Recitation 5

CS 3853: Computer Architecture

Dynamic Branch Prediction

Consider the following MIPS code. The register R0 is always 0.

```
        DADDI R1, R0, 3

L1:     DADDI R2, R0, 2

L2:     DSUBI R2, R2, 1
        BNEZ R2, L2          -- Branch 1
        DSUBI R1, R1, 1
        BNEZ R1, L1          -- Branch 2
```

Dynamic Branch Prediction

Assume that 1-bit branch predictors are used. When the processor starts to execute the above code, both predictors contain value N (Not taken). What is the number of correct predictions? Use the following tables to record the prediction and action of each branch. The first entry is filled in for you..

Workout Table

Step	Branch 1 Prediction	Actual Branch 1 Action
1	N	T
2		
3		
4		
5		
6		

Step	Branch 2 Prediction	Actual Branch 2 Action
1	N	T
2		
3		

Workout Table

Step	Branch 1 Prediction	Actual Branch 1 Action
1	N	T
2	T	N
3	N	T
4	T	N
5	N	T
6	T	N

Step	Branch 2 Prediction	Actual Branch 2 Action
1	N	T
2	T	T
3	T	N

Dynamic Branch Prediction

Now assume that 2-bit branch predictors are used. When the processor starts to execute the above code, both predictors contain value N (Not taken). What is the number of correct predictions? Use the following tables to record the prediction and action of each branch. The first entry is filled in for you..

Workout Table

Step	Branch 1 Prediction	Actual Branch 1 Action
1	N	T
2		
3		
4		
5		
6		

Step	Branch 2 Prediction	Actual Branch 2 Action
1	N	T
2		
3		

Workout Table

Step	Branch 1 Prediction	Actual Branch 1 Action
1	N	T
2	N	N
3	N	T
4	N	N
5	N	T
6	N	N

Step	Branch 2 Prediction	Actual Branch 2 Action
1	N	T
2	N	T
3	T	N

Dynamic Branch Prediction

Now assume that 2 level correlating predictors of the form (2,1) are used. Also assume that the branch predictor table has only 1 row. When the processor starts to execute the above code, the outcome of the previous two branches is not taken (N). Also assume that the initial state of predictors of all branches is not taken (N). What is the number of correct predictions?

Use the following table to record your steps. Record the "New State" of predictors in the form W/X/Y/Z where,

- W - state corresponds to the case where the last branch and the branch before the last are both TAKEN
- X - state corresponds to the case where the last branch is TAKEN and the branch before the last is NOT TAKEN
- Y - state corresponds to the case where the last branch is NOT TAKEN and the branch before the last is TAKEN
- Z - state corresponds to the case where the last branch and the branch before the last are both NOT TAKEN

Workout Table

Step	Branch 1 Prediction	Actual Branch 1 Action	New State
1	N	T	N/N/N/T
2			
3			
4			
5			
6			

Step	Branch 2 Prediction	Actual Branch 2 Action	New State
1	N	T	N/N/T/N
2			
3			

Workout Table

Step	Branch 1 Prediction	Actual Branch 1 Action	New State
1	N	T	N/N/N/T
2	N	N	N/N/N/T
3	N	T	N/T/N/T
4	N	N	N/T/N/T
5	T	T	N/T/N/T
6	N	N	N/T/N/T

Step	Branch 2 Prediction	Actual Branch 2 Action	New State
1	N	T	N/N/T/N
2	T	T	N/N/T/N
3	T	N	N/N/N/N