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Distributed Systems, Summer Term 2020
Exercise Sheet 9

1 2-coloring in paths

Show that there is no randomized distributed algorithm that finds a 2-coloring in paths in $o(n)$ rounds with probability at least 0.9. Assume that n is known and IDs are from $\{1, \dots, n\}$. Hint: for any possible output, nodes with the same view have the same probability of giving that output.

2 Independent sets in paths

An independent set (IS) is a subsets of nodes such that no two neighboring nodes are in the independent set. A maximal independent set (MIS) is an independent set that cannot be extended. Assume that n is known and IDs are from $\{1, \dots, n\}$. Show that, in paths:

1. it is trivial to find some IS in $O(1)$ time with a deterministic distributed algorithm.
2. there exists an IS with at least $n/2$ nodes.
3. it is not possible to find an IS of size at least $n/2$ in $o(n)$ rounds.
4. there is no deterministic distributed algorithm that finds an MIS in $o(\log^* n)$ rounds.

3 Counting

Assume we are given a path of size n where nodes know an upper bound on the size of the network in $\{n, \dots, cn\}$ for some constant c (i.e., nodes do not know the exact value of n but only a constant approximation). Show that there is no deterministic distributed algorithm that counts the number of nodes in paths in $o(n)$ rounds. Assume that IDs are from $\{1, \dots, n\}$.