

# Global exercise - GUE08

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Content covered:

✓ Numerics:

1. Review: QR decomposition by using
  - (a) Givens-Rotation
  - (b) Householder-Reflection
2. QR algorithm to find all eigenvalues of a matrix  $A$ .

✓ Analysis: Application of Hölder's inequality to approximate integral

## 1 Numerics: Review of QR decomposition

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## 2 Numerics: QR-algorithm

**Observation 1 (QR-algorithm vs. QR-decomposition).** *QR-algorithm (as seen in Maths III) is not QR-decomposition (as seen in Maths II). QR-algorithm (Maths III) is an algorithm used to find **all** eigenvalues of a matrix  $A$  **numerically**. Meanwhile, QR-decomposition is a technique in linear algebra used to decompose a matrix  $A$  into an orthogonal matrix  $Q$  and a right upper triangular matrix  $R$ . Nevertheless, we will still need QR-decomposition for QR-algorithm.*

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### 3 Analysis: Application of Hölder's inequality

**Example 1.** *Examine the following integral*

$$\int_{\Omega} (x+2)^{-3/5} \exp(-2x/3) dx$$

Approach:

## 4 Numerics: QR algorithm

**Example 2.** *Examine the consistency error of the following problem*

$$u''(x) - u'(x) + u(x) = 2x - 1 - x^2$$

*with the Neumann and Dirichlet BC are given, respectively, as follows*

$$u'(0) = 0, \quad u(1) = 0.$$

*The exact solution is known, i.e.  $u(x) = 1 - x^2$ .*

Approach: