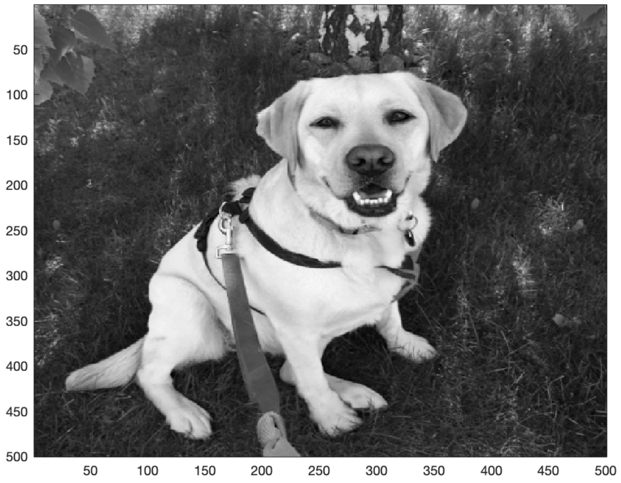
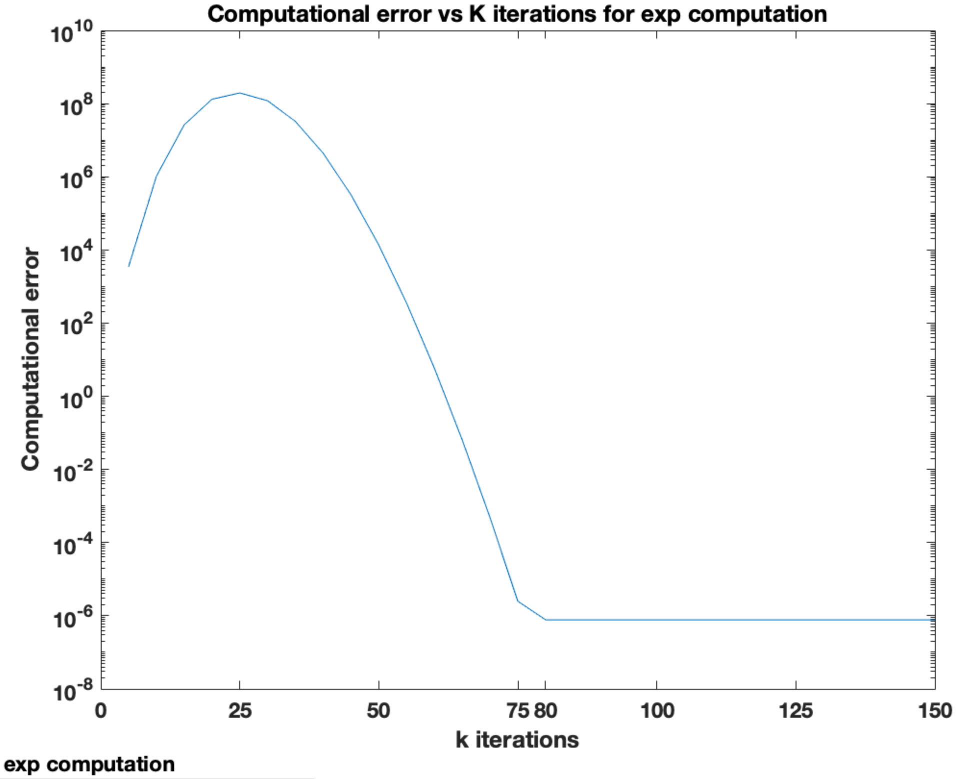
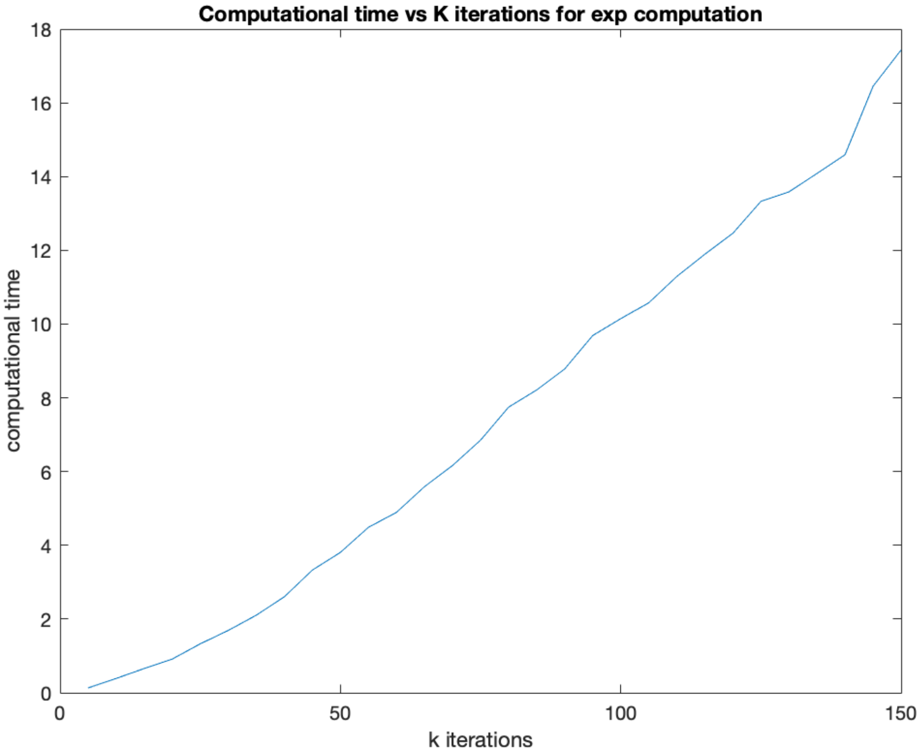
MACM316 Assignment 3 – Ngawang Kyirong 301312227

