15210: Parallel and Sequential Data Structures and Algorithms

SkylineLab

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5.1

In the divide phase, by using showt, the work is divided into two approximately even parts.
In the base case, it takes O(1) to generate the results.
In inductive cases, the task is mainly the combination. When doing this, we need to iterate all the elements in the two subsequences, therefore $W_{combine}(n)$. Besides combination, there are also some simple operations such as evaluation, which can be represented as O(1).

$$W_{skyline}(n) = 2W_{skyline}\left(\frac{n}{2}\right) + O(1) + W_{combine}(n)$$

5.2

This function is similar to flatten. It takes in a sequence of sequences, and combines them into one in the original order. The difference is that it can return all the intermediate results, that is, the combination of first one sequence, the combination of first two sequences, the combination of first three sequences, ……
(`a seq) seq → (`a seq) seq * (`a seq)

5.3

The work of scan is $O(|S|) + \sum W_f$, and the work of append is $O(|S_1| + |S_2|)$.
Assume the maximum length of the sequences is m, and there are n such sequences, then

$$W_{append} \leq O(m) + O(m) = O(m)$$

$$W(n,m) = O(n) + \sum_{i=1}^{n} W_{append} = O(n) + O(mn) = O(mn)$$

5.4

The span of scan is $O(log|S|)max\{S_f\})$, and the span of append is $O(1)$, then

$$S(n,m) = O(\log n\, O(1)) = O(logn)$$

Similar to above, but replace new W and S of append with $O(log|S|)$

5.5

$$W_{append} \leq O(logm) + O(logm) = O(logm)$$

$$W(n,m) = O(n) + \sum_{i=1}^{n} W_{append} = O(n) + O(nlogm) = O(nlogm)$$

5.6

$$S(n,m) = O(\log n\, O(logm)) = O(logn\, logm)$$