Computational Thinking for InMside

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CIAE, University of Chile

TATA

What is Computational thinking?

Compute, Logic & Programming

Computational Modeling

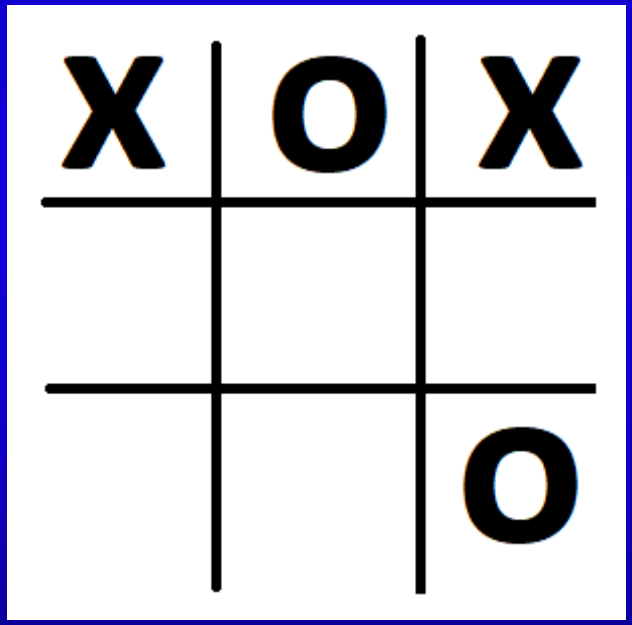
Patterns & Machine Learning

Compute, Logic & Programming

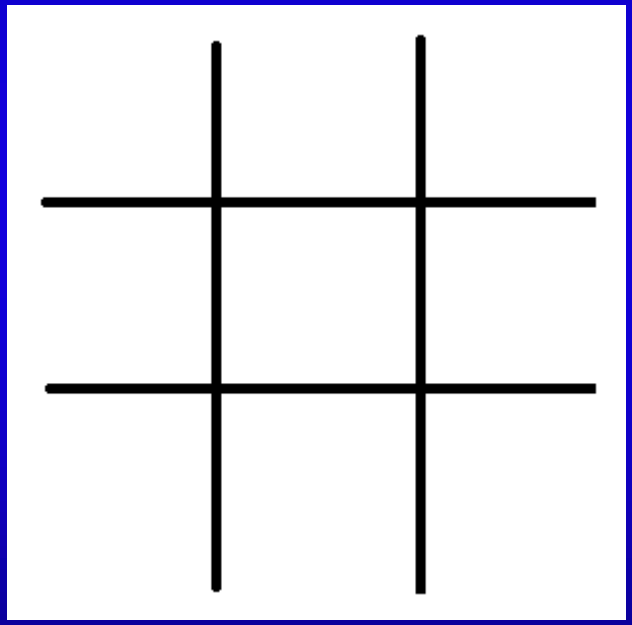
Computational Modeling

Patterns & Machine Learning

Compute, Logic & Programming



Compute, Logic & Programming



Rule:

IF

….

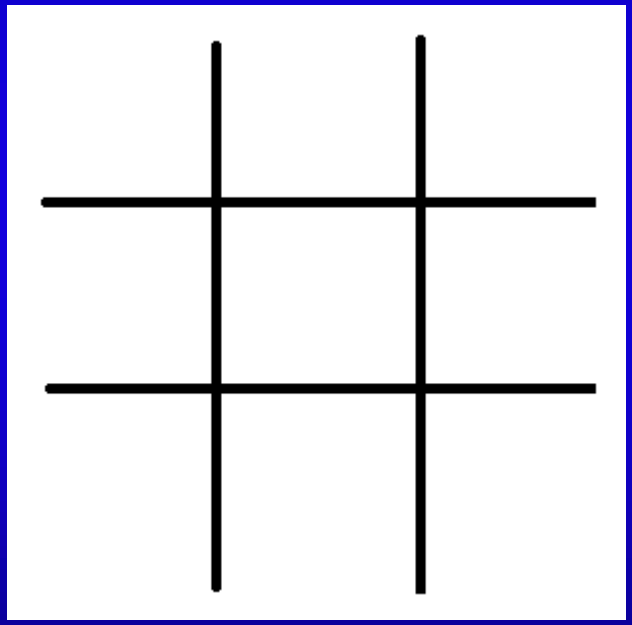
THEN

…

ELSE

…

Compute, Logic & Programming

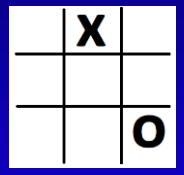


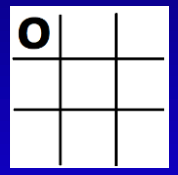
Rule 0:

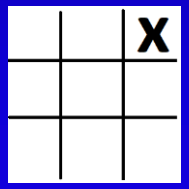
IF
opponent has 2 beads on a line
THEN
fill the empty space on the line
ELSE
fill random empty position

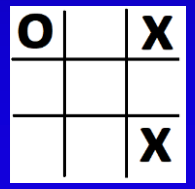
Clock

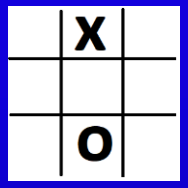
Conditions

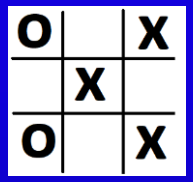




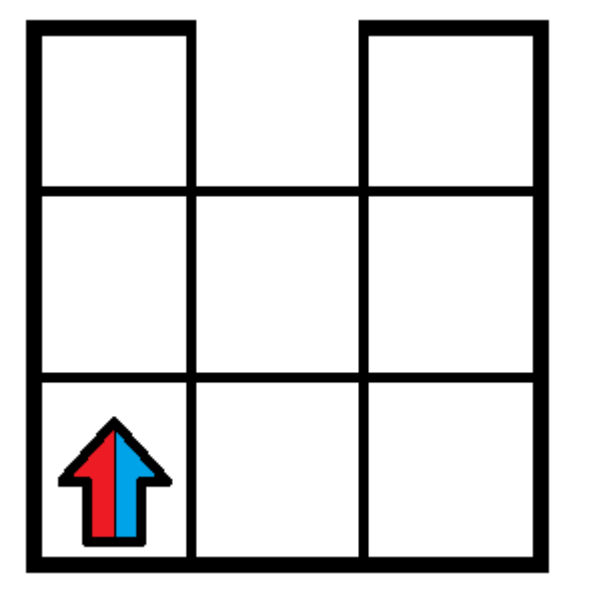








Compute, Logic & Programming



Rule:

IF

…

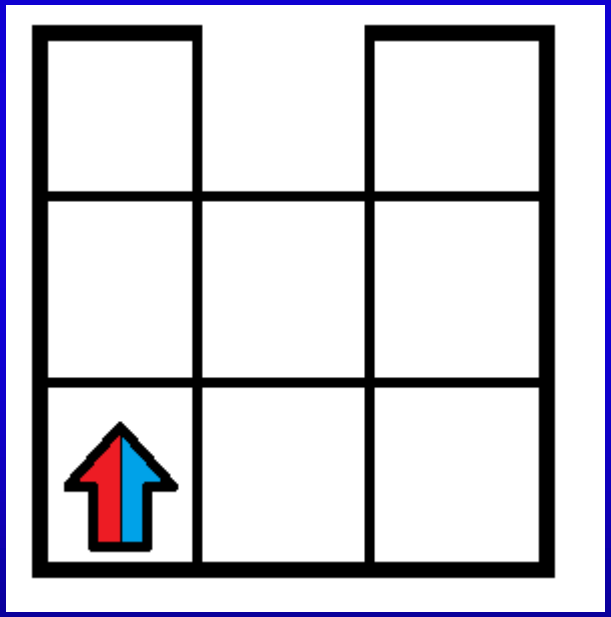
THEN

…

ELSE

…

Compute, Logic & Programming



Rule 0:

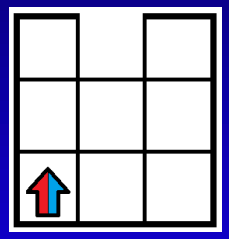
IF
Can move ahead
THEN
move one step
ELSE
turn left or right at random

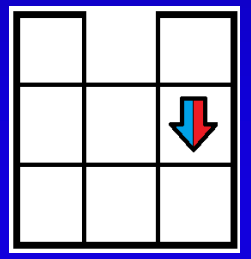
apply rule 0 again

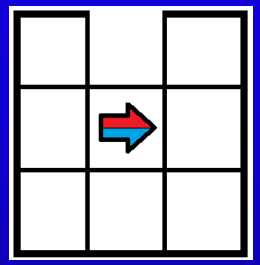
Clock

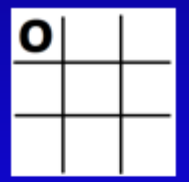
Conditions

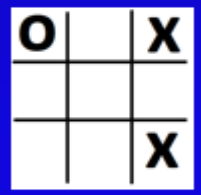
Cycles

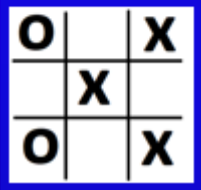












Compute, Logic & Programming

Computational Modeling

Patterns & Machine Learning

Computational Modeling

Accumulators

Spatial (boards)

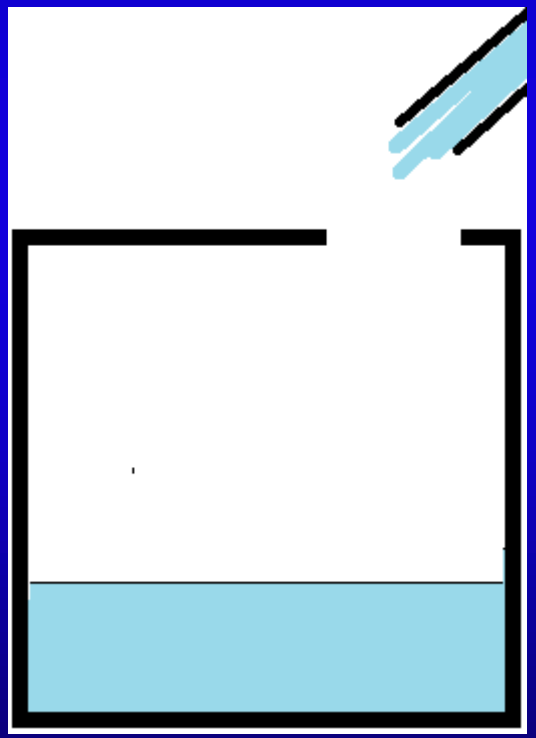
Computational Modeling

Accumulators

Spatial (boards)

