DEMOSTRACIÓN TÚNEL

Monitor: cn = coches norte cs = coches sur

$\{I: (cn>0 \rightarrow cs=0) \wedge (cs>0 \rightarrow cn=0) \wedge cs \geq 0 \wedge cn \geq 0\}$

- $\{I\}$ wants_enter $\{I\}$

```
wants_enter(dir):
    if dir = N:
        no_cars_south.wait(cs=0)
        cn = cn + 1
    if dir = S:
        no_cars_north.wait(cn=0)
        cs = cs + 1
```

$\leftarrow \{I \wedge dir=N \wedge cs=0\}$ ①

$\leftarrow \{I \wedge cn \geq 1\}$

$\leftarrow \{I \wedge dir=S \wedge cn=0\}$ ②

$\leftarrow \{I \wedge cs \geq 1\}$

① $\{I \wedge dir=N \wedge cs=0\}\ cn = cn+1\ \{I\}$

$I_{cn}^{cn+1} \Rightarrow cn+1 \geq 0 \Rightarrow cn>0 \rightarrow cs=0 \Leftarrow I \wedge cs=0$

$\Rightarrow cs \geq 0 \Leftarrow I \wedge cs=0$

$\Rightarrow cs>0 \rightarrow cn=0 \Leftarrow I \wedge cs=0$ (premisa falsa $\Rightarrow$ cierto)

$\Rightarrow cn>0 \Rightarrow cn \geq 0 \Leftarrow I \Leftarrow I \wedge cs=0$

② Análogo que 1 $\Rightarrow cn \geq 1$

- $\{I\}$ leaves_tunnel $\{I\}$

```
leaves_tunnel(dir):
    if dir = N:
        cn = cn - 1
    if dir = S:
        cs = cs - 1
```

$\leftarrow \{I \wedge (dir=N \rightarrow cn>0) \wedge (dir=S \rightarrow cs>0)\}$ (por el orden de la función car)

$\{I \wedge dir=N\} \Rightarrow \{I \wedge cn>0\} \Rightarrow I \wedge cn \geq 1$

$(I \wedge cn \geq 1)_{cn}^{cn-1} \Rightarrow I_{cn}^{cn-1} \wedge cn-1 \geq 1 \Rightarrow I_{cn}^{cn-1} \wedge cn \geq 0 \Leftarrow I$

$\{I \wedge dir=S\} \Rightarrow I \wedge cs>0 \Rightarrow I \wedge cs \geq 1$

$(I \wedge cs \geq 1)_{cs}^{cs-1} \Rightarrow I_{cs}^{cs-1} \wedge cs-1 \geq 0 \Rightarrow I_{cs}^{cs-1} \wedge cs \geq 0 \Leftarrow I$