MA5636 Homework 1 - Programming Assignment

John Cormican

February 8, 2019

1. Both functions for qr factorization are found in $qrfactoring.c$.

2. There was no significant error in $A - QR$ for either method. The error is marginally higher using the householder method but this may be because the more complex method involves more operations which may increase the floating point error.

Test No.	Error (A-QR) using basic gs	Error (A-QR) using householder
1	2.486900E-14	9.947598E-14
2	2.486900E-14	8.526513E-14
3	2.842171E-14	1.918465E-13
4	2.486900E-14	1.314504E-13
5	2.486900E-14	9.769963E-14
6	2.842171E-14	1.278977E-13
7	2.131628E-14	8.970602E-14
8	2.486900E-14	1.296740E-13
9	2.309264E-14	9.414691E-14
10	2.842171E-14	1.332268E-13

3. In this case, the householder method outperforms the basic Gram-Schmidt and is much more consistent. While the error term using the householder transformation is always in the 1.5E-15 to 2.5E-15 range, the error term in the calculation via basic Gram Schmidt varies from 2.15E-15 to over 9E-15. This range in error values for different random matrices may indicate that the error term for basic Gram Schmidt increases more with an increase in the condition number while the error using the Householder method remains reasonably stable. Hence, the householder method displays better backward stability and does not increase significantly depending on the matrix.

Test No.	$I - (Q^T)Q$ using basic gs	$I - (Q^T)Q$ using householder
1	2.157345E-15	2.442491E-15
2	8.185293E-15	1.776357E-15
3	4.056651E-15	1.554312E-15
4	3.452100E-15	1.554312E-15
5	9.140692E-15	2.220446E-15
6	3.323730E-15	2.220446E-15
7	3.603021E-15	1.776357E-15
8	7.958044E-15	1.998401E-15
9	3.905567E-15	1.776357E-15
10	9.331078E-15	1.998401E-15