CS51 PSET 5 WRITEUP

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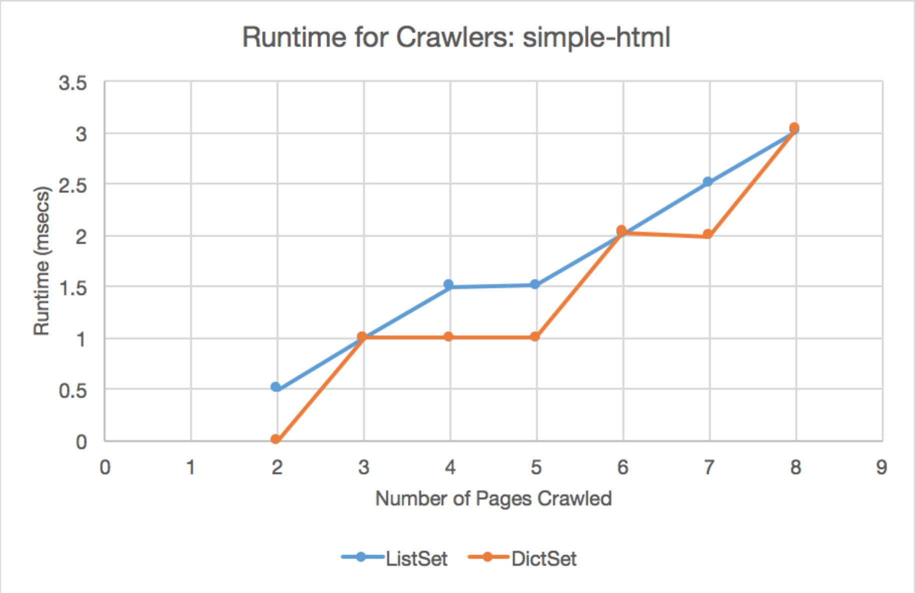
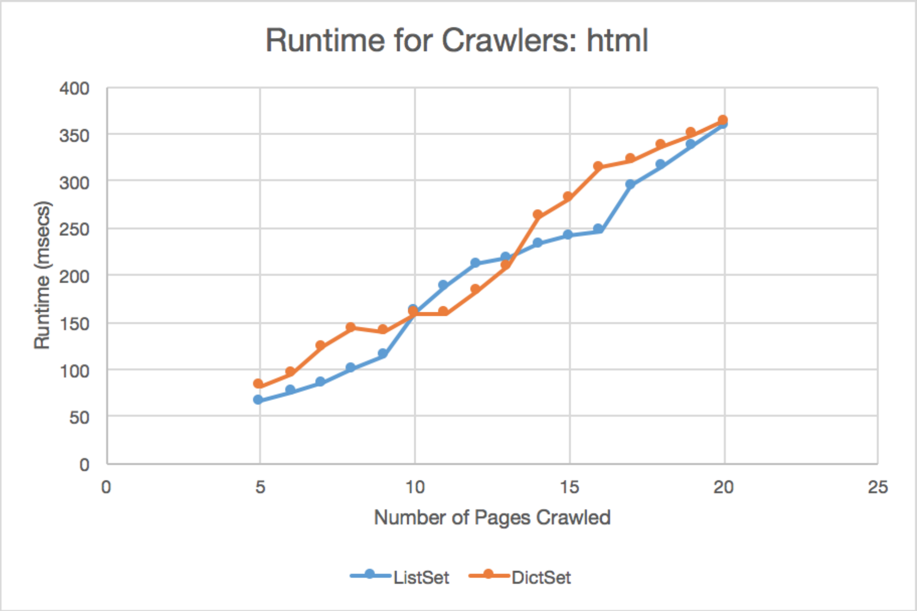
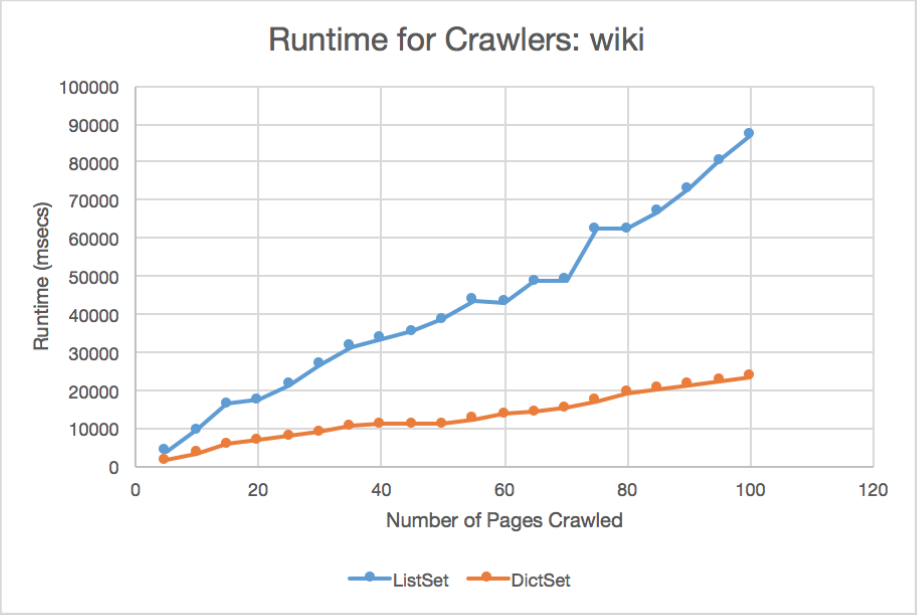
Part 1: Crawl

