

Agent Based Modeling of Crowd Behavior

Josh Zukoff

Mentor: Cliff Behrens

Brief Overview of ABM

- Agent Based Modeling is:
 - A method for simulating a variety of models
 - Studying emergent behavior resulting from low level interactions
 - Made up of:
 - Agents which have their own states and decision making processes
 - Environment of patches each with its own characteristics
 - Representation of real world (or not) objects (agents) and their interactions
 - Useful in a variety of fields and situations
 - Made accessible using programs like Netlogo

Netlogo

- Environment for coding and simulating ABM
- Uses Logo Programming Language
- Developed by Uri Wilensky
- I will show how netlogo works later on

Motivation

- The study of crowd behavior is vital to:
 - Urban planning, crowd control, and emergency planning, etc.
- Human psychology important aspect
 - Modeling crowds at a large scale can be a difficult task
 - ABM however localizes all decision making
 - Takes into account small scale goals and other psychological influences
 - Crowd behavior that approximates aspects of realistic human behavior has been achieved
- My research focuses on evacuation of crowds due to emergency situations in closed spaces

Goals

- To learn about agent based modeling and its usefulness
- To learn the netlogo program and logo programming language
- To create a graphical representation of a stadium to be evacuated
- To achieve a semi-realistic evacuation scenario using basic localized decision making processes
- To endow agents with some intelligence and realistic attributes
- To decide on one aspect of the model to study closely

Timeline

- Began by trying to figure out the basics of Netlogo and Logo programming
 - Spent a bit of time figuring out how to import an custom environment/stadium
 - First efforts very basic, just had a number of agents escaping a room.
 - I will show this model now.
- Next made a more complicated model and environment.
 - Agents still did not move with much intelligence
 - Bounce off each other and walls
- Added flocking behavior and customized it to avoid obstacles *
- Complicated my model more, adding group leaders and agent characteristics
- Finally took advice and started learning Git for version control

Flocking Behavior

- Mimics the flocking of birds
- If agents are too close to other agents in flock/group:
 - Increase separation
- If agents not close to neighbors:
 - Align direction of travel with neighbors
- If neighbors not too close:
 - Move towards neighbors
- Obstacle avoidance can be added with a simple addition



Why Flocking?

- Grouping is an important aspect of evacuation scenarios
- Accounts from evacuees of the WTC on 9/11 speak about group formation by people who had a common connection
- Groups tended to be small (5 or so members) but were dynamic.
- Group leaders tended to emerge
- Flocking is a simple representation of grouping and can be altered such that a leader is chosen

