Distributed Graph Algorithms **Spring 2023**

Exercise 5: July 12

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Exercise 1. Consider the leader election algorithm A4 for n-vertex rings shown in class.

(a) Devise a variant of this algorithm based on phases of length n/k for integer k, with complexities $Comm = O(mn/k)$ and $Time = O(nk \log n)$, where m is the smallest vertex ID.

(b) Devise a variant of the algorithm that works without the assumption of simultaneous wakeup and still achieves message complexity $O(n)$.

Exercise 2. Describe the variant of leader election algorithm A5 outlined in class that works when the vrtices are not guaranteed to wake up simultaneously. Prove that the total message complexity of the algorithm is still $O(n)$.

Exercise 3. Suppose it is known that the number of candidates to be the leader does not exceed k. Modify each of the leader election algorithms A1 to A6 shown in class to be as efficient as possible under this assumption. Prove the correctness of the modified algorithms, and analyze the time and communication complexities of the modified algorithm under the assumption.