Q1
13 Points

Q1.1
1 Point

For which of the following functions is the Big-O approximation the same as the Tilda approximation?

- [x] $f(n) = n^2 + n$
- [ ] $f(n) = 5n^2 + 7n$
- [x] $f(n) = n^2 + 7n$

Q1.2
1 Point

Assuming all keys are b-bits wide, the worst-case number of **key comparisons** to insert into a Digital Search Tree is:

- [ ] O(1)
- [x] $O(b)$
- [x] $\Theta(b)$
- [x] $\Omega(b)$
- [x] $O(b^2)$
- [ ] $\Theta(b^2)$
- [ ] $\Omega(b^2)$

Q1.3
1 Point

Assuming all keys are b-bits wide, the worst-case number of **key comparisons** to insert a into a 2-way Radix Search Trie is:

- [x] O(1)
- [ ] $O(b)$
- [ ] $\Theta(b)$
- [ ] $\Omega(b)$
- [ ] $O(b^2)$
- [ ] $\Theta(b^2)$
- [ ] $\Omega(b^2)$

Q1.4
1 Point

Assuming all keys are b-bits wide, the worst-case number of **bit comparisons** to insert into a Digital Search Tree is:

- [ ] O(1)
- [ ] $O(b)$
- [ ] $\Theta(b)$
- [x] $\Omega(b)$
- [x] $O(b^2)$
- [x] $\Theta(b^2)$
- [x] $\Omega(b^2)$

Q1.5
1 Point

Assuming all keys are b-bits wide, the worst-case number of **bit comparisons** to insert into a 2-way Radix Search Trie is:

- [ ] O(1)
- [x] $O(b)$
- [x] $\Theta(b)$
- [x] $\Omega(b)$
- [x] $O(b^2)$
- [ ] $\Theta(b^2)$
- [ ] $\Omega(b^2)$

Q1.6
1 Point

consider a 2-way Radix Search Trie with the following keys (as 4-bit integers): 5 (0101), 10 (1010), 11 (1011), 3 (0011), 15 (1111). What is the height of the trie? (Only an empty trie has a height of zero)

4

Q1.7
1 Point

consider a Digital Search Tree with the following keys (as 4-bit integers): 5 (0101), 10 (1010), 11 (1011), 3 (0011), 15 (1111). What is the height of the tree? (Only an empty tree has a height of zero)

3

Q1.8
1 Point

Which of the following key sequences (as 4-bit integers) gives a DST with the largest height?

- (●) 5 (0101), 10 (1010), 12 (1100), 15 (1111)
- ( ) 5 (0101), 10 (1010), 11 (1011), 3 (0011), 15 (1111)
- ( ) 5 (0101), 10 (1010), 11 (1011), 3 (0011), 15 (1111), 2 (0010)
- ( ) 5 (0101), 10 (1010), 11 (1011), 3 (0011), 15 (1111), 2 (0010), 4 (0100)

Q1.9
1 Point

The runtime of Horner's hashing method is constant regardless of the key length.

- ( ) True
- (●) False

Q1.10
1 Point

All brute-force algorithms have exponential worst-case runtime.

- (●) True
- ( ) False

Q1.11
1 Point

The asymptotic best-case runtime of an algorithm is $nlogn$ and the asymptotic worst-case runtime of the same algorithm is n^2. The runtime of the algorithm is then:

- [ ] $O(2^n)$
- [x] $O(n^2)$
- [ ] $O(nlogn)$
- [ ] $O(logn)$
- [ ] $\Omega(1)$
- [ ] $\Theta(n^2)$
- [ ] $\Theta(nlogn)$
- [ ] $\Omega(n^2)$
- [x] $\Omega(nlogn)$

Q1.12
1 Point

In the Boggle game with a 4x4 grid, the backtracking algorithm that searches for all possible words starting from a particular tile has to make at most _____ decisions, with at most _____ valid options for a decision.

- (●) 2^{15}, 7
- ( ) 15^2, 7
- ( ) 15, 7
- ( ) 4, 4

Q1.13
1 Point

Which of the following Symbol Table implementations require(s) the key type to implement the Java `Comparable` interface?

