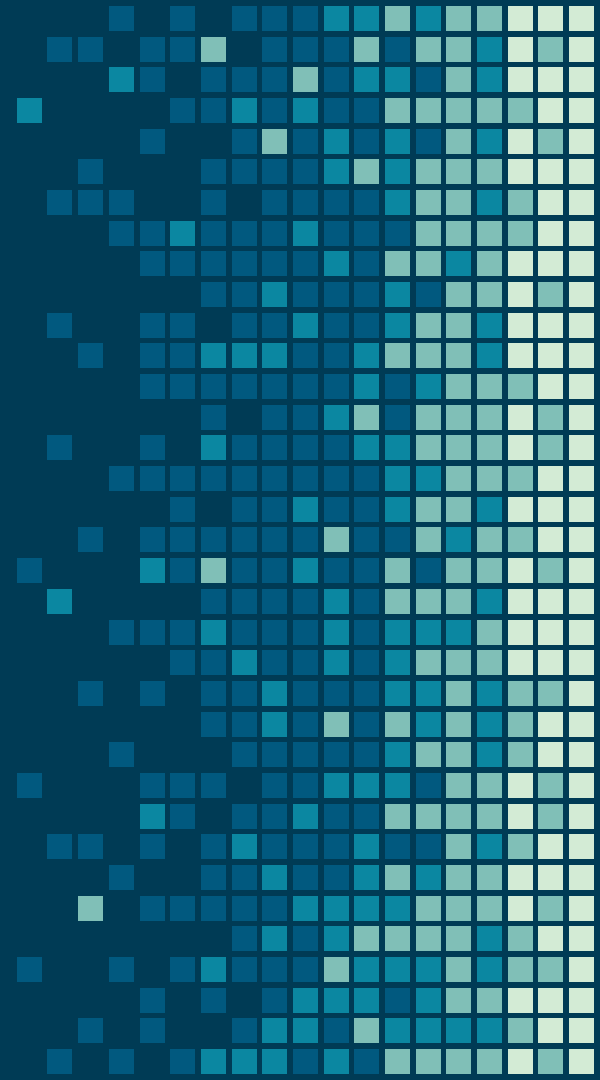# Adaptive behavior, scheduling, collectives, more tips and tricks
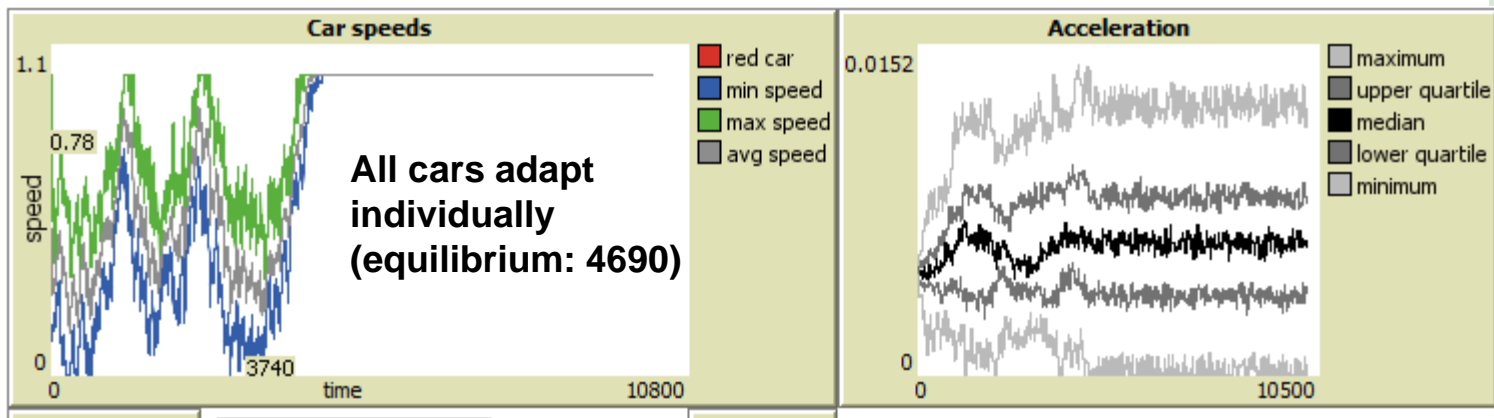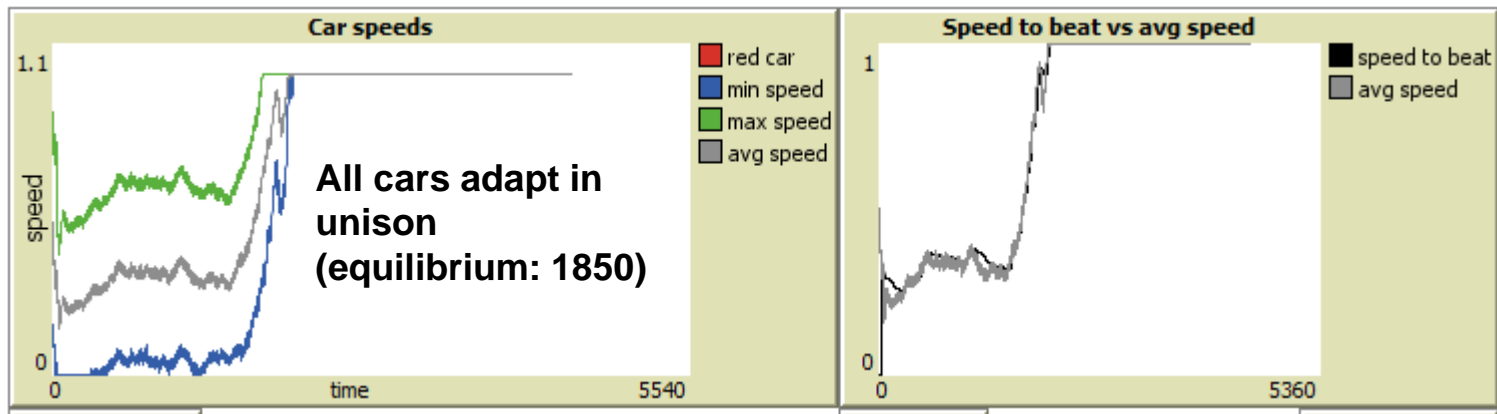
How can we model adaptive behaviors?

