MODULE *appex4_2*

EXTENDS *TLC*, *Integers*, *Naturals*

CONSTANTS $x1$, $x2$, *min*, *max*

```
--fair algorithm division{
variables y1, y2, y3, z1, z2 ;
{
l1: y1 := x1 ; y2 := 0 ; y3 := x2 ;
l2: while ( y3 ≤ y1 ) {
      y3 := 2 * y3 ;
       } ;
 l3: while ( y3 ≠ x2 ) {
      y2 := 2 * y2 ;
      y3 := y3 ÷ 2 ;
      l4: if ( y3 ≤ y1 ) {
      y1 := y1 − y3 ;
      y2 := y2 + 1 ;
       } ;
       } ;
    l5:     z1 := y1 ;
      z2 := y2 ;
    l6: print ⟨x1, x2, z1, z2⟩ ;
       }
  }
```

BEGIN TRANSLATION

CONSTANT *defaultInitValue*

VARIABLES $y1$, $y2$, $y3$, $z1$, $z2$, *pc*

$vars \triangleq \langle y1,\ y2,\ y3,\ z1,\ z2,\ pc\rangle$

$Init \triangleq$ Global variables
$\land\ y1 = defaultInitValue$
$\land\ y2 = defaultInitValue$
$\land\ y3 = defaultInitValue$
$\land\ z1 = defaultInitValue$
$\land\ z2 = defaultInitValue$
$\land\ pc = \text{“l1”}$

$l1 \triangleq \land\ pc = \text{“l1”}$
$\land\ y1' = x1$
$\land\ y2' = 0$
$\land\ y3' = x2$
$\land\ pc' = \text{“l2”}$
$\land$ UNCHANGED $\langle z1,\ z2\rangle$

$l2 \triangleq \land\ pc = \text{“l2”}$

$\land$ IF $y3 \leq y1$
THEN $\land\ y3' = 2 * y3$
$\land\ pc' =$ "l2"
ELSE $\land\ pc' =$ "l3"
$\land\ y3' = y3$
$\land$ UNCHANGED $\langle y1,\ y2,\ z1,\ z2\rangle$

$l3 \triangleq$ $\land\ pc =$ "l3"
$\land$ IF $y3 \neq x2$
THEN $\land\ y2' = 2 * y2$
$\land\ y3' = (y3 \div 2)$
$\land\ pc' =$ "l4"
ELSE $\land\ pc' =$ "l5"
$\land$ UNCHANGED $\langle y2,\ y3\rangle$
$\land$ UNCHANGED $\langle y1,\ z1,\ z2\rangle$

$l4 \triangleq$ $\land\ pc =$ "l4"
$\land$ IF $y3 \leq y1$
THEN $\land\ y1' = y1 - y3$
$\land\ y2' = y2 + 1$
ELSE $\land$ TRUE
$\land$ UNCHANGED $\langle y1,\ y2\rangle$
$\land\ pc' =$ "l3"
$\land$ UNCHANGED $\langle y3,\ z1,\ z2\rangle$

$l5 \triangleq$ $\land\ pc =$ "l5"
$\land\ z1' = y1$
$\land\ z2' = y2$
$\land\ pc' =$ "l6"
$\land$ UNCHANGED $\langle y1,\ y2,\ y3\rangle$

$l6 \triangleq$ $\land\ pc =$ "l6"
$\land\ PrintT(\langle x1,\ x2,\ z1,\ z2\rangle)$
$\land\ pc' =$ "Done"
$\land$ UNCHANGED $\langle y1,\ y2,\ y3,\ z1,\ z2\rangle$

Allow infinite stuttering to prevent deadlock on termination.
$Terminating \triangleq pc =$ "Done" $\land$ UNCHANGED $vars$

$Next \triangleq l1 \lor l2 \lor l3 \lor l4 \lor l5 \lor l6$
$\lor\ Terminating$

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

$Termination \triangleq \Diamond(pc =$ "Done")

END TRANSLATION

$Qpc \triangleq pc = \text{“Done”} \Rightarrow x1 = z2 * x2 + z1 \land 0 \leq z1 \land z1 < x2$
$COND(U) \triangleq U \neq defaultInitValue \Rightarrow min \leq U \land U \leq max$
$Qef \triangleq COND(y1) \land COND(y2) \land COND(y3) \land COND(z1) \land COND(z2)$

$Iloop(u, v) \triangleq x1 = v * x2 + u$

$i \triangleq Iloop(y1, y2)$

\ * Modification History
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