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MATH1080  
Coding Assignment #5

In this project, we implement the power iteration, inverse iteration, and the Rayleigh quotient iteration. The programs take in different outputs and use a lot more steps depending on their initial state of  $v_0$  and the epsilon value. The programs print out all the values of lambda and v at each step of their respective programs, but I did not include the entire output for all of the programs because some of them take anywhere from 20 to 700 iterations and that would literally take up tens of pages just for their output. Instead, below, I have output the final values for each program's simulation for both lambda and v:

Program	eps	Mu	Final Lambda
Power iteration	$10^{-6}$		29.0434
Power iteration	$10^{-10}$		29.0434
Inverse iteration	$10^{-10}$	1	3.7931
Inverse iteration	$10^{-10}$	1024	29.0434
Rayleigh quotient iteration	$10^{-10}$	1	3.7931
Rayleigh quotient iteration	$10^{-10}$	1024	29.0434

Clearly, the power iteration's final value of lambda has converged. They actually ended up converging to the same value. My suspicions are that with greater precision in MATLAB, their values would be slightly off in smaller precision decimal places, but MATLAB does not output that far with precision, so I cannot test that hypothesis. So, they end up converging to the same value, but the power iteration with a tolerance of  $10^{-10}$  required fewer iterations than the power iteration with  $10^{-6}$ .

Next, the inverse iteration. I kept the tolerance constant for both tests because I asked Dr. Swigon about that. However, I varied the value of mu because I did not want the value of epsilon to impact our final lambda value. Clearly, with the two different values of mu, we converged on two different eigenvalues, 3.7931 and 29.0434. Similarly, for the Rayleigh quotient iteration, with two different values of mu and a constant epsilon, the same two, different lambda values were calculated. As such, I have high confidence these are two of the true, underlying, ground-truth eigenvalues for this matrix.

Out of all three algorithms, I would take the output from the Rayleigh quotient iteration since we are able to control, somewhat, which eigenvalue we choose, in contrast with power iteration. Additionally, it is better than the inverse iteration since we can decide the initial value of lambda in the formulations, which I used the value of mu.