Emergency Evacuation

Spring 2018 EECS 372
Multi-Agent Modeling
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Motivation

- It impacts real lives during emergencies
- Agent-Based Modeling (ABM) can be applied naturally and intuitively
- Applications extend beyond emergency readiness, including computer vision and swarm intelligence

How It Works

At each tick, each person selects a target:

- Select a visible exit. If there are none, then
- Select a visible checkpoint. If there are none, then
- Select a nearby visible spot

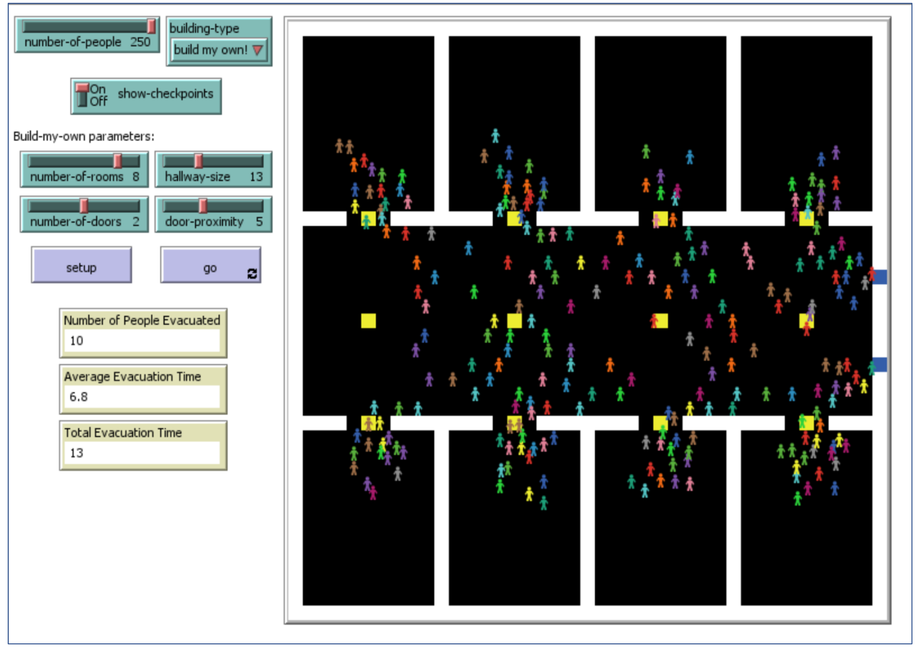
Pick an immediate-target based on target to move toward
Selection is based on five *heuristics*

The Five Heuristics

- Crowdedness: How crowded is the patch?
- Wall proximity: How many walls are near it?
- Distance from me: How far away is it from me?
- Distance from exits: How far away is it from exits?
- Crowd direction: Is the crowd heading toward or away from it?

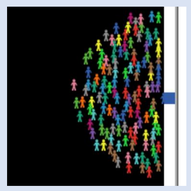
Heuristic Selection

Heuristic selection is handled differently when choosing different types of targets (exits, checkpoints, or regular patches). This is because the desirability of the heuristics varies depending on what type my target is. For example, if I am picking an exit, crowdedness is bad. However, if I don't see any exits, then crowdedness is good.



Emergent Behaviors

- People clog around exits, forming a circular crowd:



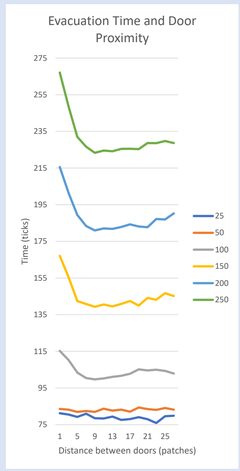
- People who cannot see exits try to follow the direction of the crowd, creating a herding or flocking behavior:

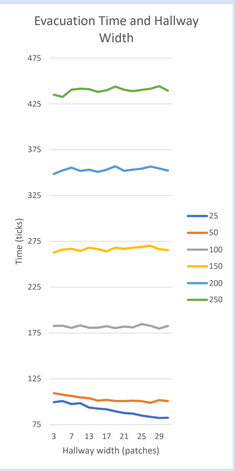
Sensitivity Analysis

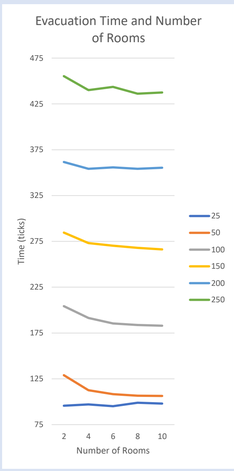
Three parameters were tested against number of people:

- Door proximity (how close together exits are)
- Hallway width
- Number of rooms

Results







Discussion

Having exits close together increases evacuation time, because crowds around two exits merge into a larger one. Exits too far apart are bad, too, because redistribution between exits takes longer. Larger hallways are better when there are not that many people, but it doesn't matter much when there are lots of people. In general, more rooms are better, unless there are few people in the room.

Possible Extensions

There are many ways to extend this model. Here are a few ideas:

- Many buildings have tables or other miscellaneous obstacles
- Can a purely heuristic model without checkpoints still exhibit realistic behavior?
- Heuristic weights can be turned into tunable parameters