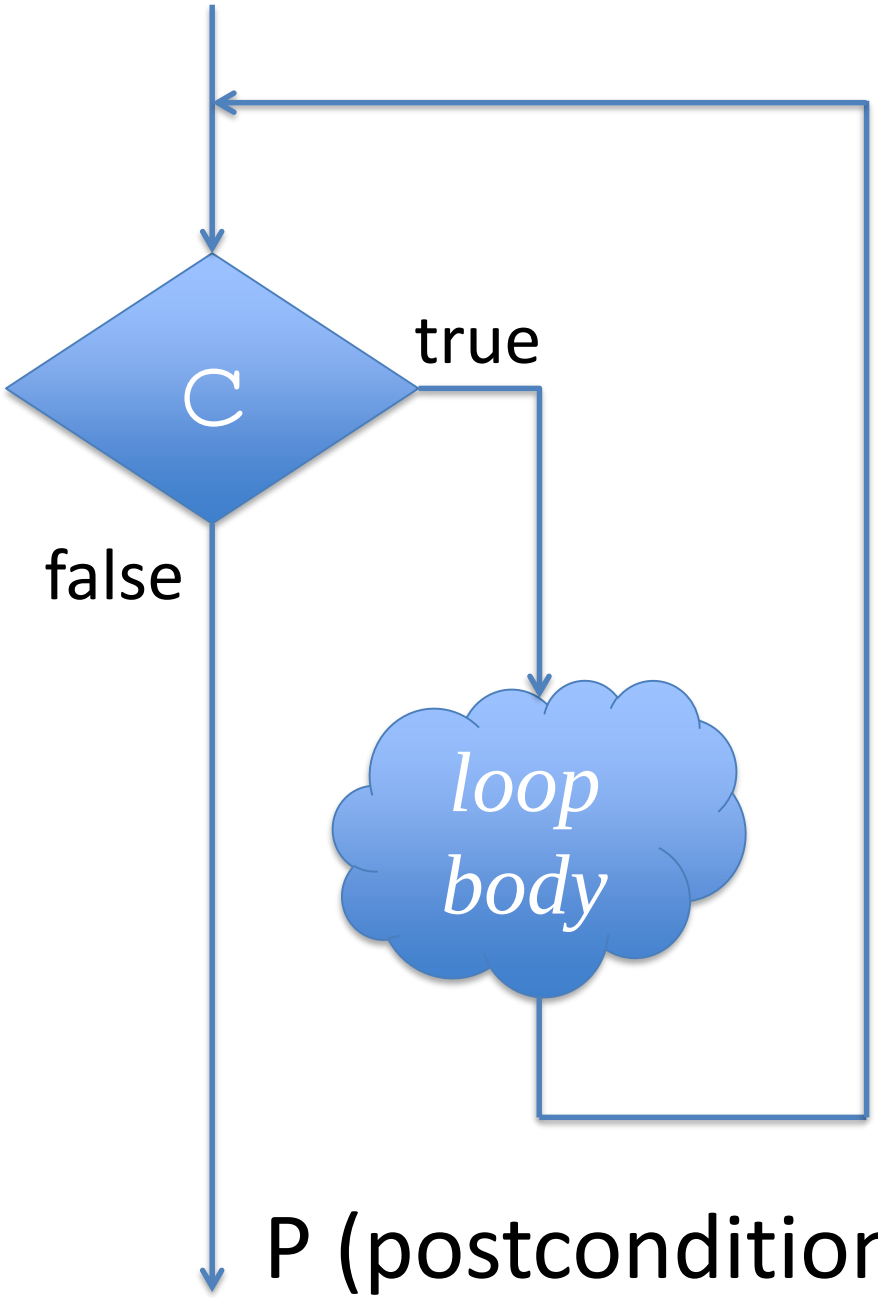
