Lecture 23: B Trees II

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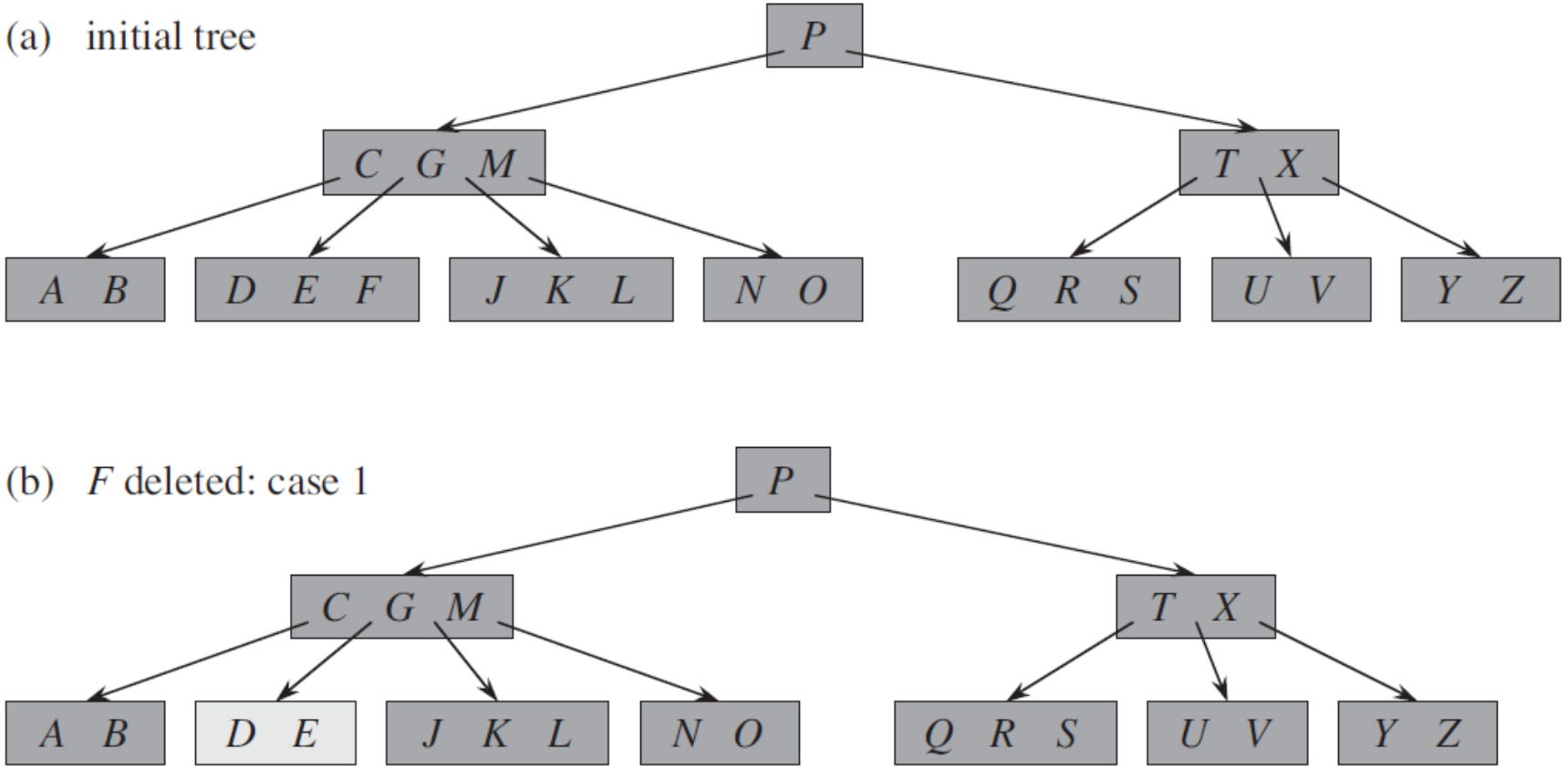
Deletion on B Trees

- More complicated: when deleting from an internal node, need to rearrange its children.
- Also need to guard against a node having too few keys.
- Aim for a single-pass algorithm.
- When called recursively on a node x, make sure x has at least t keys (rather than the minimum $t - 1$).

