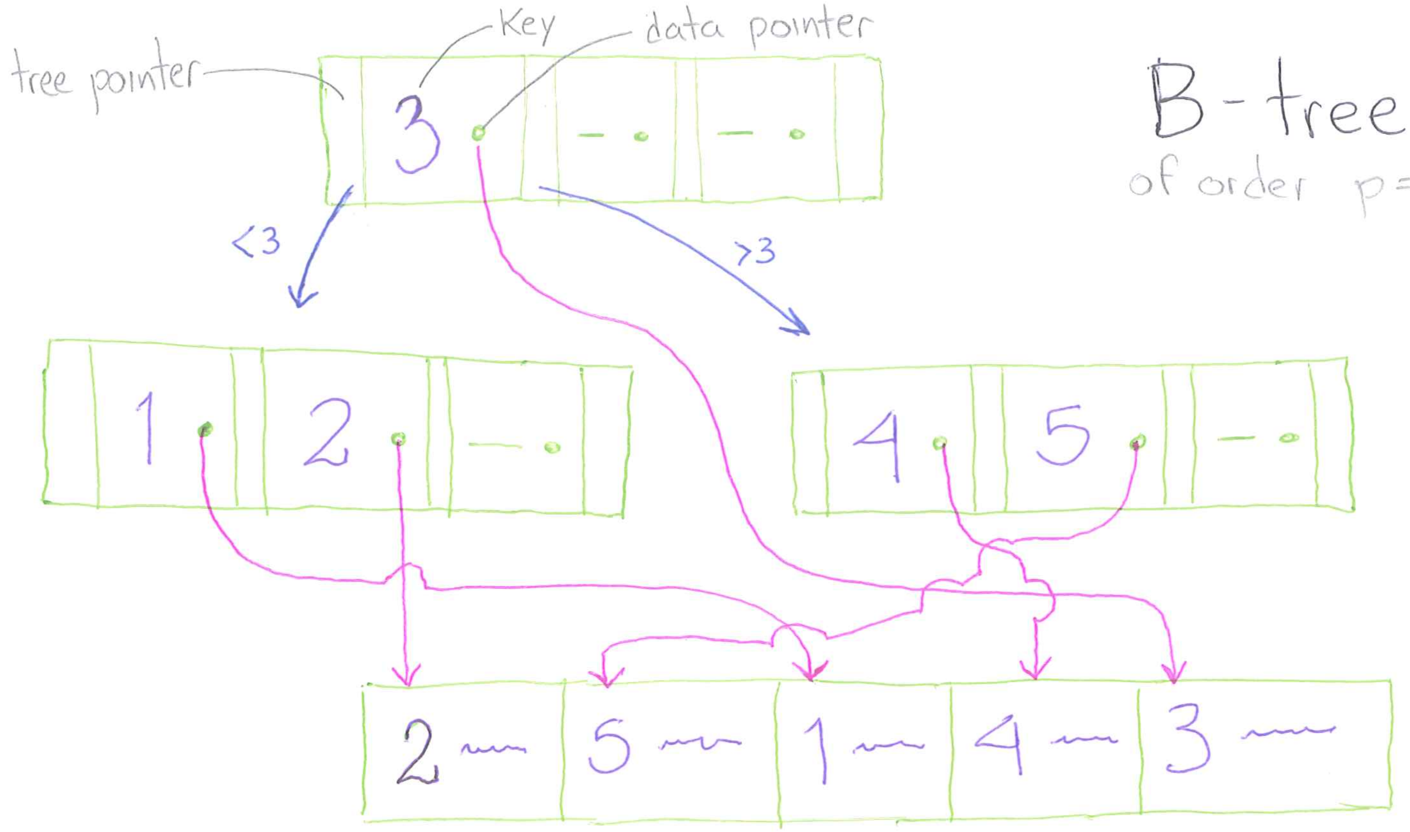
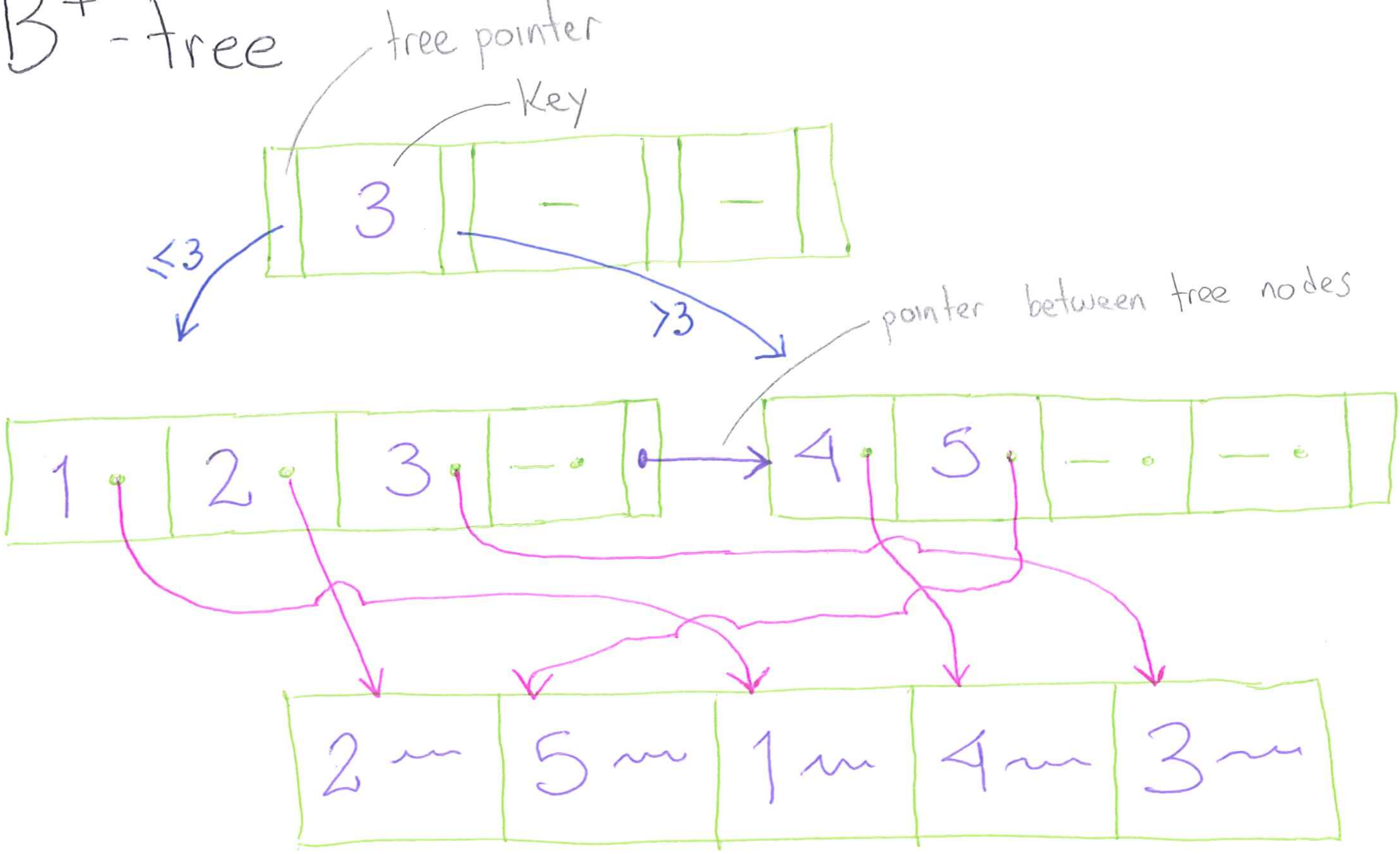
B-tree

