# Contents

**CONTEXT** c0_circuit_breaker

**SETS**

CIRCUIT_BREAKER_STATE

**CONSTANTS**

THRESHOLD

OPEN

CLOSED

TIMEOUT_PERIOD

HALF_OPEN

AMOUNT_TEST_REQUESTS

**AXIOMS**

ax1: $THRESHOLD \in \mathbb{N}_1$

ax2: $TIMEOUT\_PERIOD \in \mathbb{N}_1$

ax3: $partition(CIRCUIT\_BREAKER\_STATE, \{OPEN\}, \{CLOSED\}, \{HALF\_OPEN\})$

ax4: $AMOUNT\_TEST\_REQUESTS \in \mathbb{N}_1$

init1: $THRESHOLD = 3$

init2: $TIMEOUT\_PERIOD = 2$

init3: $AMOUNT\_TEST\_REQUESTS = 3$

**END**

**MACHINE** m0_circuit_breaker
**SEES** c0_circuit_breaker
**VARIABLES**

consecutive_errors represents the amount of consecutive errors

circuit_breaker represents the state of the circuit breaker

time represents current time, always moving forward

timestamp_cb_trips represents the timestap since when the circuit breaker trips

test_request_to_go represents the amount of test request that must respond ok during the HALF_OPEN state to switch to the CLOSED state

**INVARIANTS**

inv1: $time \in \mathbb{N}$

inv2: $timestamp\_cb\_trips \in \mathbb{N}$

inv3: $consecutive\_errors \in \mathbb{N}$

inv4: $circuit\_breaker \in CIRCUIT\_BREAKER\_STATE$

inv5: $test\_request\_to\_go \in \mathbb{N}$

**EVENTS**

**Initialisation**

**begin**

init1: $time := 0$

init2: $timestamp\_cb\_trips := 0$

init3: $consecutive\_errors := 0$

init4: $circuit\_breaker := CLOSED$

init5: $test\_request\_to\_go := AMOUNT\_TEST\_REQUESTS$

**end**

**Event** request ⟨ordinary⟩ $\widehat{=}$

**any**

microservice_response represents wheather the microservice response or not

new_circuit_breaker represents the new state of the circuit breaker

new_consecutive_errors represents the new count of consecutive errors

new_timestamp_cb_trips represents the timestap since when the circuit breaker trips

new_test_request_to_go represents the remaining number of request to switch to the CLOSED state

**where**

grd1: $microservice\_response \in BOOL$

grd2: $new\_circuit\_breaker \in CIRCUIT\_BREAKER\_STATE$

grd3: $new\_consecutive\_errors \in \mathbb{N}$

grd4: $new\_timestamp\_cb\_trips \in \mathbb{N}$

grd5: $new\_test\_request\_to\_go \in \mathbb{N}$

grd6: $circuit\_breaker = CLOSED \wedge microservice\_response = TRUE \Rightarrow new\_consecutive\_errors = 0$

grd7: $circuit\_breaker = CLOSED \wedge microservice\_response = FALSE \Rightarrow new\_consecutive\_errors = consecutive\_errors + 1$

grd8: $circuit\_breaker = CLOSED \wedge new\_consecutive\_errors \geq THRESHOLD \Rightarrow new\_circuit\_breaker = OPEN \wedge new\_timestamp\_cb\_trips = time$

grd9: $circuit\_breaker = CLOSED \wedge new\_consecutive\_errors < THRESHOLD \Rightarrow new\_circuit\_breaker = CLOSED \wedge new\_timestamp\_cb\_trips = timestamp\_cb\_trips$

grd10: $circuit\_breaker = CLOSED \Rightarrow new\_test\_request\_to\_go = AMOUNT\_TEST\_REQUESTS$

grd11: $circuit\_breaker = OPEN \Rightarrow new\_circuit\_breaker = OPEN \wedge new\_consecutive\_errors = 0 \wedge new\_test\_request\_to\_go = AMOUNT\_TEST\_REQUESTS \wedge new\_timestamp\_cb\_trips = timestamp\_cb\_trips$

grd12: $circuit\_breaker = HALF\_OPEN \wedge microservice\_response = FALSE \Rightarrow new\_circuit\_breaker = OPEN \wedge new\_test\_request\_to\_go = AMOUNT\_TEST\_REQUESTS$

grd13: $circuit\_breaker = HALF\_OPEN \wedge microservice\_response = TRUE \Rightarrow new\_test\_request\_to\_go = test\_request\_to\_go - 1$

grd14: $circuit\_breaker = HALF\_OPEN \wedge microservice\_response = TRUE \wedge new\_test\_request\_to\_go = 0 \Rightarrow new\_circuit\_breaker = CLOSED$

grd15: $circuit\_breaker = HALF\_OPEN \wedge microservice\_response = TRUE \wedge new\_test\_request\_to\_go > 0 \Rightarrow new\_circuit\_breaker = HALF\_OPEN$

grd16: $circuit\_breaker = HALF\_OPEN \Rightarrow new\_consecutive\_errors = 0 \wedge new\_timestamp\_cb\_trips = time$

**then**

act1: $consecutive\_errors := new\_consecutive\_errors$
act2: $circuit\_breaker := new\_circuit\_breaker$
act3: $timestamp\_cb\_trips := new\_timestamp\_cb\_trips$
act4: $test\_request\_to\_go := new\_test\_request\_to\_go$

**end**

**Event** clock ⟨ordinary⟩ $\widehat{=}$

**any**

new_circuit_breaker

**where**

grd1: $new\_circuit\_breaker \in CIRCUIT\_BREAKER\_STATE$
grd2: $circuit\_breaker = OPEN \wedge (time + 1 - timestamp\_cb\_trips = TIMEOUT\_PERIOD) \Rightarrow new\_circuit\_breaker = HALF\_OPEN$
grd3: $circuit\_breaker = OPEN \wedge (time + 1 - timestamp\_cb\_trips \neq TIMEOUT\_PERIOD) \Rightarrow new\_circuit\_breaker = circuit\_breaker$
grd4: $circuit\_breaker = CLOSED \vee circuit\_breaker = HALF\_OPEN \Rightarrow new\_circuit\_breaker = circuit\_breaker$

**then**

act1: $time := time + 1$
act3: $circuit\_breaker := new\_circuit\_breaker$

**end**

**END**