HW3 Answers

Prey-predator DEVS

X = {}
S = {(prey,pred)|prey in Nat, pred in Nat} where Nat = 0,1,2,…
Y = Nat

$delta_{int}$(prey,pred) = (prey-pred,2*pred) if prey >= pred
= (0,pred+prey) if 0 < prey < pred
= (0,0) otherwise (i.e., prey = 0)

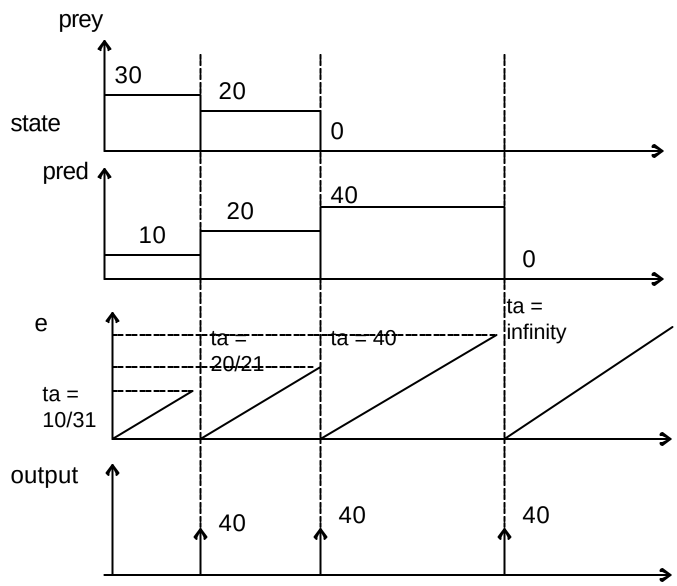
ta(prey,pred) = pred/(prey+1) if pred>0
= infinity otherwise

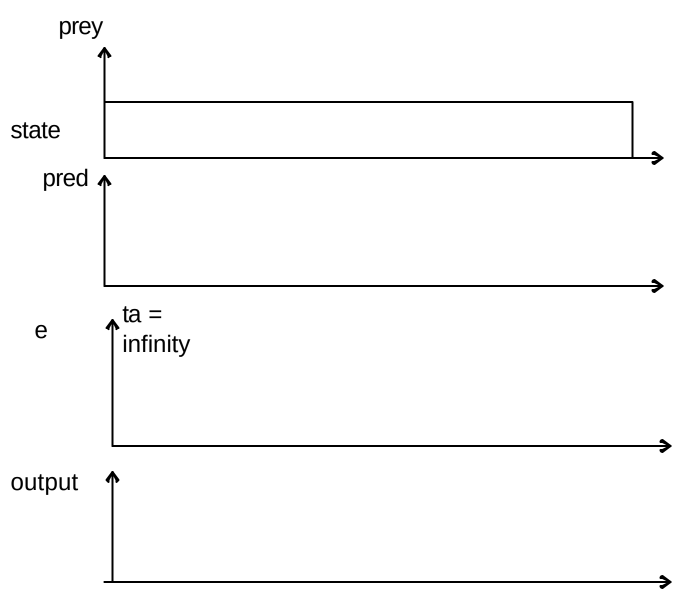
lambda(pred,prey) = pred+prey

Note: when there are fewer prey than predators, the prey are extinguished and the predators that do this divide as usual, the others remain to the next transition and they will die out in the transition after that. It is also possible to allow the predators that don't find prey to die out on this transition (so there will be 2*prey instead of pred+prey). The English statement of the model is somewhat ambiguous on this point. However, the choice of pred+prey is better because then all predators live the same time rather than some dying early and some much later (considering the time advance function).

Also note that the problem statement allowed the time advance to be zero for the case of some prey with zero predators. Since this state transitions back to itself, we have a cycle of states with zero time advance, and therefore an illegitimate DEVS. To correct this situation, the time advance for any case of vanished predators is set to infinity. In general, you must be aware of the possibility that your model may have a non-diverging sum of time advances along a state trajectory.

Below are some state and output trajectories drawn against time lines


prey
state
30
20
0
pred
10
20
40
0
e
ta =
10/31
ta =
20/21
ta = 40
ta =
infinity
output
40
40
40


prey
state
pred
e
ta =
infinity
output