$$\begin{bmatrix} A_{11} & C_1 \\ A_{21} & C_2 \end{bmatrix}$$

Figure 1: Decomposition of $A$ used in DORGQR

# Contents

# 1 What does Reference DORGQR do?

The algorithm for the current Reference DORGQR is as follows. We will assume for simplicity's sake that $n$ is a perfect multiple of $k$ and that we start blocking exactly at $k$. This is not exactly how DORQR is currently written, but it will allow us to talk about the algorithm and ignore some technical difficulties in the implimentations

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**Algorithm 1** Reference DORGQR

---
**Require:** $A \in \mathbb{R}^{m \times n}$ output of DEQRF. IE the $i^{\text{th}}$ column of $A$ is the vector defining the $i^{\text{th}}$ elementary reflector ($H_i$ for the starting matrix for $i = 1, \ldots, k$, and $m \geq n$

**Ensure:** $A = Q \in \mathbb{R}^{m \times n}$ such that $Q = H_1 H_2 \cdots H_k$

  **if** blocking **then**

    determine blocking parameter $nb$

  **else**

    $Q \leftarrow$ DORG2R($A$)

    **return** $Q$

  **end if**

  Break $A$ down according to Figure 1 where $C_1 \in \mathbb{R}^{k \times n-k}$ and $C_2 \in \mathbb{R}^{m-k \times n-k}$ are the last $k$ columns of $A$.

  $C_1 \leftarrow \mathbf{0}$

  $C_2 \leftarrow$ DORG2R($C_2$)

  **for** $i = k - nb, k - 2nb, \cdots 1$ **do**

    asdf

  **end for**

---

# 2 What did we aim to do?/Deliverables

We aim to increase the performance of the reference DORGQR in both time and memory used

# 3 Why do we care?

# 4 Hardware Used

We ran the following tests using a Lenovo Thinkpad E430 running Arch Linux with the following system specifications

- Kernel: 6.5.8-arch1-1

- CPU: Intel i3-3120M (4 cores, 8 threads) @ 2.500GHz

# 5 Version 1

The file that contains just the changes mentioned here is: `my_dorgqr_v1.f`

## 5.1 Changes

For the first version, we aimed to take advantage of the fact that in our first step, we have an identity matrix in the slot of $C_2$, and 0 inside the slot of $C_1$ on every iteration.

## 5.2 Numerical Performance

We compare this version against two baselines.

- Reference DORGQR

- MKL DORGQR

# 6 Version 2

The file that contains the changes mentioned here and the ones described in Section 5 is: `my_dorgqr_v2.f`

## 6.1 Changes

## 6.2 Numerical Performance

# 7 Summary