

Unorthodox Modelling: Pictures, Numbers and Words

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Pictures, numbers and words

Pictures provide holistic representations

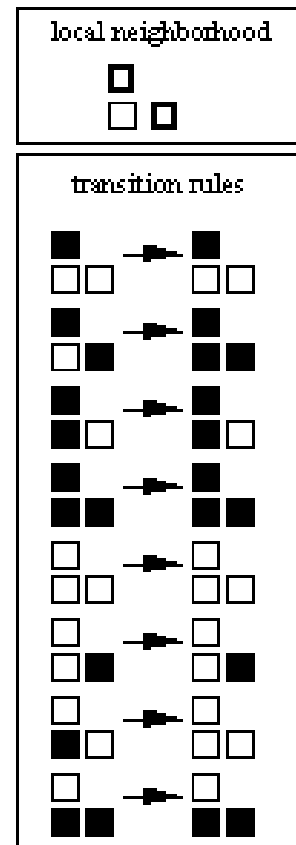
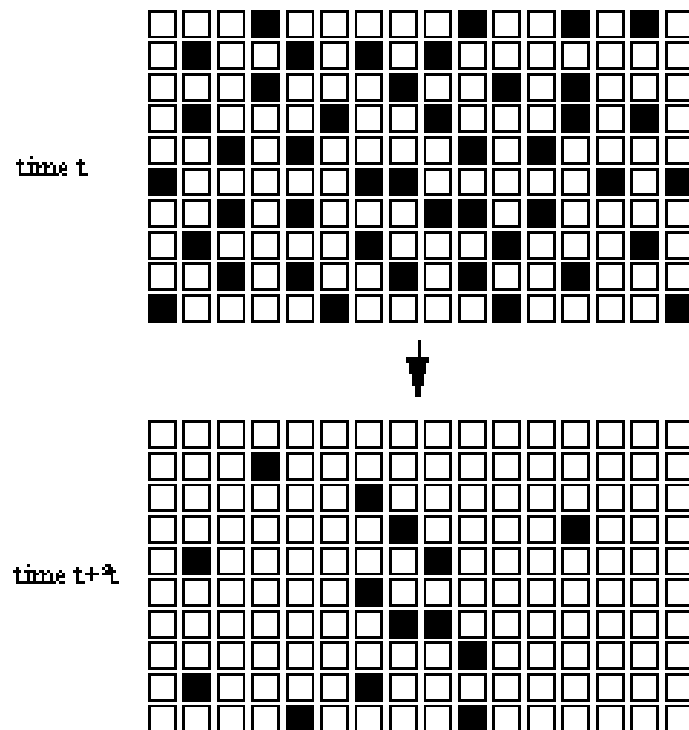
Pictures can be decoded into numbers

Numbers provide precision

Abstract concepts can only be represented by words

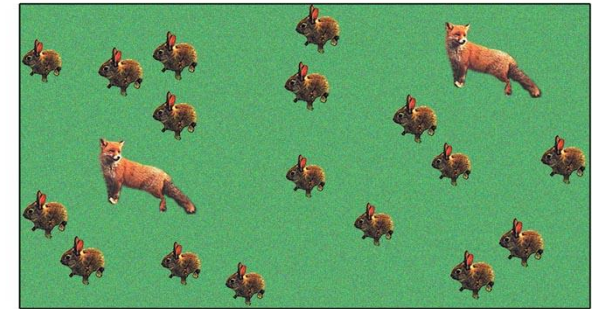
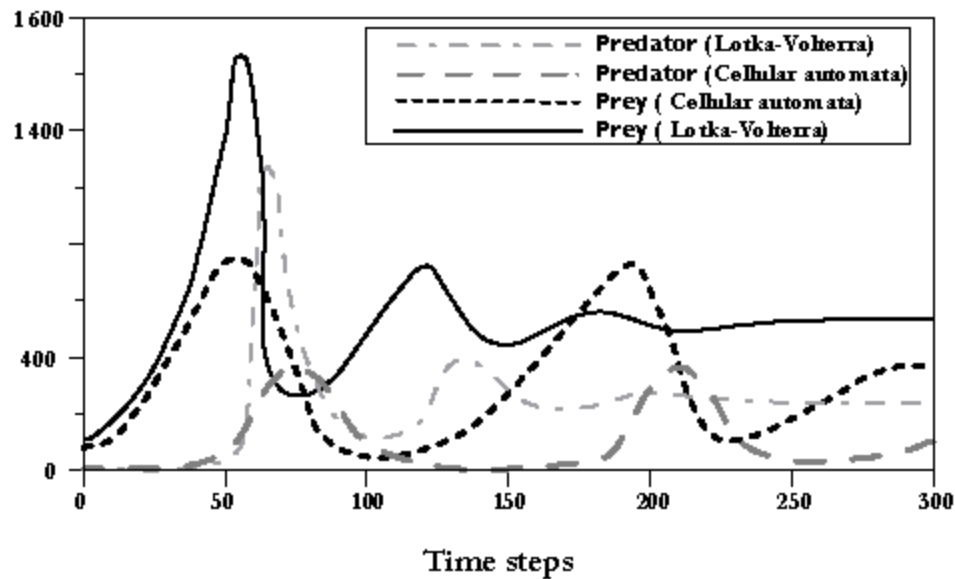
Working with pictures at the pixel level

- Examples of transition rules cellular automata(CA)



