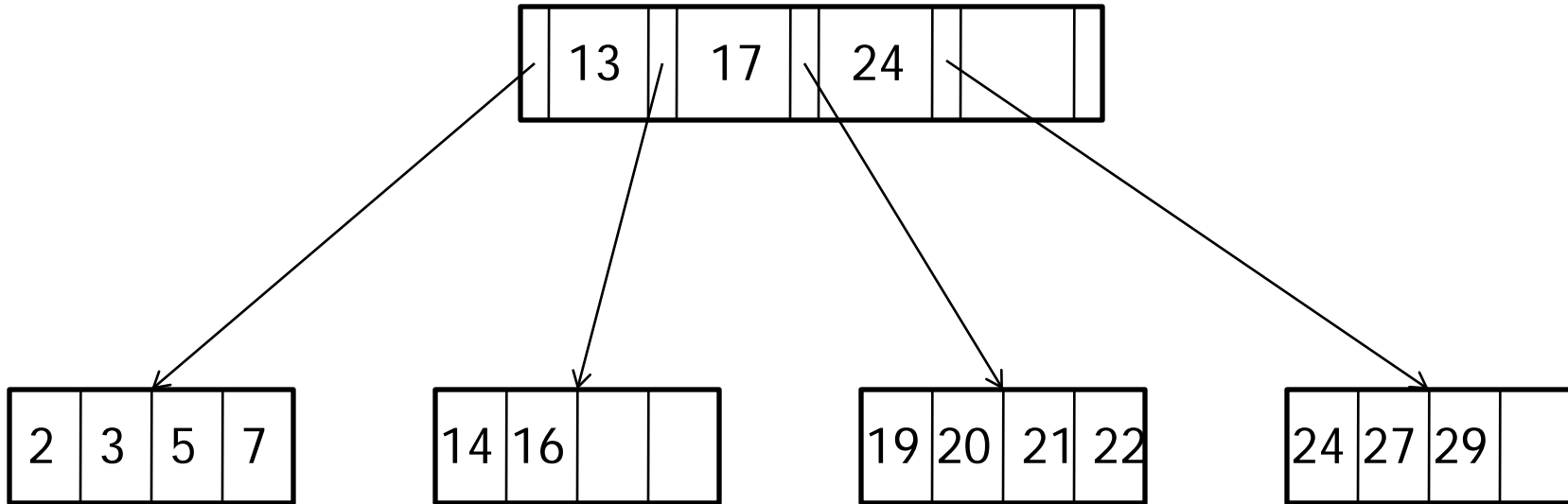


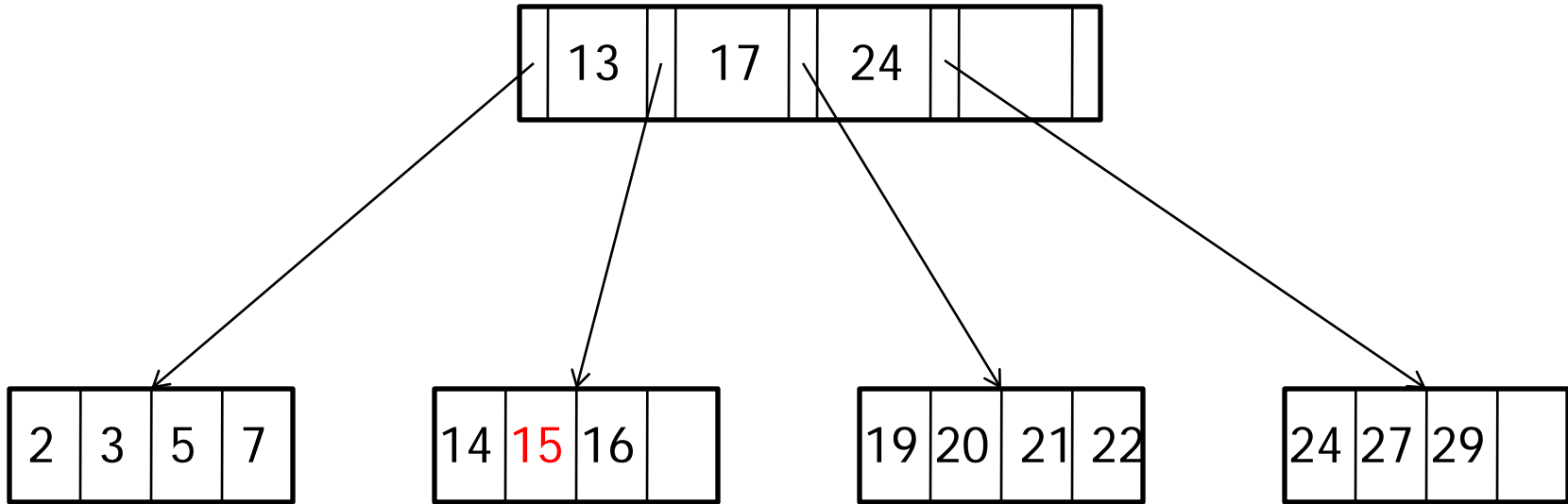
ADM – Week 2 examples
Alex Poulouvassilis

