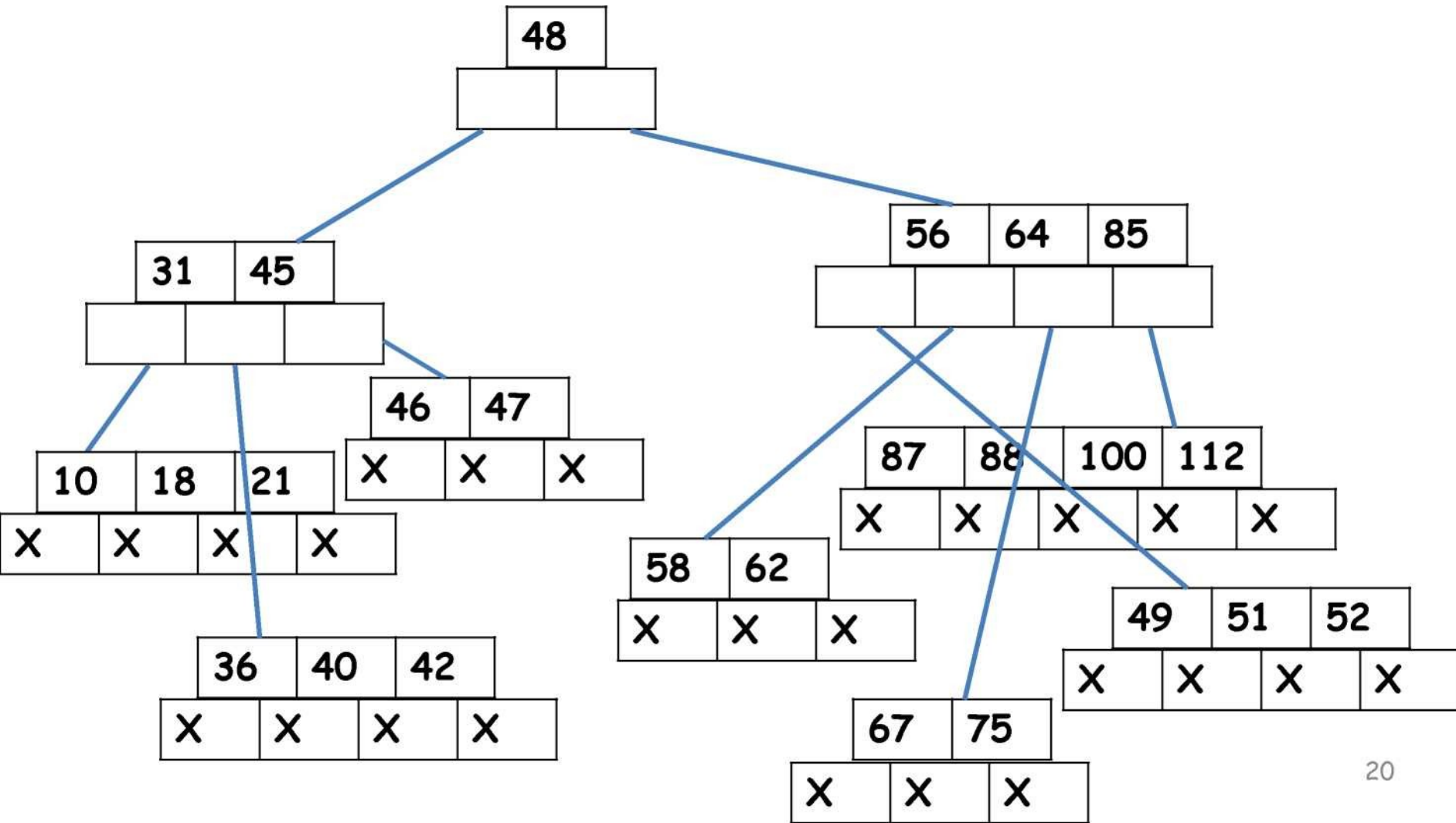# B Trees

B tree is a balanced m-way *search* tree

A B tree of order m, if non empty is an m-way search tree in which

[i]   the root has at least two child nodes and at most m child nodes

[ii]   internal nodes except the root have at least $\lceil \frac{m}{2} \rceil$ child nodes and at most m child nodes

B Trees

[iii]   the number of keys in each internal node is one less than the number of child nodes and these keys partition the keys in the subtrees of nodes in a manner similar to that of m-way search trees

[iv]   all leaf nodes are on the same level

B Tree of order 5

Searching a B Tree

Searching for a key in a B-tree is similar to the one on an m-way search tree.

