Modelling
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Grid Based Modelling
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Agent based Modelling
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Visualize ComplexCities

Modelling & Simulation

Chair of Information Architecture
ETH Zürich

March 22, 2013

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Grid Based Modelling
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Grid Based Modelling
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Agent based Modelling
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Modelling

The process of creating abstract or conceptual model and the use of objects in the creation of a predictive statement.
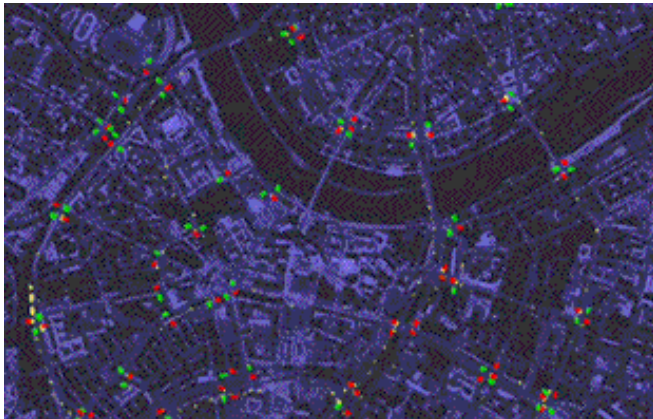
Source: http://www.wikipedia.org/
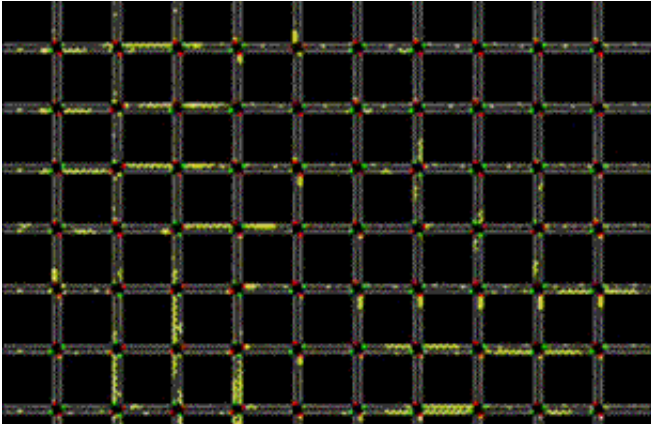
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Grid Based Modelling
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Abstraction

Picture source: http://www.soms.ethz.ch/

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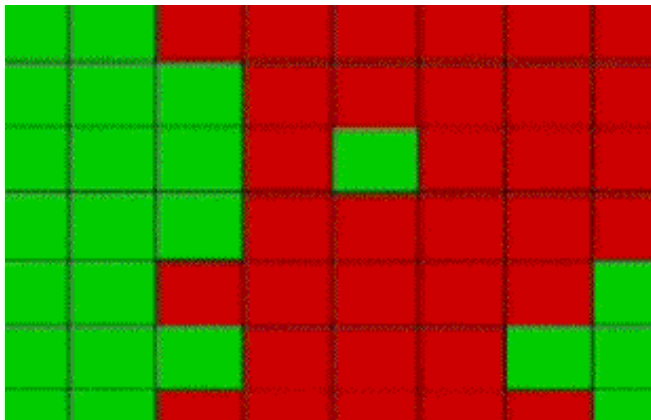
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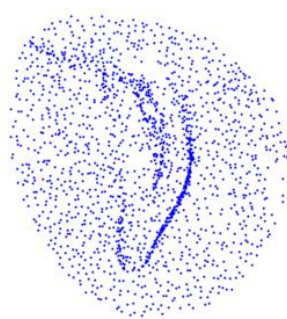○○●

