BPU Question 1

Considering a 2-bit saturating counter BHT of 1K entries; and assuming that the processor executes the following code fragment, determine the BHT final state and calculate the misprediction ratio in the presented case. The BPU initial state is indicated in the table.

General assumptions:
- R10 is the main loop control register and is initialized to 100
- R3 and R7 are reference values set to 5
- R2 and R6 are input registers
    - R2 input values are always higher than 5
    - R6 input values are always lower than 5

Address	Instruction	BHT (2-bit)	Prediction	misP. counter
0x0000	L0: …	0	NT	
…	; ***Reading input values***	0	NT	
0x0010	SLT R1, R2, R3	0	NT	
0x0014	BEQZ R1, L1	0-1-2-3…	T	1-1-0
0x0018	DADDI R2, R0, 10	0	NT	
0x001C	L1: SLT R4, R6, R7	0	NT	
0x0020	BEQZ R4, L2	0…	NT	
0x0024	DADDI R12, R0, 10	0	NT	
0x0028	L2: DSUB R3, R1, R2	0	NT	
0x002C	BEQZ R3, L3	0…	NT	
0x0030	…	0	NT	
0x0038	L3: …	0	NT	
0x003c	DADDI R10, R10, #-1	0	NT	
0x0040	BNEZ R10, L0	0-1-2-3-…-2	T	1-1-0-…-1
0x0044	…	0	NT	

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Note:

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SLT R1,R2,R3      ;IF (R2 < R3) R1 ← 1
                  ;ELSE R1 ← 0
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BPU Question 2

Considering a (2,2) correlating predictor of 1K entries; and assuming that the processor executes the following code fragment, determine the BPU final state and calculate the misprediction in the presented case. The BPU initial state is indicated in the table.

General assumptions:
- R10 is the main loop control register and is initialized to 100
- R3 and R7 are reference values set to 5
- R2 and R6 are input registers
    - R2 input values are always higher than 5
    - R6 input values are always lower than 5

Address	Instruction	2-bit predictors				2-bit shift register		misP. counter
		00	01	10	11			
0x0000	L0: …	0	0	0	0	00-01-01		
…	; *Reading input values*	0	0	0	0	init	end	
0x0010	SLT R1, R2, R3	0	0	0	0			
0x0014	BEQZ R1, L1	0-1	0-1-2-3	0	0	00 01 01	01 11 11	1-1-1
0x0018	DADDI R2, R0, 10	0	0	0	0			
0x001C	L1: SLT R4, R6, R7	0	0	0	0			
0x0020	BEQZ R4, L2	0	0…	0	0…	01 11 11	10 10 10	0-0-0
0x0024	DADDI R12, R0, 10	0	0	0	0			
0x0028	L2: DSUB R3, R1, R4	0	0	0	0			
0x002C	BEQZ R3, L3	0	0	0…	0	10 10 10	00 00 00	0-0-0
0x0030	…	0	0	0	0			
0x0038	L3: …	0	0	0	0			
0x003c	DADDI R10, R10, #-1	0	0	0	0			
0x0040	BNEZ R10, L0	0-1-2-3-…-2	0	0	0	00 00	01 01	1-1-0-…-1
0x0044	…	0	0	0	0			

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