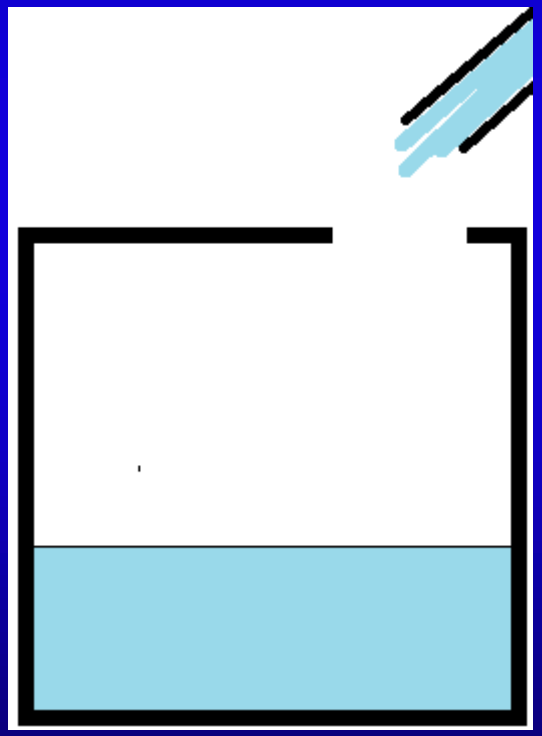
Computational Modeling

Accumulators



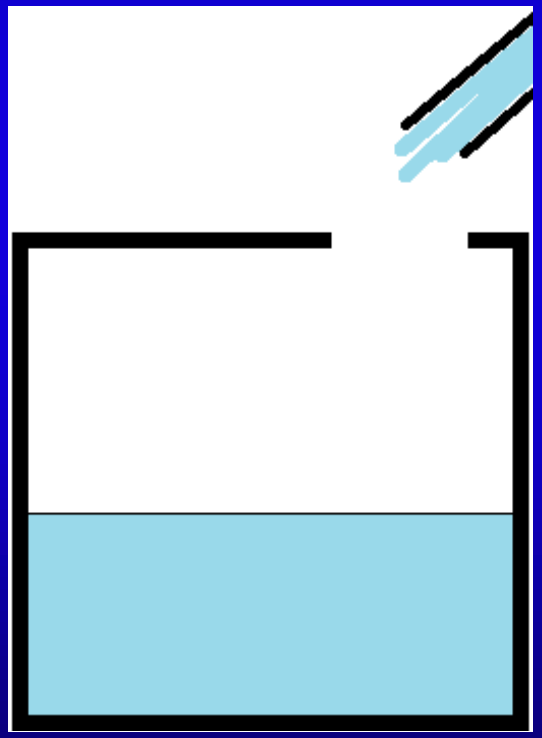
Computational Modeling

Accumulators



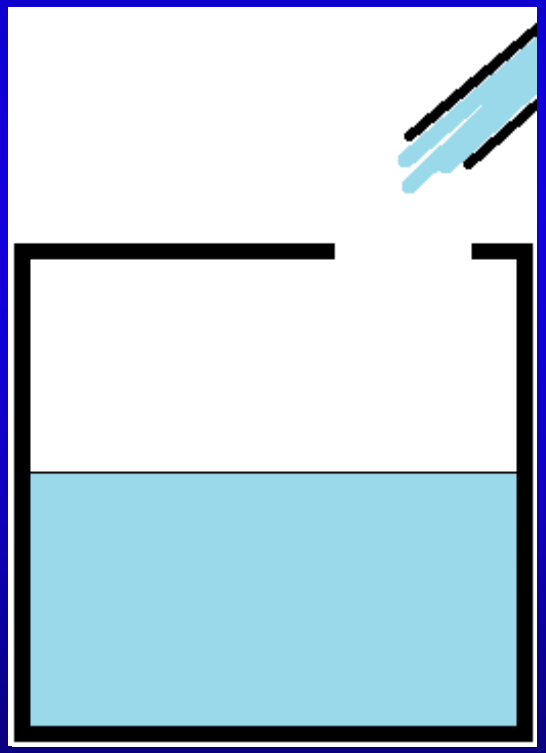
Computational Modeling

Accumulators



Computational Modeling

Accumulators

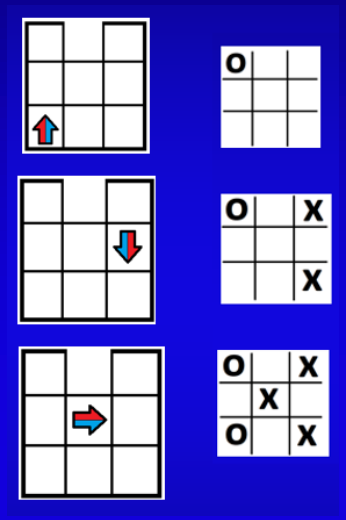


$$V(t+1) = V(t) + b$$

Clock

Conditions

Cycles

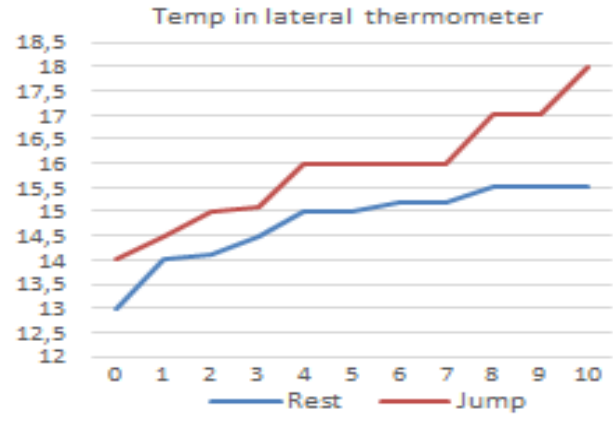


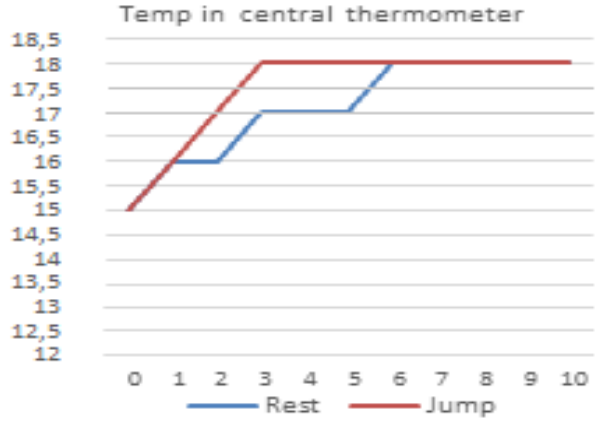
Rules as equations

Computational Modeling

Accumulators

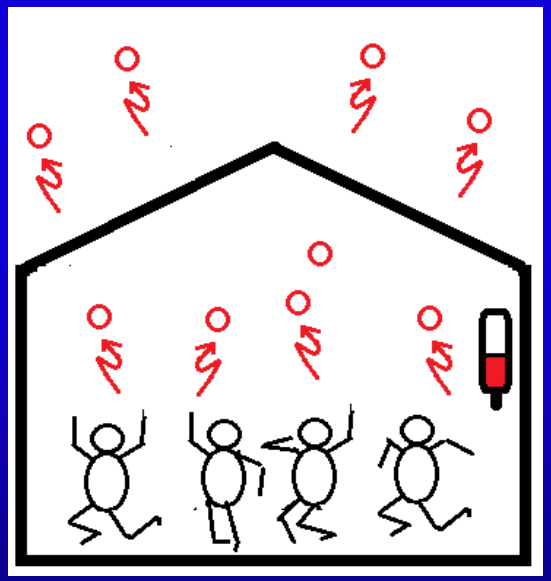
$$T(t+1) = T(t) + b$$





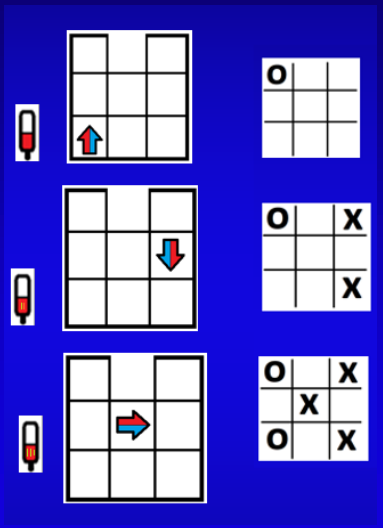
Computational Modeling

Accumulators



$$T(t+1) = T(t) + b - 0.1[\, T(t) - T_{ext} \,]$$

Clock
Conditions
Cycles



Rules as equations
Sensors

Computational Modeling

Accumulators

Spatial (boards)

Computational Modeling

Accumulators

Spatial (boards)

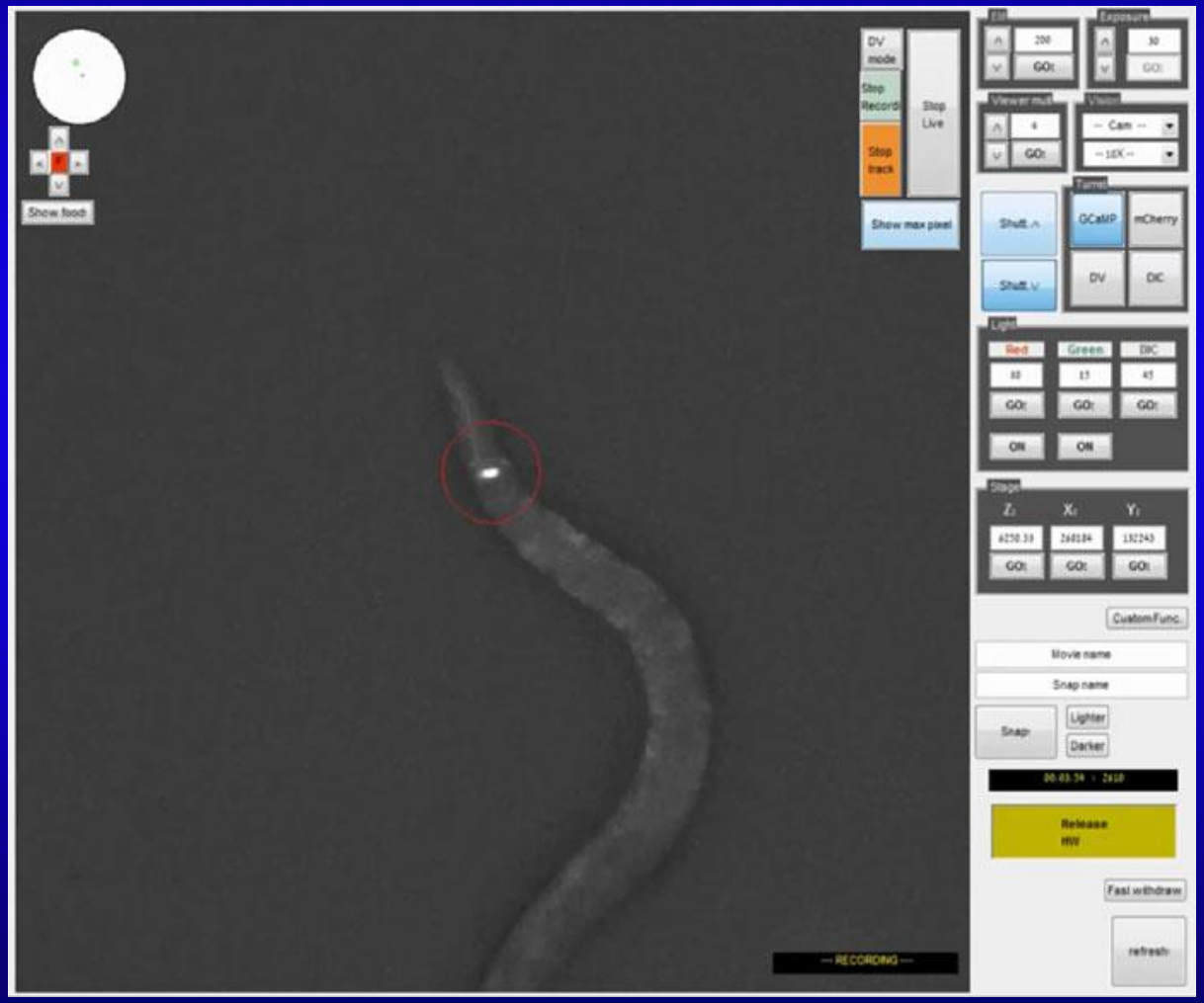
Computational Modeling
Spatial (boards)

