

Parker Pearson
Analysis
Boggle

Figure 1: Benchmarking Results

Type of Lexcon	Iter Time	Word Time	Pref Time
SimpleLexicon	.01	.007	.022
TrieLexicon	.073	.001	.021
BinarySearchLexicon	.001	.00000	.015

The above data was gathered by running LexiconBenchmark.java for the above lexicons. LexiconBenchmarkw as ran several times to eliminate possibility of an extreme case, but the results were generally consistent. It was found that the BinarySearchLexicon was the fastest in both iteration time and prefix time. Trielexicon was the second fastest in prefix time, but the slowest in iteration time. Simple lexicon was the second fastest in iteration time, but the slowest in word time and prefix time. Overall, it is clear that the BinarySearch Lexicon was the fastest running algorithm. It was able to iterate much faster than the other lexicons.

Figure 2: Benchmarking Ouput

```
size of SimpleLexicon: 80612
  iter time: 0.010000    size: 80612
  word time: 0.007000    words: 80612
  pref time: 0.022000    size: 16466

size of TrieLexicon: 80612
  iter time: 0.073000    size: 80612
  word time: 0.001000    words: 80612
  pref time: 0.021000    size: 16466

size of BinarySearchLexicon: 80612
  iter time: 0.001000    size: 80612
  word time: 0.000000    words: 80612
  pref time: 0.015000    size: 16466
```

Figure 3: Run Times from Boggle Stats for Various Players, Lexicons, Counts, and Boards

Lexicon Player	Lexicon	Count	Max:	Time	Board
LFAP	Simple	10	205	.0464	4x4
BFAP	Simple	10	205	.076	4x4
LFAP	Trie	10	205	.806	4x4
BFAP	Trie	10	205	.049	4x4
LFAP	Binary	10	205	.408	4x4
BFAP	Binary	10	205	.066	4x4
LFAP	Simple	10	753	.756	5x5
BFAP	Simple	10	753	.168	5x5
LFAP	Trie	10	753	1.089	5x5
BFAP	Trie	10	753	.124	5x5

Lexicon Player	Lexicon	Count	Max:	Time	Board
LFAP	Binary	10	753	.668	5x5
BFAP	Binary	10	753	.136	5x5
LFAP	Simple	100	423	4.278	4x4
BFAP	Simple	100	423	.294	4x4
LFAP	Trie	100	423	7.225	4x4
BFAP	Trie	100	423	.371	4x4
LFAP	Binary	100	423	4.186	4x4
BFAP	Binary	100	423	.501	4x4
LFAP	Simple	100	1301	6.815	5x5
BFAP	Simple	100	1301	.471	5x5
LFAP	Trie	100	1301	9.792	5x5
BFAP	Trie	100	1301	.488	5x5
LFAP	Binary	100	1301	6.645	5x5
BFAP	Binary	100	1301	.724	5x5
LFAP	Simple	1000	889	41.351	4x4
BFAP	Simple	1000	889	1.12	4x4
LFAP	Trie	1000	889	69.874	4x4
BFAP	Trie	1000	889	.854	4x4
LFAP	Binary	1000	889	40.753	4x4
BFAP	Binary	1000	889	.922	4x4
LFAP	Simple	1000	1301	67.705	5x5
BFAP	Simple	1000	1301	2.533	5x5
LFAP	Trie	1000	1301	96.81	5x5
BFAP	Trie	1000	1301	1.821	5x5
LFAP	Binary	1000	130	69.529	5x5
BFAP	Binary	1000	1301	1.781	5x5

Because LexiconFirstAutoPlayer results were taking too long data for counts greater than 1000 were not found

