199 (duplicate) Write a program to find whether a given nonempty list has any duplicate items.

After trying the question, scroll down to the solution.

§ Let the list be L. Let d be a binary variable for reporting the result. Let n and m be *nat* variables used for indexing. Define

$P \;=\; d' \;=\; (\exists i{:}\ 0,..\#L{-}1{\cdot}\ \exists j{:}\ i{+}1,..\#L{\cdot}\ L\,i = L\,j) \;\wedge\; t' \;\leq\; t + (\#L){\times}(\#L{-}1)/2$

$Q \;=\; n{<}\#L \;\Rightarrow\; d' \;=\; (\exists i{:}\ n,..\#L{-}1{\cdot}\ \exists j{:}\ i{+}1,..\#L{\cdot}\ L\,i = L\,j)$
$\qquad\qquad \wedge\; t' \;\leq\; t + (\#L{-}n){\times}(\#L{-}n{-}1)/2$

$R \;=\; n{<}m{<}\#L \;\Rightarrow\; d' = ((\exists j{:}\ m,..\#L{\cdot}\ L\,n = L\,j) \vee (\exists i{:}\ n{+}1,..\#L{-}1{\cdot}\ \exists j{:}\ i{+}1,..\#L{\cdot}\ L\,i = L\,j))$
$\qquad\qquad \wedge\; t' \;\leq\; t + \#L{-}m + (\#L{-}n{-}1){\times}(\#L{-}n{-}2)/2$

And the refinements are

$P \;\Leftarrow\; n{:=}\,0.\ Q$

$Q \;\Leftarrow\;$ **if** $n = \#L{-}1$ **then** $d{:=}\,\bot$ **else** $m{:=}\,n{+}1.\ R$ **fi**

$R \;\Leftarrow\;$ **if** $L\,n = L\,m$ **then** $d{:=}\,\top$
else $m{:=}\,m{+}1.$ **if** $m{=}\#L$ **then** $n{:=}\,n{+}1.\ Q$ **else** $t{:=}\,t{+}1.\ R$ **fi fi**

Proof: NOT YET WRITTEN