Exercice:
Firefly synchronization

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https://www.youtube.com/watch?v=a-Vy7NZTGos

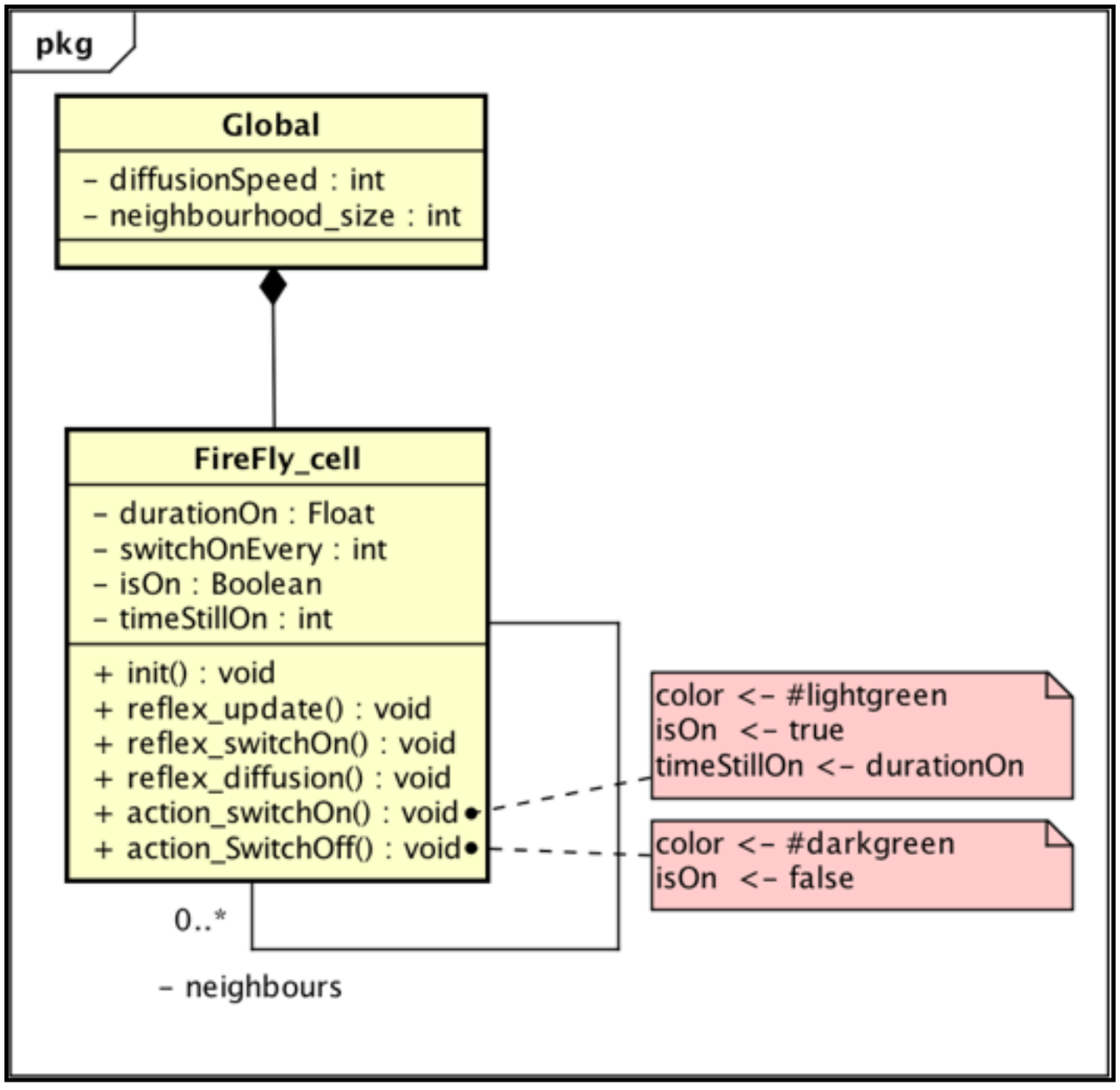
- At night, fireflies start to light up and down, each at its own frequency. But after few minutes, they start to synchronize the time they produce light and time they do not.

