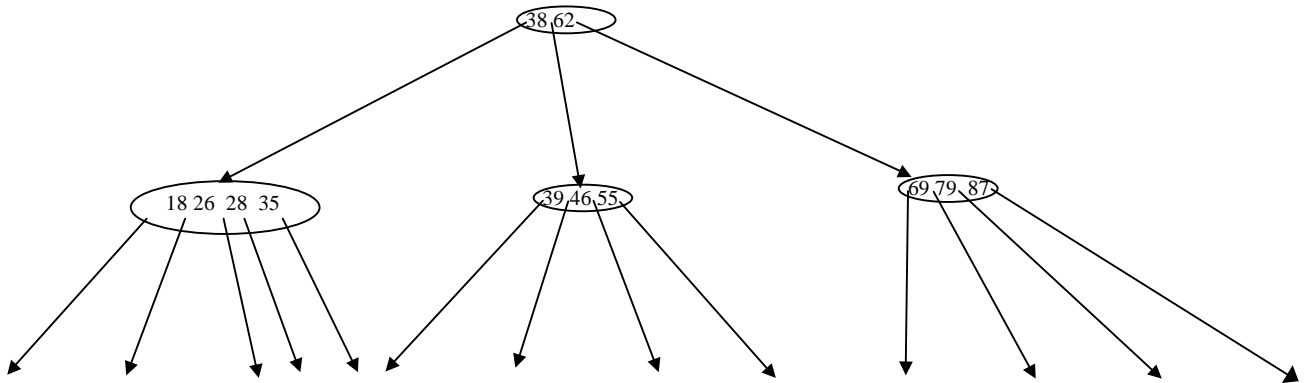# CIS 671 Introduction to Database Systems II   Winter 2002
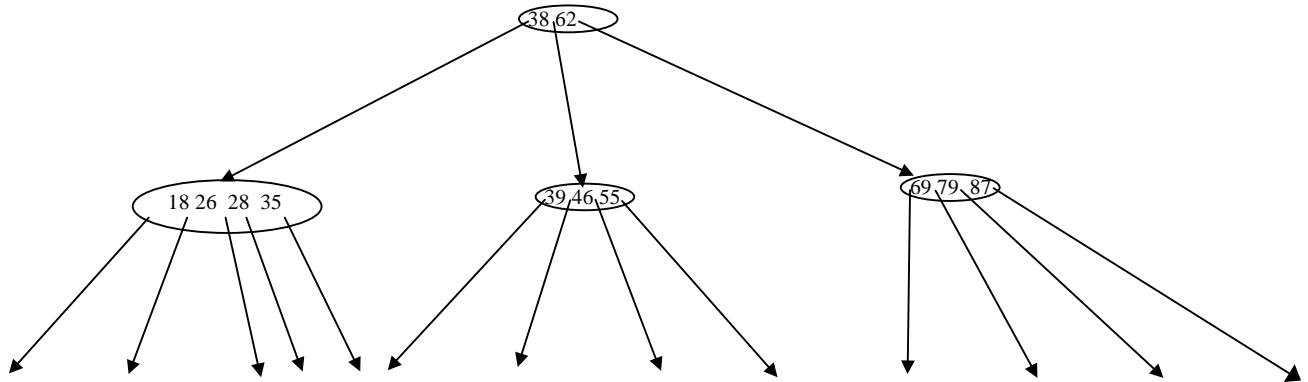# Homework 9   Name _____