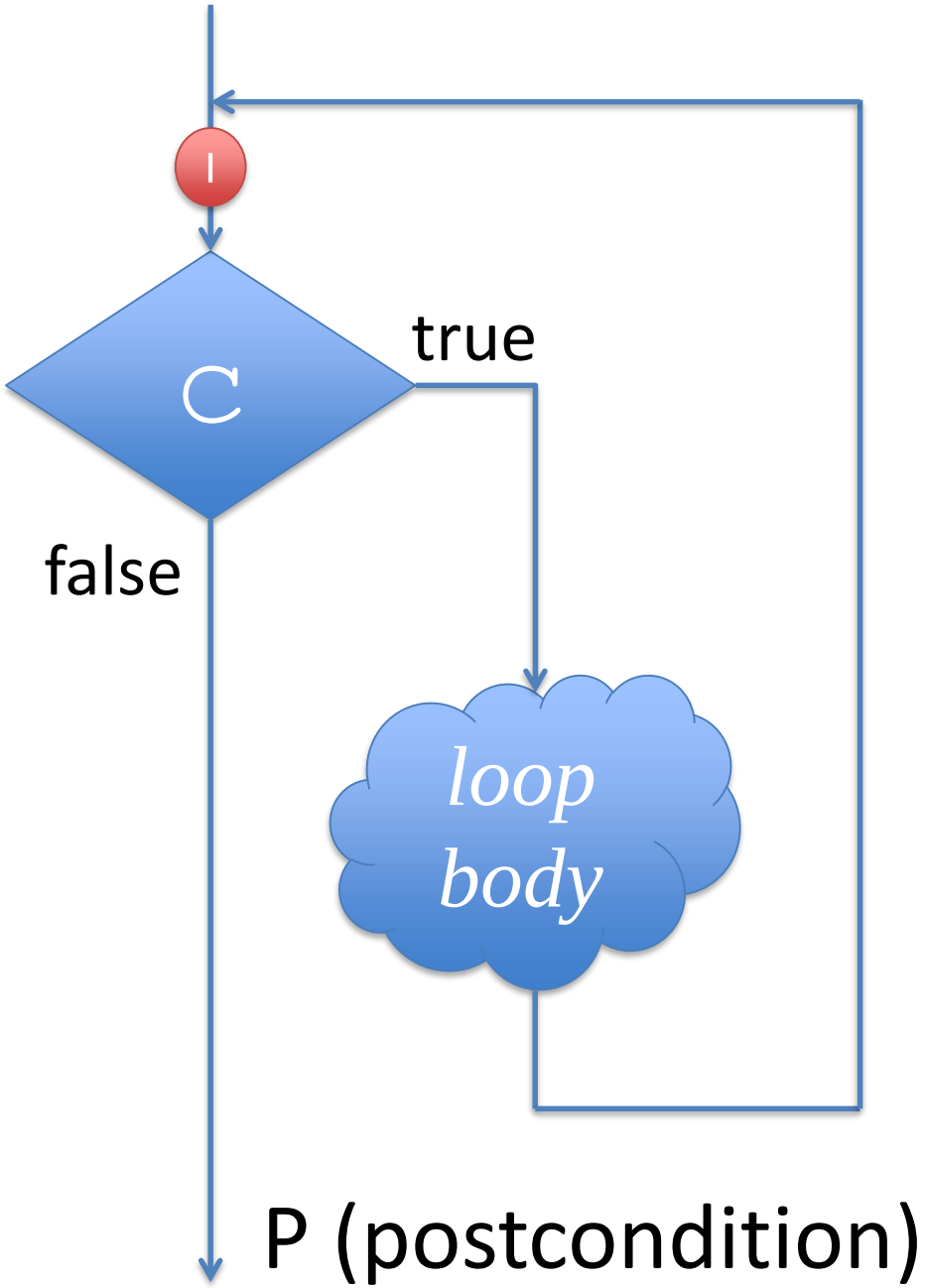



```
while (c) {
    loop body
}
```

