

# TIP8419 - Tensor Algebra

## Homework 5

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### Unfolding, folding, and $n$ -mode product

**Problem 1** For a third-order tensor  $\mathcal{X} \in \mathbb{C}^{I \times J \times K}$ , using the concept of  $n$ -mode fibers, implement the function *unfold* according to the following prototype

$$[\mathcal{X}]_{(n)} = \text{unfold}(\mathcal{X}, n)$$

Hint: Use the file “unfolding\_folding.mat” to validate your function.

**Problem 2** Implement the function *fold* that converts the unfolding  $[\mathcal{X}]_{(n)}$  obtained with *unfold*( $\mathcal{X}, n$ ) back to the tensor  $\mathcal{X} \in \mathbb{C}^{I \times J \times K}$  (i.e., a 3-d array in Matlab/Octave), according to the following prototype:

$$\mathcal{X} = \text{fold}([\mathcal{X}]_{(n)}, [I \ J \ K], n)$$

Hint: Use the file “unfolding\_folding.mat” to validate your function.

**Problem 3** For given matrices  $\mathbf{A} \in \mathbb{C}^{P \times I}$ ,  $\mathbf{B} \in \mathbb{C}^{Q \times J}$ , and  $\mathbf{C} \in \mathbb{C}^{R \times K}$  and tensor  $\mathcal{X} \in \mathbb{C}^{I \times J \times K}$ , calculate the tensor  $\mathcal{Y} \in \mathbb{C}^{P \times Q \times R}$  via the following multilinear transformation:

$$\mathcal{Y} = \mathcal{X} \times_1 \mathbf{A} \times_2 \mathbf{B} \times_3 \mathbf{C}.$$

Hint: Use the file “multilinear\_product.mat” to validate your result.