A balls and bins analysis of insertion and update buffers

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Abstract

External memory databases are traditionally based on B-trees. Insertion buffers aggregate database insertions, and only flush into the external memory structure itself when full, attempting to batch multiple insertions destined for the same B-tree leaf, and therefore perform those insertions with only one disk access. Insertion buffers are implemented, for example, in the InnoDB storage engine. We develop a balls-and-bins model for insertion buffers and show that they have inherent limits on the amount of optimization they provide. This speedup is a small factor of $m/n$, where $m$ is the buffer size and $n$ is the number of leaves. Thus in databases with large rows as well as in big data settings, we might expect $m/n = O(1)$, and therefore insertion buffers would only provide a constant improvement.

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