The influence of Moore and von-Neumann neighbourhood on the dynamics of pedestrian movements

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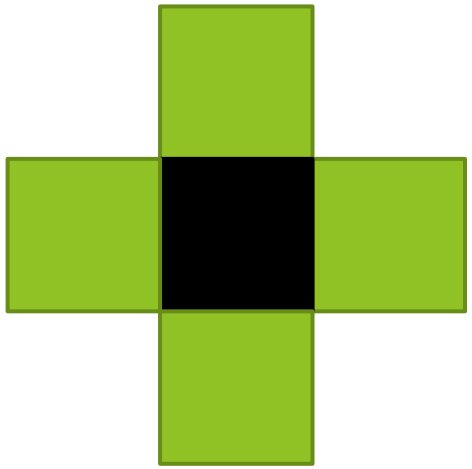
Table of Contents

Introduction

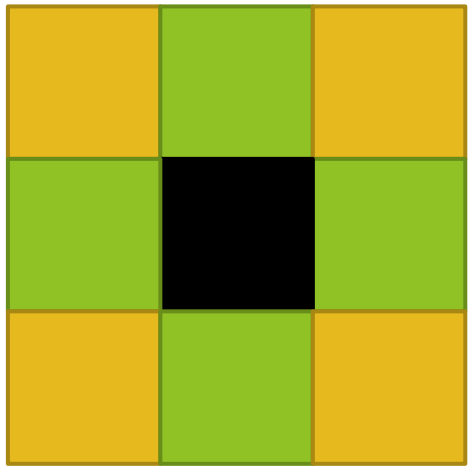
- A model/software-tool needs some kind of „wayfinding“
- This is done in most of the cases by using a distance map /potential field / floor field…
- Normally, a square lattice for the distance map is used, thus the question is: how is it calculated?
- In this presentation, we discuss the von-Neumann neighbourhood and the Moore neighbourhood for the underlying map