- Assume that agents are objective driven.

- How can they reach their objective? Are there tradeoffs?

- Objective functions: set of steps designed to optimize reaching objective.
    - Maximizing fitness/utility

- Do behaviors change while working towards objective?

Objective functions

- Identify alternatives
- Eliminate infeasible
- Evaluate feasible by how well they meet objective function
- Select best alternatives
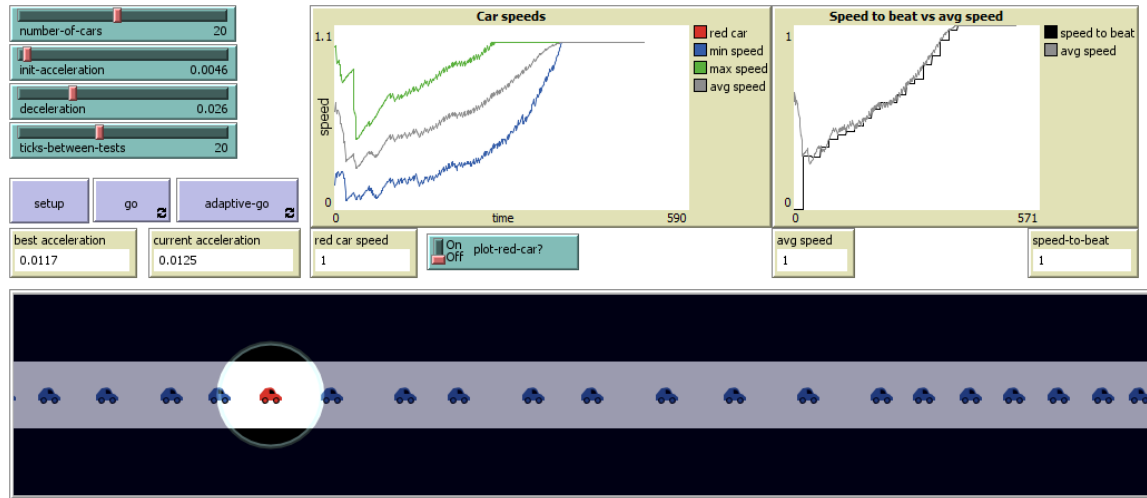
Objective: maintain smooth flow of traffic
Behaviors: accelerate if no cars ahead; decelerate if car is close ahead