First, we use our crawl function to crawl through simple-html, html, and wiki. We compare the runtime speeds of using the ListSet module versus DictSet. The results are shown below:







- ***Note:*** *Raw data were obtained from the test file tests.ml, and can be found in the file* cs51pset5.xlsx *under the tabs simple-html, html, and wiki.*

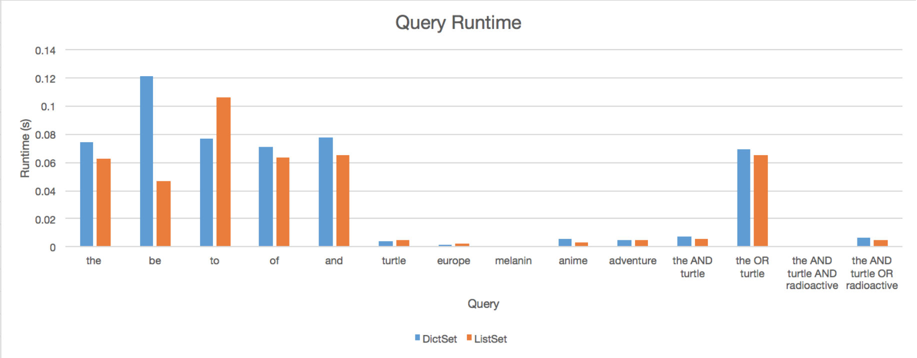
From these data, we see that, for smaller sample sizes (fewer webpages to crawl), there is no significant difference in the efficiency of the two modules; occasionally, the ListSet crawler yields faster runtimes than the DictSet one. However, for larger numbers of pages, DictSet is considerably faster for crawling and indexing pages than ListSet.

This is likely because the DictSet module we use results in sets of binary trees, while the ListSet module simply uses lists as sets. Binary search trees have O(log(n)) search time, while lists have O(n) search time. Since our crawler needs to search through the **frontier** and **visited** sets in order to avoid infinite looping and to reduce the size of the frontier, the runtime of the crawler depends upon the efficiency of searching the set.

Since binary search trees are considerably more efficient than lists for large amounts of data, the crawler using DictSet will become much faster than that using ListSet as the amount of data increases.

Part 2: Queries

Next, we compare the runtimes of different queries using a ListSet and DictSet-based implementation. Our search words include common words like "the" and "be" and more specific terms such as "turtle" and "melanin". We also have queries using AND and OR. We expect that common words will take more time to search and record than rarer ones, because although the average runtime should be equal regardless of the query, it takes some time to update the dictionary by inserting new values. In addition, due to variation in computation time, we have averaged runtime results for 5 different trials for each query. The results are displayed below:



- ***Note:*** *Raw data were obtained from manual testing, and can be found in the file* cs51pset5.xlsx *under the tab* queries.

We see that, as expected, more common words have taken more time to search and store (insert) than less common ones. Also, a query between some two words that uses AND requires less runtime than one using OR. This is expected, as OR yields >= search results than AND, and these search results would require more time to store.

Although DictSet was faster than ListSet in crawling and indexing, it is, on average, slower than ListSet when it comes to querying, despite utilizing binary search trees. This may be due to the fact that, although binary search trees are faster to search through than lists, they take longer to display a list of results (the links that we see). This is because DictSet uses binary search trees, which are not automatically displayable as lists. So we have to iterate through each node to convert the tree to a list. Meanwhile, it takes longer to search through a list in ListSet, but since ListSet already uses lists, once we find the value, we can easily display it with almost no time expended. Therefore, most of ListSet's query runtime comes from the searching itself, while most of DictSet's query runtime comes from the conversion of the tree to an easily displayable list format. The more frequent the query, the longer DictSet's runtime in comparison with ListSet's.