GENAPSYS SIGNAL PROCESSING CHALLENGE

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Let us assume that we have a data matrix X with the following model:

$$X = A_s B_s^T + A_n B_n^T + Z \tag{1}$$

where,

- X is a real $m \times n$ matrix.
- Z is a real $m \times n$ are i.i.d samples of a zero mean Gaussian process $\sim \mathcal{N}(0, \sigma)$.
- A_n is an unknown $m \times d$ matrix, where we do not know the exact value of d, but $d << m, n$.
- B_n is an unknown $n \times d$ matrix.
- A_s is an unknown $m \times q$ matrix, where q is *known*, and $q << m, n$. Also we know that each column of A_s is in the column span of a *known* matrix S.
- B_s is an unknown $n \times q$ matrix. But we know that each row of B_s has at most one non-zero element.
- It is assumed that $\text{span}(A_n) \not\subset \text{span}(A_s)$.

The goal is to find a computation efficient method to estimate A_s and B_s .
We expect that the candidates to provide:

(1) A short presentation describing the algorithm that they chose to solve this problem.
(2) An implementation of their solution in Matlab, Python or R.
(3) Show the performance of their algorithm, with the following simulation parameters:
    - Entries of A_s are derived from the class of random staircase functions, of integer step heights , and width 32. In the Matlab notation:
    $$\text{kron}(\text{randi}(8, m/32, 1), \text{ones}(32, 1))$$
    .
    - Rows of B_s are zero except for possibly one random location where it is one.
    - Entries of B_n are i.i.d samples from a Gaussian process of a given variance.
    - Columns of A_n are random traces of a random walk process.
    - $m = 256$, $q = 4$, $d = 16$, $n = 1024$.

Simulations results should show the sensitivity of the proposed solution with respect to variance of entries of A_n , the variance of Z. Additionally, it will be interesting to show simulation results for sensitivity with d and q.