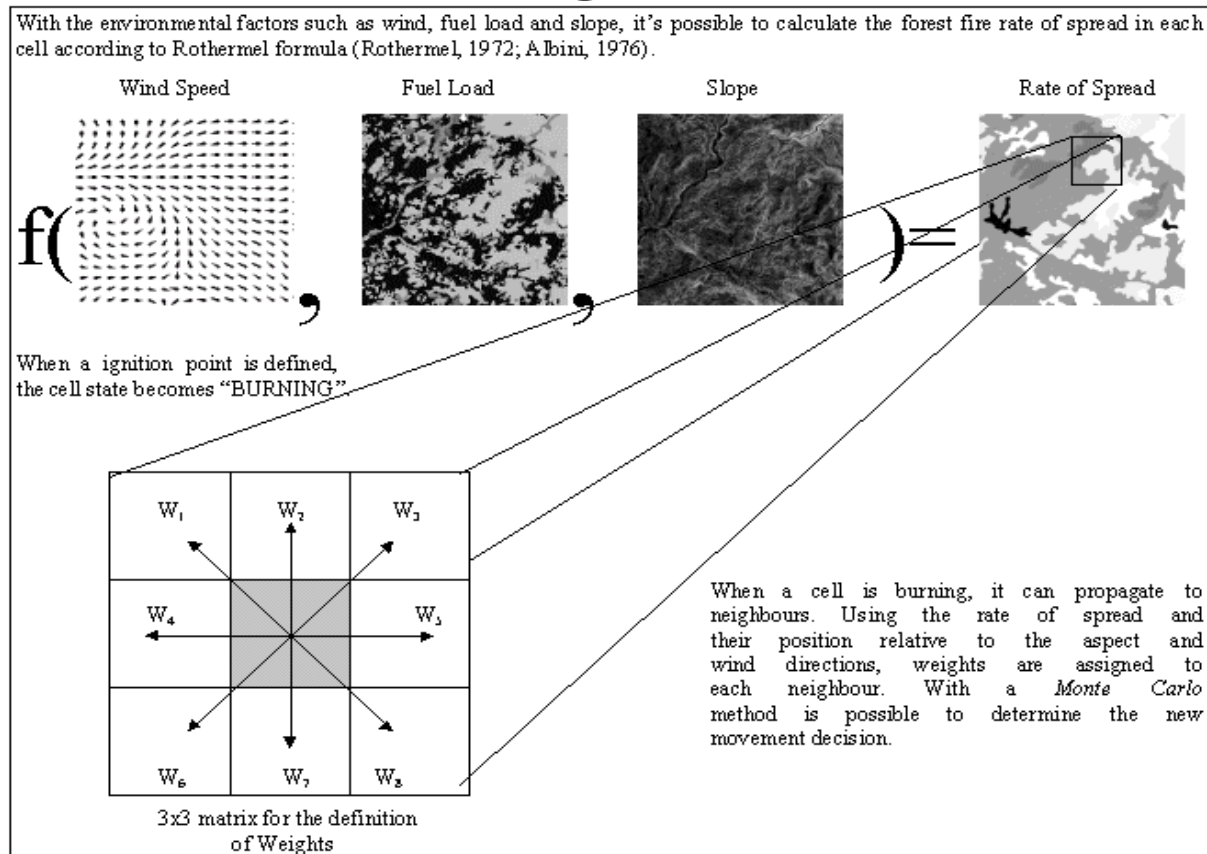
Applications

- Predator-prey models



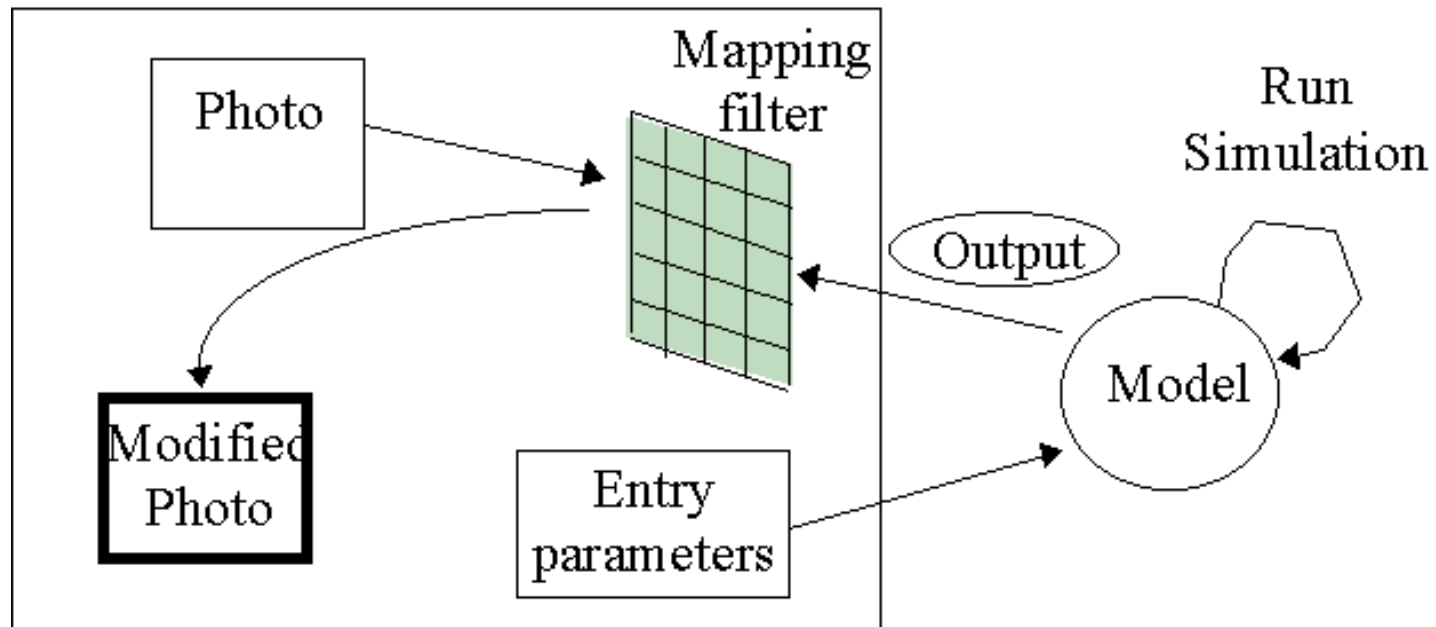
Applications

- Forest fire modelling



Applications

- CA models running on aerial photos (oil spills)



Unorthodox developments

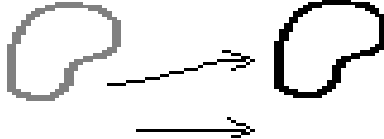
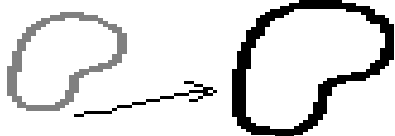
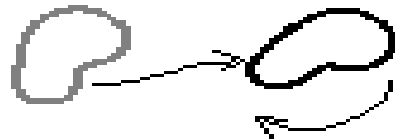
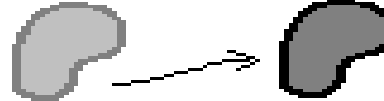
- Pictorial simulation
- Live sketching
- Programming by reproduction and interactive video