Potentials

Propagations

Cellular automats

C. elegans nematodes
302 neurons

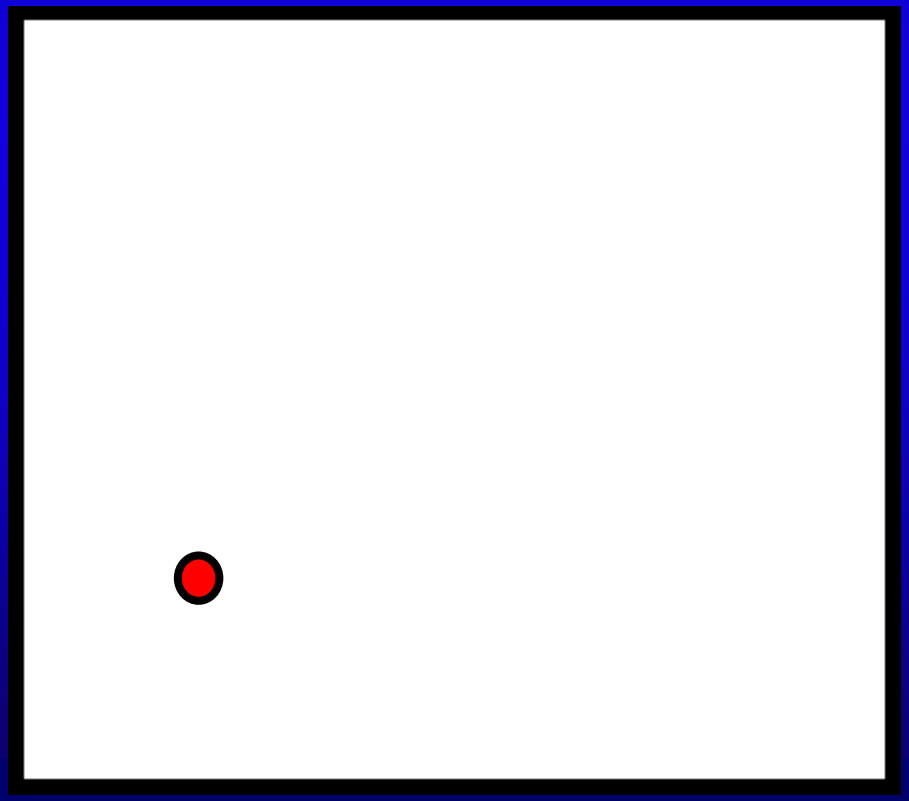


Itskovits, Ruach. Zaslaver
Nature Communications 2018

Computational Modeling

Spatial (boards)

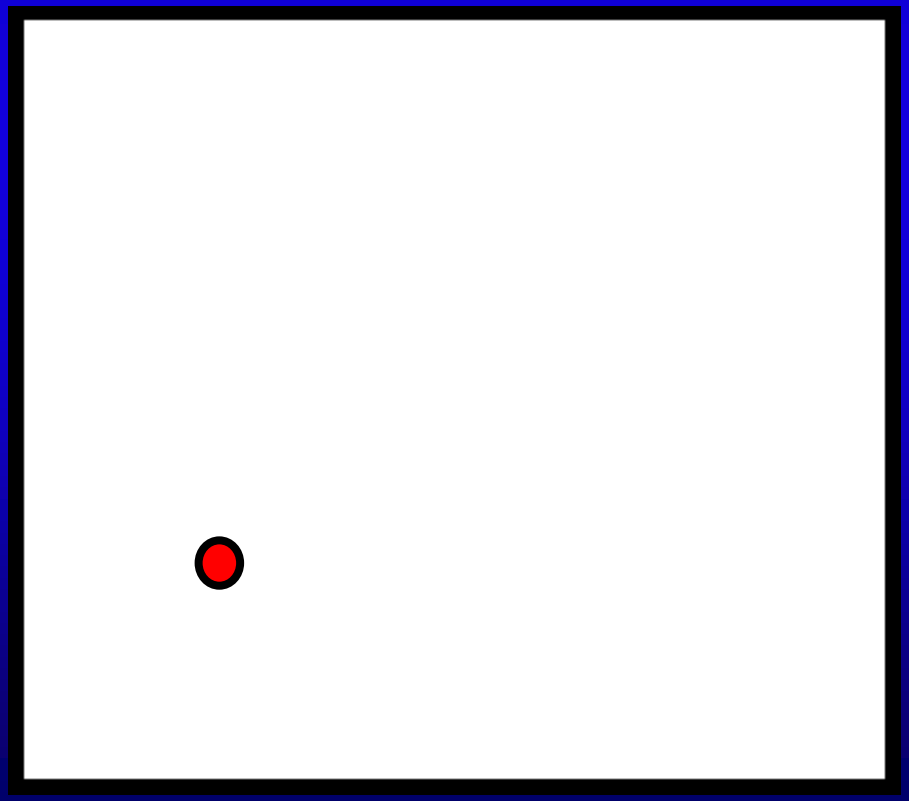
Potentials



Computational Modeling

Spatial (boards)

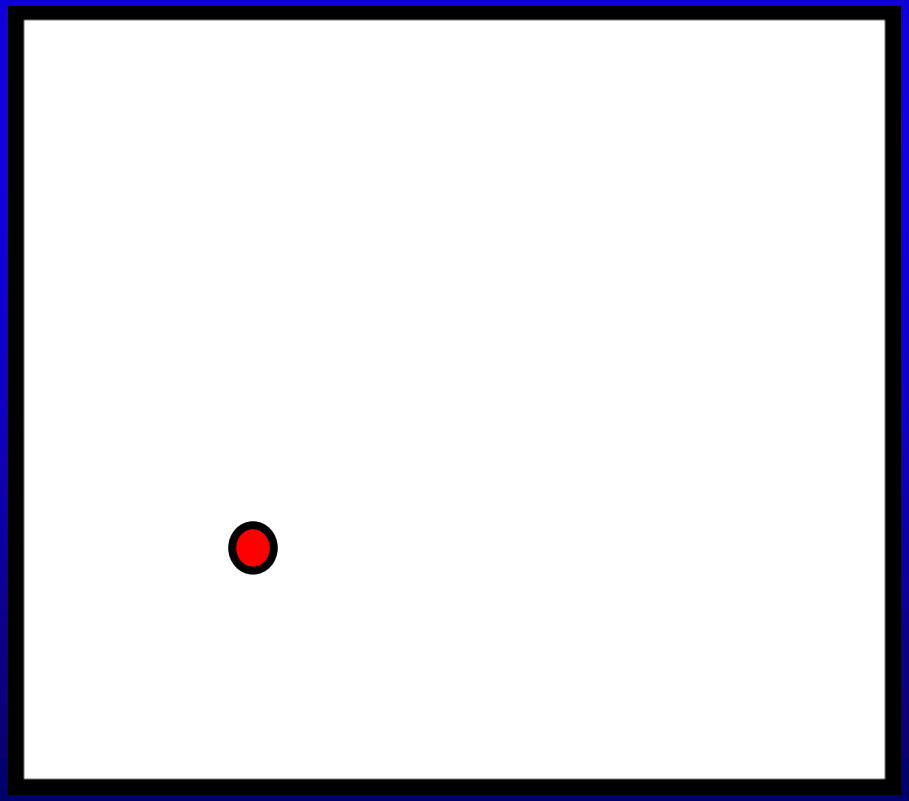
Potentials



Computational Modeling

Spatial (boards)

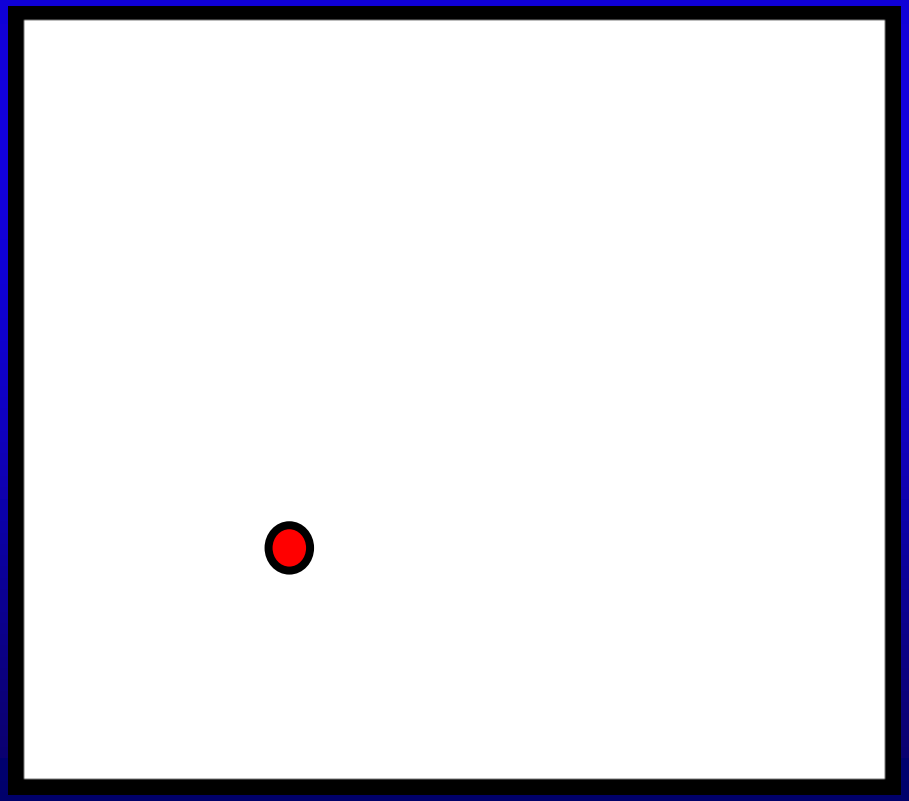
Potentials



Computational Modeling

Spatial (boards)