- The aim of this model is to propose a mechanism to reproduce this phenomenon.

Class diagram

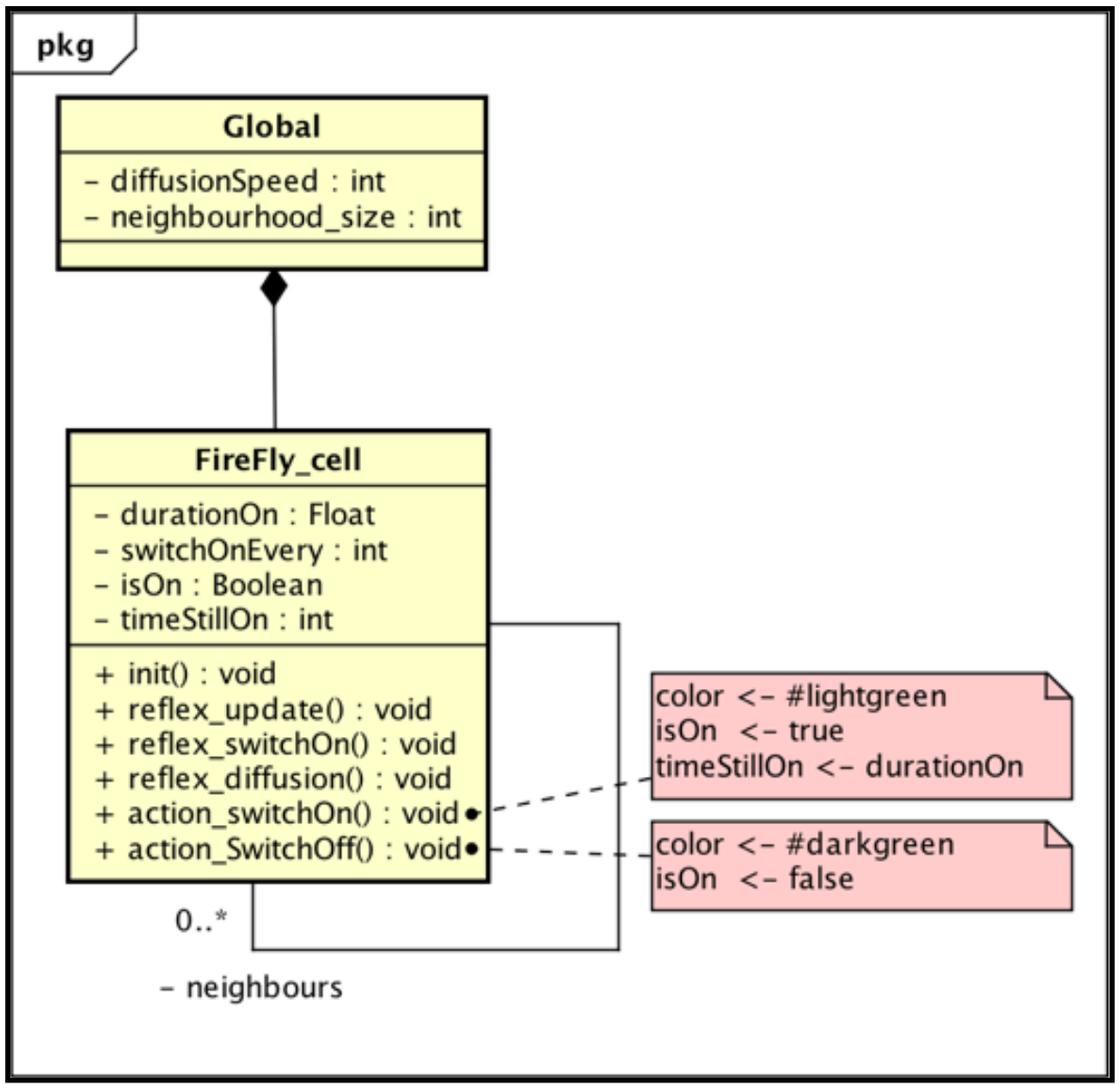
- We consider fireflies located on a **grid** (each cell being a firefly)

