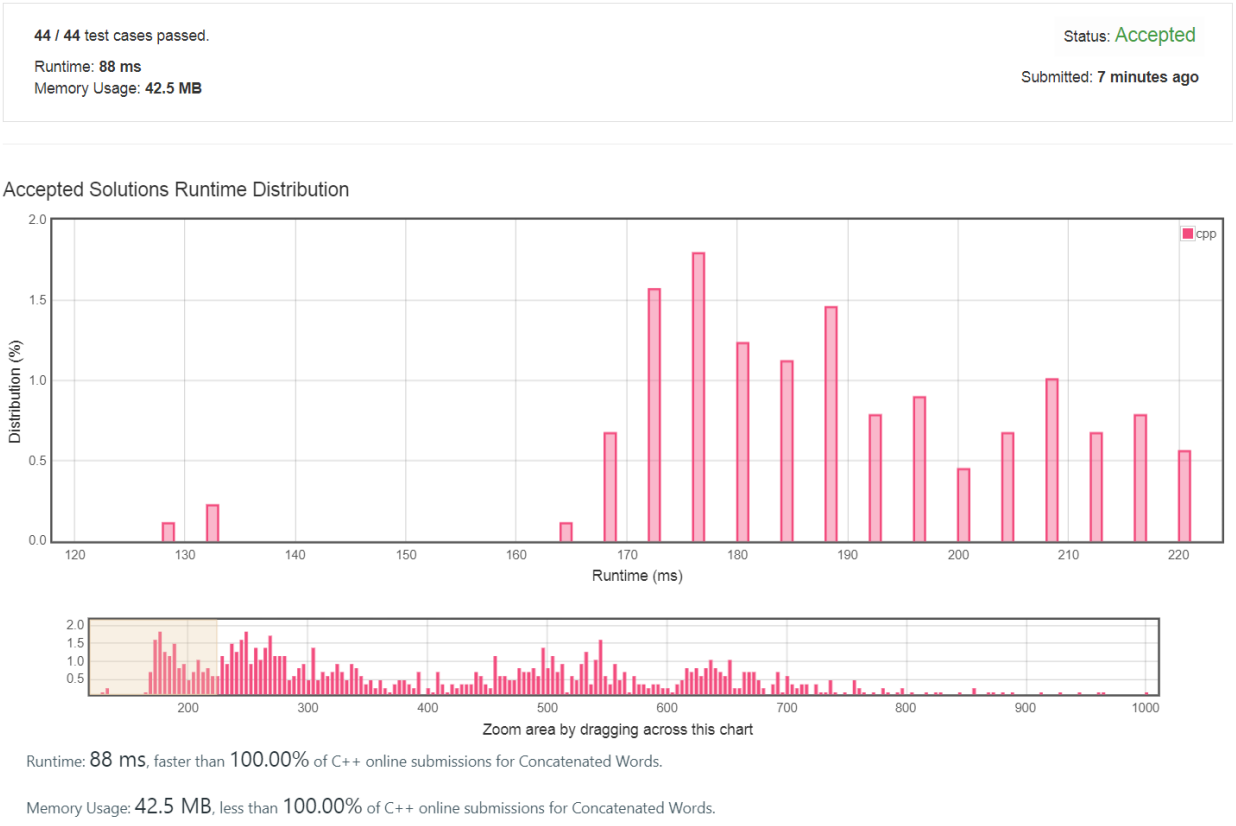
Let n denote the number of strings, ℓ denote the maximum length of a string, and m denote the total length of the dictionary.
This is the word break problem with multiple queries, so it is at least as hard as 139. Word Break (the all-targets version).
1. Using the algorithm for word break, we can get $\tilde{O}(m^{4/3})$ running time.
2. DP+trie. $O(m\ell)$.
3. Aho-Corasick automaton. $O(m \cdot \frac{\ell}{w})$ (using bit packing), or $O(m\sqrt{m})$ (or $O(m \cdot \frac{\sqrt{m}}{\sqrt{w}})$ using bit packing on matching words with length $O(\sqrt{m} \cdot \sqrt{w})$).



References