1-Bit Bimodal Prediction

0 = Not Taken

1 = Taken

- For each branch, keep track of what happened last time and use that outcome as the prediction

BR-1 == PC1

- What are prediction accuracies for branches 1 and 2 below:

```
while (1) {
    for (i=0;i<10;i++) {
        ...
PC1 } BR1
    for (j=0;j<20;j++) {
        ...
PC2 } BR2
}
```

branch-1: PC3 → PC1 (BR1), 8/10 = 80%

branch-2: PC4 → PC2 (BR2), 18/20 = 90%

26/30 = 87%

	PC1	PC3
BR-1		
BR-2	PC2	PC4

	1	

	×	✓	✓	×
PRED	0	1 ···	1	1
TRUE OUTCOME	1	1 ···	1	0
DEF PRED	0	0 ···	0	0

1/10 = 10%

1-Bit Bimodal Prediction

NT ← 00 - Str NT, 01 - Mild NT

2-bit Bimodal Sat Counter Predictor ← 10 - Mild T, 11 - Str T

- For each branch, keep track of what happened last time and use that outcome as the prediction

87% → 93%

- What are prediction accuracies for branches 1 and 2 below:

True outcome 0 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 ... 1 0 ...

Predictor 1 1 1 1 1 0 1 1 1 1 1 ...

Taken

T/NT

BR1 → PC1 [1] PC3

```
while (1) {
    for (i=0;i<10;i++) {          branch-1
        ...
    }
    for (j=0;j<20;j++) {          branch-2
        ...
    }
}
```

