COMPUTER SYSTEMS RESEARCH
Code Writeup of your program, example report form 2008-2009

1. Your name: Dheeraj Manjunath, Period: 2
2. Date of this version of your program: Oct. 30-2008
3. Project title: Modeling Virus Transmission with NetLogo using Agent Based and Systems Dynamics Modeling
4. Describe how your program runs as of this version. Include

    -- files that may be needed

    -- algorithms, specific procedures or methods you wrote

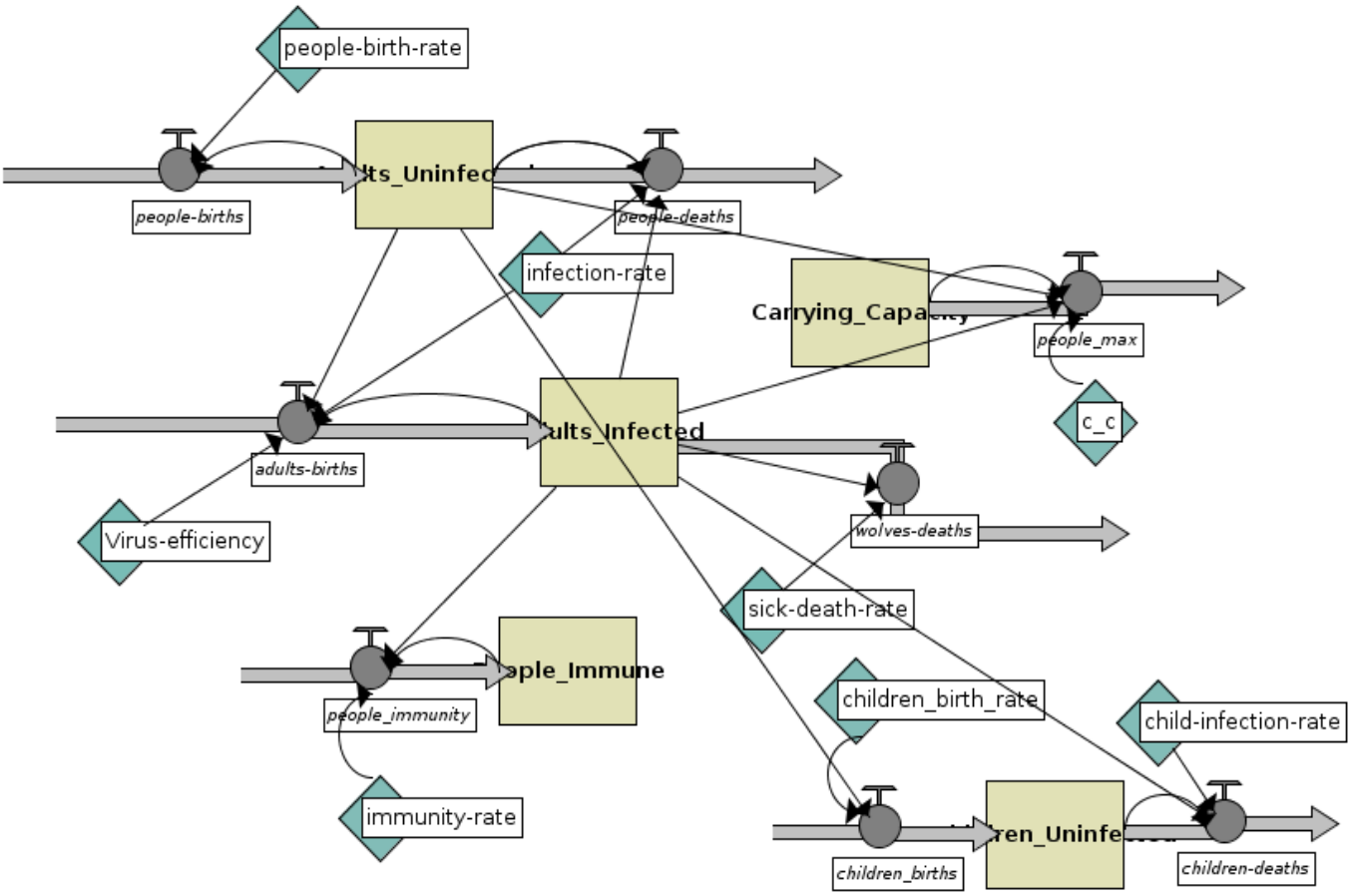
    -- kinds of input your program uses

    -- screenshots, what kinds of output does your program have

    -- does your program handle errors, or does it crash on errors of input?

    -- tests: summarize the basic analysis and testing of this version of your program

I used systems dynamics, and my flowchart is:



I also wrote code in the agent based model to do systems dynamics functions. The methods with the comment ;;systems dynamics function does a systems dynamics related task.

The reason I had to do this, for example, is that the systems dynamics won't accept loops in some conditions, so it's easier to write it in agent based and transfer the values over.