Loop Invariant

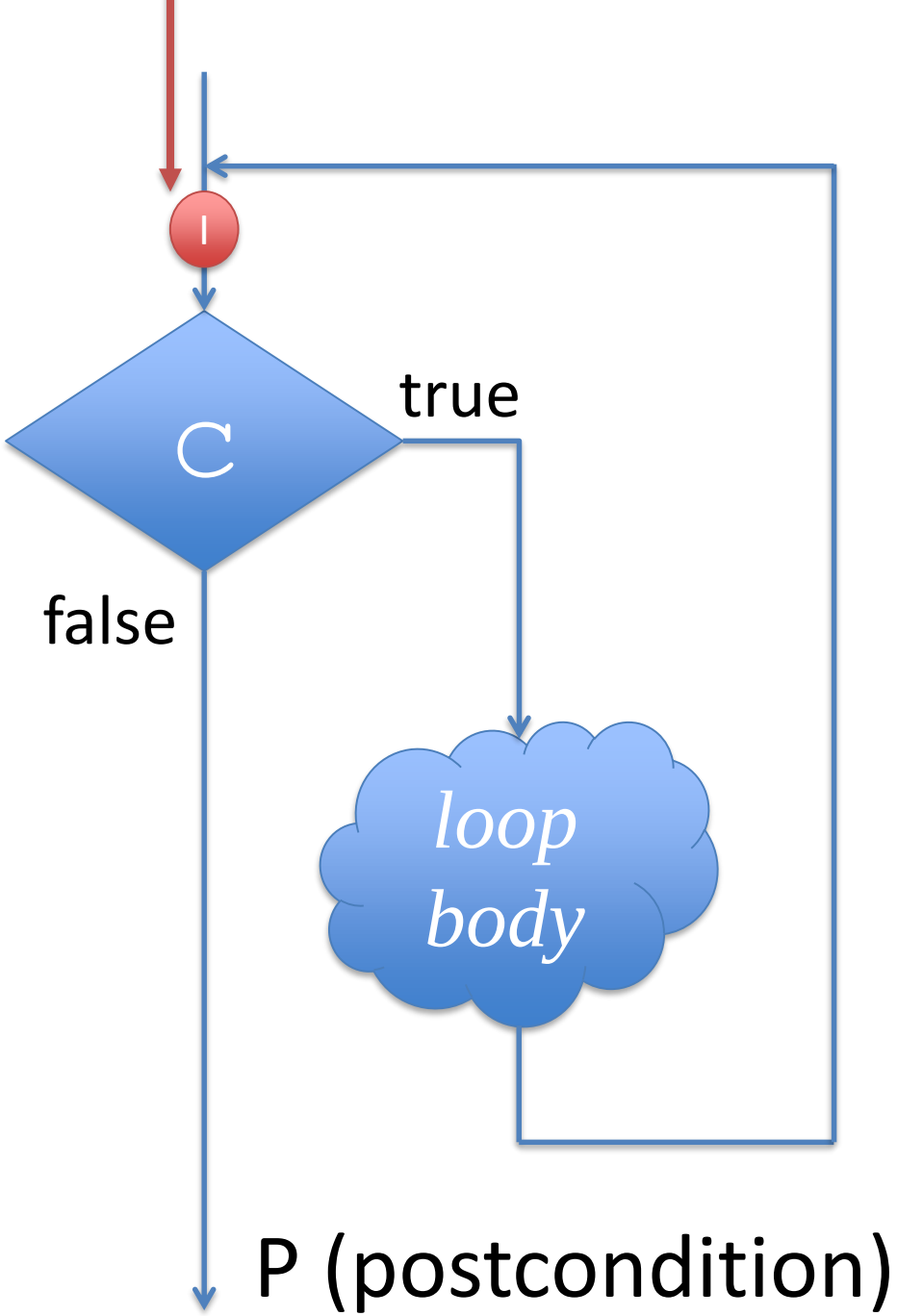
- Def'n: A boolean condition that is checked *immediately before every evaluation of the loop guard*.



