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MATH 2121
Problem 1
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a.) In temple_abm_mexican_wave, the vector x in initialized with the line of code “x = double(1:n==round(n/3));”. This sets vector x to be a row vector of size n=40, representing a row of spectators in a stadium. Each entry in the vector x is either 1 or 0 depending on the outcome of the logical statement n==round(n/3), so when initialized, the row vector’s entries are 0 (false) at each index except at index 13, where the entry is 1 (true). Each 0 represents a person sitting, while a 1 represents a person standing. The initial condition has the 13th person, the beginning of the wave, standing and everyone else sitting down. This is how the wave arises. Next in the code, a for-loop begins which represents a time loop that will run 80 times, so the plotting at each interval and update rule will occur 80 times total. The update rule is “x = ~x&x([end 1:end-1]);”, which is why the wave travels to the right. Each entry in vector is shifted one entry to the right, then ~x (the vector whose entries are the negated entries of the original x vector) is compared to the right-shifted x vector with the & logical operation. This will result in a 1 (true) if the right-shifted x contains a 1 in this entry while also ~x contains a 1 here. In context, this means if the person to the right of the standing person is sitting, then they stand, and the person who was standing sits down. Thus, next time x is printed in the for-loop, the 1 will appear to have moved to the right, hence the wave moves right as the code runs. It is worth noting that each time x is updated, its last entry is moved to the beginning, to represent that the stadium is circular.

b.) In janeczko_problem1b, temple_abm_mexican_wave is modified so that it is possible to have waves traveling to the left and waves traveling to the right. As an initial condition, there are 3 vectors. The vectors x and y respectively represent a wave traveling right and a wave traveling left. The vector z represents the combined behavior of x and y. Initially, as in temple_abm_mexican_wave, only the 13th entry is 1 (standing up). Then, the update rule causes x to shift the 1 to the right, and x to shift to the left, hence in z it appears that 2 waves traveling opposite direction has arisen. This is because z, the vector representing the combined behavior of both waves, is produced with the logical operator |. That means if a certain entry in x is a 1 and the corresponding entry in y is 1, the corresponding entry in z is 1. Similarly, if that entry in x is 1 but in y is 0, or vice versa, that entry in z is 1. Otherwise, it is 0 in z, since no one is standing up in either wave in this case. The loop runs 80 times. When the waves collide, only one person is standing since 1|1 results in 1. On the next iteration of the loop, the wave divides into 2 separates waves traveling opposite directions once again since the neighbors of the singular standing person are both sitting.

d.) In janeczko_problem1d, temple_abm_mexican_wave_alternative is modified so that it is possible to alter the size of the initial wave starters. The loop runs 120 times instead of 80 in order to view the model for a longer period of time. The update rule when each loop runs is based on each individual’s behavior with some randomness accounted for. If the person in question is sitting (is 0) and notices the wave approaching from their left, they will most likely stand up (become 1) if the person to their left is standing (neighbor is 1). I chose a 90% chance since it seems pretty likely from the videos we watched in class that the person would continue the wave. A person who has just stood up for the wave (is 1) whose left neighbor has now sat down (neighbor is 0) will most likely also sit down (become 0), but there is a chance they may sit down late or be less aware, so I assigned a 10% chance to not sitting down in this case. I think my model is realistic because I accounted for the fact that a person may stand up late or sit down late, introducing some noise to the wave. I also introduced a parameter m representing the number of people who collectively decide to begin a wave. This is an appropriate agent-based model because each individual agent's behavior is based off their neighbors', but as a user of the program we can view the way the crowd behaves as a whole as a result. When introducing "noise" through randomness, it travels in a reasonably stable fashion, however on some runs it fizzles out. I believe this behavior to be accurate because sometimes a Mexican wave at a sports game does not last very long, although sometimes it does last a while, all depending on each individual's behavior. Its size as it runs may also fluctuate, which my model demonstrates.