Introduction

In order to explore the relationship between number of budgets and search quality, an additional test of different budgets are tested under different layouts. All the data are collected through program of Assignment 3 by command:

./pegsol [Layout] AI [budgets]

In which [layout] is an integer between 0 and 6, which budgets are one of 10000, 100000, 1000000, 1500000.

Before experiment, a prediction is that as the increase of nodes, more time and expanded nodes are required to get solution.

Results and Analysis

The result of first test can be witnessed in Appendix 1.1.

According to Appendix 1.1, it is clear that numbers of expanded nodes and generated nodes are only related to layout. The total execution time is recorded by program time counting and expended rate is simply expanded number divided by total execution time. Unlike expanded nodes and generated nodes, these two data are not consist during experiment, even when typing in exactly same command. This indicate that the execution time will be influenced by a random error generated by computer device system.

In terms of the data of layout 0 to 4, a consist proportional relation was not found in execution time of first 5 layouts in situation with different budgets number. One common point is that the expanded nodes are less than budgets number. Considering that then total numbers of nodes generated and execution time are quite small, it is likely that the proportional increase are counteracted by random error, so that irregular changes are found. However, this problem can be solved by increase the initial number of nodes of layouts.

In Appendix 2.1, it is obvious that lines which indicated higher budgets number always have same or lower number of nodes left comparing to others, which means number of budgets did have positive effect in increasing search quality. However, it can be also found that there is no difference if numbers of nodes is quite low.

Number of budgets defined the max number of expanded nodes, increase of which improves the ability to search a more complex layout bu no effect in enhancement of efficiency.

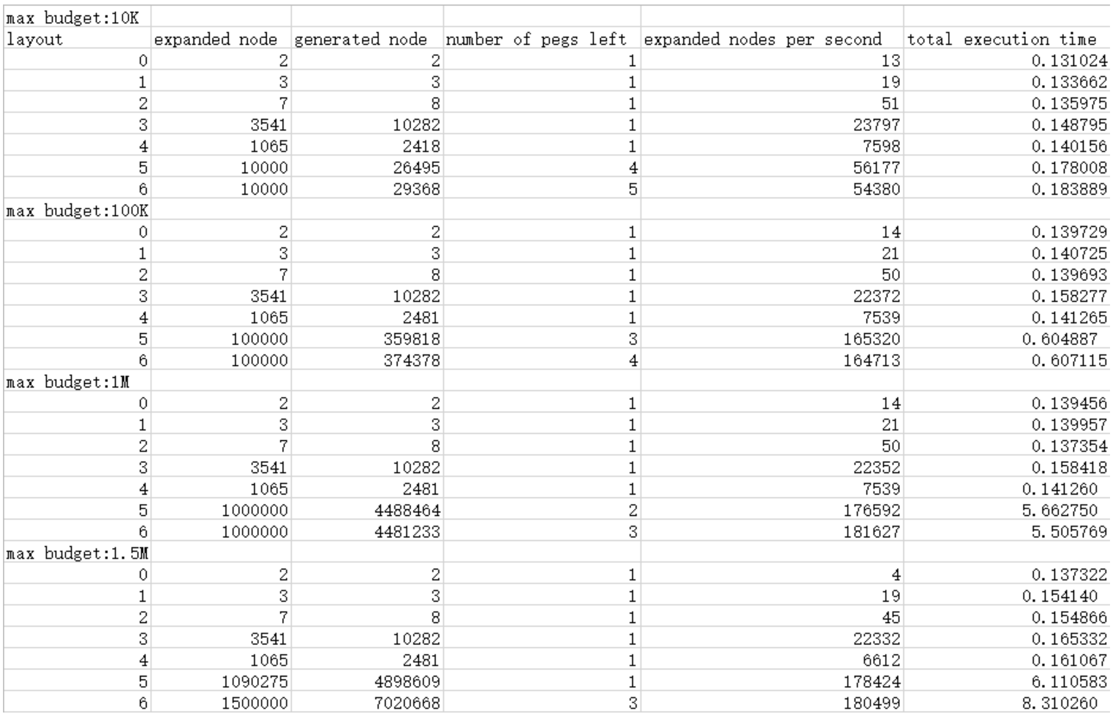
Appendix 2.2 pointed out the effect of budgets to the expanded nodes per second which is the rate of search. Data in first two group, whose expanded node are less than budgets number, fluctuated around same level. As explained in former stage, search time are heavily affected by random errors generated by computer device system, which therefore decrease the search rate. The important finding is the rate in layout 6, as the budgets number increased from 1 million to 1.5 million, the rate kept in same level. Continuing increase the budgets also gave same result that increase of expansion rate end up with number around 180000. This number indicated real search rate of this program and validate that budgets number has no effect on increasing efficiency.

Conclusion

Budgets number indicates the maximum nodes expanded in program. Higher number of budgets allows program to address game with more complex layout. But this value will not affect search efficiency. Search rate will be influenced by random errors generated by computer device system, which can not be eliminated but can be minimized by increase execution time, for example, searching solution for a extremely complex game.

