Algo FindMin (A, n)

Input: Array A of n integers

Output: Return the smallest element in A

```
i ← 1
m ← A[0]
while (i < n)
    if (A[i] < m) then m ← A[i]
    i ← i+1
return m
```

Loop invariant: $\boxed{\text{At iteration } i,\ m = \min\{A[0], \ldots A[i-1]\}}$

Goal: Prove the loop invariant hold

① Initialization: Before the start of the loop, LI holds

$i = 1,\quad m = A[0] = \min\{A[0], \ldots A[i-1]\}$

② Maintenance: Assume L.I. holds at beginning of ~~loop~~ an iteration of loop. We must show that L.I holds at the end of that iteration

Assume $m = \min\{A[0] \ldots A[i-1]\}$

If $(A[i] < m)$, then replacing m with $A[i]$ results in m being $\min\{A[0] \ldots A[i]\}$

If $(A[i] \geq m)$, then m remains unchanged. m is now $\min\{A[0] \ldots A[i]\}$

After increasing i by one: $\underbrace{\boxed{m = \min\{A[0] \ldots A[i-1]\}}}_{\text{L.I.}}$

③ Termination

3.1. Algo will stop. because counter variable i get increased by one at each iteration. so, it will eventually reach n.

3.2. When loop terminates,

$$m = \min\{A[0], \dots A[n-1]\}$$

Loop stops when $i = n$

Loop invariant says $m = \min\{A[0], \dots A[i-1]\}$

$\iff m = \min\{A[0] \dots A[n-1]\}$