1. Disks: EN 5.23.

2. Files: EN 5.24, 5.25

3. The following problems are about a B-tree of order 5. Also assume the *left* subtree is chosen for any change whenever there could be a choice between the left and right subtrees.
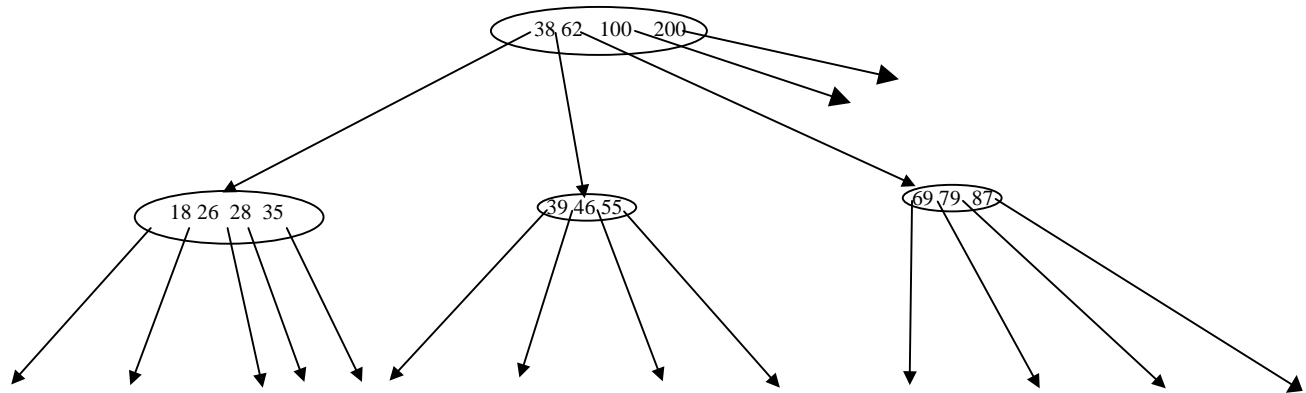
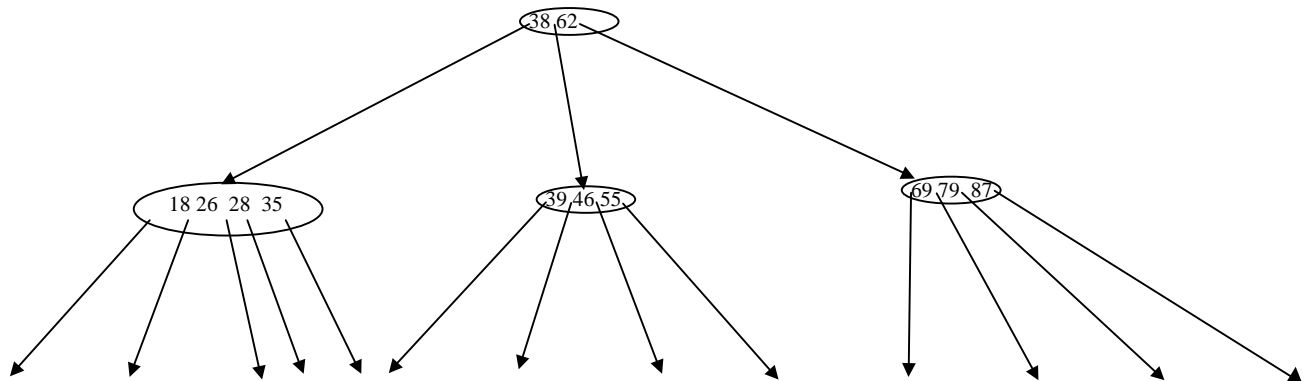   a) Show the B-tree that results from inserting a record with key 57.

    b) Show the B-tree that results from inserting a record with key 37.

c)   Show the B-tree that results from inserting a record with key 37.

38 62 100 200

18 26 28 35

39 46 55

69 79 87

d)   Show the B-tree that results from deleting a record with key 55.

38 62

18 26 28 35

39 46 55

69 79 87

e)   Show the B-tree that results from deleting records with keys 46 and 55.

