# Concurrent Double-Ended Priority Queues

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## Motivation

- DEPQs are widely used in critical systems: Job scheduling, external sorting, Computer graphics and other applications requiring prioritized access from both ends.
- DEPQs have enhanced Functionality compared to single ended priority queues. Supports efficient deletion of both min and max elements.
- No existing implementations of concurrent DEPQs in the literature - we can create a DEPQ using BSTs

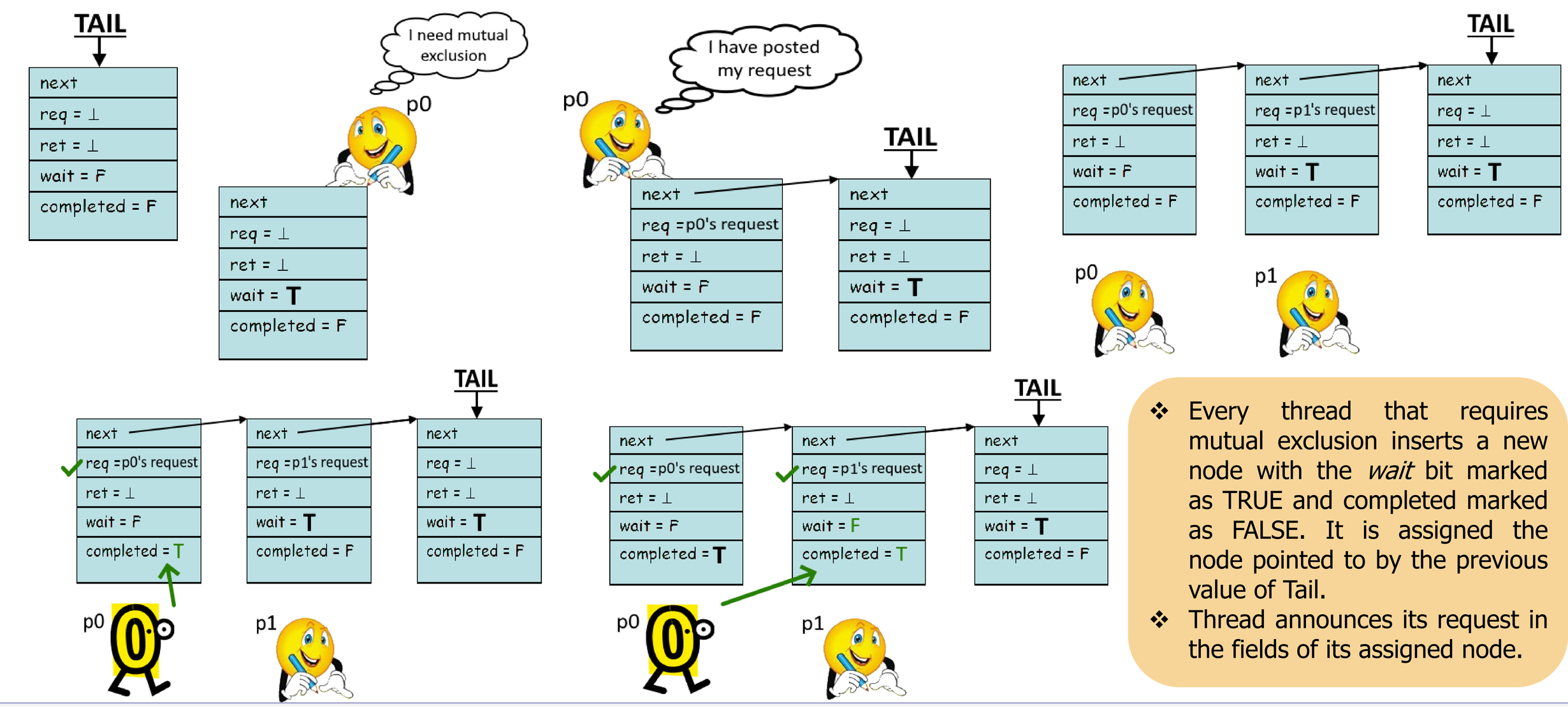
## Challenge

- Synchronization is required between threads operating on the same and on different sides of the DEPQ.
- Deletes are more complex than priority queue deletions: they support additional functionality, and thus require implementing more operations.

## Implementation

- Employs SoTA software combining algorithms: CC-Synch (Fatourou and Kallimanis PPoPP 2012).
- It uses one instance of CC-Synch for each of its two endpoint.