- Multidimensional simulation
- Visualization schemes

Pictorial simulation

- Objects may be pictographs, signs or symbols
- They may be described by their color, position, size and position
- Transition rules may include behavior and interaction rules
- Boundary conditions: donnut, barrier, unlimited

Pictorial simulation

- Behaviour rules

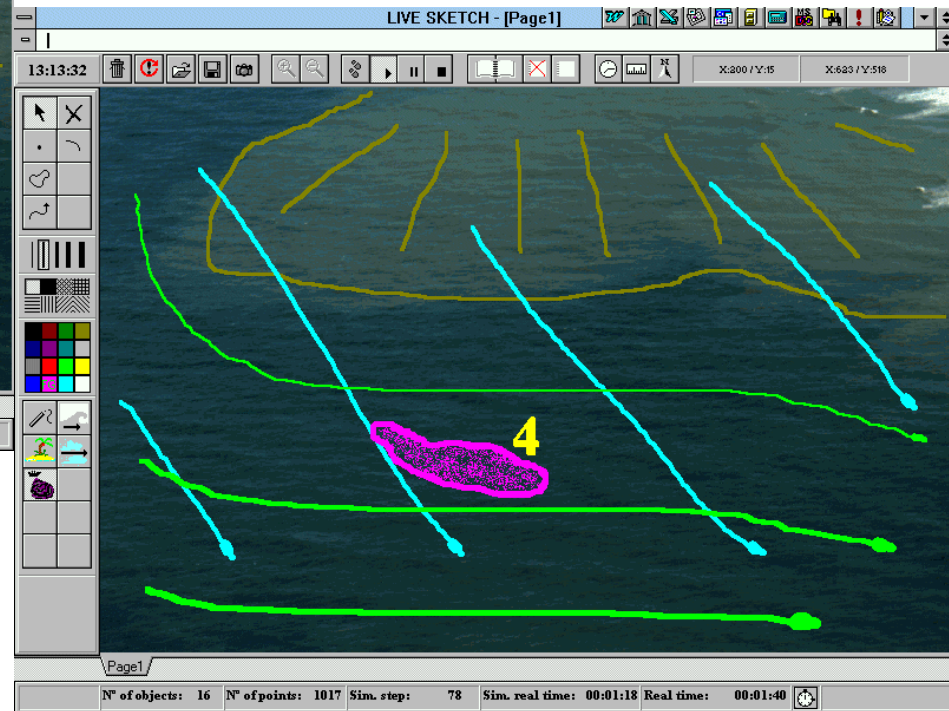
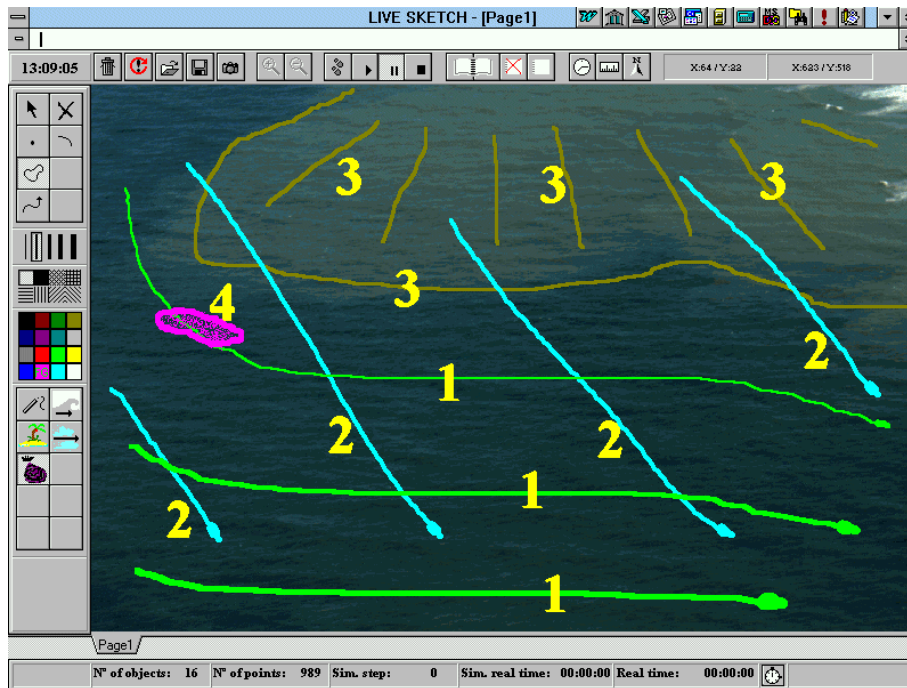
Decay 	Multiply 	Move 
Expand 	Retract 	Divide 
Invert 	Rotate 	Change colour 