- They are characterized by:
  - their state (alight or not): **isOn**
  - the duration they are alight: **durationOn**
  - the frequency between each time they light: **switchOnEvery**
  - **timeStillOn** is here to store the number of step they will remain on.



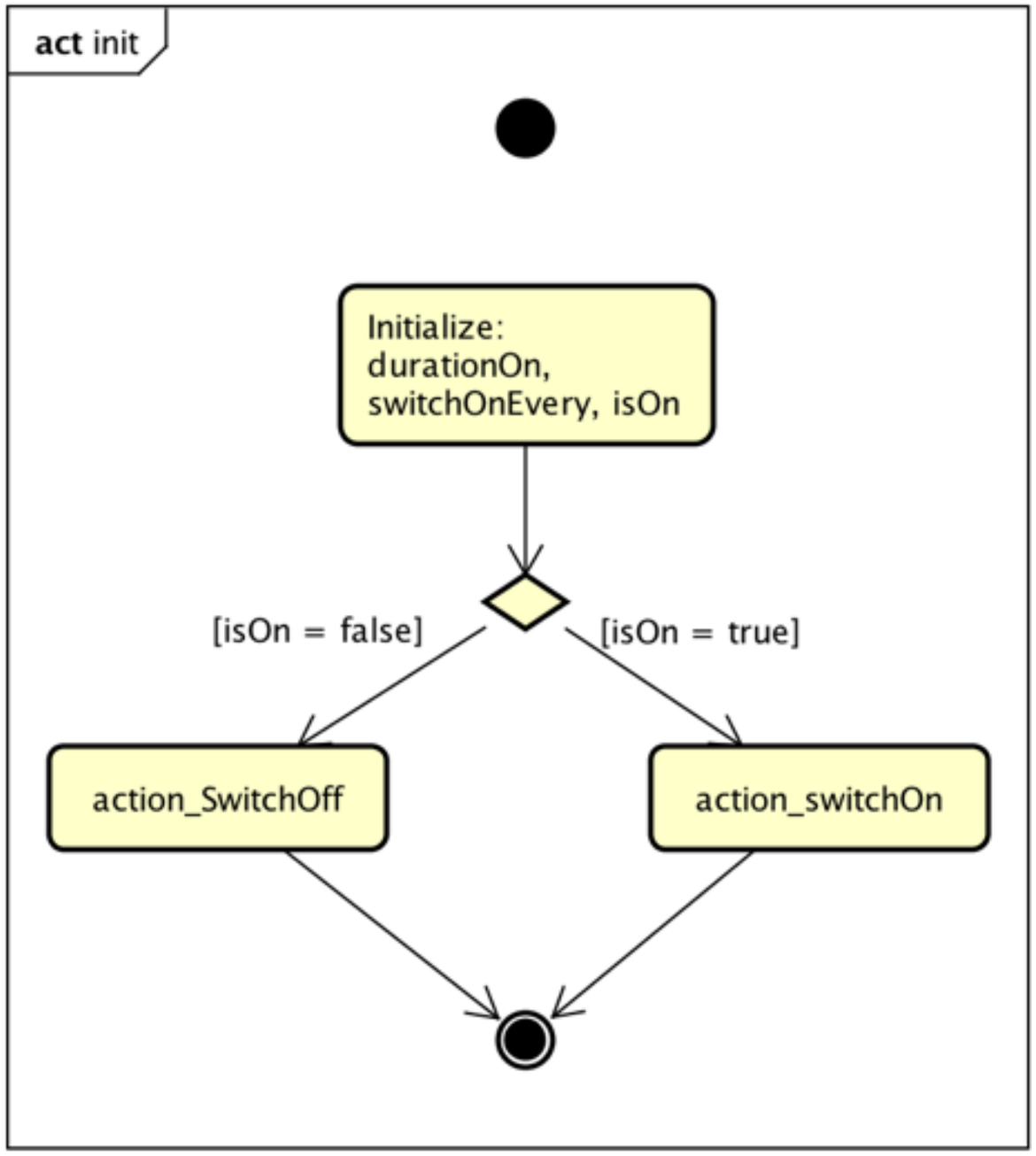
Class diagram

- **reflex_update** will mainly update the state of the agent (in particular decrease timeStillOn and change the state depending on its value).
- **reflex_switchOn** will be called only when its time to switch on.
- **reflex_diffusion:** each firefly will choose 1 random neighbor and will tend to be closer to it w.r.t. to durationOn and switchOnEvery (it will get closer depending on a speed, that is a simulation parameter)