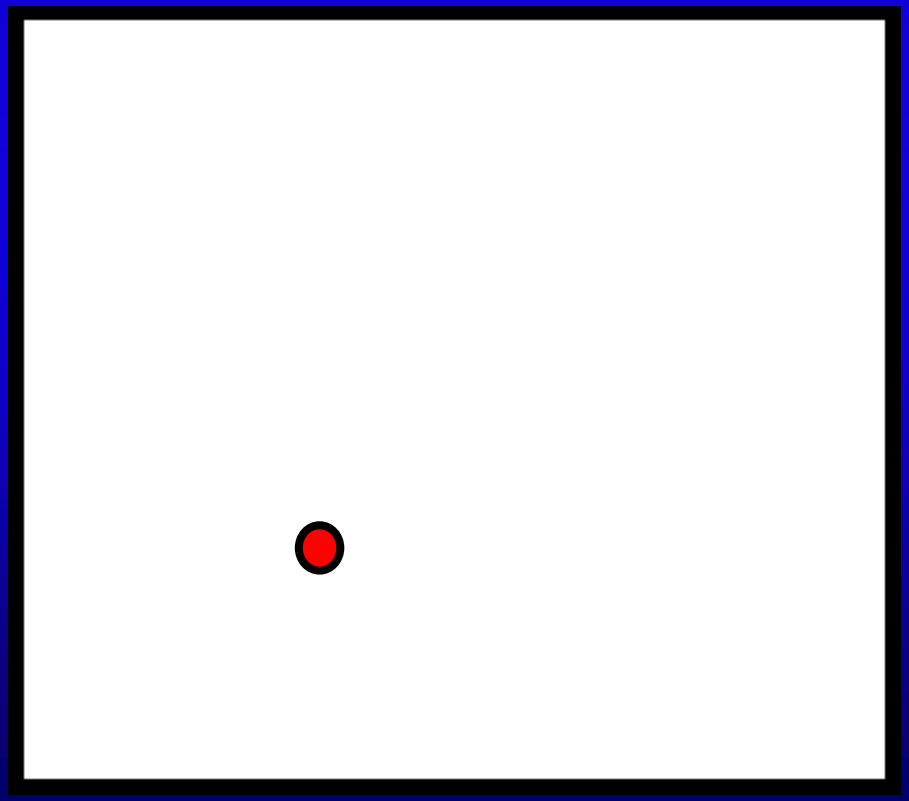
Potentials



Computational Modeling

Spatial (boards)

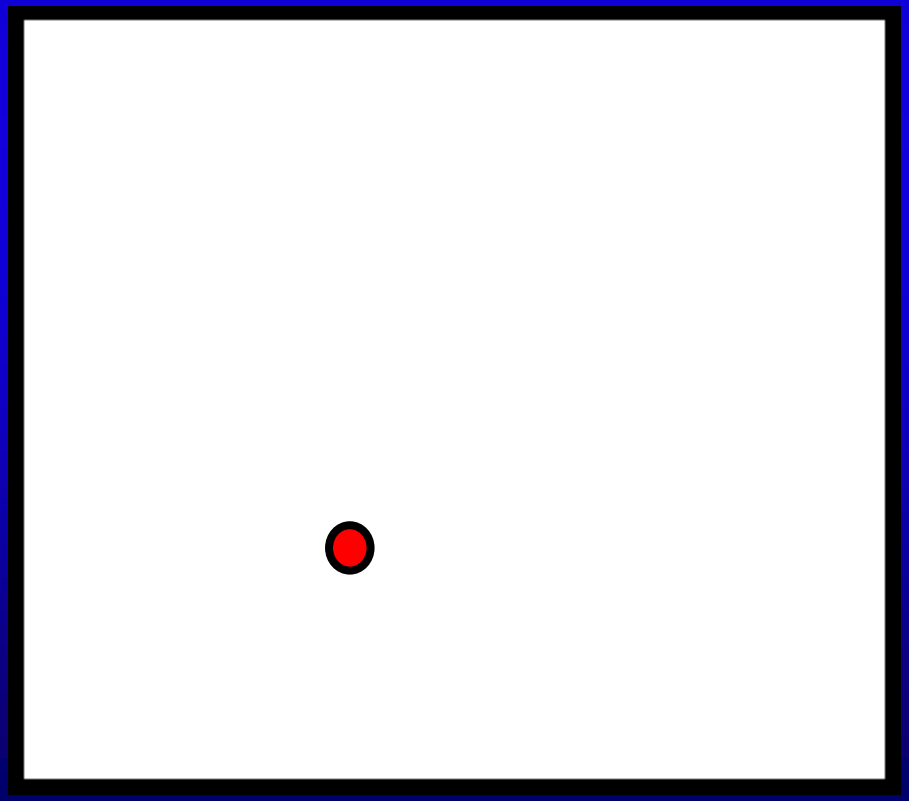
Potentials



Computational Modeling

Spatial (boards)

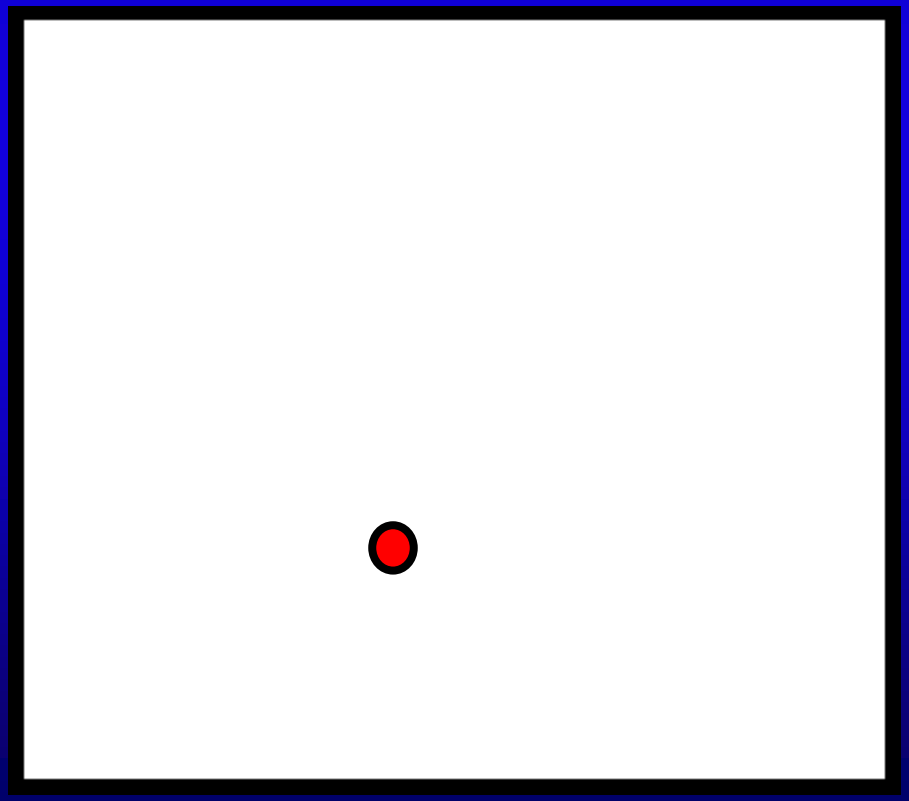
Potentials



Computational Modeling

Spatial (boards)

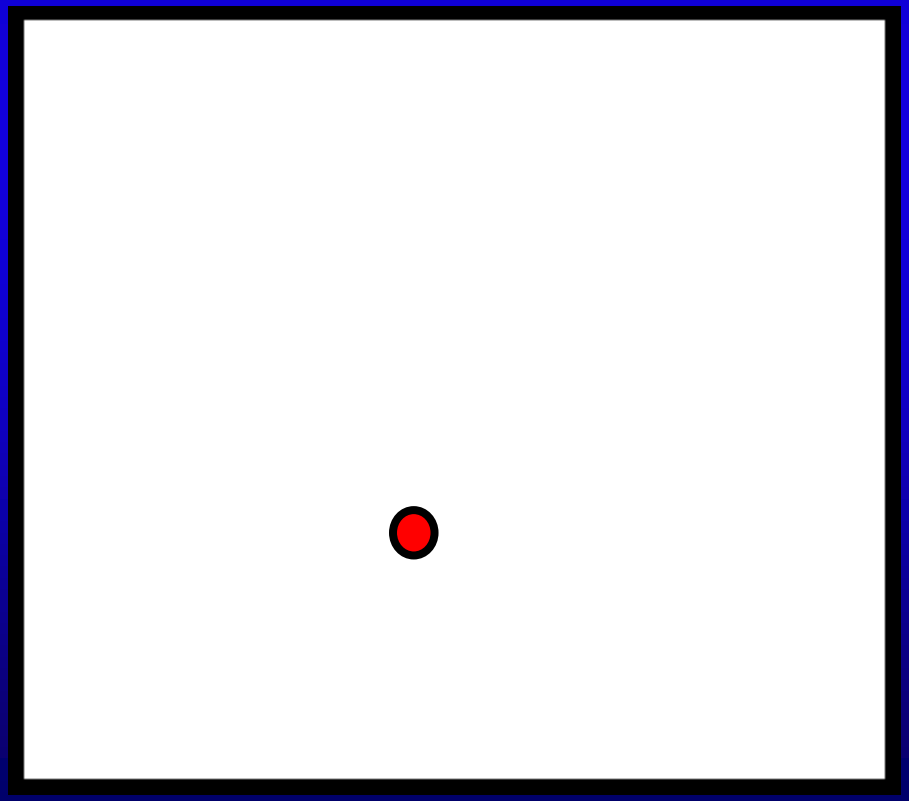
Potentials



Computational Modeling

Spatial (boards)

