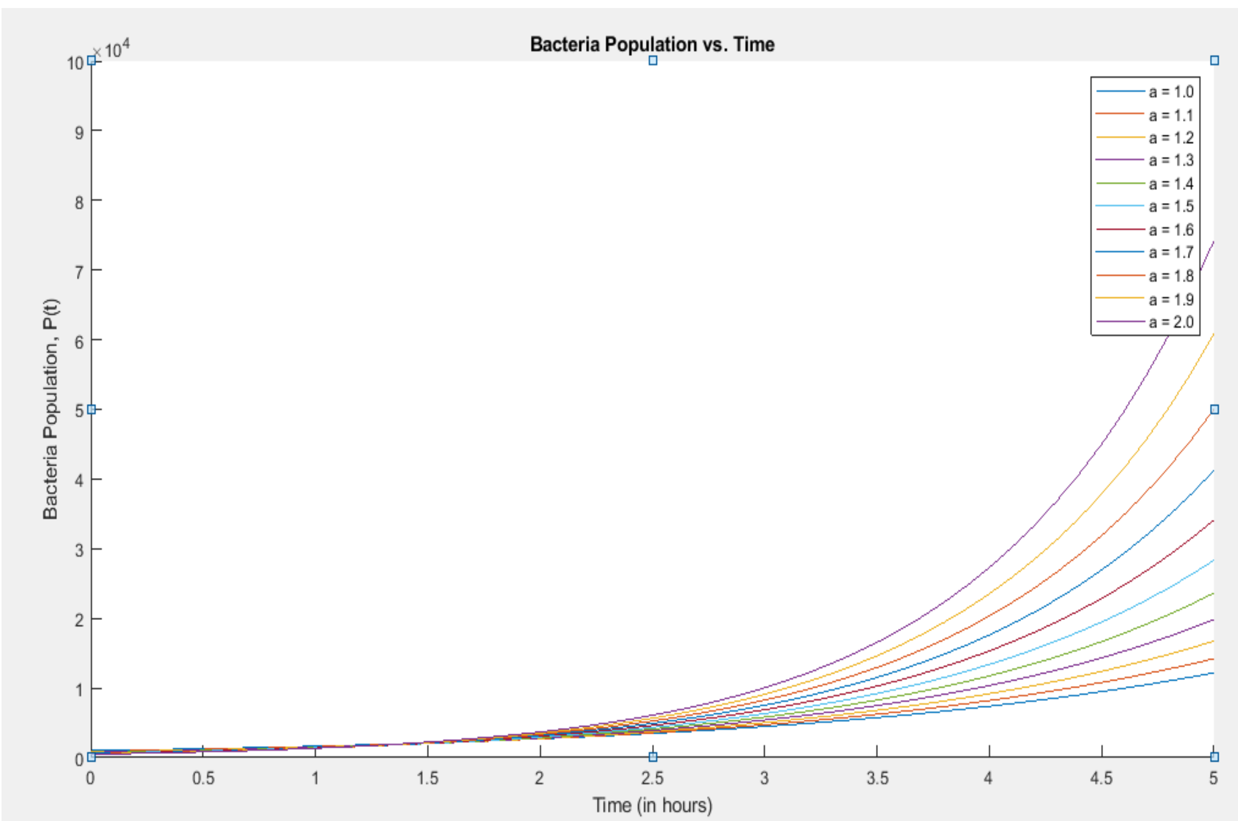
Lab #5: Matrices and For Loops

Malhar Shah - 1004926912

Table 1

Expressions	Result
A./B	3.0000 1.0000 3.0000 0.5000 1.0000 0.5000 1.0000 1.3333 0.3333
A.*B	3 1 3 2 4 2 9 12 3
A.^2	9 1 9 1 4 1 9 16 1
rank(A)	3
rank(B)	1

Graph 1



Code for Graph

```
hold on
a = [];
t = (0:0.1:5)
for a = 1:0.1:2
    P = (1000/a)*exp(0.5*a*t);
    plot(t,P)
end
title('Bacteria Population vs. Time')
xlabel('Time (in hours)')
ylabel('Bacteria Population, P(t)')
legend('a = 1.0','a = 1.1','a = 1.2','a = 1.3','a = 1.4','a = 1.5','a =
1.6','a = 1.7','a = 1.8','a = 1.9','a = 2.0')
```

Question

1. As a value increases, the bacteria population grows faster within the same time. Therefore, the pattern for the exponential graph is the way it is. The graph with the largest a value (purple line) has the steepest graph. The graph with the smallest a value (blue value) has the least steep curve.

2. As t approaches infinity, the rate of change of exponential function is:
$$\frac{dy}{dx} = 500te^{0.5at}$$
So, as t approaches infinity, the population becomes the biggest at a = 2.0
As t approaches infinity, the population, the population continues growing without limit, therefore, there is no max value of t where the population is the greatest.

3. To get doubling time, the following relationship should be used;
$$2 = \frac{\frac{1000}{a}e^{0.5atf}}{\frac{1000}{a}e^{0.5ati}} = \frac{e^{0.5atf}}{e^{0.5ati}} = e^{0.5a(tf-ti)}$$
$$\ln 2 = 0.5a(tf - ti)$$
$$\Delta t = tf - ti = \frac{2\ln 2}{a}$$
tf= End of doubling time, ti = Start of doubling time. I chose a = 1.0, 1.5, and 2.0. The doubling time for each a (in hours) is:
$$\Delta t = \frac{2\ln 2}{1.0} = 1.386 \quad (for\ a = 1.0)$$
$$\Delta t = \frac{2\ln 2}{1.5} = 0.924\ (for\ a = 1.5)$$
$$\Delta t = \frac{2\ln 2}{2.0} = 0.693\ (for\ a = 2.0)$$

This shows that doubling time decreases as the value of a increases. This also suggests that the rate of increment is higher when a is higher.

4. The similarities between doing the matrix math by hand versus via MatLab is that we will receive the same answers if all the calculations are correct. Doing the matrix calculation by hand is easier for smaller matrices and for easier calculations. However, using MatLab becomes more useful for larger matrices and for carrying out larger calculation. Some important considerations an engineer should think about when using the “for” loop are the concepts being understood? What results can we draw upon from using the “for” loop. These are the important questions that should be considered by an engineer.