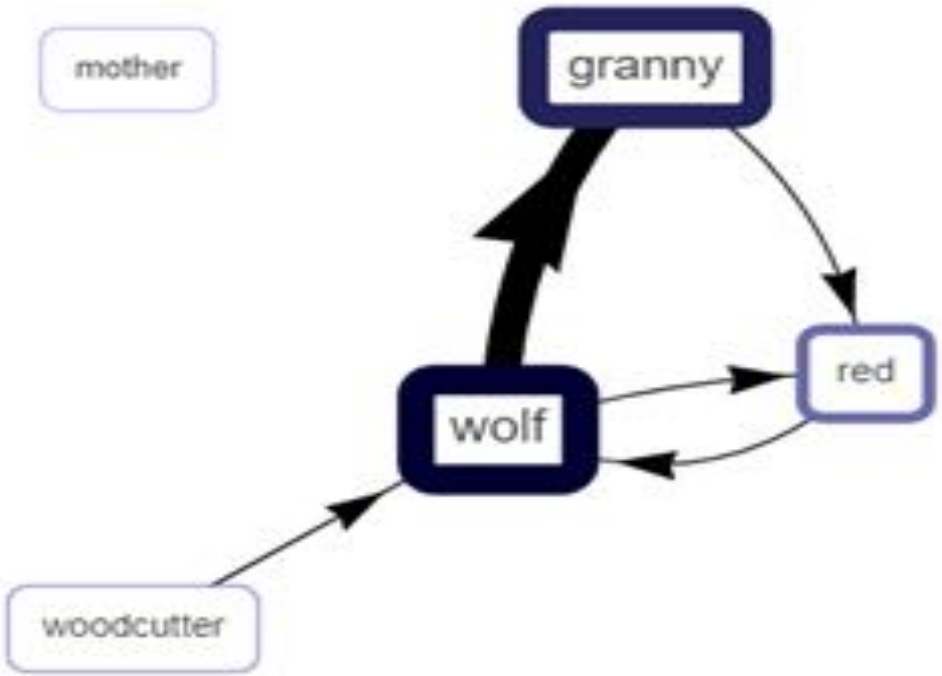


Frequencies of appearance of the characters:

Granny	10
Mother	1
Little Red Riding Hood	5
Wolf	12
Woodcutter	2

Little Red Riding Hood





In the 1960s and 1970s we allowed, and even encouraged, the perception"CS = programming," which is now to our dismay widely accepted outside the field

- Denning, P. (2009) **Beyond Computational thinking**

Computational Thinking is much more than computer programming

- Jeannete Wing, https://www.youtube.com/watch?v=YVEUOHw3Qb8 *at 26:02*

Computational Thinking

Decompose in elementary machines

Computational modeling

Machine Learning

Building models not only relies in abstractions like number and computation with numbers.

*It uses also the human ability that capture patterns and the **dynamic** of unfolding actions.*