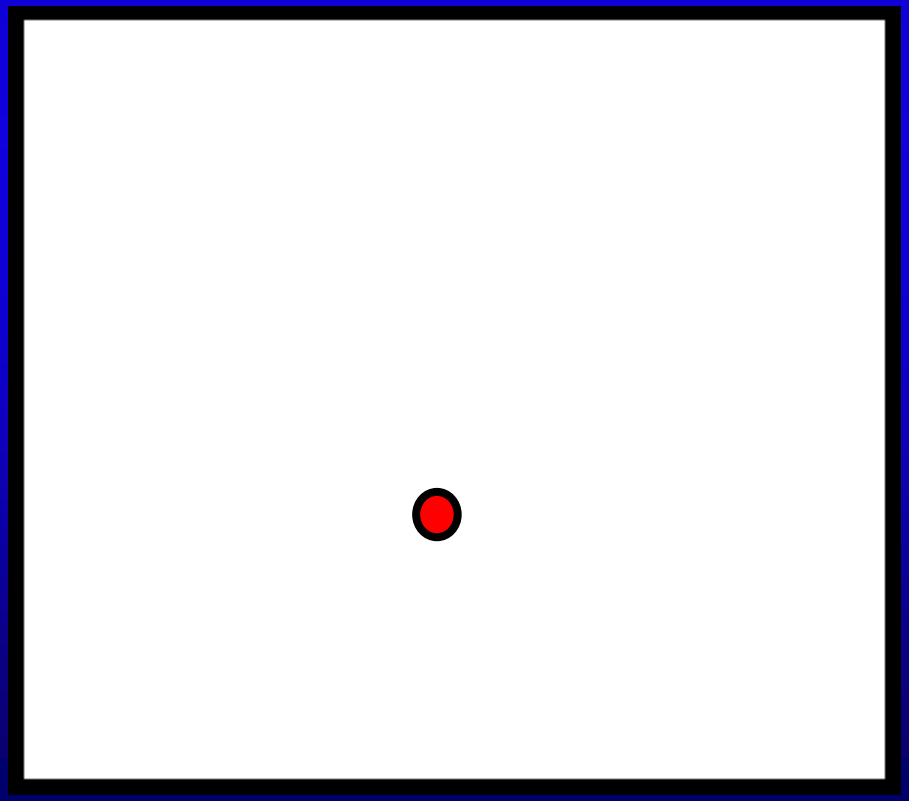
Potentials



Computational Modeling

Spatial (boards)

Potentials



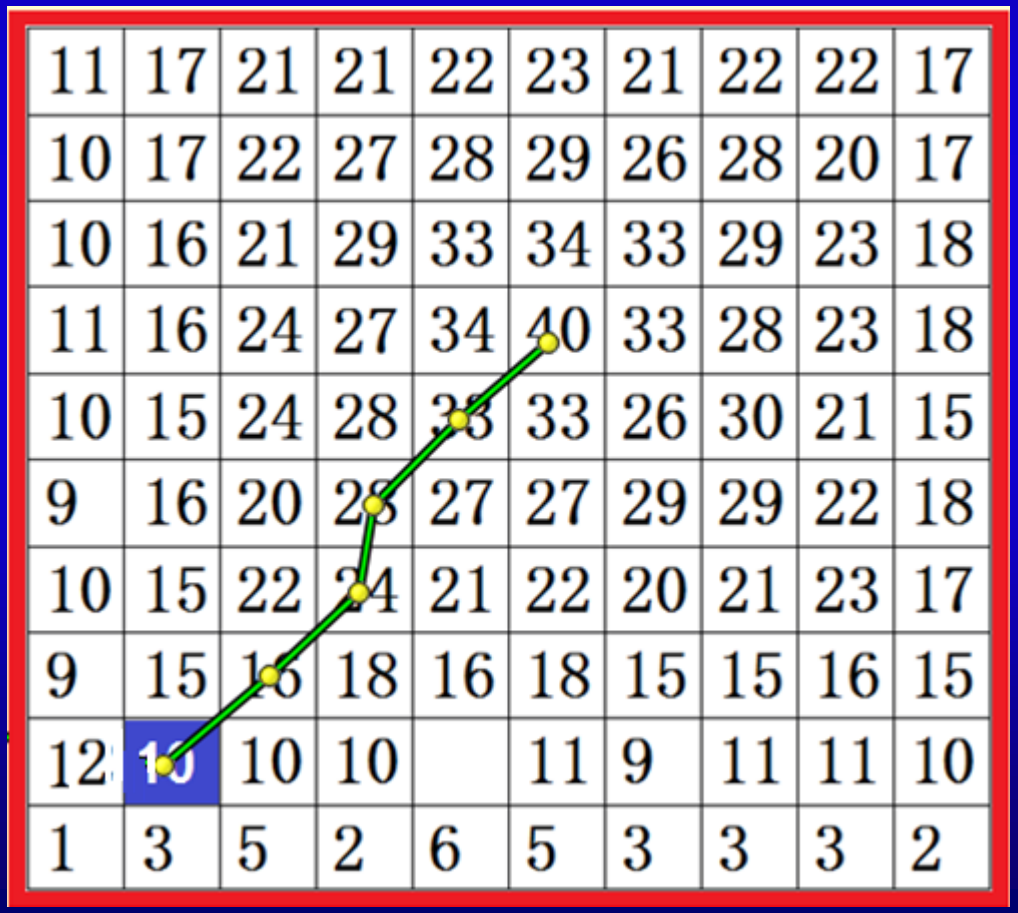
Computational Modeling

Spatial (boards)

11	17	21	21	22	23	21	22	22	17
10	17	22	27	28	29	26	28	20	17
10	16	21	29	33	34	33	29	23	18
11	16	24	27	34	40	33	28	23	18
10	15	24	28	33	33	26	30	21	15
9	16	20	28	27	27	29	29	22	18
10	15	22	24	21	22	20	21	23	17
9	15	16	18	16	18	15	15	16	15
12	10	10	10	11	11	9	11	11	10
1	3	5	2	6	5	3	3	3	2

Computational Modeling
Spatial (boards)

Chemotaxis

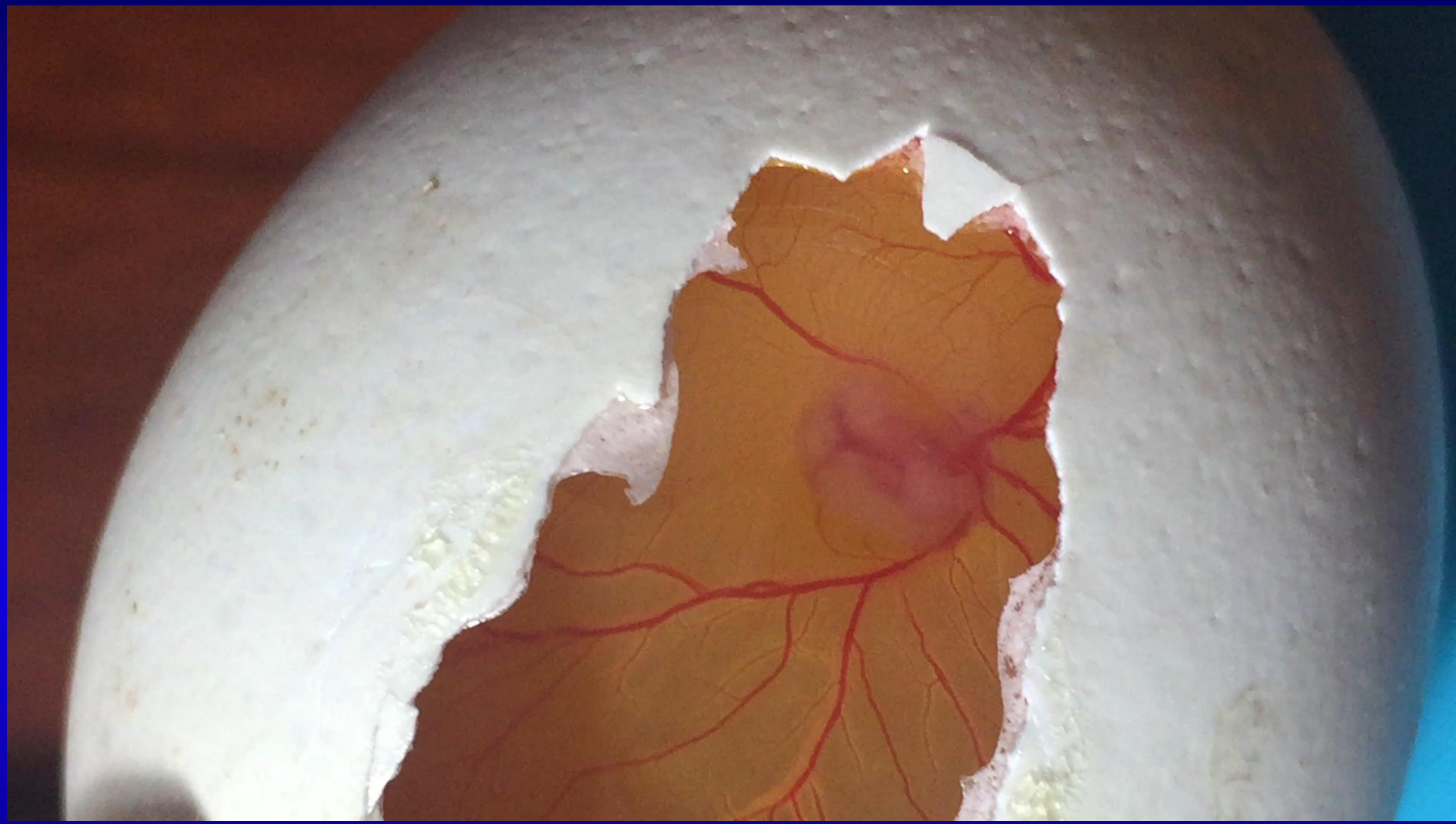


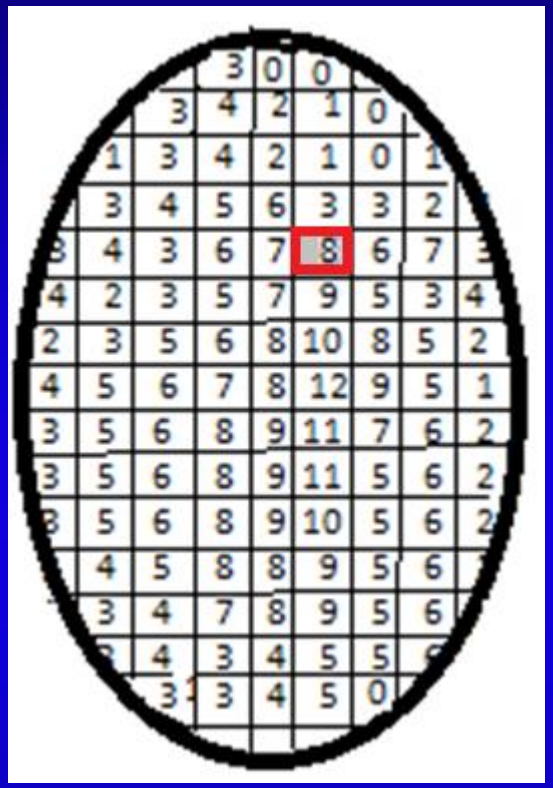
Computational Modeling: Spatial (boards)

