**NAME:**

**CS 623**

**HW 7**

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| **Exercise** | **Points** |
| Exercise 1 | 40 |
| Exercise 2 | 40 |
| Exercise 3 | 10 |
| Exercise 4 | 10 |
| Total | 100 |

NOTE: Collaboration is allowed but plagiarism is not! Do not copy random answers off the internet as I would know. Please attempt this HW individually as the final exam would have similar questions.

**Exercise 1**

1. Consider an extendible hashing structure that,

1. Each bucket can hold up to 2 records

2. Is initially empty (only one empty bucket)

Consider the result after inserting key 8, 16, 4, 3, 11, 12 in order, using the lowest-bits for the hash function. That is, records in a bucket of local depth d agree on their rightmost d bits. For example, key 4 (0100) and key 12 (1100) agree on their rightmost 3 bits (100).

1. What is the global depth of the resulting directory?
2. Now insert key 18. What is the local depth of the bucket that contains the key 18?

NOTE: Show/Explain how you arrived at your answer.

Diagram, engineering drawing

Description automatically generated

b.) Answer the following questions about Figure 1. Suppose we insert keys 28, 30, 4, 8, 34 in order.

I. Which key will cause the first split?

II.) Which key will first cause the directory to double in size?

**Exercise 2**

**Consider the B+ tree below:**

**Diagram, engineering drawing

Description automatically generated**

1. What is the minimum number of pointers to be followed to satisfy the query: Get all records with key greater than 11 and less than 27?
2. Write a code(an algorithm) for an insert into this tree in the form <k,p> where k is the search key value and P is the pointer. Simulate an insertion. Attach a screenshot of the code and input. Use any programming language of choice.
3. Give an upper bound on the number of pages that must be fetched to perform a binary search for a particular name in the phonebook of say NY city (hint: think time complexity). By how much is this number reduced if an index is prepared giving the name of the first entry on each page pf the phone book?
4. Why can a file only have one clustered index?

NOTE: Explain/Show how you arrived at the numbers in I.

**Exercise 3**

Answer the following question for the hash table of Figure 2. Assume that a bucket split occurs whenever an overflow page is created. h0(x) takes the rightmost 2 bits of key x as the hash value, and h1(x) takes the rightmost 3 bits of key x as the hash value.

Diagram

Description automatically generated

What is the smallest key that is larger than 25 whose insertion will cause a split?

NOTE: Show/Explain how you arrived at your answer.

**Exercise 4**

1. Describe a search algorithm for a B+ tree in which the search key is not a candidate key. Assume that overflow pages are not used to handle duplicates.
2. Does the final structure of a B+ tree depend on the order in which items are added to it? Explain your answer.