- Peter Denning

0	16	32	10	0	2	14	22	0	0	0	0	22	0	0	29	6	33	26	0	5
9	27	0	0	31	0	0	0	10	0	22	0	6	20	0	0	0	20	0	4	0
0	0	32	0	14	0	0	0	0	33	9	2	0	0	0	5	0	0	34	0	0
0	0	21	0	30	0	0	19	13	0	20	26	7	0	0	0	0	0	0	0	7
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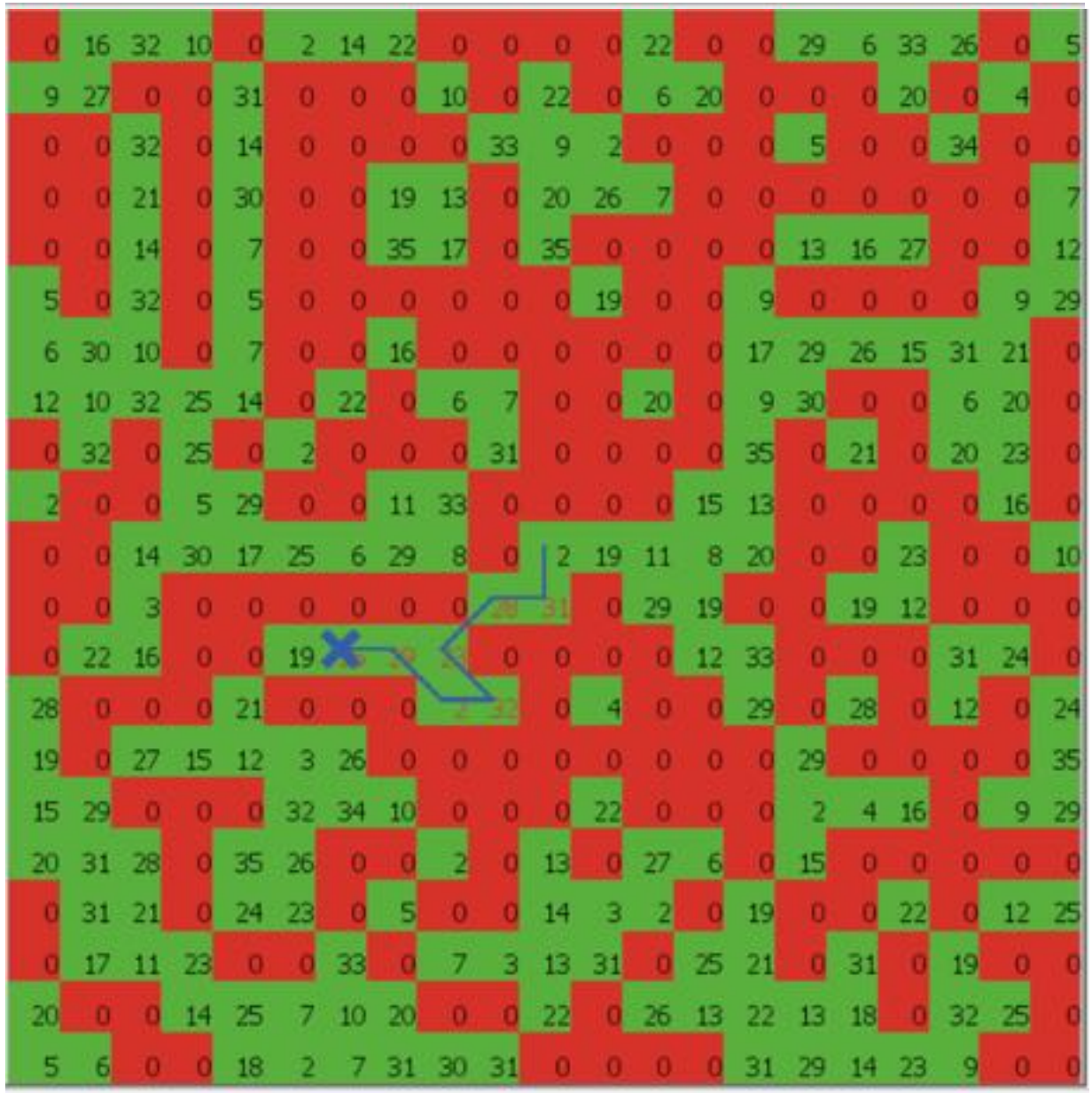
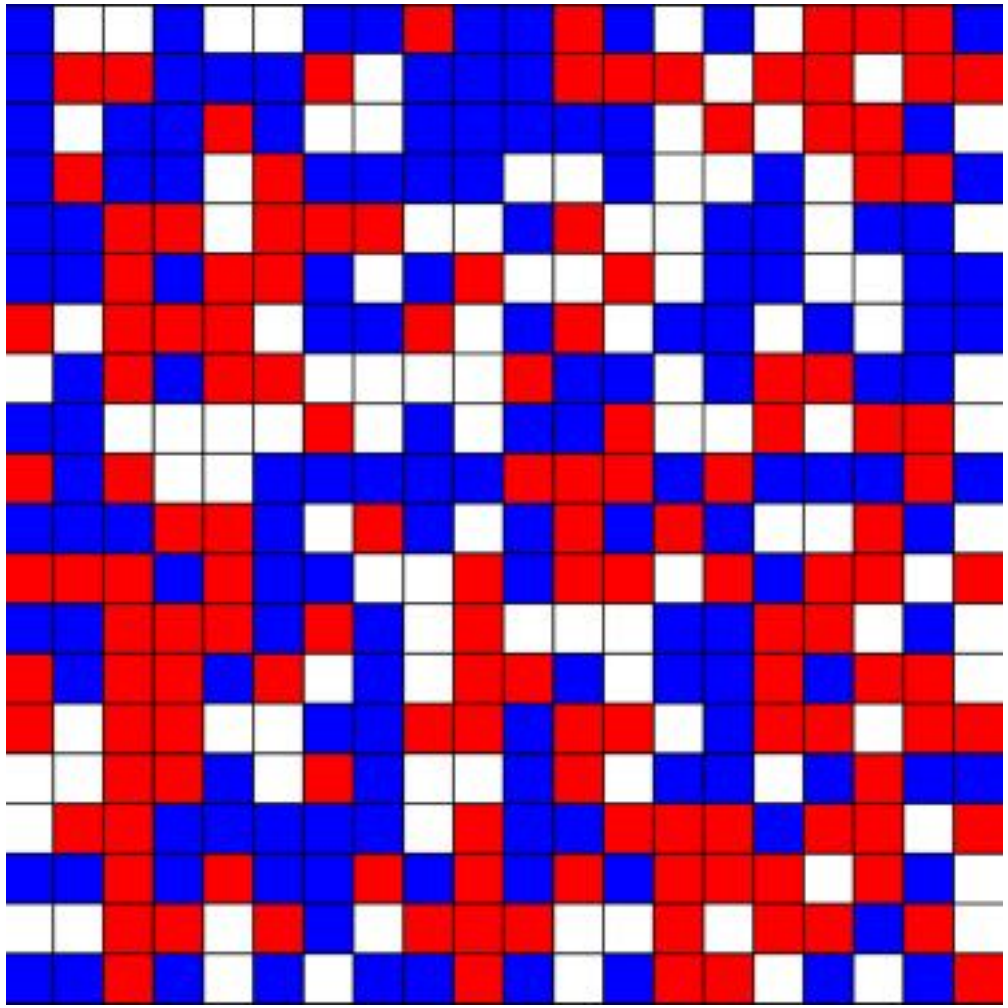
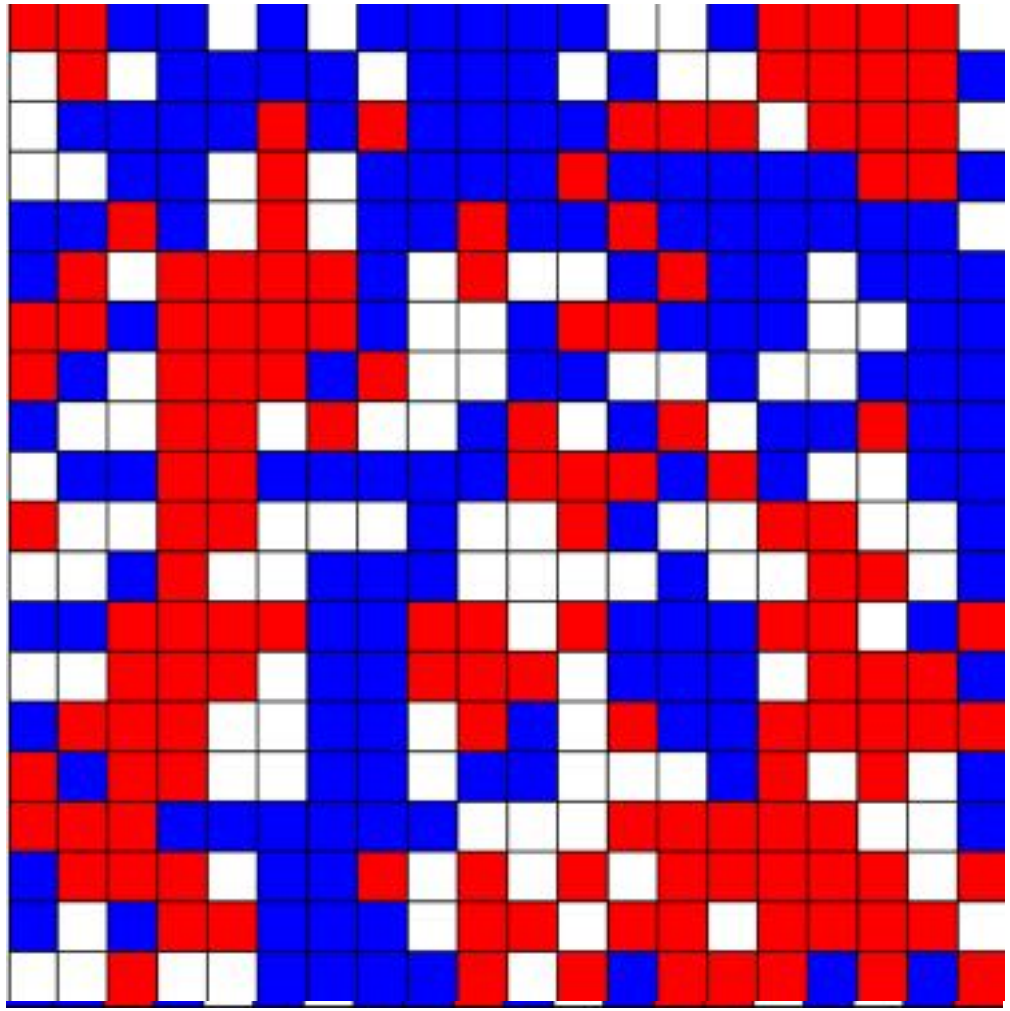