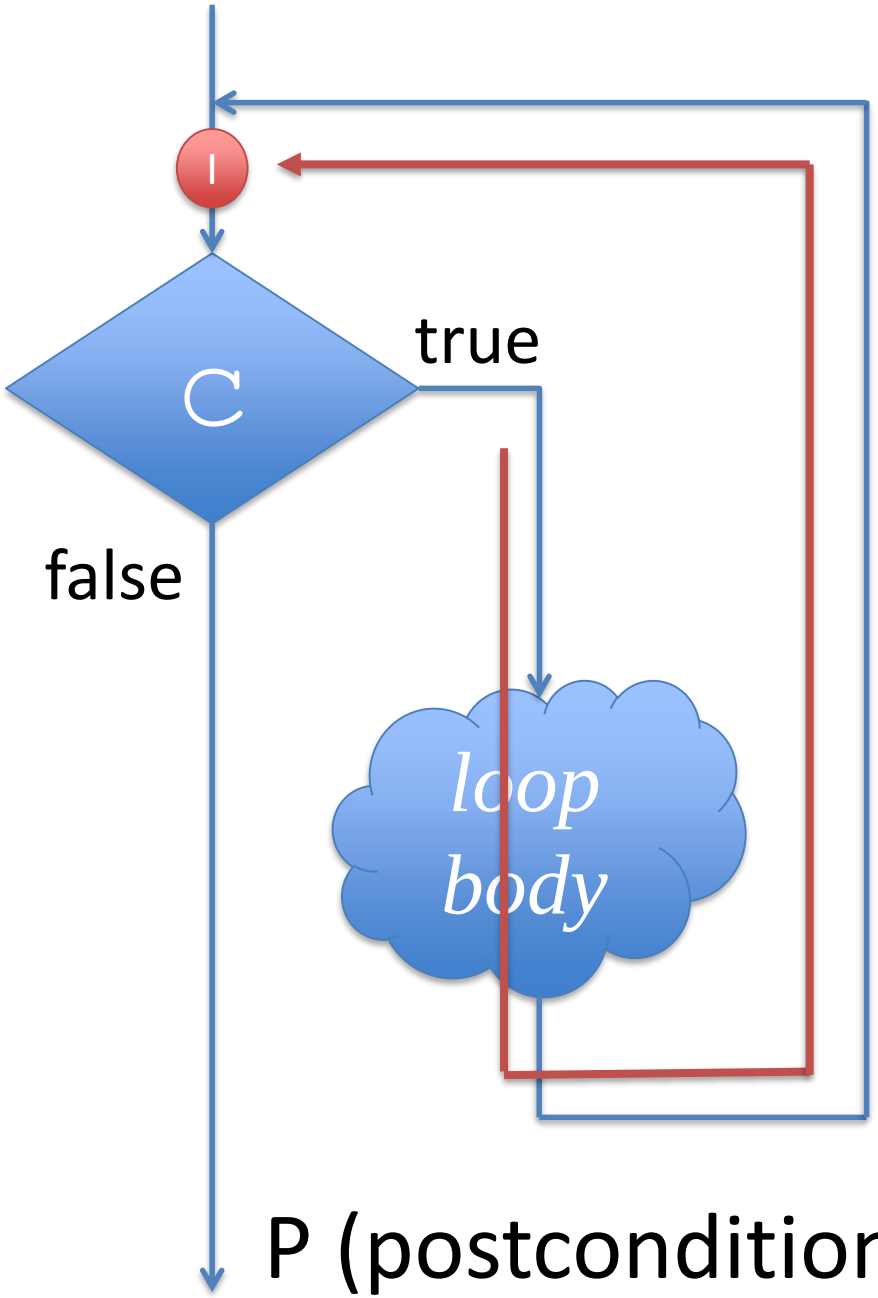

```
while (c)
//@loop_invariant I;
{
    loop body
}
//@assert P;
```

