Project

CSCD 320: Algorithms Fall 2016

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Questions:

1) Time complexity (worst case) :

Constructing the Tree 4^N

Searching the dictionary + 4^N

$2(4^N)$

$O(4^N)$

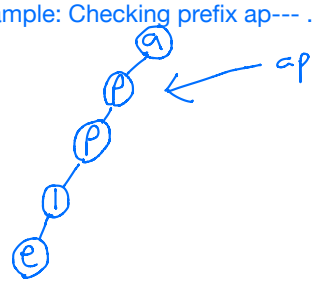
Note: In the worst case all digits have 4 possible values and every combination is a word in the dictionary.

2) An exhaustive search is where you search through all of the possible values. Generating all combinations of words from the given digits (not using branch and bound) is an exhaustive search.

3) Branch and bound is where you only search a category of solution that has a chance of being correct.

4) You can use Branch and bound to eliminate all prefixes that are not part of a word. The prefix tree provides a convenient way to check if a prefix exists.

Example: Checking prefix ap--- .



Since ap--- is a prefix, it makes sense to continue searching for the words that can be build with it, you could continue checking:

app--

apl--

apr--

app--

...

5)

This table summarizes the results of the output below:
(Branch and Bound will be abbreviated with BB)

SEARCH TIMES
(milliseconds)

N	Using BB	Not Using BB
2	1	1
3	1	2
4	2	2
5	3	3
6	2	4
7	2	6
8	2	9
9	2	13
10	3	31

Notice the increased runtimes when not using branch and bound.

output with Branch and Bound

```
Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
46
------ Start Results -------
go
hm
im
in
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 172 milliseconds
Find Matches Time:     1 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
463
------ Start Results -------
gne
god
imf
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 170 milliseconds
Find Matches Time:     1 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
4635
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 176 milliseconds
Find Matches Time:     2 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
46353
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 178 milliseconds
Find Matches Time:     3 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
463532
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 181 milliseconds
Find Matches Time:     2 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
4635328
------ Start Results -------
inflect
------- End Results --------
Using Trie for dictionary
```

```
Dictionary Build Time: 176 milliseconds
Find Matches Time:     2 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
46353284
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 170 milliseconds
Find Matches Time:     2 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
463532846
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 173 milliseconds
Find Matches Time:     2 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb T
Enter a numbered keypad sequence:
4635328464
------ Start Results -------
inflecting
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 170 milliseconds
Find Matches Time:     3 milliseconds
```

output without Branch and Bound (notice the times get longer toward the end)

```
Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
46
------ Start Results -------
go
hm
im
in
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 173 milliseconds
Find Matches Time:     1 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
463
------ Start Results -------
gne
god
imf
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 182 milliseconds
Find Matches Time:     2 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
4635
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 174 milliseconds
Find Matches Time:     2 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
46353
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 169 milliseconds
Find Matches Time:     3 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
463532
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 177 milliseconds
Find Matches Time:     4 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
4635328
------ Start Results -------
inflect
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 183 milliseconds
```

```
Find Matches Time:     6 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
46353284
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 175 milliseconds
Find Matches Time:     9 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
463532846
------ Start Results -------
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 180 milliseconds
Find Matches Time:     13 milliseconds

Michaels-MacBook-Pro-2:src michael$ java Tester -f dictionary.txt -dt TR -bb F
Enter a numbered keypad sequence:
4635328464
------ Start Results -------
inflecting
------- End Results --------
Using Trie for dictionary
Dictionary Build Time: 185 milliseconds
Find Matches Time:     31 milliseconds
```