Algorithm Stability for computing the QR factorization of a matrix

To compute the QR factorization of the matrix, you can use the Gram-Schmidt process, householder reflection, or Givens rotations.

The Gram-Schmidt process is considered the least stable of the three methods, since the orthogonalization itself is prone to numerical error. This is because when implemented on a computer, rounding errors cause the orthogonal vectors to be not quite orthogonal. The non-orthogonality accumulates error over time. The householder reflection is considered more numericaly stable and more efficient than the Gram-Schmidt process (And even Givens rotations) to compute the QR factorization. The Householder method computes the Q-factor as a product of accurate Householder reflections, which doesn’t accumulate error over time. Givens rotations are considered more efficient and parrelisable than the householder reflection, although Givens rotations are more difficult to implement, and slower than Householder refelctions.

https://en.wikipedia.org/wiki/QR\_decomposition

https://www-old.math.gatech.edu/academic/courses/core/math2601/Web-notes/3num.pdf

<http://iacs-courses.seas.harvard.edu/courses/am205/fall13/AM205_unit_2_chapter_3.pdf>

<https://en.wikipedia.org/wiki/Gram%E2%80%93Schmidt_process#Numerical_stability>

<https://www-old.math.gatech.edu/academic/courses/core/math2601/Web-notes/3num.pdf>