Q3.1

For B1: misprediction rate is 0% since LARGE goes to infinity, every cycle is taken and predicted as taken.

For B2: The taken/not taken series will be:

T N N N T N N N ...

Since LARGE goes to infinity, the first prediction doesn't influence the misprediction rate, then predicted series will be (from second):

- T N N N T N N ...

So the misprediction rate is 50%.

For B3: similar as B2, The taken/not taken series:

T N T N ...

The prediction (from second):

- T N T ...

The misprediction rate is 100%.

Q3.2

For B1: is still 0%. Because the taken/not taken series:

TTTT....

The 2-bit saturating counter:

00 01 11 11 11 ...

As LARGE goes to infinity, the misprediction rate will tend to 0%.

For B2: The taken/not taken series:

TNNNTNNN...

The 2-bit saturating counter:

00 01 00 00 00 01 00 00 00, (will be 01 00 00 00...01 00 00 00...)

Thus it always predict not taken, the misprediction rate is 25%.

For B3: The taken/not taken series:

 $\mathsf{T}\,\mathsf{N}\,\mathsf{T}\,\mathsf{N}\,\mathsf{T}\,\mathsf{N}\,\mathsf{I}\,\mathsf{N}\,\ldots$

The 2-bit saturating counter:

00 01 00 01 00 01 00 ...

This also always predict not taken, the misprediction rate is 50%.

Q3.3

00

00

01

00

i=0, B3

Predict as N

actually T

В2

В3

00 00

00 00 B2

В3

00 01

00

i=0, B3

update PHB, BHR

00

00 00

00

01

misprediction rate.

Assui	me B	HR is	also	00 sin	ce LAR	GE go	es to	infin	ity, it (doesn't	t influ	ience	e the r	nisp
			BHR	00				BHR	00				BHR	10
		Pl	ΗВ				PI	НВ				Р	НВ	
B1	00	00	00	00	B1	00	00	00	00	B1	01	00	00	00
В2	00	00	00	00	B2	00	00	00	00	В2	00	00	00	00
В3	00	00	00	00	В3	00	00	00	00	В3	00	00	00	00
		sta	art				i=0	, B1				i=0), B1	
						F	Predic	ct as I	V		upo	late	PHB, E	BHR
							actu	ally T						
			BHR	00				BHR	10					
		PI	ΗВ				PI	НВ						
B1	00	00	00	00	B1	01	00	00	00					
B2	00	00	00	00	В2	00	00	00	00					
В3	00	00	00	00	В3	00	00	00	00					
		i=0	, B1				i=0	, B1						
	F	redic	ct as I	N		upo	late I	PHB, I	BHR					
		actu	ally T											
	BHR 10							BHR	11					
	РНВ					РНВ								
B1	01	00	00	00	B1	01	00	00	00					
В2	00	00	00	00	В2	00	01	00	00					
В3	00	00	00	00	В3	00	00	00	00					
								••						
		i=0	, B2				i=0	, B2						
	F		ct as I	V		upo	late I	PHB, I	3HR					
		actu	ally T											
			BHR	11				BHR	11					
			НВ		1			HB						
B1	01	00	00	00	B1	01	00	00	00					

		ı	BHR	11				١	BHR	11			
	РНВ							РНВ					
B1						B1	01	00	00	01			
B2	00	01	00	00		B2	00	01	00	00			
В3	00	00	00	01		В3	00	00	00	01			
		i=1,	, B1			i=1, B1							
	F	redic	ct as I	N		update PHB, BHR							
		actu	ally T										
			BHR	11					BHR	01			
						PHB BHK 01							
B1	PHB B1 01 00 00 01						01	00	00	01			
B2	00	01	00	00		B1 B2	00	01	00	00			
B3	00	00	00	01		B3	00	00	00	01			
				0_						0-			
		i=1				i=1, B2							
	F		ct as l	N		update PHB, BHR							
		actua	ally N			, ,							
			BHR	01					BHR	00			
į			НВ			į		PH					
B1	01	00	00	01		B1	01	00	00	01			
B2	00	01	00	00		B2	00	01	00	00			
В3	00	00	00	01		В3	00	00	00	01			
	_	i=1,		.1		i=1, B3							
			ct as f ally N	N		update PHB, BHR							
		actu	ally IN										
			BHR	00		BHR 10							
		PI	ΗВ			РНВ							
B1	01	00	00	01		B1	11	00	00	01			
B2	00	01	00	00		B2	00	01	00	00			
В3	00	00	00	01		В3	00	00	00	01			
		i=2	, B1			i=2, B1							
	Predict as N							update PHB, BHR					
		actu	ally T										

			BHR	10	Т							
		BHR 01										
		PHB										
B1	11	00	00	01		B1	11	00	00	01		
B2	00	01	00	00		B2	00	01	00	00		
В3	00	00	00	01		В3	00	00	00	01		
		i=2	, B2 ct as N		i=2, B2							
		update PHB, BHR										
		BHR				ı	BHR	11				
		PHB										
B1	11	00	00	01		В1	11	00	00	01		
B2	00	01	00	00		В2	00	01	00	00		
В3	00	00	00	01		В3	00	00	01	01		
		i=2	, ВЗ			i=2, B3						
	P	redic	t as I	N		update PHB, BHR						
		actu	ally T									
			BHR	11					BHR	11		
		Ph						PH				
B1	11	00	00	01		В1	11	00	00	11		
B2	00	01	00	00		В2	00	01	00	00		
В3	00	00	01	01		В3	00	00	01	01		
		i=3, B1										
		i=3	, B1			•		i=3,	B1			
	F		B1 t as N	N		·	upd		, B1 PHB, E	BHR		
	F		t as I	N		·	upd			BHR		
	F	Predic actua	ct as f				upd	late P	PHΒ, Ε			
	F	Predic actua	ct as fally T	N 11	 		upd	late P	PHB, E	3HR 11		
		Predicture actual Prediction Pred	et as I ally T BHR HB	11		D4		late P	BHR	11		
B1	11	Prediction of the prediction o	et as fally T BHR HB	11		B1	11	late F	BHR OO	11		
В2	11 00	Prediction actual Prediction 1	et as fally T BHR HB 00	11 11 00		B2	11 00	PH 00 01	BHR 1B 00 00	11 11 00		
B2 B3	11	Prediction of the prediction o	et as fally T BHR HB	11		B2 B3	11	late F	BHR OO	11		
В2	11 00	Prediction actual Prediction of the prediction o	ally T BHR 00 00 01	11 11 00		B2	11 00	PH 00 01 00	BHR 00 00 01	11 11 00		
B2 B3	11 00 00	Prediction actual Prediction 1	BHR 00 00 01	11 11 00 01		B2 B3	11 00 00	PH 00 01 00 i=3,	BHR 18 00 00 01	11 11 00 01		
B2 B3	11 00 00	Prediction actual Prediction 1	BHR 00 00 01 B2	11 11 00 01		B2 B3	11 00 00	PH 00 01 00 i=3,	BHR 00 00 01	11 11 00 01		

We can continue do this steps via program simulation, choose LARGE=100000 we will get misprediction for B1, B2 and B3 will be 6, 25000 and 25002 respectively. Therefore, as LARGE goes to infinity, the misprediction rate for B1: 0%, B2: 25%, B3: 25%.