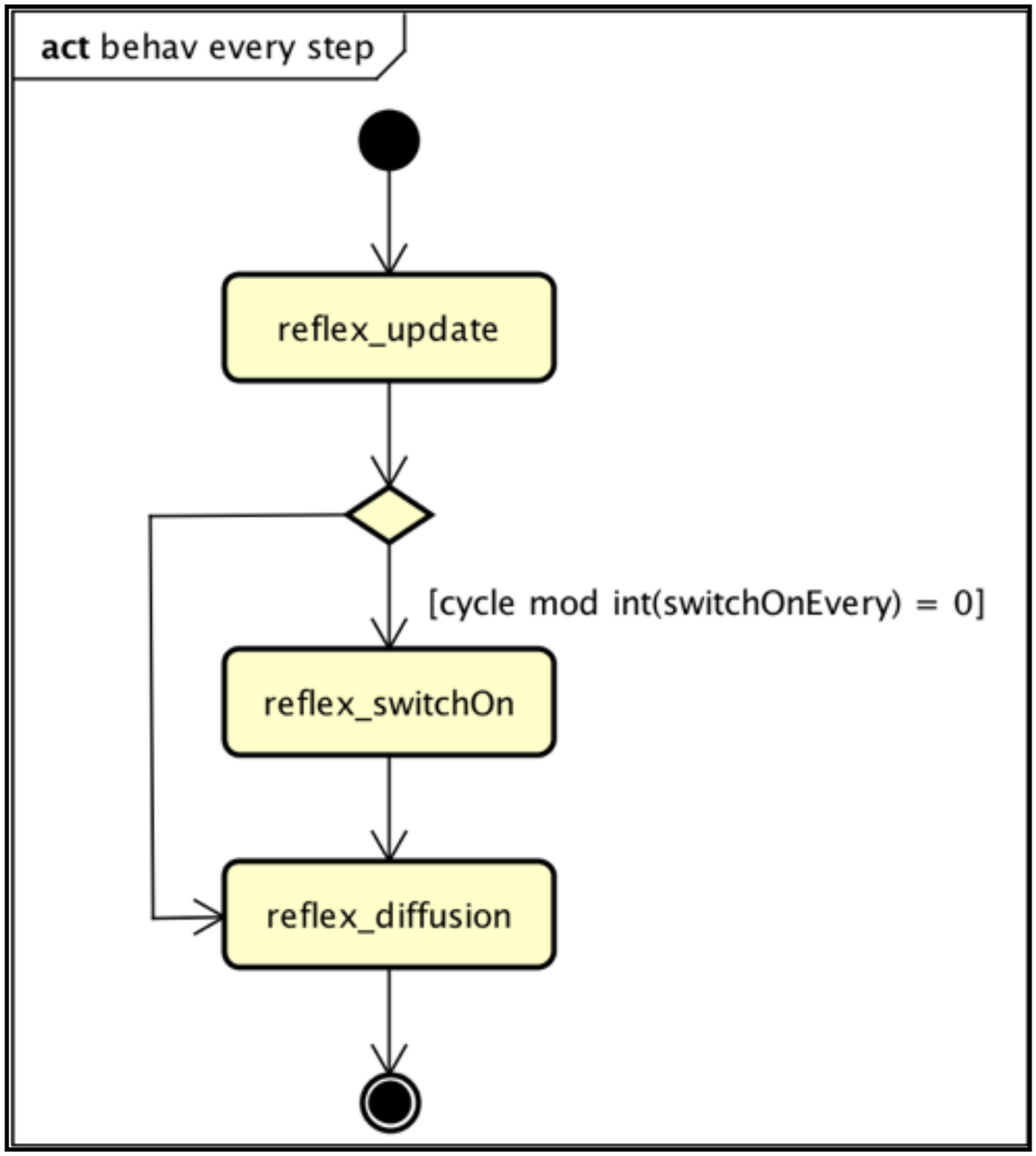


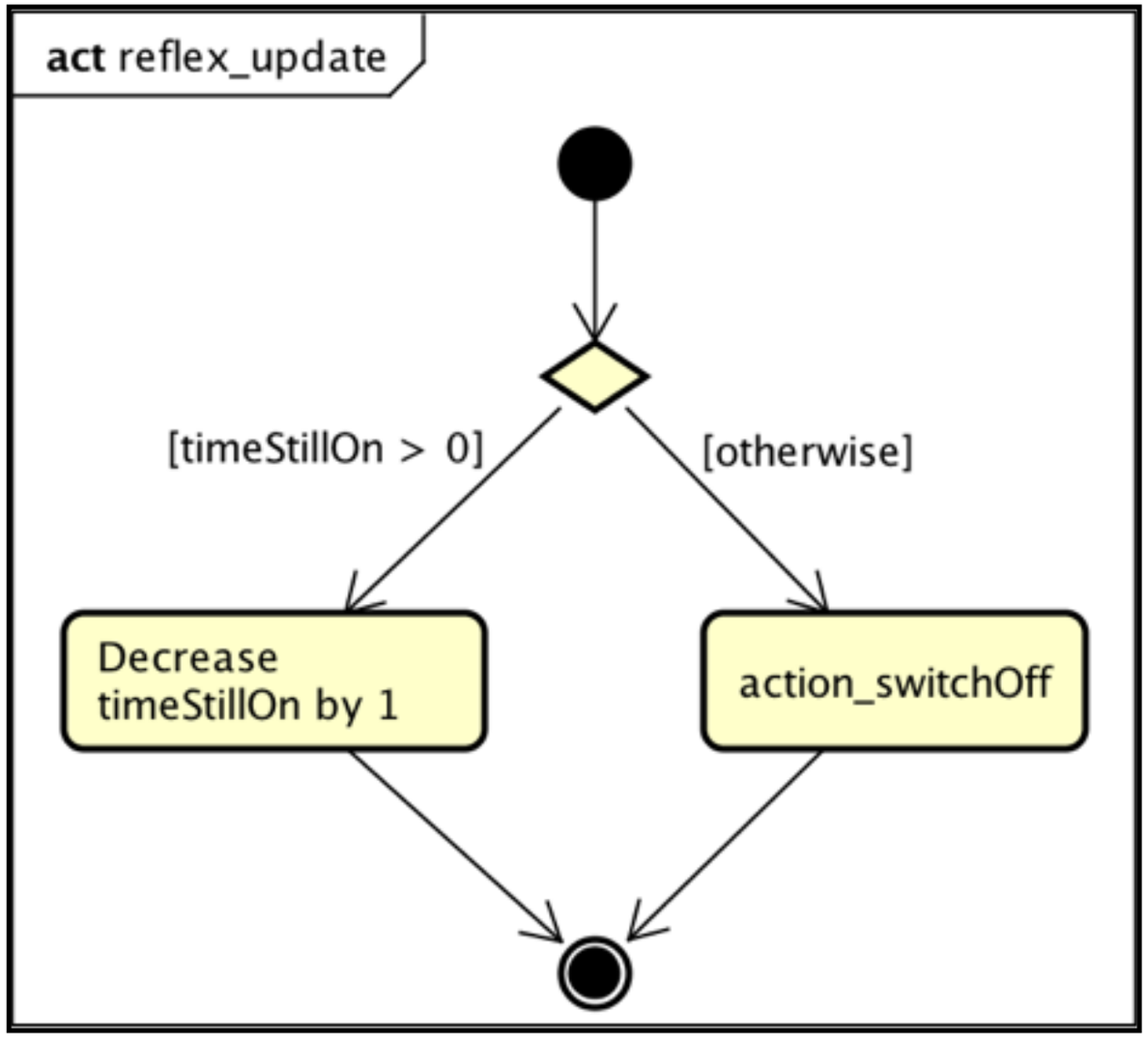
Initialization

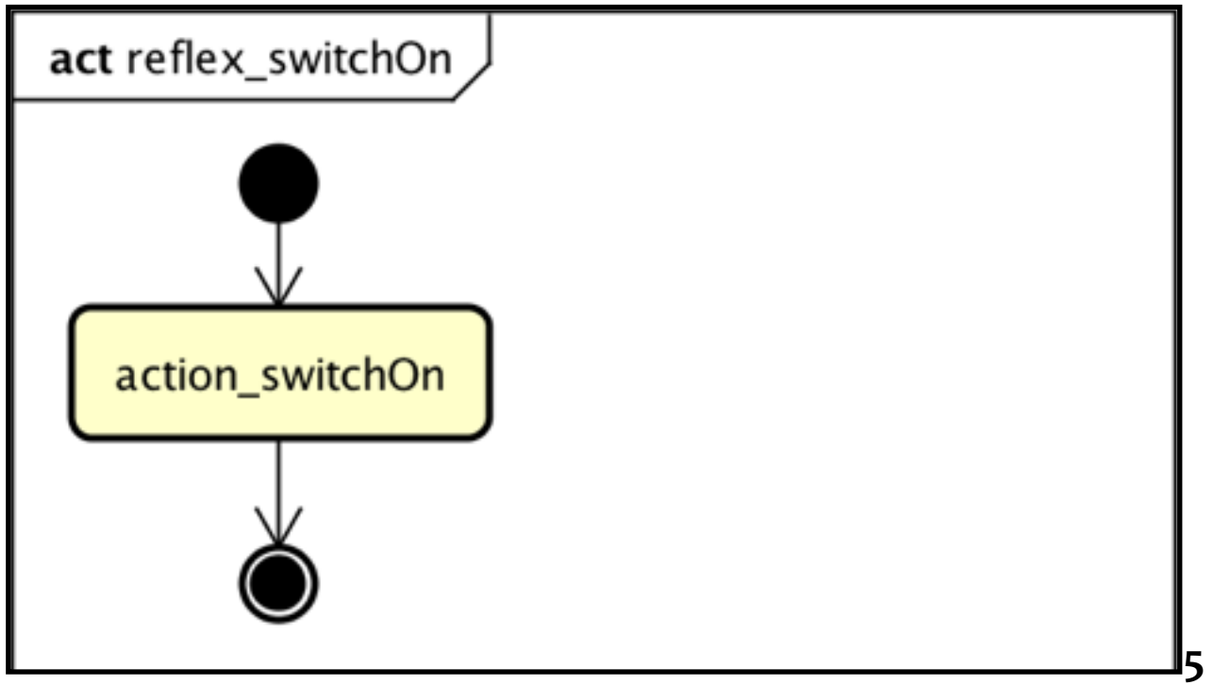
- Global variables
  - neighbourhood_size : 2
  - diffusionSpeed : 0.4
- Firefly
  - number of cells: 50 x 50
  - durationOn: random value between 0 and 10
  - switchOnEvery : random value between 1 and 21
  - isOn : 50% true, 50% false



