Department of BES-I

COURSE: Data Structures

COURSE CODE: 24SC1203

Topic:

NAME OF THE TOPIC:

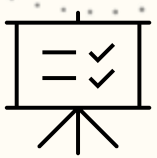
Construction of B-Tree

Session – 32

AIM OF THE SESSION

To familiarize students with the basic concept of B-Tree.

INSTRUCTIONAL OBJECTIVES



This Session is designed to:

1. Demonstrate The Concept of B-Tree.
2. Describe the concept of m-way ordered Balanced Tree.
3. List out the operations possible on the construction of B-Tree.
4. Describe the each operation.
5. List out the advantages and applications of B-Tree.

LEARNING OUTCOMES

At the end of this session, you should be able to:

1. Define Construction of B-Tree.
2. Describe three different ordered of B-Tree. And their operations.
3. Summarize definition, types and operations of construction of B-Tree and its applications.

Construction of B-Tree

INTRODUCTION

- B-Tree is a balanced m-way tree.
- Generalization of BST in which a node can has more than one key and more than two children.
- Maintain Sorted (ascending order) data.
- All leaf nodes must be at same level.
- B-Tree of order m has following properties
  - * Every node has maximum m no of children
  - *Minimum children : leaf node-> 0
    root -> 2
    internal nodes -> ceiling(m/2)

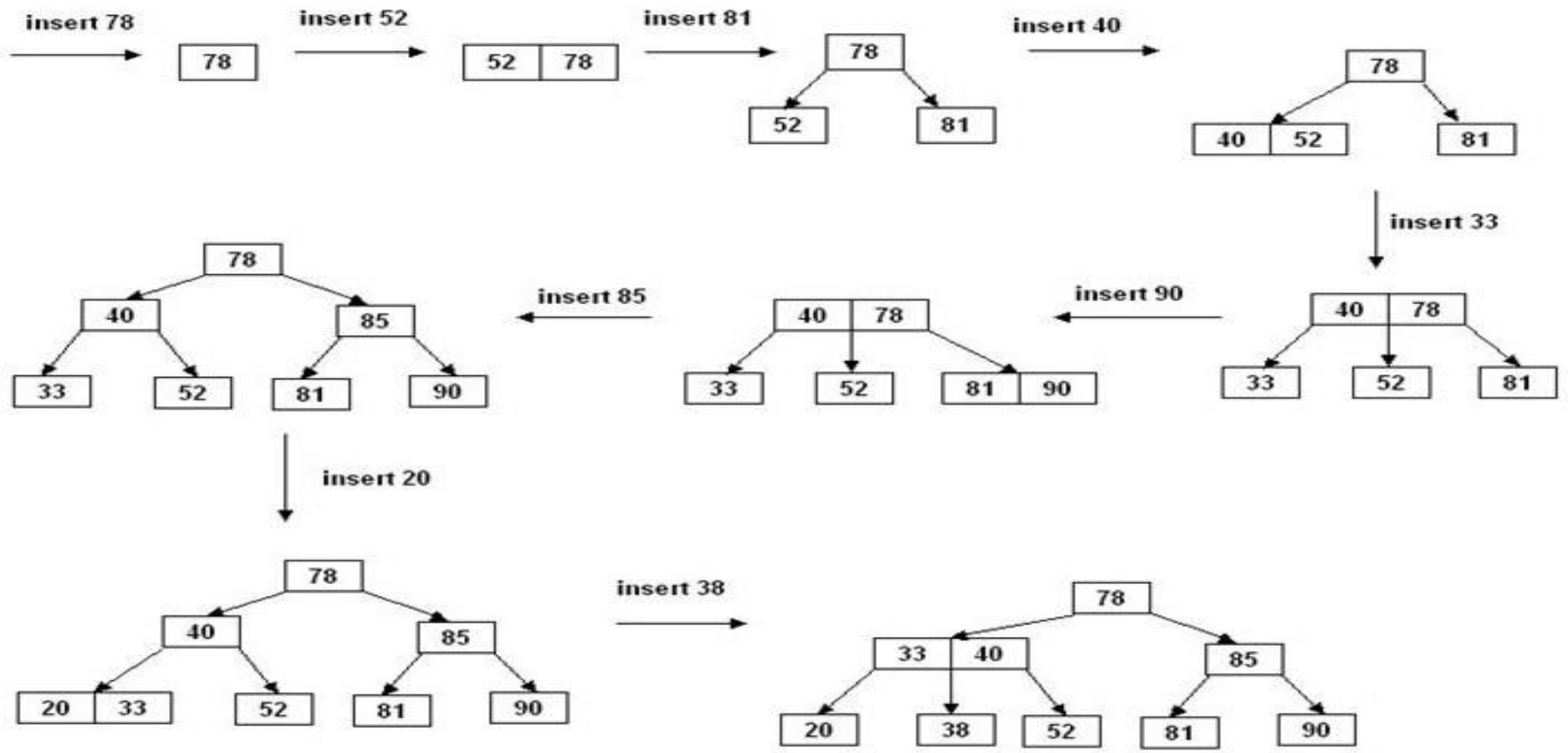
Construction of B-Tree

INTRODUCTION

- Every node has maximum (m-1) keys.
- Minimum keys:
  - Root -> 1.
  - All other nodes -> ceiling(m/2) – 1.

