─── MODULE *three_process_asynchronous* ───

Initially $x = 0$

3 process $P\_i \ i \in \{0, 1, 2\}$

for process Pi

```
0 : for k_i = 1; k_i ≤ 5;  ++ k_i{
1 :     r_i ← x
2 :     r_i ← r_i + 1
3 :     x ← r_i
4 : }
5 : DONE
```

Check if it is possible that after all three programs have exited the loop, value of x is 2

EXTENDS *Integers*

VARIABLE $k0$, $k1$, $k2$, $pc0$, $pc1$, $pc2$, $r0$, $r1$, $r2$, x

$Init0 \triangleq$
$\wedge k0 = 1$
$\wedge pc0 = 0$
$\wedge r0 = 0$

$Init1 \triangleq$
$\wedge k1 = 1$
$\wedge pc1 = 0$
$\wedge r1 = 0$

$Init2 \triangleq$
$\wedge k2 = 1$
$\wedge pc2 = 0$
$\wedge r2 = 0$

$Init \triangleq Init0 \wedge Init1 \wedge Init2 \wedge (x = 0)$

$A01 \triangleq$
$\wedge k0 \leq 5$
$\wedge pc0 = 0$
$\wedge pc0' = 1$
$\wedge$ UNCHANGED $\langle k0, r0, x \rangle$

$A12 \triangleq$
$\wedge pc0 = 1$
$\wedge pc0' = 2$
$\wedge r0' = x$
$\wedge$ UNCHANGED $\langle k0, x \rangle$

$A23 \triangleq$

1

$\wedge\ pc0 = 2$
$\wedge\ pc0' = 3$
$\wedge\ r0' = r0 + 1$
$\wedge\ \text{UNCHANGED}\ \langle k0,\ x\rangle$

$A34\ \triangleq$
$\wedge\ pc0 = 3$
$\wedge\ pc0' = 4$
$\wedge\ x' = r0$
$\wedge\ \text{UNCHANGED}\ \langle r0,\ k0\rangle$

$A40\ \triangleq$
$\wedge\ k0 \neq 5$
$\wedge\ pc0 = 4$
$\wedge\ pc0' = 0$
$\wedge\ k0' = k0 + 1$
$\wedge\ \text{UNCHANGED}\ \langle r0,\ x\rangle$

$A45\ \triangleq$
$\wedge\ k0 = 5$
$\wedge\ k0' = 6$
$\wedge\ pc0 = 4$
$\wedge\ pc0' = 5$
$\wedge\ \text{UNCHANGED}\ \langle r0,\ x\rangle$

$SLOG\_A\ \triangleq\ \text{UNCHANGED}\ \langle r0,\ pc0,\ k0,\ x\rangle$

$B01\ \triangleq$
$\wedge\ k1 \leq 5$
$\wedge\ pc1 = 0$
$\wedge\ pc1' = 1$
$\wedge\ \text{UNCHANGED}\ \langle k1,\ r1,\ x\rangle$

$B12\ \triangleq$
$\wedge\ pc1 = 1$
$\wedge\ pc1' = 2$
$\wedge\ r1' = x$
$\wedge\ \text{UNCHANGED}\ \langle k1,\ x\rangle$

$B23\ \triangleq$
$\wedge\ pc1 = 2$
$\wedge\ pc1' = 3$
$\wedge\ r1' = r1 + 1$
$\wedge\ \text{UNCHANGED}\ \langle k1,\ x\rangle$

$B34\ \triangleq$
$\wedge\ pc1 = 3$

$\wedge\, pc1' = 4$
$\wedge\, x' = r1$
$\wedge$ UNCHANGED $\langle r1,\, k1 \rangle$

$B40 \triangleq$
$\wedge\, k1 \neq 5$
$\wedge\, pc1 = 4$
$\wedge\, pc1' = 0$
$\wedge\, k1' = k1 + 1$
$\wedge$ UNCHANGED $\langle r1,\, x \rangle$

$B45 \triangleq$
$\wedge\, k1 = 5$
$\wedge\, k1' = 6$
$\wedge\, pc1 = 4$
$\wedge\, pc1' = 5$
$\wedge$ UNCHANGED $\langle r1,\, x \rangle$

$SLOG\_B \triangleq$ UNCHANGED $\langle r1,\, pc1,\, k1,\, x \rangle$

$C01 \triangleq$
$\wedge\, k2 \leq 5$
$\wedge\, pc2 = 0$
$\wedge\, pc2' = 1$
$\wedge$ UNCHANGED $\langle k2,\, r2,\, x \rangle$

$C12 \triangleq$
$\wedge\, pc2 = 1$
$\wedge\, pc2' = 2$
$\wedge\, r2' = x$
$\wedge$ UNCHANGED $\langle k2,\, x \rangle$

$C23 \triangleq$
$\wedge\, pc2 = 2$
$\wedge\, pc2' = 3$
$\wedge\, r2' = r2 + 1$
$\wedge$ UNCHANGED $\langle k2,\, x \rangle$

$C34 \triangleq$
$\wedge\, pc2 = 3$
$\wedge\, pc2' = 4$
$\wedge\, x' = r2$
$\wedge$ UNCHANGED $\langle r2,\, k2 \rangle$

$C40 \triangleq$
$\wedge\, k2 \neq 5$
$\wedge\, pc2 = 4$

$\wedge\ pc2' = 0$
$\wedge\ k2' = k2 + 1$
$\wedge\ \text{UNCHANGED}\ \langle r2,\ x \rangle$

$C45\ \triangleq$
$\wedge\ k2 = 5$
$\wedge\ k2' = 6$
$\wedge\ pc2 = 4$
$\wedge\ pc2' = 5$
$\wedge\ \text{UNCHANGED}\ \langle r2,\ x \rangle$

$SLOG\_C\ \triangleq\ \text{UNCHANGED}\ \langle r2,\ pc2,\ k2,\ x \rangle$

$NextA\ \triangleq$
$\vee\ A01$
$\vee\ A12$
$\vee\ A23$
$\vee\ A34$
$\vee\ A40$
$\vee\ A45$
$\boxed{\vee\ SLOG\_A}$

$NextB\ \triangleq$
$\vee\ B01$
$\vee\ B12$
$\vee\ B23$
$\vee\ B34$
$\vee\ B40$
$\vee\ B45$
$\boxed{\vee\ SLOG\_B}$

$NextC\ \triangleq$
$\vee\ C01$
$\vee\ C12$
$\vee\ C23$
$\vee\ C34$
$\vee\ C40$
$\vee\ C45$
$\boxed{\vee\ SLOG\_C}$

$Next\ \triangleq$
$\vee\ (NextA\ \wedge\ \text{UNCHANGED}\ \langle pc1,\ pc2,\ k1,\ k2,\ r1,\ r2 \rangle)$
$\vee\ (NextB\ \wedge\ \text{UNCHANGED}\ \langle pc0,\ pc2,\ k0,\ k2,\ r0,\ r2 \rangle)$
$\vee\ (NextC\ \wedge\ \text{UNCHANGED}\ \langle pc0,\ pc1,\ k0,\ k1,\ r0,\ r1 \rangle)$

$CHECK \triangleq$
$\neg(k0 = 6$
$\land k1 = 6$
$\land k2 = 6$
$\land x = 2)$