Introduction

- The Moore neighbourhood and the von-Neumann neighbourhood

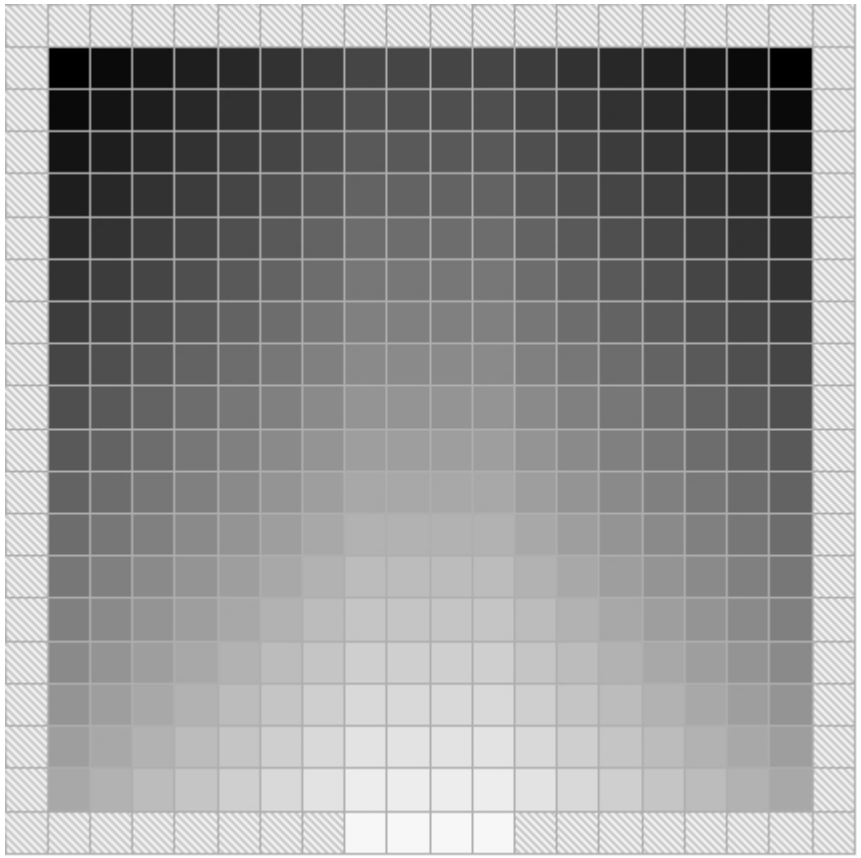


Von-Neumann

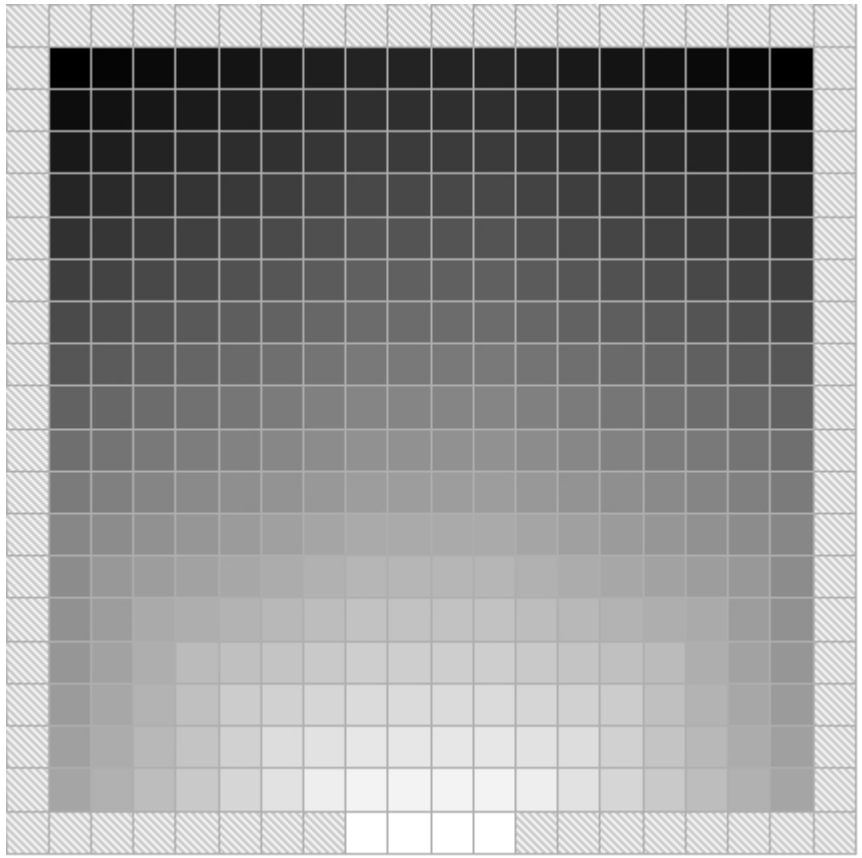


Moore

Introduction



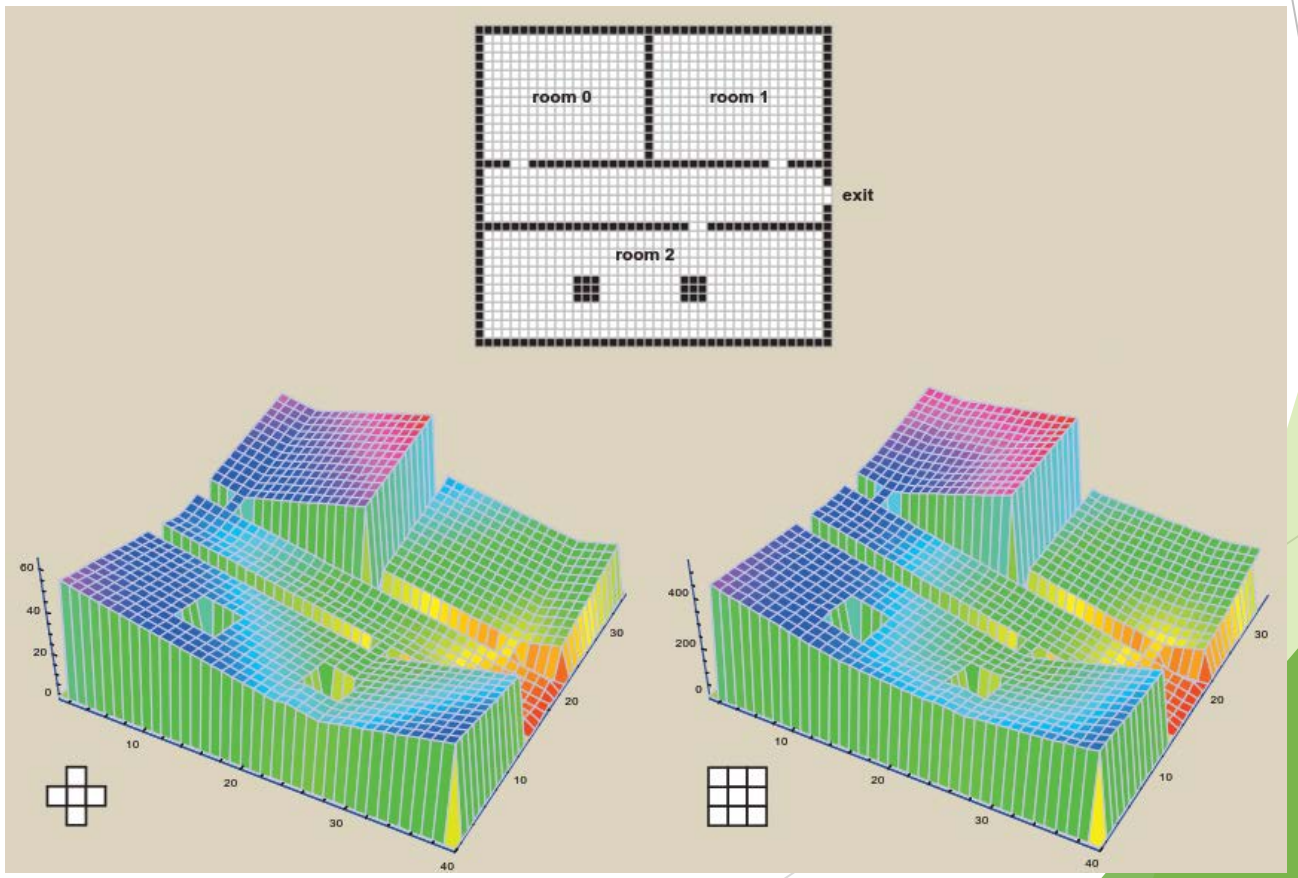
Von-Neumann



Moore

Introduction

- The Moore neigbourhood makes the potential field „more smooth“



Model / Software

- QuoVadis Software developed by Jörg Meister
- FloorFieldModel with „attractiveness factor“

$$p_{ij} = N * \underbrace{e^{(k_S * (S_{ij} - S_{00}))}}_{static\ floor\ field} * \underbrace{e^{(k_D * (D_{ij} - D_{00}))}}_{dynamic\ floor\ field} * \underbrace{(1 - n_{ij})}_{pedestrian\ in\ cell?} * \underbrace{(1 - \xi_{ij})}_{wall?} * \underbrace{\min(1, e^{D_{00} - D_{00}^{max}})}_{attractiveness}$$

If Simulation only „interested“ in static floor field:

$k_S = 10$, $k_D = 0$

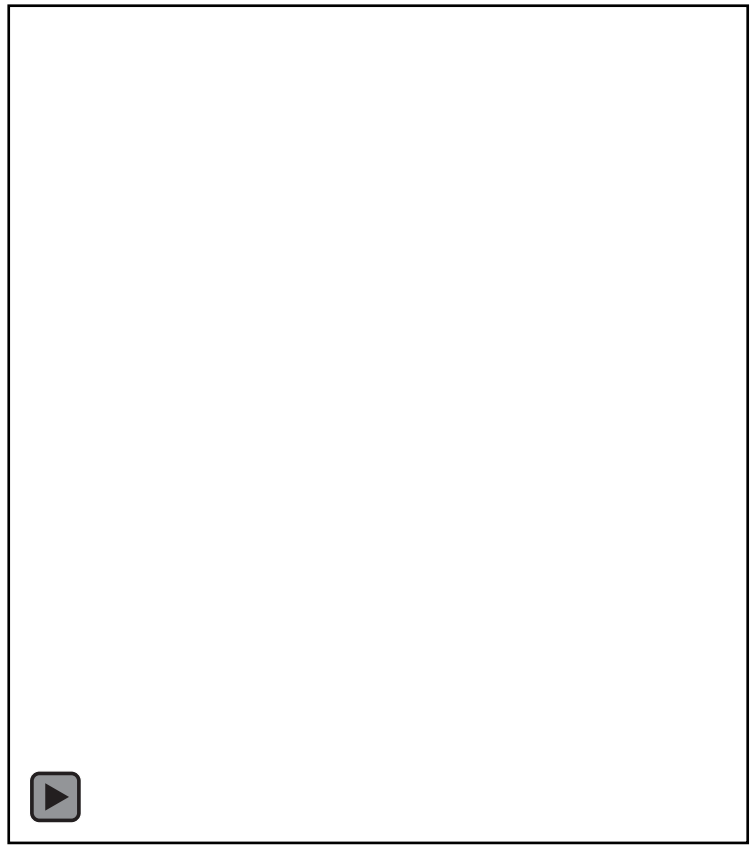
If Simulation runs in „original“ mode:

$k_S = 3$, $k_D = 1$

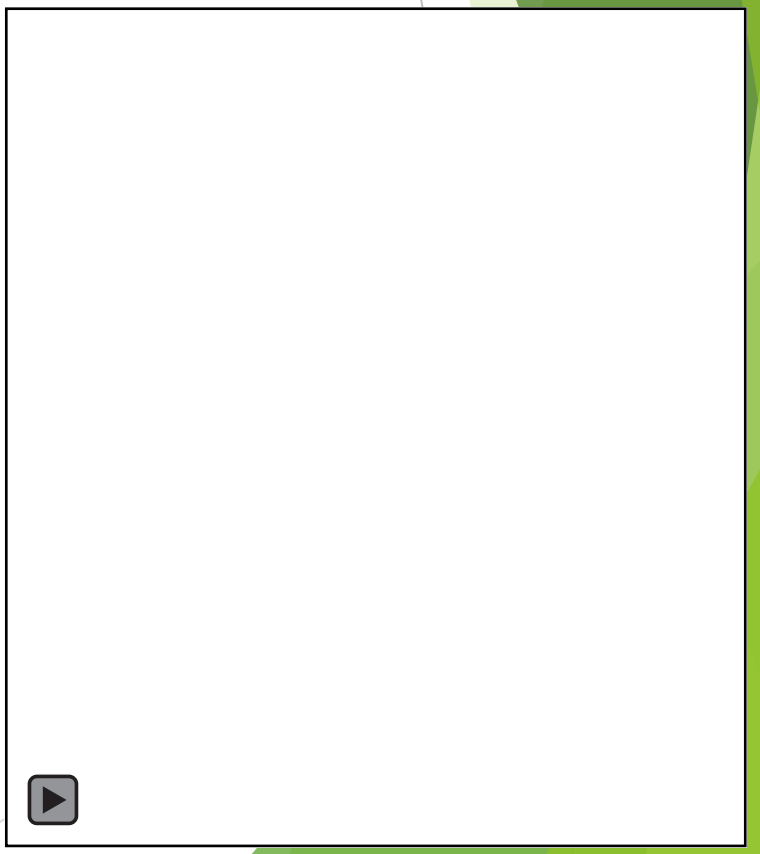
- Parallel Update

Scenarios

- Single Room, 1 pedestrian

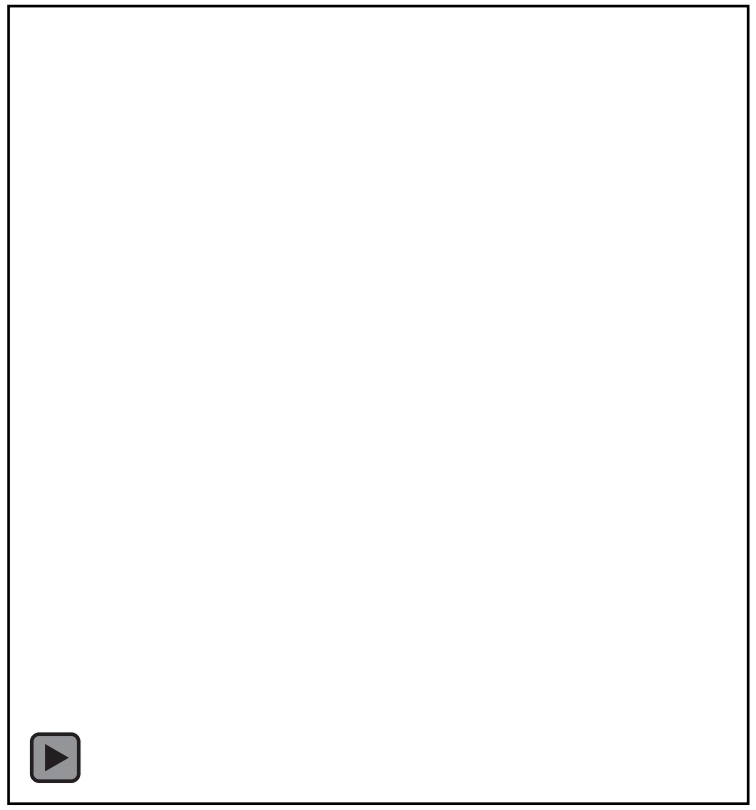


Left: von-Neumann, 28 steps
Right: Moore, 19 steps

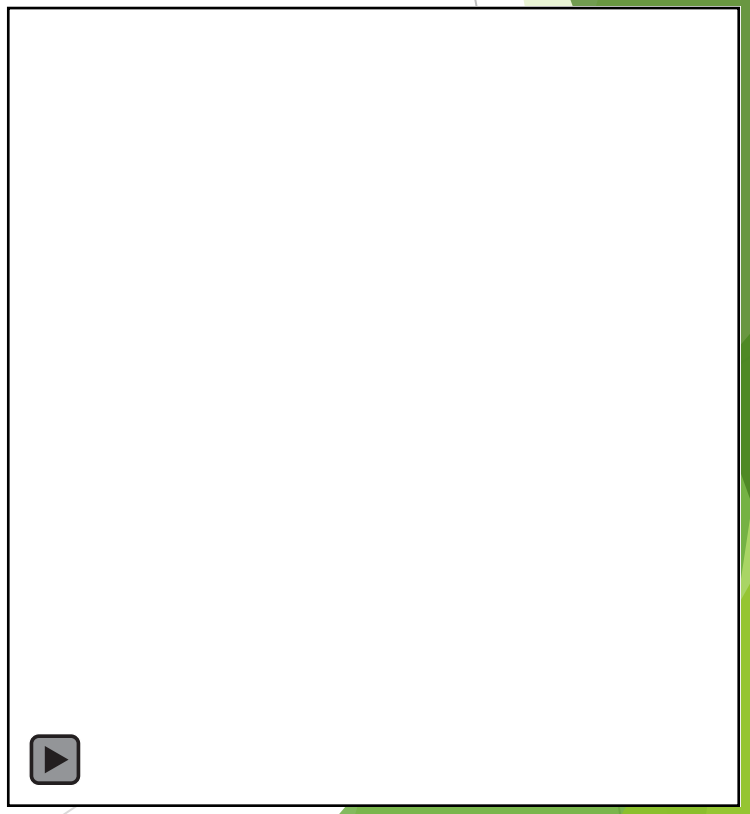


Scenarios

- Single Room, multiple pedestrians

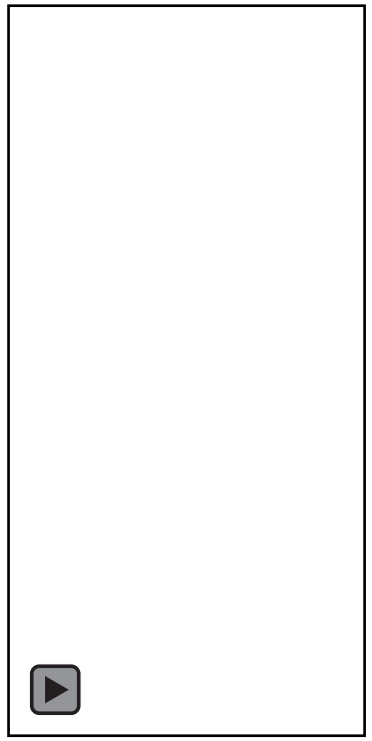


Left: von-Neumann, 51 steps
Right: Moore, 38 steps

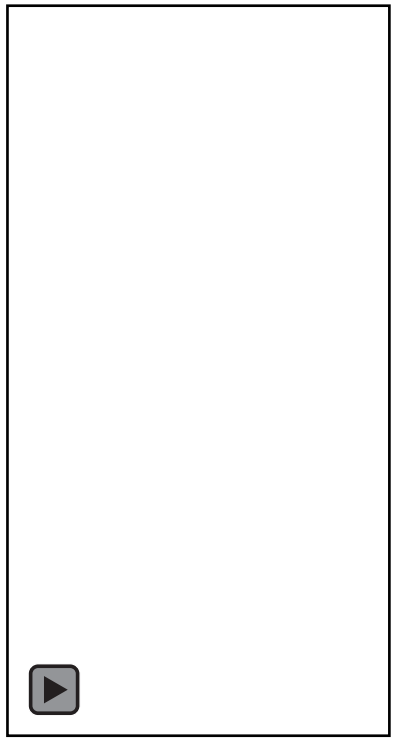


Scenarios

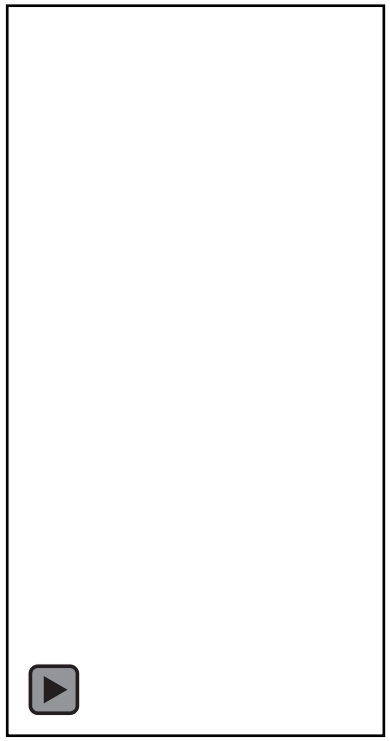
- Simple floor



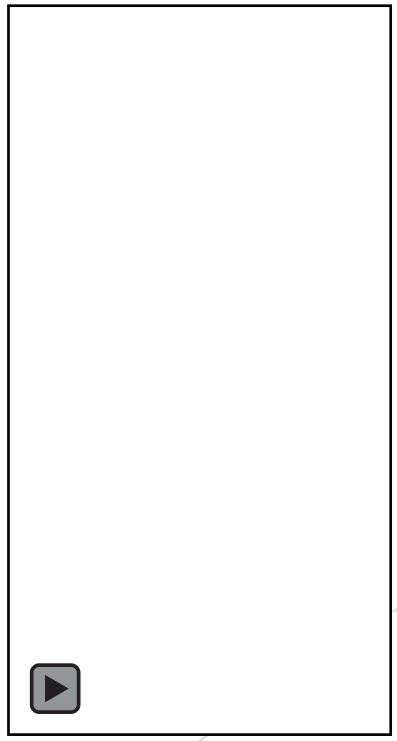
Von Neumann



Moore



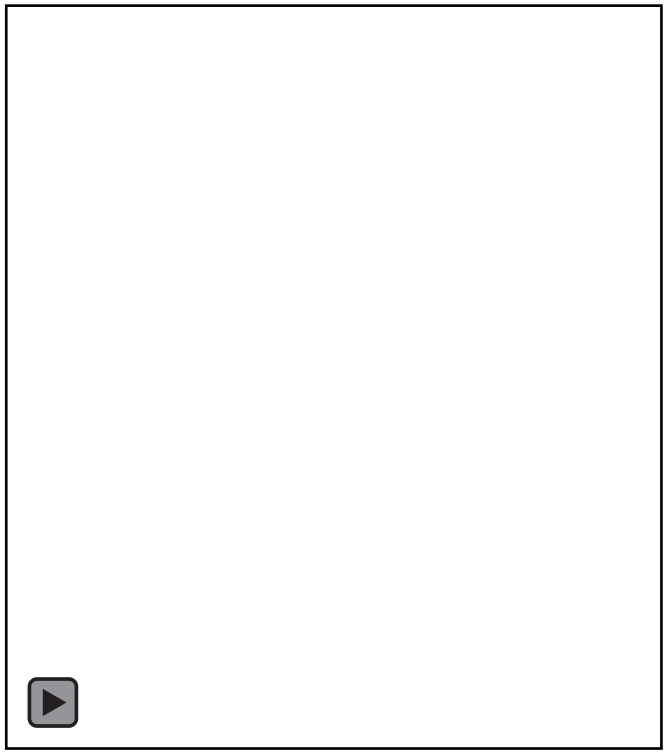
Von Neumann



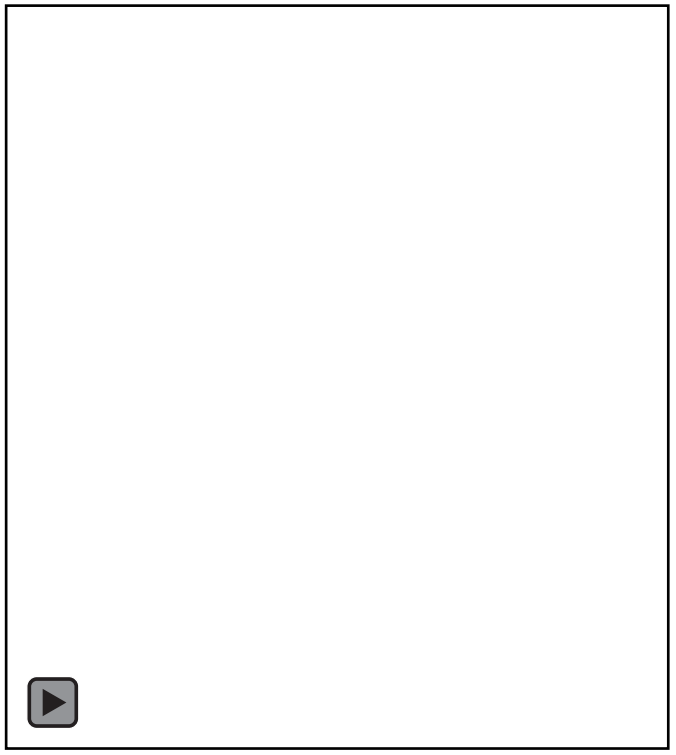
Von Neumann – dyn. FloorField

Scenarios

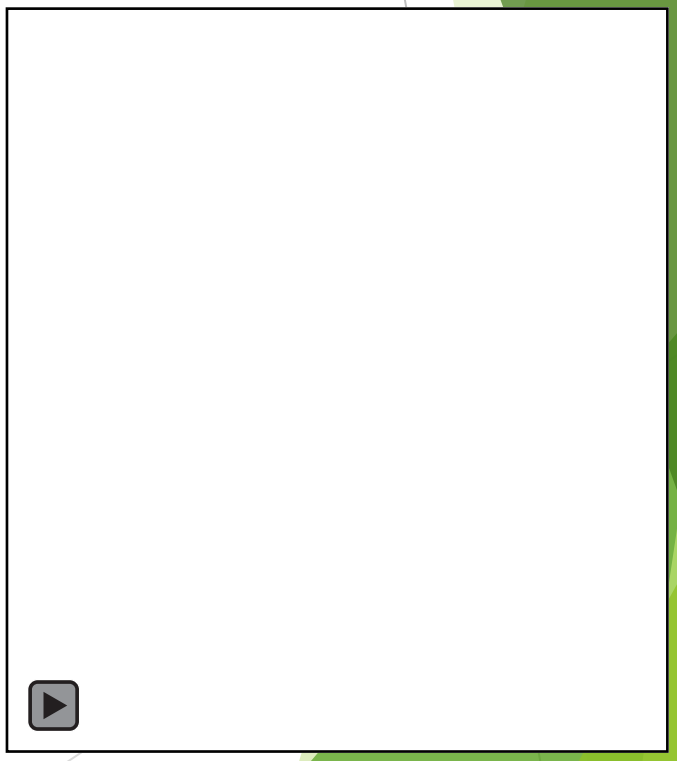
- Corner



Von Neumann



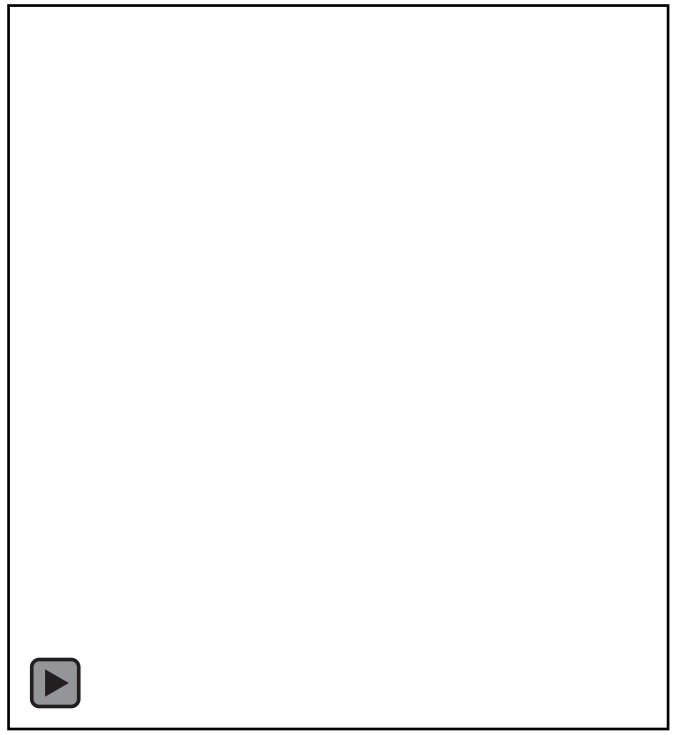
Moore



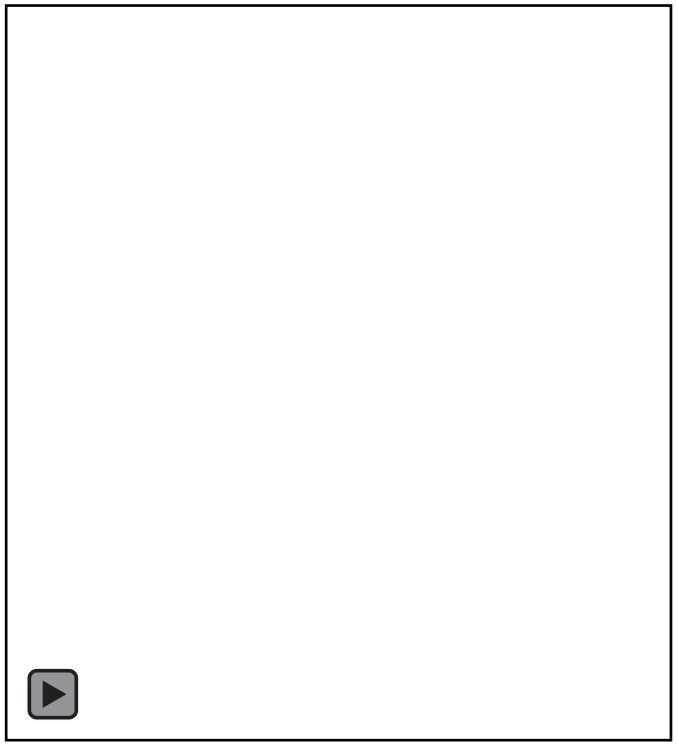
Von Neumann, dyn. FloorField

Scenarios