38 62

18 26 28 35

39 46 55

69 79 87
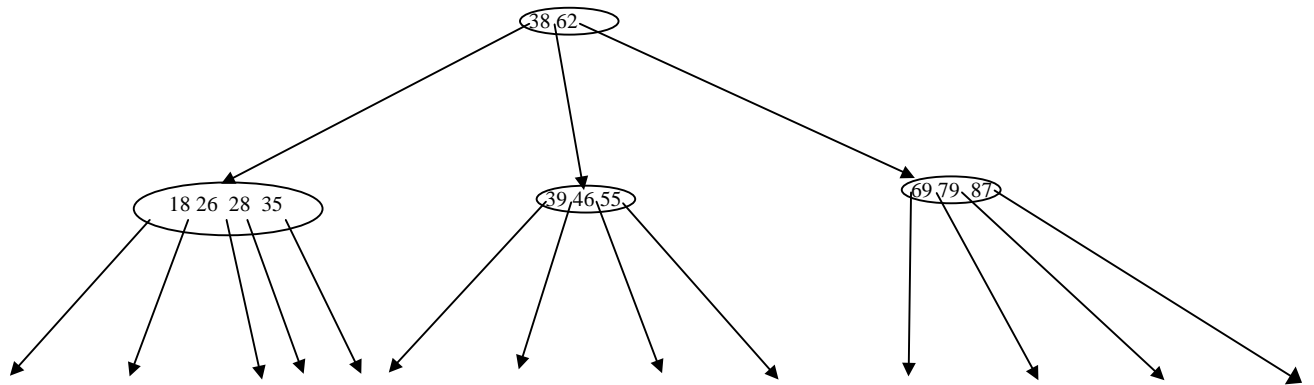
f)   Show the B-tree that results from deleting records with keys 55, 79 and 87.

33 62

18 26 28 35

39 46 55

69 79 87
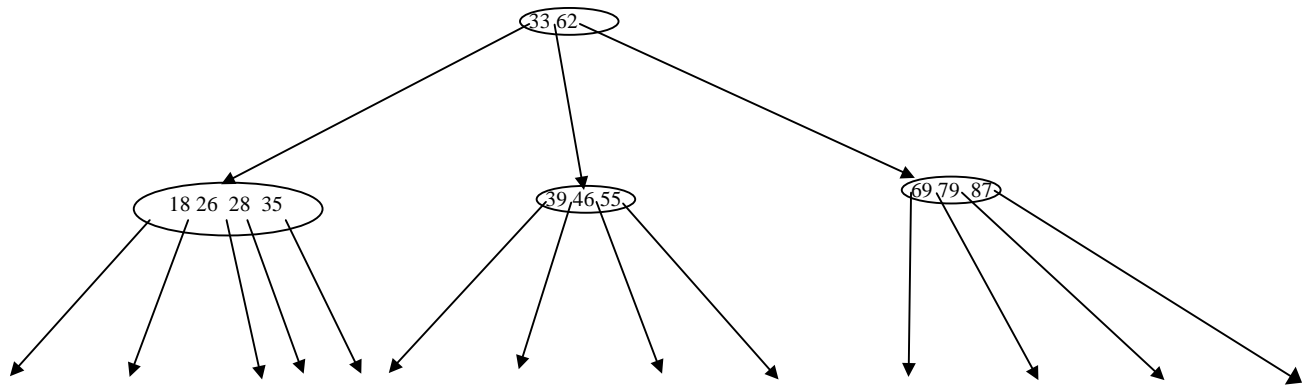
4. The following problems are about B$^+$-trees. Assume the index is a B-tree of order 4. Assume each leaf node holds at most 4 keys and record pointers. Also assume the *left* subtree is chosen for any change whenever there could be a choice between the left and right subtrees. Finally assume a leaf node splits to have 3 keys in the leftmost node and 2 keys in the rightmost node.

Show the B$^+$-tree that results from inserting a record with key 37.

