MATH 2121 **Mathematical Modeling and Simulation** **Spring 2024**

Problem Set 7

(Out Tue 04/02/2024, Due Thu 04/11/2024)

Submissions are to be done by emailing to the course instructor: all requested Matlab files, plus a single file (PDF preferred), called `yourfamilyname_pset7.pdf` .

Problem 7

Conduct the following modifications to the Matlab file `temple_abm_swarming_birds.m` from the course website `http://math.temple.edu/~seibold/teaching/2024_2121/` .

(a) Add a zone of attraction to the swarming model, so that there is repulsion for distances less than 1/3, alignment for distances between 1/3 and 2/3, and attraction for a distances between 2/3 and 1. Submit your code under the filename `yourfamilyname_problem7a.m` . Compare the modified model (with attraction) to the model without attraction, describe the differences, and explain why they happen.

(b) Change the boundary conditions away from fixed walls to the domain being periodic. Note that you must treat the agent interactions correctly in this periodic setting, i.e., an agent to the right of the domain may be affected by an agent to the left of the domain. Submit your code (without an attraction zone) under the filename `yourfamilyname_problem7b.m` .

(c) Change your code from part (b) to have a zone of attraction, as in part (a). Submit this code under the filename `yourfamilyname_problem7c.m` . Now, using the codes from parts (b) and (c), run representative simulations that investigate whether the presence of a zone of attraction makes it more likely (or less likely) for all agents to form a single swarm. Explain your observations and interpret them.

(d) Based on your code from part (a) [i.e., with walls], modify the agent laws so that agents who are within a distance 1 to a wall know about the presence of the wall and adjust their behavior accordingly (i.e., they turn preemptively to avoid the wall). This can be thought of as the birds in the front of the swarm acting as leaders who conduct obstacle avoidance. Submit this code under the filename `yourfamilyname_problem7d.m` . Describe how this modification affects the emergent swarm behavior relative to the model in part (a).