Deletion: examples ($t = 3$)

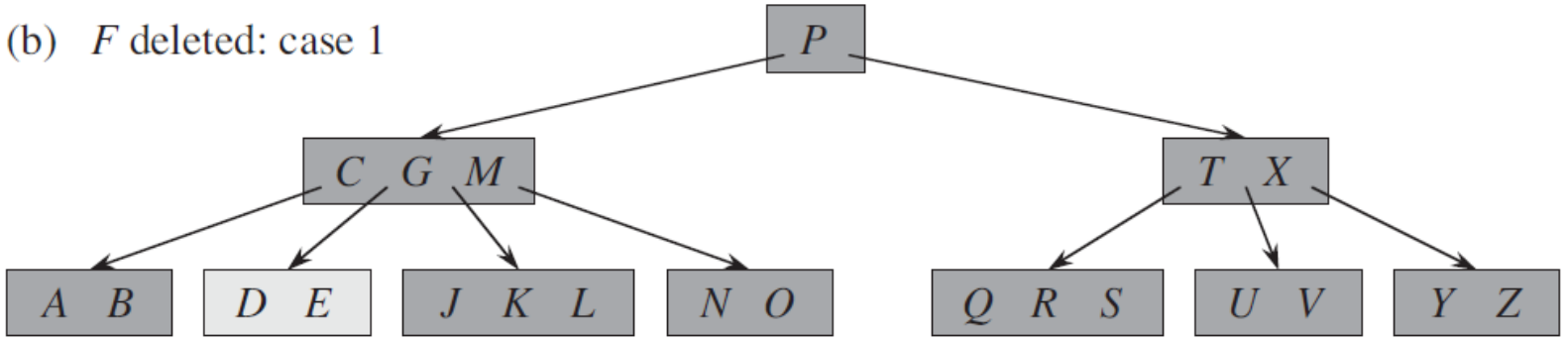
- (Case 1) When k is in a leaf node x, simply delete k from x.

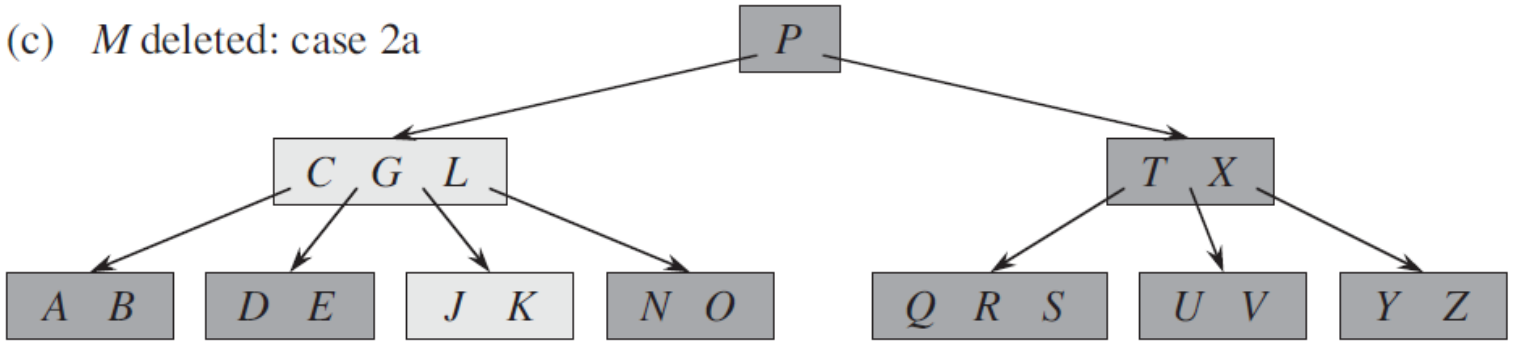


Deletion: examples ($t = 3$)

- (Case 2a) When k is in an internal node, and the child node preceding it has at least t keys, delete its predecessor k' and replace k by k'.