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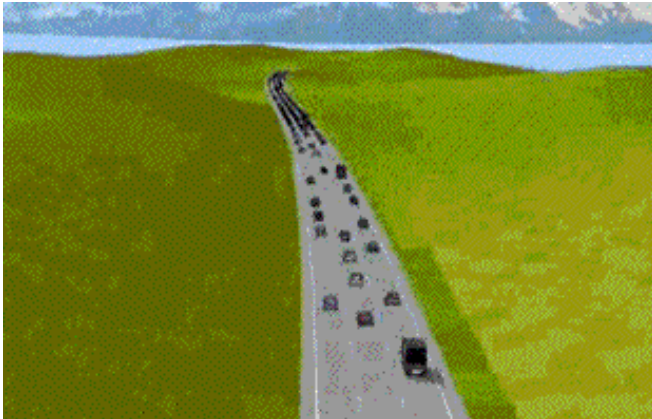
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Two Modelling Approaches

Grid based
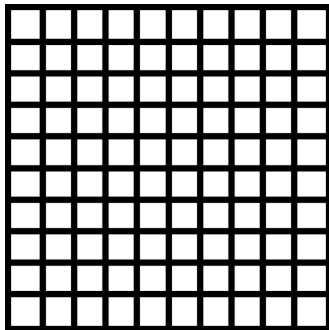
Agent/Particle based

Grid Based Modelling

In grid based modelling, we have fixed entities in the room,
which interact with each other. They change their value
according to this interaction.

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Agent based Modelling
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Cellular Automata

Cellular Automata (CA) are a discrete model. The basic model consists of a row of cells, which are either black or white. They change their state in every step according to their neighbors.

Picture source: http://http://mathworld.wolfram.com/
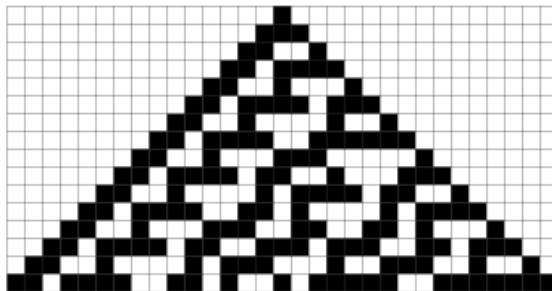
CA in More Dimensions

The CA can be extended to more dimensions. With that, the rule set increases to cover all possible neighborhoods.

- http://www.youtube.com/watch?v=KGPSoxHemcw
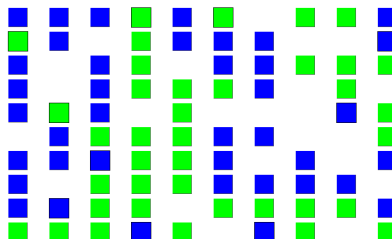- http://www.youtube.com/watch?v=CYgbnI_R1E0
- http://www.youtube.com/watch?v=4DhgYuQONvE

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Predator-Prey CA

There are two species, a predator and a prey. The predator
needs to eat the prey to survive. The prey can survive on its
own. An example could be with sheep and wolves.

- http://www.youtube.com/watch?v=sGKiTL_Es9w

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Segregation

We have two groups, for example green and blue. The people prefer to live next to their own kind. If the fraction of neighbors of the other kind gets to big, they move to a place they prefer.

Picture source: http://www.wolfram.com/

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Non-Uniform CA

The grid does not necessarily need to be uniform. The different cells could for example also be the faces of a Voronoi diagram.
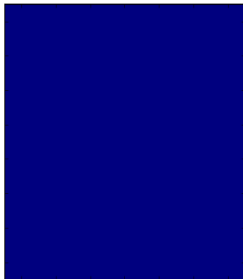

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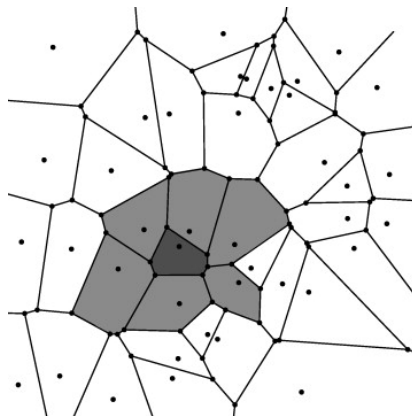
Stocks & Flows

The cells in the grid can also be used to contain stocks of some
material, for example some amount of water.

