

TIP8419 - Tensor Algebra

Homework 6

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2019.2

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.