Root: 33 62

Internal nodes: 18 26 | 39 46 55 | 69 79 87

Leaf nodes:
- 10 15 16 18
- 20 22 23 26
- 28 29 31 33
- 35 36 38 39
- 41 43 44 46
- 49 50 53 55
- 57 59 60 62
- 64 65 68 69
- 73 74 76 79
- 82 83 85 87
- 89 90 92 93
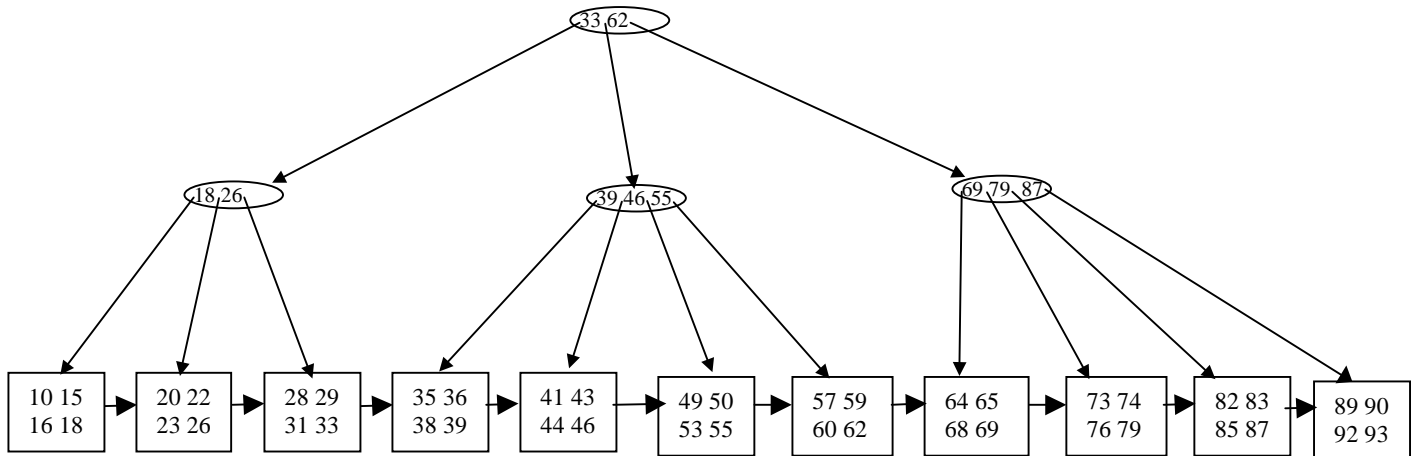
b) Show the B$^+$-tree that results from inserting a record with key 84.
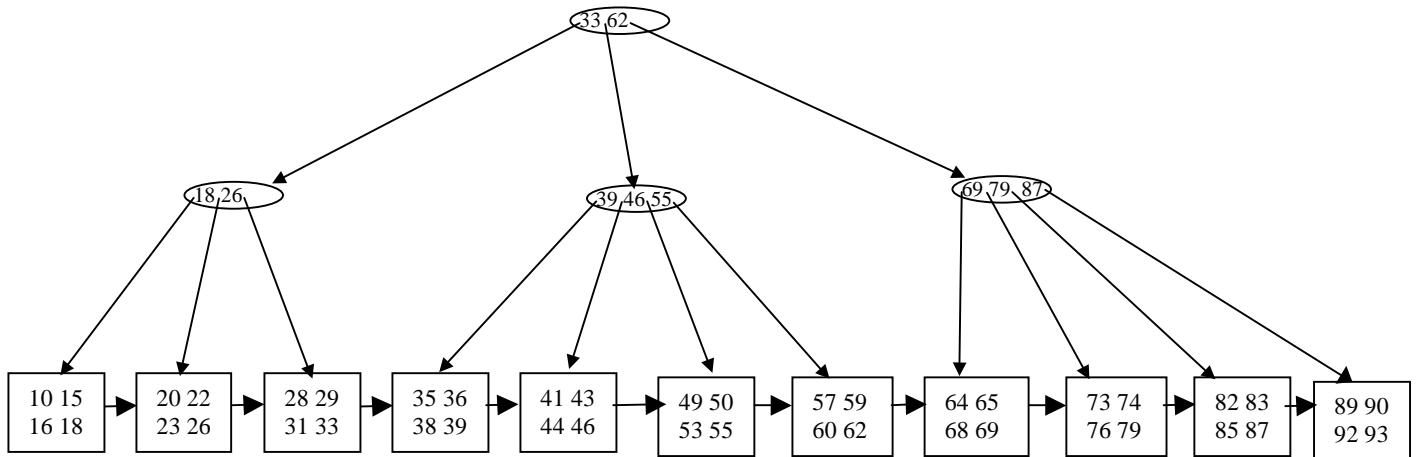
c) Show the B$^+$-tree that results from deleting the node with 28, 29, 31, 33.