Car speeds

All cars adapt in unison
(equilibrium: 1850)

Speed to beat vs avg speed

Car speeds

All cars adapt individually
(equilibrium: 4690)

Acceleration

4

Filtering and subsetting

- Create agentsets to filter out unwanted patches/turtles

- Evaluate filtered set

Example: Create subset of blue patches with orange neighbors
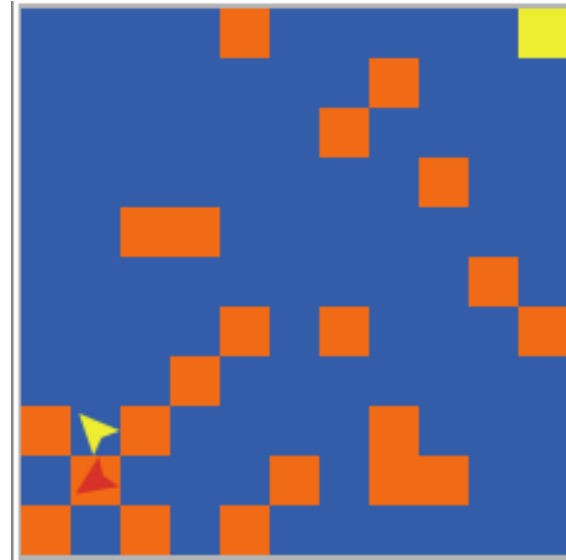
Objective: get to the yellow patch.
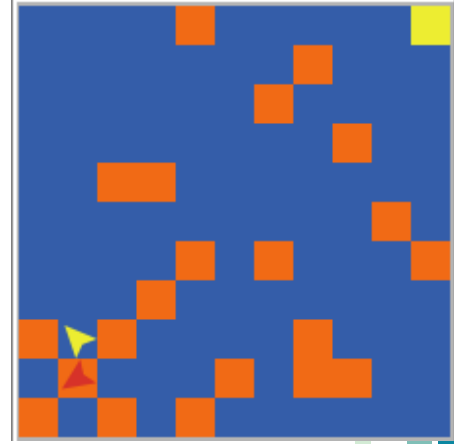Behavior: move faster in orange patches and slower in blue

With & And

With: Agentset then a [condition]

      turtles with [color = red]

And: requires true/false conditions (e.g.,

   *if (age > 2) and (spawned? = FALSE) set…*

Let new-patchset patches with [(pcolor = blue) and (one-of neighbors with [pcolor = orange])]

- Throws an error. Why?

set new-patchset patches with [(pcolor = blue) and (any? (neighbors with [pcolor = orange]))]

6

Subsetting coding: what's the difference?