- `http://www.youtube.com/watch?v=bYb9iIwTaEU`
- `http://www.youtube.com/watch?v=q5c7Hx-ssvE`

Normally this also increases the complexity of the interaction
between different cells, especially when it comes to physics, as
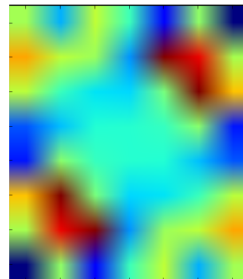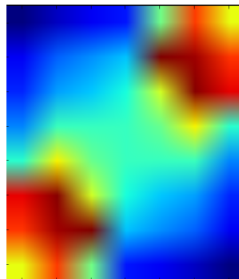in the first video with the diffusion equation.

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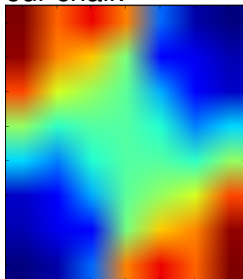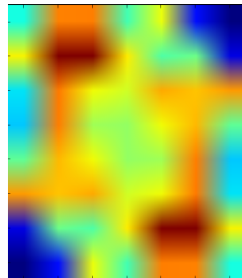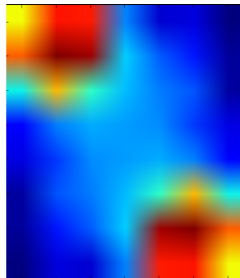00000000●0
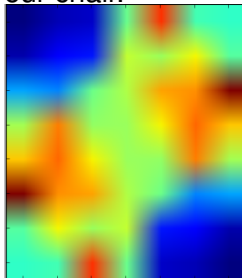
Agent based Modelling
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Stocks & Flows in Cities

The pictures show different densities (residents, employees, total) within an artificial urban area from a model developed in our chair.

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Grid Based Modelling
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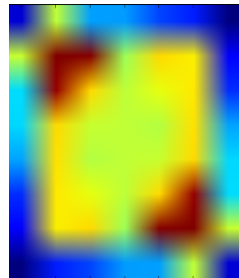Agent based Modelling
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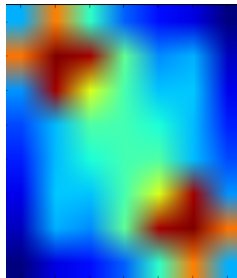○○○○○○○●○

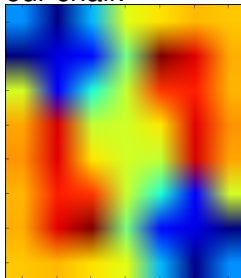Agent based Modelling
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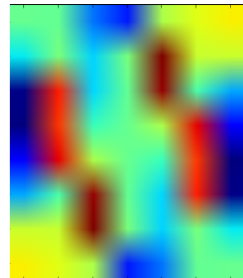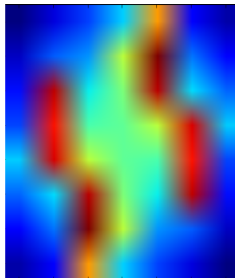
Agent based Modelling
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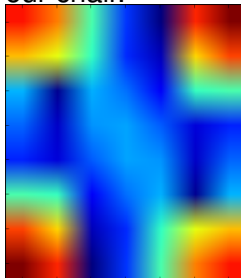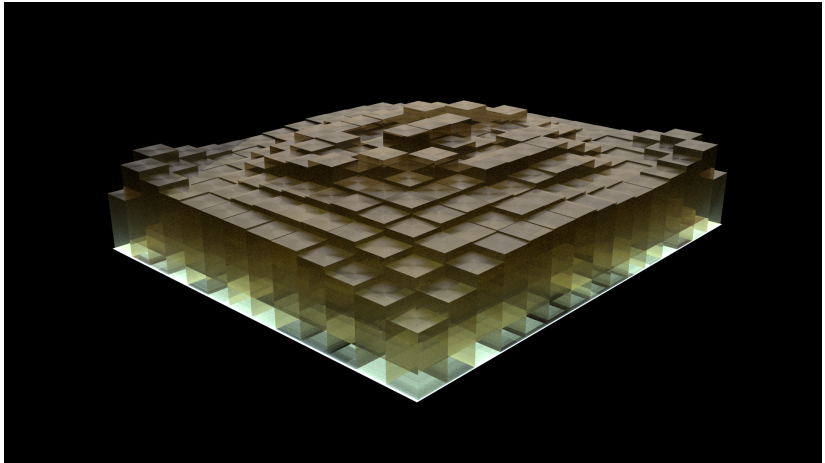Agent based Modelling
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Stocks & Flows in Cities

