

X4.3 Using the notations and methods of this course, write a program to calculate  $n$  factorial,  $n! = 1 \times 2 \times 3 \times \dots \times n$ , for  $n: \text{nat}$ . Write all specifications formally, and show all refinements, but you do not need to prove the refinements.

After trying the question, scroll down to the solution.

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$f := n! \Leftarrow \text{if } n=0 \text{ then } f := 1 \text{ else } n := n-1. f := n!. n := n+1. f := f \times n \text{ fi}$

OR

$f' = n! \Leftarrow f := 1. f' = f \times n!$

$f' = f \times n! \Leftarrow \text{if } n=0 \text{ then ok else } f := f \times n. n := n-1. f' = f \times n! \text{ fi}$

OR

$f' = n! \Leftarrow f := 1. i := 0. f' = f \times n! / i!$

$f' = f \times n! / i! \Leftarrow \text{if } i=n \text{ then ok else } i := i+1. f := f \times i. f' = f \times n! / i! \text{ fi}$

OR

$f' = n! \Leftarrow f := 1. F 0$

$F 0 \Leftarrow \text{for } i := 0; ..n \text{ do } f := f \times (i+1) \text{ od}$

where  $F i = f' = f \times n! / i!$