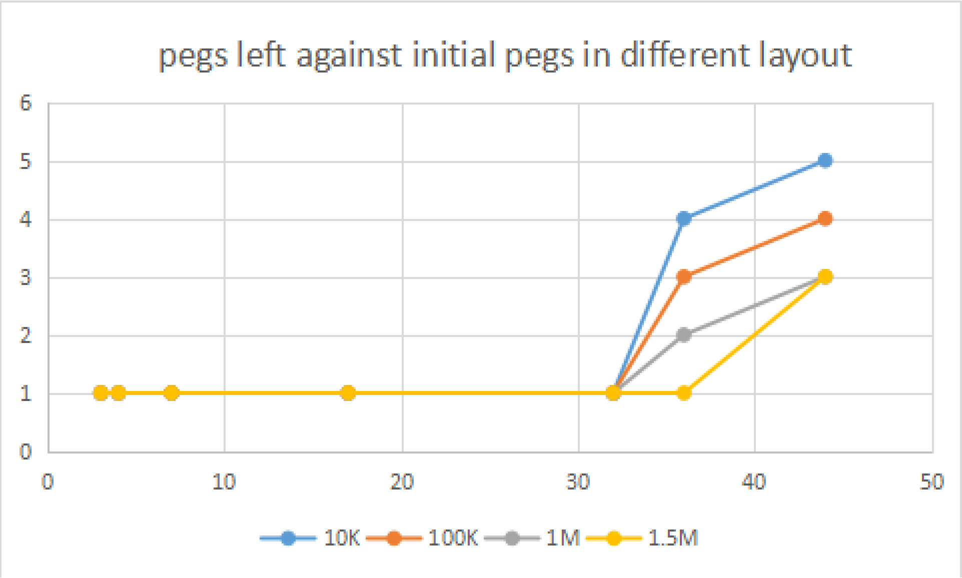
Appendix

1.1

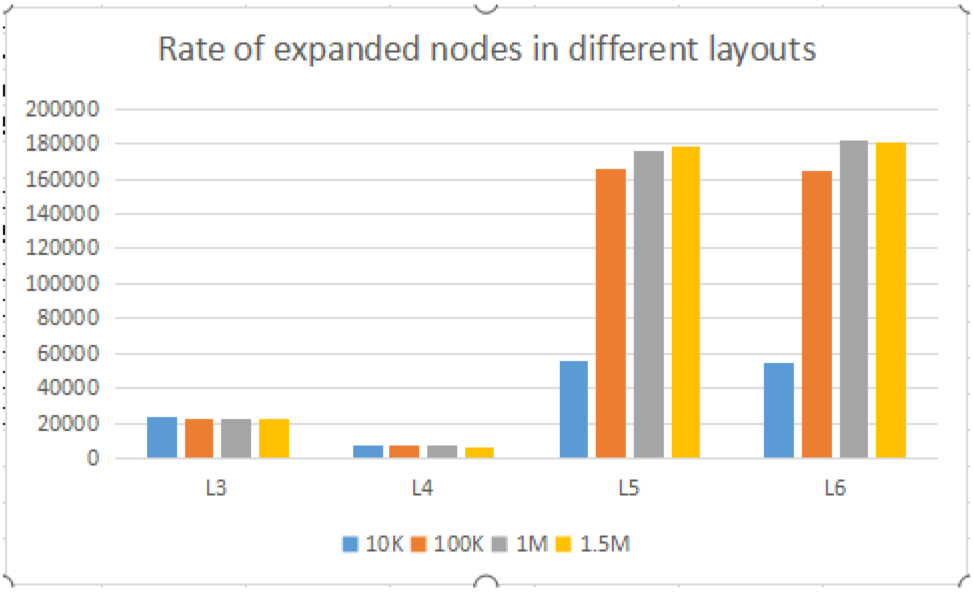


max budget:10K					
layout	expanded node	generated node	number of pegs left	expanded nodes per second	total execution time
0	2	2	1	13	0.131024
1	3	3	1	19	0.133662
2	7	8	1	51	0.135975
3	3541	10282	1	23797	0.148795
4	1065	2418	1	7598	0.140156
5	10000	26495	4	56177	0.178008
6	10000	29368	5	54380	0.183889
max budget:100K					
0	2	2	1	14	0.139729
1	3	3	1	21	0.140725
2	7	8	1	50	0.139693
3	3541	10282	1	22372	0.158277
4	1065	2481	1	7539	0.141265
5	100000	359818	3	165320	0.604887
6	100000	374378	4	164713	0.607115
max budget:1M					
0	2	2	1	14	0.139456
1	3	3	1	21	0.139957
2	7	8	1	50	0.137354
3	3541	10282	1	22352	0.158418
4	1065	2481	1	7539	0.141260
5	1000000	4488464	2	176592	5.662750
6	1000000	4481233	3	181627	5.505769
max budget:1.5M					
0	2	2	1	4	0.137322
1	3	3	1	19	0.154140
2	7	8	1	45	0.154866
3	3541	10282	1	22332	0.165332
4	1065	2481	1	6612	0.161067
5	1090275	4898609	1	178424	6.110583
6	1500000	7020668	3	180499	8.310260

2.1



2.2


Rate of expanded nodes in different layouts
200000
180000
160000
140000
120000
100000
80000
60000
40000
20000
0
L3
L4
L5
L6
10K
100K
1M
1.5M