9/10

19/20

28/30

[01] NT → 01

00 →T 01 →T 10 →T 11 →T 11 →NT 10 →T 11

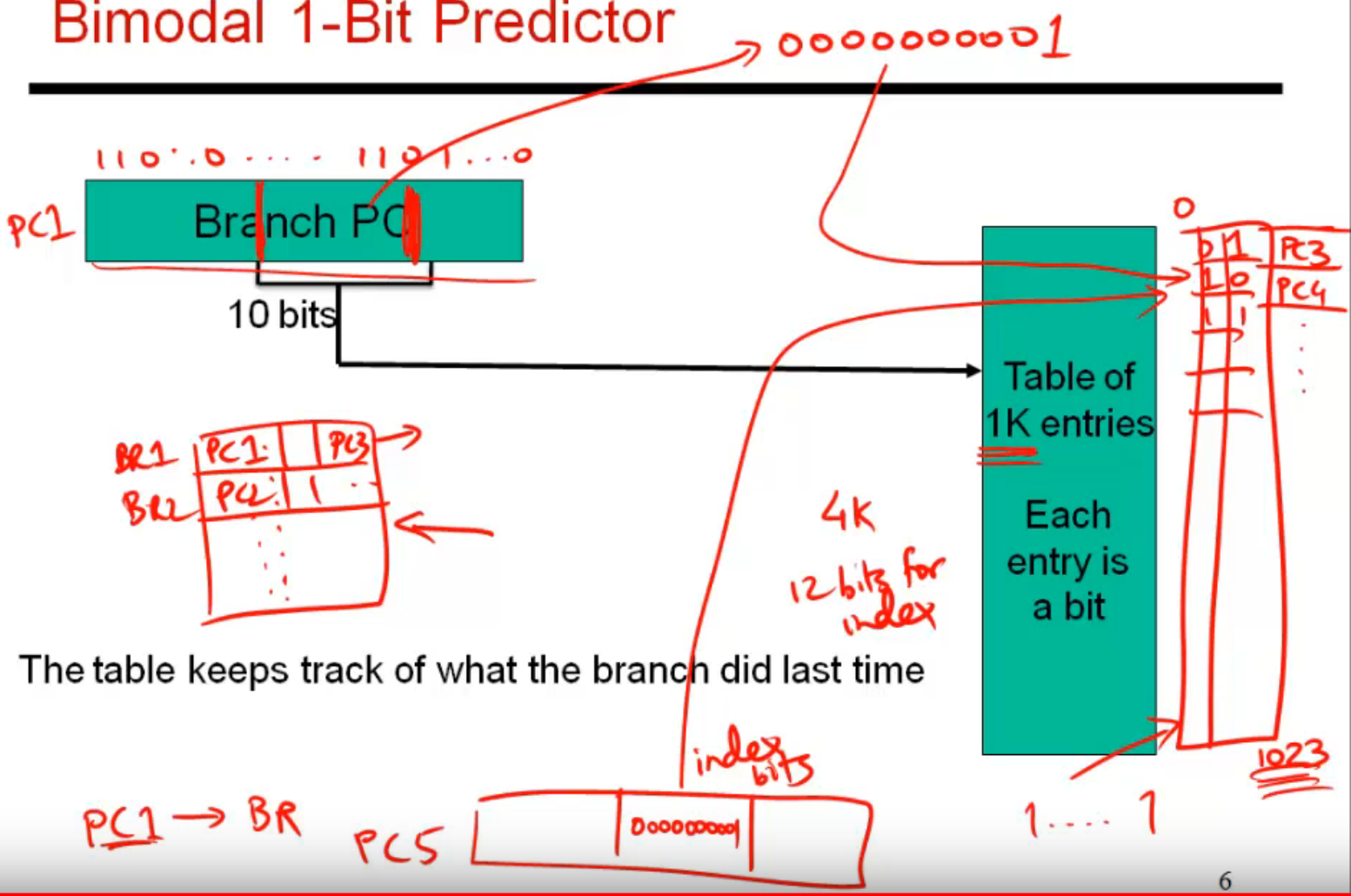
Taken

Taken – inc counter

Not Taken – decr counter

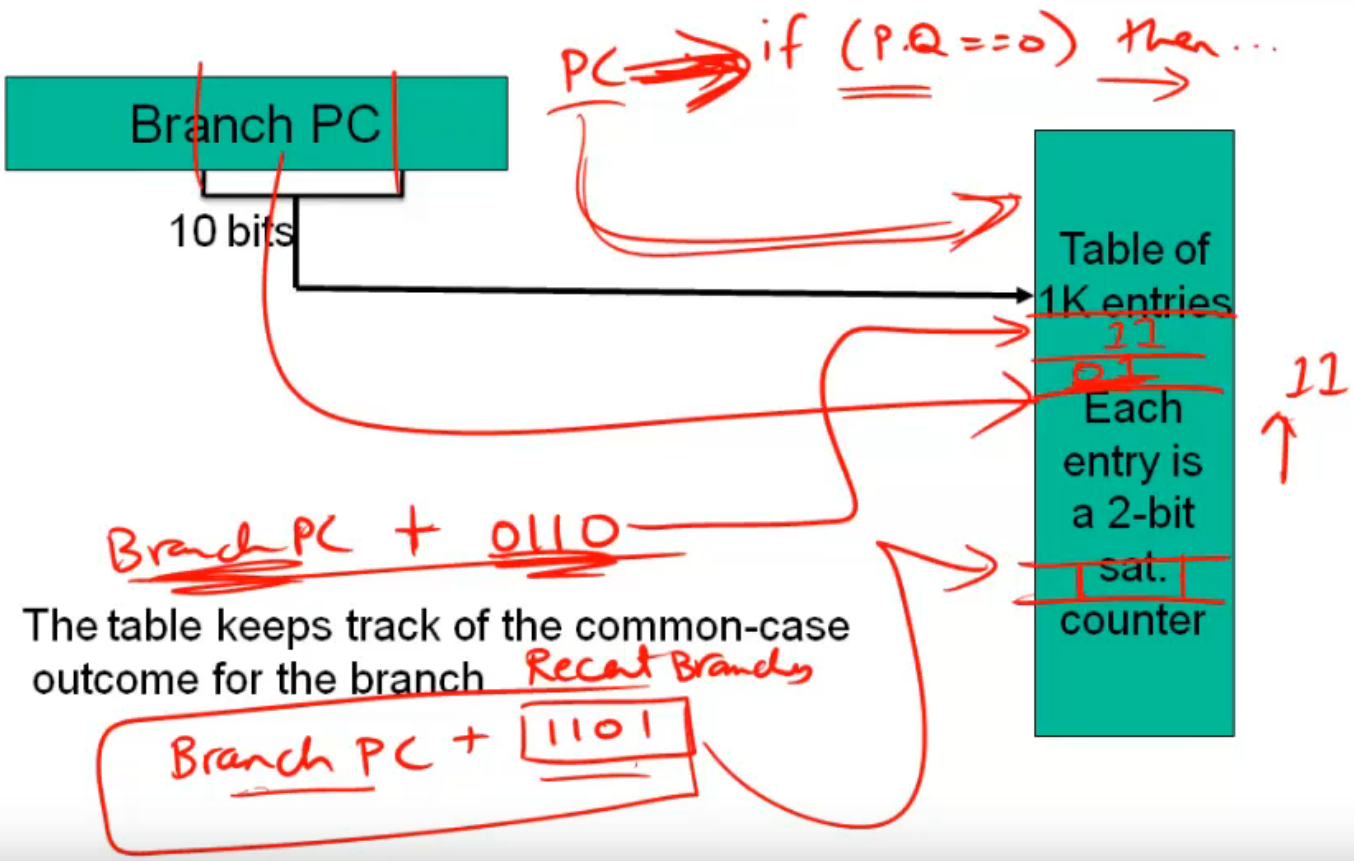
saturating 2-bit counter

Bimodal 1-Bit Predictor

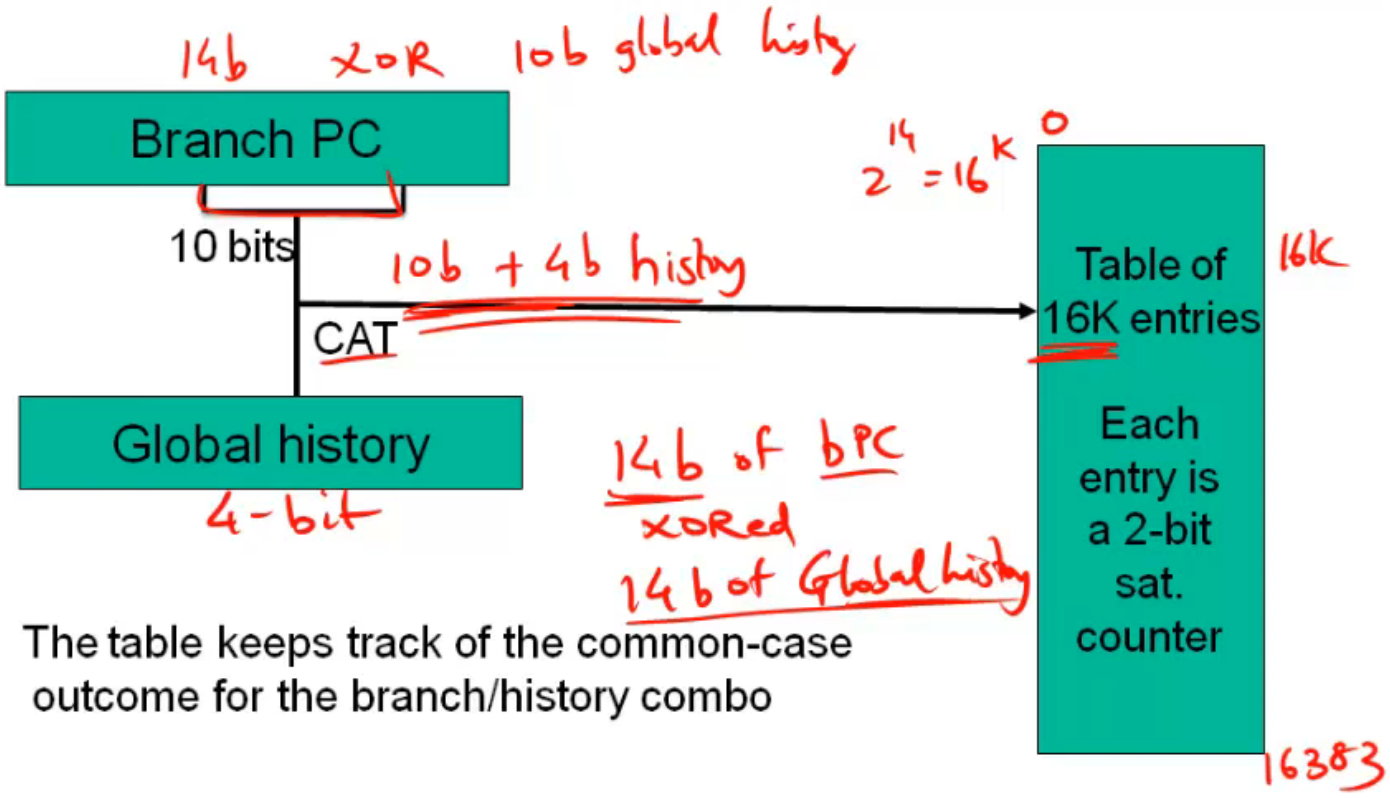


The table keeps track of what the branch did last time

Bimodal 2-Bit Predictor



Global Predictor



The table keeps track of the common-case outcome for the branch/history combo

Local Predictor