Loop Invariant

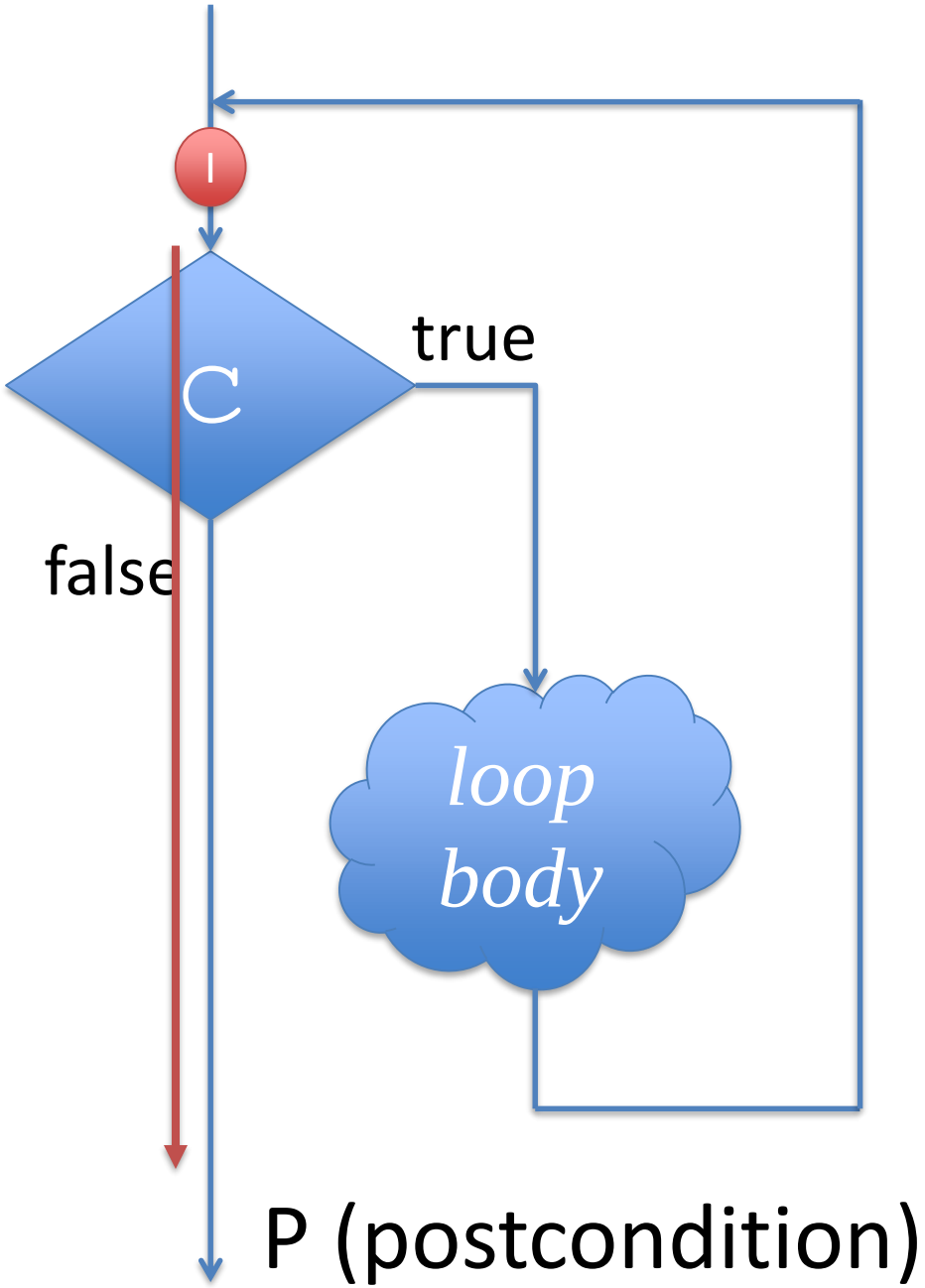
- Def'n: A boolean condition that is checked *immediately before every evaluation of the loop guard*.
- It is true even if the loop runs 0 times (i.e. is skipped).
- It is true immediately before each evaluation of the loop guard, including the last evaluation if the loop terminates.
- It is true immediately after the loop terminates, if the loop terminates.



1. **INIT**
Show that the loop invariant I is true immediately before the first evaluation of the loop guard C.