of order p=4



B^+-tree



EXAMPLE 2.

How many levels of indexing would be needed for the file from example 1?

- Assume: ORDERED FILE WITH PRIMARY INDEX.

$b = $ number of data blocks $= 3{,}000$

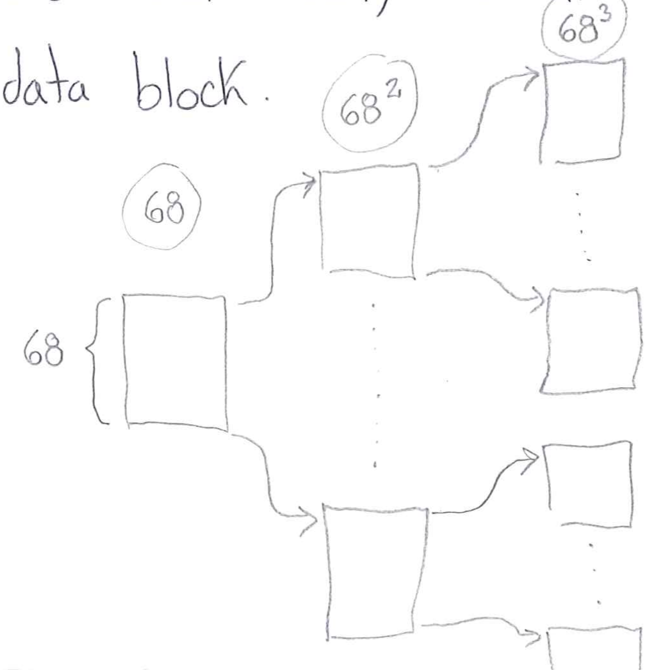
number of index blocks $= 45$

BFRI = blocking factor for index block $= 68$

We will need to add 45 second-level index entries to access 45 primary-level index blocks.

45 entries fits in one block.

The total numbers of disk blocks read is $\boxed{3}$:
one at second level index, one at primary level index and one data block.



level 1 $= 68^1 = 68$

level 2 $= 68^2 = 4{,}624$

level 3 $= 68^3 = 314{,}432$

EXAMPLE 3.

Calculate the order p of a B^+ tree given:

BS = block size = 512

V = index size = 9 ← this is the size of the Key

P_r = pointer size = 7

P = index tree pointer size = 6 ← this is the size of the tree pointer

↖ capital p

"How many tree pointers can we store?"

$$[p * 6] + [(p-1) * 9] \leq 512$$

$$6p + 9p - 9 \leq 512$$

$$15p - 9 \leq 512$$

$$15p \leq 512 + 9$$

$$15p \leq 521$$

$$p \leq 521/15$$

$$p \leq 34.7 \qquad \therefore p = 34$$

Approximately how many levels in this B^+ tree would we need to store 1 million records? $\log_{34}(1{,}000{,}000) \approx 4$ $\quad 34^4 = 1{,}336{,}336$

•) 512 byte / block , 64 byte readord
What is the blocking factor of the disk?

$$BFR = \frac{512}{64} = 8$$

$\therefore$ 8 records per block.

•) 512 byte/block , 65 byte record

BFR = 7.87... $\longrightarrow$ UNSPANNED = 7 records per block
SPANNED = 7.87 records per block

B+ Trees (multi-level index)

- Efficient direct access to records.
  - ⇒ Multi-level index, so we can do a multi-level seacch
- Efficient ordered access through all records.
  - ⇒ Bottom level is chain together as a linked list
- Efficient overall balanced index structure.
  - ⇒ Expand tree upward, add values to blocks or split blocks
  - ⇒ It is wide, we have a large BFR
  - ⇒ It is shallow, we donot need many levels to represent it
- Efficient insertion and deletion.
  - ⇒ It is proportional to the height of the tree.