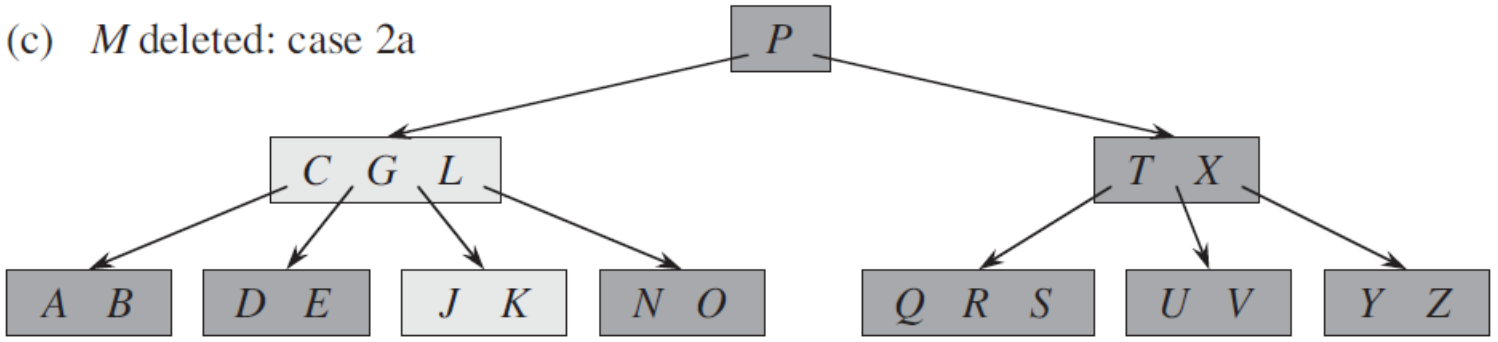
(Case 2b) Similarly for the case of succeeding child node.

