

Studies have shown:

20% to 30% of program instructions involve branching

About 65% of branches are taken

Instructions along the predicted path are speculative
the work done must be undone if the prediction is wrong

There are two options for branch prediction:

- static prediction & dynamic prediction

 - Static prediction can be done by the compiler

 - Dynamic prediction requires extra hardware

Static (fixed) Prediction

The prediction is always the same (taken or not taken)

Forward branches may be predicted not taken

Backwards branches may be predicted taken
e.g. at end of loops

Once actual behavior is known, work may have to be undone

Dynamic Branch Prediction Increases accuracy of prediction

Previous history of branch behavior is recorded

Shows if branch was taken or not when last encountered

Branch prediction buffer

Branch History table (BHT)

Decode History table (DHT)

These tables are high-speed buffers (caches)

address of branch instruction is used to access them

BHT is accessed as soon as PC is updated

- Hits only occur for branch instructions already in the table

- Hits provide the predicted target address

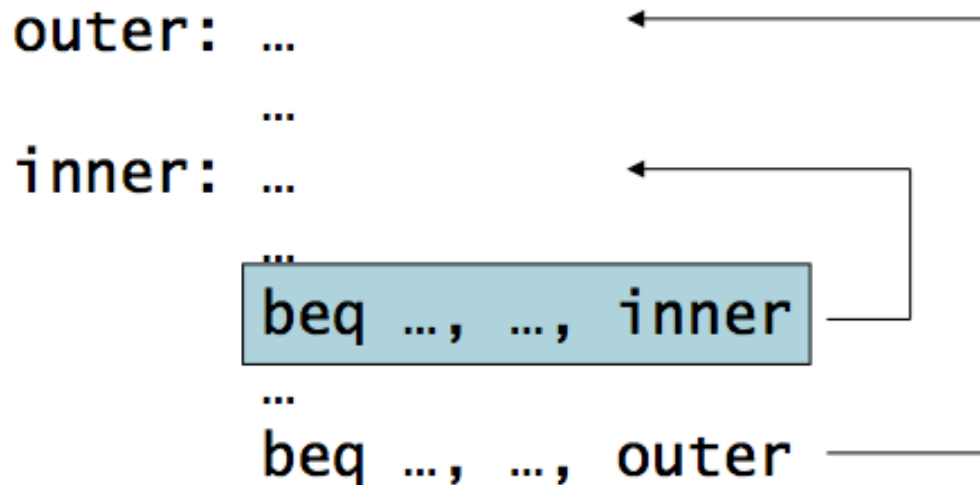
- Non-branch instructions cause misses

- Can be accessed before branch enters the pipeline

DHT is only accessed after branch is decoded

- It is not checked for non-branch instructions

- hits provide the predicted target instruction



Let's base prediction on a recorded bit (=0 if not taken, =1 if taken)

Assume 9 iterations of inner loop, 1st prediction & 9th are wrong

For each iteration of outer loop, inner beq is mispredicted twice

A 2-bit predictor would be better

2-bit predictor	Meaning
00	Strongly not taken
01	Weakly not taken
10	Weakly taken
11	Strongly taken

On 1st encounter bits change from 00 to 01 (for previous example)

On 2nd encounter bits change from 01 to 10

On 3rd encounter bits change from 10 to 11

On 9th encounter bits change from 11 to 10

Inner prediction is wrong three times for 1st iteration of outer loop

But wrong only once for each remaining outer loop iteration

- Only change prediction on two successive mispredictions

