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CSC 142

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Assignment #6

1.

4.16.1

Actual	Pred
T	T
NT	T
T	T
T	T
NT	T

$$\frac{3}{5} = \boxed{0.6}$$

4.16.2

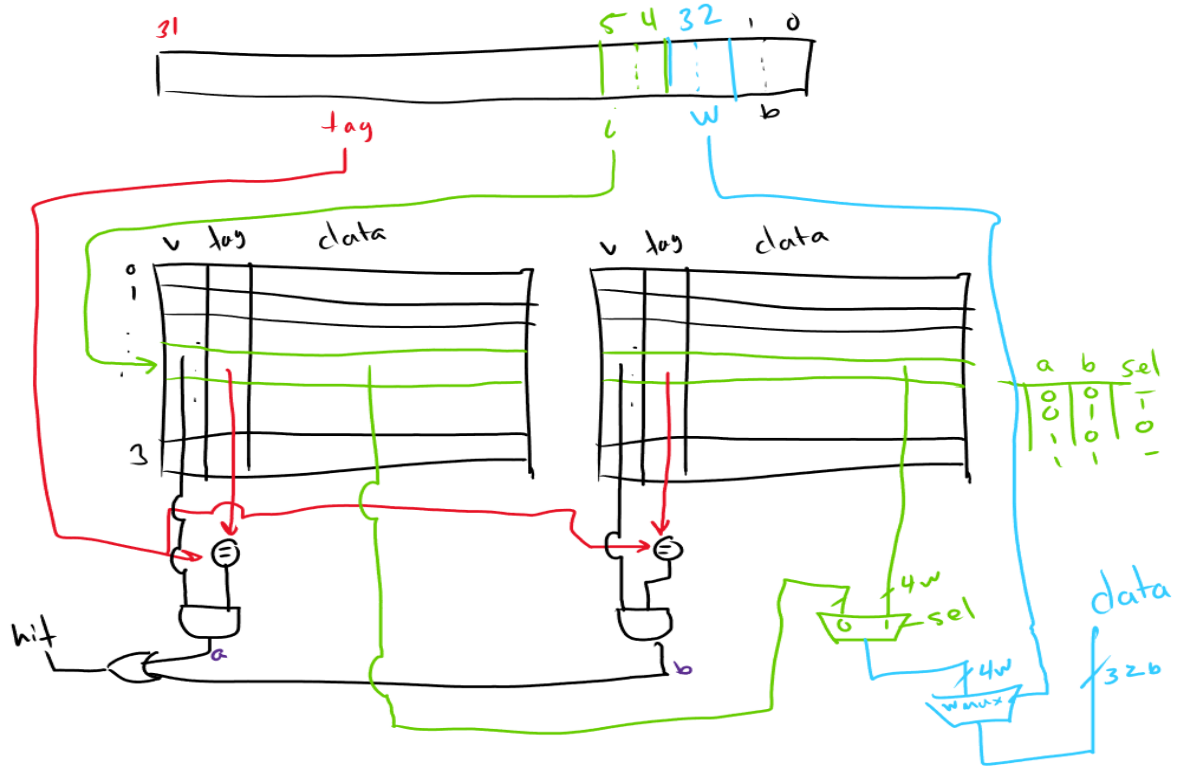
Actual	Pred
T	NT
NT	NT
T	NT
T	NT
NT	NT

$$\frac{2}{5} = \boxed{0.6}$$

2. We can enhance instruction level parallelism by:

- dynamic multiple-issue instruction
- dynamic scheduling for out-of-order execution

3.



4.

Address of memory block accessed	Address in binary	Set	Hit/miss	Words in Block
2	00000000000000000000000000000010	00	Miss	0, 4, 8, 12
3	00000000000000000000000000000011	00	Hit	0, 4, 8, 12
11	00000000000000000000000000001011	00	Hit	0, 4, 8, 12
16	00000000000000000000000000010000	01	Miss	16, 20, 24, 28
21	00000000000000000000000000010101	01	Hit	16, 20, 24, 28
13	00000000000000000000000000001101	00	Hit	0, 4, 8, 12
64	00000000000000000000000001000000	00	Miss	64, 68, 72, 76
48	00000000000000000000000001100000	11	Miss	48, 52, 56, 60
19	000000000000000000000000010011	01	Hit	16, 20, 24, 28
11	00000000000000000000000000001011	00	Hit	0, 4, 8, 12
3	00000000000000000000000000000011	00	Hit	0, 4, 8, 12
32	00000000000000000000000001000000	10	Miss	32, 36, 38, 42
22	00000000000000000000000000010110	01	Hit	16, 20, 24, 28

	Proc.	Size	MR	Hit Time
5.6.1	P1	2kiB	.0%	0.66ns
	P2	4kiB	6.0%	0.90ns

$$P_{1CR} = \frac{1 \text{ cycle}}{0.66\text{ns}} = \boxed{1.51 \text{ GHz}}$$

$$P_{2CR} = \frac{1 \text{ cycle}}{0.90\text{ns}} = \boxed{1.11 \text{ GHz}}$$

$$\begin{aligned} 5.6.2 \quad P_{1\text{avg time}} &= 0.66\text{ns} + 0.08 \cdot 70\text{ns} \\ &= 0.66\text{ns} + 5.6\text{ns} = \boxed{6.26 \text{ ns}} \end{aligned}$$

$$\begin{aligned} P_{2\text{avg time}} &= 0.90\text{ns} + 0.06 \cdot 70\text{ns} \\ &= 0.90\text{ns} + 4.2\text{ns} = \boxed{5.1 \text{ ns}} \end{aligned}$$

5.6.3

$$\text{CPU time} = \left(\frac{(1-.36) \text{ instructions} \cdot \frac{1.0 \text{ cycle}}{\text{cycle}}}{\text{ns}} + \text{Mem-stall time} \right) \cdot \frac{\text{ns}}{\text{cycle}}$$

$$\text{Mem-stall time} = \frac{.36 \cdot \text{MR} \cdot \text{MP}}{\text{CR}}$$

$$\begin{aligned} \frac{P_1 \text{ w/ stalls}}{P_2 \text{ w/ stalls}} &= \frac{\left(\frac{(1-.36) \cdot 1.6 \text{ ns}}{1.51} + \frac{.36 \cdot .08 \cdot 0.66}{1.51} \right) \cdot \frac{1}{1.51}}{\left(\frac{(1-.36) \cdot 1.0 \text{ ns}}{1.11} + \frac{.36 \cdot .06 \cdot 0.9}{1.11} \right) \cdot \frac{1}{1.11}} \\ &= 0.438 \end{aligned}$$

$$P_1 \text{ is faster by } 0.438^{-1} = \boxed{2.28 \text{ times}}$$