BRANCH PREDICTION

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1.

1/ Predict-a-matic:

- increase cycle time 15% => clock_cycle_time_with_predict = (1 + 0.15) clock_cycle_time_baseline
  => clock_cycle_time_with_predict / clock_cycle_time_baseline = 1.15

We have: CPI = 1 + branch freq x mispredict freq x penalty
=> CPI_with_Predict = 1 + 0.15 x 0.1 x 2 = 1.03
=> CPI_without_predict = 1 x 0.15 x 1 x 2 = 1.3
=> speedup = 1.15 x (1.03 / 1.3) = 0.91
=> SUF = 1 / speedup = 1 / 0.91 = 1.09

2/ CB-predictor:

- increase cycle time 10% => clock_cycle_time_with_predict = (1 + 0.1) clock_cycle_time_baseline
  => clock_cycle_time_with_predict / clock_cycle_time_baseline = 1.1

CPI_with_Predict = 1 + 0.15 x 0.12 x 2 = 1.036
=> CPI_without_predict = 1 x 0.15 x 1 x 2 = 1.3
=> speedup = 1.1 x (1.036 / 1.3) = 0.87
=> SUF = 1 / speedup = 1 / 0.87 = 1.14

2.

2.1 Always-not-taken predictor

A. Branch behavior: T T T T T T T T N

Actual: T T T T T T T T N

Predict : N N N N N N N N N

⇨ Accuracy : 1/10

B. Branch behavior: T N T N T N T T T N

Actual : T N T N T N T T T N

Predict: N N N N N N N N N N

⇨ Accuracy: 4/10
⇨

2.2 Always-taken predictor

A. Branch behavior: T T T T T T T T N

Actual : T T T T T T T T N

Predict: T T T T T T T T T

⇨ Accuracy: 9/10

B. Branch behavior: T N T N T N T T T N

Actual: T N T N T N T T T N

Predict: T T T T T T T T T T

- ⇨ Accuracy: 6/10
- ⇨

2.3 Predict-last-taken predictor

A. Branch behavior: T T T T T T T T T N

Actual: T T T T T T T T T N

Predict: N T T T T T T T T

- ⇨ Accuracy: 8/10

B. Branch behavior: T N T N T N T T T N

Actual: T N T N T N T T T N

Predict: N T N T N T N T T T

- ⇨ Accuray: 2/10

2.4 Saturating counter

A. Branch behavior: T T T T T T T T T N

Actual: T T T T T T T T T N

Status: 0 1 2 3 3 3 3 3 3 2

Predict: N N T T T T T T N

➔ Accuracy: 7/10

B. Branch behavior: T N T N T N T T T N

Actual: T N T N T N T T T N

Status: 0 0 1 0 1 0 1 2 3 2

Predict: N N N N N N N T T T

➔ Accuracy: 5/10

2.5 2-bit prediction

A. Branch behavior: T T T T T T T T T N

Status: 0 1 3 3 3 3 3 3 3 2

Predict: N N T T T T T T T T

➔ Accuracy: 7/10

B. Branch behavior: T N T N T N T T T N

Status: 0 0 1 0 1 0 1 3 3 2

Predict: N N N N N N N T T T

⇨ Accuracy: 5/10

2.6 Steady state accuracy

A. Branch behavior: T T T T T T T T T N T T T T T T T T T N

Status: 0 1 3 3 3 3 3 3 3 2 3 3 3 3 3 3 3 3 3 2

Predict: N N T T T T T T T T T T T T T T T T T T T T

⇨ Accuracy: 8/10

B. Branch behavior: T N T N T N T T T N T N T N T N T T T N

Status: 0 0 1 0 1 0 1 3 3 2 3 2 3 2 3 2 3 3 3 2

Predict: N N N N N N N T T T T T T T T T T T T T T T

⇨ Accuracy: approximately 6 /10