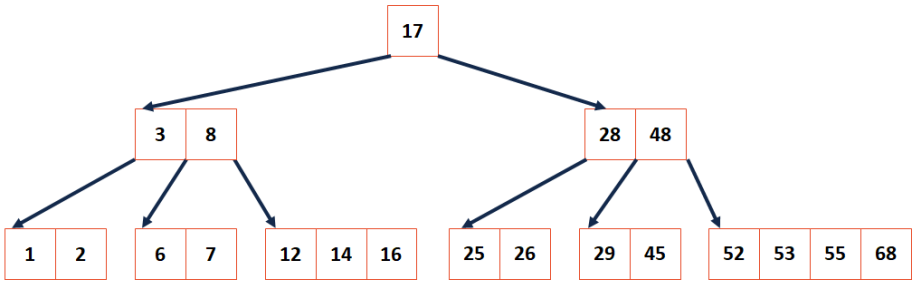
CS 225

#25: BTrees Analysis

October 25, 2017



BTree Properties

For a BTree of order **m**:

1. All keys within a node are ordered.
2. All nodes contain no more than **m-1** keys.
3. All internal nodes have exactly **one more child than key**.
4. Root nodes can be a leaf or have **[2, m]** children.
5. All non-root, internal nodes have **[ceil(m/2), m]** children.
6. All leaves are on the same level.

BTree Analysis

The height of the BTree determines maximum number of _____ possible in search data.

...and the height of our structure:

Therefore, the number of seeks is no more than: _____.

...suppose we want to prove this!

Remember from our AVL analysis:

- Finding an upper bound on the height (given **n**) is the same as finding a lower bound on the nodes (given **h**).
- Goal: Find a relationship for BTrees between the number of keys (**n**) and the height (**h**).

BTree Strategy:

1. Count the number of nodes, level by level.
2. Add the minimum number of keys per node.
3. Proving a minimum number of nodes provides us with an upper-bound for the maximum possible height.

1a. The minimum number of nodes for a BTree of order **m** at each level is as follows:

root:

level 1:

level 2:

level 3:

...

level h:

1b. The total number of nodes is the sum of all levels:

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2. The total number of keys:

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3. Finally, we show an upper-bound on height:

So, how good are BTrees?
Given a BTree of order 101, how much can we store in a tree of height=4?

Minimum:

Maximum:

Hashing

Locker Number	Name
103	
92	
330	
46	
124	

…how might we create this today?

Dictionary ADT (Part 2)

Dictionary.h

```
1  #ifndef DICTIONARY_H
2  #define DICTIONARY_H
3  template <class K, class V>
4  class Dictionary {
5    public:
6      void insert(K & k, V & v);
7      void remove(const K & k);
8      V & find(const K & k) const;
9
10
11
12
13
14
15   private:
16 };
17 #endif
```

Goals for Understanding Hashing:

1. We will define a **keyspace**, a (mathematical) description of the keys for a set of data.

2. We will define a function used to map the **keyspace** into a small set of integers.

CS 225 – Things To Be Doing:

1. Exam #7 (theory exam) is live!
2. MP5 is available now; extra credit +7 deadline is Monday
3. lab_btree starts today
4. Daily POTDs