Example of Construction of B-Tree 3 order

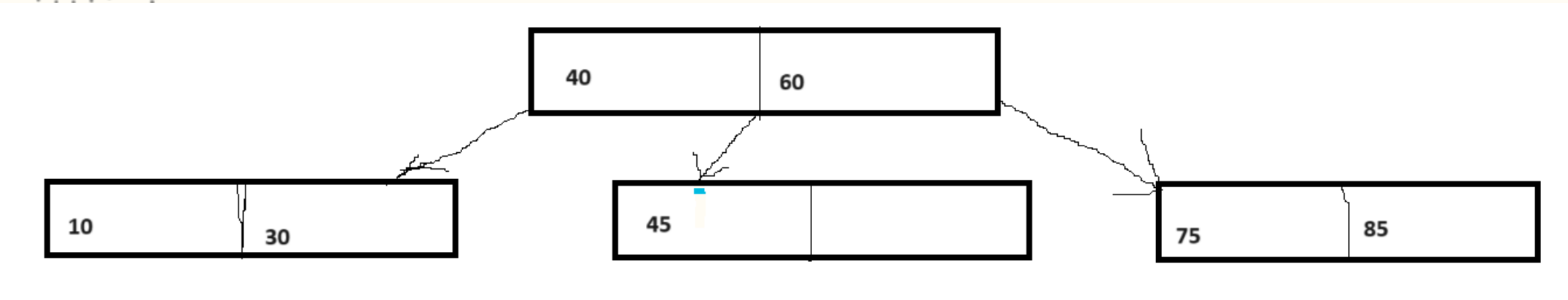
- Example: Insert the keys 78, 52, 81, 40, 33, 90, 85, 20, and 38 in this order in an initially empty B-tree of order 3



Types of B-Tree Cont…

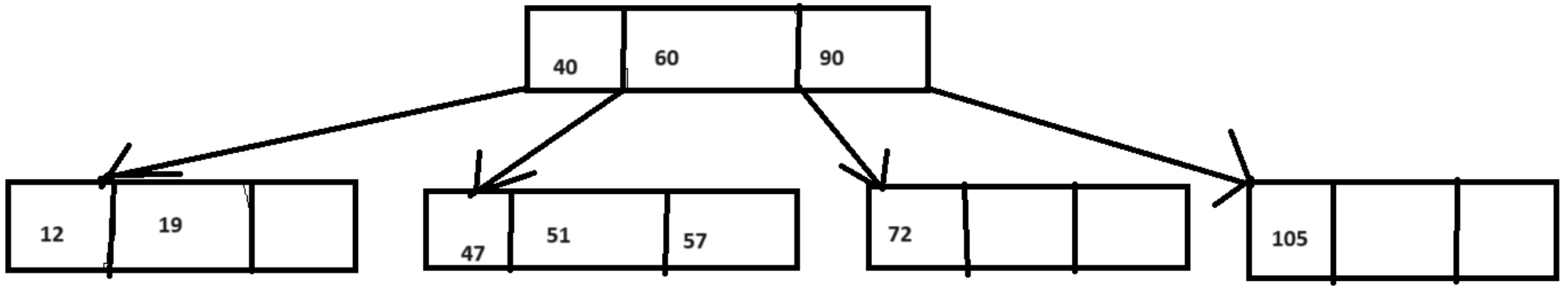
1. Order 3 balanced B-Tree:

- Here, each node can holds max 2 keys.



Order 4 balanced B-Tree:

- Here, each node can holds max 3 keys.



OPERATIONS ON B-Tree (Cont..)

In a B-Tree, we can perform the following operations...

- Insertion
- Deletion
- Display

Steps for insertion an element in a B-Tree (Cont..)

- Always insert element at leaf node and in sorted manner.
- Before insert check no of keys at that node. Maximum no of keys are possible in a node is m-1.
- Explain with example:
- Insert all the following numbers in a B-Tree having m=4.

  6, 3, 12, 10, 5.

As m=4, so maximum no of keys are possible ia a node is 3.