1. Let destination (patches in-radius 3)
2. Let destination (patches in-radius 3) of patch-here

3. Let destination other patches in-radius 3
4. Let destination (other patches in-radius 3) of patch-here
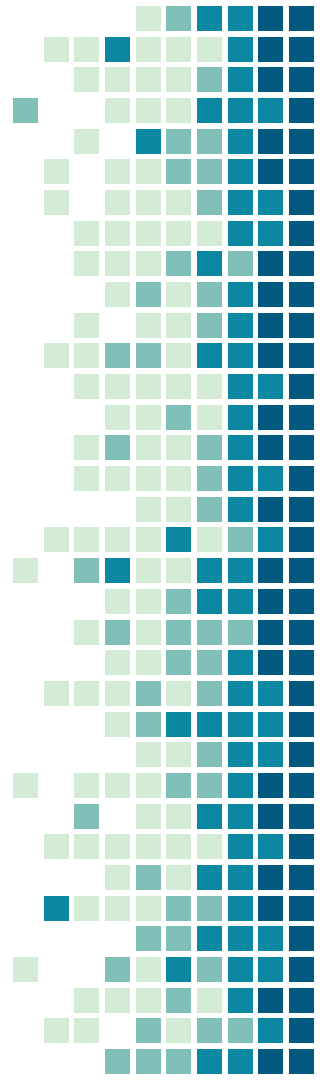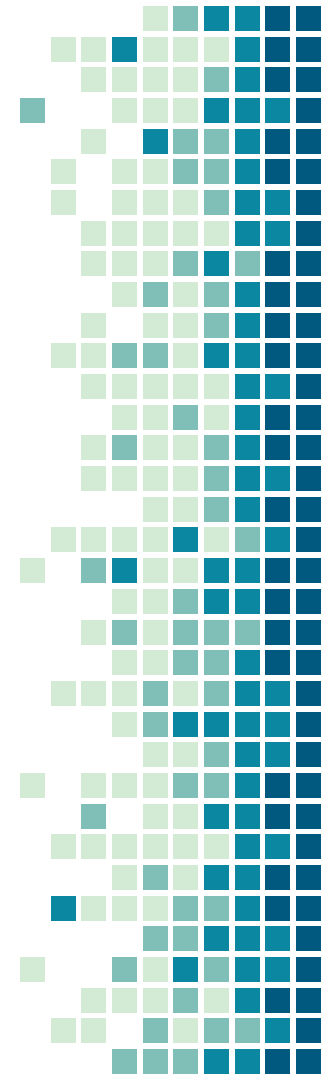
Subsetting coding: what's the difference?

Turtle 1 is trying to find the nearest turtle and asks:

1. Let nearest-neighbors turtles **with-min** [**distance myself**]
2. Let nearest-neighbors **other turtles with-min [distance myself]**
3. Let nearest-neighbors (**other turtles) with-min [distance myself]**

4. **Simplest code**
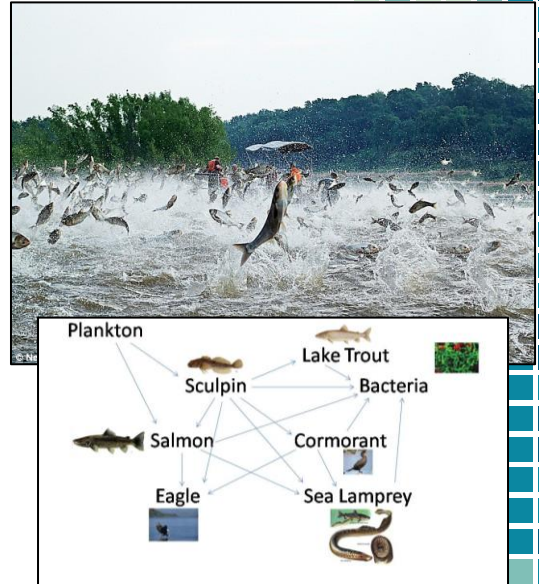   **Let nearest-neighbor min-one-of other turtles [distance myself]**
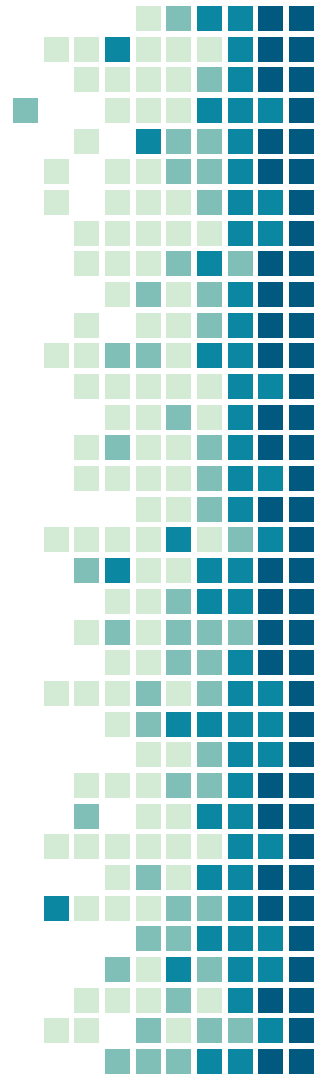
Scheduling

