Callie Mao

Compsci 201 - Boggle Analysis

1. Fastest Lexicon Implementation

The below times were measured for LARGE_LEXICON with iterative size 80612, word size 80612, and prefix size 16466:

	SimpleLexicon	TrieLexicon	BinarySearchLexicon
Iteration Time (seconds)	0.014	0.224	0.001
Word Time (seconds)	0.009	0	0.001
Prefix (seconds)	0.033	0.034	0.023

The below times were measured for SMALL_LEXICON with iterative size 19912, word size 19912, and prefix size 6143:

	SimpleLexicon	TrieLexicon	BinarySearchLexicon
Iteration Time (seconds)	0.01	0.221	0.001
Word Time (seconds)	0.003	0	0
Prefix (seconds)	0.023	0.036	0.032

Based on the above data, BinarySearchLexicon is the fastest lexicon implementation. Its times are consistently lower than all times of SimpleLexicon and TrieLexicon measured with LARGE_LEXICON and roughly less than all times of SimpleLexicon and TrieLexicon for SMALL_LEXICON. The larger the number of words in the lexicon, the more efficient BinarySearchLexicon becomes relative to the other two methods, since it is able to halve its search options with each recursive call. BinarySearchLexicon becomes more efficient the larger the N, since BinarySearch usually has a runtime of O(logN) in relation to the size of the lexicon (a relationship that is not shared with SimpleLexicon and TrieLexicon) and thus becomes less efficient as N gets large.

2. High-Score Board

Based on 50,000 auto-game runs, the 4x4 and 5x5 boards giving the maximum score were generated to be the following:

```
c  l  i  t
s  m  e  r
b  d  a  s
c  l  e  h
```

4x4

Max Score: 1101

```
p  a  c  o  d
o  x  s  e  r
a  t  n  t  r
n  I  e  a  s
d  r  n  c  e
```

5x5

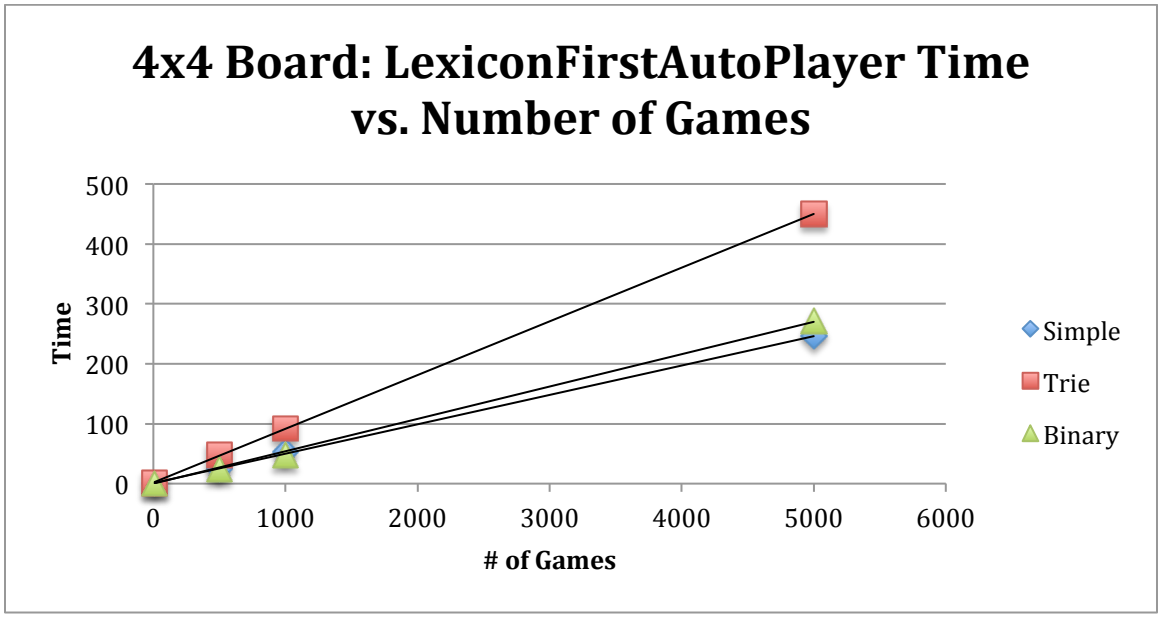
Max Score: 2120

3. Time for Auto-runs

For a 4x4 board, the following number of seconds were measured for the implementation of LexiconFirstAutoPlayer and BoardFirstAutoPlayer:

