# HW3

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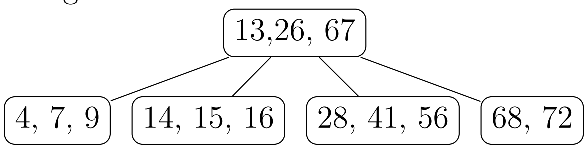
October 1, 2024

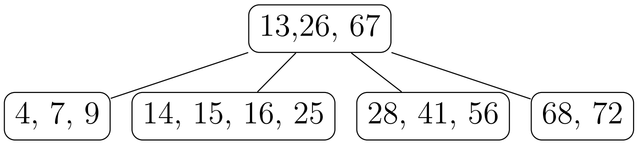
## 1

(a) : original tree:



insert 25:

1. find the leaf node that 25 should be inserted into.
2. insert 25 into the leaf node.

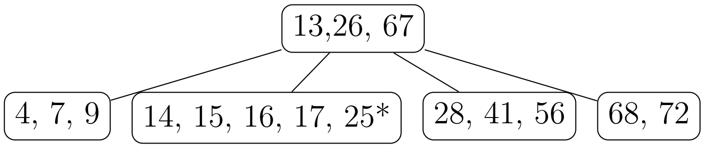


3. because m=2, adding 25 to the leaf node don’t violate the B-tree property.

insert 17:

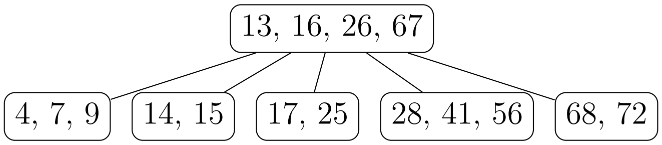
1. find the leaf node that 17 should be inserted into.

2. insert 17 into the leaf node.



3. because m=2, adding 17 to the leaf node violate the B-tree property.

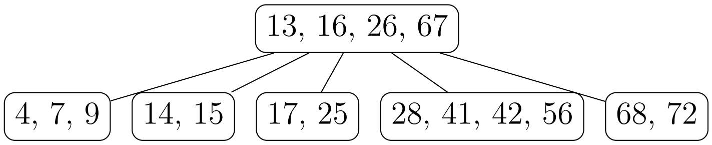
4. find the mid number of the leaf node, which is 16.
put 16 to the parent node, and split the leaf node into two nodes.



5. parent node has 4 children, which don't violate the B-tree property.

insert 42:

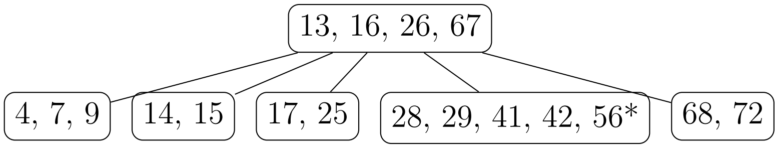
1. find the leaf node that 42 should be inserted into.
2. insert 42 into the leaf node.



3. adding 42 to the leaf node don't violate the B-tree property.

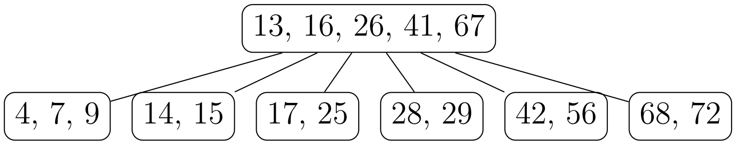
insert 29:

1. find the leaf node that 29 should be inserted into.
2. insert 29 into the leaf node.



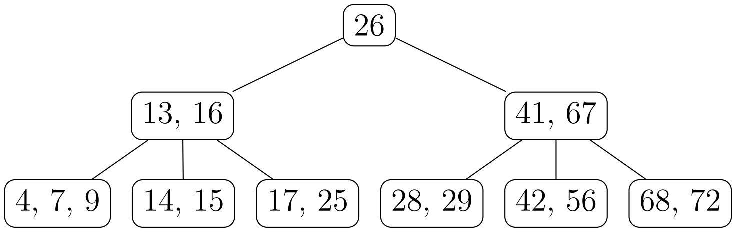
3. adding 29 to the leaf node violate the B-tree property.

4. find the mid number of the leaf node, which is 41.
   put 41 to the parent node, and split the leaf node into two nodes.

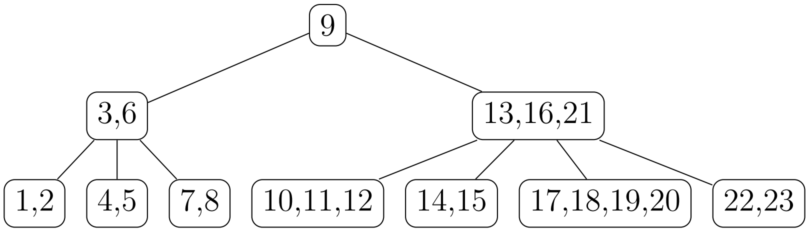


5. parent node has 5 children, which violate the B-tree property.

6. find the mid number of the parent node, which is 26.
   put 26 to the grandparent node, and split the parent node into two nodes.

