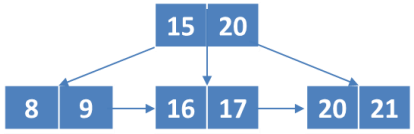
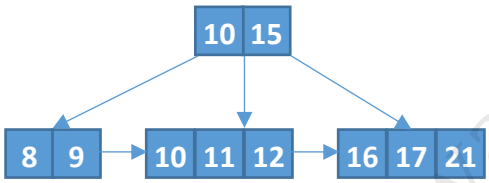
Name: _____ USC ID: _____

Quiz 10: B+-Tree Index & External Sorting (10 points. 15 minutes)

1. [4 points] Consider a B+-tree with an order of **2** as shown below. Note that this simplified drawing only shows the slots occupied with keys. Show the final B+-tree after inserting keys 10, 11, 12 in this order, and then removing key 20.





2. [6 points] Consider merge-sorting a file with **1000** blocks using **10** buffer pages. Assume block size = page size.
   a. [5 points] How many runs will be generated at each pass (both sorting and merging)? What are their sizes (i.e., how many blocks)?

Pass	# of runs	size
0	100	10
1	12	90 (10 for the last one)
2	2	810 (190 for the other one)
3	1	1000

   b. [1 point] How many block I/O's are needed for this entire process?

There're 4 passes, each of which needs to read and write 1000 blocks.

The total cost is: $4\times(2\times1000) = \mathbf{8,000}\ block\ I/O's$