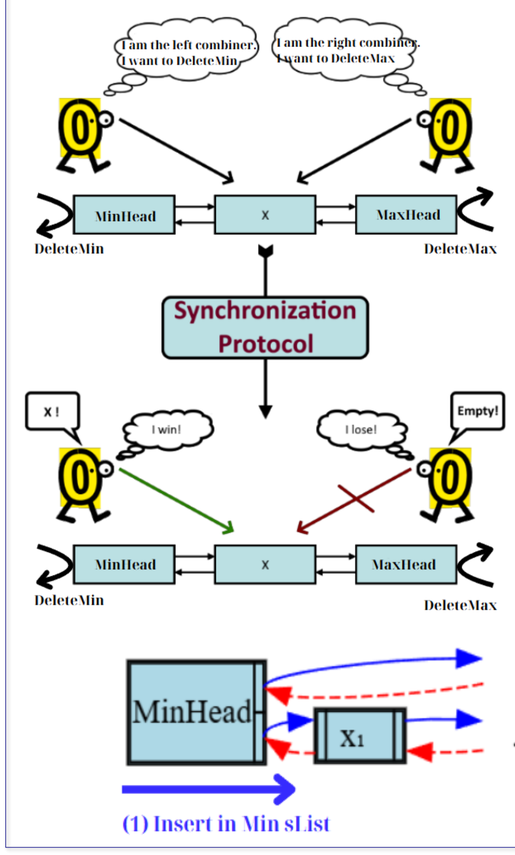
## Software Combining




- Every thread that requires mutual exclusion inserts a new node with the *wait* bit marked as TRUE and completed marked as FALSE. It is assigned the node pointed to by the previous value of Tail.
- Thread announces its request in the fields of its assigned node.

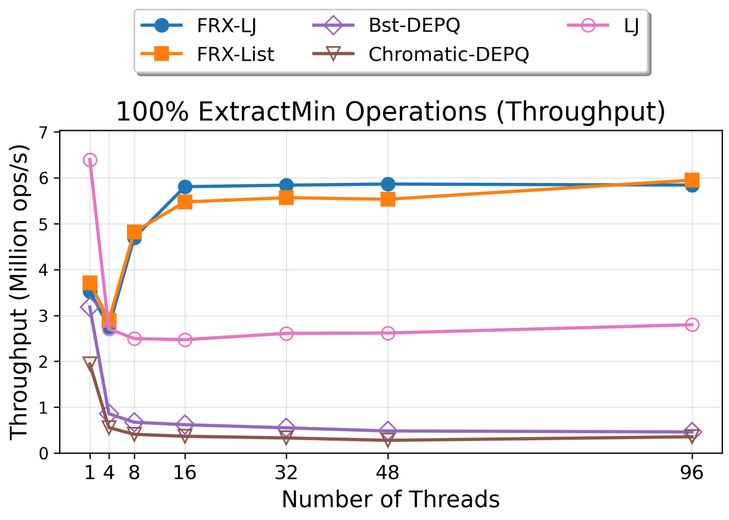
## Double-Ended Priority Queues

Which combiner gets the node if both are trying to delete?



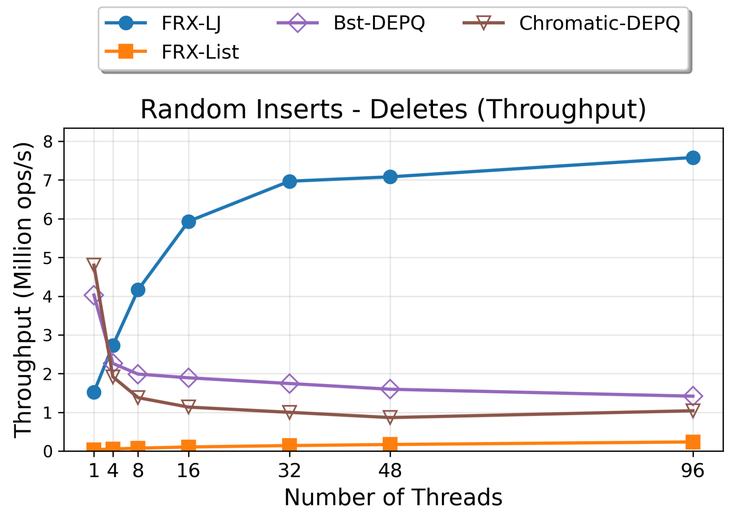

- Insertion: skips the logically deleted nodes at level-0 and then makes bottom-up updates at all levels.
- Deletion: First, nodes are marked as deleted and then fully removed from both skip lists.

## Experiments




- FRX significantly outperforms concurrent tree-based DEPQs, thanks to its dual-skip-list design that avoids expensive rebalancing
- FRX implementations outperform single-ended PQ (Linden), despite supporting more complex operations.

- FRX-LJ outperforms both the chromatic and BST tree DEPQs implementations, thanks to its lightweight synchronization and elimination of rebalancing costs.

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