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Lab 2 Answers

1. Assuming a simple 2-bit branch predictor that uses 8 bits from the PC to index into the BHT, how many entries does the BHT have? What is the size of the BHT (in bytes)?

$$2^8 = 256\ entries$$

$$256\ entries\ \times 2\ bits = 512\ bits\ in\ the\ BHT$$

$$512\ bits\ \times \frac{1\ byte}{8\ bits} = 64\ bytes\ (size\ of\ the\ BHT)$$

2. Assuming a (4,2) predictor, how many total entries does this predictor have? What is the total size of this correlating predictor (in bits)?

$$Assumeing\ 8\ bits\ from\ the\ PC\ to\ index\ into\ the\ BHT = \ 2^8 = 256\ entries\ per\ BHT$$

$$2^4 = 16\ BHTs$$

$$256\ entries\ per\ BHT \times 16\ BHTs = 4096\ entries$$

$$4096\ entries \times 2\ bits\ an\ entry = 8192\ bits$$

3. What is the misprediction rate of the given traces and predictor?

Trace	(0,1)	(0,2)	(6,1)	(6,2)
gcc-10K.txt	30.58%	28.74%	20.29%	26.15%
gcc-8M.txt	31.23%	28.17%	8.59%	7.31%

4. Is every entry in our branch predictor utilized? For our (6,1) predictor, how many entries are utilized?

   No, not all of the entries are used. For our (6,1) predictor:
   - 2447 entries are used for gcc-10K.txt.
   - 7966 entries are used for gcc-8M.txt.

5. How does the global branch history help improve branch prediction rates? Will all applications benefit from using global branch history?

   Global branch history captures global behaviors (global predictor). It detects patterns including neighboring branches. No, not all applications benefit from using global branch history (for example, if the neighboring branches of an application are uncorrelated).

6. What is a local predictor? How does it help with branch prediction? Can it be combined with the predictors that we implemented in lab 2?

   The local predictor consists of a two-level predictor. The top level is a local history table consisting of entries; each entry corresponds to the most recent branch outcomes for the entry. The selected entry from the local history table is used to index a table of entries consisting of saturating counters, which provide the local prediction. Local predictor helps branch prediction by capturing patterns belonging to the branch being predicted. Yes, it can be combined with the predictors we implemented in lab 2.