- Corner, different pedestrian placement



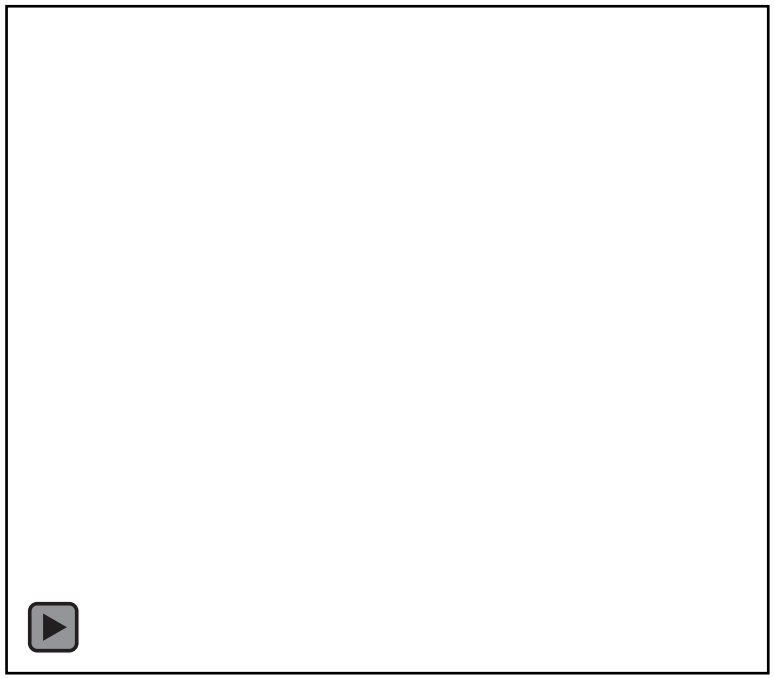
Von Neumann



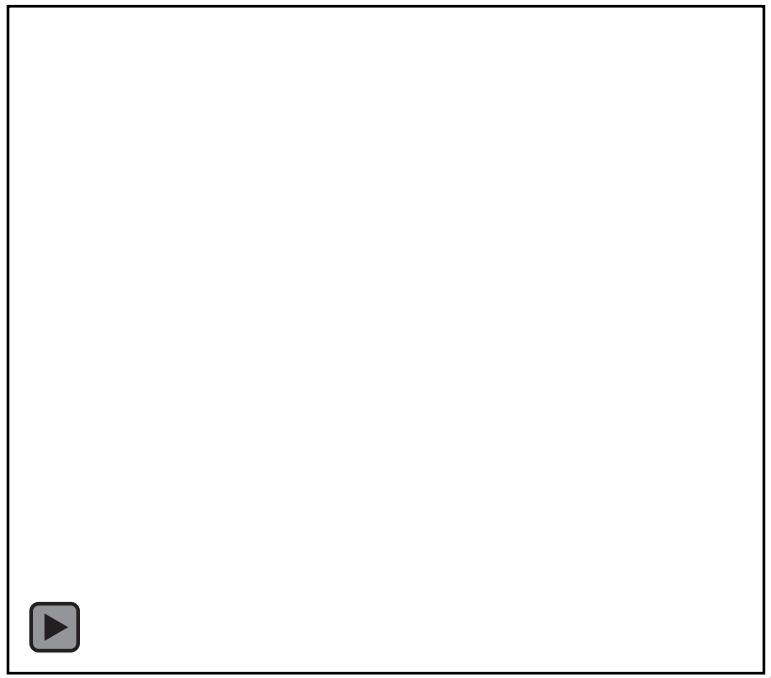
Von Neumann

Scenarios

- 6 Rooms



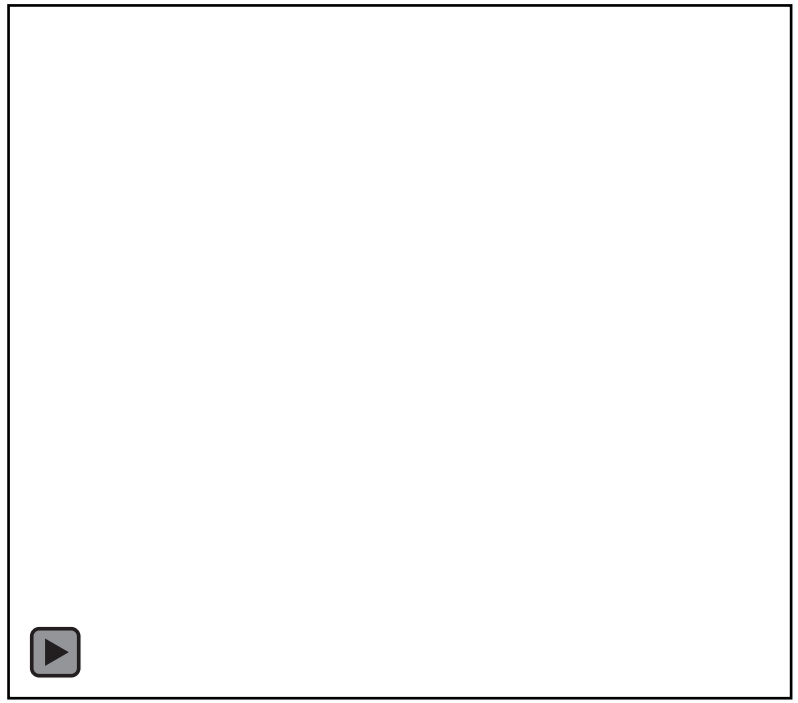
Von Neumann



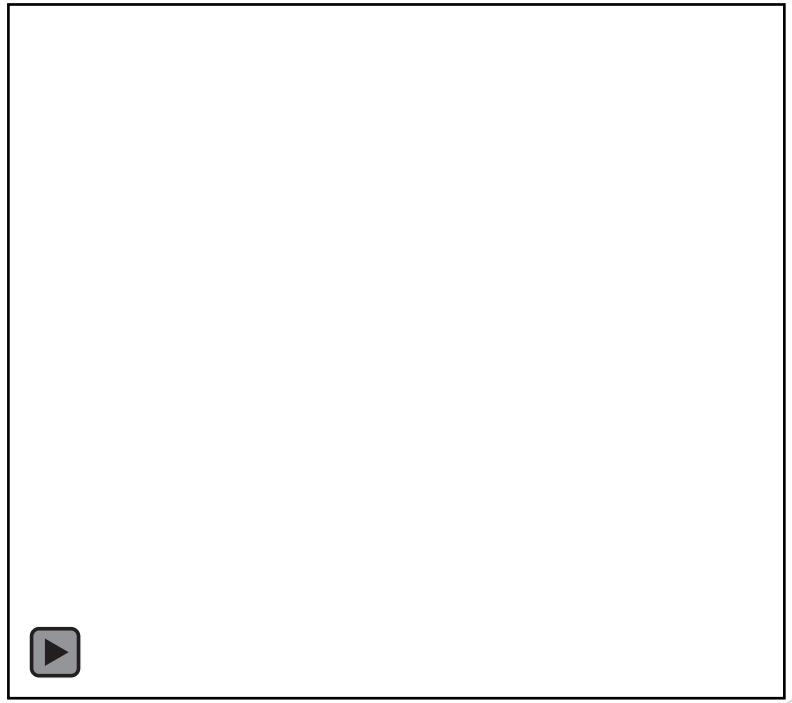
Moore

Scenarios

- 6 Rooms, now with dynamic FloorField



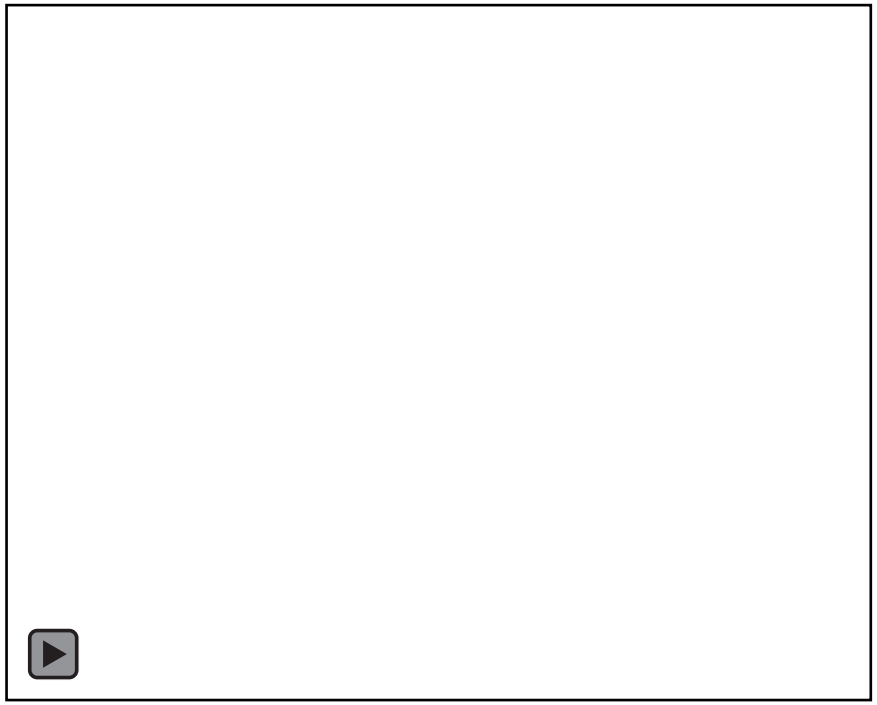
Von Neumann



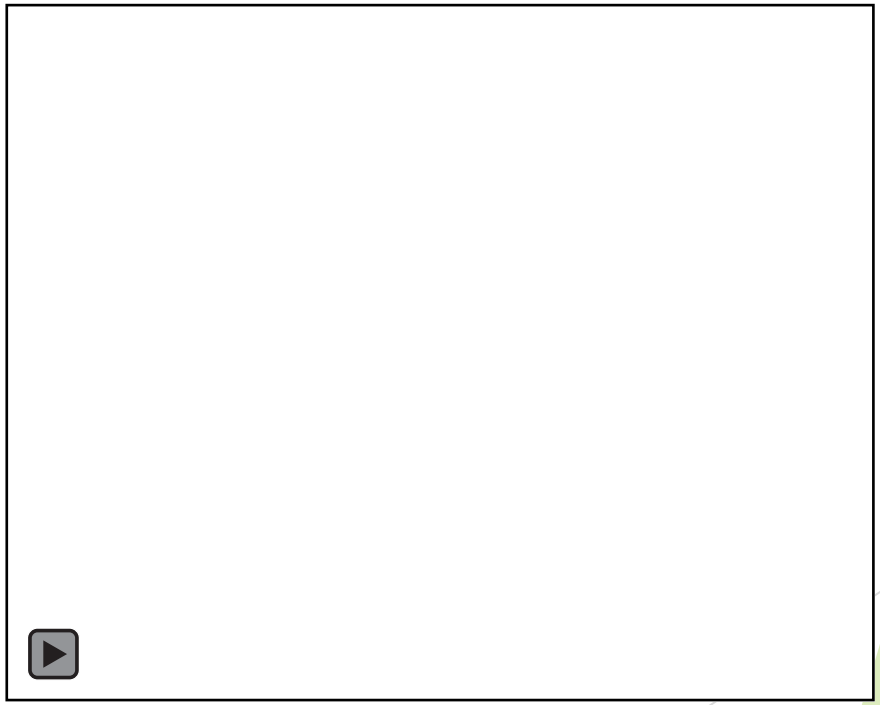
Moore

Scenarios

- More rooms, now 9 and a corner…