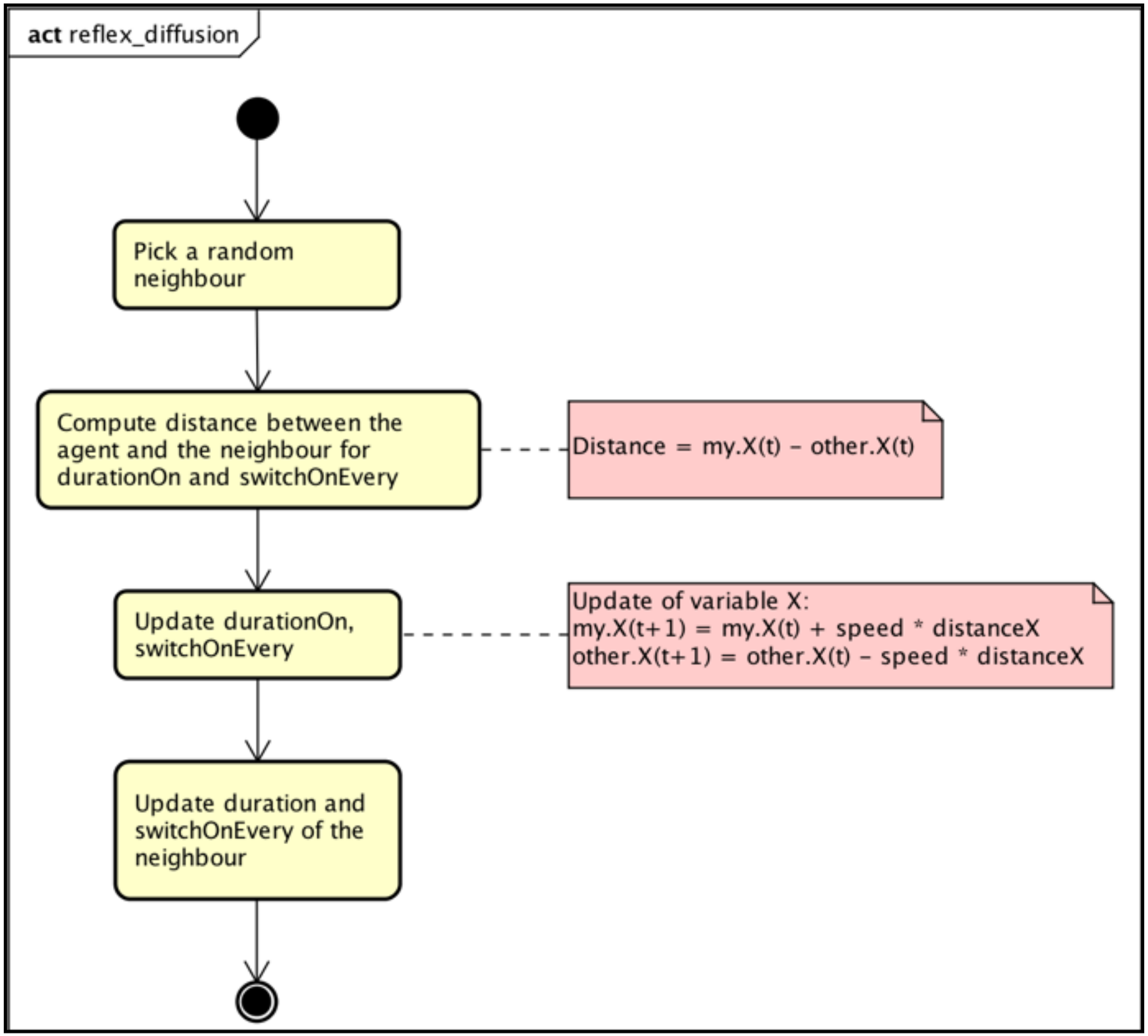
Dynamics


act behav every step
reflex_update
[cycle mod int(switchOnEvery) = 0]
reflex_switchOn
reflex_diffusion