Schelling segregation model



http://nifty.stanford.edu/2014/mccown-schelling-model-segregation/

Schelling segregation model



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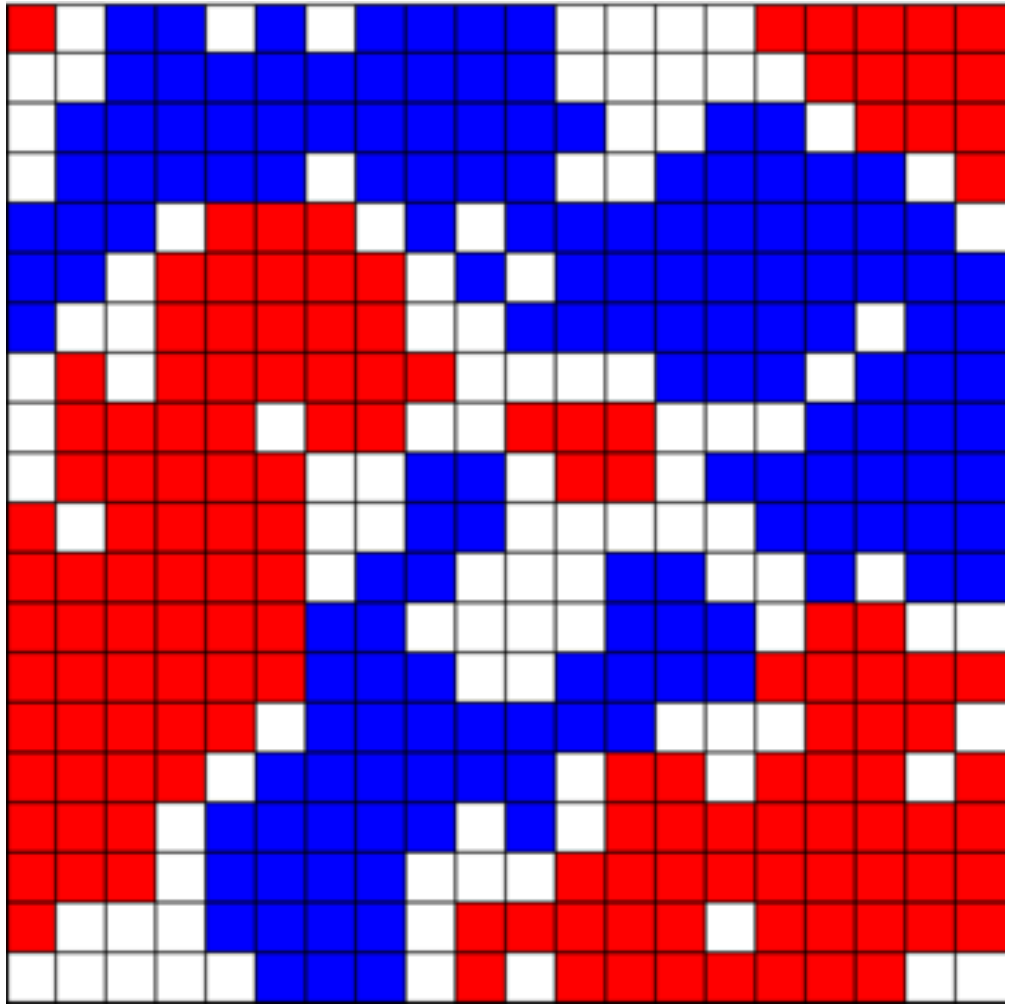
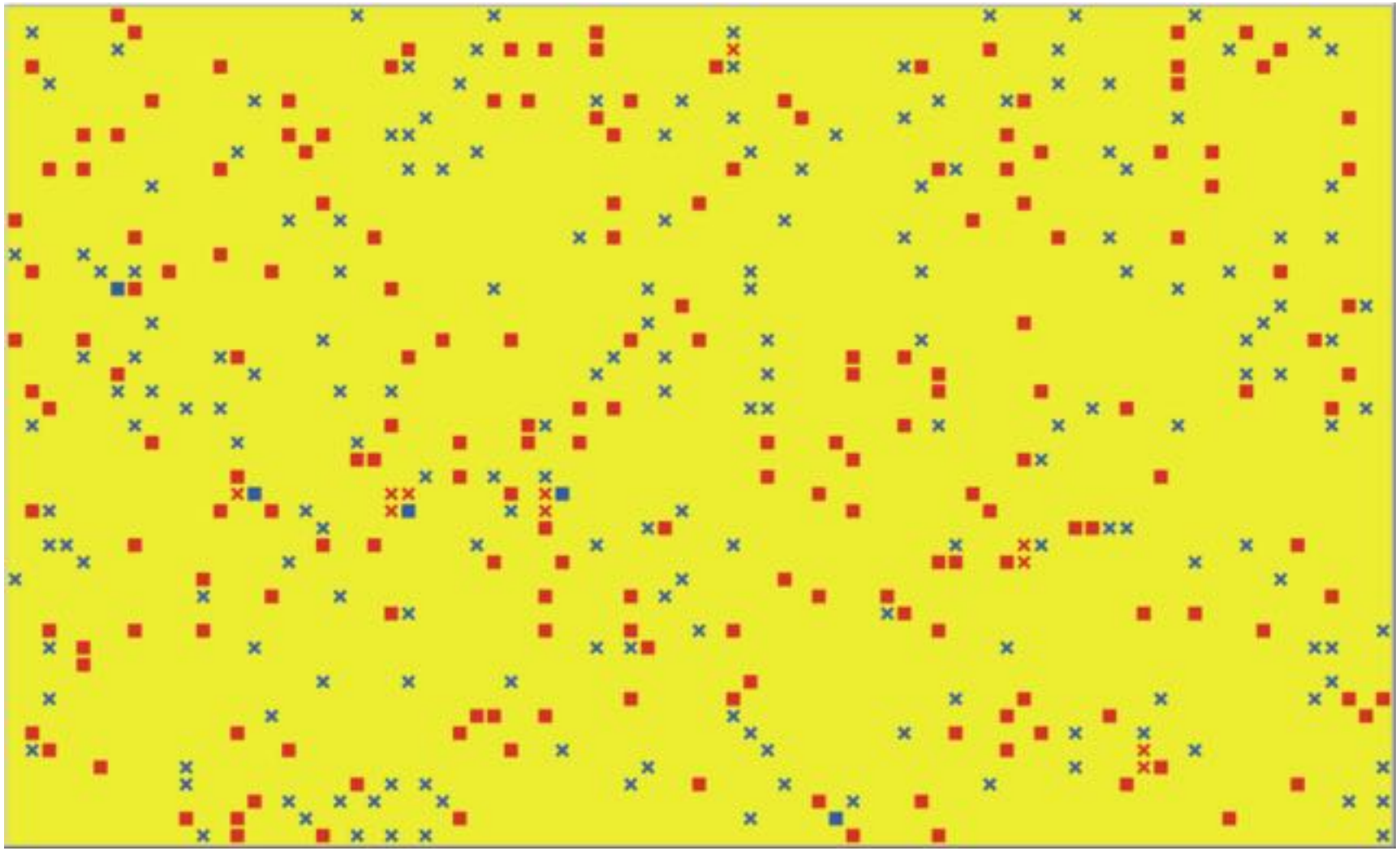
Schelling segregation model