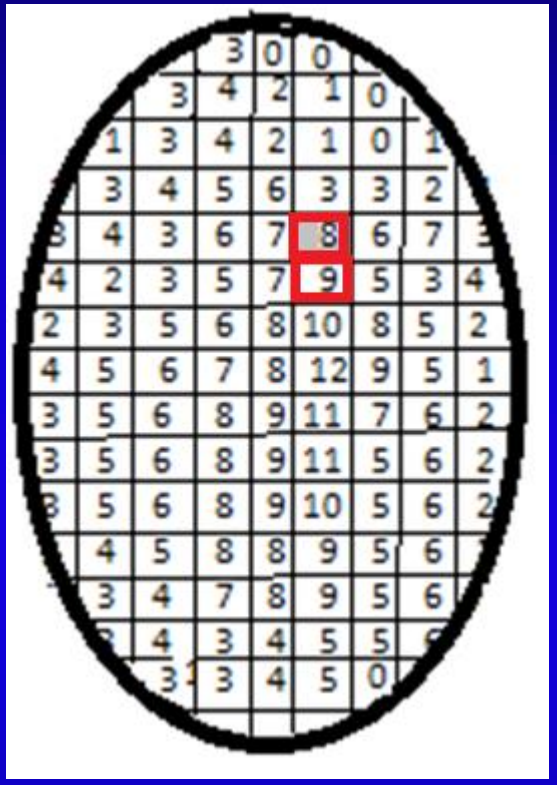
¿Embryology?

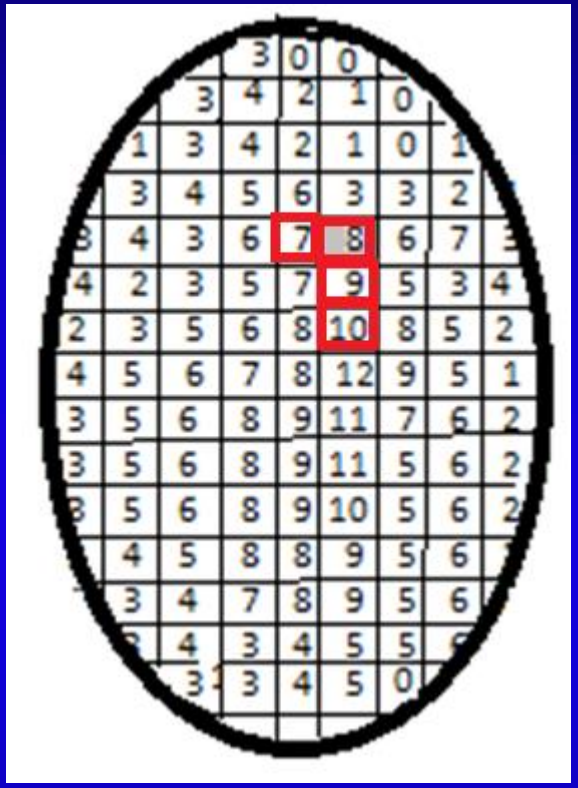
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2562489/

Korn & Cramer (2007) Journal of Visualized Experiments









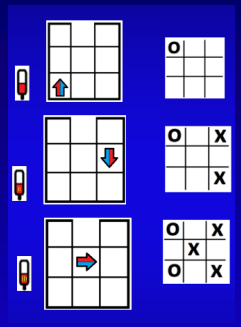
Chuai, Hughes & Weijer, ***Current Genomics***, 2012

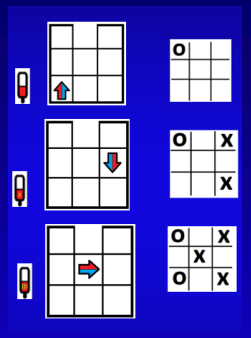
Chemotaxis & cell division

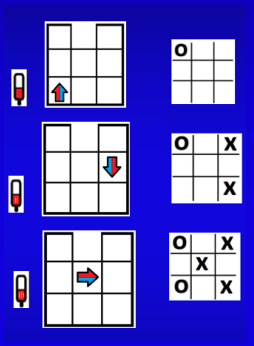
Clock

Conditions

Cycles







Rules as equations

Sensors

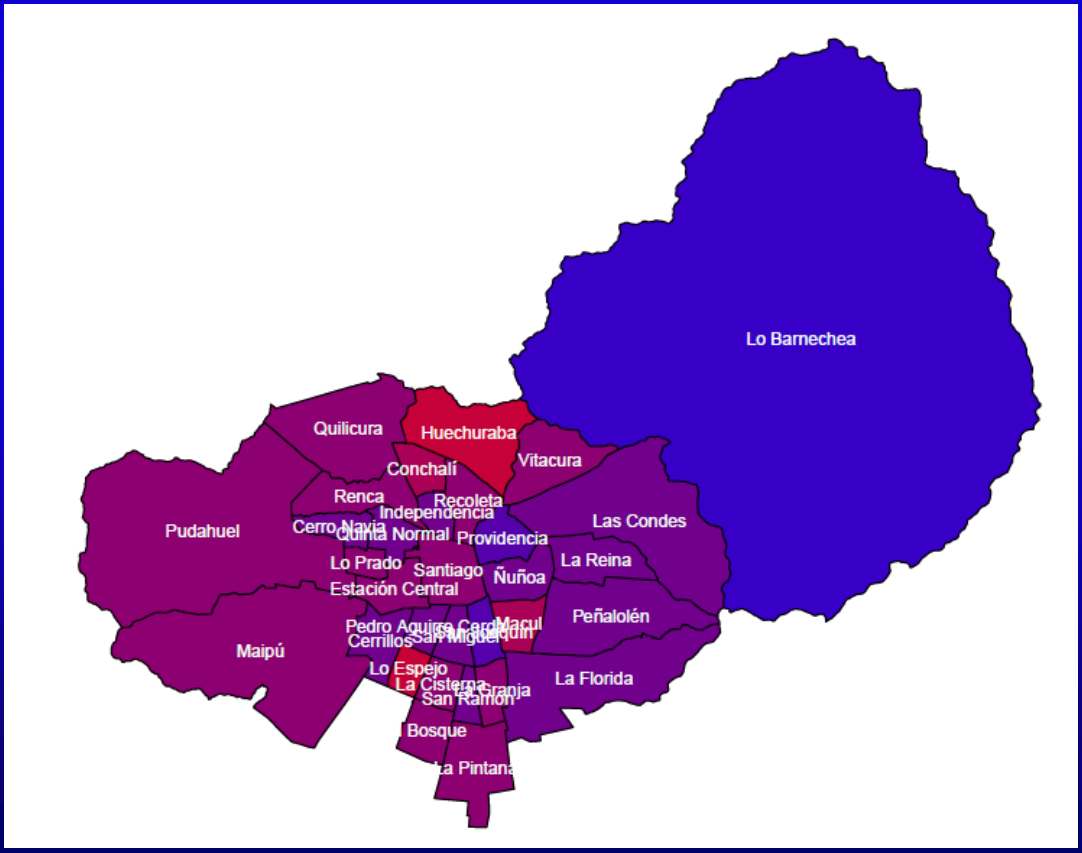
Spatial reasoning

Reproduction

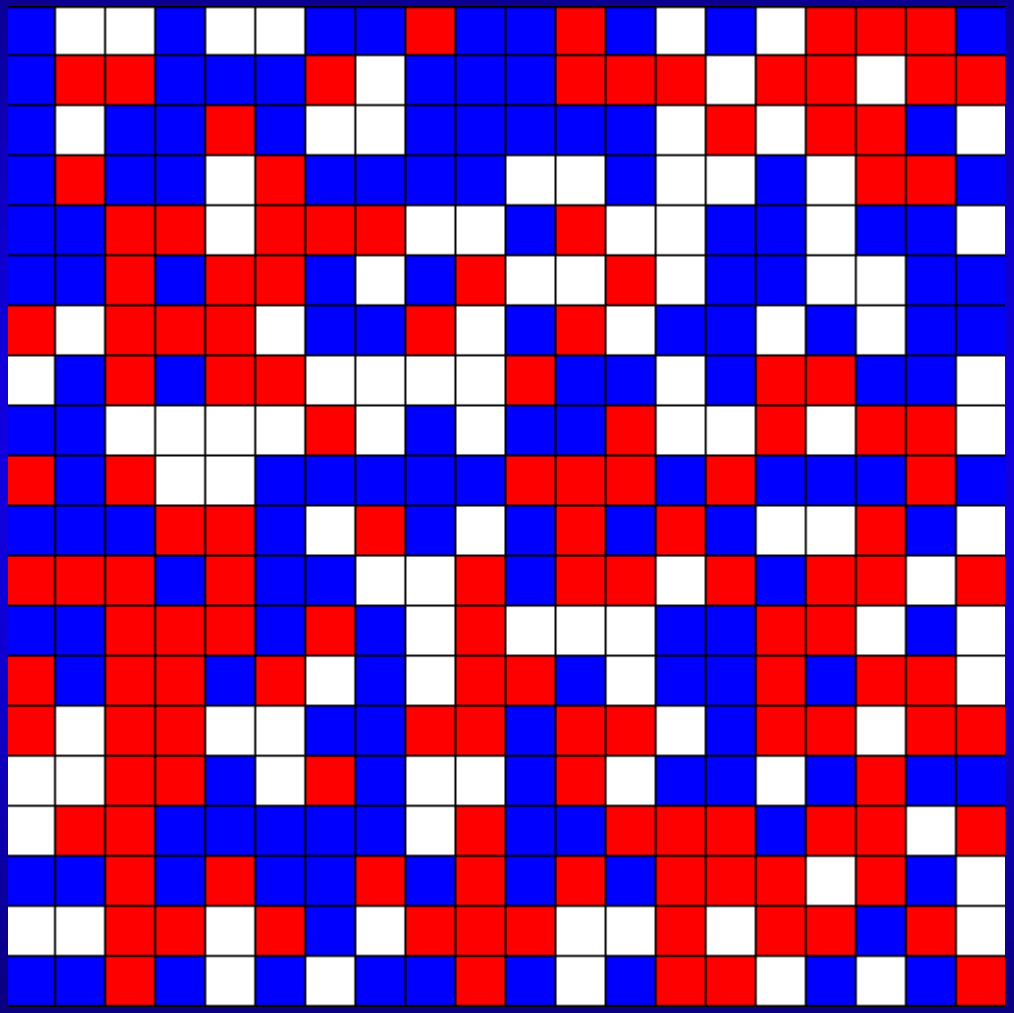
Computational Modeling

Spatial (boards)