for 1→5

1111 0 11110 11110

BR

Also a two-level predictor that only uses local histories at the first level

87%, 93%

6 bits

Branch PC

Use 6 bits of branch PC to index into local history table

BR

6-b index

14 b index

14 b

10110111011001

Table of 64 entries of 14-bit histories for a single branch

L1

14-bit history indexes into next level

Table of 16K entries of 2-bit saturating counters

01

L2

5-b hist

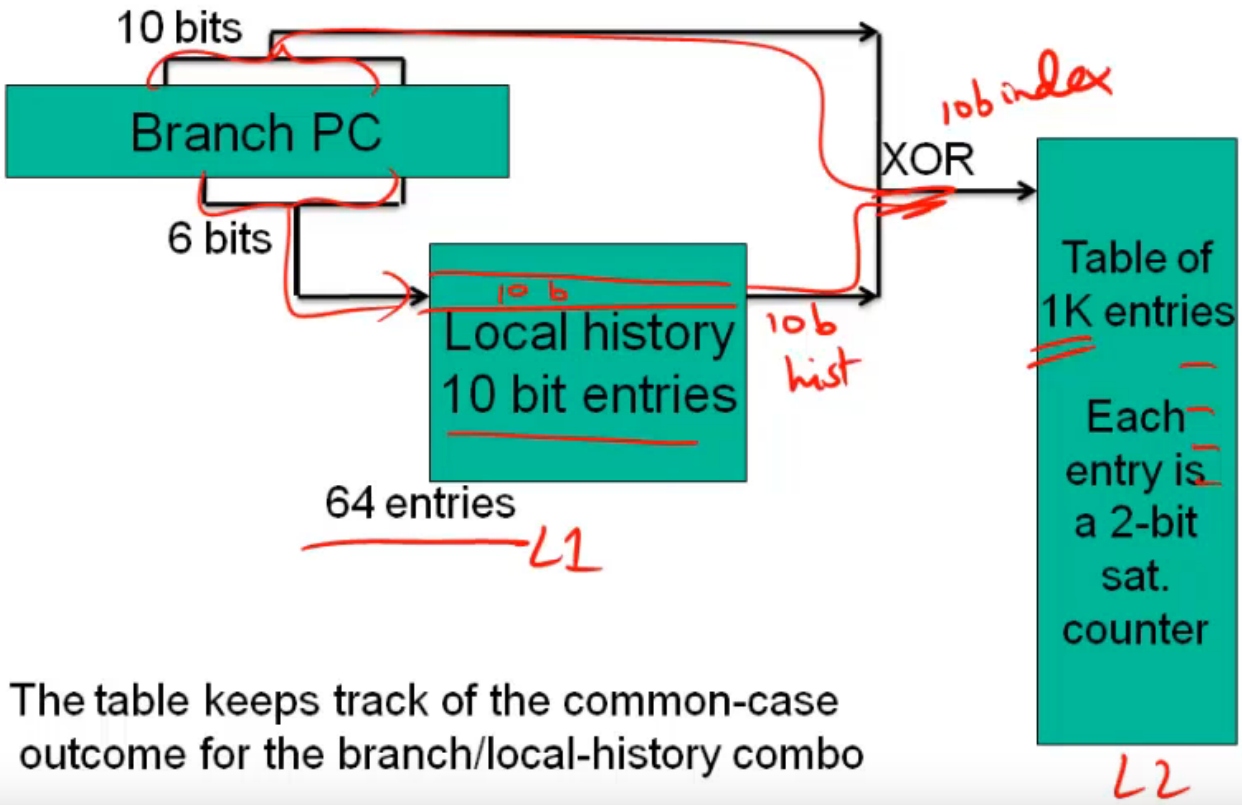
BR 11011

BR 01111

1 Taken

0 Not Taken

