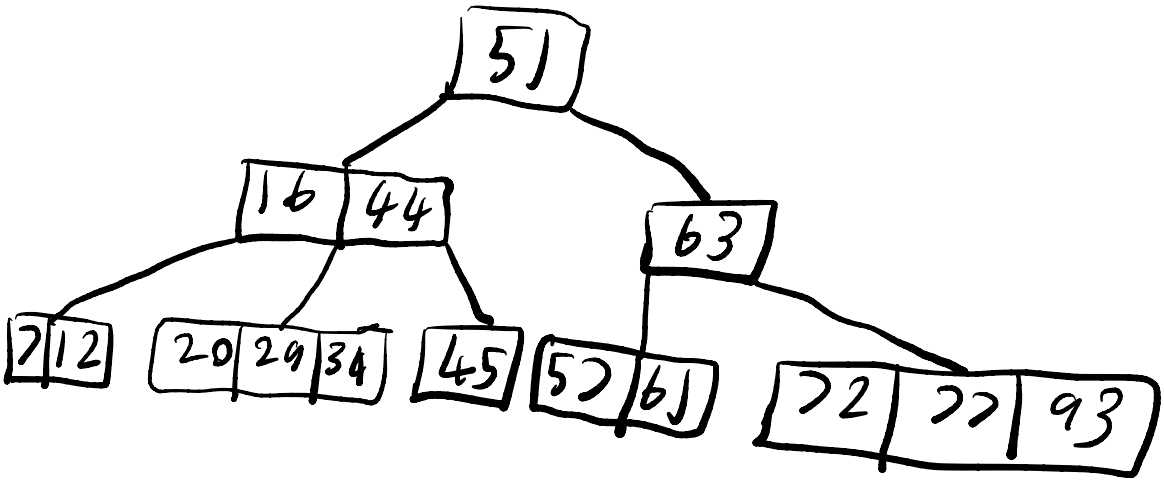
Ex. 45 $t=2$

minimum: $t-1=1$

maximum: $2t-1=3$

This is just a 2-3-4 tree.



I split nodes 5 times. All insertions were into nodes with space in them as I split full nodes as I got to them.

This tree has a depth of 2, i.e. there are 3 layers.

Layer 0 has a capacity of 3 keys and 4 children.

∴ Layer 1 has a capacity of $3\times4=12$ keys, and $4\times4=16$ children as there can be up to 4 nodes.

∴ Layer 2 has a capacity of $3\times16=48$ keys.

∴ There is a total capacity of $3+12+48=63$ keys in this tree. There are 15 keys in the tree, so there are 48 free spaces.

∴ The ratio of free space to total space is 48:63 i.e. 16:21.