Advanced Algorithms 11/15, 2019

Exercise 08

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1 Counting Distinct Elements Deterministically [Recommended]

Prove that any deterministic streaming algorithm that computes the exact number of distinct elements requires space n bits.

Hint:

There are $2^n - 1$ non-empty subsets of $[n]$ but at most 2^{n-1} memory configurations if we have less than n bits of memory.

2 Deterministic Approximate Counting [Recommended]

Show that any deterministic algorithm that computes a 1.1 approximation of the number of distinct elements requires space $\Omega(n)$ bits.

Hint:

Suppose a graph on subsets of $[n]$. We put an edge between two subsets if and only if the size of their symmetric difference is at most $\frac{n}{5}$. Find a large independent set in this graph.