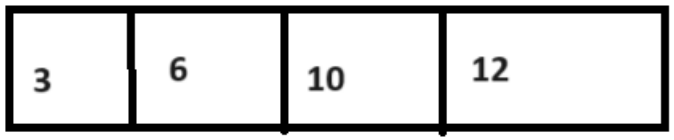
First insert 6:

Next Insert 3. As 3 is less than 6 so it comes at left side of 6.

Insertion

- Next Insert 12. As 12 is greater than 3 as well as 6. So it comes right side of 6.

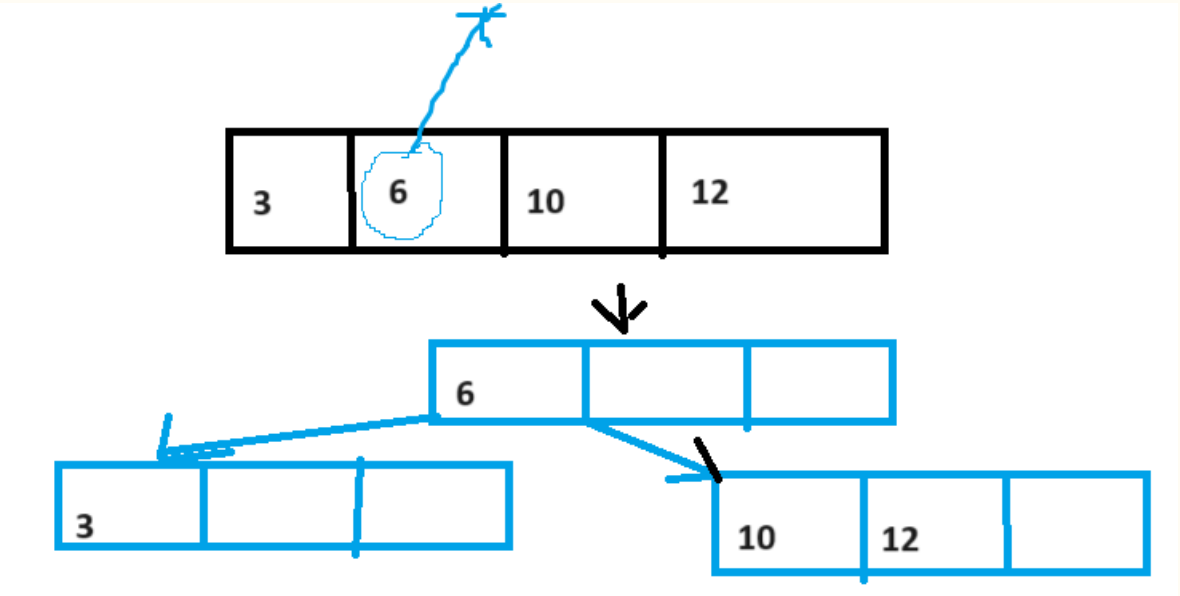
- Next insert 10. 10 is greater than 6 but less than 12. so it comes in between 6 and 12



But here, the problem is number keys of the above node are 4 which is more than the value of m-1(as m=4). So we have to sent the middle element of the node towards the up node.

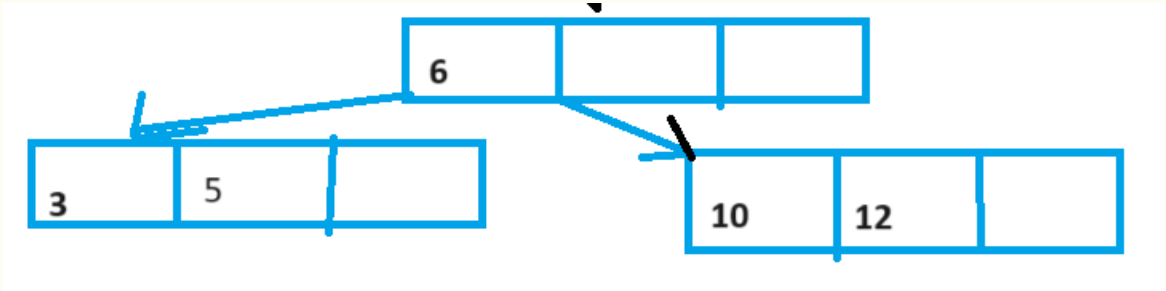
Insertion

Here middle elements are 6 and 10. We can send any one. If we send 6 to upwards then it is called Left Biased. If we send 10 to upwards then it is called Right Biased. Let, we consider Left Biased.



Insertion

Next element is 5. We have to check from root node. 5 is less than 6, so it goes to the left child node of 6. Next we have to compare with 3. 5 is grater than 3 so it comes right side of 3. Always insert at leaf node.



