Introduction to Languages for Scientific Computing

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Matrix inversion $\mathbf{L := L^{-1}}$

Input: $\hat{L} \in \mathbb{R}^{n \times n}$, lower triangular; $\hat{L}$ denotes the initial content of L

Output: $L \in \mathbb{R}^{n \times n}$, lower triangular; $L = \hat{L}^{-1}$

Partition $L \rightarrow \left(\begin{array}{c|c} L_{TL} & \\ \hline L_{BL} & L_{BR} \end{array}\right)$

where L_{TL} is 0×0

While $m(L_{TL}) < m(L)$ **do**

$\kappa = \min(b, m(L_{BR}))$

Repartition

$$\left(\begin{array}{c|c} L_{TL} & \\ \hline L_{BL} & L_{BR} \end{array}\right) \rightarrow \left(\begin{array}{c|c|c} L_{00} & & \\ \hline L_{10} & L_{11} & \\ \hline L_{20} & L_{21} & L_{22} \end{array}\right)$$

where L_{11} is $\kappa \times \kappa$

Algorithm 1:

$$\begin{array}{l} L_{10} := L_{11}^{-1} L_{10} \\ L_{10} := -L_{10} L_{00} \\ L_{11} := L_{11}^{-1} \end{array}$$

Algorithm 2:

$$\begin{array}{l} L_{21} := -L_{22}^{-1} L_{21} \\ L_{20} := L_{20} - L_{21} L_{10} \\ L_{10} := L_{10} L_{00} \\ L_{11} := L_{11}^{-1} \end{array}$$

Continue with

$$\left(\begin{array}{c|c} L_{TL} & \\ \hline L_{BL} & L_{BR} \end{array}\right) \leftarrow \left(\begin{array}{c|c|c} L_{00} & & \\ \hline L_{10} & L_{11} & \\ \hline L_{20} & L_{21} & L_{22} \end{array}\right)$$

endwhile

Challenge #3

1. Code up Algorithms 1 and 2 as a Matlab function,
   in **the most elegant** and **descriptive** way.

2. The prototype (interface) must be `TriInv( L, b, alg )`,
   where `b` is the block size, and `alg` = [1|2] indicates the algorithmic variant.
   - The function $m(M)$ returns the number of rows of M.
   - To create lower triangular matrices, generate a `rand` matrix, add `n*eye(n)` to it, and extract the lower triangular part.
   - For the recursive calls, use your routine with block size = 1:
     `TriInv( *, 1, * )`.

3. Write the driver `challenge3.m` to generate two plots, titled “Accuracy” and “Execution time”, respectively.
   - The plots should be self explanatory, and present results for $10 \leq n \lesssim 2000$.
   - You decide what “accuracy” means.
   - Present results for different values of `b`.

Submission

- Individual assignment
- Prepare the files `triinv.m`, `challenge3.m`, and the plots `accuracy.pdf`, and `time.pdf`
- Archive them as `<your name>.zip`, or `<your name>.tgz`
- Submit the archive by email to `pauldj@aices.rwth-aachen.de`
- Email's subject: ``LSC-17 Challenge3 <your last name>''
- **Deadline: Friday, June 23, midnight.**