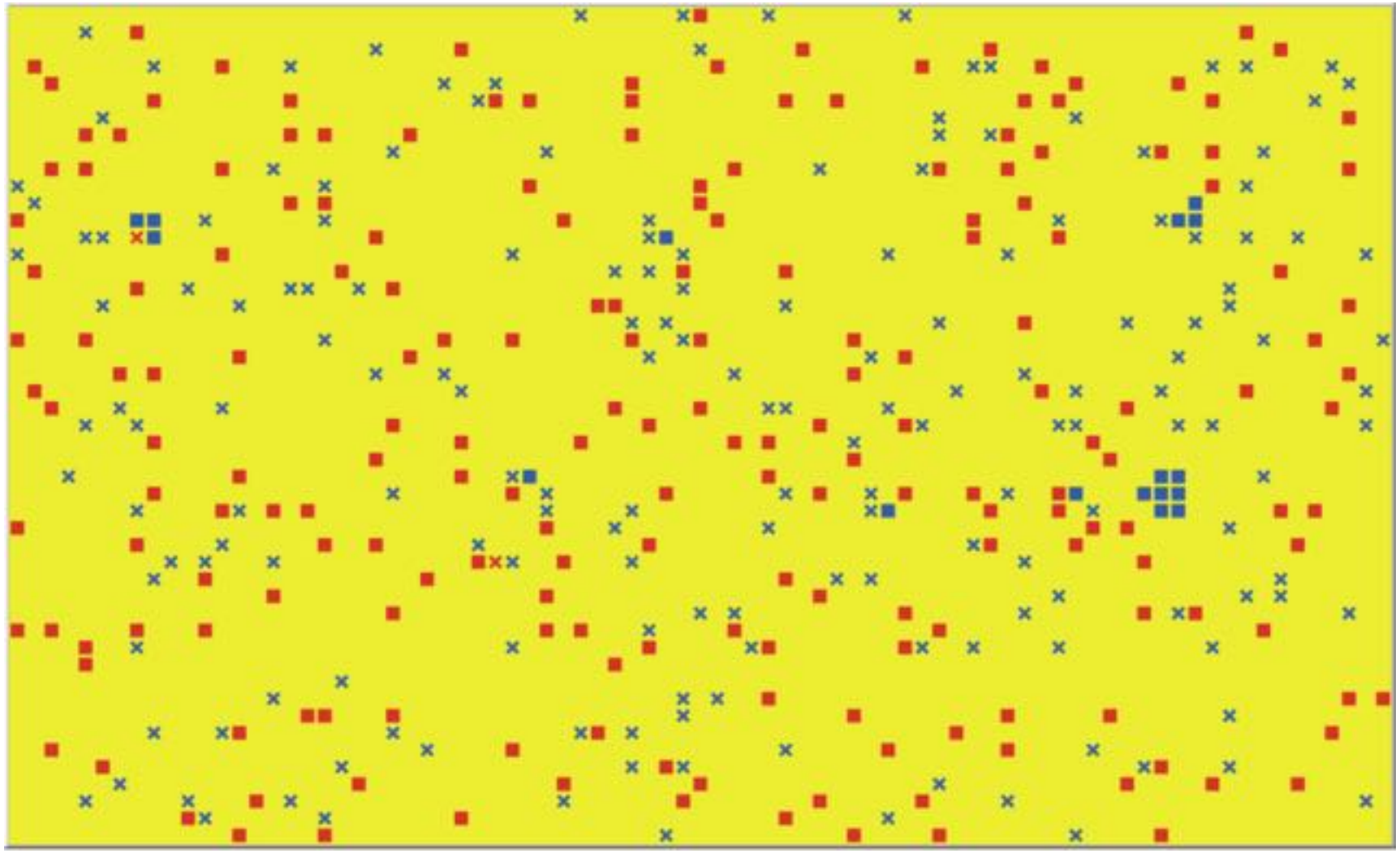


http://nifty.stanford.edu/2014/mccown-schelling-model-segregation/

Social polarization between ‘*Somewhere*’ people and ‘*Anywhere*’ people



Social polarization between ‘*Somewhere*’ people and ‘*Anywhere*’ people



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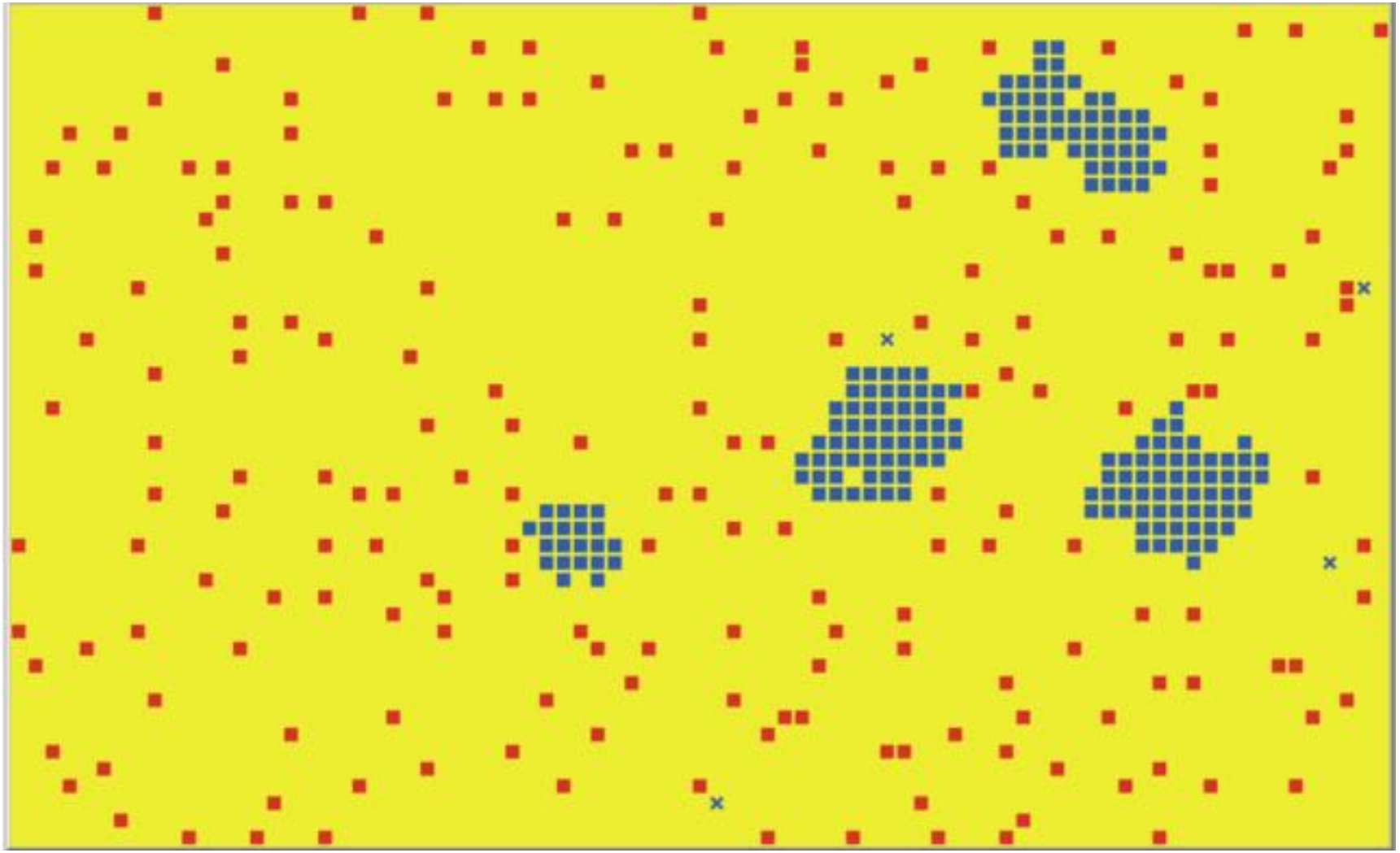
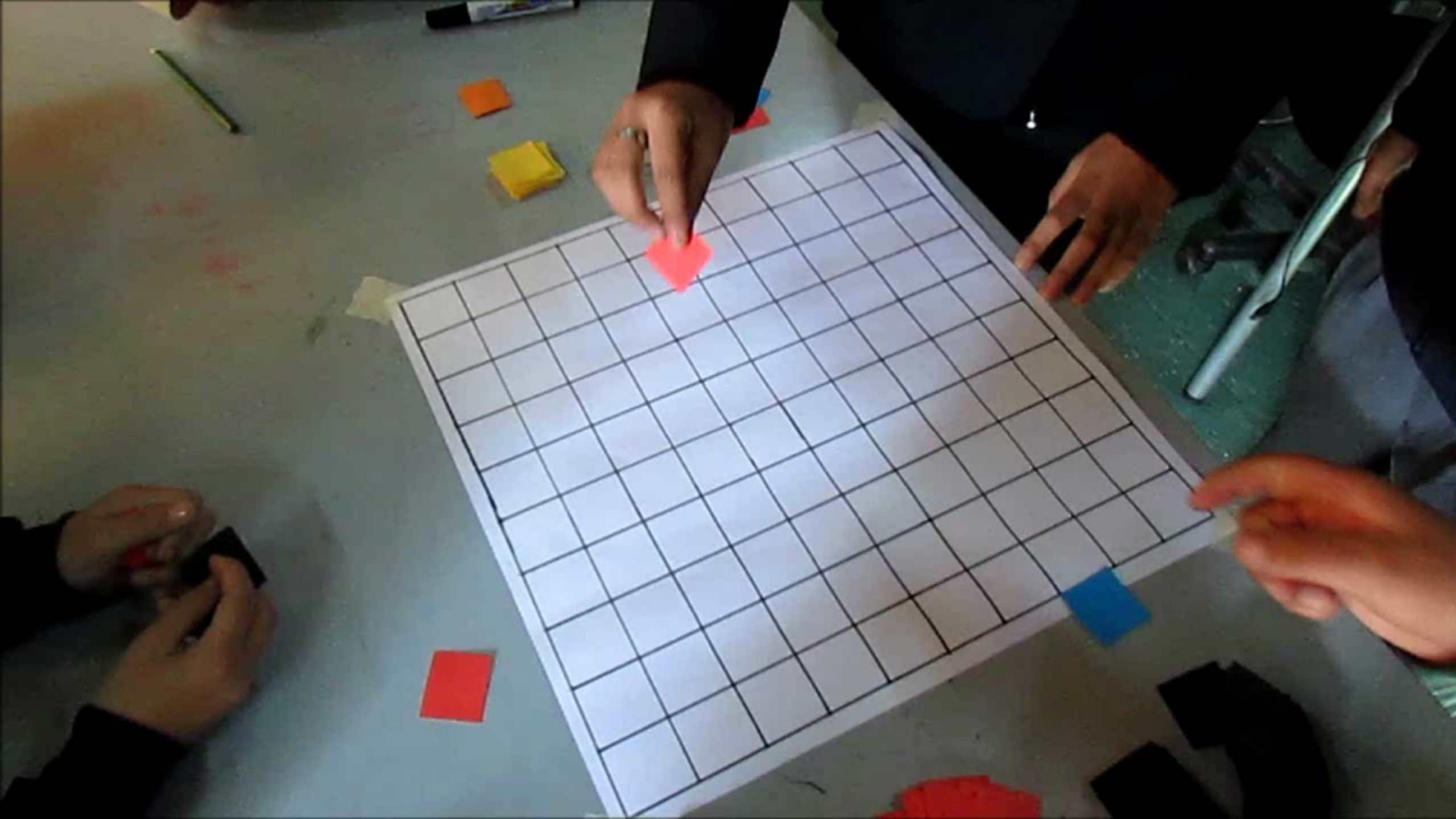
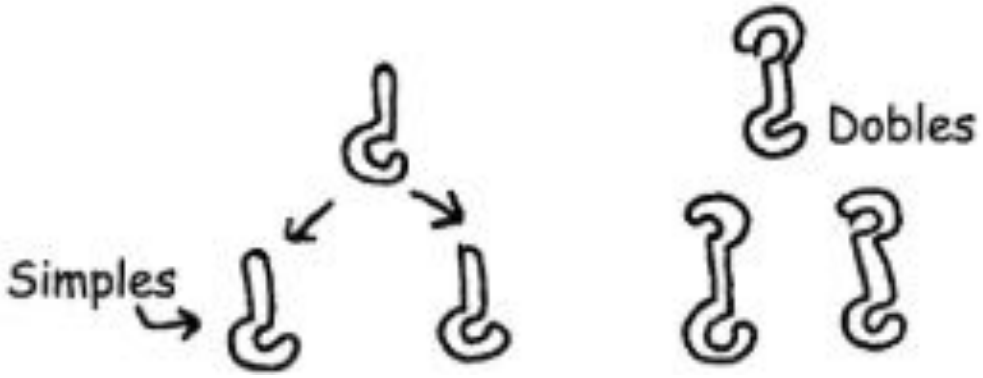
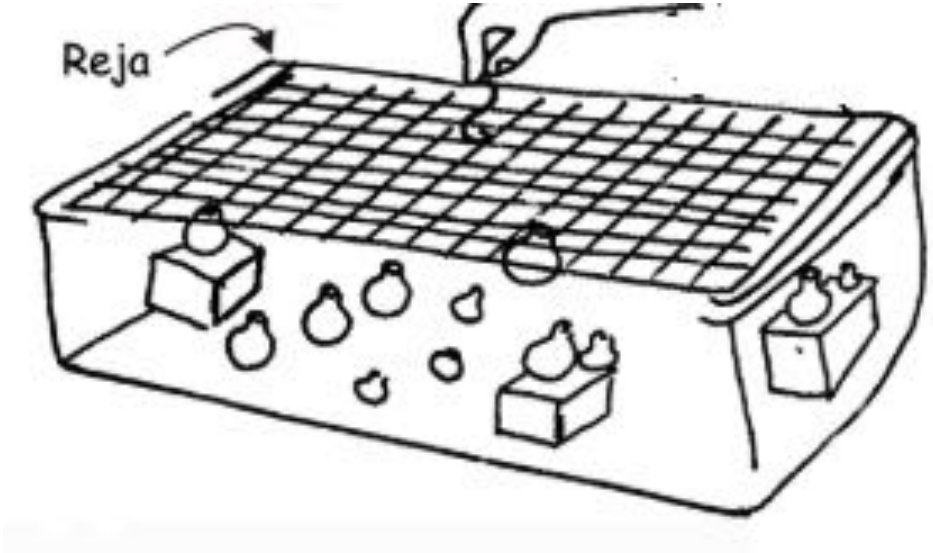