Cellular automats

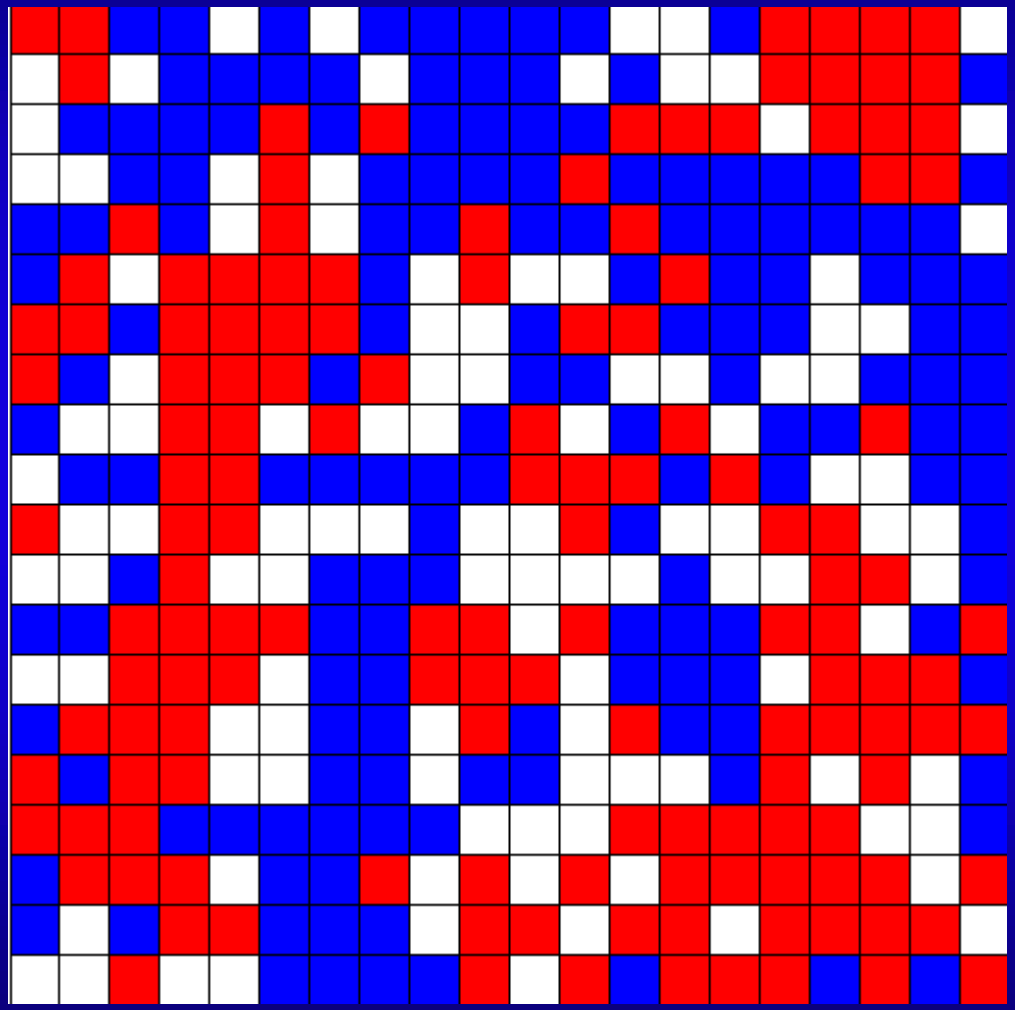


Schelling segregation model



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

Schelling segregation model



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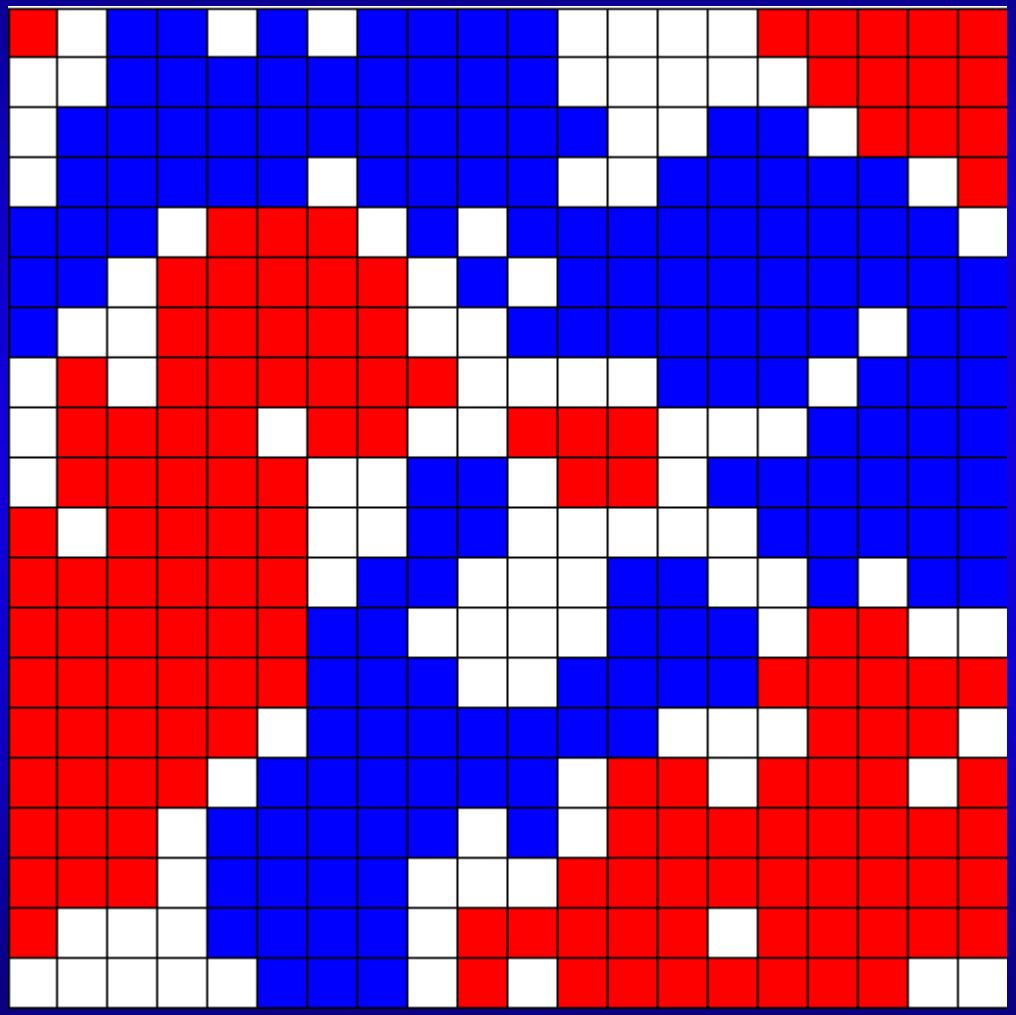
Schelling segregation model



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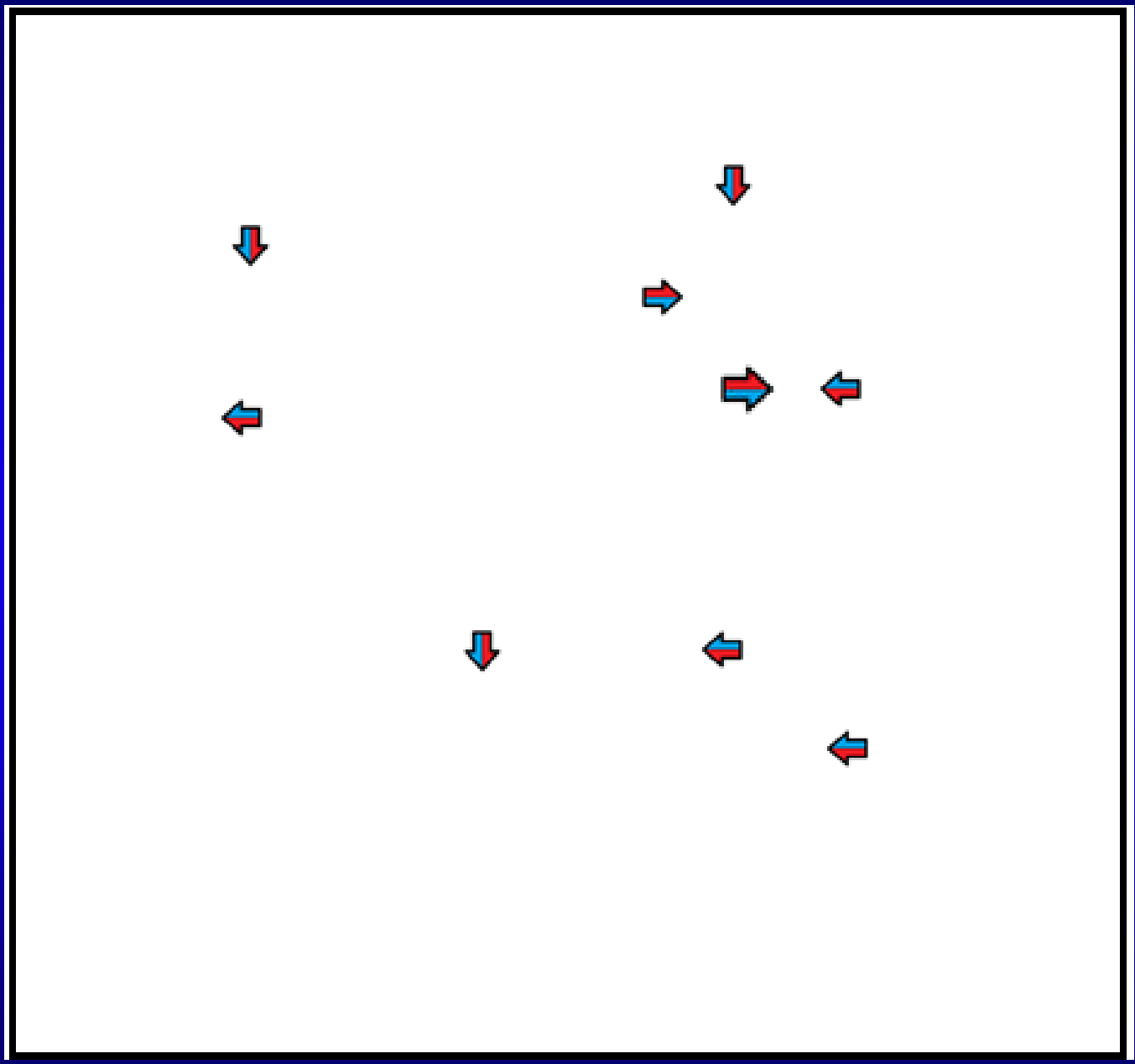
Clock
Conditions
Cycles

