### BTree Motivation

Big-O assumes uniform time for all operations, but this isn’t always true.

However, seeking data from the cloud may take 100ms+. ...an O(lg(n)) AVL tree no longer looks great:

![BTree Example](image)

#### Consider Facebook profile data:

<table>
<thead>
<tr>
<th>How many profiles?</th>
<th>AVL Tree</th>
<th>BTree</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much data/profile?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### BTree Motivations

Knowing that we have long seek times for data, we want to build a data structure with two (related) properties:

1. 

2. 

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#### BTree Insert, using m=5

...when a BTree node reaches m keys:

#### BTree Insert, m=3:

![BTree Insert Example](image)

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#### Great interactive visualization of BTrees:

[https://www.cs.usfca.edu/~galles/visualization/BTree.html](https://www.cs.usfca.edu/~galles/visualization/BTree.html)
BTree Properties
For a BTree of order \( m \):
1. All keys within a node are ordered.
2. All leaves contain no more than \( m-1 \) nodes.
3. All internal nodes have exactly one more key than children.
4. Root nodes can be a leaf or have \([2, m]\) children.
5. All non-root, internal nodes have \([\lceil m/2 \rceil, m]\) children.
6. All leaves are on the same level.

Example BTree

What properties do we know about this BTree?

BTree Search

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!

BTree Analysis
In our AVL Analysis, we saw finding an upper bound on the height (given \( n \)) is the same as finding a lower bound on the nodes (given \( h \)).

Goal: We want to find a relationship for BTrees between the number of keys (\( n \)) and the height (\( h \)).

CS 225 – Things To Be Doing:
1. Programming Exam B starts next tomorrow (March 13\textsuperscript{th})
2. MP4 due tonight
3. lab\textsubscript{btree} released this week; due Tuesday, March 27\textsuperscript{th} at 11:59pm 
(That's the Tuesday evening after spring break)
4. Daily POTDs are ongoing!