Agent Based Code:

```
globals [ ticks

;;sheepStock
;;wolveStock
area
sum_of_people    ;;system dynamics function initializer
people_immune_var;;system dyanmics function initializer
]

breed [ sheep a-sheep ]
breed [ wolves wolf ]
turtles-own [ energy ]
sheep-own [ grabbed? ]     ;; used to prevent two wolves from eating the same sheep
patches-own [ countdown ]
```

```
to setup
  ct
  cp
  set-current-plot "agent-populations"
  clear-plot
  set ticks 0
  ask patches [ set pcolor green ]


  set-default-shape sheep "person"
  create-custom-sheep initial-number-adults  ;; create the sheep, then initialize their variables
  [
    set color white
    set label-color blue - 2
    set energy random (2 * sheep-gain-from-food)
    setxy random-xcor random-ycor
    set grabbed? false
    set size 1.5
  ]

  set-default-shape wolves "person"
  create-custom-wolves initial-adult-sick  ;; create the wolves, then initialize their variables
  [
    set color black
    set energy random (2 * wolf-gain-from-food)
    setxy random-xcor random-ycor
    set size 1.5
  ]

  display-labels

  do-plot
end

to setup-aggregate
  set-current-plot "populations"
  clear-plot
  set sum_of_people  (Adults_Infected + Adults_Uninfected + Children_Uninfected)      ;;system dynamics function setup
value
  set people_immune 0                                    ;;system dynamics function setup value
  ;; call procedure generated by aggregate modeler
  system-dynamics-setup
end

to step-aggregate
  ;; each agent tick is DT=1
    set sum_of_people  (Adults_Infected + Adults_Uninfected + Children_Uninfected)    ;;system dynamics function setup
value
    set people_immune 0                                  ;;system dynamics function setup value
  repeat ( 1 / dt ) [ system-dynamics-go ]
  system-dynamics-do-plot
end

to go-systems-dynamics
system-dynamics-go
set sum_of_people (Adults_Infected + Adults_Uninfected + Children_Uninfected)          ;;system dynamics function
set carrying_capacity sum_of_people                                                    ;;system dynamics function
```

```
if carrying_capacity > c_c                                          ;;system dynamics function
[ set Adults_Infected Adults_Infected - ((sum_of_people - c_c) * .1) ]
set people_immune_var  (Adults_Infected * (immunity-rate * 0.01));;system dynamics function0.

set People_Immune people_immune_var                          ;;system dynamics function

;;type "People Infected: " type (Adults_Infected * sick-death-rate) type "  Uninfected: " type (Adults_Uninfected *
( infection-rate * Adults_Infected )) type "  Capacity= " type carrying_capacity type "\n"

system-dynamics-do-plot
end


to go
  ask sheep [
    move
    reproduce-sheep
    death
  ]
  ask wolves [
    move
    set energy energy - 1  ;; wolves lose energy as they move
    catch-sheep
    reproduce-wolves
    death
  ]
  do-plot  ;; plot populations
  every 0.5
    [ display-labels ]
  set ticks ticks + 1
  if not any? turtles [ stop ]
end

to move  ;; turtle procedure
  rt random-float 50 - random-float 50
  fd 1
end

to eat-grass  ;; sheep procedure
  ;; sheep eat grass, turn the patch brown
  if pcolor = green [
    set pcolor brown
    set energy energy + sheep-gain-from-food  ;; sheep gain energy by eating
  ]
end

to reproduce-sheep  ;; sheep procedure
  if random-float 100 < sheep-reproduce [  ;; throw "dice" to see if you will reproduce
    set energy (energy / 2)          ;; divide energy between parent and offspring
    hatch 1 [ rt random-float 360 fd 1 ]   ;; hatch an offspring and move it forward 1 step
  ]
end

to reproduce-wolves  ;; wolf procedure
  if random-float 100 < wolf-reproduce [  ;; throw "dice" to see if you will reproduce
    set energy (energy / 2 )  ;; divide energy between parent and offspring
    hatch 1 [ rt random-float 360 fd 1 ]  ;; hatch an offspring and move it forward 1 step
```

```
  ]
end

to catch-sheep  ;; wolf procedure
  let prey one-of (sheep-here             ;; grab a random sheep
                   with [not grabbed?]) ;; that no one else is grabbing
  if prey != nobody                        ;; did we get one?  if so,
    [ set grabbed?-of prey true               ;; prevent other wolves from grabbing it
      ask prey [ die ]                      ;; kill it
      set energy energy + wolf-gain-from-food ]     ;; get energy from eating
end

to death  ;; turtle procedure
  ;; when energy dips below zero, die
  if energy < 0 [ die ]
end


to do-plot
  set-current-plot "agent-populations"
  set-current-plot-pen "sheep"
  plot count sheep
  set-current-plot-pen "wolves"
  plot count wolves
end

to display-labels
  ifelse show-energy?
  [

     ask wolves
     [ set label round energy ]
     ask sheep
     [ set label "" ]
  ]
  [
    ask turtles
    [ set label "" ]
  ]
end
```

5. What do you expect to work on next quarter, in relation to the goal of your project for the year?
I want to finish the different age classes and have them affected by the functions. I also want to finish the susceptibility rate so that people have variable susceptibilities rather than just a percent become infected.

Code Description-The basic structure of my Agent Based program is that there is a population, with births and deaths, and there is an infection rate. The population is then split into two classes, infected and uninfected. The flows then show the general population trend in the form of graphs in the NetLogo GUI.
In addition to the infection rate, there are other variables, such as virus efficiency, immunity rate, and sick death rate, all controlled by the user.

The agent based code with
;;systems dynamics functions
modify values of the systems dynamics.
One of the examples would be:

```
if carrying_capacity > c_c                              ;;system dynamics function
[ set Adults_Infected Adults_Infected - ((sum_of_people - c_c) * .1) ]

set people_immune_var  (Adults_Infected * (immunity-rate * 0.01));;system dynamics
function.
```

The first and second life are the if loop, and if the condition is met, the Adult_Infected values are changed.
The third line sets a value to people_immune_var.