CENG331 Take-Home Final

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Q3.4

Assume that the input array is a[] = {1,1,1,1,0,0,2,2,2,1}.

Since we hold the static instructions in the Load Value Prediction Table, the corresponding instruction address where the following load operation takes places gets registered to the LVPT. Let X be the instruction address and let LVPT[X] denote the 1-depth history of the instruction.

max_ending_here = max_ending_here + a[i];

In the article, it is stated that if the LVPT[X] value is the same as the input, in other words when the prediction is correct, the counter (00 = "don't predict", 01 = "don't predict", 10 = "predict", 11 = "constant") that keeps track of the states at Load Classification Table is incremented and decremented otherwise. However, the state at which the instruction is registered to the LCT at the beginning is not specified explicitly. No prediction can be made before seeing any data so it is not possible to start the state as "predict" or "constant". So I decided to start at state 00 ("don't predict").

For the given array above;

At start, LVPT[X] = NULL and LCT = 00 (don't predict).

after i=0 cycle, LVPT[X] = 1 (prediction not made because no value in LVPT[X]) and LCT = 00 (don't predict).

after i=1 cycle, LVPT[X] = 1 (prediction not made because LCT==00) and LCT = 01 (don't predict).
after i=2 cycle, LVPT[X] = 1 (prediction not made because LCT==01) and LCT = 10 (predict).
after i=3 cycle, LVPT[X] = 1 (prediction successful) and LCT = 11 (constant).

at i=4 cycle, CVU is checked but not found. The actual value is not equal to LVPT[X] so demote LCT.

after i=4 cycle, LVPT[X] = 0 (prediction unsuccessful) and LCT = 10 (predict).
after i=5 cycle, LVPT[X] = 0 (prediction successful) and LCT = 11 (constant).

at i=6 cycle, CVU is checked but not found. The actual value is not equal to LVPT[X] so demote LCT.

after i=6 cycle, LVPT[X] = 2 (prediction unsuccessful) and LCT = 10 (predict).
after i=7 cycle, LVPT[X] = 2 (prediction successful) and LCT = 11 (constant).

at i=8 cycle, CVU is checked but not found because the data address is different. Still, the actual value is the same so don't demote LCT.

After i=8 cycle, LVPT[X] = 2 (prediction successful) and LCT = 11 (constant).

at i=9 cycle, CVU is checked but not found. The actual value is not equal to LVPT[X] so demote LCT.

after i=9 cycle, LVPT[X] = 1 (prediction unsuccessful) and LCT = 10 (predict)

Since we didn't make any predictions for the first 3 indexes, there are a total of 7 predictions. 4 of these are successful. So the accuracy of the value prediction scheme for this input is 4/7 = 0.57.