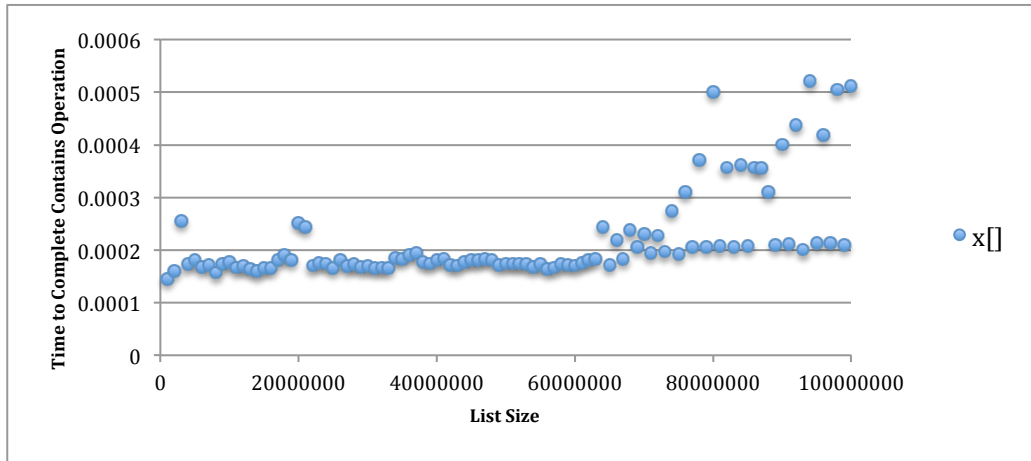


数据结构与算法第三次作业

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1. 做计时实验，验证 List 的按索引取值确实是 $O(1)$

