

### CSE/ECE511:Quiz3 Rubric

Question 1 is common to both Set A and Set B.

Ans1.

#### **Part 1 [5 Marks]**

MP = mispredict

CP = correct predict

→ For predictor with 1-bit history table

i=0 NT T MP

I = 1 T T CP

I = 2 T T CP

...

I = 99 T T CP

I = 100 T NT MP

2 MP 99 CP 101 iterations

Correct number of mispredict from the pattern = 2 [2 Marks]

If the mispredicts are incorrect, deduct 1 mark

→ For predictor with a 2-bit history table

i=0 SNT T MP

I = 1 WNT T MP

I = 2 WT T CP

i = 3 ST T CP

i=4 ST T CP

...

I = 99 ST T CP

I = 100 ST NT MP

3 MP 98 CP 101 iterations

Correct number of mispredict from the pattern = 3 [2 Marks]

If the mispredicts are incorrect, deduct 1 mark

→ 1-bit branch history performs better [1 Mark]

#### **Part 2[5 Marks]**

→ For predictor with 1-bit branch history :

I = 0 NT T MP

J = 0 T T CP

J = 1 T T CP

J = 2 T T CP

...

J = 9 T T CP

J = 10 T NT MP

I = 1 NT T MP

J = 0 T T CP

J = 1 T T CP

...  
 J = 9 T T CP  
 J = 10 T NT MP  
 I = 2 NT T MP  
 ...  
 ...  
 I = 9 NT T MP  
 J = 0 T NT MP  
 J = 1 T T CP  
 ...  
 J = 10 T NT MP  
 I = 10 NT NT CP

$2 \times 10 = 20$  miss predictions

Correct number of mispredict from the pattern = 20 [2 Marks]

If the mispredicts are incorrect, deduct 1 mark

→ For 2 bit branch history

I = 0 SNT T MP  
 J = 0 WNT T MP  
 J = 1 WT T CP  
 J = 2 ST T CP  
 J = 3 ST T CP  
 ...  
 J = 9 ST T CP  
 J = 10 ST NT MP  
 I = 1 WT T CP  
 J = 0 ST T CP  
 ...  
 J = 9 ST T CP  
 J = 10 ST NT MP  
 I = 2 WT T CP  
 ...  
 ...  
 I = 9 WT T CP  
 J = 0 ST T CP  
 J = 1 ST T CP  
 ...  
 J = 10 ST NT MP  
 I = 10 WT NT MP

$9 \times 1 + 1 + 3 = 13$  mispredictions

Correct number of mispredict from the pattern = 13 [2 Marks]

If the mispredicts are incorrect, deduct 1 mark

→ 2-bit history table performs better [1 Marks]

## Set A

Ans 2.

### Without Victim Cache:

$$\text{Miss Rate} = 0.064$$

$$\text{Hit Rate} = 1 - 0.064 = 0.936$$

$$\text{Hit Latency} = 1 \text{ cycle}$$

$$\text{Miss Latency} = 48 \text{ cycle}$$

$$\text{AMAT w/o victim cache} = 48 * 0.064 + 1 = 4.072 \text{ cycles}$$

[3 Marks]

### With Victim Cache:

With the victim cache, the conflict miss alone is reduced. Whereas the compulsory and capacity miss remain the same.

$$\text{Total Conflict miss w/o victim cache} = 6.4\% * 67\% = 4.288\%$$

$$\text{Total compulsory and capacity misses} = 6.4\% * 33\% = 2.112\%$$

$$\text{Conflict misses found in the victim cache having a penalty of 2 cycles} = 6.4\% * 67\% * 80\% = 3.4304\%$$

$$\text{Conflict misses not found in victim cache having a penalty of (2+48) cycles} = 6.4\% * 67\% * 20\% = 0.08576\%$$

$$\text{(AMAT = Hit time + Miss Rate of L1 * Percentage of Compulsory and Capacity Misses * Penalty for Compulsory and Capacity Misses + Miss rate of L1 * Percentage of Conflict Misses * (Hit time + Miss rate * Penalty) )}$$

### **Calculation for Compulsory and Capacity Misses**

[2 Marks]

### **Calculation for Conflict Misses**

[3 Marks]

$$\text{AMAT w/o victim cache} = 1 + 0.064 * 0.33 * 48 + 0.064 * 0.67 * (2 + 0.2 * 48) = 2.51168 \text{ cycles.}$$

[1 Mark]

Hence, we have an improved AMAT due to Victim Cache

$$\text{Percentage calculation} = (4.072 - 2.51168) / (4.072) = 38.31\%$$

[1 Mark]

Notes:

$$\text{AMAT} = \text{Hit rate} * \text{Hit time} + \text{Miss rate} * (\text{Hit time} + \text{penalty})$$

$$= (\text{Hit rate} + \text{Miss rate}) * \text{Hit time} + \text{Miss rate} * \text{penalty}$$

$$= \text{Hit time} + \text{Miss rate} * \text{penalty}$$

### Set B

Ans 2.

#### Without Victim Cache:

$$\text{Miss Rate} = 0.07$$

$$\text{Hit Rate} = 1 - 0.07 = 0.93$$

$$\text{Hit Latency} = 1 \text{ cycle}$$

$$\text{Miss Latency} = 50 \text{ cycles}$$

$$\text{AMAT w/o victim cache} = 50 * 0.07 + 1 = 4.5 \text{ cycles}$$

[3 Marks]

#### With Victim Cache:

With the victim cache, the conflict miss alone is reduced. Whereas the compulsory and capacity miss remain the same.

$$\text{Total Conflict miss w/o victim cache} = 7\% * 70\% = 4.9\%$$

$$\text{Total compulsory and capacity misses} = 7\% * 30\% = 2.1\%$$

$$\begin{aligned} \text{Conflict misses found in the victim cache having a penalty of 2 cycles} &= 7\% * 70\% * 80\% \\ &= 3.92\% \end{aligned}$$

$$\begin{aligned} \text{Conflict misses not found in the victim cache having a penalty of (2+48) cycles} &= 7\% * \\ 70\% * 20\% &= 0.98\% \end{aligned}$$

$$\begin{aligned} \text{(AMAT} &= \text{Hit time} + \text{Miss Rate of L1} * \text{Percentage of Compulsory and Capacity} \\ &\text{Misses} * \text{Penalty for Compulsory and Capacity Misses} + \text{Miss rate of L1} * \\ &\text{Percentage of Conflict Misses} * (\text{Hit time} + \text{Miss rate} * \text{Penalty}) \text{ )} \end{aligned}$$

#### Calculation for Compulsory and Capacity Misses

[2 Marks]

#### Calculation for Conflict Misses

[3 Marks]

$$\text{AMAT} = 1 + 0.07 * 0.3 * 50 + 0.07 * 0.7 * (2 + 0.2 * 50) = 1 + 1.05 + 0.588 = 2.63$$

[1 Mark]

Hence, we have an improved AMAT due to Victim Cache

$$\text{Percentage calculation} = (4.5 - 2.63) / (4.5) = 41.56\%$$

[1 Mark]

Notes:

$$\text{AMAT} = \text{Hit rate} * \text{Hit time} + \text{Miss rate} * (\text{Hit time} + \text{penalty})$$

$$= (\text{Hit rate} + \text{Miss rate}) * \text{Hit time} + \text{Miss rate} * \text{penalty}$$

$$= \text{Hit time} + \text{Miss rate} * \text{penalty}$$