Systems Medicine
Uri Alon (Spring 2020)
Exercise 1

1) In the SIr model, show using equations (1)-(3) that S(t)+I(t)+r(t)=1 at all times. Hint: use the initial conditions in which this sum equals one at time t=0.

2) Choose a non-corona virus whose name starts with the first letter of your last name (if there is none, the first letter of your given name). Read about its mechanism of entry into the cell and replication inside the cell, and summarize in 100 words.
   A list of Human viruses and associated pathologies can be found here: https://viralzone.expasy.org/678, Further data can be also found here https://talk.ictvonline.org/.

3) Simulation:
   a. Plot the infection curve as a function of time for I(0)=0.01, S(0)=0.99, and Ro=2. Assume β=0.3 /day, and γ=1/7day.
   b. Check whether the maximum infection is reached at the point mentioned in the lecture, and whether the susceptible fraction at long times matches the lecture prediction.
   c. What is the value of I(t) at its maximum? Assuming a death rate of 1%, and a population of 1 million, approximately how many fatalities are expected at the end of the epidemic based on this simulation? Hint for fatalities: plot r(t), defined as the fraction recovered or dead. At long times when the epidemic is over, everyone that has been infected has either recovered or died from the disease. Another approach is to use the section on S_∞ in the lecture notes.
   d. Plot the infection curve for a small value of Ro (choose a value of β that makes Ro slightly larger than 1) and a large value of Ro. What do you observe about the curves? (100 words).
   e. Plot the infection curve as in a., but now Ro drops to Ro=0.9 at t=5 days due to a lockdown. What do you observe (50 words).

Resources: Tutorials and sample computer code provided in Mathematica, Python, Matlab and R in the AlonLab website
https://www.weizmann.ac.il/mcb/UriAlon/systems-medicine-course-2020