Overview of My Model



Begin In Seats

Overview of My Model



Overview of My Model



Overview of My Model



Overview of My Model



Overview of My Model



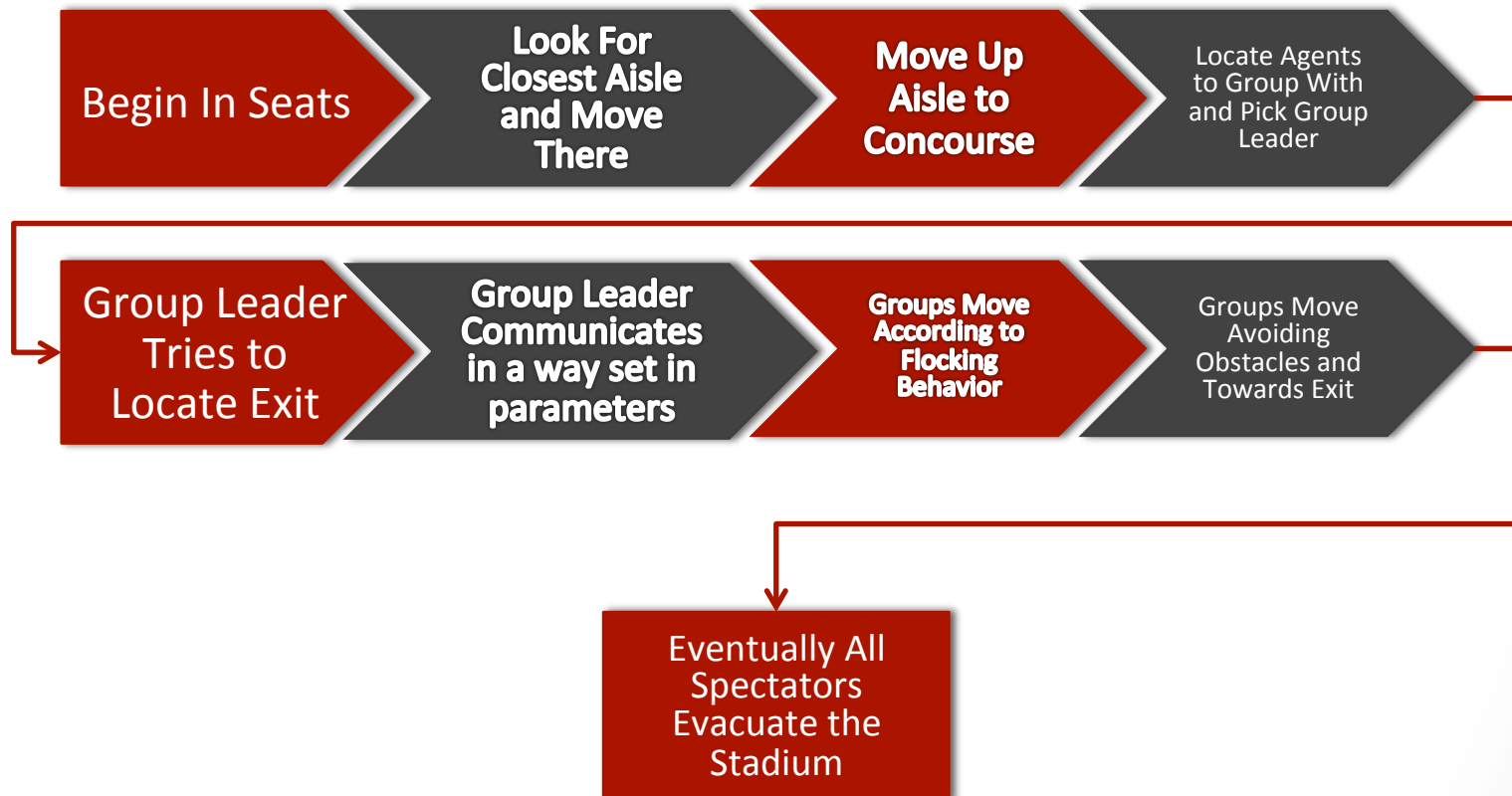
Overview of My Model



Overview of My Model



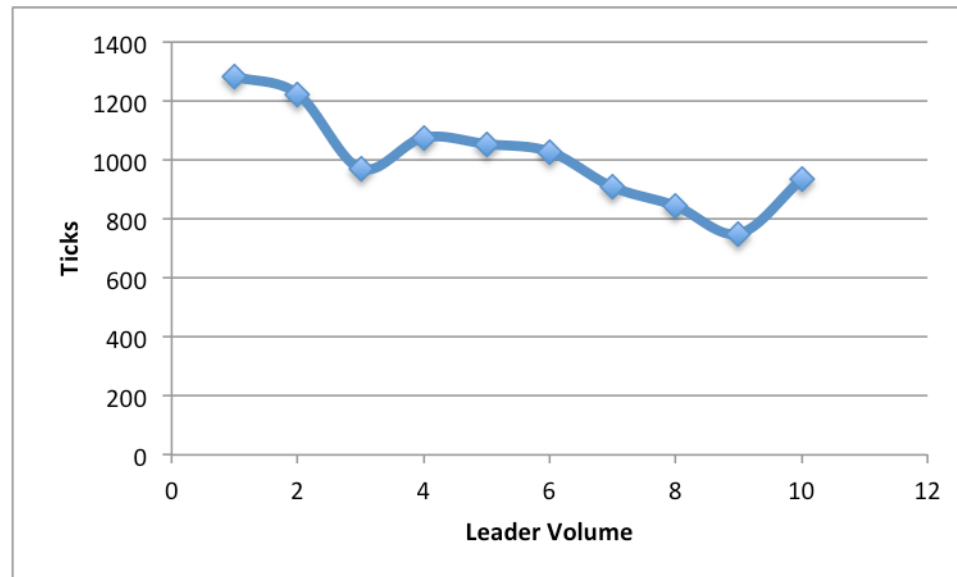
Overview of My Model



My Model

Results

- Flocking seems to be a fairly good method of representing crowds in an abstract way
- Seemingly reasonable evacuations can be modeled using simple interactions and processes
- Communication is an important aspect of evacuation behavior



Future Work/Goals

- Complicate the model
- Study the sensitivity of the evacuation to a more exact degree
- Add more realism/intelligence
- Model a more realistic stadium
- Clean up my code a bit

References

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 - Helbing and Johansson
- Modeling Emergent Crowd Behavior
 - Lightfoot and Milne
- Multi agent simulation of pedestrian behavior in closed spatial environments
 - Camillen et. al
- Continuum Crowds
 - Treuille et. Al
- WTC Papers
 - <http://www.nrc-cnrc.gc.ca/obj/irc/doc/pubs/nrcc47309/nrcc47309.pdf>
 - http://www.fpemag.com/archives/article.asp?issue_id=10&i=75&p=3
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The End