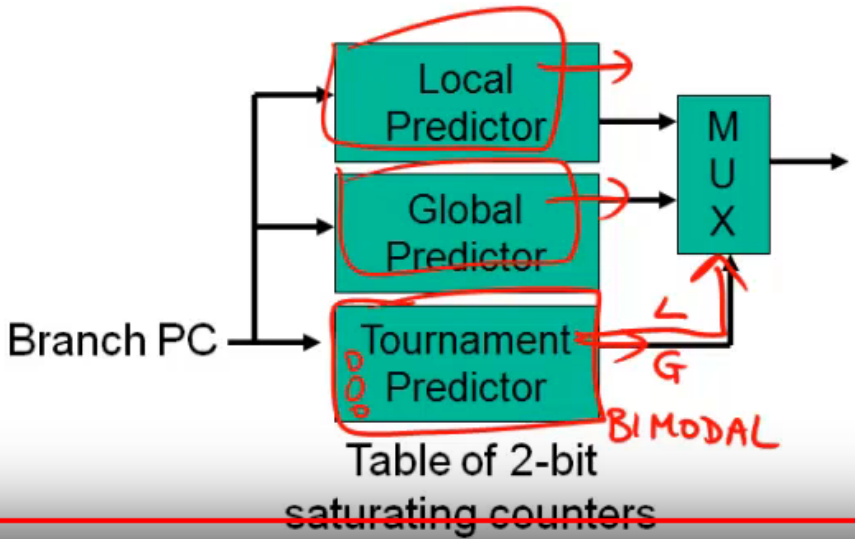
Local Predictor



The table keeps track of the common-case outcome for the branch/local-history combo

Tournament Predictors

- A local predictor might work well for some branches or programs, while a global predictor might work well for others
- Provide one of each and maintain another predictor to identify which predictor is best for each branch



Alpha 21264:
1K entries in level-1
1K entries in level-2

4K entries
12-bit global history

4K entries

Total capacity: ?