- [ ] Unsorted Linked list with Linear Search
- [ ] Sorted Linked list with Linear Search
- [ ] Unsorted Array with Linear Search
- [x] Sorted Array with Binary Search
- [x] Binary Search Tree
- [ ] Digital Search Tree
- [ ] 2-way Radix Search Trie
- [ ] R-way Radix Search Trie
- [ ] DLB Trie
- [ ] Hash table

Q2
4 Points

Assume that you have been tasked with building a symbol table that will map Pitt usernames to full names (e.g., the key `abc123` would map to the value "Bot Anonymous"). Further, assume that you will be using this symbol table to perform the following operations:

Operation 1: Given a username, return the associated full name.
Operation 2: Given a sequence of 3 characters (e.g., `abc`), determine the next available number (e.g., if `abc1` to `abc123` exist, then `124` is the next available number.

Q2.1
1 Point

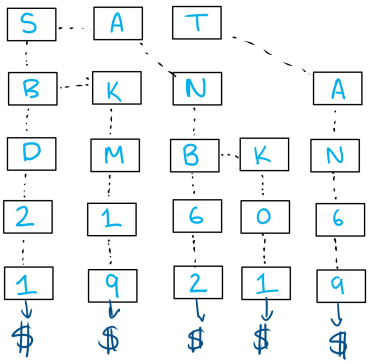
Assuming that you select to use a DLB Trie to implement the symbol table. Draw the DLB after inserting **five** Pitt usernames of your choice. List the usernames that you selected.

SBD22, SKM19, ANB62, ANK01, TAN71

Q2.2
1 Point

Upload your drawing:

mydlb.jpg Download



Q2.3
1 Point

What is the asymptotic worst-case runtime of **Operation 1** using your data structure?

O(wR)