Pictorial simulation

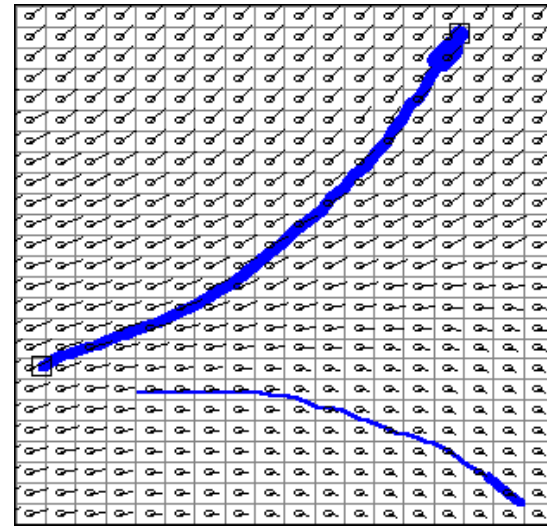
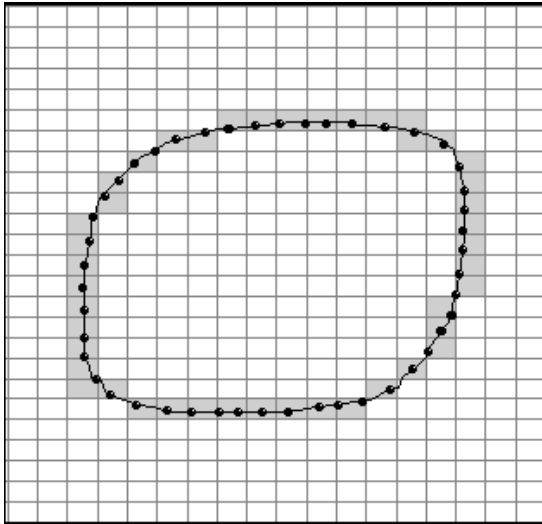
- Interaction rules

Atraction 	Repulsion 	Neutralization 
Reunion/Absorption 	Intersect./Reproduction 	
Transformation 	Colour blending 	