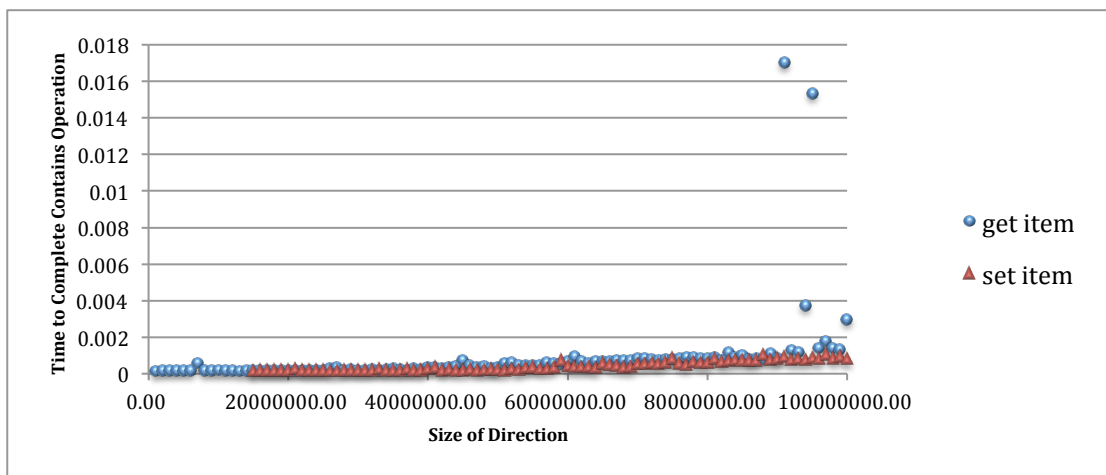
- 实验数据见附录
- 实验图表



• 实验结果：List 索引取值用时基本不随列表长度的变化而变化，为 $O(1)$ 数量级，但同时存在异常点，且随着列表规模增大异常点出现的更加频繁。

2. 做计时实验，验证 Dict 的 get item 和 set item 都是 $O(1)$ 的

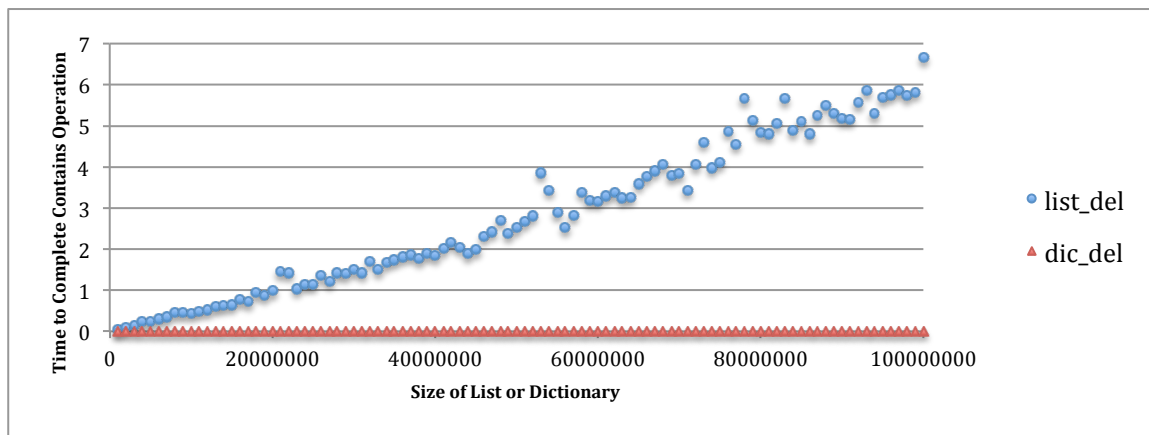
- 实验数据见附录
- 实验图表



• 实验结果：Dict 的 get item 和 set item 用时随着字典长度增加不发生显著变化，都为 $O(1)$ 数量级，但也存在少量异常点，且随着字典长度增加，get item 和 set item 用时都有很轻微上升。

3. 做计时实验，比较 **List** 和 **Dict** 的 **del** 操作符性能

- 实验数据见附录
- 实验图表



- 实验结果：实验结果可发现，**List** 的 **del** 操作时间随列表规模加大而线性上升，为 $O(n)$ 数量级，而 **Dict** 的 **del** 操作时间不随字典长度增加而发生显著变化，为 $O(1)$ 数量级。

附录

实验 1 数据：

size	x[]
1000000	0.00014505
2000000	0.00016036
3000000	0.00025584
4000000	0.00017316
5000000	0.00018038
6000000	0.00016873
7000000	0.00017131
8000000	0.00015702
9000000	0.0001731
10000000	0.00017741
11000000	0.00016734
12000000	0.00016966
13000000	0.00016435
14000000	0.00015983
15000000	0.00016598
16000000	0.00016606
17000000	0.0001812
18000000	0.00019114
19000000	0.000182
20000000	0.00025178
21000000	0.00024328
22000000	0.00017019
23000000	0.00017565
24000000	0.00017391
25000000	0.00016577
26000000	0.00018032
27000000	0.00016921
28000000	0.0001732
29000000	0.0001676
30000000	0.00016951
31000000	0.00016595
32000000	0.00016712
33000000	0.00016564
34000000	0.00018504
35000000	0.00018231
36000000	0.00019163
37000000	0.00019537

38000000	0.00017781
39000000	0.00017401
40000000	0.00018073
41000000	0.00018418
42000000	0.00017177
43000000	0.00017124
44000000	0.00017736
45000000	0.00018072
46000000	0.00018097
47000000	0.00018265
48000000	0.00018178
49000000	0.00017241
50000000	0.00017425
51000000	0.00017397
52000000	0.00017457
53000000	0.00017356
54000000	0.00016801
55000000	0.00017328
56000000	0.00016492
57000000	0.00016678
58000000	0.00017336
59000000	0.00017238
60000000	0.00017019
61000000	0.00017524
62000000	0.00018085
63000000	0.00018322
64000000	0.00024367
65000000	0.00017219
66000000	0.0002199
67000000	0.00018261
68000000	0.00023744
69000000	0.00020604
70000000	0.00022991
71000000	0.0001952
72000000	0.00022817
73000000	0.00019749
74000000	0.0002744
75000000	0.00019211
76000000	0.00031014
77000000	0.00020621
78000000	0.00037203
79000000	0.00020631

80000000	0.00049997
81000000	0.00020765
82000000	0.00035646
83000000	0.00020622
84000000	0.00036148
85000000	0.00020827
86000000	0.00035675
87000000	0.00035555
88000000	0.00031115
89000000	0.0002094
90000000	0.00040031
91000000	0.00021063
92000000	0.0004385
93000000	0.00020089
94000000	0.0005213
95000000	0.00021339
96000000	0.00041865
97000000	0.00021334
98000000	0.00050529
99000000	0.00020957
100000000	0.00051087

