



**SPECTRE: SPECTACULAR EXERCUTION**

3

9

A



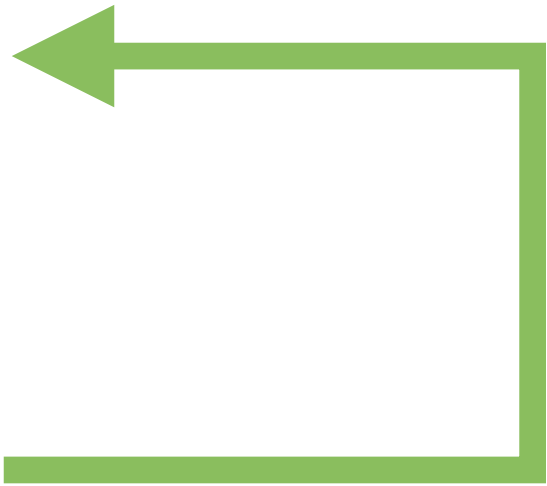
B



c

D

E



D

The CPU has learned that  $\text{Counter} \text{ probably } is > 0$

Reading Counter from memory is very slow



The CPU *speculatively* executes to improve performance

3

counter

2

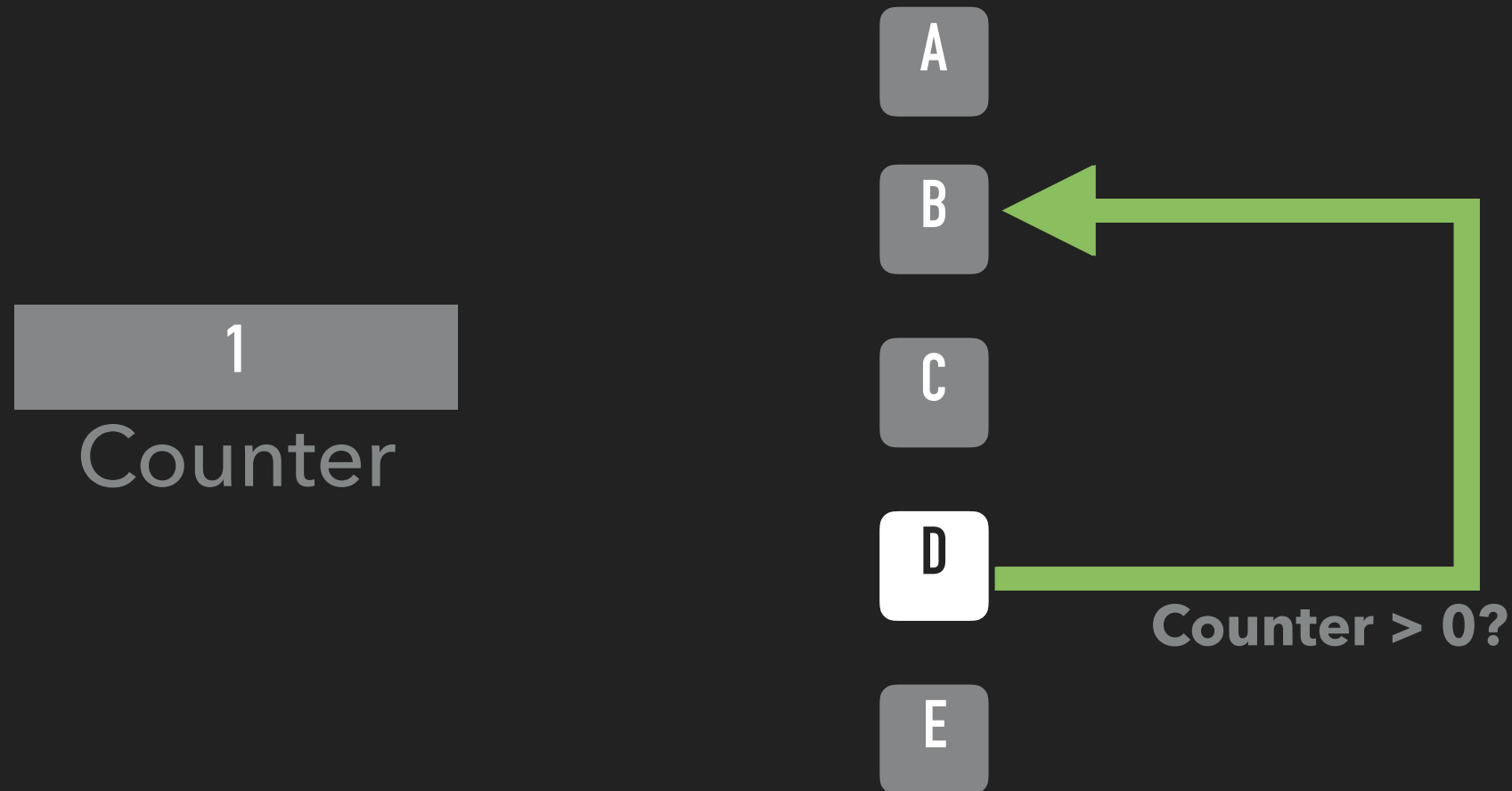
1

counter=0?

B

C

# SPECTRE: SPECULATIVE EXECUTION



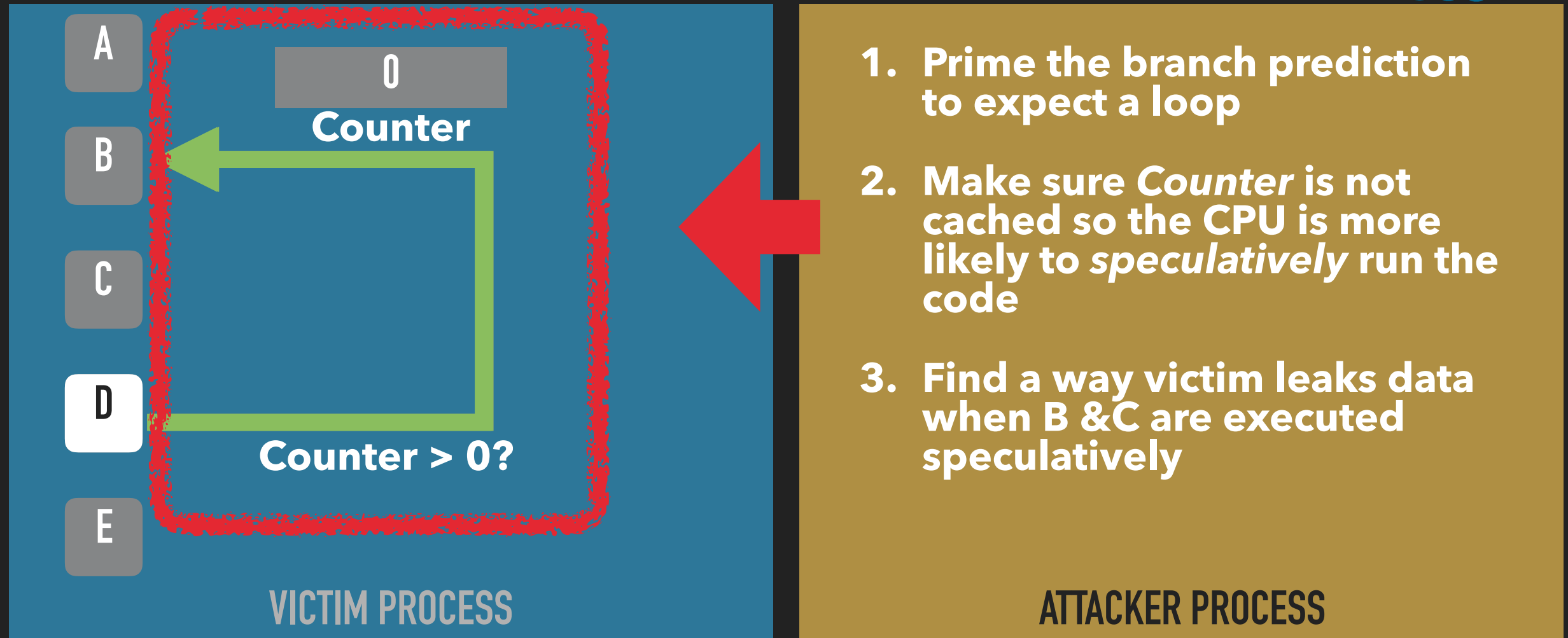
The CPU has learned that Counter *probably* is  $> 0$

Reading Counter from memory is very slow

The CPU *speculatively* executes **B** **C** to improve performance



# SPECTRE: SPECULATIVE EXECUTION



Attacker can influence the CPU's branch prediction of victim.  
Making the victim *speculatively* execute "wrong" code.  
E.g. loop even when Counter is == 0.