Aufgabe 1 (Substring select)

Given a text $T$ of length $n$ over an alphabet of size $\sigma$ and a query $q$ of length $m$. A substring select query $\text{select}(i, q, T)$ returns the position of the $i$-th occurrence of $q$ in $T$. Show how a substring select query can be answered in $O((m + 1) \log^2 n)$ time using at most $n \lceil \log n \rceil + \sigma \lceil \log n \rceil + o(n \log n)$ bits of space.

Hint: Use the result of 2.3.

Aufgabe 2 (Top-k range reporting)

Given a set of $n$ points $p_0, \ldots, p_{n-1}$ of the form $p_i = (i, Y[i])$ with $0 \leq Y[i] < \log n$. We associate a weight $w_i$ with each point $p_i$.

Devise a data structure which takes

(a) $O(n \log \log n)$

(b) $n \log \log n + 2n + o(n \log n)$

bits of space (on top of the space for the weights) and can answer top-$k$ range reporting queries in $O(\log \log n)^2 + k \log \log n)$ time for (a) and $O(\log n + k \log \log n)$ time for (b).

Aufgabe 3 (Longest palindromic substring)

A string $s$ is called palindromic if it reads the same forward or backward. E.g. $ada$, $gog$, or $hannah$ are palindromic strings. Given a text $T$ of size $n$ over an alphabet of size $\sigma$. Design a linear time algorithm to calculate the longest palindromic substring of $s$. If there is more than one longest palindromic substring we are interested in the lexicographic smallest one.