MODULE *ThreeBean*

EXTENDS *Integers*
CONSTANTS M, N, O
ASSUME $\land M \in 1 \,..\, 100$
$\land N \in 1 \,..\, 100$
$\land O \in 1 \,..\, 100$
$\land M + N + O > 0$

```
--fair algorithm ThreebeansAlg{
  variable r = M, g = N, b = O ;
 { S: while ( TRUE )
      { either
       { await (r > 1) ;   \* same color and red
            r := r − 2 ;
             } ;
         or
      { await (g > 1) ;   \* same color and green
            g := g − 2 ;
            } ;
         or
      { await (b > 1) ;   \* same color and blue
            b := b − 2 ;
             } ;
         or
      { await (r > 0 ∧ g > 0) ;   \* one red and one green
             r := r − 1 ;
             g := g − 1 ;
             b := b + 1 ;
              } ;
         or
    { await (g > 0 ∧ b > 0) ;   \* one blue and one green
          g := g − 1 ;
          b := b − 1 ;
          r := r + 1 ;
           } ;
       or
    { await (b > 0 ∧ r > 0) ;   \* one blue and one red
          b := b − 1 ;
          r := r − 1 ;
          g := g + 1 ;
          } ;
       }
     }
    }
```

BEGIN TRANSLATION

VARIABLES $r,\ g,\ b$

$vars \triangleq \langle r,\ g,\ b \rangle$

$Init \triangleq$ Global variables
$\land\ r = M$
$\land\ g = N$
$\land\ b = O$

$Next \triangleq$
$\lor\ \land\ (r > 1)$
$\quad \land\ r' = r - 2$
$\quad \land\ b' = b$
$\quad \land\ g' = g$
$\lor\ \land\ (g > 1)$
$\quad \land\ g' = g - 2$
$\quad \land\ r' = r$
$\quad \land\ b' = b$
$\lor\ \land\ (b > 1)$
$\quad \land\ b' = b - 2$
$\quad \land\ r' = r$
$\quad \land\ g' = g$
$\lor\ \land\ (r > 0 \land g > 0)$
$\quad \land\ r' = r - 1$
$\quad \land\ g' = g - 1$
$\quad \land\ b' = b + 1$
$\lor\ \land\ (g > 0 \land b > 0)$
$\quad \land\ r' = r + 1$
$\quad \land\ g' = g - 1$
$\quad \land\ b' = b - 1$
$\lor\ \land\ (r > 0 \land b > 0)$
$\quad \land\ r' = r - 1$
$\quad \land\ g' = g + 1$
$\quad \land\ b' = b - 1$

$Spec \triangleq \land\ Init \land \Box[Next]_{vars}$
$\land\ \mathrm{WF}_{vars}(Next)$

END TRANSLATION

$TypeOK \triangleq$
$\land\ r \in 0\,..\,100$
$\land\ g \in 0\,..\,100$
$\land\ b \in 0\,..\,100$
$r + g + b > 0$

$NonTermination \triangleq r + g + b > 1$

$Termination \triangleq \Diamond(r + g + b < 2)$

* Modification History
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Consider a can of coffee beans.

Each bean is either red, blue or green. The can is initially nonempty ($r+g+b>0$). Now consider the following program:

Choose two beans from the can;

- if they are the same color, toss them both out

- if they are different colors, toss them out and put in a bean of third color

This action is repeated.