

### Option 2: Ants collecting Food

This is not strictly a game, but simulates a possible technique which Ants may use when foraging for food. This scenario is to be developed in Visual Studio 2012 / 13 / 15. Any other environment (e.g. Unity, etc.) is not possible,

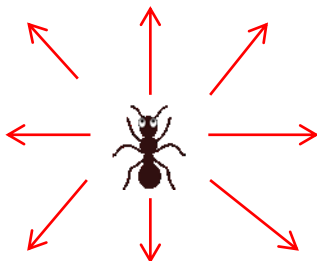
In the domain of Artificial Life (ALife) the behaviour of social insects has been used to study how simple creatures can be used to solve complex problems.

While individually insects are behaviourally unsophisticated, they collectively can solve complex problems. For example, 'real world' ants can:

- Form bridges by chaining their own bodies
- Build and protect nest
- Sort brood and food items
- Co-operate in carrying large items
- Find shortest route to food source

It is this collective 'intelligent' behaviour which has led to many studies and simulations. The following involves a group of ants collecting food and returning the food to a nest is just one possibility.

The ants live in a 2D discrete (grid based) world<sup>3</sup>. For ease of movement it maybe an idea to wrap the world into a toroidal shape. At each time step each the ant can move one step in one of the possible eight directions:



So assume the ant is at location  $(x, y)$ , and the start location  $(0, 0)$  is top left. Then for the ant to make one step east the next  $x$  location is:  $x = x + 1$

Similarly for the ant to move north-east both  $(x, y)$  coordinates are changed and become:

$$\begin{aligned}x &= x + 1 \\y &= y - 1\end{aligned}$$

At the start there is no food or nest in the world and a number of ants are created at random positions in the world. These ants do not know where food is, nor do they know where their nest is. Their eventual role is to find food and carry it back to a nest. The ants move randomly until they:

- **Either** encounter another ant who knows where food or a nest is, in which case they ask the ant for the information they need. What happens now depends on if they have food or not. If they have food they move towards their nest, if they do not have food they move towards the food.
- **Or** they walk close to a food or a nest.

In either case they remember the location of the food and / or the nest.

<sup>3</sup> A discrete (grid based) world, must be used. Do not submit an assignment which uses a continuous based world, or one which is based on a continuous world. For either of these cases the assignment will not be accepted (i.e. will receive a mark of zero for the coding element)

Once they deposit food at the nest they steer back to where they 'remember' where the food is.

If they arrive where they thought food was and none is there (because other ants have picked it all up), they forget where the food was and now move randomly.

Each ant will need to have a 'radius' within which they can detect food / nest, and detect other ants who may have information about food / nest. These two radii may be different.

At any given time there may be more than one ant in the radius. You may decide to only ask the closest ant or all of them in order to find out where the food was.

Allow the user to deposit food using mouse clicks. Assume one click leaves  $n$ -units of food (the user can place several bits of food in close proximity) and each time an ant picks up food it picks up  $m$  units (also  $m$  is much less than  $n$ , i.e.  $m \ll n$ ), so the food will eventually disappear.

Also allow the user to place nests in the world via mouse clicks.

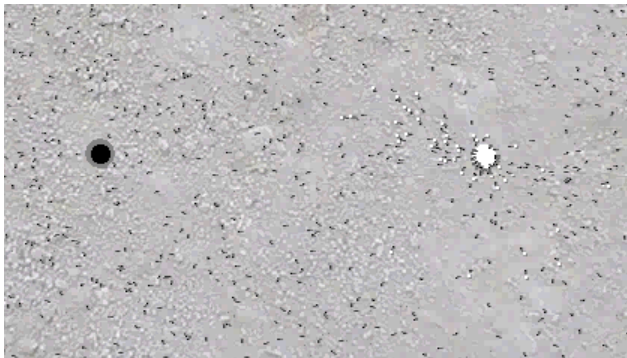
Assume the ant is a bit forgetful: It may forget where its nest was or forget where the food was (or both!) and as outlined above will need to either stumble across it or ask another ant.

**Extra credit:**

Allow for a separate population (or populations) of ants who steal the food off the other ants. These robber ants have their own nest and do not get food from the food piles, but move randomly until they find an ant with food. They can remember where this ant is. The chances are the ant with food is in a chain of ants carrying food and thus there is a good chance returning to that position

**Some screen shots of an application is shown below**

[Note the algorithm is slightly different to that given above and is based on a continuous world, but should elicit similar behaviour]



Start of simulation nest (in black) and food (in white). The ants are the tiny black dots.