284 (greatest square under a histogram) You are given a histogram in the form of a list H of natural numbers. Write a program to find the longest segment of H in which the height (each item) is at least as large as the segment length.

After trying the question, scroll down to the solution.

§ Here is a sketch of the solution. The specifications are informal, the proofs are missing, and the timing is missing.

I will check all segments $m,..n$ from longest ($\#H$) to shortest (0), and at each length from left to right, stopping the first time I find a square. For each length $n\text{–}m$, there are $\#H - (n\text{–}m) + 1$ segments to check. For each segment, we can discard it when we find the first height ($H\ i$) that's too short (< segment length $n\text{–}m$). A longest segment will be found; the empty segment if nothing longer. So there's no need to check whether we have run out of segments.

$S = (\ m',..n'$ is the base of the largest square)
$R = (\ m,..n$ is the next segment to be checked)
$Q = (\ m \le i \le n$ and $m,..i$ is fine and $i,..n$ needs to be checked)

$S \Leftarrow m:= 0.\ n:= \#H.\ R$

$R \Leftarrow i:= m.\ Q$

$Q \Leftarrow$ **if** $i=n$ **then** ok
else if $H\ i \ge n\text{–}m$ **then** $i:= i+1.\ Q$
else if $n<\#H$ **then** $m:= m+1.\ n:= n+1$ **else** $n:= \#H - m - 1.\ m:= 0$ **fi**.
R **fi fi**