An Efficient Algorithm for Dynamic Implicit Strict Posets with Conflict Resolution

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The maintenance of strict partially ordered sets (posets) in dynamic environments presents significant challenges when new assertions conflict with existing transitive relations. An efficient algorithm is presented for implementing dynamic implicit strict posets that identifies and extracts the specific edges forming cycles introduced by contradictory inputs. By employing a recursive path-tracing method utilizing contiguous arena memory, the algorithm achieves $O(V + E)$ time for queries and assertions while maintaining $O(V + E)$ space—a substantial improvement over the $O(V^2)$ requirements of full transitive closure matrices. A central innovation is an $O(L)$ conflict identification mechanism that leverages edge attributes cached during the search to reconstruct the cyclic path of length L. This reconstruction requires zero additional graph traversals or edge-store lookups, as the path history is preserved during the forward search. The algorithm enables sophisticated resolution policies by providing a candidate set of conflicting edges for analysis or removal without increasing the underlying search complexity.

Keywords: partial orders, dynamic graphs, cycle detection