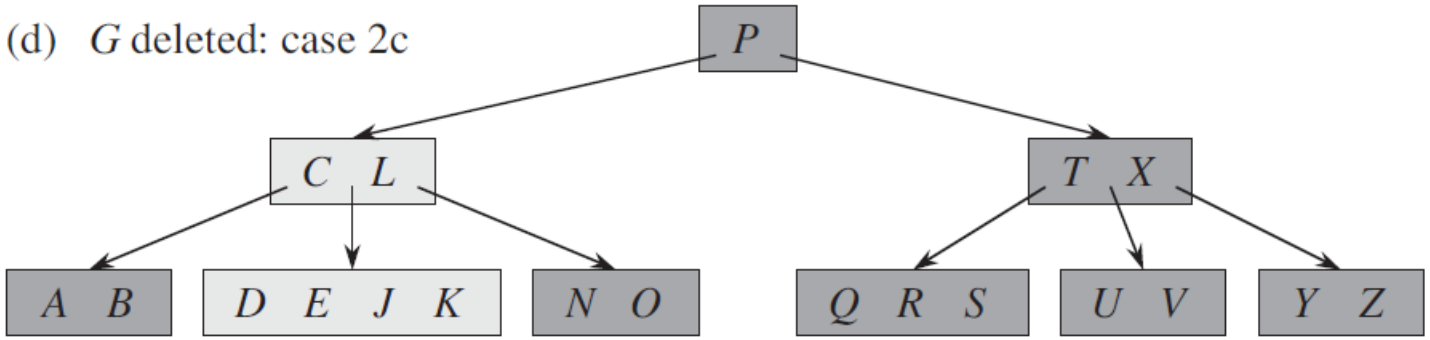




Deletion: examples

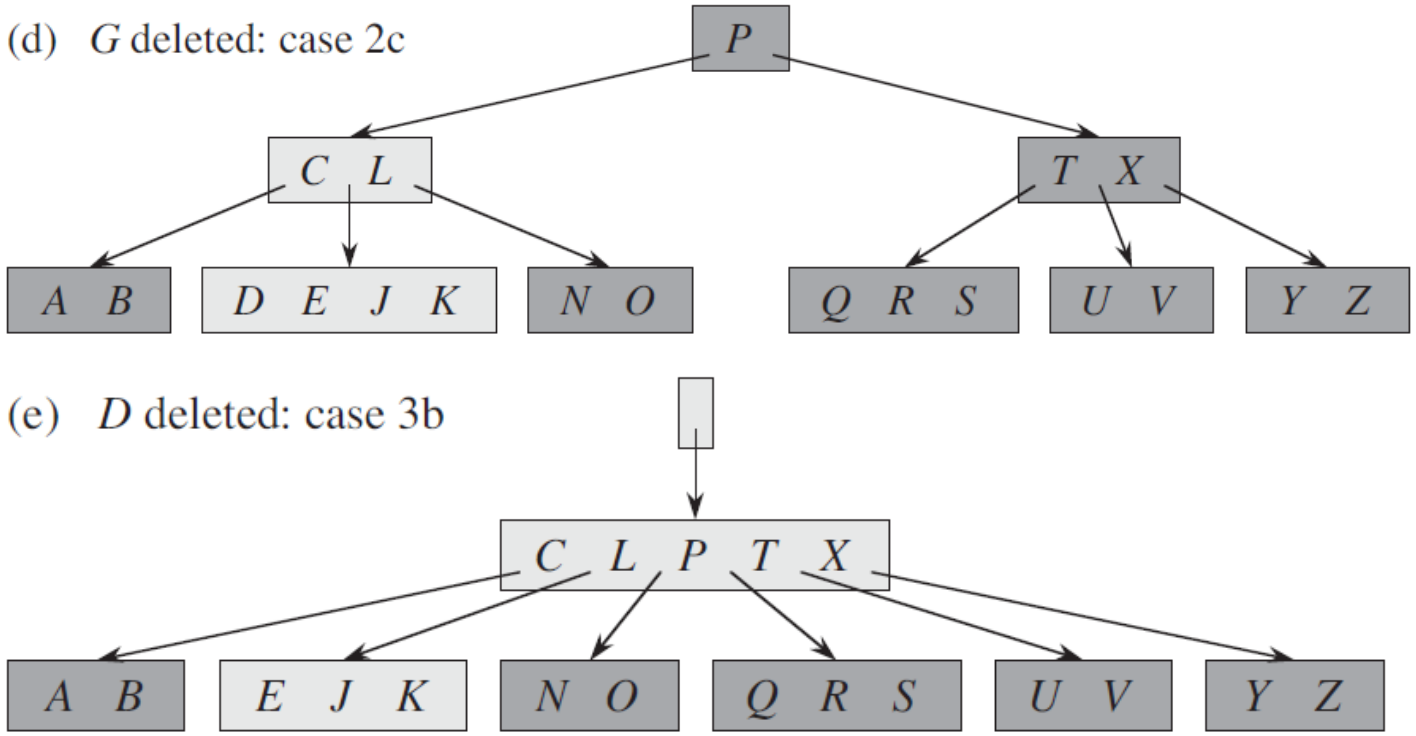
- (Case 2c) When k is in an internal node, and the child nodes preceding/succeeding it has only $t - 1$ keys, merge the two child nodes.





