­­­Part 1 Written Component

***Why is it justifie­­d to use the LU or QR-factorizations as opposed of calculating an inverse matrix?***

It takes fewer operations to solve through LU and QR versus an inverse matrix.

For LU: Rather than solving with Gaussian elimination, it is faster to decompose the matrix into the lower triangular and upper triangular matrices and solving . is first solved where . Each of these solutions is trivial with forward and backward substitution, which is fast for a computer.

For QR: becomes . As is orthonormal, . It is much faster to transpose a matrix than to compute the inverse. therefore becomes . is a constant vector and is upper triangular, so is fast to solve with backward substitution.

***What is the benefit of using LU or QR-factorizations in this way? (Your answer should consider the benefit in terms of conditioning error.)***

QR/LU is stable with regards to error unlike the inverse operation. For example LU is O(4n3/3) while Gaussian Elimination is O(n4/3) which leaves much more room for Gaussian Elimination to accumulate error since there are so many iterations it needs to go through.

Givens algorithm listed at <http://www.math.usm.edu/lambers/mat610/sum10/lecture9.pdf>

Householder’s algorithm listed at <http://davidstutz.de/matrix-decompositions/matrix-decompositions/householder>

