

Introduction to Languages for Scientific Computing

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High Performance and
Automatic Computing

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Challenge #2: `spin`, `spin_MV`

1) Function `spin`

Input: an integer n

Output: the “spin matrix” C_n of size $n \times n$, as defined in the next three slides.

2) Function `spin_MV`

Input: an integer n , and a vector v of size n

Output: the vector y , also of size n , resulting from the multiplication of the spin matrix C_n by the input vector v ; mathematically: $y = C_n * v$.

Challenge: Write the Matlab functions `spin` and `spin_MV`.

Goal #1 (`spin`): Readability, appearance.

Goal #2 (`spin_MV`): Do NOT form the spin matrix.

Definition of C_n (1/3)

If n is a multiple of 3

$$C_n := \begin{bmatrix} 1 & & & -2 & \dots & -2 & & & 1 \\ & \ddots & & \vdots & \ddots & \vdots & & \ddots & \\ & & 1 & -2 & \dots & -2 & 1 & & \\ -3 & \dots & -3 & & & & 3 & \dots & 3 \\ \vdots & \ddots & \vdots & & & & \vdots & \ddots & \vdots \\ -3 & \dots & -3 & & & & 3 & \dots & 3 \\ & & -1 & 2 & \dots & 2 & -1 & & \\ & & & \vdots & \ddots & \vdots & & \ddots & \\ -1 & & & 2 & \dots & 2 & & & -1 \end{bmatrix}$$

Otherwise

$$C_n := \begin{bmatrix} 1 & & & -2 & & & 1 \\ & \ddots & & \vdots & & \ddots & \\ & & 1 & -2 & 1 & & \\ -3 & \dots & -3 & & 3 & \dots & 3 \\ & & -1 & 2 & -1 & & \\ & \ddots & & \vdots & & \ddots & \\ -1 & & & 2 & & & -1 \end{bmatrix}$$

Examples

$$C_3 = \begin{bmatrix} 1 & -2 & 1 \\ -3 & 0 & 3 \\ -1 & 2 & -1 \end{bmatrix}$$

$$C_9 = \begin{bmatrix} 1 & 0 & 0 & -2 & -2 & -2 & 0 & 0 & 1 \\ 0 & 1 & 0 & -2 & -2 & -2 & 0 & 1 & 0 \\ 0 & 0 & 1 & -2 & -2 & -2 & 1 & 0 & 0 \\ -3 & -3 & -3 & 0 & 0 & 0 & 3 & 3 & 3 \\ -3 & -3 & -3 & 0 & 0 & 0 & 3 & 3 & 3 \\ -3 & -3 & -3 & 0 & 0 & 0 & 3 & 3 & 3 \\ 0 & 0 & -1 & 2 & 2 & 2 & -1 & 0 & 0 \\ 0 & -1 & 0 & 2 & 2 & 2 & 0 & -1 & 0 \\ -1 & 0 & 0 & 2 & 2 & 2 & 0 & 0 & -1 \end{bmatrix}$$

Examples

$$C_8 = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & -1 & -1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 0 & 0 & -1 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 & 0 & -1 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 & 0 & -1 \end{bmatrix}$$

$$C_7 = \begin{bmatrix} 1 & 0 & 0 & -2 & 0 & 0 & 1 \\ 0 & 1 & 0 & -2 & 0 & 1 & 0 \\ 0 & 0 & 1 & -2 & 1 & 0 & 0 \\ -3 & -3 & -3 & 0 & 3 & 3 & 3 \\ 0 & 0 & -1 & 2 & -1 & 0 & 0 \\ 0 & -1 & 0 & 2 & 0 & -1 & 0 \\ -1 & 0 & 0 & 2 & 0 & 0 & -1 \end{bmatrix}$$

- Individual assignment.
- Prepare 2 files: `spin.m` and `spin_MV.m`.
- Write your name in each file.
- Archive them: `<your name>.zip` Or `<your name>.tgz`
- Submit the archive by email to `pauldj@aices.rwth-aachen.de`
- Email's subject: `'LSC-17 Challenge2 <your last name>'`
- **Deadline: Wednesday, May 31, noon.**