B+ tree insertion example

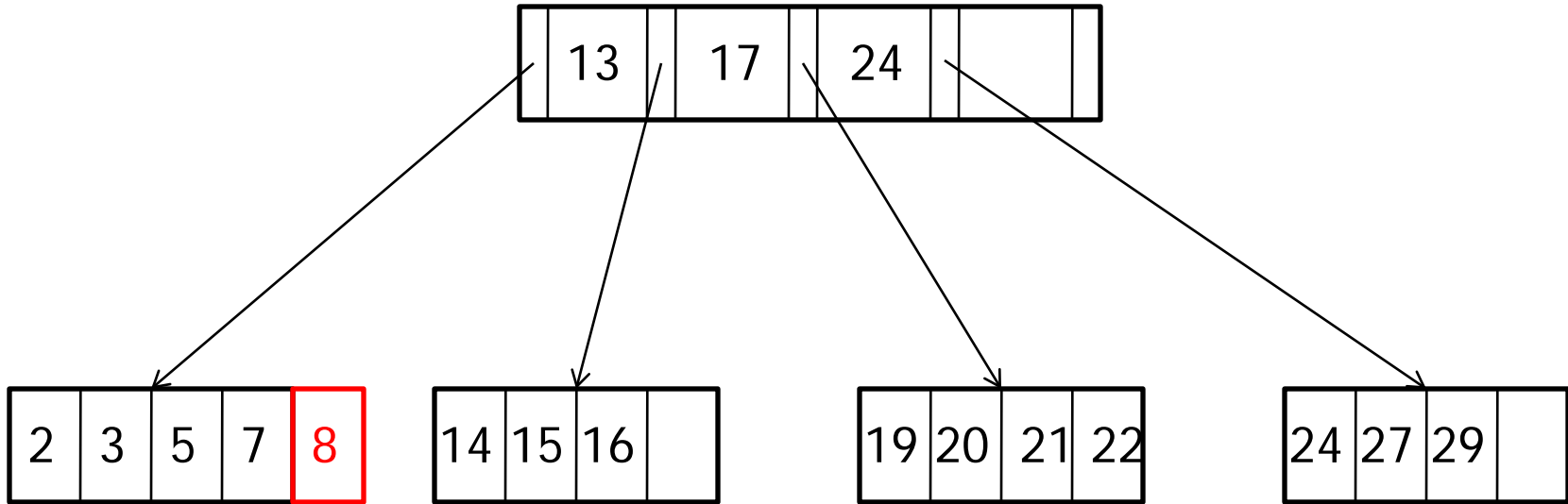


Initial tree, of order 2

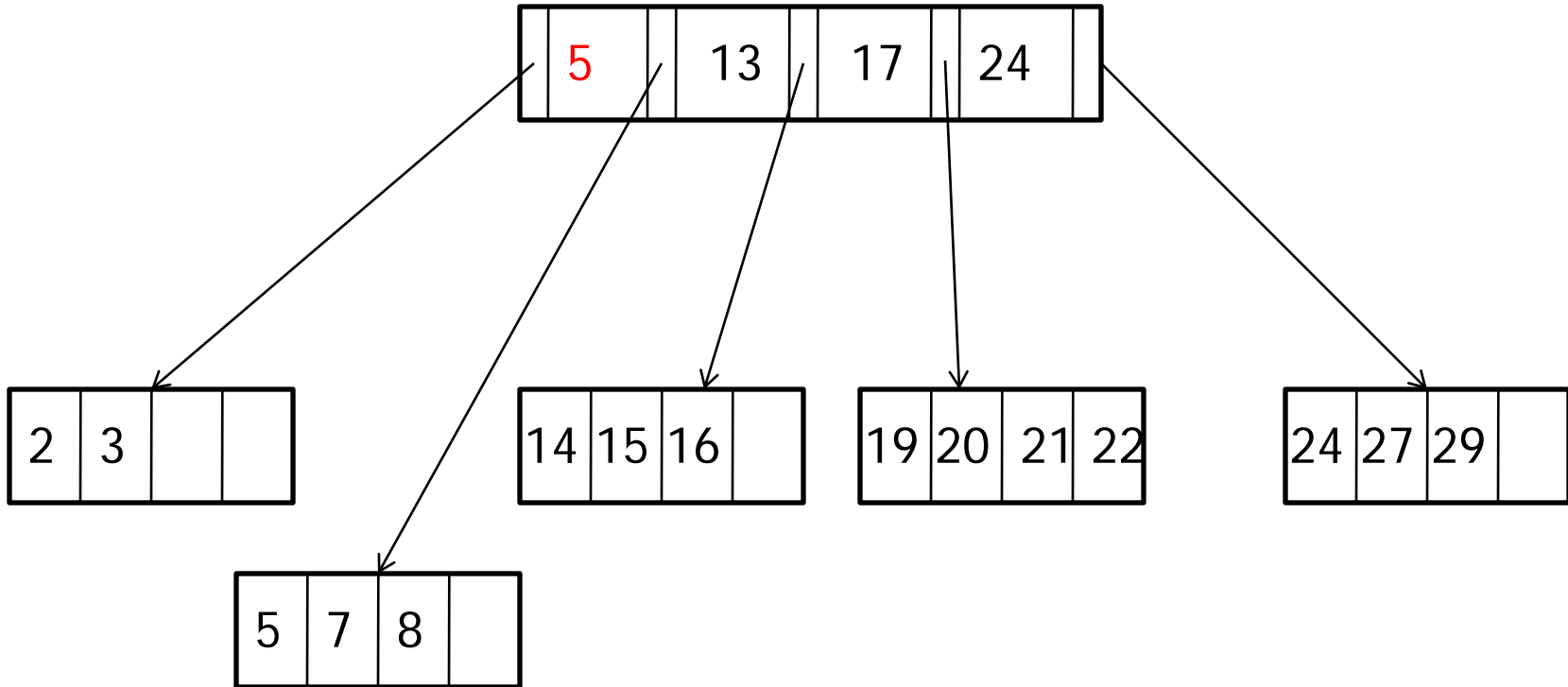
(1) insert 15:



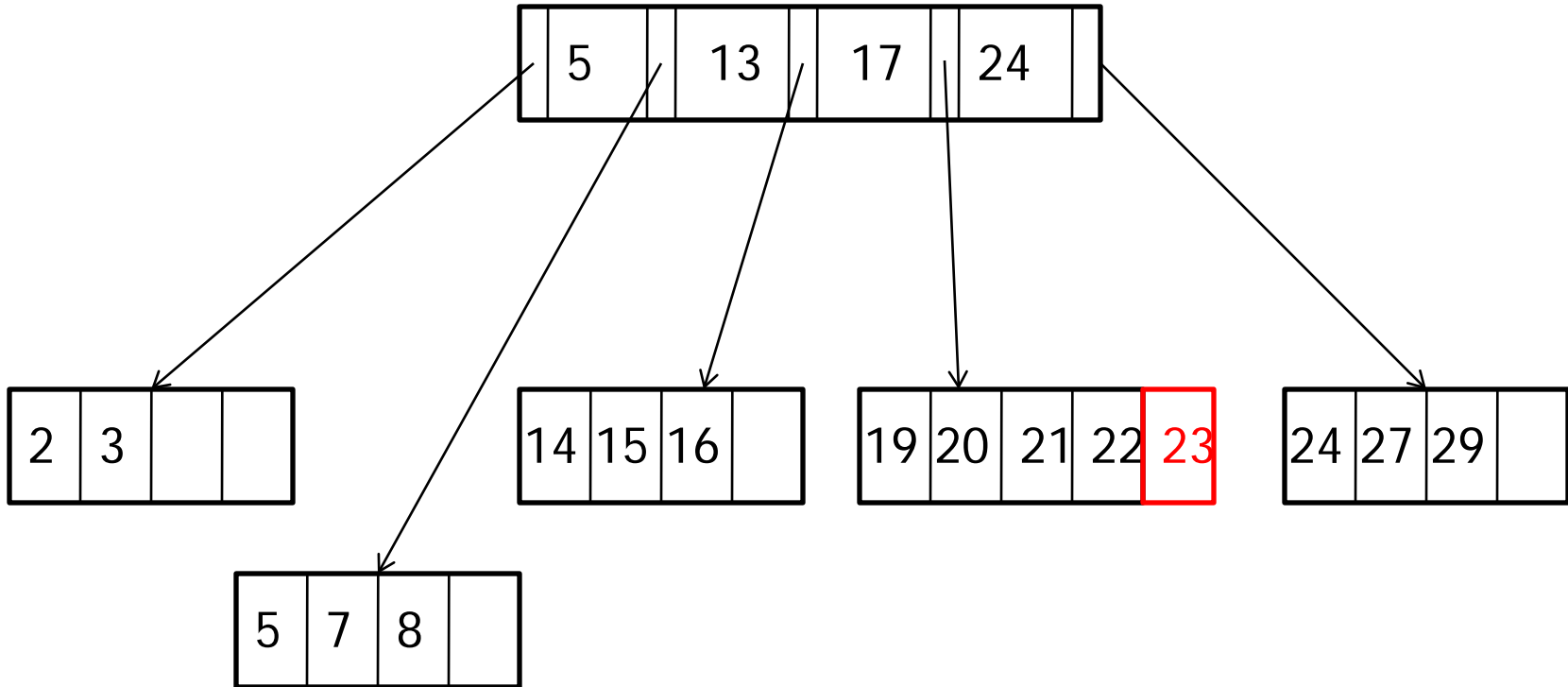
(2) insert 8:



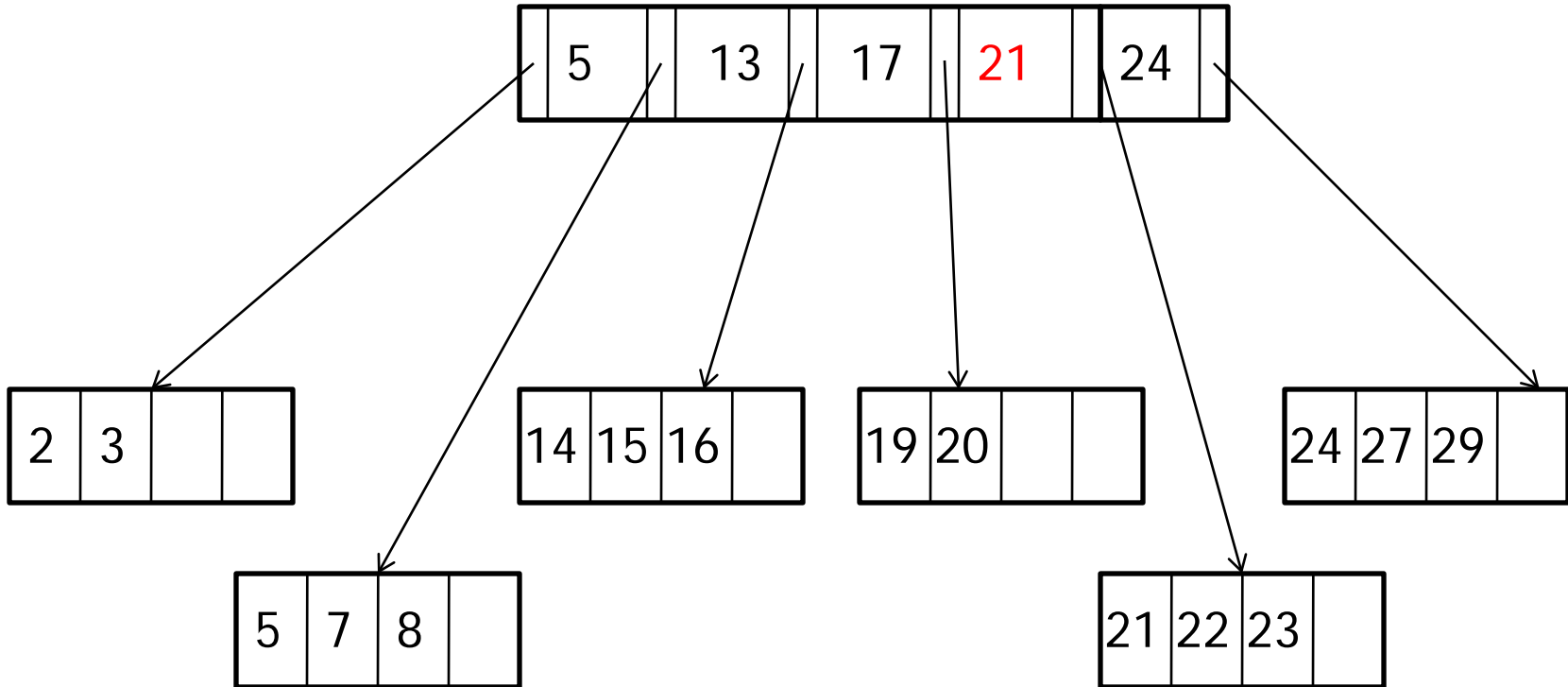
split leaf node and *copy* 5 up into its parent:



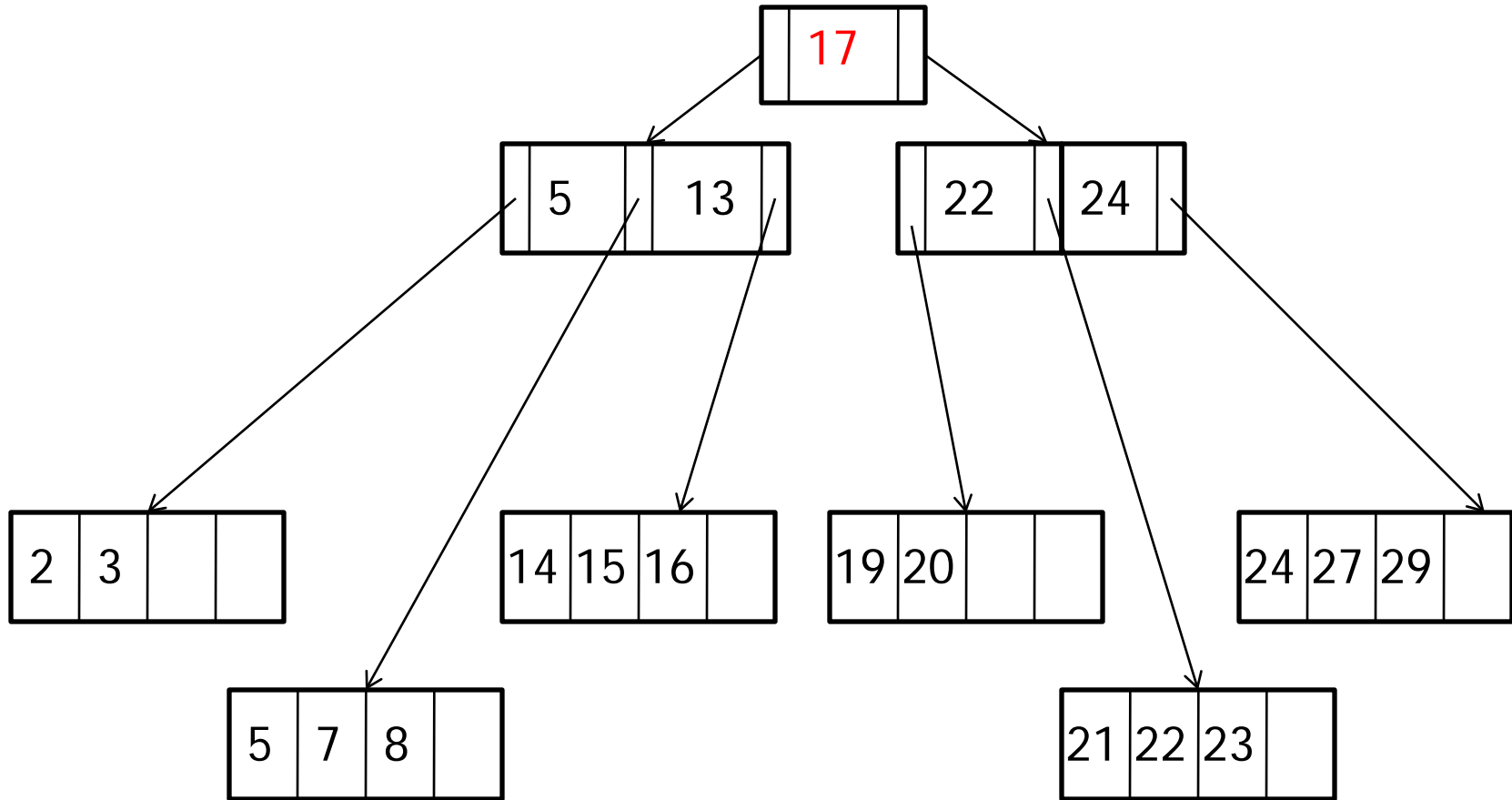
(3) insert 23:



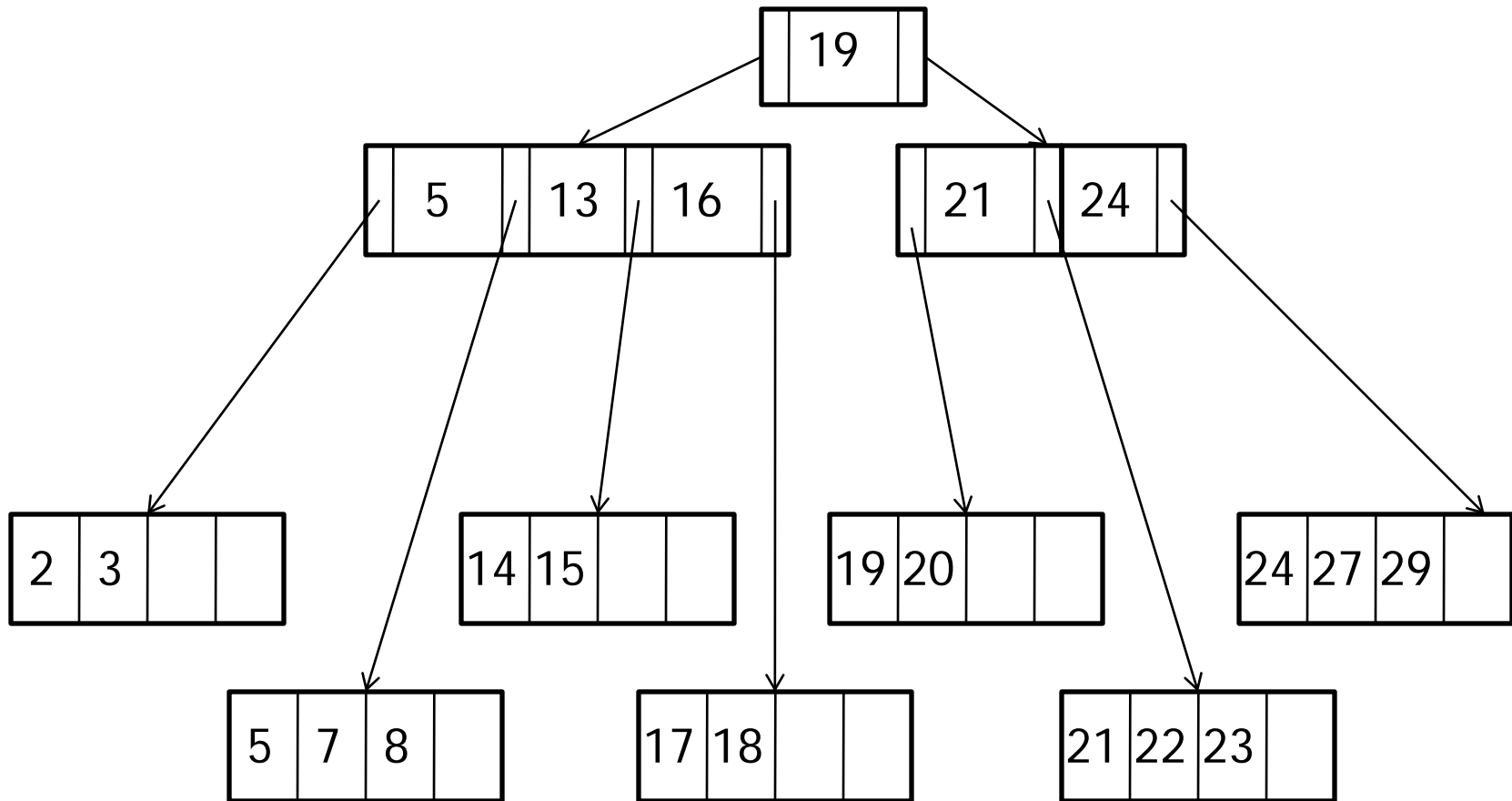
split leaf node and *copy* 21 into its parent:



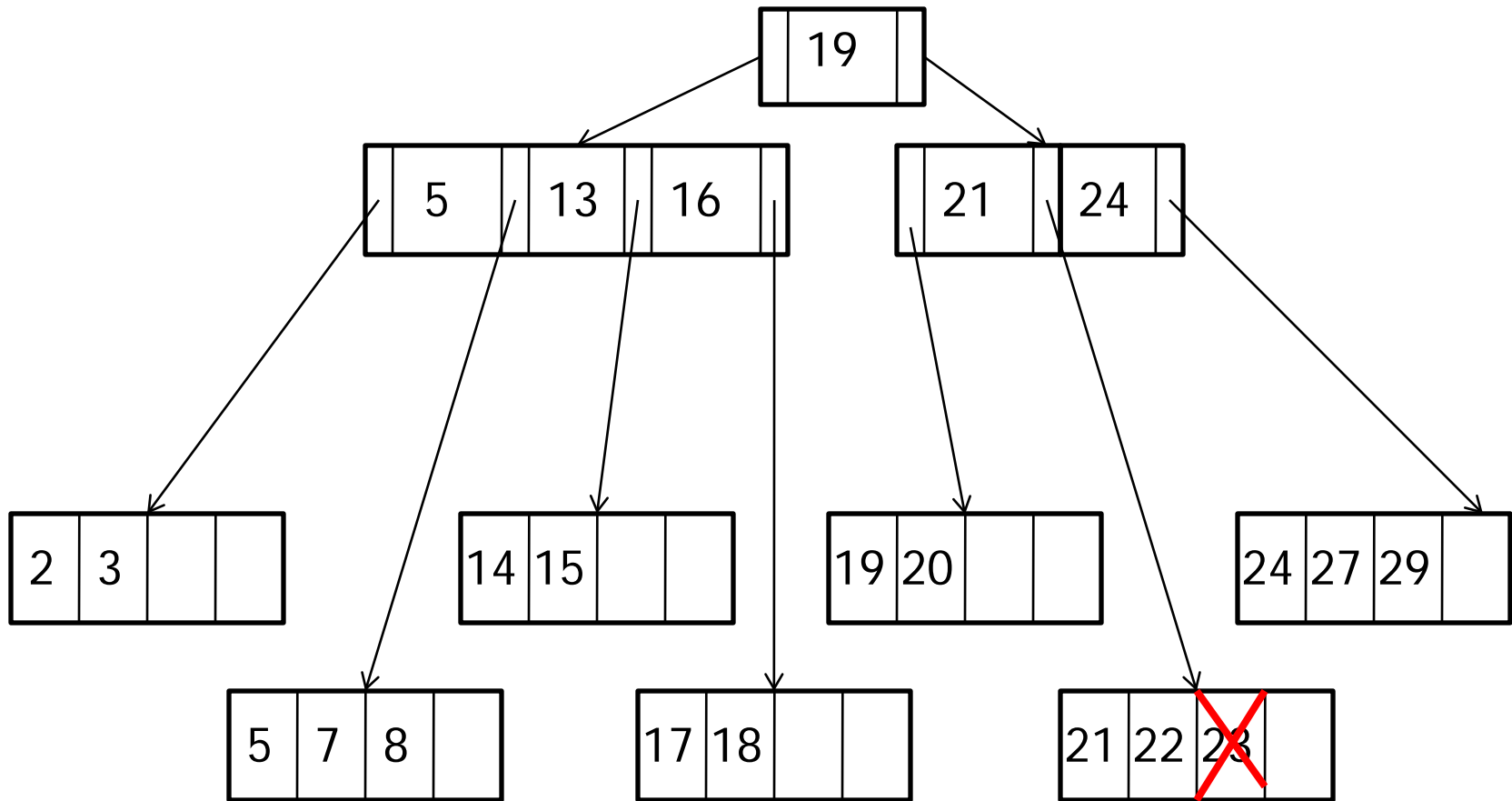
split inner node and *move* 17 into its parent (creating a new root):



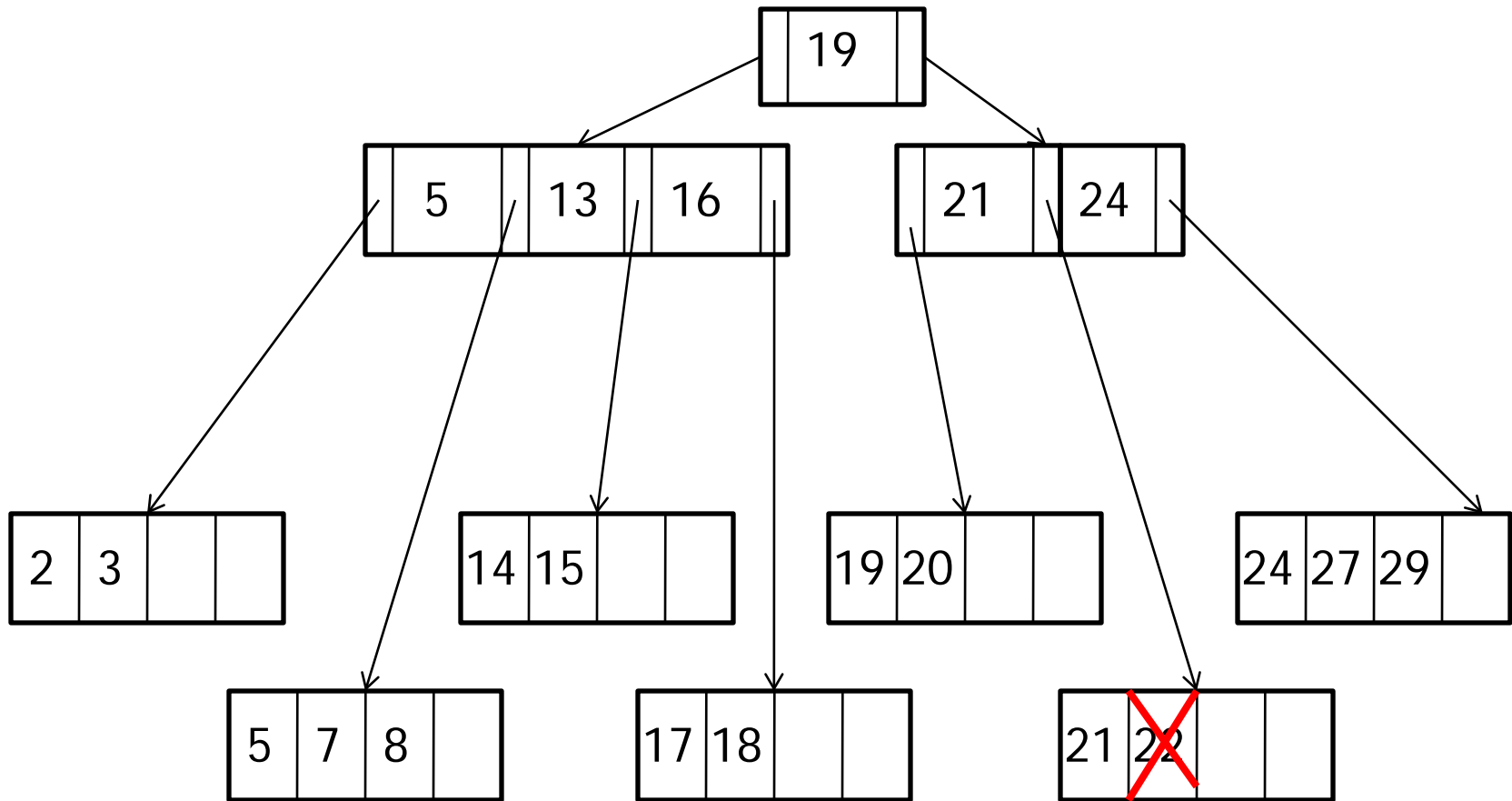
B+ tree deletion example – initial tree:



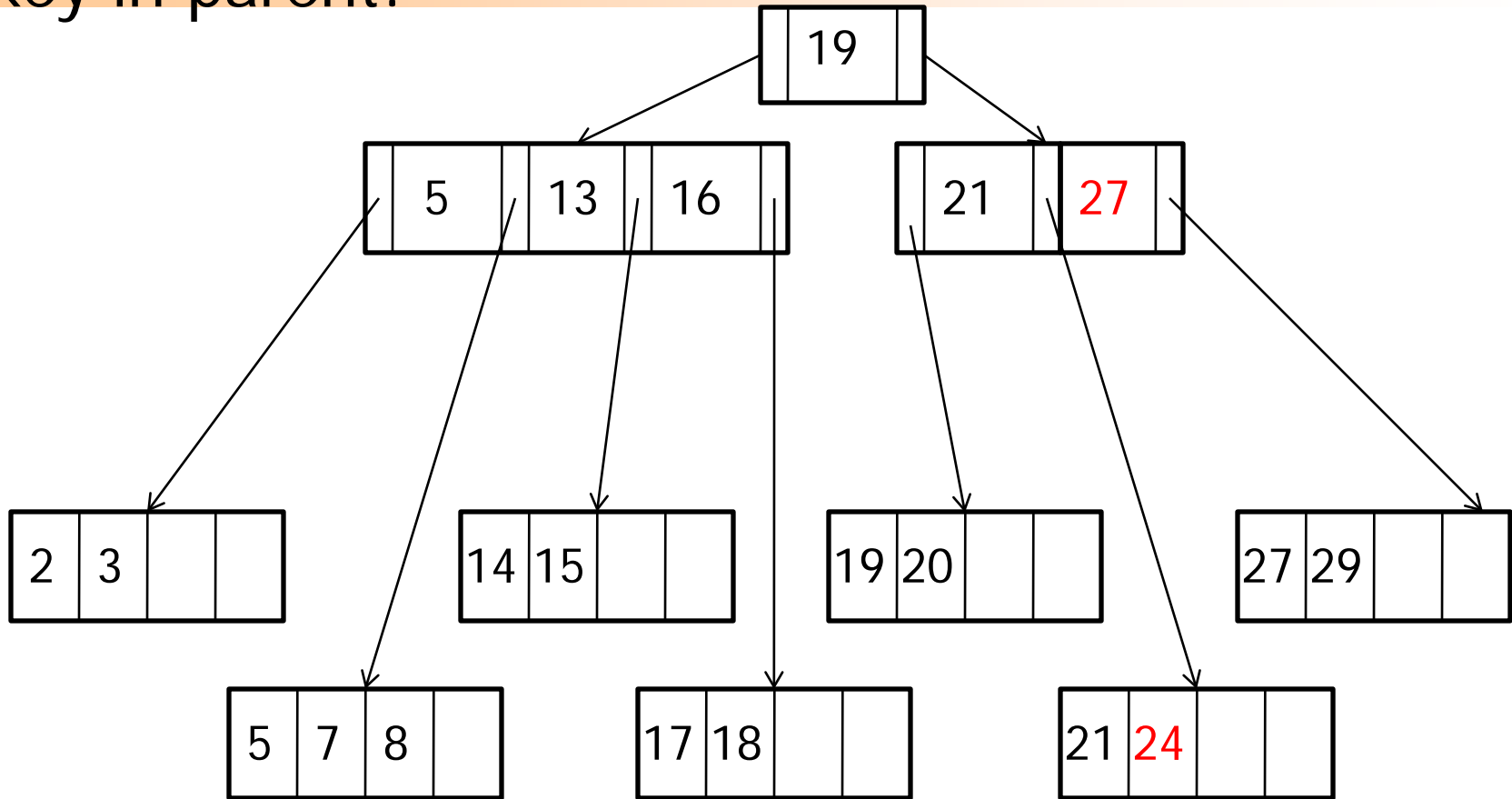
(1) delete 23:



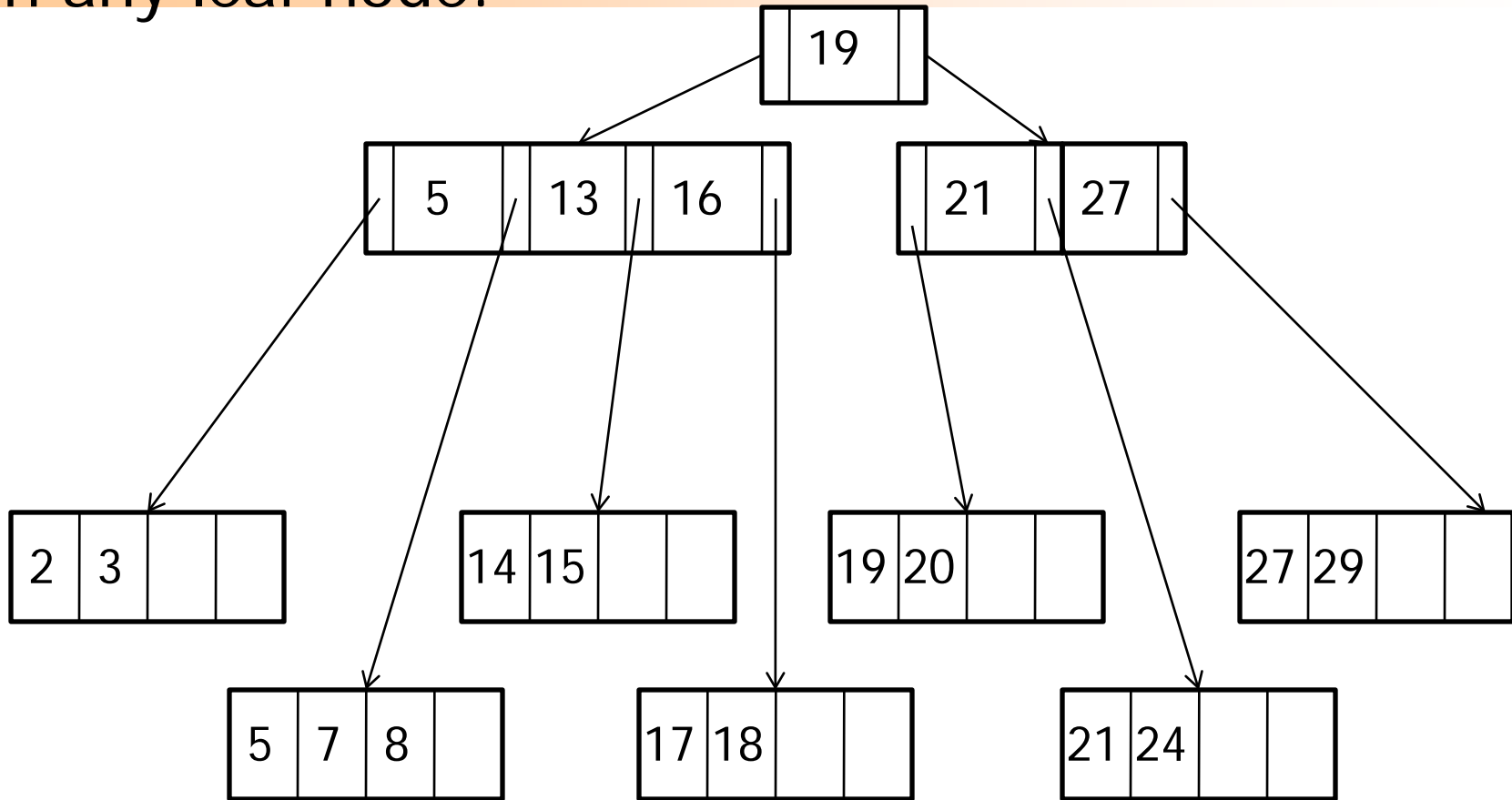
(2) delete 22:



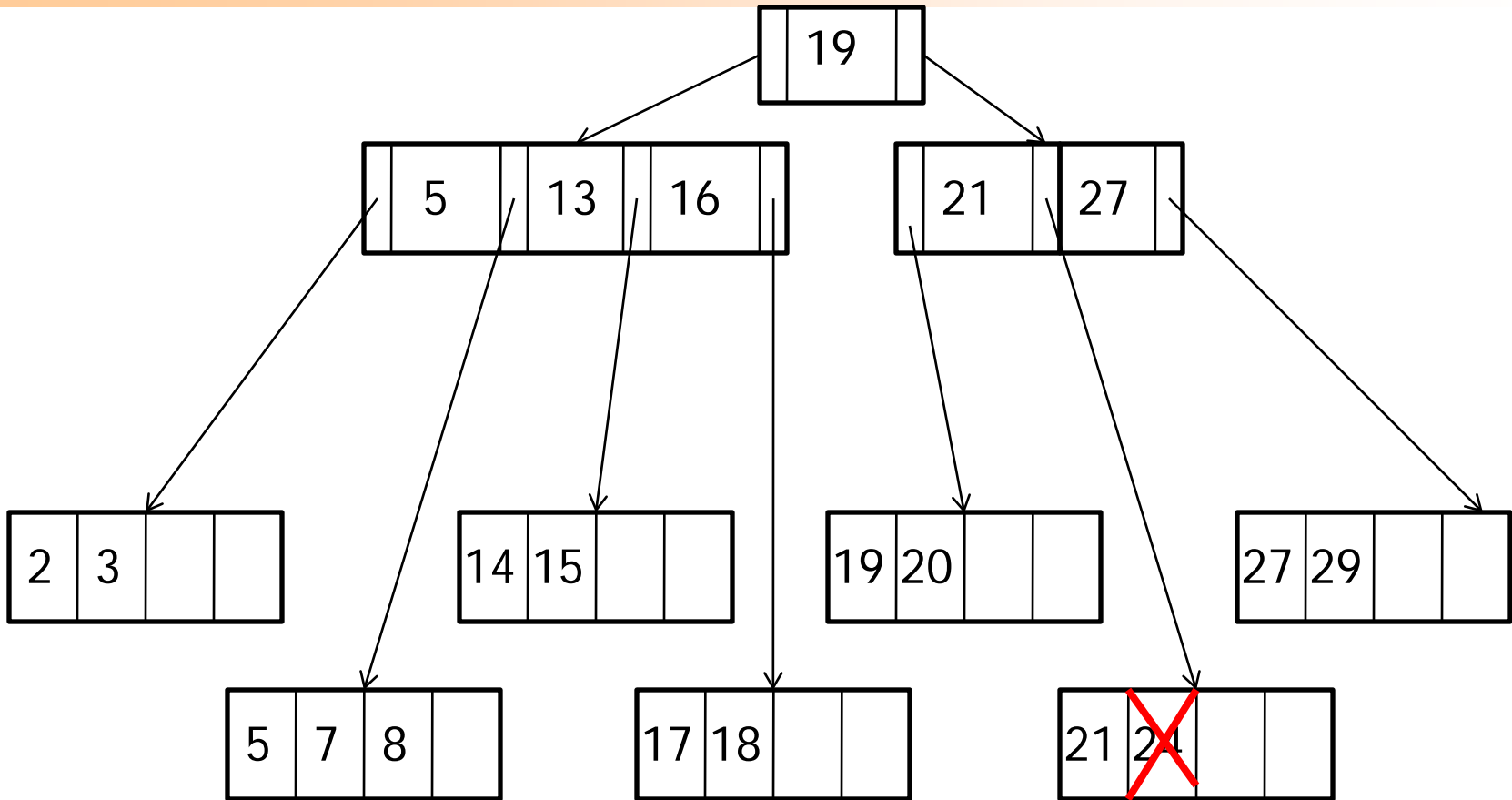
redistribute keys with sibling leaf and update separator key in parent:



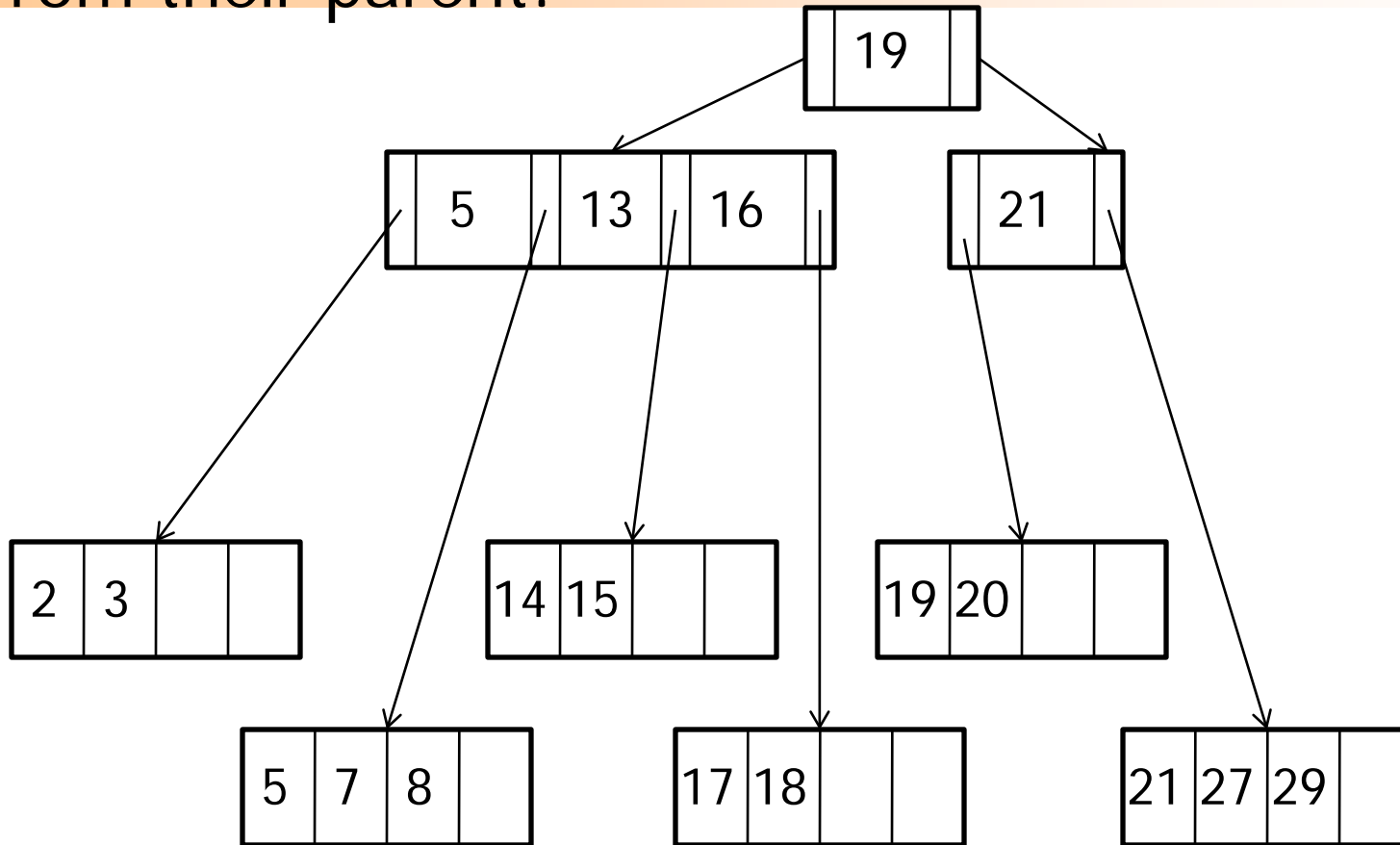
(3) Delete 13 – no change! Because 13 is not present in any leaf node:



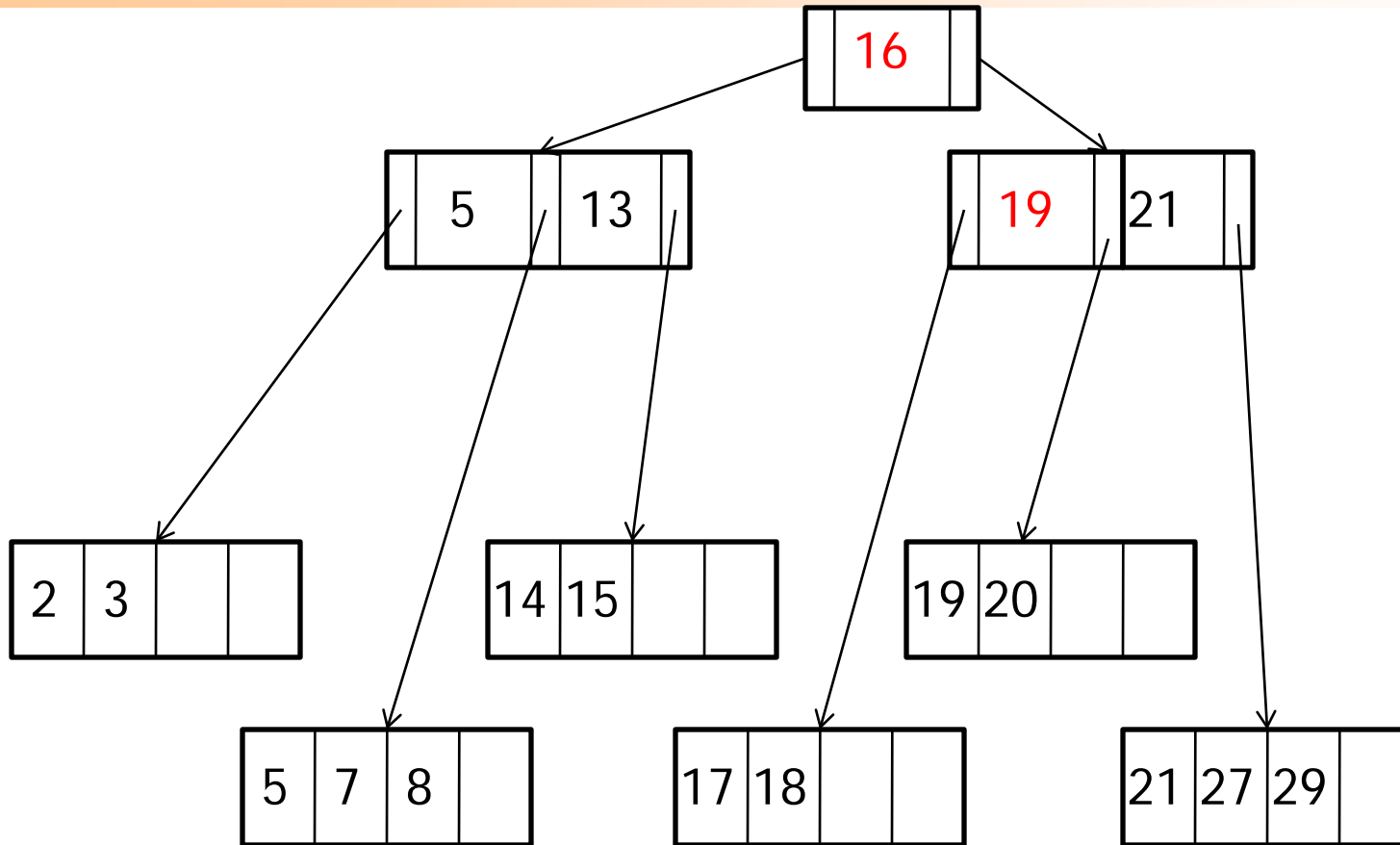
(4) delete 24:



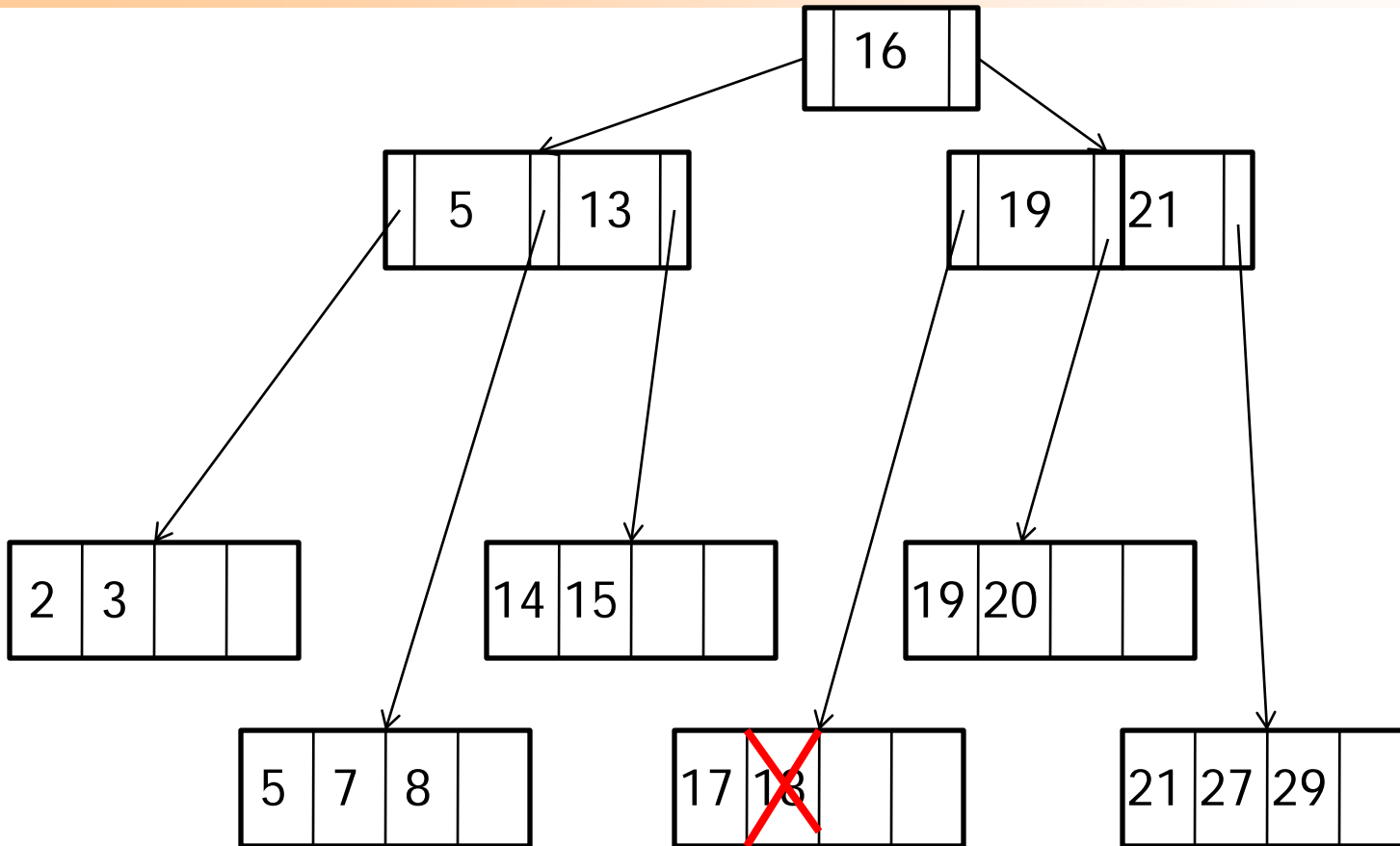
Concatenate with sibling and delete separator key 27 from their parent:



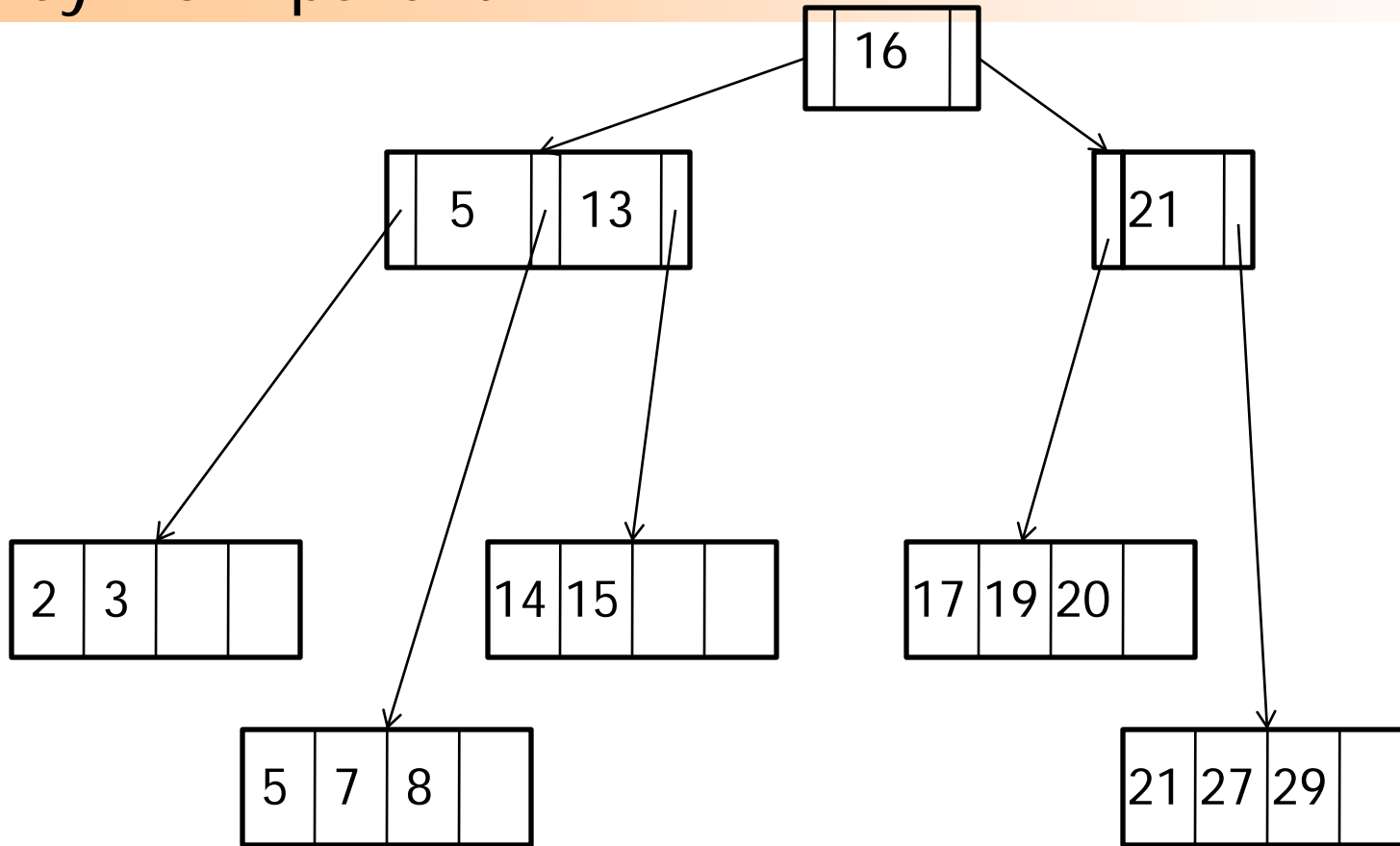
Redistribute keys between parent and its sibling:



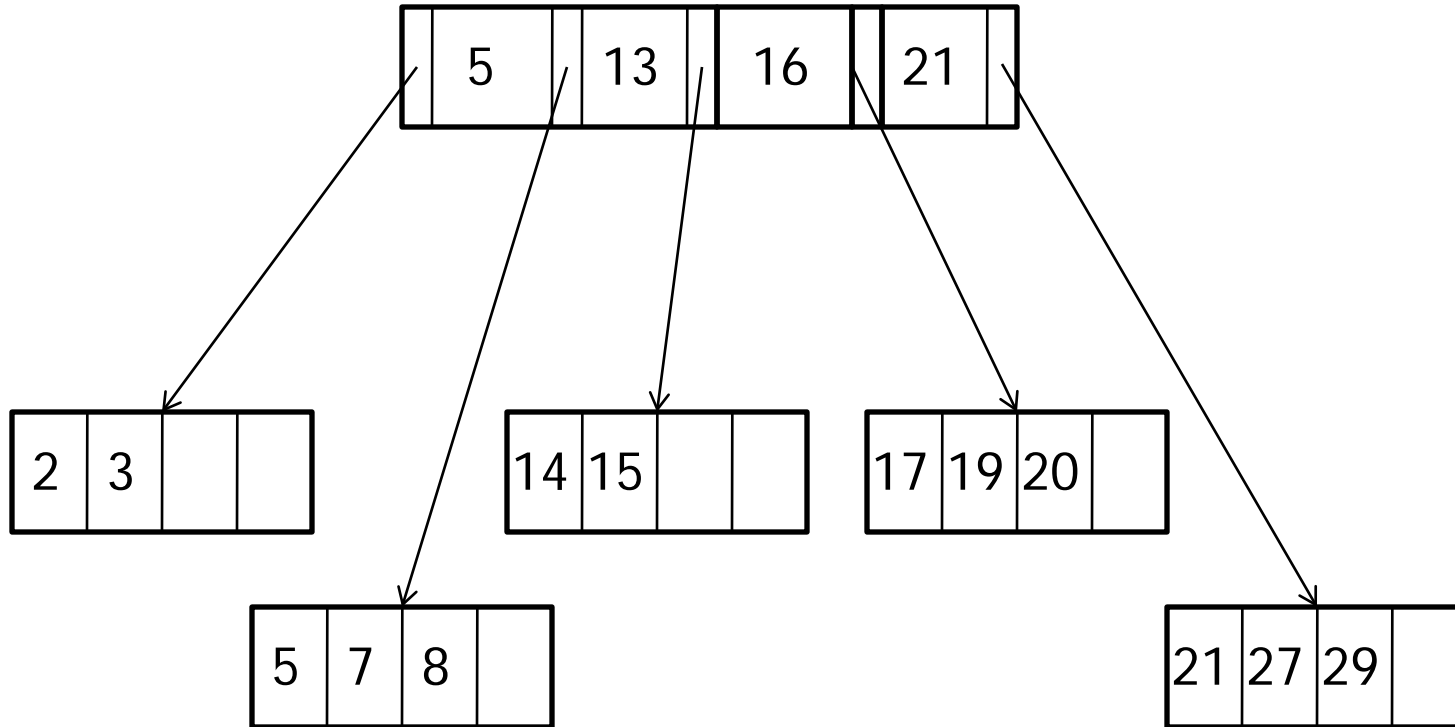
(5) delete 18:



concatenate with sibling leaf node and remove separator
key from parent:

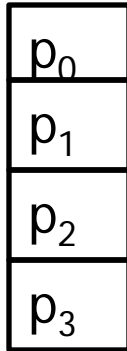


concatenate parent with its sibling inner node and remove separator key from their parent (hence removing the old root and decreasing height of tree by 1):



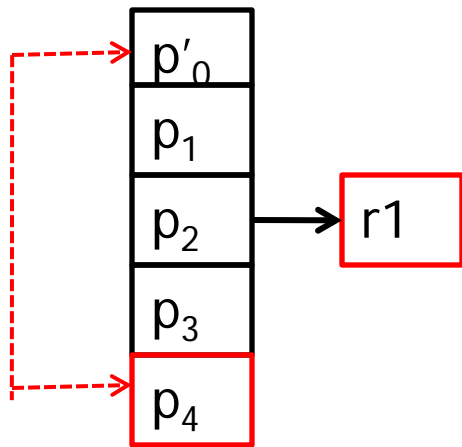
Linear hashing example

- Suppose we have the following hash file organised according to the linear hashing scheme, and suppose that all 4 pages are currently full (so we are currently using hash function h_2):



(1) insert record r_1 , where $h_2(r_1) = 2$ and $h_3(r_1) = 6$:

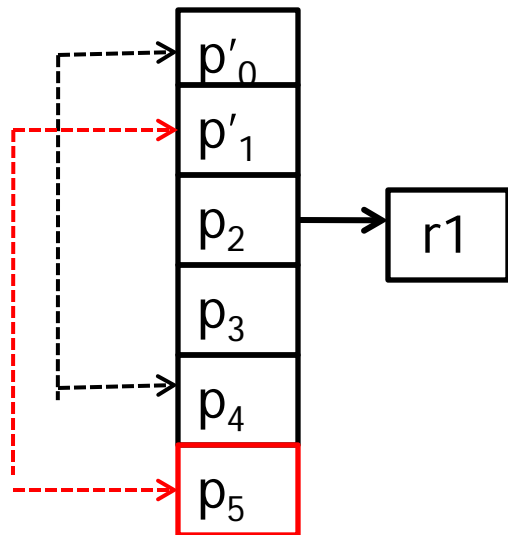
(this illustrates creation of an overflow page and expansion of the file with a new page that is appended to the end of the file)



the contents of the old page p_0 have been redistributed into p'_0 and its *buddy*, the new page p_4 , using the hash function h_3

(2) insert record r_2 , where $h_2(r_2) = 1$ and $h_3(r_2) = 1$:

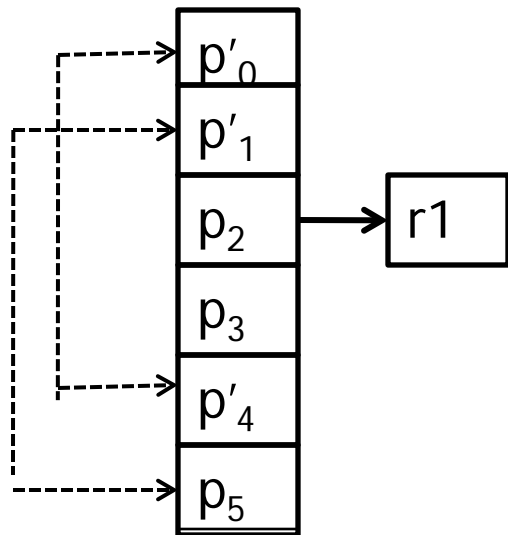
(this also illustrates expansion of the file with a new page that is appended to the file; however, this time the new record fits into the main file and no overflow page is needed)



the contents of the old page p_1 have been redistributed into p'_1 and its buddy, the new page p_5 , using the hash function h_3 ;
the new record r_2 has been placed into p'_1

(3) insert record r_3 , where $h_2(r_3) = 0$ and $h_3(r_3) = 4$:

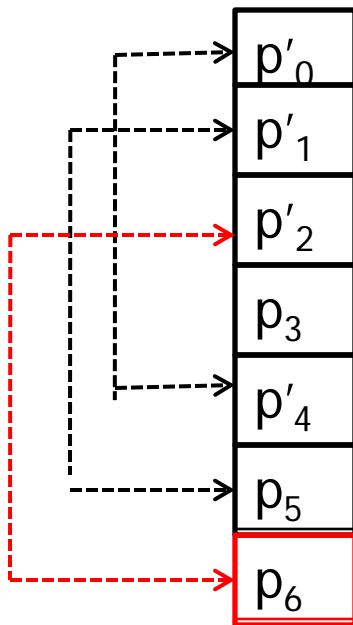
(this does not require expansion of the file – assuming that p_4 is not yet full)



the contents of p'_4 are the same p_4 but with the new record r_3 added here too

(4) insert record r_4 , where $h_2(r_4) = 2$ and $h_3(r_4) = 2$:

(this illustrates expansion of the file with re-absorption of an overflow page into the main file)



the contents of the old page p_2 plus its overflow page have been redistributed into p'_2 and its buddy p_6 using the hash function h_3 ; the record r_1 is now in p_6 (because remember from earlier that $h_3(r_1) = 6$); the new record r_4 has been placed into p'_2