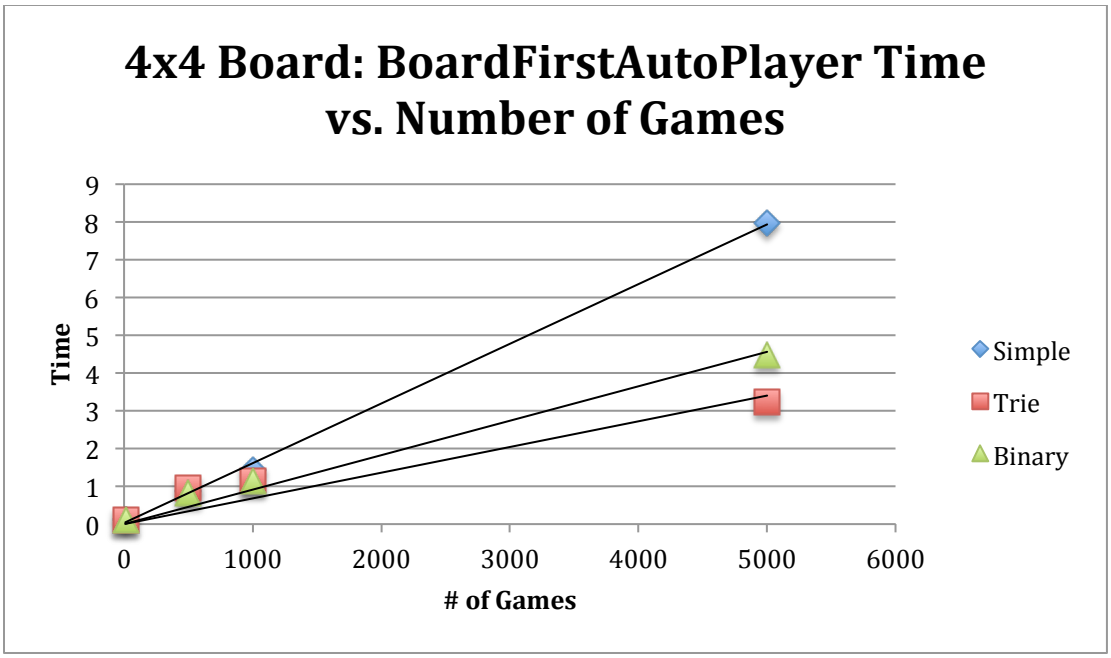
LexiconFirstAutoPlayer

# Games	SimpleLexicon Time	TrieLexicon Time	BinarySearchLexicon Time
10	0.542	1.152	0.467
500	24.465	48.053	24.327
1000	52.076	91.841	47.045
5000	245.715	449.786	271.637



BoardFirstAutoPlayer

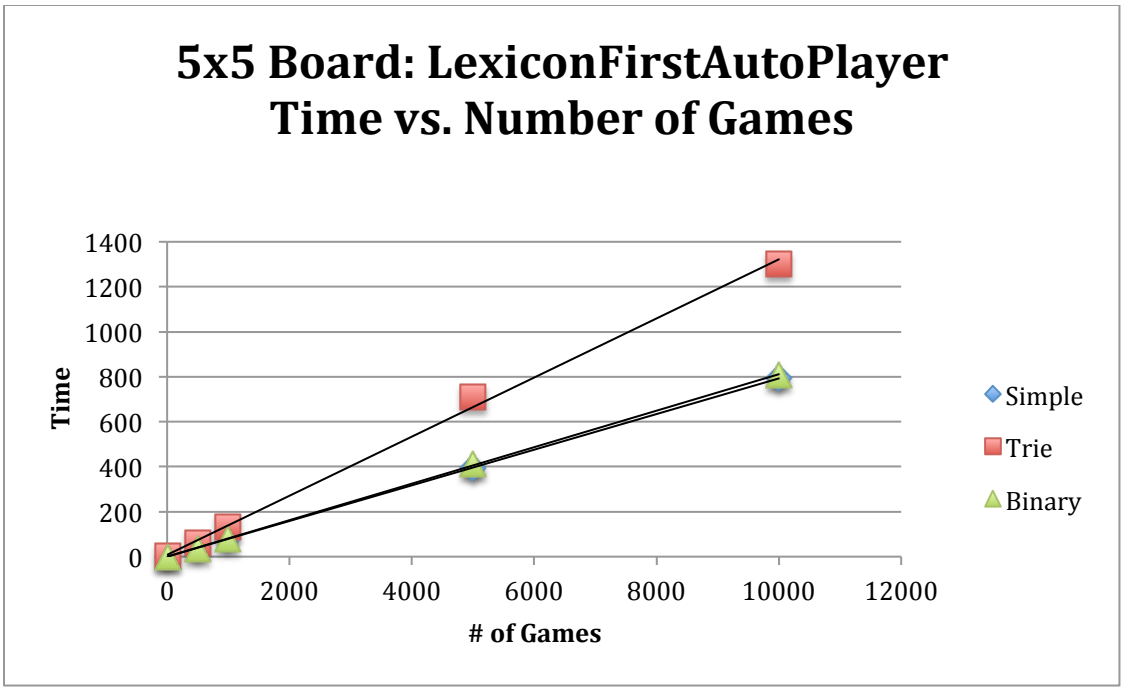
# Games	SimpleLexicon Time	TrieLexicon Time	BinarySearchLexicon Time
10	0.126	0.101	0.101
500	0.886	0.956	0.817
1000	1.443	1.156	1.136
5000	7.963	3.246	4.481



