

Workshop on World Modeling • Workshop on Methods of Human Security Studies
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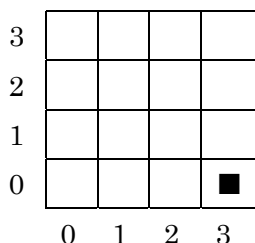
Lecture Ten: Leave a Trail in Space; Order of Execution (June 28th)

Today's Target:

This time we will discuss how to leave trails (traces) in space. Also for the purpose of accurate simulation, the order of execution will be handled with a bit of more intricacy.

● Leaving Trails in Space.

This is like leaving pheromones in the ground, a pile of sand or a wake in the sea. What can we do, when we want to create a variable that belongs to the 「space」? In order to leave a trail inside space, we use the 「variable of space」 that is a variable created right under the space in the tree. In this type of variable, the values are saved per each integer of x, y, layer. For example;



In this space, you can save values in each of the sixteen boxes created by layers. In order to designate each value from the rule, you must write the following;

`Universe.Kuukan.hensuu(x, y, layer)` If you want to make ■ box a 5, write the following;

$$\text{Universe.Kuukan.hensuu}(3, 0, 0) = 5$$

Example ①

Let's say there are a lot of tangerines placed on a desk in a warehouse. Some are already bad and rotten. From the rotten tangerines, 1 fungal spore flies each time to all the neighbors that surround it. 1. If there are 5 spores, even a non-rotten tangerine is doomed to become rotten.

Sample Answer:

- Make a desktop of 51×51 . No loop. Make the tangerines. Choose the number of tangerines using the control panel.

Try the following;

MikanSousuu(integer type) is established in the Universe,

```
Univ_Init{
  dim i as integer
  for i = 0 to universe.MikanSousuu - 1
    createagt(universe.TUKUE.Mikan)
  next i
}
```

- Let's now place the tangerines, at random, around the center of the desk. But we don't want any of them to fall off the desk, so there are none placed in 5 cells from the edge.
- Each tangerine is rotten with a certain probability from the very beginning. Let's make it that this probability can be set using the control panel.

```
Agt_Init{
  Movetocenter()      ←move to the center of the desk
  Movetospaceowncell(20) ← they can randomly roll to empty
                        places within 20 steps above, below, right and
                        left.
  if rnd() < universe.RRate then ← RRate is the rotten rate (0-1)
    my.fuhai = true           ← it is rotten
    my.iro = RGB(150, 70, 0) ← rotten ones are colored like this
  else
    my.fuhai = false         ←it is not rotten
    my.iro = RGB(255, 170, 0)←tangerine is colored like this
  end if
}
```

- The rotten tangerine spreads 1 fungal spore every time to surrounding range 1. The non-rotten tangerines become rotten if more than five spores land on it.

```

Agt_Step{
    dim i as integer
    dim j as integer

    if my.fuhai == true then          ← if rotten
        for i = 0 to 2                ← I is either 0,1, till 2.
            for j = 0 to 2            ← j is either 0,1, till 2
                universe.TUKUE.Houshi(my.X+i-1, my.Y+j-1, 0) =
universe.TUKUE.Houshi(my.X+i-1, my.Y+j-1, 0) + 1
            next j                    ↑ i±1 is -1,0,1. At the 9th place, +1 occurs.
        next i
    else                               ← if not rotten
        if universe.TUKUE.Houshi(my.X, my.Y, 0) >= 5 then ←if more than5
            my.fuhai = true           ←will become rotten
            my.iro = RGB(150, 70, 0) ←color if rotten
        end if
    end if
}

```

· Don't forget output setting, spores also. Let's make it so that the color of the spores can change in the range of 0 to 5.

* **For** sentence for nest.

By this rule, **for** sentence comes in two steps. The operation involves spreading the spores 3×3 for a total of 9 times. At this time, using the values **i** and **j** on top of one's ± 1 of **x** and ± 1 of **y**, you are adding one more spore. In this manner, **for** sentence is handy when you want to completely change the space variables of multiple boxes. Let's take the Snowing Model and turn on the snow in all the boxes to 1.

This would be how you do it;

```

dim i as integer
dim j as integer

for i = 0 to getwidthspace(universe.jimen) - 1
    for j = 0 to getheightspace(universe.jimen) - 1
        Universe.jimen.yuki(i, j, 0) = 1
    next j

```

next i

If you write it in the `init` of Universe, it would mean once at the very beginning. If you write it in `Step_begin` it would be 1 at beginning of every step.

● Execution Order

In fact there is a problem with the Rotten Tangerine Model that we've just made. For simplification, let's say that tangerines become rotten by coming into contact with only one spore. There are four tangerines in a line touching each other; a, b, c, d. Let's say we execute in this order.

①	③	a	c
②	④	b	d

then,

- 1: tangerine a no spore
- 2: tangerine b no spore
- 3: tangerine c (rotten) spreads spores
- 4: tangerine d has spore so it will become rotten

In reality, the spores that are spread by `c` should effect `a` and `b`. This problem can be resolved by letting the spores that spread in this step have an effect in the next step. This is how you can do this.

Step 1 Spores of rotten tangerine `c` spreads.

↓

Step 2 All tangerine wait till completion of former step, then become rotten if there is a spore present.

(`a`, `b` and `d` do rotten)

Spores of rotten tangerines `a,b,c,d` spread.

↓

Step 3 All tangerines wait for the completion of the former step...

In such cases, we use `Gethistory()` and let the agents wait and evaluate the end of the former step and make a decision on the action to be taken. If a reference to the past

value of variables is required, you must first of all set it so the values are recorded in the property of the variables. To do this, open Properties and designate [using History size] how many steps back you need to memorize. In order to tap this, `Gethistory` (name of variable, history number) is used. For example, let's say you want to refer to x axis of the last `aite` of the previous one step; Then you would write `Gethistory(aite.x, 1)`. In this case you'd just rewrite the part where you make a decision as to whether you'd be rotten or not;

if `gethistory(universe.TUKUE.Houshi(my.X, my.Y, 0), 1) >= 5` then

Assignment ①

Renovate the Rotten Tangerine Model and have 2 spores spread to surrounding vicinity 1 and have 1 spore spread in vicinity 2. Hint: $1 + 1 = 2$

Assignment ②

Try making a Snow Sled Model that leaves a trail or a Ship Model that also leaves a wake. The trails disappear with time.

Assignment ③

Try making your own Forrest Fire Model.

- Trees grow at random. The number of trees can be set by the control panel.
- If even one of the trees in the vicinity of 1 is on fire, the fire will burn you.
- Take care in selecting the order in which the execution takes place.