IMPORTANT FACTS RELATED TO THE SESSION

Advantages of a B-Tree

- B-Tree can Balance themselves
- High throughput and concurrency
- Efficient use of storage space

Disadvantages of B-Tree

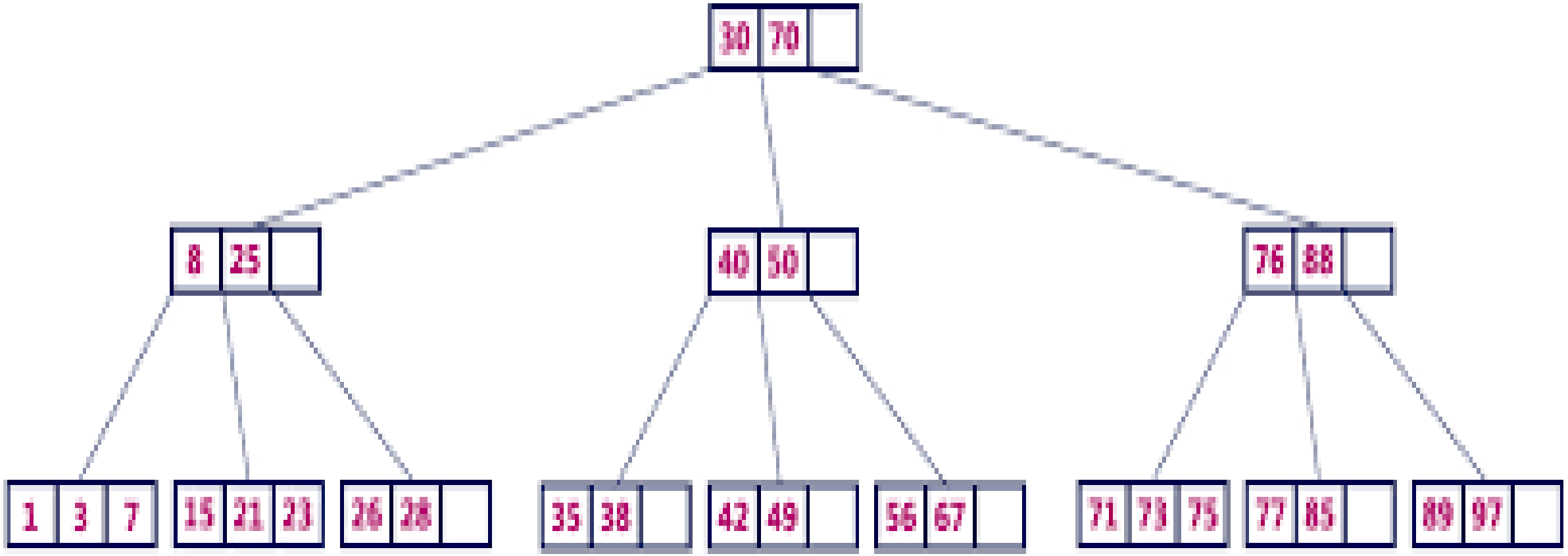
- B-Tree require more space
- Not efficient for write-heavy workloads.
- slow

Applications/Uses of B-Tree in real life

- Database system
- File Organisation
- Information Retrival

EXAMPLES

B-Tree of Order 4



SUMMARY

- B-Tree is a m-way balanced tree.
- Store data in sorted way.
- If the order is m then each node can have maximum m-1 keys.
- Always insert element into leaf node.
- If the no of keys reaches at m-1 of a node then middle element of the node has to move up.

SELF-ASSESSMENT QUESTIONS

1. How many max keys are there in a node of order m?

a) m

b) m+1

c) m/2

d) m-1

2. Which of the following is false about a construction of B-Tree?

a) Max no of keys of a node is m-1
b) If the order is m, then a node can have max m no of children
c) Time complexity for deleting the last node is O(n)
d) All Leaf nodes are in same level.

TERMINAL QUESTIONS

1. Describe About Construction of B-Tree.

2. Define order of the B-Tree.

3. List out the different properties of B-Tree.

3. Analyze the time complexity of B-Tree.

4. Summarize What is B-Tree, its types and operations possible on it?

REFERENCES FOR FURTHER LEARNING OF THE SESSION

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2010 , Second Edition, PearsonEducation.
2. 2. Ellis Horowitz, Fundamentals of Data Structures in C: Second Edition, 2015
3. A.V.Aho, J. E. Hopcroft, and J. D. Ullman, “Data Structures And Algorithms”, Pearson Education, First Edition Reprint2003.

Sites and Web links:

1. https://nptel.ac.in/courses/106102064
2. https://in.udacity.com/course/intro-to-algorithms--cs215
3. https://www.coursera.org/learn/data-structures?action=enroll

THANK YOU

Team – Data Sructures