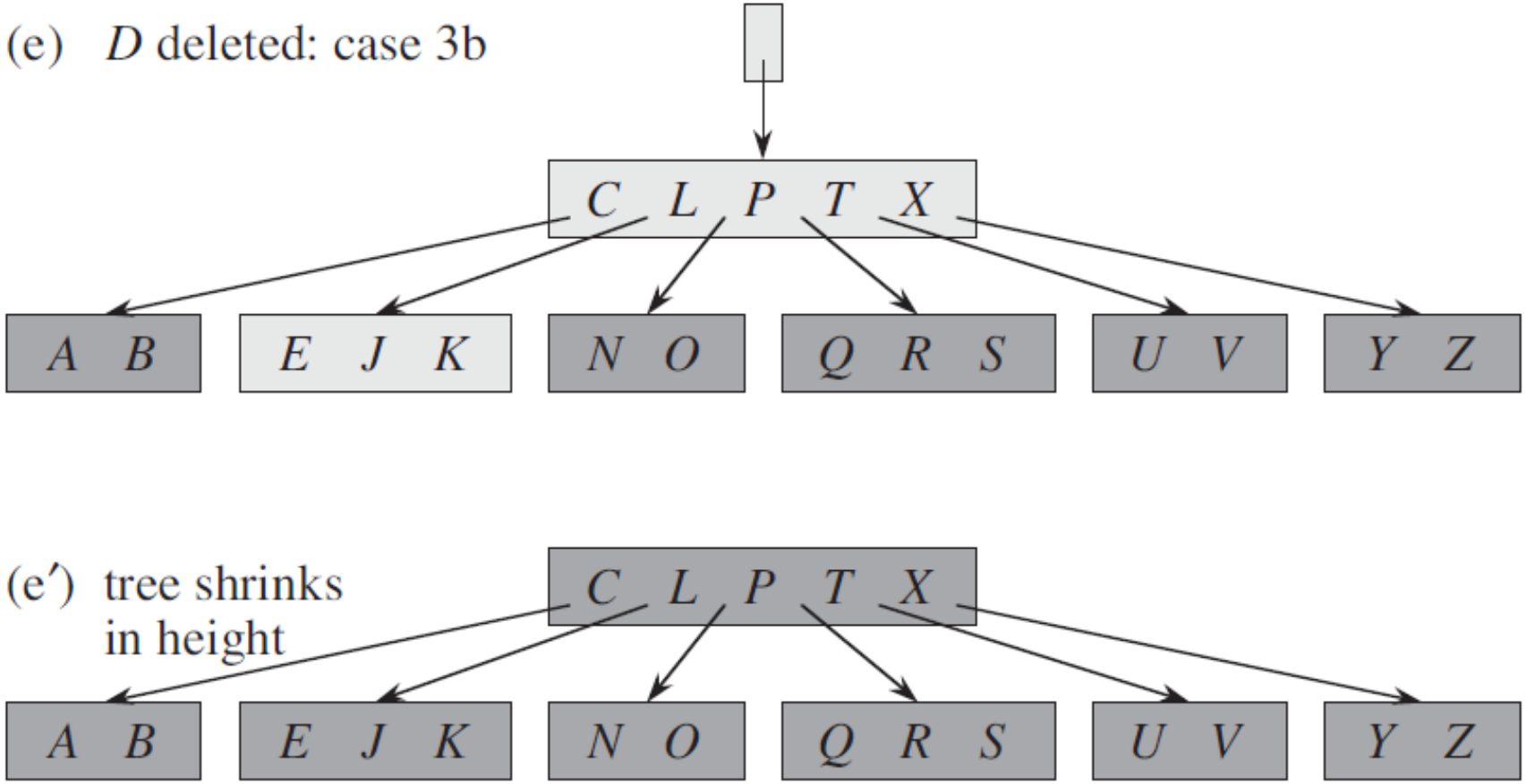
Deletion: examples

- (Case 3b) When k is not in the internal node, and the node that is descended to has only $t-1$ keys, with neighbors also have $t-1$ keys, merge node with one of the neighbors.



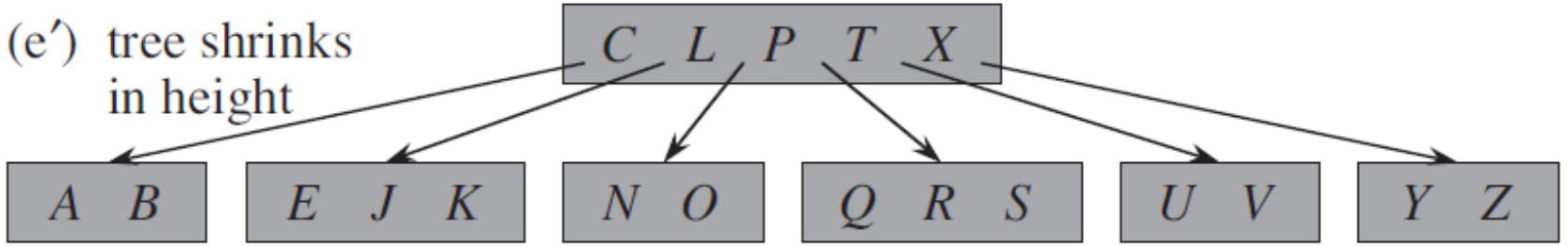
Deletion: examples

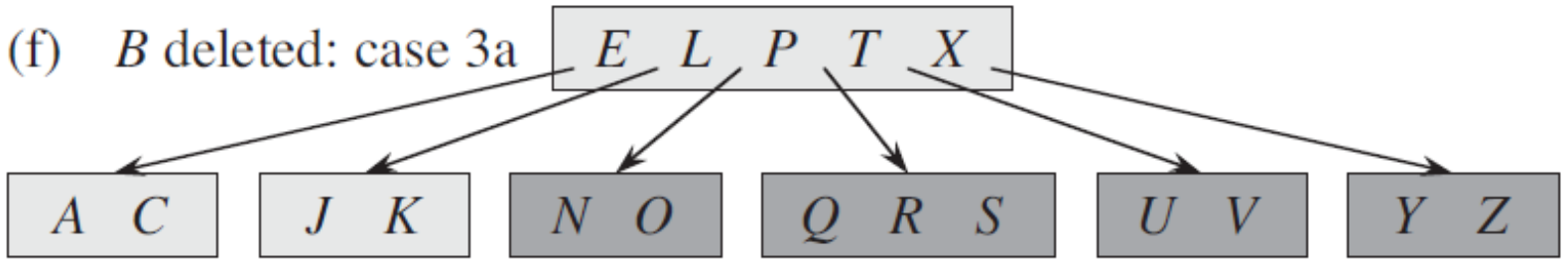
- If this causes root to become empty, remove root (shrinks height by 1).



Deletion: examples

- (Case 3a) When k is not in the internal node, and the node that is descended to has only $t-1$ keys, with a neighbor has at least t keys, move a key from the neighbor and proceed to delete.





Exercise (18.3-1)

- Starting from the last tree on the previous slide, delete C, P and V in order.