Erratum: The Approximability of the Exemplar Breakpoint Distance Problem

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Abstract. The paper "The Approximability of the Exemplar Breakpoint Distance Problem" [1], which appeared in AAIM 2006, contained several negative results and one positive result — a claimed $O(\log n)$-factor greedy approximation for the One-sided Exemplar Breakpoint Distance Problem. Here, we show that the analysis was incorrect and the approximation factor of the greedy algorithm could be $\Theta(n)$, where n is the size of the alphabet.

In Section 5 of [1], a greedy algorithm is presented for the One-sided Exemplar Breakpoint Distance Problem. The claimed approximation factor is $O(\log n)$. We show that the factor could be $\Theta(n)$ with an example. In our example, G is exemplar, so it satisfies the k-span condition. We start with a small $n = 9$.

$G = \langle 1, 2, 3, 4, 5, 6, 7, 8, 9\rangle$, and
$H = \langle 9, 8, 7, 6, 1, 6, 2, 7, 3, 8, 4, 9, 5, 1, 2, 3, 4\rangle$.

The optimal solution is to have $H^* = \langle \underline{6, 7, 8, 9}, 5, \underline{1, 2, 3, 4}\rangle$. In other words, we will have two breakpoints between G and H^*.

The greedy algorithm would first select the NB-interval in H: $\langle 1, 2, 3, 4, 5\rangle$. So the greedy algorithm would have a solution $H' = \langle 9, 8, 7, 6, \underline{1, 2, 3, 4, 5}\rangle$. In other words, we will have four breakpoints between G and H'. (We thank Minghui Jiang for the idea regarding this example.)

By generalizing the alphabet to be $n = 2m + 1$, i.e., $|G| = 2m + 1$ and $|H| = 4m + 1$, the greedy algorithm would generate m breakpoints while the optimal solution only introduces two breakpoints. So the approximation factor of the greedy algorithm is $m/2 = \Theta(n)$.

It is an open question whether the One-Sided Exemplar Breakpoint Distance Problem admits a polynomial time $o(n)$-factor approximation. The only known negative result is the APX-hardness of the problem.

References

1. Z. Chen, B. Fu and B. Zhu. The approximability of the exemplar breakpoint distance problem. *In: Cheng,S.-W., Poon, C.K. (eds.) AAIM 2006. LNCS, vol. 4041, pp. 291-302. Springer, Heidelberg* (2006)