183 Write a program to find the smallest power of 2 that is bigger than or equal to a given positive integer without using exponentiation.

After trying the question, scroll down to the solution.

§ Let n be the given positive integer, and let the final value of variable p indicate the smallest power of 2 that is bigger than or equal to n.

$p'\colon 2^{nat} \;\wedge\; n \le p' < 2\times n \;\Longleftarrow\; p := 1.\; p < 2\times n \;\Rightarrow\; p'\colon p\times 2^{nat} \;\wedge\; n \le p' < 2\times n$

$p < 2\times n \;\Rightarrow\; p'\colon p\times 2^{nat} \;\wedge\; n \le p' < 2\times n \;\Longleftarrow$

if $n \le p$ **then** *ok* **else** $p := 2\times p.\; p < 2\times n \;\Rightarrow\; p'\colon p\times 2^{nat} \;\wedge\; n \le p' < 2\times n$ **fi**

$t' \le t + log\ n \;\Longleftarrow\; p := 1.\; p < 2\times n \;\Rightarrow\; t' \le t + log\ n - log\ p$

$p < 2\times n \;\Rightarrow\; t' \le t + log\ n - log\ p \;\Longleftarrow$

if $n \le p$ **then** *ok* **else** $p := 2\times p.\; t := t+1.\; p < 2\times n \;\Rightarrow\; t' \le t + log\ n - log\ p$ **fi**

Proof: NOT YET WRITTEN