- What does a tick represent? How is time being modeled?
- ABMs work well with discrete events
- Events should occur within a given time step
- Order can matter

Choosing the time step

- Have to choose how often the model is updated, and how long to run it.
  - We plan for 50 yr horizon, but how often do you need to calculate changes in order to get an accurate idea?

    - What processes are you interested in? How often do they occur?
    - Time step needs to reflect what's happening in nature, not what's convenient
    - Don't have to choose familiar units
      - Can use 12 seconds, 3 days, 14 months, 50 yrs, etc…

Time step, con't.

- Can have nested time-steps within a model
- What level of precision is necessary?

Looping

- Repeat, while, loop

- Repeat: performs action X number of times
- Loop: repeats action until told to stop
- While: repeats until a Boolean becomes false
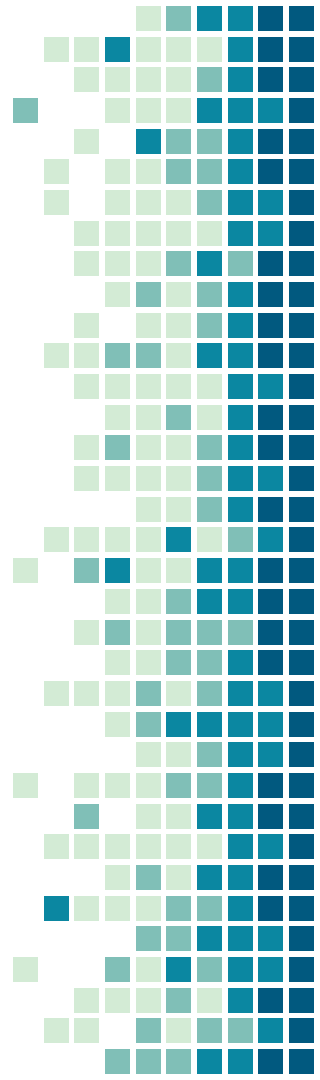
While example

while [numlayer != 0] ;loops through number of layers in plant

[

    set depthlayer waterdepth - (plantheight / numlayer)

    let test (photosynthesis depthlayer PAR1) ;calculates photosynthesis amount in each layer

    set fgross lput (test) fgross   ; Adds photosythesis biomass to vector
                                      ; print word "calculatex: " calculate-photosythn
    set numlayer numlayer - 1   ; reduces number of layers
    set temp-assim sum fgross   ; sums biomass accumluated across all three layers

    ;print word "temp-assim: " temp-assim

] ;while numlayer !=0 (depth layer loop)

Nested time steps

- Mod primitive
  - Reports *number1* modulo *number2*
  - 49 mod 7 = 0
  - 62 mod 5 = 2