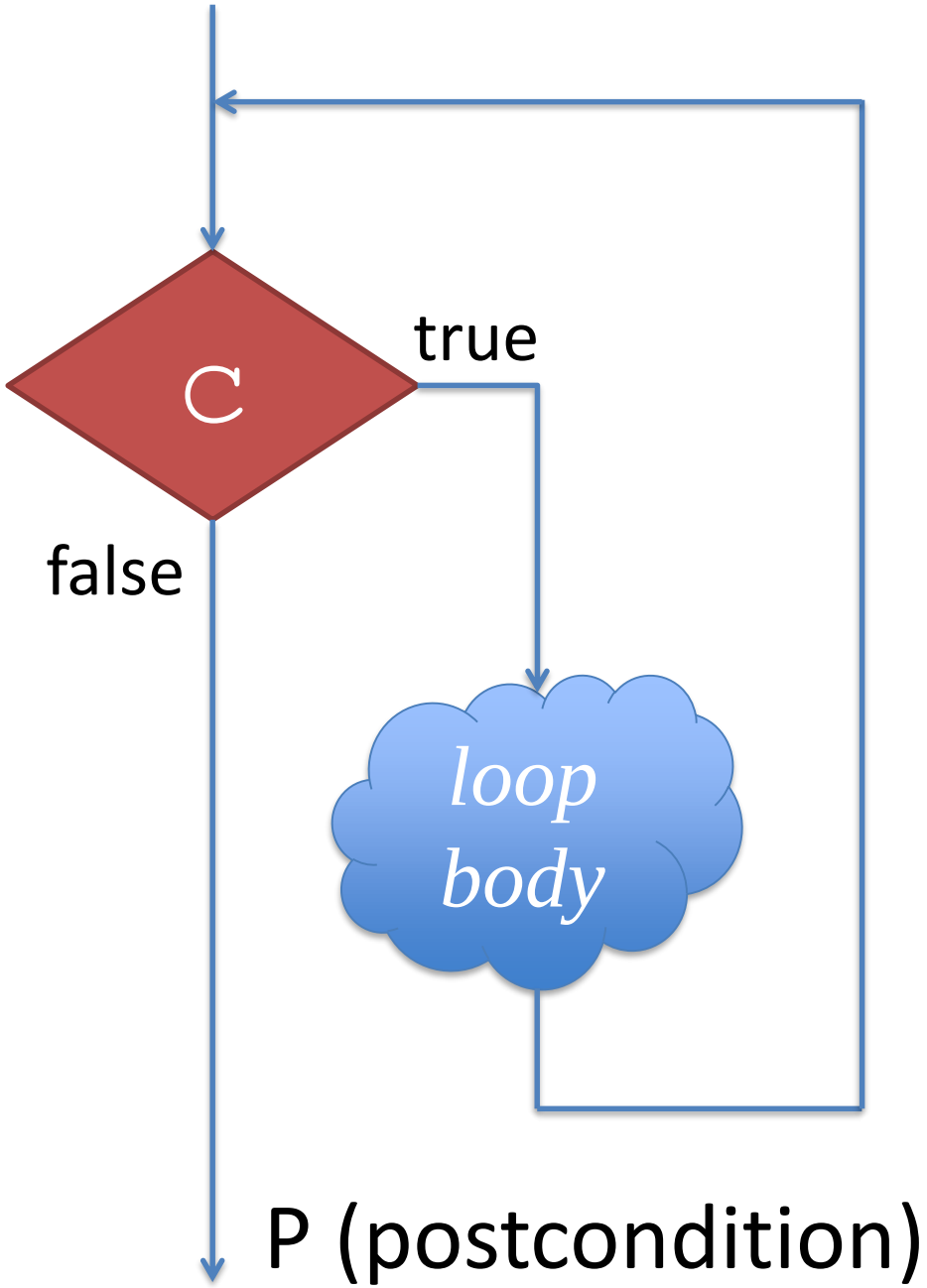
2. **PRESERVATION**
Show that if the loop invariant I is true immediately before the evaluation of the loop guard C, then I is true immediately before the next evaluation of the loop guard C.



3. **EXIT**

Once we have a valid loop invariant, we can show that the logical conjunction of the loop invariant I and the negation of the loop guard C implies the desired postcondition P:

$$I \wedge \sim C \rightarrow P$$



4. **TERMINATION**
Show that the loop will always terminate (i.e. that C must eventually be false).