act reflex_update
[timeStillOn > 0]
[otherwise]
Decrease
timeStillOn by 1
action_switchOff


act reflex_switchOn
action_switchOn

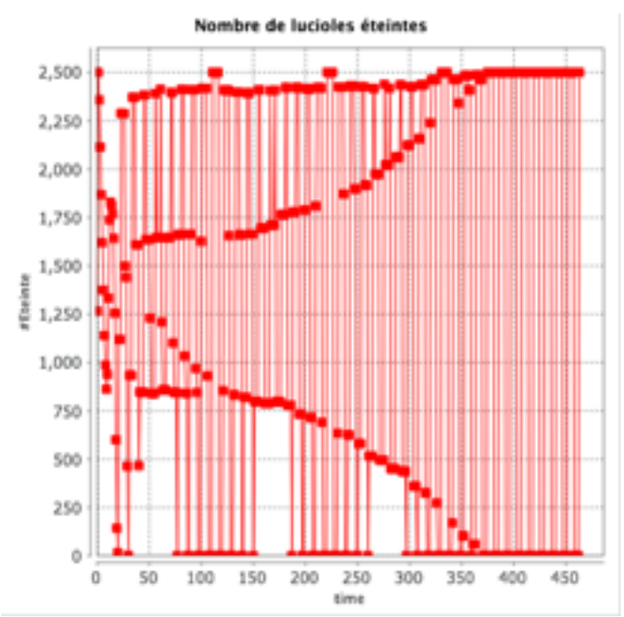
Dynamics

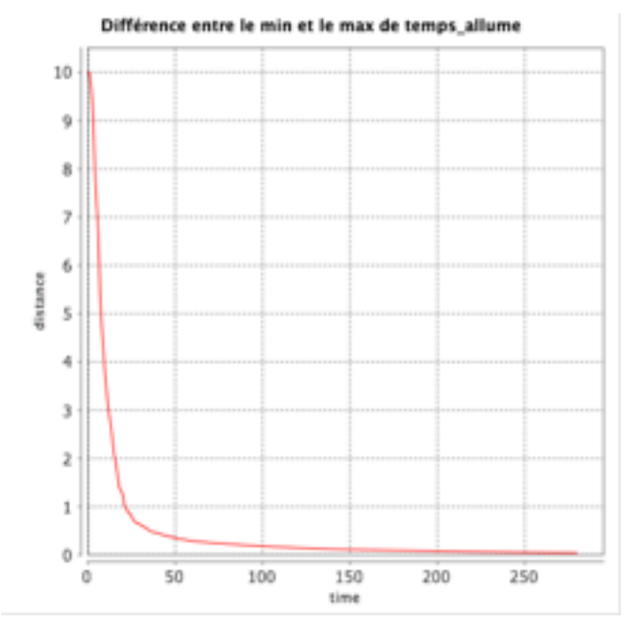

act reflex_diffusion
Pick a random neighbour
Compute distance between the agent and the neighbour for durationOn and switchOnEvery
Distance = my.X(t) - other.X(t)
Update durationOn, switchOnEvery
Update of variable X:
my.X(t+1) = my.X(t) + speed * distanceX
other.X(t+1) = other.X(t) - speed * distanceX
Update duration and switchOnEvery of the neighbour

Displays

- The fireflies (with their color)

- Charts:
  - The number of fireflies that are off.
  - Difference between the maximum of durationOn and the minimum of durationOn





Extensions

- Once the model runs, you can try to modify:
  - the diffusion speed
  - the size of the neighborhood
  - the type of neighborhood (Von Neumann and Moore).

- You can modify the model by:
  - making the fireflies a regular species (and not a grid anymore)
  - They thus will need to be created explicitly.
  - You will need to take into account the size of the environment and the number of agent.