

Multi-attribute Bloom Filter Query Scheme

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Abstract

Bloom filter, with its succinct representation, has been widely employed as a front-line means for efficiently determining whether a query identifier exists in a database, where invalid queries can be promptly denied from accessing the database in the Internet environment, thus reducing bandwidth usage and computational overhead on the service machine. The Bloom filter, however, has been noticed an existing drawback that it inevitably accompanies with a certain number of false positives because of its embedded hashing process. Another drawback lies in that the filter could only discriminate single attribute, namely the existence of the input identifier, which becomes impractical when multi-attribute determinations are desirable. Theoretically, implementing several one-dimension arrays of the Bloom filter in parallel could resolve the multi-attribute query needs, but it also introduces possibilities of a true-negative problem. In this paper, we propose a scheme that includes a second-layer array consisting of real numbers for dealing with the multi-attribute query requirement. The proposed scheme adopts a neural network mapping in the second layer, associated with a windowing technique, which could not only dramatically decrease the false positives, resulted from the Bloom filter layer, but also the multi-attribute querying could be achieved without the hazardous true negatives. Experimental results show our scheme is capable of discriminating multiple attributes while attaining a very low false-positive error in existence checking. The proposed scheme is also suitable for implementing on various mobile devices, such as cellular phones, PDAs and portable computers.

Keyword : Bloom filter, Artificial Neural Network, Multi-attribute querying, Internet database