实验 2 数据：

size	get item	set item
1000000.00	0.0001408	0.00013996
2000000.00	0.00015805	0.00015486
3000000.00	0.00016683	0.00015447
4000000.00	0.00016093	0.00016774
5000000.00	0.00017413	0.00015963
6000000.00	0.00015559	0.00015338
7000000.00	0.0005995	0.00026332
8000000.00	0.00016267	0.00018545
9000000.00	0.00018309	0.00017006
10000000.00	0.00021366	0.00018037
11000000.00	0.00017036	0.00017685
12000000.00	0.00016477	0.00014945
13000000.00	0.00015037	0.0001487
14000000.00	0.00018469	0.00016236
15000000.00	0.00016908	0.00016183
16000000.00	0.00016341	0.00015995

17000000.00	0.00018555	0.00016806
18000000.00	0.0001797	0.00017508
19000000.00	0.00017797	0.00029224
20000000.00	0.00018185	0.00018051
21000000.00	0.00017594	0.00017117
22000000.00	0.00016192	0.00015561
23000000.00	0.0002126	0.00026977
24000000.00	0.00020421	0.00017217
25000000.00	0.00018414	0.00017333
26000000.00	0.00028262	0.0002825
27000000.00	0.00036632	0.00034378
28000000.00	0.00016582	0.00016373
29000000.00	0.00024631	0.00024048
30000000.00	0.00018508	0.00017426
31000000.00	0.00017342	0.0001653
32000000.00	0.00025655	0.0002465
33000000.00	0.0001762	0.00017031
34000000.00	0.00023421	0.00020359
35000000.00	0.00028386	0.0002347
36000000.00	0.00024952	0.00021644
37000000.00	0.0001822	0.00017878
38000000.00	0.00027112	0.00027247
39000000.00	0.00023322	0.00022207
40000000.00	0.00037274	0.00030344
41000000.00	0.00039487	0.00034746
42000000.00	0.00026176	0.00025867
43000000.00	0.00037541	0.00028493
44000000.00	0.00039822	0.00033443
45000000.00	0.00075256	0.00071796
46000000.00	0.00045521	0.00042267
47000000.00	0.00039274	0.0003878
48000000.00	0.00041359	0.00037166
49000000.00	0.00032146	0.00039232
50000000.00	0.00036587	0.00032171
51000000.00	0.0005787	0.0005639
52000000.00	0.00063774	0.0004946
53000000.00	0.00049137	0.00041304
54000000.00	0.00044128	0.00034677
55000000.00	0.00044402	0.00039486
56000000.00	0.00047968	0.0005267
57000000.00	0.00062448	0.00053277
58000000.00	0.00060707	0.00060682

59000000.00	0.00057259	0.00051588
60000000.00	0.00065813	0.00061265
61000000.00	0.00093317	0.00082996
62000000.00	0.00067876	0.00055623
63000000.00	0.00059688	0.00049279
64000000.00	0.00068434	0.00065914
65000000.00	0.00065535	0.00060518
66000000.00	0.00064804	0.00058295
67000000.00	0.00075338	0.00078373
68000000.00	0.00073606	0.00066226
69000000.00	0.00073649	0.00070763
70000000.00	0.00084912	0.00075639
71000000.00	0.00088585	0.00074476
72000000.00	0.0008158	0.00073945
73000000.00	0.00075839	0.00071386
74000000.00	0.00081005	0.00100331
75000000.00	0.00081289	0.0007802
76000000.00	0.00085214	0.00084894
77000000.00	0.00089724	0.00089911
78000000.00	0.00091212	0.00077924
79000000.00	0.00084705	0.00078811
80000000.00	0.00083004	0.00078026
81000000.00	0.00089871	0.00087643
82000000.00	0.00077675	0.0008136
83000000.00	0.00114166	0.00106202
84000000.00	0.00090504	0.00082726
85000000.00	0.00099878	0.00093844
86000000.00	0.00079948	0.00078631
87000000.00	0.00082579	0.00071565
88000000.00	0.00083831	0.00078532
89000000.00	0.00112447	0.00210126
90000000.00	0.00088729	0.00083388
91000000.00	0.01701882	0.01524657
92000000.00	0.00128835	0.00115961
93000000.00	0.00119972	0.00115876
94000000.00	0.00376151	0.00260047
95000000.00	0.01535434	0.00960495
96000000.00	0.00139997	0.00146059
97000000.00	0.00177171	0.00141396
98000000.00	0.00139953	0.00132966
99000000.00	0.0013192	0.00131965
100000000.00	0.00296057	0.00130188

