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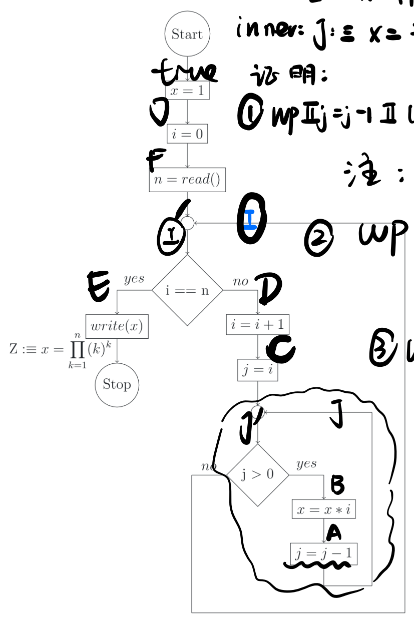
Prove Z using weakest preconditions.



Out: $I :\equiv x = \prod_{k=1}^{i} k^k \wedge i \ge 0$

inner: $J :\equiv x = i^{i \cdot j} * \prod_{k=1}^{i-1} k^k \wedge i \ge 0 \wedge j \ge 0$

证明:

① $WP[\![j = j-1]\!](J) = i^{i(j-1)} * \prod_{k=1}^{i-1} k^k \wedge i \ge 0 \wedge j > 0 :\equiv A$

注: $j \ge 1 \Leftrightarrow j > 0$

② $WP[\![x = x * i]\!](A) = i^{ij} * \ldots \equiv: B$

③ $WP[\![j > 0]\!](J, B) \equiv \ldots$

$\Leftarrow J$ ✓

④ 同理:

$J \to C \to D \to E \Leftarrow I$

⑤ $\Rightarrow F \Rightarrow J \Rightarrow true$

Hint: If you have to find invariants for nested loops, it is usually easiest to work from outermost loop to innermost loop.

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