- Can use mod = 0 for nested time steps

- *to-report nested-time-steps [x]*

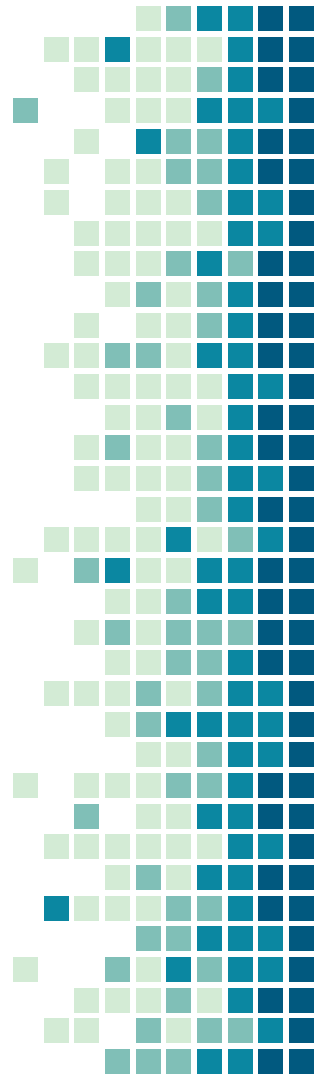   *report (ticks mod x)*

- *end*
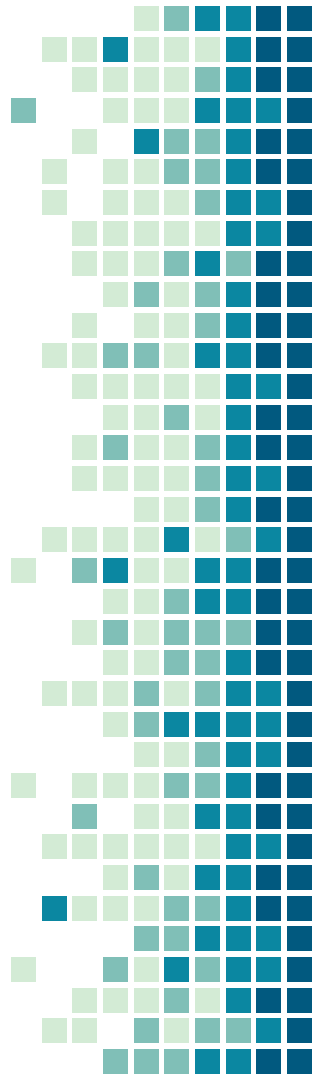
Collectives

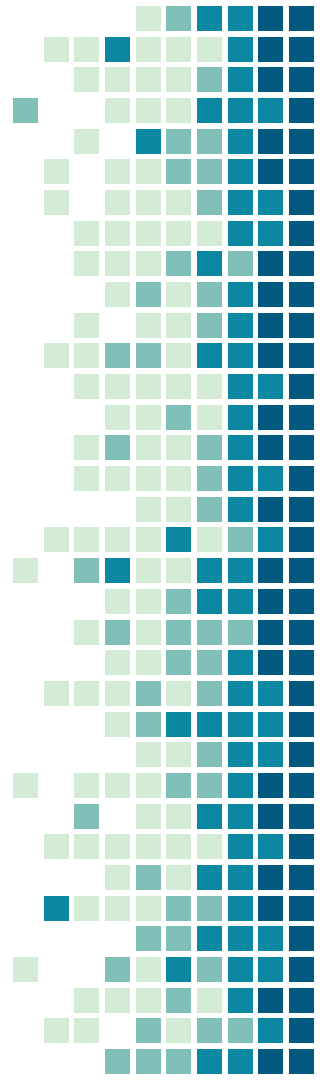Agents can organize into groups (open flocking model)

Modeling separate agents

- Breeds – can model different kinds of turtles or links.
  - All breeds are also turtles (or links)

- Great for modeling groups, different species, data turtles, etc.

Breed syntax

- Must be defined at top of model

- Breed [plural singular]
  - Breed [mice mouse]
  - Create-mice [ ]
  - Mice-own[ ]

THANKS!

Any questions?

You can find me at:

Todd.m.Swannack@usace.army.mil