The number of accesses depends on the height h of the B-tree

Insertion in a B-Tree

A key is inserted according to the following procedure
[1] If the leaf node in which the key is to be inserted is not full, then the insertion is done in the node.

A node is said to be full if it contains a maximum of (m-1) keys given the order of the B-tree to be m

Insertion in a B-Tree

[2] If the node were to be full then insert the key in order into the existing set of keys in the node. Split the node at its median into two nodes at 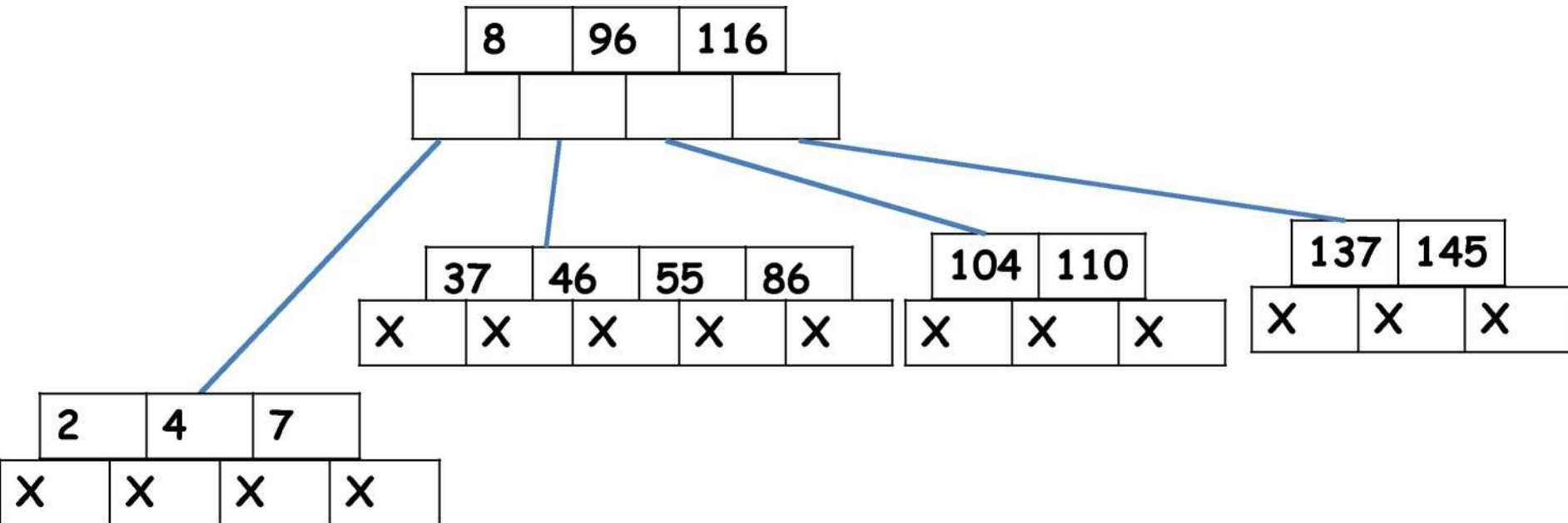the same level, pushing the median element up by one level. Accommodate the median element in the parent node if it is not full. Otherwise repeat the same procedure and this may call for rearrangement of the keys in the root node or the formation of new root itself.
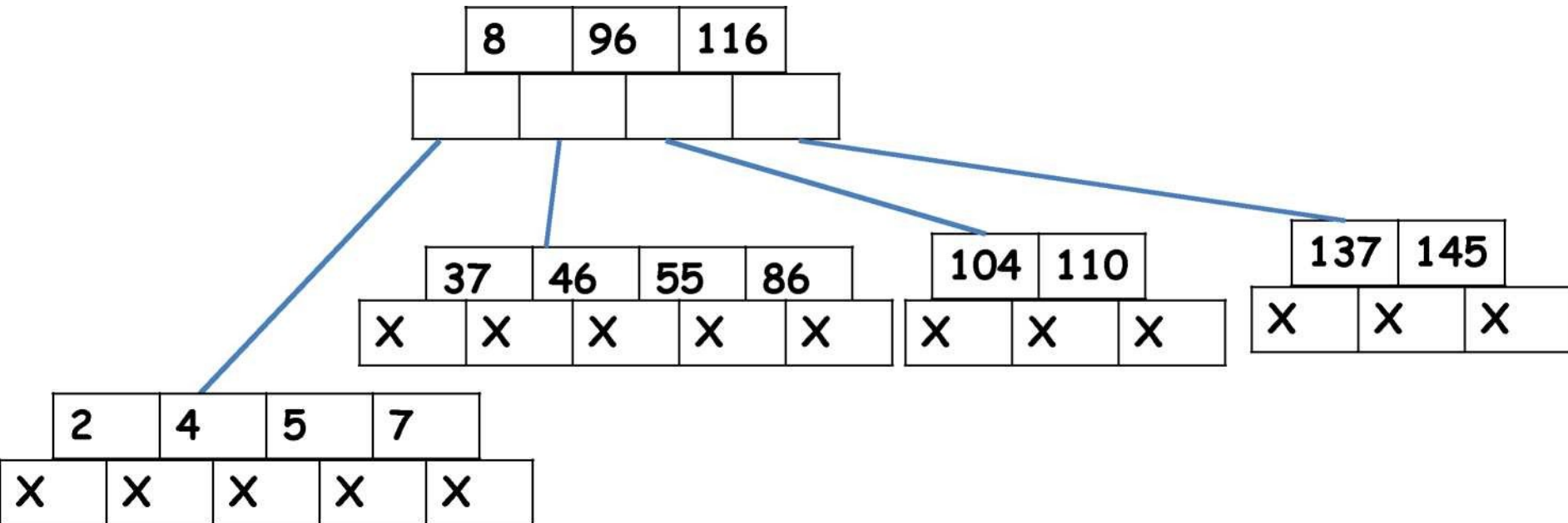
5-Way *B* Tree
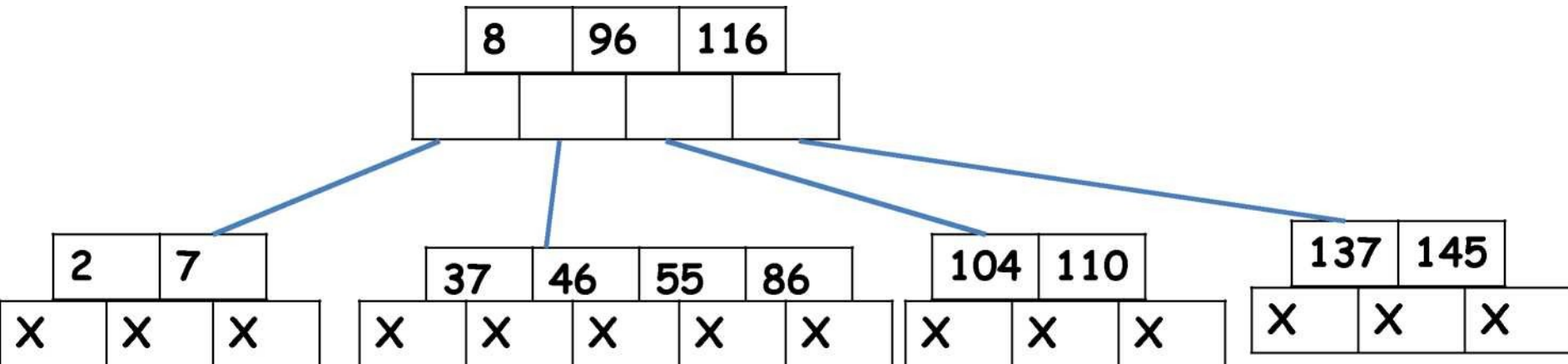
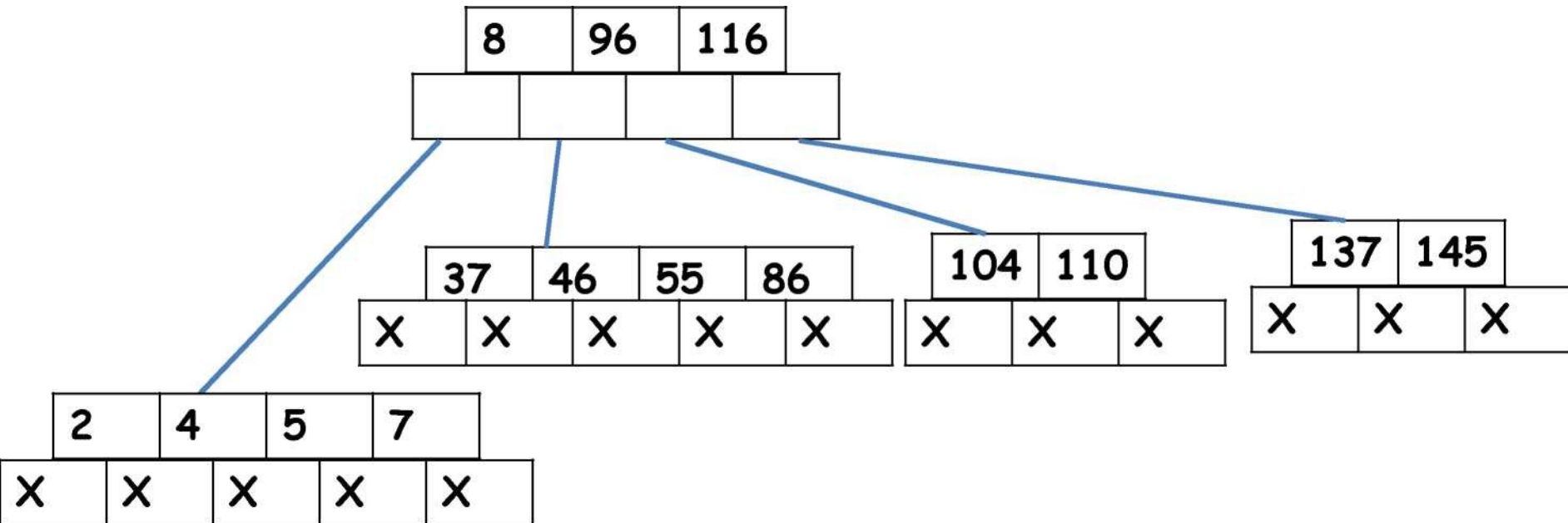Insert $4, 5, 58, 6$ in the order

5-Way *B* Tree

after inserting 4

5-Way *B* Tree

after inserting 4, 5
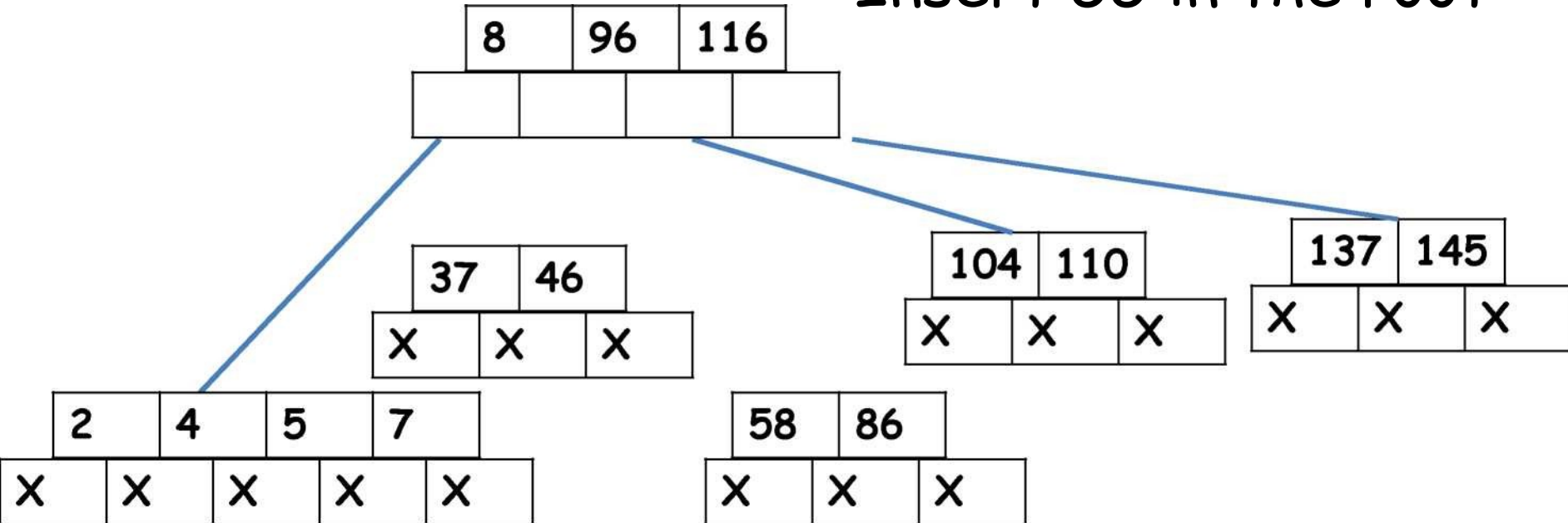
5-Way *B* Tree

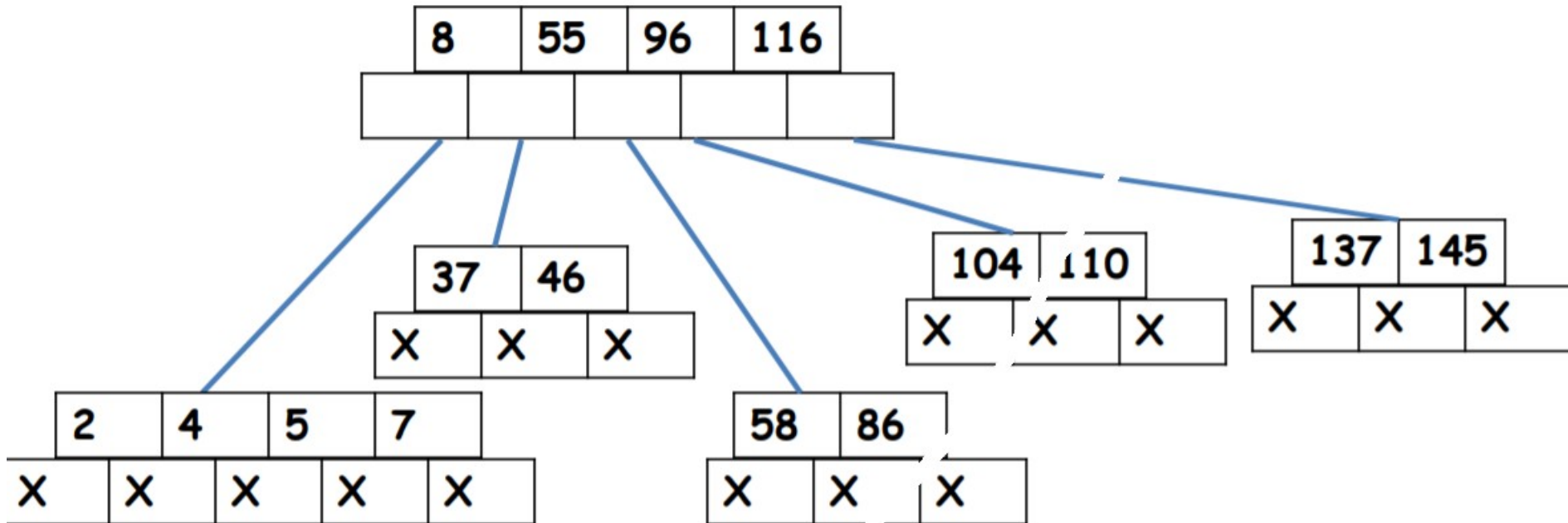**Insert in 37,46,55,58,86**

Split the node at its median into two node, pushing the median element up by one level

