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### Miscellaneous models

# **Minimal model**

```
<MorpheusModel>
      <minimal/>
</MorpheusModel>
```



Minimal valid XML model

### Introduction

This example does nothing - expect being the minimal valid Morpheus model.

Such a model is generated when choosing File → New.

## **Model description**

The basic model only includes the required nodes MorpheusModel, Description, Space and Time. Their required nodes and attributes are added recursively, such as Lattice class and StopTime value.

## Things to try

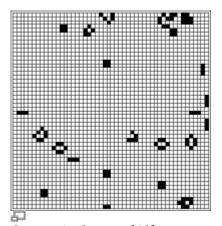
• Invalidate this minimal model by editing it (but keeping it well-formed). When opening this model in morpheus-gui, it triggers a warning saying that what went wrong, and how it was solved. Check the Fixboard to see the changes that are made to model.

### Model

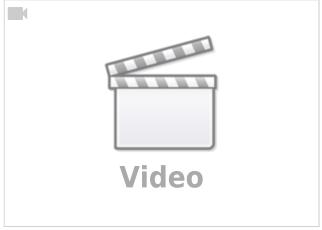
h Minimal.xml |h

In Morpheus GUI: File → New.

# **Game of Life: Cellular Automata**



Conway's Game of Life



### Introduction

This example models probably the best-known classic cellular automaton (CA) model: Conway's Game of Life.

It shows an alternative use of System for synchronous updating of Equations.

# **Model description**

In this model, the lattice is filled with cells of size 1. Each cell counts the number of neighboring cells

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that are 'alive' and acts accordingly. The rules that make up the Game of Life are implemented in a System of Equations in which all Equations are updated synchronously.

# Things to try

• Change the Neighborhood from a Moore (2nd order) to von Neumann (1st order).

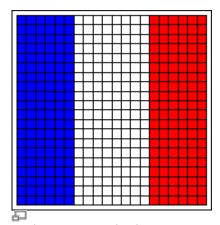
#### Model

h GameOfLife.xml |h

extern>http://imc.zih.tu-dresden.de/morpheus/examples/Miscellaneous/GameOfLi
fe.xml

In Morpheus GUI: Examples → Miscellaneous → GameOfLife.xml

# French Flag: Morphogen gradient



Wolpert's French Flag

### Introduction

This example shows Wolpert's classical French Flag model. Depending on the local concentration of a morphogen, cells adopt one of three cell types based on internal thresholds.

# **Model description**

The model sets up a morphogen gradient in the x direction PDE. Note that no diffusion is used, since we use the steady-state solution of diffusion.

The cells in CellType register the (average) local morphogen concentration using PDEReporter. Based on the specified threshold values, they choose an identity I as defined in the Equation.

Note that this model is not time-dependent. Time is therefore set from StartTime 0 to StopTime 0.

# Things to try

- Change the physical length of the domain by editing Space → NodeLength that controls the physical size per lattice site.
- Change the model such that the morphogen gradient is set up by production and diffusion, using Diffusion and a System with DiffEqn. That is, change the model into a time-dependent model.

#### Model

h FrenchFlag.xml |h

extern>http://imc.zih.tu-dresden.de/morpheus/examples/Miscellaneous/FrenchFl
ag.xml

In Morpheus GUI: Examples → Miscellaneous → FrenchFlag.xml.

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