Dobles
Simples


Reja

Artificial, Natural & Sexual Selection

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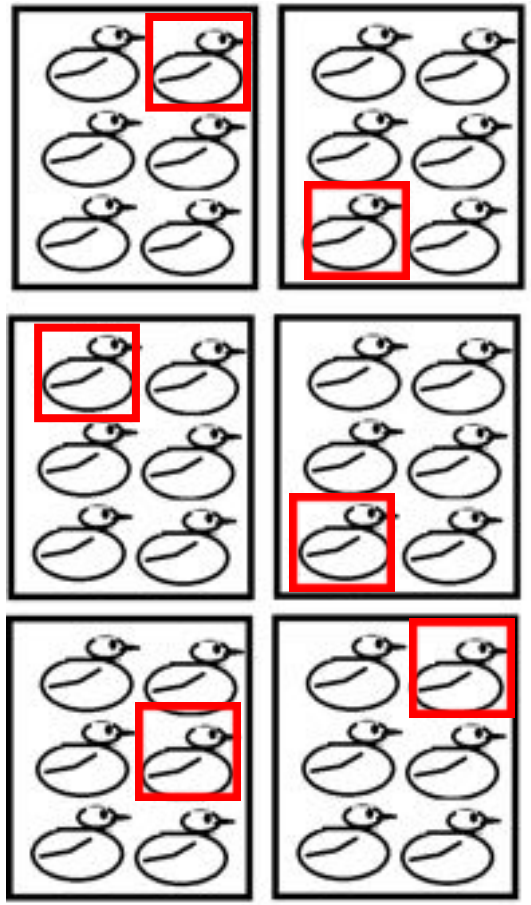