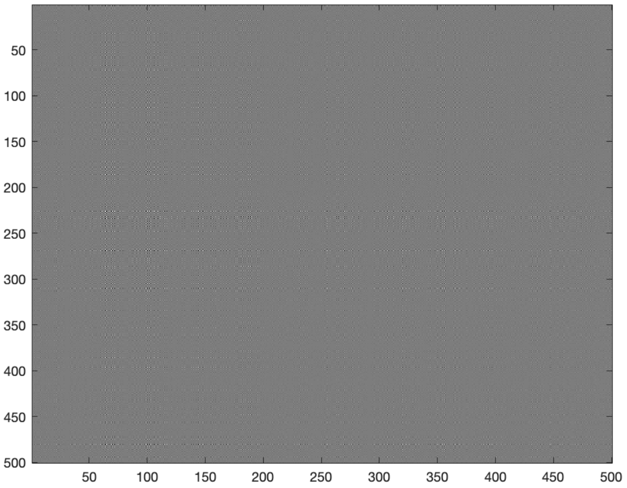
K = 150







K=50



b.) As seen in the “Computational time vs K iterations for exp computation” plot, there is a **linear** relationship between the increasing values of **k** iterations and the increasement in **time**. There also appears to be a linear relationship between **k** and the amount of **flops**. However, the amount of **time** it takes to complete is linear but increases slower because for every increase in k by 5, the number of loops inside is also increased by 5 and the tic is before the inside loop with the toc immediately following afterwards (this is $O(k)$ because of the 1 for loop being used for timing). While the number of flops increases linearly to k but quicker because it is also dependant on the number flops: $O(number\ of\ flops * k)$. Therefore, it is in agreement with the assumption that time will be linear, but not in agreement with how fast due to the number of flops. **c.)** As seen in the “Computational error vs K iterations for exp computation” plot, the error increases until k=25 and then starts to decrease until k=80 and then stays constant. The **accuracy** of the algorithm is limited and not very accurate even though the error decreases to 10^{-6}**.** As k increases, the error should decrease and go towards machine epsilon but it does not. The **robustness** of the algorithm is good as the calculations do not seem to be effected by floating point errors.

```
A = load('CA3matrix.mat');
I = eye(500);
k_50 = 50;
k_150 = 150;
expAk = I;
expAk2 = I;
expAk3 = I;

% part a (k=50)
for n = 1:k_50
    expAk = expAk + ((1/factorial(n)) * A.A^n);
end
imagesc(real(expAk));
colormap gray

% part a (k=150)
for n = 1:k_150
    expAk = expAk + ((1/factorial(n)) * A.A^n);
end
imagesc(real(expAk));
colormap gray

% part b
times = [];
for n = 5:5:150
    tic;
    for i = 1:n
        expAk2 = expAk2 + ((1/factorial(i)) * A.A^i);
    end
    times = [times toc];
    expAk2 = I;
end

plt = plot(5:5:150, times);
xlabel("k iterations");
ylabel("computational time");
title("Computational time vs K iterations for exp computation");

% part c
error = [];
expA = expm(A.A);
for n = 5:5:150
    for i = 1:n
        expAk3 = expAk3 + ((1/factorial(i)) * A.A^i);
    end
    error = [error norm(expA - expAk3)/norm(expA)];
    expAk3 = I;
end

plt = semilogy(5:5:150, error);
xlabel("k iterations");
ylabel("Computational error");
title("Computational error vs K iterations for exp computation");
```