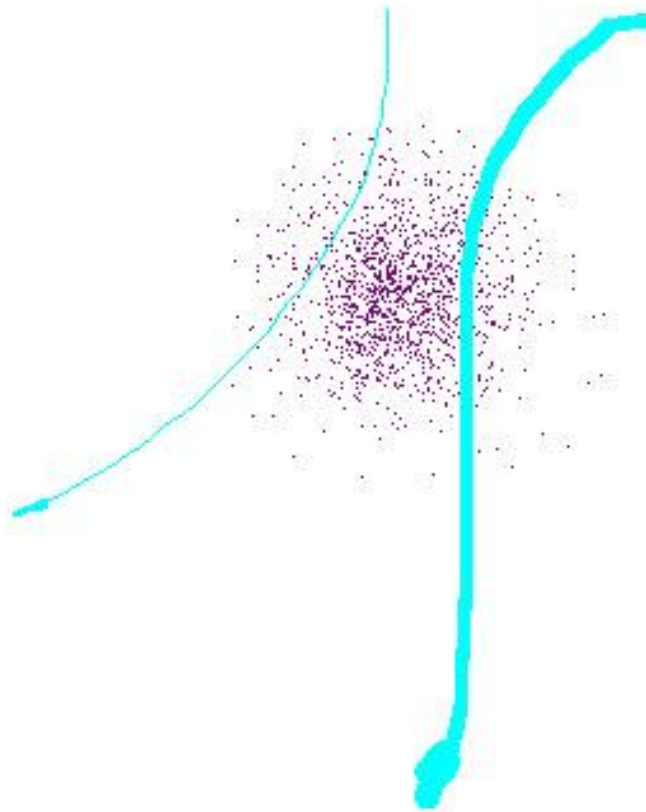
Live sketching



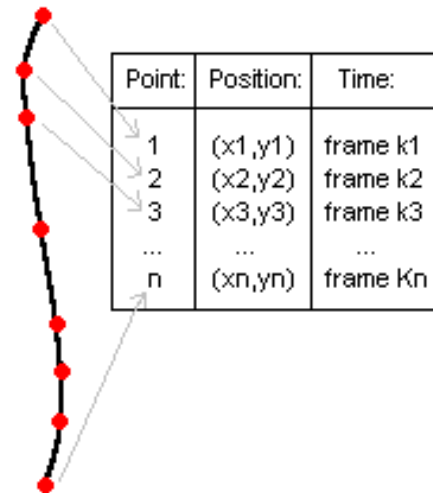
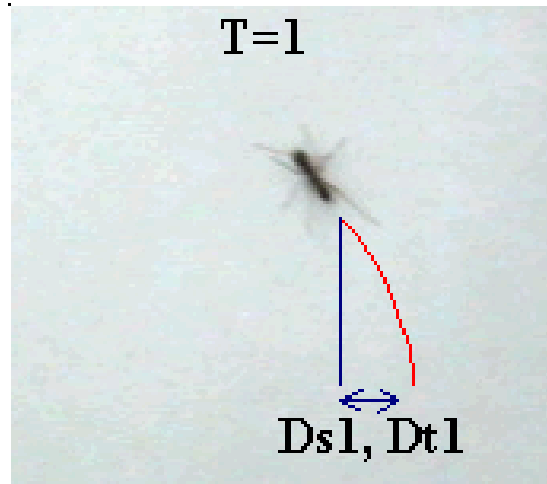
Live sketching



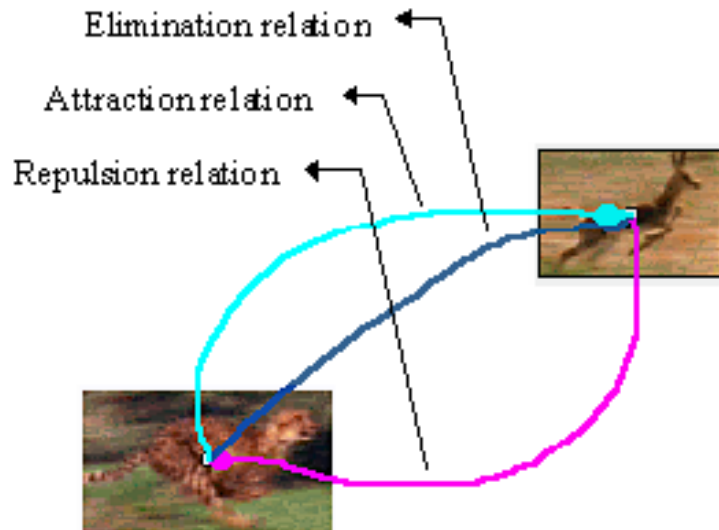
Live sketching



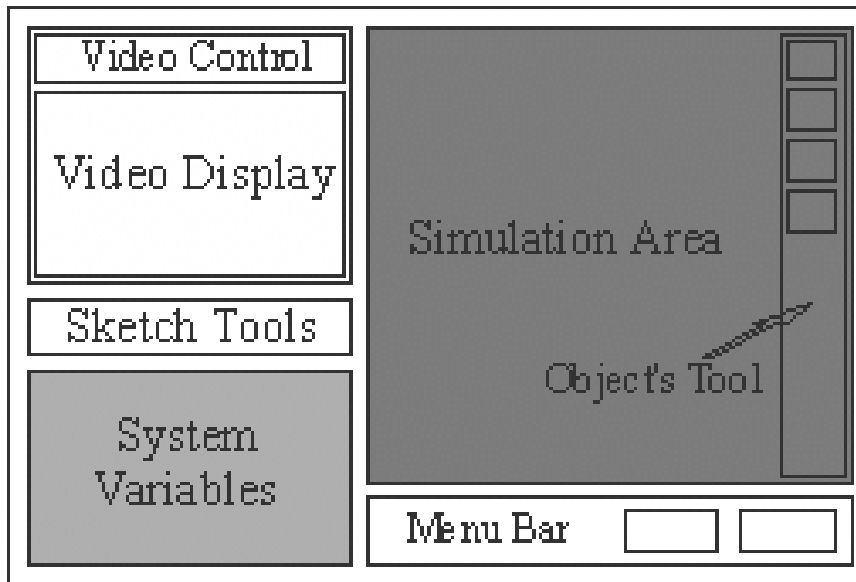
Programming by reproduction and interactive video