实验 3 数据：

Size	list_del	dic_del
1000000	0.03817878	0.00016199
2000000	0.10172832	0.00032118
3000000	0.14583496	0.00018303
4000000	0.23624662	0.00017511
5000000	0.24122533	0.00019758
6000000	0.29816028	0.00018402
7000000	0.34647633	0.00026329
8000000	0.46454966	0.00037067
9000000	0.4593948	0.00019259
10000000	0.43743733	0.0001946
11000000	0.48447138	0.00024353
12000000	0.52070555	0.00019052
13000000	0.59533262	0.00018601
14000000	0.63422373	0.00018602
15000000	0.64858984	0.00018915
16000000	0.76831825	0.00025999
17000000	0.72250296	0.00034373
18000000	0.94400554	0.00021058
19000000	0.88157382	0.00019428
20000000	0.98790356	0.00020014
21000000	1.45403672	0.00036188
22000000	1.4313907	0.00019128
23000000	1.02822482	0.00019007
24000000	1.14587134	0.00018726
25000000	1.14544485	0.0001956
26000000	1.35755044	0.00019526
27000000	1.22267442	0.00019936
28000000	1.42712543	0.00019958
29000000	1.41315261	0.00019247
30000000	1.5059792	0.00017482
31000000	1.42575165	0.00019028
32000000	1.70197382	0.0001965
33000000	1.51007813	0.00018485
34000000	1.6741627	0.00020947
35000000	1.73629357	0.00021229
36000000	1.81468807	0.00058726
37000000	1.86185582	0.00020777
38000000	1.76483912	0.0002538
39000000	1.89950319	0.00038429
40000000	1.85085136	0.00021118

41000000	2. 01705094	0. 0002057
42000000	2. 18012575	0. 00023614
43000000	2. 0489104	0. 00020369
44000000	1. 88604056	0. 00020468
45000000	1. 98680571	0. 00051909
46000000	2. 31911569	0. 00052082
47000000	2. 42488126	0. 00078751
48000000	2. 69677847	0. 00048278
49000000	2. 36990738	0. 00116232
50000000	2. 52409375	0. 00049495
51000000	2. 6658994	0. 00063399
52000000	2. 8140457	0. 0004074
53000000	3. 85795892	0. 00042699
54000000	3. 43049527	0. 00046975
55000000	2. 89204361	0. 00041703
56000000	2. 53505758	0. 00041901
57000000	2. 82698815	0. 0003993
58000000	3. 38076745	0. 00044916
59000000	3. 18062373	0. 00049726
60000000	3. 16373813	0. 00049051
61000000	3. 28862344	0. 0003529
62000000	3. 38266193	0. 00041479
63000000	3. 24169937	0. 00041524
64000000	3. 26628792	0. 00037863
65000000	3. 5943492	0. 00034078
66000000	3. 76875775	0. 0003978
67000000	3. 90606734	0. 00035944
68000000	4. 05294667	0. 00034107
69000000	3. 79922959	0. 00033659
70000000	3. 84766749	0. 00033909
71000000	3. 43261314	0. 00037225
72000000	4. 05569508	0. 00034805
73000000	4. 61081848	0. 00037397
74000000	3. 98231761	0. 00031809
75000000	4. 10754703	0. 00034784
76000000	4. 86923425	0. 00039673
77000000	4. 5500609	0. 00043096
78000000	5. 66968882	0. 00046421
79000000	5. 12818252	0. 00048812
80000000	4. 84170147	0. 00057245
81000000	4. 79977484	0. 00054183
82000000	5. 05593779	0. 00053207

830000000	5.66170409	0.00077523
840000000	4.8812678	0.0005257
850000000	5.10693206	0.00049392
860000000	4.81096757	0.00069919
870000000	5.26394755	0.00074968
880000000	5.51146758	0.00073192
890000000	5.30357947	0.00080155
900000000	5.18309306	0.00127378
910000000	5.15762927	0.00091688
920000000	5.56377833	0.00107593
930000000	5.85889738	0.0009328
940000000	5.30277097	0.00100191
950000000	5.68912026	0.00112695
960000000	5.76286883	0.00103679
970000000	5.87272002	0.00102735
980000000	5.74579372	0.00118377
990000000	5.81700329	0.0016204
1000000000	6.65578519	0.00118976