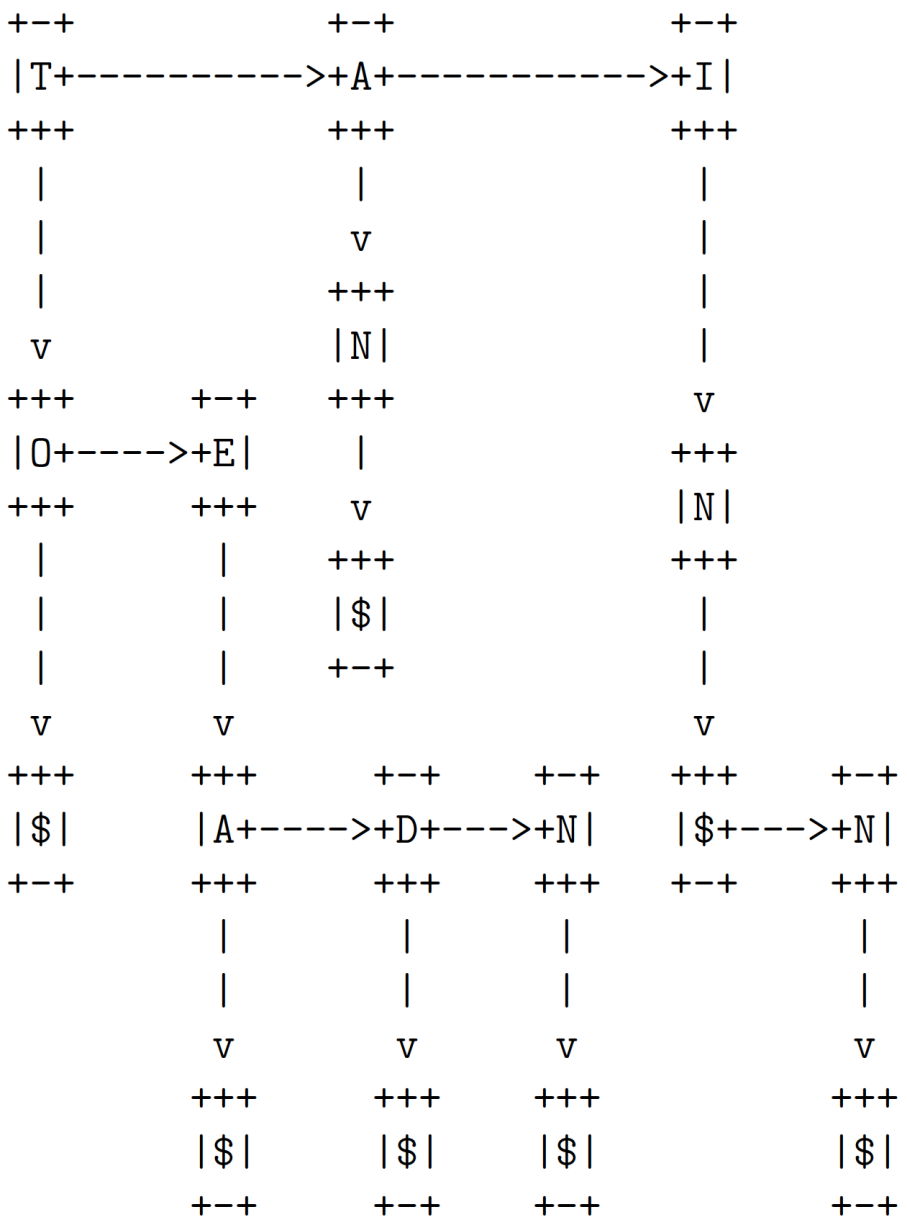
Q2.4
1 Point

What is the asymptotic worst-case runtime of **Operation 2** using your data structure?

O(wR)

Q3
7 Points

Consider the following De La Briandais (DLB) Trie. $ is the string termination character. Answer the following questions with respect to the given trie.



Q3.1
1 Point

The root node of the given trie is the node that contains the letter

T

Q3.2
1 Point

The number of keys in the trie is

7

Q3.3
1 Point

The string IN is:

- ○ neither a prefix nor a word#
- ○ a prefix but not a word
- ○ a word but not a prefixx
- ◉ both a word and a prefixx

Q3.4
1 Point

The number of letter comparisons for the target string `TEAR` is

5

Q3.5
1 Point

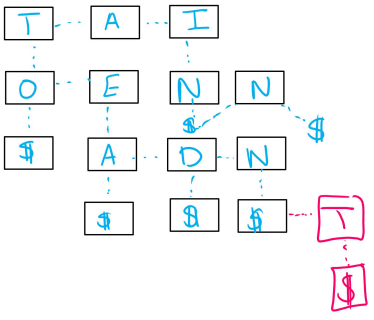
The number of letter comparisons for the target string `INK` is

6

Q3.6
1 Point

Draw the trie after inserting the string TENT.

tent.jpg Download



Q3.7
1 Point

The number of nodes that you had to add to the trie in the previous question is

2

Homework 1

GRADED

STUDENT
Sushruti Bansod

TOTAL POINTS
18.5 / 24 pts

QUESTION 1

(no title) — **8** / 13 pts

1.1	(no title)	**1** / 1 pt
1.2	(no title)	**1** / 1 pt
1.3	(no title)	**0** / 1 pt
1.4	(no title)	**1** / 1 pt
1.5	(no title)	**1** / 1 pt
1.6	(no title)	**0** / 1 pt
1.7	(no title)	**1** / 1 pt
1.8	(no title)	**1** / 1 pt
1.9	(no title)	**1** / 1 pt
1.10	(no title)	**0** / 1 pt
1.11	(no title)	**0** / 1 pt
1.12	(no title)	**0** / 1 pt
1.13	(no title)	**1** / 1 pt

QUESTION 2

(no title) — **4** / 4 pts

2.1	(no title)	**1** / 1 pt
2.2	(no title)	**1** / 1 pt
2.3	(no title)	**1** / 1 pt
2.4	(no title)	**1** / 1 pt

QUESTION 3

(no title) — **6.5** / 7 pts

3.1	(no title)	**1** / 1 pt
3.2	(no title)	**1** / 1 pt
3.3	(no title)	**1** / 1 pt
3.4	(no title)	**1** / 1 pt
3.5	(no title)	**1** / 1 pt
3.6	(no title)	**0.5** / 1 pt
3.7	(no title)	**1** / 1 pt