



COS 212 Tutorial 6: Version A

- 30/03/2012
 - 50minutes
 - 3 questions for a total of 30 marks.
-

Name: _____

Student/staff Nr: _____

Marker (office use): _____

Question 1 B^{*}-Trees (14 marks)

- 1.1 Discuss two motivations behind using B^{*}-trees over B-trees.

(4)

Answer:

Solution: Nodes are fuller, meaning trees become shallower as each node has more keys.
Splitting which could become expensive is delayed for as long as possible.

- 1.2 Describe the problem that arises when the root node in a B^{*}-tree needs to split. Also suggest (a) solution(s) to this problem.

(3)

Answer:

Solution: There are not enough keys to divide between siblings and new root so that siblings remain $2/3$ full

Suggestion: Because inserts always happen in leaf nodes, allow new root's children to underflow for now.

- 1.3 Use your suggestion from the previous question and insert the following keys, in the given order, into an initially empty B^* -tree where $m = 9$. Only draw your final tree. (5)

10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 40, 39, 38, 37, 36, 35, 34

Answer:

- 1.4 What is the maximum height that a B*-tree which contains n keys can have? (1)

Answer:

Solution: For a tree of order m , the min number of children (except the root) is $\lfloor \frac{2m-1}{3} \rfloor + 1$.

Let $m_{min} = \lfloor \frac{2m-1}{3} \rfloor + 1$

Then roughly: $\log_{m_{min}}(\frac{n+1}{2})$

- 1.5 What is the minimum number of keys that may be contained in a B*-tree of order 9 ($m = 9$) and height 8? (1)

Answer:

Solution: Root is 1.

The number of keys in every other node is $\lfloor \frac{18-1}{3} \rfloor = 5$

Each node (except the root) has 6 children. We can see this as a 6-order tree that is completely full except for the root.

Total number of keys is in each of the root's children is $6^7 - 1 = 279935$

There are two such subtrees so: $279935 * 2 = 559870$

then plus the root's one key gives: $1 + 559870 = 559871$

Question 2 B⁺-Trees (9 marks)

- 2.1 In terms of searching, is there an advantage of using a standard B-tree over a B⁺-tree? Motivate your answer. (2)

Answer:

Solution: Data is in the internal nodes as well and can be retrieved quicker.

B⁺ trees have all data in the leaf nodes so before data can be retrieved traversal proceeds to the lowest level.

- 2.2 For B-trees m cannot be even. Is this also the case for B⁺-trees? Motivate your answer. (2)

Answer:

Solution: Because copies and not keys are sent up and not data one can safely split internal nodes by omitting separators between siblings and dividing children sensibly.

- 2.3 Insert the following keys, in the given order, into a **prefix** B⁺-tree of order 5. Only draw your final tree. (5)
110707, 33333, 44444, 110866, 110877, 110856, 33444, 444098, 110899, 321123.

Answer:

Question 3 Tries (7 marks)

- 3.1 What is the height of a trie containing only the following words? Also mention how you determined your answer. (2)

cat, cater, catering, closet, closed, ant, an, another,
seen, sun, supercalifragilisticexpialidocius

Answer:

Solution: 7

- 3.2 Apply the `compressTrie` algorithm to the trie from the previous question and draw the compressed version on this trie. (5)

Answer: