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# Algorithm for Ant Image Analysis

# 12/5/15

One of the best ways to envision this algorithm as it would be viewed in a real world environment is to picture a room full of aquariums, each of these aquariums has a specific pattern of food scattered across the base of each aquarium surface. The walls of these aquariums serve as barrier to keep anything from wandering off. The bottom of each aquarium serves as a flat terrain that is to be traversed by ants that will search for food in a variety of ways. The ants are placed into the selected aquarium, by sprinkling them, or randomly placing them at different parts along the aquarium base. From there, it is up to the ants as to how they will move, collect information, and behave.

The explanation of this analogy takes us to the first step of the algorithm, selecting an image, or aquarium that is going to facilitating the ants and their behaviors. The image that we select has binary values of 0 and 1, 1s representing food bits. It is the ant’s job to collect all the food bits, 1s, from the selected image. The next step after selecting an image is to determine the X and Y axis, so that the ants know where the boundaries are, and know how to record the coordinates of found food bits.

After the image has been properly selected, the ants are dropped in randomly between the maximum and minimum X/Y values. Each time an ant is dropped onto the image, it makes sure it didn’t land on top of anther ant. If it did, it is picked back up, and dropped to a new random location on the image. After all the ants are properly dropped on the image, they check to see if they were dropped on top of food or not. In the event that an ant is dropped onto a food bit, 1, then it remembers, records, that food bits X/Y coordinate location. In addition, it also sets off a smell so that other ants in the area may be drawn to that smell, however, overtime that smell will lessen until it is gone completely.

After each ant verifies what it was dropped on to, they begin to move around the image a set number of times. Prior to each movement an ant has to make, it has to decide between two styles of movement, normal or relative. An ant will move in a normal fashion if it is looking for its first food bit coordinate, or if it has just found a coordinate the movement cycle before. An ant will move in a relative fashion if it has both found a food bit coordinate, and has also already moved once onto another food bit from the initial coordinate.

When moving in a normal fashion, an ant may move in 4 directions across the image, up, right, down, and to the left. Before each move, the ants take a minute to decide what the best move option can be. It first wants to look for areas that have food bits, have been unexplored by other ants, and have a pheromone scent. If none of the four possible move locations have this criteria met it searches again for a location with food, is unexplored, and is away from the other ants in the area. Lastly, it’ll check to see if there is any food in an unexplored area. If none of these provide the ant with what it wants, it will randomly move to one of the 4 locations. Once it arrives at the location, the ant will check to see if it does indeed have a food bit there. If it does, the ant checks to see if it is coming off of a food coordinate spot, as in it had found food the movement cycle before and saved that food bits coordinate. If it is coming off of the food coordinate, then it records the direction that it traveled, up, right, down or left. If the ant is searching for its first food bit, the ant will then record the coordinate of this food bits location. Along with this, each time an ant finds food, it sets off a smell in the surrounding area, with hopes to attract more ants to the food.

In the event that the ant is moving in a relative fashion, the ant may move in 5 directions. These directions depend strictly on the ant’s last movement, because it works with whatever direction the ant is facing. The 5 directions are forward, forward-right, right, left, and forward-left. Prior to each movement it makes here it first and foremost checks the forward position to see if it is has food, is unexplored, has a pheromone scent, has a dense smell (set by other ants in the area also finding food creating a thicker sent), or has a lower proximity value, so that it can gain distance from other ants that aren’t around food. If the forward location doesn’t have suitable food, then it searches the other 4 locations with the same criteria. Lastly, if still no food is found in any of the 5 locations, the ant will randomly move to one of the five locations. Once it has moved, the ant will check to see if it has found a food bit. If it has, the ant will record the relative direction that it traveled, and continue on to search for food in a relative manner the during the next move cycle.

After all of the ants have moved the set number of movement ticks, the algorithm will collect a complete record listing from each ant, at which point it will take their records and create a new image using the information collected by the ants, and see if the images are identical and that no information was loosed in the transition.