Programming by reproduction and interactive video

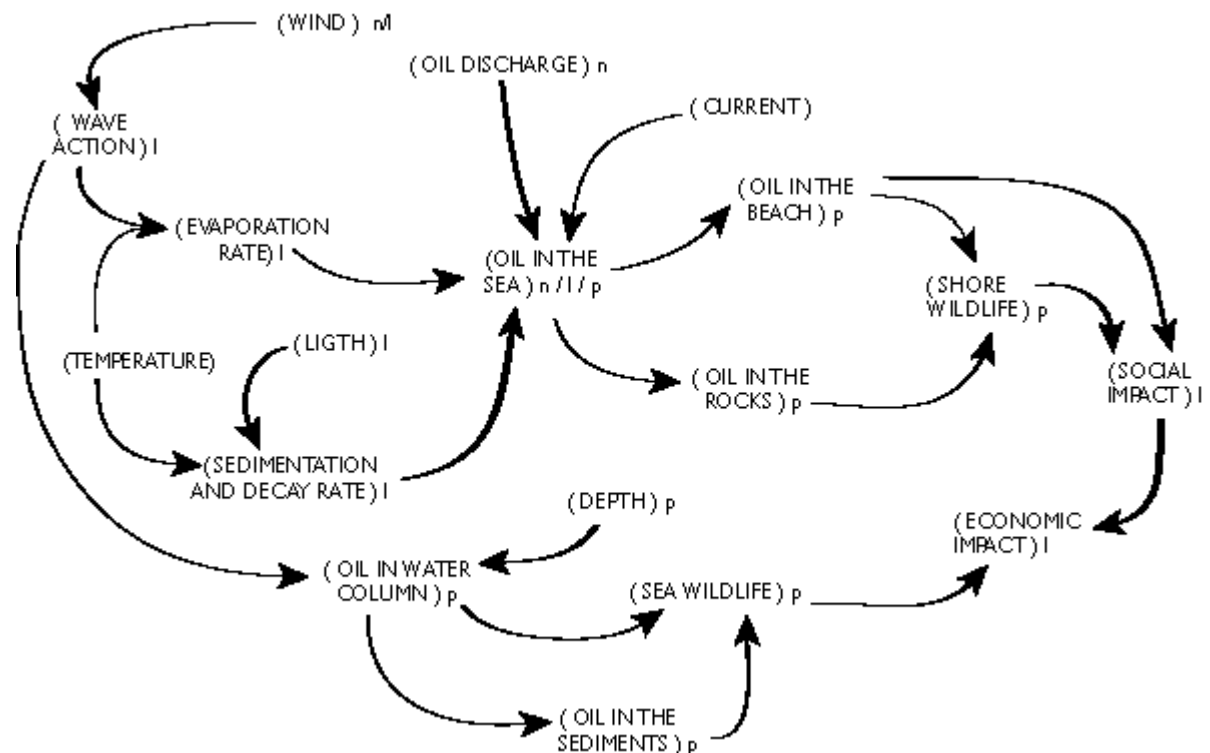


Programming by reproduction and interactive video



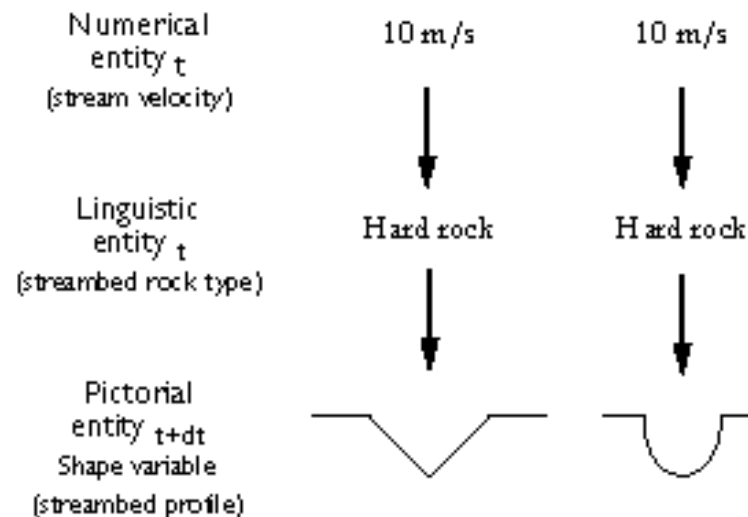
Multidimensional simulation

- From a verbal description to a causal diagram



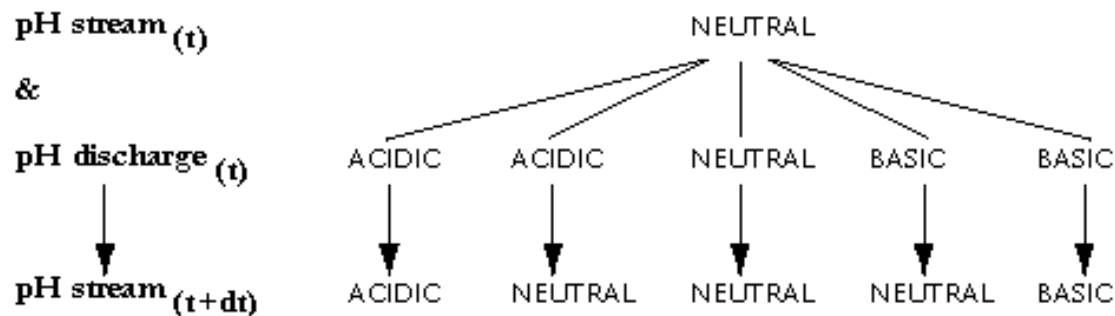
Multidimensional simulation

- CA model as a driver complemented by qualitative relationships



Multidimensional simulation

- Linguistic modelling



Multidimensional simulation

- Multidimensional relationships

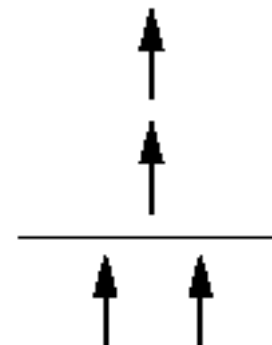
Initial value of linguistic entity: value at t = **LOW**
(oil in the beach)

Computation of change of linguistic value

Contribution of pictorial entity
(oil in the sea)

Contribution of numerical entity
(wind speed)

