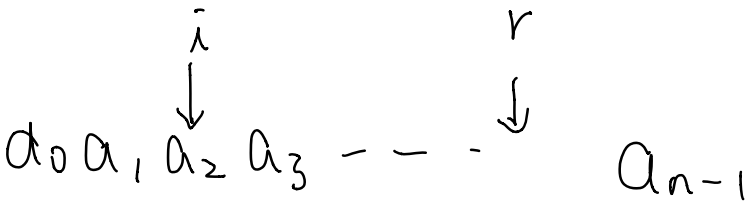
Proof: max_freq invalid at some point will not affect our answer!

max_freq will only become greater if $[i, r)$ has a char's freq > max_freq



Case 1: for every $[i, r)$ where true_max_freq ≤ max_freq

⇒ Because their true_max_freq ≤ max_freq they will only expand at most len = max_freq + k

⇒ will not affect answer

Case 2: for every $[i, r)$ where true_max_freq > max_freq

Because

max_freq will be updated in the while loop, len = true_max_freq ++