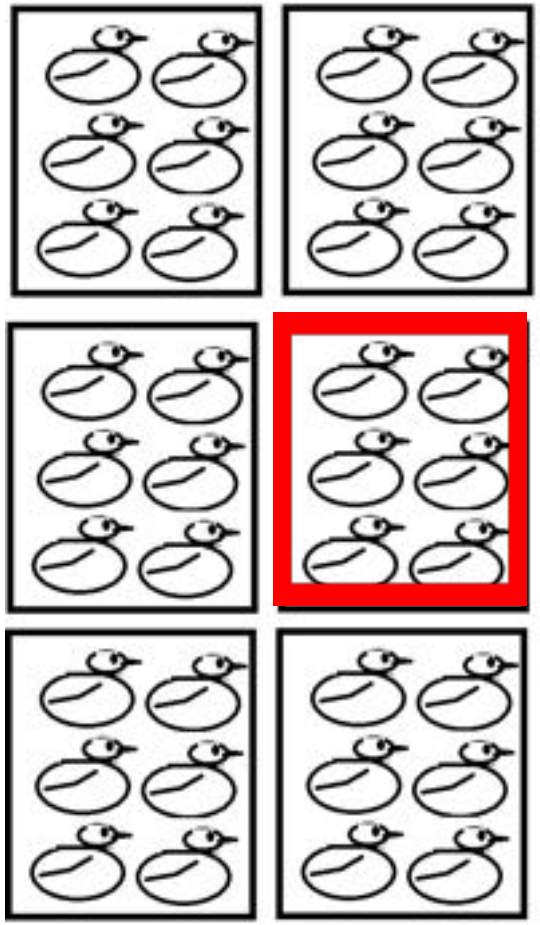

Group Selection

Computational Thinking

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Machine Learning

Machines that learn?

How does the Machine learn?

Machine learning

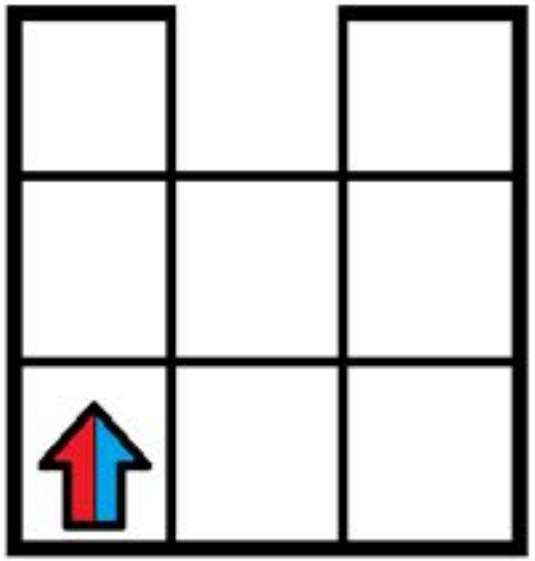
Machine learning techniques mark a break with the classic algorithm.

In particular, as they mark the gradual transition from a programming logic to a learning logic

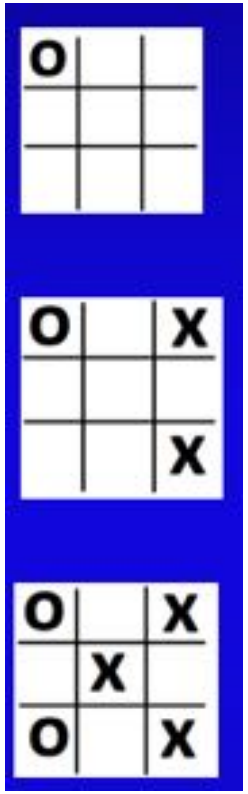
- C. Villani
  Fields Medal Mathematics

Vehicles & robots

Games



Trained with millions of examples:
NO RULES



Machine learning

´The end of the code´:

in the future, we will no longer program computers, we will train them.

- Wired Magazine

Google Books Ngram Viewer

Graph these comma-separated phrases: machine learning case-insensitive

between 1800 and 2000 from the corpus English with smoothing of 3 . Search lots of books

Google Trends | Comparar

machine learning
Término de búsqueda

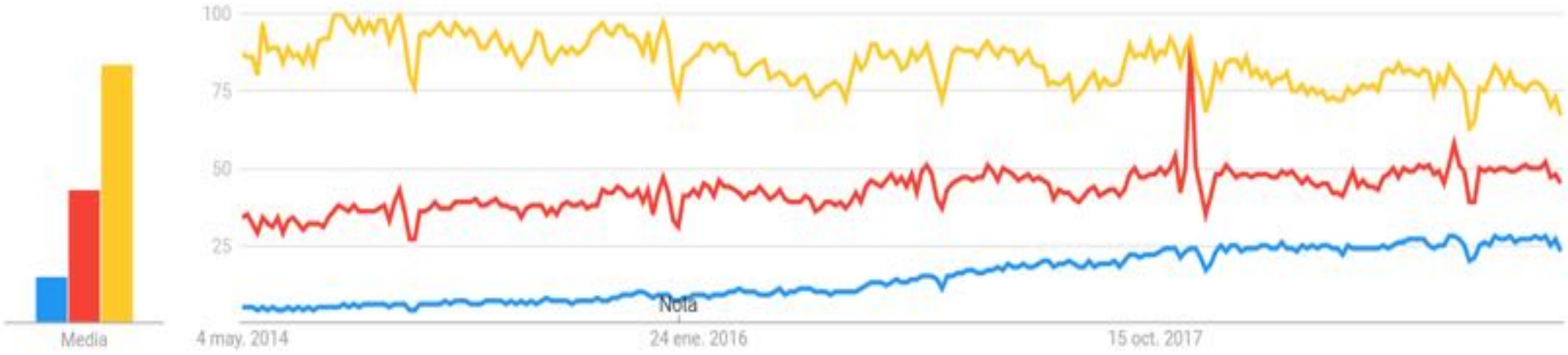
Coding
Término de búsqueda

programming
Término de búsqueda

+ Añadir comparación

Todo el mundo | Últimos 5 años | Todas las categorías | Búsqueda web

Interés a lo largo del tiempo



I don´t think throwing hardware and software onto the lab of nine year olds necessarily is the best way to teach computational thinking