Rules as equations
Sensors
Spatial reasoning
Reproduction
Population thinking



Compute, Logic & Programming

Computational Modeling

Patterns & Machine Learning

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Computational Modeling

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Fixed code

v/s

Automatic learning

Patterns & Machine Learning

Machine that learns from examples

World soccer cup

Disease diagnosis

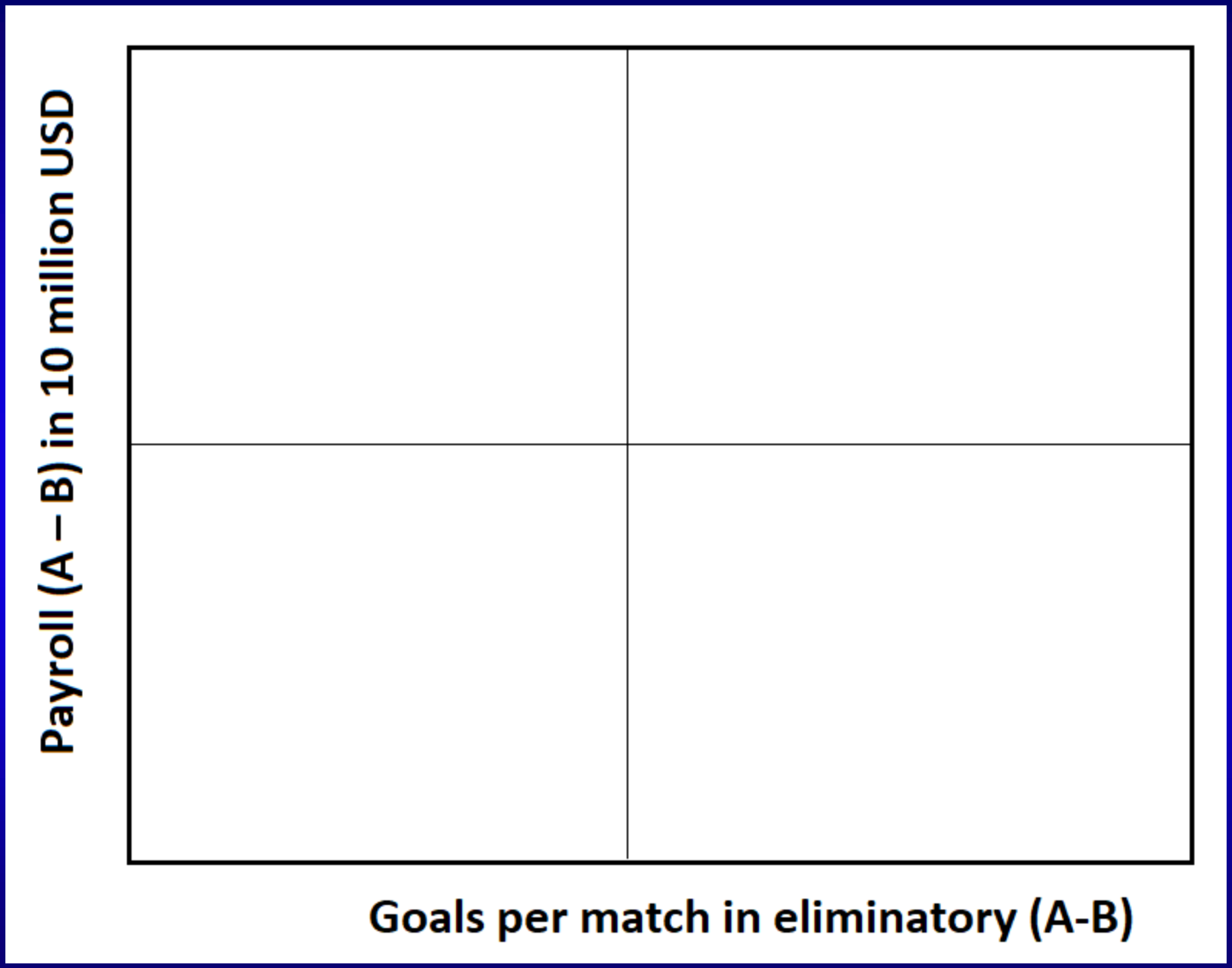
Face recognition

Speech recognition

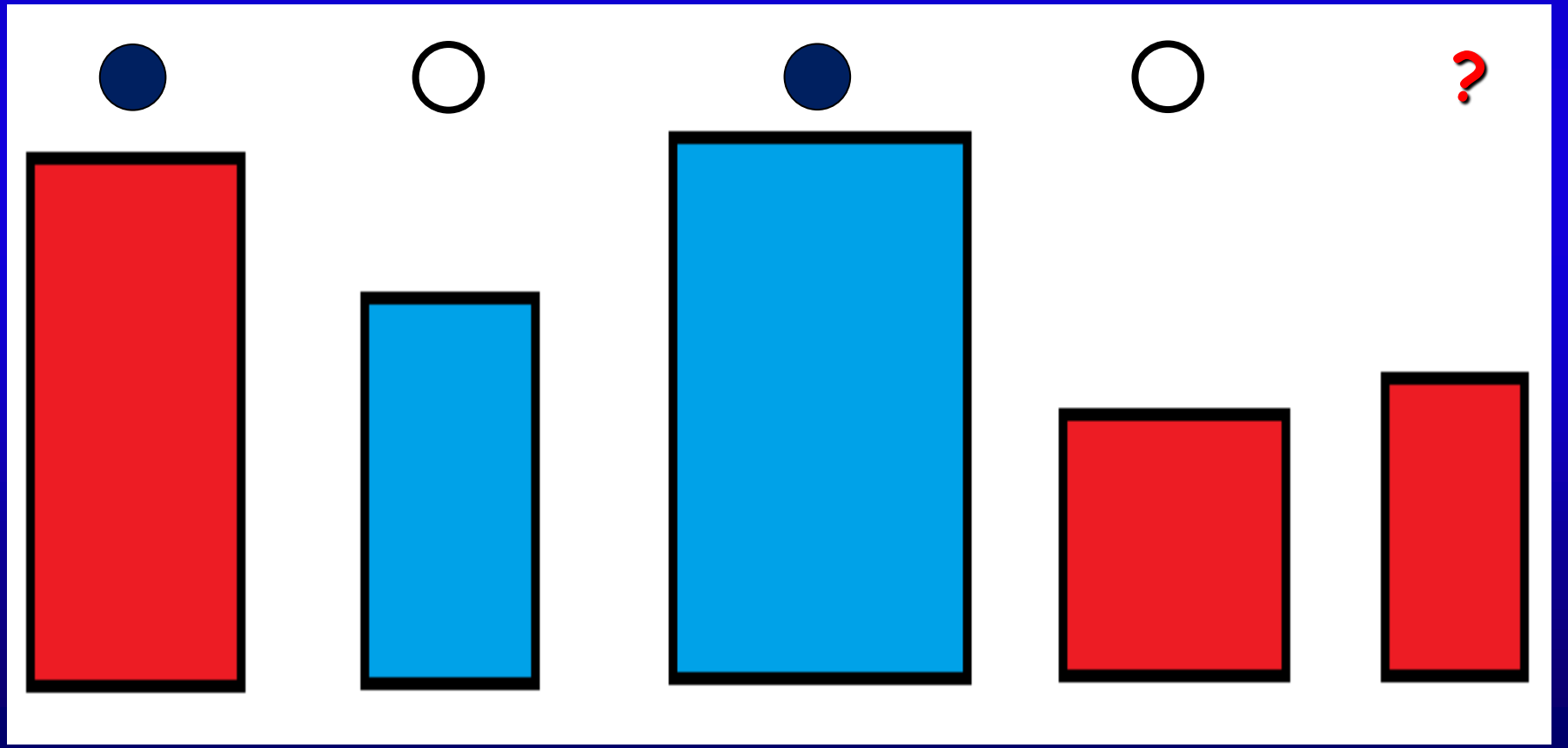
Patterns & Machine Learning

Machine that learns from examples

A vs B	Goals per match in eliminatory (A-B)	Payroll (A – B) in 10 million USD		Winner in WCup
Spain vs Peru	0.5	10		A
England vs USA	0.1	2		B
France vs Russia	-0.2	3		B
Brazil vs Germany	0.8	-5		A
Mexico vs Sweden	0.4	0		A
France vs Peru	-0.4	5		B
Japan vs Italy	0.3	-1		?


Payroll (A – B) in 10 million USD
Goals per match in eliminatory (A-B)

Rules?



Apostando

Synchronized Tournaments

Find a pattern and bet with a model (rules)

IF

length **+ 2.5*width* > 3**

THEN

cell color **= white**

ELSE

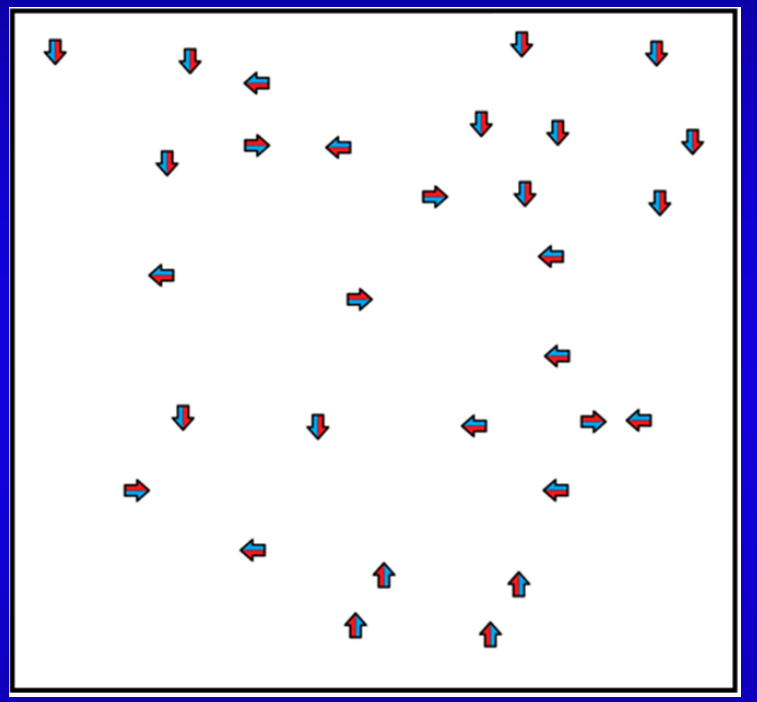
cell color **= black.**

Ensayo Torneo Matemáticas
Golda Meir
Lo Prado

Clock
Conditions
Cycles

Rules as equations
Sensors
Spatial reasoning
Reproduction
Population thinking

Training the machine



Computational Thinking for InMside

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Computational Thinking for InMside

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Thank you