CSE 100:
B TREES (CONTD)
CAPES and End of year survey

- Have you filled out the CAPE form?
  A. Yes
  B. No

Deadline Mon Dec 15th
Insertion and properties of B-trees

Insert 15 into this B-tree
Insertion and properties of B-trees

Insert 22 and 23
Insertion and properties of B-trees

Insert 16
Insertion and properties of B-trees

Insert 16, after
Insertion and properties of B-trees

Insert 62

Which key will be promoted up?
A. 61   B. 62   C. 68   D. 75   E. 80
Insertion and properties of B-trees

Which key will be promoted up?
A. 13    B. 25    C. 60    D. 85    E. 68
Insertion and properties of B-trees

Insert 62
Insertion and properties of B-trees

B-trees grow up! (Which is why all their leaves are always at the same level)
Insertion and properties of B-trees

B-trees grow up! (Which is why all their leaves are always at the same level)
What is the time to find an element in a B-tree of order $M$ with $N$ keys?

• What is the maximum height of the tree in terms of $M$ and $N$?
Exact expression for the worst case time to find an element in a B-tree of order $M$ with $N$ keys?

- Maximum height: $\log_{M/2} N$
- Given
  - $T_m$ is the time to access an element in memory
  - $T_d$ is the time to access an element on disk
Exact expression for the worst case time to find an element in a B-tree of order M with N keys?

- Maximum height: \( \log_{M/2} N \)
- Given
  - \( T_m \) is the time to access an element in memory
  - \( T_d \) is the time to access an element on disk
- Time to find an element: \( T_m \log M \times \log_{M/2} N + T_d \log_{M/2} N \)

What is the worst case big O run time of find?
A. \( O(\log_2 M) \)
B. \( O(\log_2 N) \)
C. Neither
B-Tree performance

• Worst case $O(\log_2 N)$ which doesn’t reflect their true benefit

• The time savings in a B-Tree comes from *efficiently reading lots of data from disk*

• When B-Trees are stored in memory they are typically comparable to other search trees

• When they have to access disk they are a big win
(2-3-4) B-trees
(2-3-4) B-trees == RBTs!
(2-3-4) B-trees == RBTs!

So which are asymptotically faster? RB-trees or 2-3-4 (B) trees?
A. RB trees
B. B-trees
C. They are the same
B-Tree performance

• Refer Paul Kube’s slides

http://cseweb.ucsd.edu/users/kube/cls/100/Lectures/lec17/lec17.pdf