

Experimentation

Dictionary 1:

Number of PUDatetimes to be searched	Time
5	2 minutes 52 seconds
6	3 minutes 13 seconds
7	3 minutes 3 seconds
8	3 minutes 5 seconds
9	3 minutes 5 seconds
10	3 minutes 11 seconds
11	3 minutes 16 seconds
12	3 minutes 16 seconds

```
Girish-MacBook-Pro:asgi girish$ make dict1
make[1]: dict1 is up to date.
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.887s
user    2m57.872s
sys     6m8.852s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.204s
user    2m57.388s
sys     6m8.877s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.802s
user    2m57.852s
sys     6m8.952s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m7.732s
user    2m57.784s
sys     6m8.952s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m7.470s
user    2m57.458s
sys     6m8.952s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m7.332s
user    2m57.320s
sys     6m8.999s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.490s
user    2m56.458s
sys     6m8.952s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.332s
user    2m56.320s
sys     6m8.999s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.272s
user    2m56.272s
sys     6m8.952s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.376s
user    2m56.320s
sys     6m8.952s
Girish-MacBook-Pro:asgi girish$ time ./dict1 2018full_size_no_headers.csv output.txt keyfile.txt
2018-01-01 00:31:17 --> 1
2018-01-01 16:49:56 --> 58
2018-01-02 13:09:09 --> 187
2018-01-02 18:27:38 --> 127
2018-01-02 18:27:38 --> 127

real    3m6.192s
user    2m56.182s
sys     6m8.959s
Girish-MacBook-Pro:asgi girish$
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### Dictionary 2:

Number of PULocationID to be searched	Time
5	0 minutes 26 seconds
6	0 minutes 27 seconds
7	0 minutes 27 seconds
8	0 minutes 27 seconds
9	0 minutes 28 seconds
10	0 minutes 27 seconds
11	0 minutes 28 seconds
12	0 minutes 28 seconds

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Girinta-MacBook-Pro:assagi girin@t make dict*
make: dict? is up to date.
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5

real    0m26.262s
user    0m25.375s
sys      0m0.495s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5

real    0m27.498s
user    0m27.029s
sys      0m0.372s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5

real    0m27.788s
user    0m27.136s
sys      0m0.506s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5
187 --> 2

real    0m27.852s
user    0m27.383s
sys      0m0.516s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5
187 --> 2
61 --> 9

real    0m28.815s
user    0m27.371s
sys      0m0.556s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5
187 --> 2
61 --> 9
238 --> 7

real    0m28.815s
user    0m27.371s
sys      0m0.565s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5
187 --> 2
61 --> 9
238 --> 7
48 --> 6

real    0m27.646s
user    0m26.941s
sys      0m0.583s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5
187 --> 2
61 --> 9
238 --> 7
48 --> 6

real    0m28.892s
user    0m27.493s
sys      0m0.538s
Girinta-MacBook-Pro:assagi girin@t ./dict2 2018Full_size_no_headers.csv output.txt <keyfile.txt
162 --> 1
148 --> 6
164 --> 8
164 --> 8
239 --> 9
7 --> 5
13 --> 5
187 --> 2
61 --> 9
238 --> 7
48 --> 6
98 --> 5

real    0m28.188s
user    0m27.588s
sys      0m0.551s
Girinta-MacBook-Pro:assagi girin@t

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Average bigO:

BigO of inserting in linked list-  $O(1)$

BigO of inserting in binary search tree-  $O(\log(n))$

BigO of searching in linked list-  $O(n)$

BigO of searching in binary search tree-  $O(\log(n))$

Worst case bigO:

BigO of inserting in linked list-  $O(1)$

BigO of inserting in binary search tree-  $O(n)$

BigO of searching in linked list-  $O(n)$

BigO of searching in binary search tree-  $O(n)$

When we see the comparisons of dictionary 1: We see that the time gradually increases by 2- 20 seconds more each time a new PUDatetime is added to the keyfile to search. Since PUDatetime in many cases are not the same it doesn't become a linked list and hence is a node in the tree.

When we see the comparisons of dictionary 2: We see that the time is almost constant and there is little to no difference in the time when a new PULocationID is added to the keyfile for searching. This is because many of the nodes are similar and gets added to a linked list making only list head a root in the binary search tree.

Hence it takes more time for dictionary 1 as there are more roots of a tree and more values are getting inserted and searching in the binary search tree, whereas dictionary 2 is faster as it has similar nodes making the list head a root in the tree and have less nodes in the tree and having more in the linked list, which is faster for insertion and searching.