Explanation

**Least Squares with QR Decomposition**

Solve if

However, often we don’t have a solution (ie: ), so our best bet is to minimize

**Main Goal:**

In the case of QR Factorization (A = QR):

| Steps | Explanation |
| --- | --- |
|  | Minimizing value |
|  | Since , then is also an orthogonal matrix  Rows of Q also form an orthonormal basis, so is an orthogonal matrix  Thus, |
|  | By definition, A = QR |
|  | so regardless of the dimensions of Q |

Hence, to compare which QR decomposition method is better, we must calculate , and whichever method has the smallest residual value is the best method.

<https://johnwlambert.github.io/least-squares/>

Householder Factorization

| Steps |
| --- |
| 1. Let    1. Includes the column with the pivot    2. = 1st standard basis vector for wtv we’re currently in    3. Sign = opposite sign of first entry 2. 1. Matrix with scalar 3. F = I - 2P    1. Smaller than Q after round 1 4. Q1 = Replace corresponding chunk in A with F    1. Will always be a square matrix 5. Repeat but use A2 = Q1\*A |

Classical Gram Schmidt

| Code | Explanation |
| --- | --- |
|  | Code explanation is commented   * <https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/related-resources/MIT18_06S10_gramschmidtmat.pdf> |