Figure 4: Graphical Representation of Run Time on a 4x4 Boggle Board

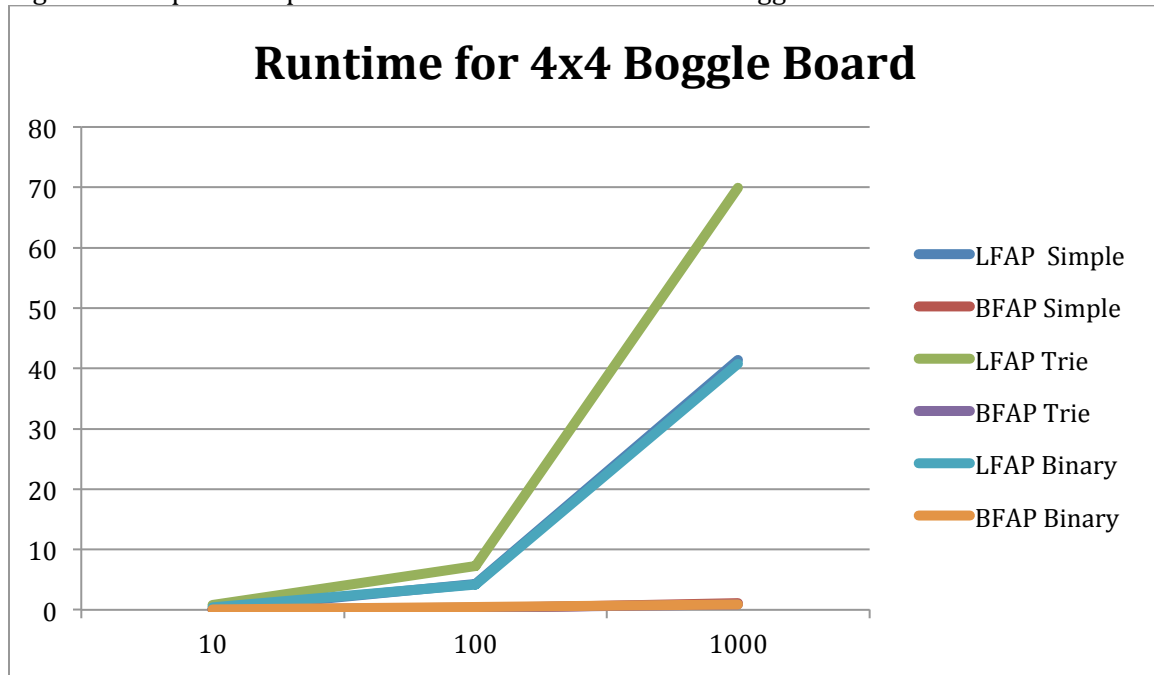
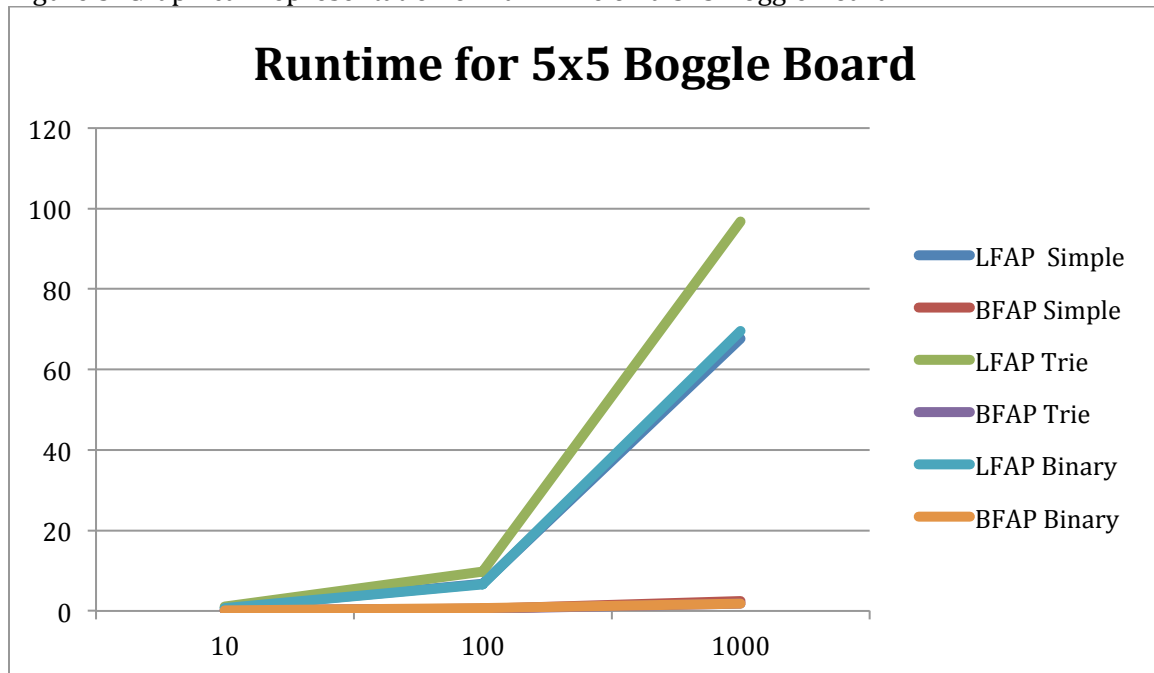


Figure 5: Graphical Representation of Run Time on a 5x5 Boggle Board



Though the scaling on the above two graphs are not linear, due to my inability to format the x-axis the above data shows a linear relationship for each of the lexicons. This suggests that they all run in $O(n)$ time. For example, on the 5x5 board using LexiconFirstAutoPlayer with a simple lexicon the times were about .7 for 10 runs, 7 for 100 runs, and 70 seconds for 1000 runs. A similar pattern appeared across all the data. It makes sense that each of the lexicons results in the same amount of max words because they all analyze all possible

words on the board, but just in different manners. This resulted in differences in run time. The LexiconFirstAutoPlayer resulted in run times much higher than expected which could either be an unnoticed problem in the code, or poor expectations. Regardless, the times still result in a linear increase in time. Nevertheless, the large runtimes prevented me from testing for 10,000 or more games. I have thus included my estimations for the runtimes in the tables below.

Figure 6: Estimated Runtime for a 5x5 Boggle Board (seconds)

Count	LFAP Simple	BFAP Simple	LFAP Trie	BFAP Trie	LFAP Binary	BFAP Binary
10,000	700	12.5	1000	7.5	700	4
100,000	7000	62	10000	30	7000	8
1,000,000	70000	300	100000	120	70000	16

Figure 7: Estimated Runtime for a 4x4 Boggle Board (seconds)

Count	LFAP Simple	BFAP Simple	LFAP Trie	BFAP Trie	LFAP Binary	BFAP Binary
10,000	400	5	700	2	400	2
100,000	4000	25	7000	4	4000	4
1,000,000	40000	125	70000	8	40000	8

With 1,000 runs the max 5x5 Board was found to be

```

o t r p w
d b n o l
r e s e s
s t n i m
w n i s h

```

With 1,000 runs the max 4x4 Board was found to be

```

g s r g
n e t i
i o s b
p r e n

```