7.1.6 Cluster pruning

In *cluster pruning* we have a preprocessing step during which we cluster the document vectors. Then at query time, we consider only documents in a small number of clusters as candidates for which we compute cosine scores. Specifically, the preprocessing step is as follows:

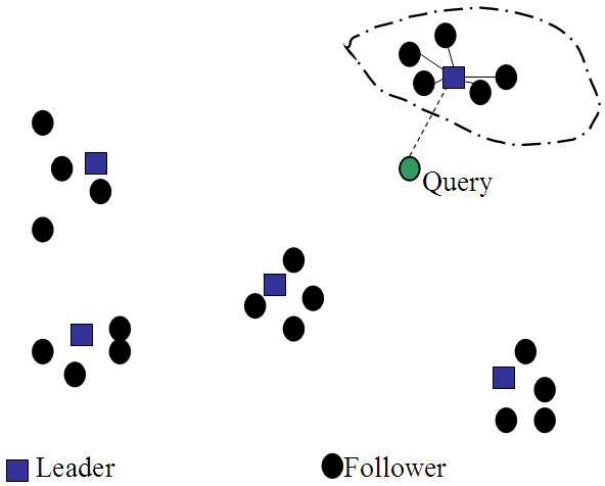
1. Pick $\sqrt{N}$ documents at random from the collection. Call these *leaders*.
2. For each document that is not a leader, we compute its nearest leader.

We refer to documents that are not leaders as *followers*. Intuitively, in the partition of the followers induced by the use of $\sqrt{N}$ randomly chosen leaders, the expected number of followers for each leader is $\approx N/\sqrt{N} = \sqrt{N}$. Next, query processing proceeds as follows:

1. Given a query q, find the leader L that is closest to q. This entails computing cosine similarities from q to each of the $\sqrt{N}$ leaders.
2. The candidate set A consists of L together with its followers. We compute the cosine scores for all documents in this candidate set.

The use of randomly chosen leaders for clustering is fast and likely to reflect the distribution of the document vectors in the vector space: a region of the vector space that is dense in documents is likely to produce multiple leaders and thus a finer partition into sub-regions. This illustrated in Figure 7.3.

Variations of cluster pruning introduce additional parameters b_1 and b_2, both of which are positive integers. In the pre-processing step we attach each follower to its b_1 closest leaders, rather than a single closest leader. At query time we consider the b_2 leaders closest to the query q. Clearly, the basic scheme above corresponds to the case $b_1 = b_2 = 1$. Further, increasing b_1 or



► **Figure 7.3** Cluster pruning.