Total contribution



Final value of linguistic entity: value at $t + dt$ = **VERY HIGH**

Multidimensional simulation

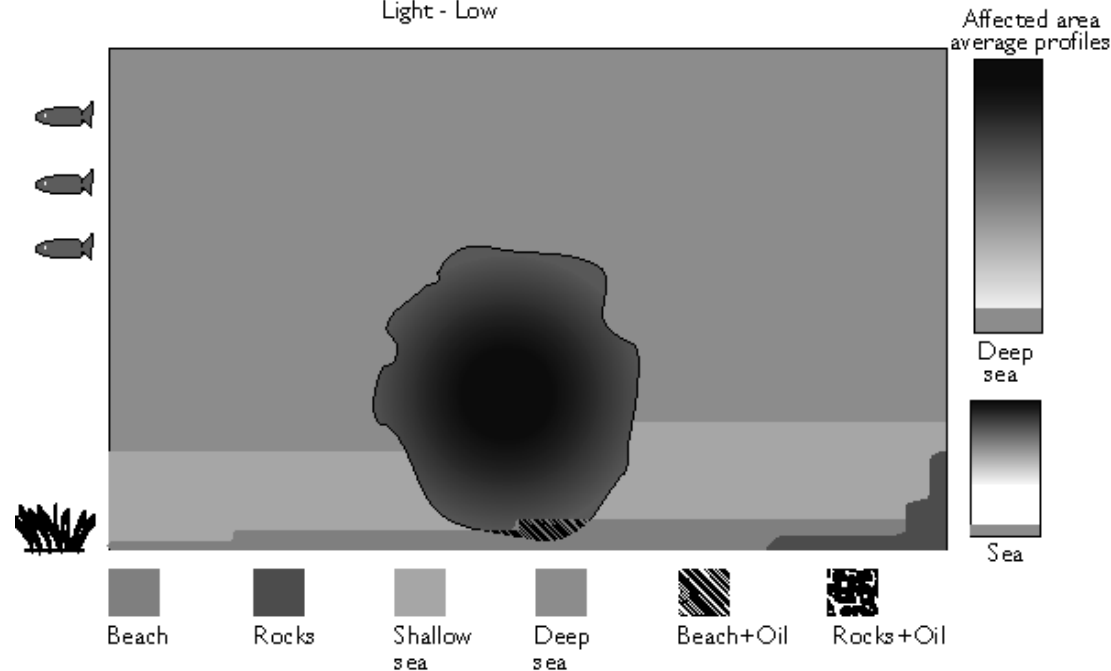
Numerical variables

Oil discharge - 50 000 ton.
Wind speed - 60 Km/h
Wind direction - East

Linguistic variables

Wave action - High
Current - North
Evaporation rate - 3% /day
Temperature - Medium
Light - Low

Sedimentation/
/ decay rate - .1% /day
Social impact - High
Economic impact - High



Shore wildlife:



Non-affected



Affected



Severe situation

Sea wildlife:



Non-affected



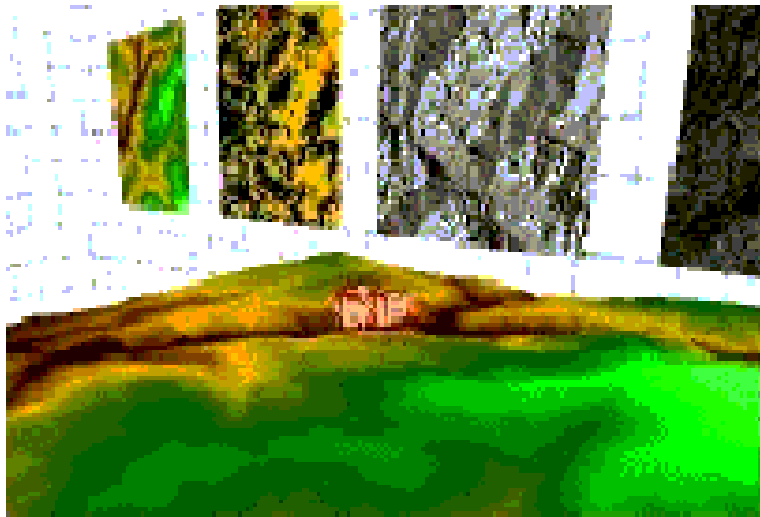
Affected

General indicators:

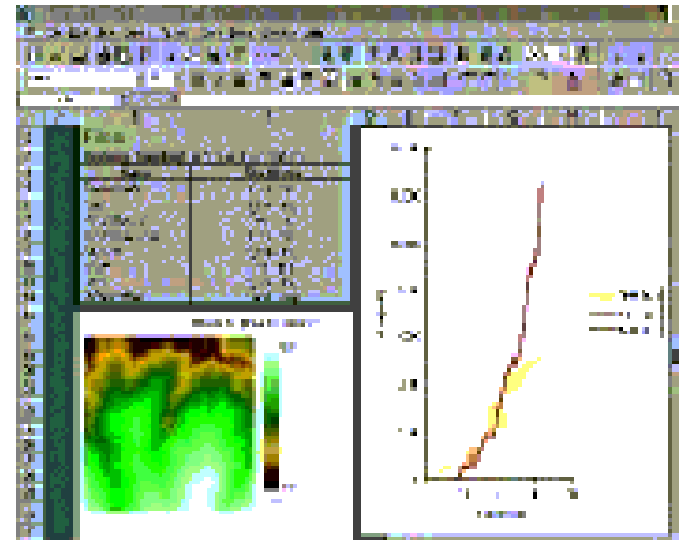
Simulation time: 18 days
Affected area (Km²): 86 300
Oil (ton): 29 143.8

Visualization schemes

- 3D interactive visualization of 2D models



(a)



(b)

