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 $n-m$, there are $#H - (n-m) + 1$ segments to check. For each segment, we can discard it when we find the first height ($H_i$) that's too short (< segment length $n-m$). 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)

$Q = (m\leq i \leq n$ 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 \begin{array}{l}
\text{if } i=n \text{ then } \text{ok} \\
\text{else if } H_i \geq n-m \text{ then } i:=i+1. \ Q \\
\text{else if } n < #H \text{ then } m:=m+1. \ n:=n+1 \ \text{else } n:= #H - m - 1. \ m:= 0 \ \text{fi.} \\
\end{array} \ R \ \text{fi} \ \text{fi}