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Agent Based Modelling

In contrast to the grid based modelling, we look at different entities in the room and look how they move. The different particles or agents interact with each other.
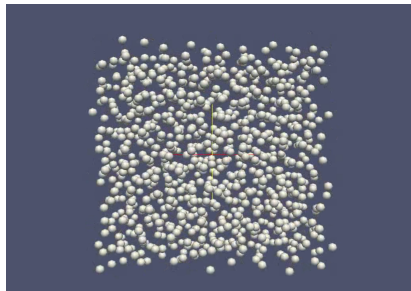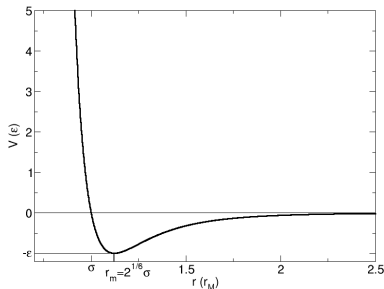
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Simple Particle Dynamics
Particles only interact with their direct neighbors.

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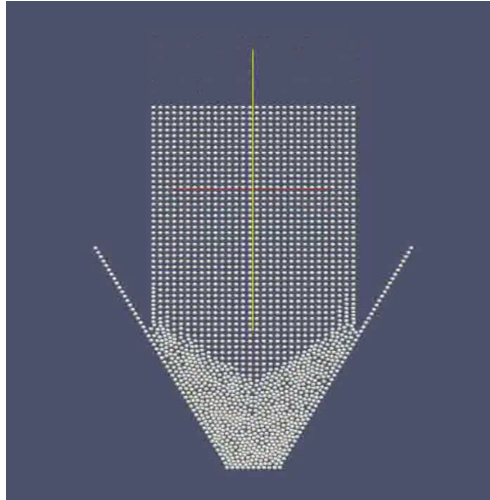
Long Range Interaction

Particles can also have an influence on all other. For pure gases, this is described with the Lennard-Jones potential.

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Pendulum

We can also restrict the movement of particles.

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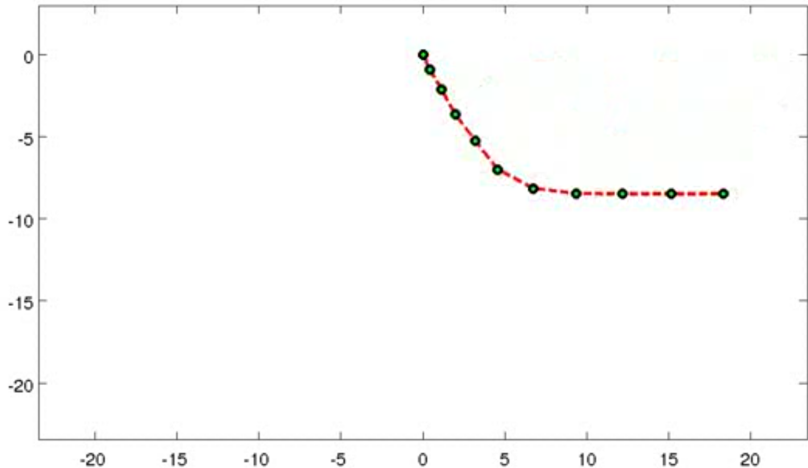
Simulating Movements of People

The techniques can be used to simulate the movement of people.