This task is based on reversible programming languages. Everything you need to know is provided here.
Prove inv-correct below. Remember that your goal is to complete the proof as fast as possible.

We define expressions, statements, and states:

$$\begin{aligned}
\mathsf{expr} &:= \mathsf{CONST\ bool} \\
&\mid \mathsf{GET1} \\
&\mid \mathsf{GET2}
\end{aligned}$$

$$\begin{aligned}
\mathsf{stmnt} &:= \mathsf{COND\ expr\ stmnt\ stmnt\ expr} \\
&\mid \mathsf{FLIP} \\
&\mid \mathsf{SEQ\ stmnt\ stmnt}
\end{aligned}$$

$$\mathsf{state} := \mathsf{bool}$$

We define how expressions evaluate:

$\boxed{\mathsf{eval\ state\ expr\ bool}}$

$$\frac{}{\mathsf{eval}\ st\ (\mathsf{CONST}\ b)\ b}\ \text{E-CONST}$$

$$\frac{}{\mathsf{eval}\ st\ (\mathsf{GET1})\ st}\ \text{E-GET1}$$

$$\frac{}{\mathsf{eval}\ st\ (\mathsf{GET2})\ (\mathsf{negb}\ st)}\ \text{E-GET2}$$

And how statements execute:

$\boxed{\mathsf{exec\ state\ stmnt\ state}}$

$$\frac{\mathsf{eval}\ st\ e_1\ \mathsf{true} \qquad \mathsf{exec}\ st\ s_1\ st' \qquad \mathsf{eval}\ st'\ e_2\ \mathsf{true}}{\mathsf{exec}\ st\ (\mathsf{COND}\ e_1\ s_1\ s_2\ e_2)\ st'}\ \text{E-COND1}$$

$$\frac{\mathsf{eval}\ st\ e_1\ \mathsf{false} \qquad \mathsf{exec}\ st\ s_2\ st' \qquad \mathsf{eval}\ st'\ e_2\ \mathsf{false}}{\mathsf{exec}\ st\ (\mathsf{COND}\ e_1\ s_1\ s_2\ e_2)\ st'}\ \text{E-COND2}$$

$$\frac{}{\mathsf{exec}\ st\ \mathsf{FLIP}\ (\mathsf{negb}\ st)}\ \text{E-FLIP}$$

$$\frac{\mathsf{exec}\ st\ s_1\ st' \qquad \mathsf{exec}\ st'\ s_2\ st''}{\mathsf{exec}\ st\ (\mathsf{SEQ}\ s_1\ s_2)\ st''}\ \text{E-SEQ}$$

YOUR TASK is to prove the theorem below about the correctness of this function for inverting statements:

$$\mathsf{inv}\ (s : \mathsf{stmnt}) : \mathsf{stmnt} := \begin{cases} \mathsf{COND}\ e_2\ (\mathsf{inv}\ s_1)\ (\mathsf{inv}\ s_2)\ e_1 & \text{when } s = \mathsf{COND}\ e_1\ s_1\ s_2\ e_2 \\ \mathsf{FLIP} & \text{when } s = \mathsf{FLIP} \\ \mathsf{SEQ}\ (\mathsf{inv}\ s_2)\ (\mathsf{inv}\ s_1) & \text{when } s = \mathsf{SEQ}\ s_1\ s_2 \end{cases}$$

This is the theorem you need to prove:

Theorem (inv-correct).
For all statements s and states st, st', if $\mathsf{exec}\ st\ s\ st'$, then $\mathsf{exec}\ st'\ (\mathsf{inv}\ s)\ st$.