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                                    ( 33 62 )
              /                         |                          \
        ( 18 26 )                  ( 39 46 55 )                ( 69 79 87 )
       /    |    \              /    |    |     \            /    |    |     \
  ┌─────┐┌─────┐┌─────┐    ┌─────┐┌─────┐┌─────┐┌─────┐  ┌─────┐┌─────┐┌─────┐┌─────┐
  │10 15││20 22││28 29│ →  │35 36││41 43││49 50││57 59│→ │64 65││73 74││82 83││89 90│
  │16 18││23 26││31 33│    │38 39││44 46││53 55││60 62│  │68 69││76 79││85 87││92 93│
  └─────┘└─────┘└─────┘    └─────┘└─────┘└─────┘└─────┘  └─────┘└─────┘└─────┘└─────┘
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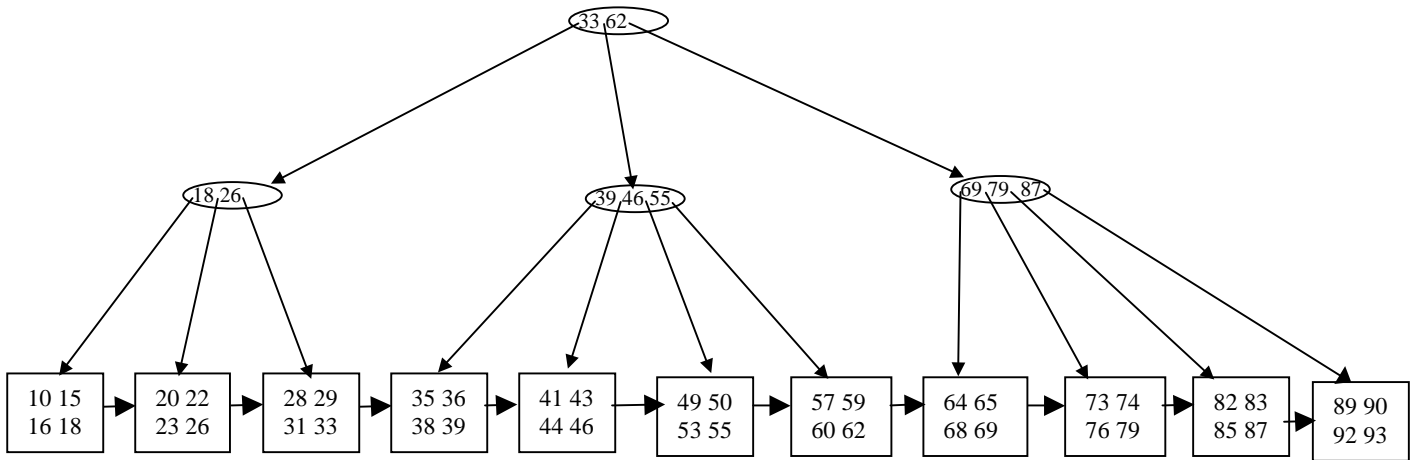
5. Assume you have a disk drive with the following characteristics:

Bytes per sector	512
Sectors per track	60
Sectors per cluster	4
Tracks per cylinder	16
Cylinders	4000
Average seek time	10 ms
Average rotational delay	6 ms
Transfer rate	3000 bytes/ms

You have been asked to set up a B^+-tree file of 300,000 records, each of length 400 bytes using leaf nodes that hold 5 keys.

a) How much space, in cylinders, will the data blocks take? Explain your answer.

b) Assume a B^+-tree using a B-tree of order 50 for the index. How many levels will be needed in the index? Give both the best and worst cases. Explain your answers.

c) How long does it take to retrieve a random data record? Give both the best and worse case.