

1501 Midterm Practice Questions

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Score: _____ / 50

- The use of any notes or electronic devices will be considered cheating.
- You must turn in ALL pages of the exam for your exam to be graded. Failure to turn in all pages of this exam booklet will result in a 0 on the exam.
- Illegible answers will receive 0 points.

1. (10 points) Carefully read each prompt and select the best answer for each question.

(a) Which of the following is a stable sorting algorithm?

- A LZW
- B Heapsort
- C Radix sort
- D We did not discuss any stable sorting algorithms

(b) Which of the following is a property shared by all of the tries we discussed?

- A Worst case height is guaranteed to be $O(\lg n)$
- B Tied values always maintain their relative ordering
- C Nodes are tuned to be 1 disk block in size
- D Keys are implicitly stored as paths from root to leaf

(c) Which of the following cannot be used to implement a symbol table?

- A Rabin-Karp
- B A binary search tree
- C A B-tree
- D All of the above can be used to implement a symbol table

(d) Assume that $f(x)$ is $O(x^2)$ and $f(x)$ is $\Omega(\log(x))$. Which of the following must be true?

- A $f(x)$ is $\Omega(x^3)$
- B $f(x)$ is $O(x^3)$
- C $f(x)$ is $\Theta(x)$
- D None of the above

(e) Which of the following is a property of a good hash function?

- A Produces the same output for every input
- B Exploits differences between keys
- C Produces a normal distribution of hash values
- D Utilizes most of the key

2. (8 points) The following code is used in the book's implementation of LSD Radix sort. Fill in the blanks so that the code works properly.

```
public static void sort(String[] a, int w) {
    int n = a.length;
    int R = 256;    // extend ASCII alphabet size
    String[] aux = new String[n];

    for (int d = w-1; d >= 0; d--) {
        // sort by key-indexed counting on dth character

        // compute frequency counts

        int[] count = _____;
        for (int i = 0; i < n; i++)

            _____;

        // compute cumulates
        for (int r = 0; r < R; r++)

            _____;

        // move data
        for (int i = 0; i < n; i++)

            _____;

        // copy back
        for (int i = 0; i < n; i++)
            a[i] = aux[i];
    }
}
```

3. (10 points) Consider the following B-tree.

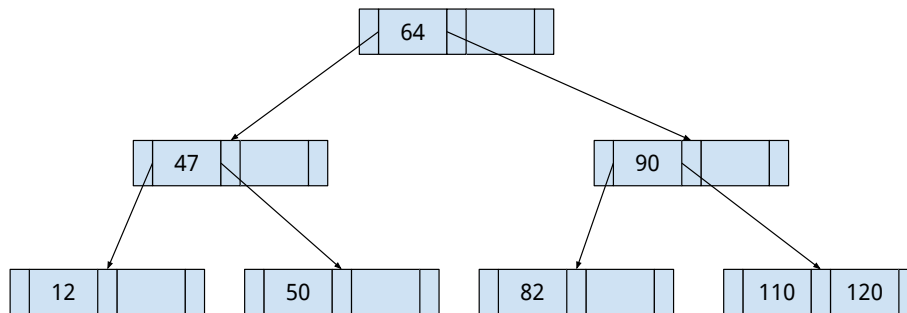


Figure 1: An example B-tree

- Show the B-tree that would result from inserting 115 into the B-tree shown in Figure 1.

- Show the B-tree that would result from removing 12 from the B-tree shown in Figure 1.

- What is the order of the B-tree shown in Figure 1?

4. (12 points) Consider using Huffman encoding to compress the following string:
“DONTTELLMEILLTELLYOU”.

Show the following:

- The Huffman tree
- The codeword/character pairs

State any assumptions that you make.

5. (10 points) Use separate chaining to insert the following numeric keys into a hash table backed by a length 7 array and show the resulting data structure. Insert the keys in the order shown (from left to right). Use the hash function provided.

$$h(x) = x \bmod 7$$

Values to insert: 14, 5, 3, 7, 15, 17, 6, 23