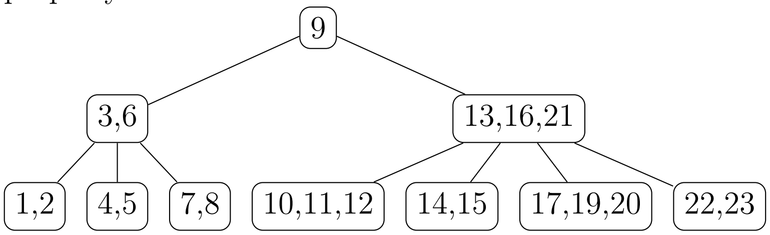


(b) : original tree:



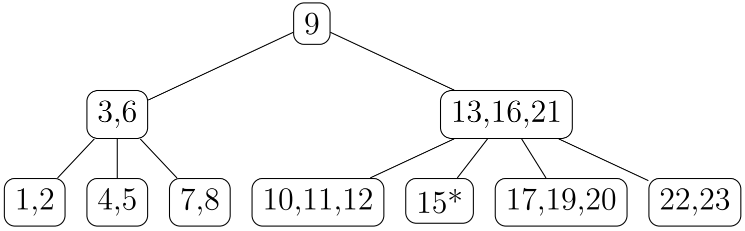
delete 18:

1. find the leaf node that 18 should be deleted from.
2. delete 18 from the leaf node.
3. check the number of the leaf node, which is not violating B-tree property.

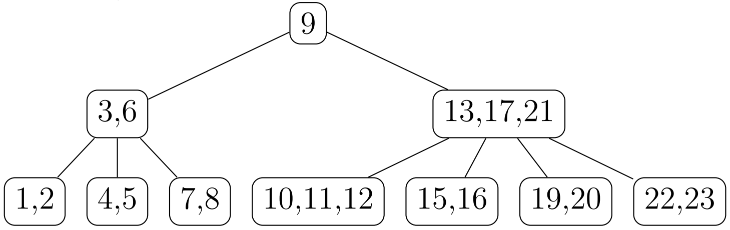


delete 14:

1. find the leaf node that 14 should be deleted from which is a leaf node.
2. delete 14 from the leaf node.
3. check the number of the leaf node, which is violating B-tree property.

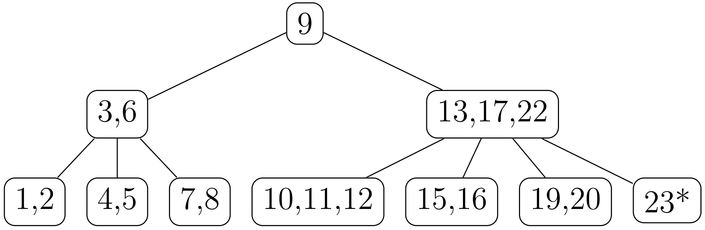


4. current node's rightsibling has 3 numbers, which is more than m. rightsibling can let closest 17 be their joint father and previous father 16 come to the current node.

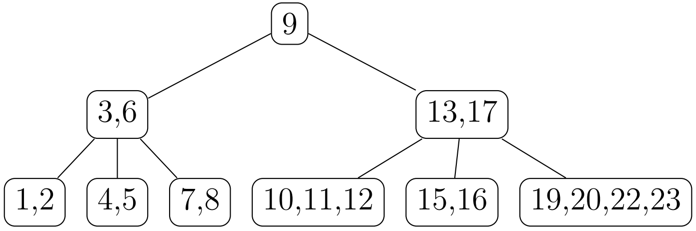


delete 21:

1. find the leaf node that 21 should be deleted from which is a directory node.
2. switch 21 with the closest number in the leaf node which is 22
3. delete 21 from the leaf node.

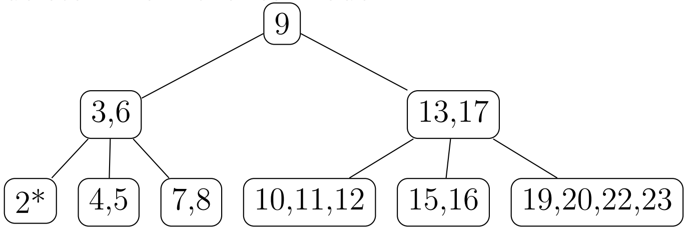


4. check the number of the current node, which is violating B-tree property. Since there is no rightsibling we can find leftsibling and find that leftsibling only have 2 numbers. We collapse currentNode and leftsibling and then build new node contaning all keys links to the parent node.

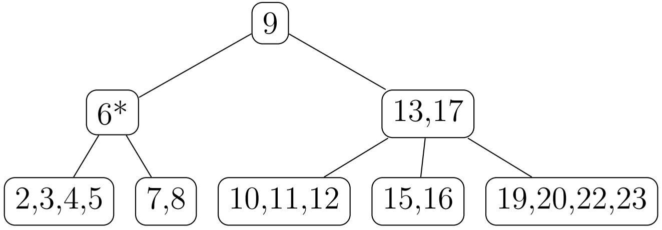


delete 1:

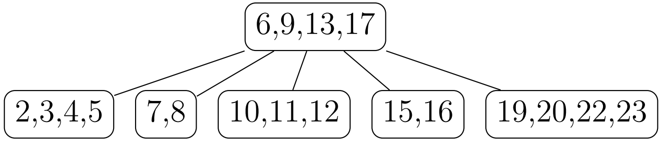
1. find the leaf node that 1 should be deleted from which is a leaf node.
2. delete 1 from the leaf node.



3. check the number of the current node, which is violating B-tree property. We can find rightsibling that leftsibling only have 2 keys. We collapse currentNode and rightsibling and then build new node contaning all keys links to the parent node.



4. check parent node and find that it don't meet B-tree requirements. We find that parent node's rightsibling only have 2 keys so we collapse them and build a new node


6,9,13,17
2,3,4,5
7,8
10,11,12
15,16
19,20,22,23