Visualization schemes

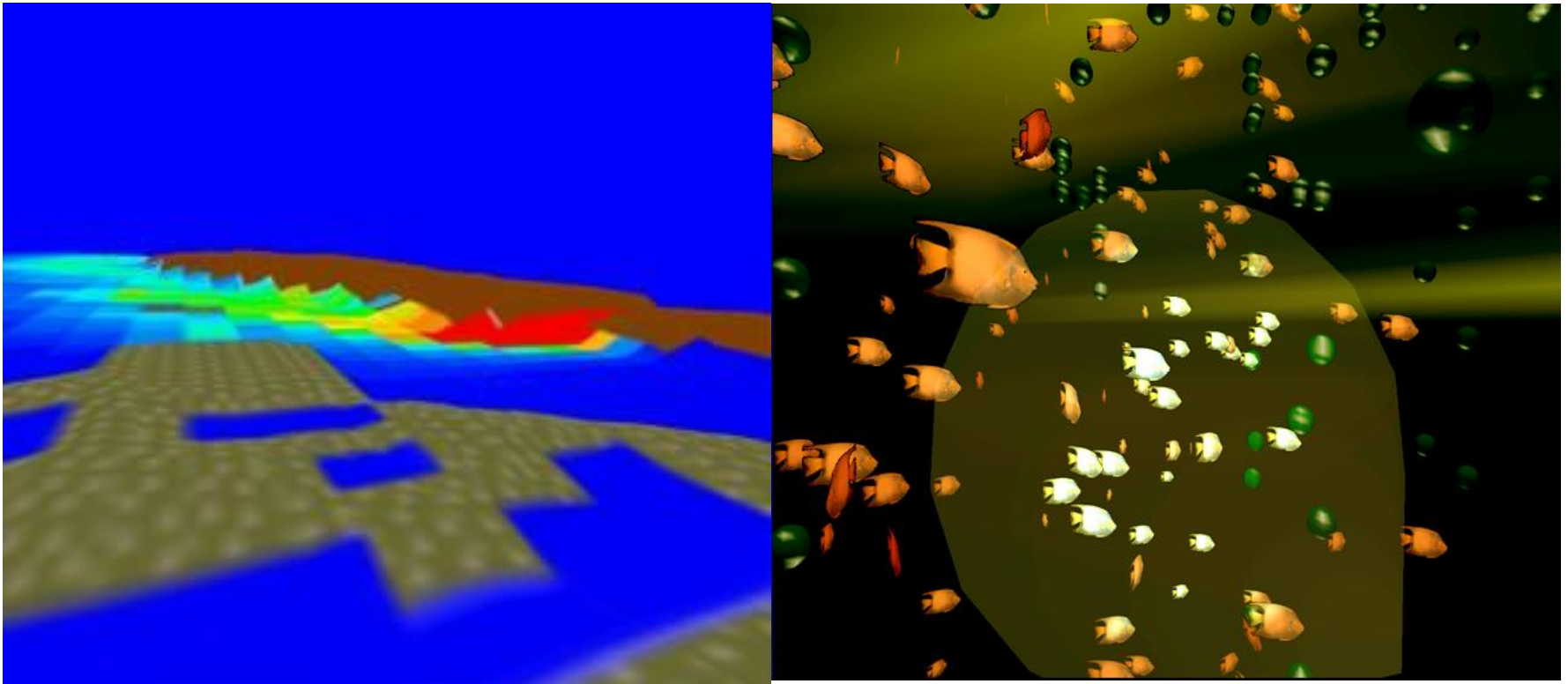
- Video game like approach



- 1 - Create building
- 2 - Create factory
- 3 - Create tree
- 4 - Translate object
- 5 - Rotate object
- 6 - Delete object
- 7 - Move / Stop toggle
- 8 - Fly / Walk toggle
- 9 - Virtual pointer

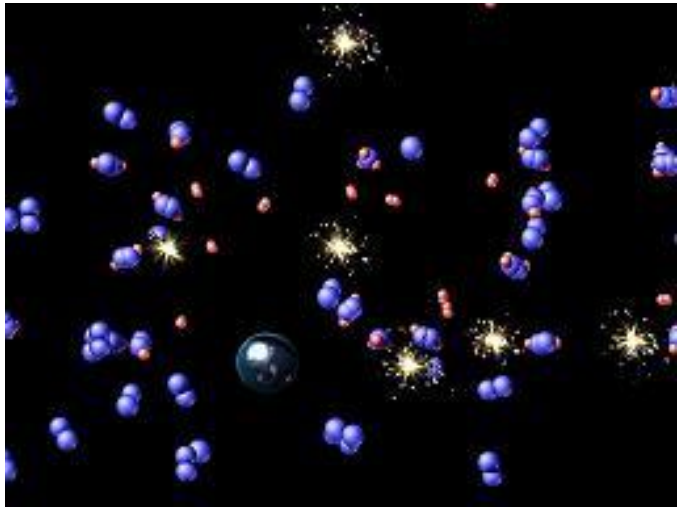
Visualization schemes

- Video game like approach



Visualization schemes

- Interactive installations



Summary and conclusions

- CA modelling is simple provided that you can code the problem: set of discrete values; transition rules
- CA provides the framework for pictorial modelling
- Pictorial modelling can be supplemented by linguistic modelling using knowledge based rules
- Multidimensional modelling (using pictures, numbers and words) can be used as engines for games and interactive installations
- Visualization of multidimensional models can range from desktop to tangible or any other interactive installation

Useful links

- Neil Gershenfeld et al., Avogadro-Scale Computing
<http://cba.mit.edu/events/08.04.ASC/>
- Antonio Camara, Environmental Systems, A Multidimensional Approach, Oxford University Press
<http://books.google.com/books?id=WWp9or5WSw4C&pg=PP1&dq=antonio+camara+environmental+systems&ei=seEiSI-3KYuOywTUzZW-DQ&sig=fjESxnpXWUNlyHTummEO7zw5HTM>
- Stephen Wolfram, A New Kind of Science <http://www.wolframscience.com/>