Algorithm 1 Borda Count algorithm

Input: Noisy observed data tensor $\mathcal{Y} \in \mathbb{R}^{d \times \cdots \times d}$

1: **Sorting stage:** Compute a permutation $\hat{\pi}^{\mathrm{BC}}$ such that $\tau \circ (\hat{\pi}^{\mathrm{BC}})^{-1}$ is monotonically increasing, where $\tau(i) = \frac{1}{d^{m-1}} \sum_{(i_2,\ldots,i_m) \in [d]^m} \mathcal{Y}_{i,i_2,\ldots,i_m}$.

2: Obtain a rearranged observation $\tilde{\mathcal{Y}}_{i_1,\ldots,i_m} = \mathcal{Y}_{(\hat{\pi}^{\mathrm{BC}})^{-1}(i_1),\ldots,(\hat{\pi}^{\mathrm{BC}})^{-1}(i_m)}$

3: **Block-wise polynomial approximation stage:** Given degree ℓ and block k, solve the following optimization problem, $\hat{\Theta}^{\mathrm{BC}} = \arg\min_{\mathcal{B} \in \mathscr{B}(k,\ell)} \|\tilde{\mathcal{Y}} - \Theta\|_F$.

Output: Estimated signal tensor and permutation $(\hat{\Theta}^{\mathrm{BC}}, \hat{\pi}^{\mathrm{BC}})$.