- Wing, https://www.youtube.com/watch?v=YVEUOHw3Qb8 at 1:02:00

Computational Thinking

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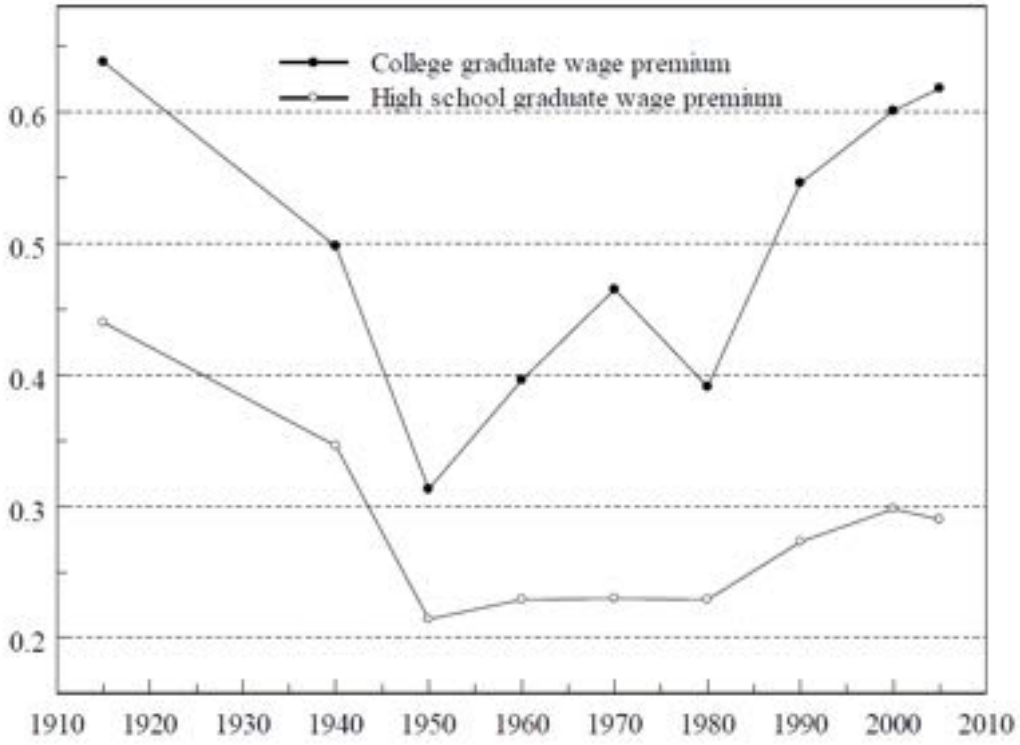
The Human Capital Century?

In recent decades the lion's share of rising wage inequality can be traced to an increase in educational wage differentials



The Race between Education and Technology

-Goldin,C.; Katz, L.

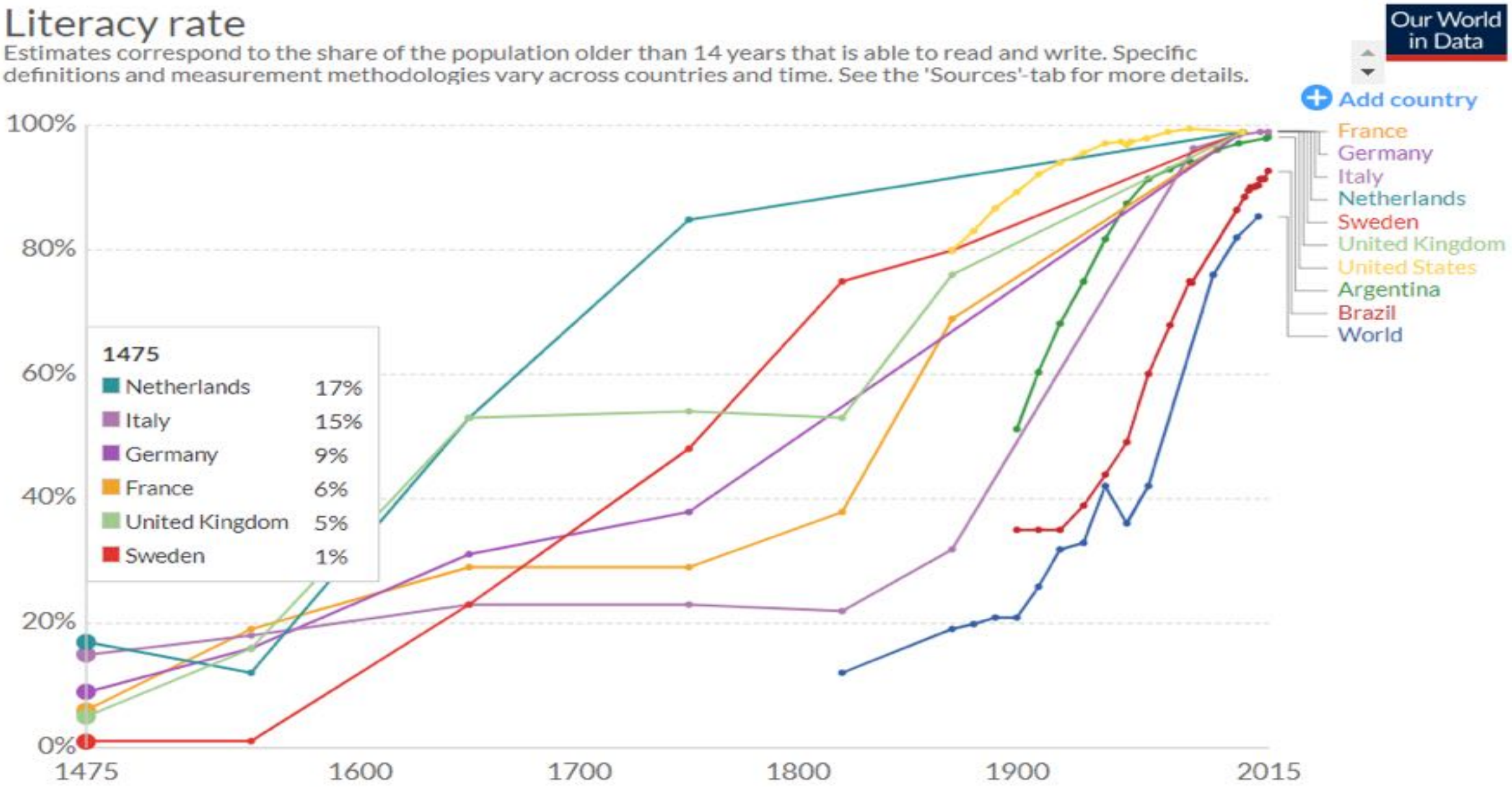
In the year 1,100 CE only 2% of the male population of the West was full literate (Morris, 2015)

and practically 0% of the females were literate

For a common citizen of that time, learning to read and write was probably considered a very complex endeavor, and not for everyone

Literacy rate

Estimates correspond to the share of the population older than 14 years that is able to read and write. Specific definitions and measurement methodologies vary across countries and time. See the 'Sources'-tab for more details.



Source: WDI, CIA World Factbook, & other sources

CC BY

1475 2015 CHART MAP DATA SOURCES

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