Part B - Designing a Treatment Plan With Two Drugs

One approach to addressing the problem of acquired drug resistance is to use cocktails – administration of multiple drugs that act independently to attack the virus population.

In this problem, we use two independently-acting drugs to treat the virus. We will use this model to decide the best way of administering the two drugs. Specifically, we examine the effect of a lag time between administering the first and second drugs on patient outcomes.

Use the following parameters to initialize a `TreatedPatient`:

- `viruses`, a list of 100 `ResistantVirus` instances.
- `maxPop`, maximum sustainable virus population = 1000

Each `ResistantVirus` instance in the viruses list should be initialized with the following parameters:

- `maxBirthProb`, maximum reproduction probability for a virus particle = 0.1
- `clearProb`, maximum clearance probability for a virus particle = 0.05
- `resistances`, the virus's genetic resistance to drugs in the experiment: {'guttagonol': False, 'grimpex': False}
- `mutProb`, probability of a mutation in a virus particle's offspring = 0.005

Run the simulation for 150 time steps before administering guttagonol to the patient. Then run the simulation for 300, 150, 75, and 0 time steps before administering a second drug, grimpex, to the patient. Finally, run the simulation for an additional 150 time steps.

For each of these 4 conditions, repeat the experiment for enough trials to get a reasonable condition, while recording the final virus populations. Use pylab's `hist()` function to plot a histogram of the final total virus populations under each condition.

Hint: time it takes to run simulation

As with Part A, the simulation will take a few minutes to run. Use print statements to monitor the simulation's progress.

Fill in the function `simulationTwoDrugsDelayedTreatment(numTrials)` to perform this simulation. Feel free to break down the problem into smaller subparts and define helper functions for each.

Create 4 histograms (for 300, 150, 75, and 0 time steps) and then answer the following set of questions.