5-Way *Search* Tree
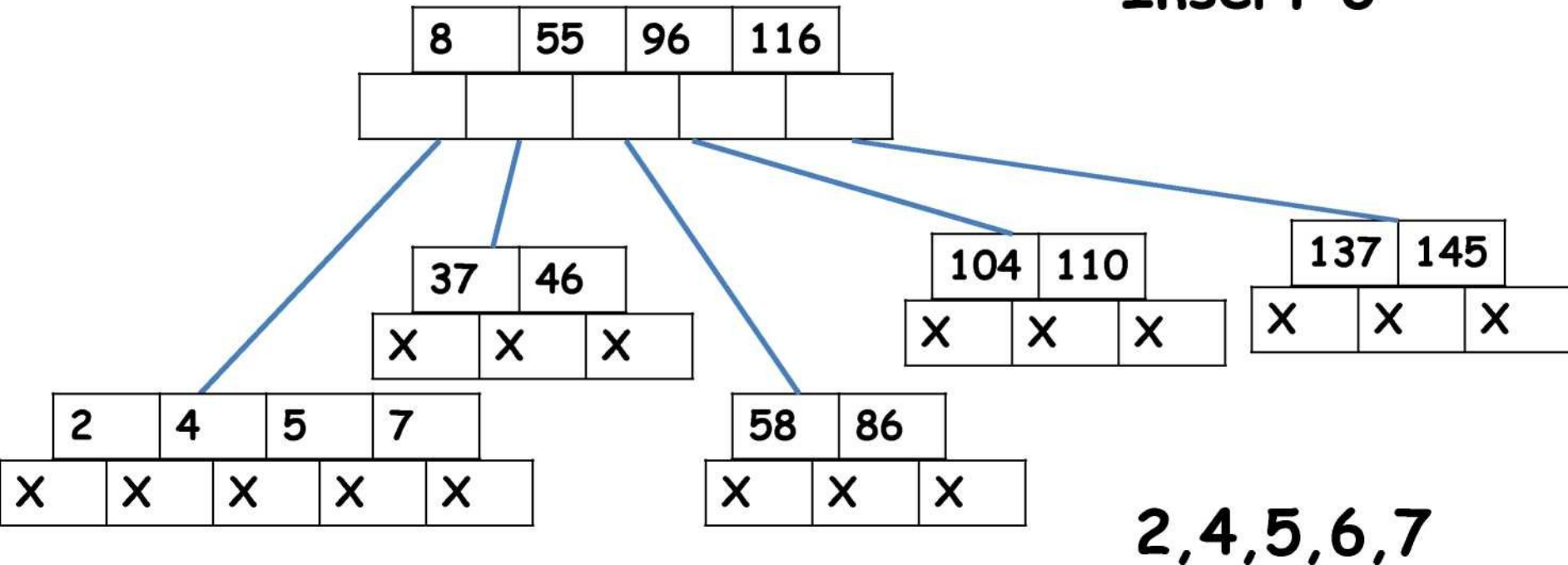
Insert 55 in the root