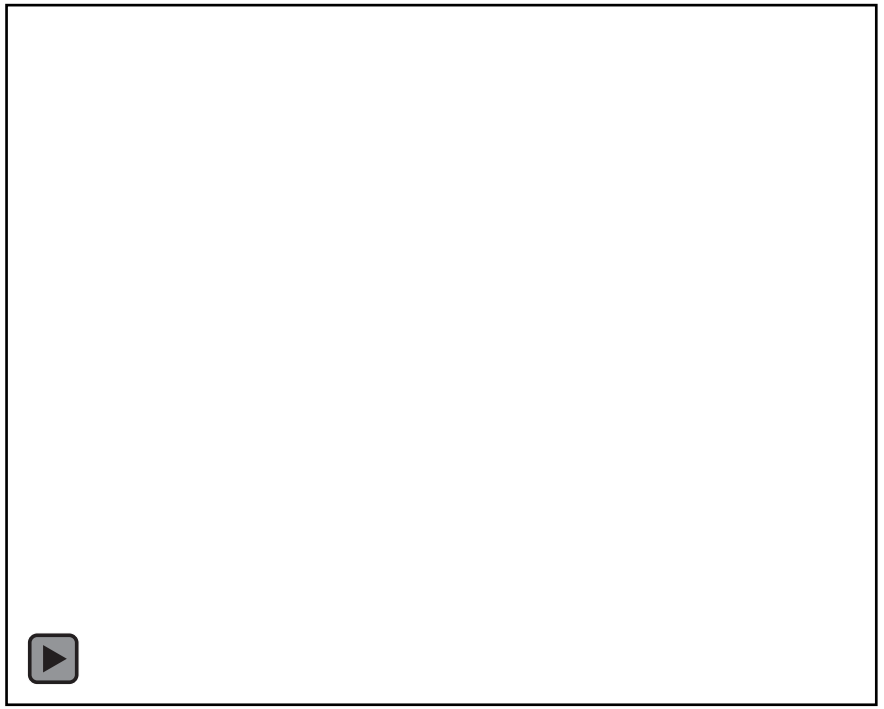
Von Neumann



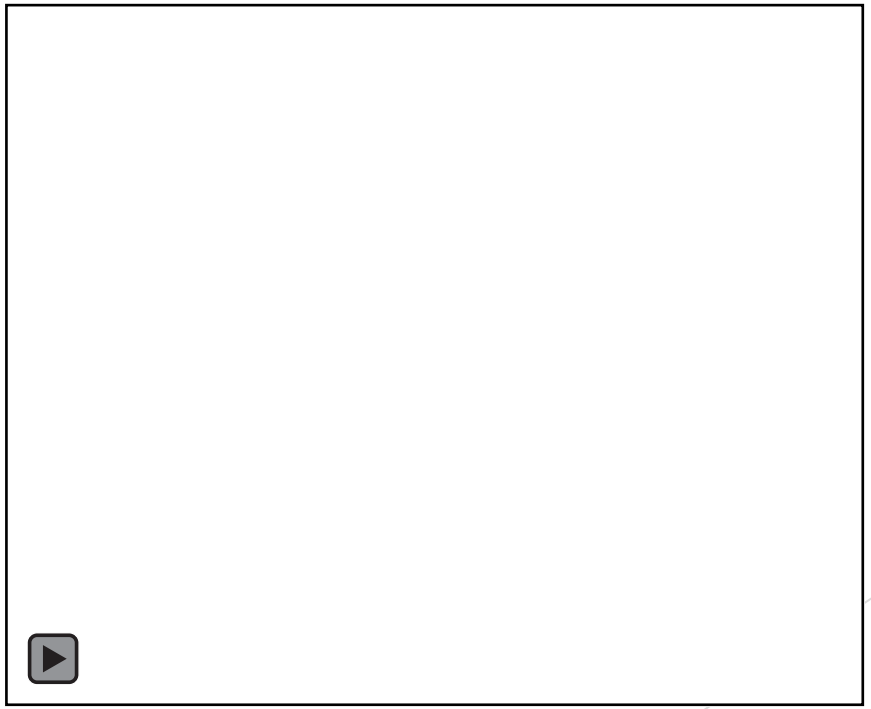
Moore

Scenarios

- … and now with the dynamic FloorField



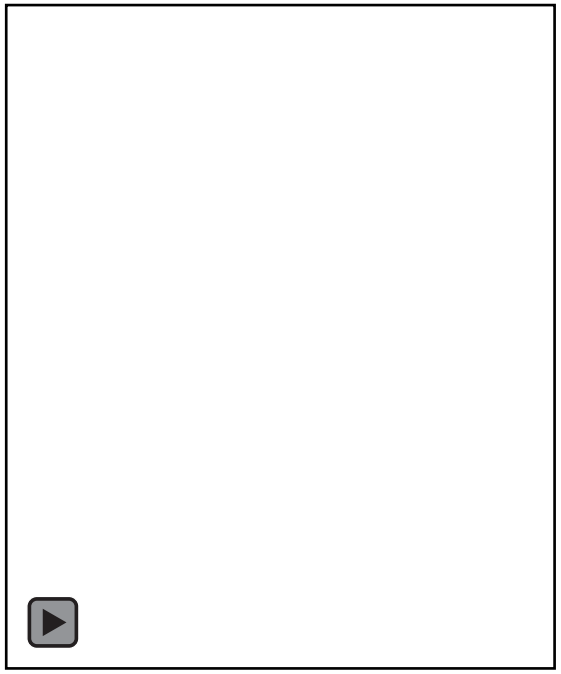
Von Neumann



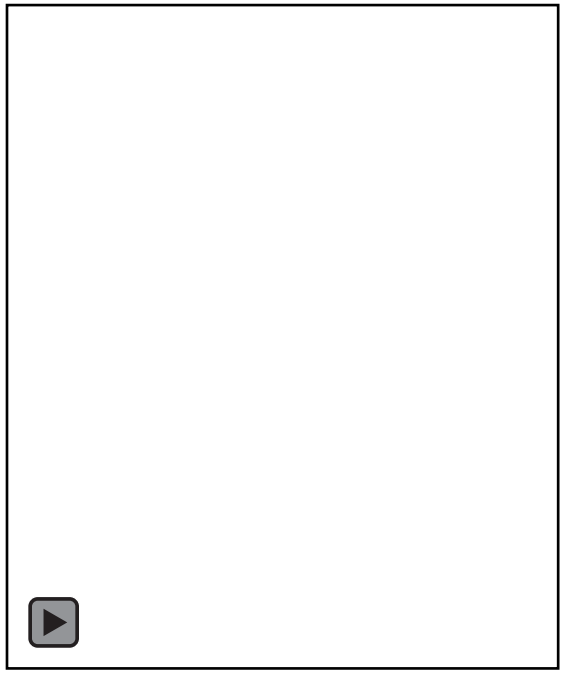
Moore

Scenarios

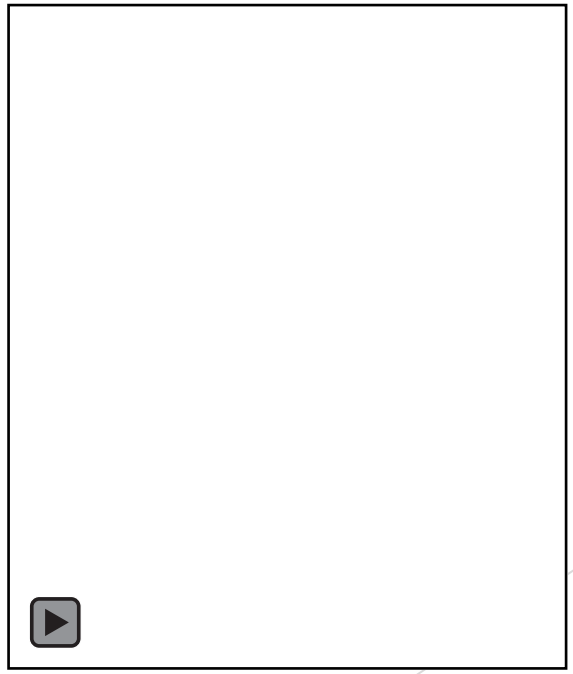
- Because we like rooms and corners, here is the full dose… and additionally with dyn. FloorField!



Von Neumann



Moore



Von Neumann, dyn. FF

Moore, dyn. FF

Results and Conclusions

- If you place pedestrians in your simulation, be aware that you can get „strange“ results!
- If a von-Neumann neighbourhood is used with very low „randomness“, results look not „real“.
- If „randomness“ is introduced (here: dyn. FloorField), the results look more „real“ by using a von-Neumann neighbourhood.
- If a Moore-neighbourhood is used, more „randomness“ is introduced in straight floors.
- Moore neighbourhood has more „uncertainties“: How to deal with moving over corner, speeds > 1cell/sec, forbidden moves between two pedestrians,…

Results and Conlusions

- Here we have only rectangle and „fitting-to-the-lattice“ geometries, what happens to non-rectangular geometries?
- How do results change, if the scene is rotated in any possible angle? – The results will change, but how to deal with this?
- We see, more questions than answers!

Thanks for your attention!