1.6 Appendix: SIR.sws code for Exercises Part 5, Section 1.3

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# SIR program, for studying an epidemic using Euler's method

# First, specify the starting and ending points, stepsize, and total number of observation points

tstart=0
tfin= 120
stepsize=0.5
length=((tfin-tstart)/stepsize)+1

# Next, specify values of parameters, and initial values of variables

a=0.00001
b=1/14
T=50000
S=49990
I=T-S
R=0
t=tstart

# Set up empty lists for the values we're about to compute

Svalues=[]
Ivalues=[]
Rvalues=[]
tvalues=[]

# The following loop does three things:

# (1) stores the current values of S, I, R, and t into the lists created above;
# (2) computes the next values of S, I, R using Euler's method;
# (3) increases t by the stepsize

for i in range(length):

    # Store current values

    Svalues.append(S)
    Ivalues.append(I)
    Rvalues.append(R)
    tvalues.append(t)

    # Compute rates of change using SIR equations

    Sprime=-a*S*I
    Iprime=a*S*I-b*I
    Rprime=b*I

    # Net change equals rate of change times stepsize

    DeltaS=Sprime*stepsize
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    DeltaI=Iprime*stepsize
    DeltaR=Rprime*stepsize

    # New values equal current values plus net change

    S=S+DeltaS
    I=I+DeltaI
    R=R+DeltaR
    t=t+stepsize

    # Next time through the loop, the above new values play the role of current values

# Zip the t values with the S/I/R values into lists of ordered pairs, and create plots of these

Splot=list_plot(list(zip(tvalues,Svalues)),marker='o',color='blue',legend_label="Susceptible",
legend_color='blue')
Iplot=list_plot(list(zip(tvalues,Ivalues)),marker='o',color='red', legend_label="Infected",
legend_color='red')
Rplot=list_plot(list(zip(tvalues,Rvalues)),marker='o',color='green', legend_label="Recovered",
legend_color='green')

# Now plot the computed S,I,R values together on a single graph, with axes labelled appropriately

SIRgraph=Splot+Iplot+Rplot
show(SIRgraph,axes_labels=['$t$ (days)','$S$,$I$,$R$ (individuals)'])
```