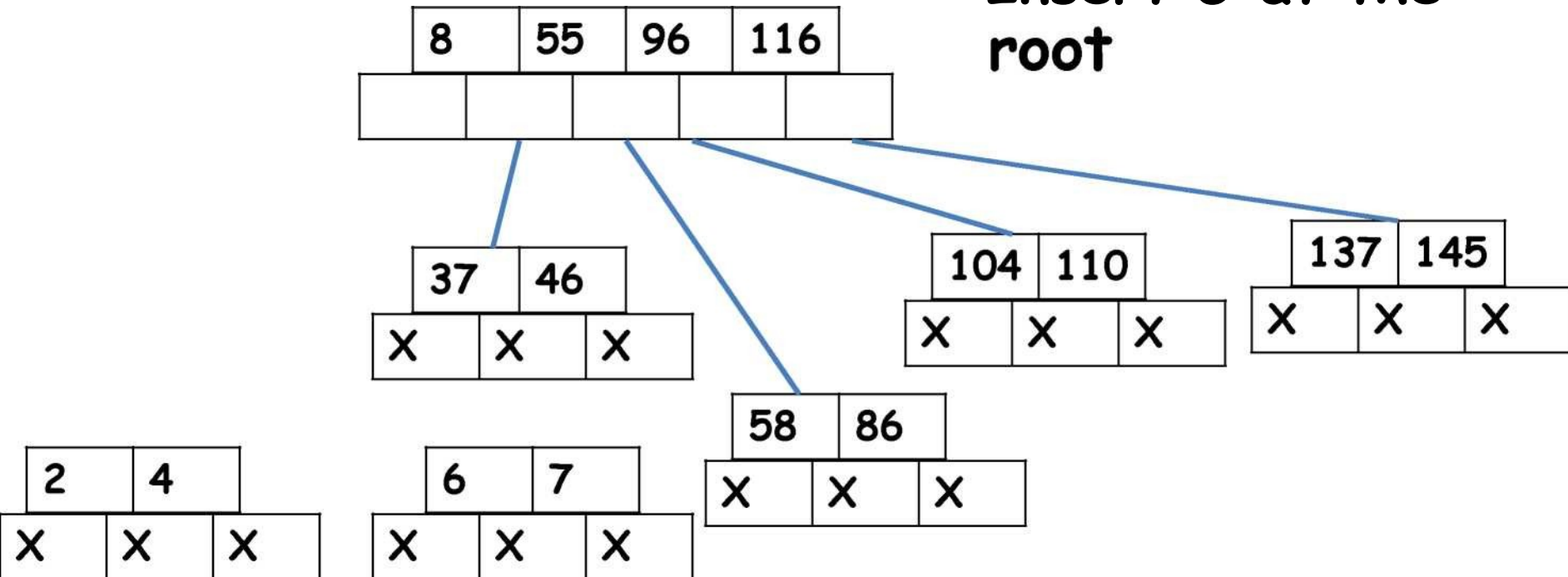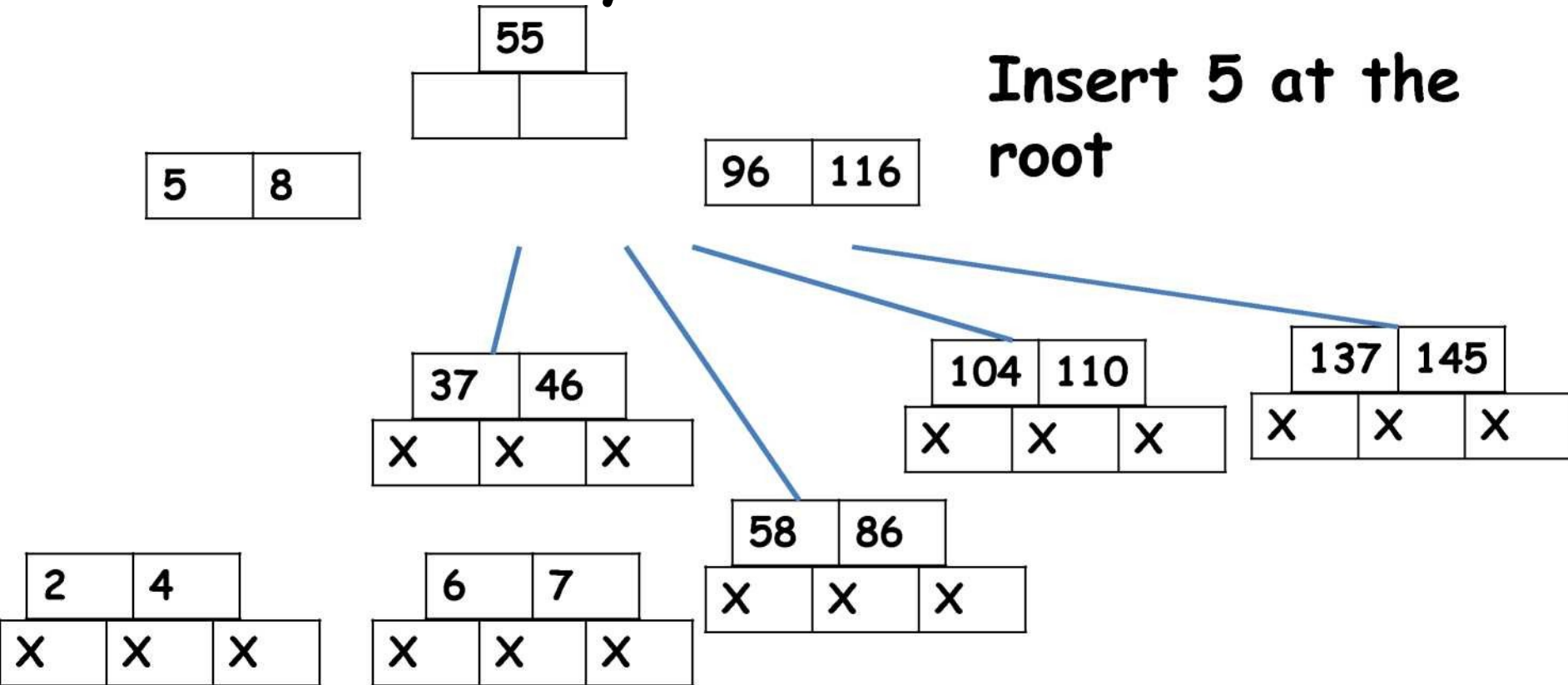# 5-Way B Tree

after inserting 4, 5, 58

5-Way *B*Tree

Insert 6

8	55	96	116

37	46

X X X

104	110

X X X

137	145

X X X

2	4	5	7

X X X X X

58	86

X X X

2,4,5,6,7

Split the node at its median into two node, pushing the median element up by one level

5-Way *B* Tree

Insert 5 at the root

5-Way *B* Tree

Insert 5 at the root

5-Way *B* Tree

Insert 5 at the root