For a 5x5 board, the following number of seconds were measured for the implementation of LexiconFirstAutoPlayer and BoardFirstAutoPlayer:

LexiconFirstAutoPlayer

#Games	SimpleLexicon Time	TrieLexicon Time	BinarySearchLexicon Time
10	0.816	1.489	0.705
500	36.007	63.798	33.453
1000	81.063	134.658	77.889
5000	392.339	707.702	412.933
10000	794.432	1301.489	808.166



BoardFirstAutoPlayer

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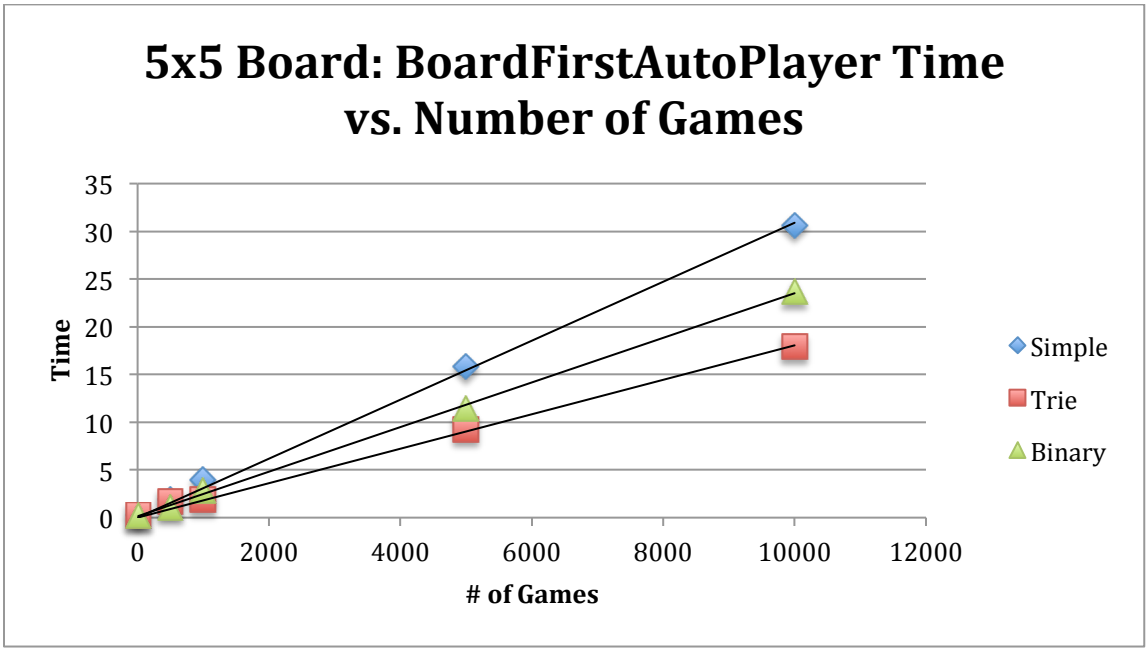

Based on the above data, each of the different autoplayer and lexicon combinations result in an O(N) runtime. From this, it is not difficult to extrapolate how long 100,000 and 1,000,000 auto-runs will take. I use the equation of each line for each condition and plug in 100,000 and 1,000,000 auto-games to obtain the estimated time taken. The auto-runs will simply be a factor of the time that 10 auto-runs would take. 100,000 would be 10,000x the time of 10 auto-runs, while 1,000,000 runs would be 100,000x the time of 100 auto-runs.

Below are the predicted results for 100,000 games/trials for each of the auto-player and lexicon combinations:

		Time Prediction for 100,000 Auto-Games (in seconds)		
		SimpleLexicon	**TrieLexicon**	**BinarySearchLexicon**
4x4	**LexiconFirstAutoPlayer**	8,961.8284	4,930	5,400
	BoardFirstAutoPlayer	160	70	90
5x5	**LexiconFirstAutoPlayer**	7,920	13,148	8,110
	BoardFirstAutoPlayer	310	230.1419	180

Below are the predicted results for 1,000,000 games/trials for each of the auto-player and lexicon combinations:

		Time Prediction for 1,000,000 Auto-Games (in seconds)		
		SimpleLexicon	**TrieLexicon**	**BinarySearchLexicon**
4x4	**LexiconFirstAutoPlayer**	89,618.284	49,300	54,000
	BoardFirstAutoPlayer	1600	700	900
5x5	**LexiconFirstAutoPlayer**	79,200	131,480	81,100
	BoardFirstAutoPlayer	3,100	2301.419	1,800