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CSCE A248
12/19/2022
Final exam

31182634

1.)

a.) Clock time = 200ps 1 second / $200\text{ps} = \boxed{5.0 \text{ gigahertz}}$

b.) $1000\text{ps} = 5 \text{ stages} \cdot 200\text{ps/stage}$

2.) Prog Seg.: ADD R₀, R₁, R₂ →

LDR R₃, [R₄, #4]

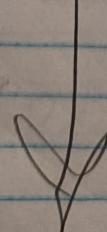
STR R₅, R₀, #4

	Inst. Fetch	Req. Read	ALU Op.	Data access	Req. write
CLK1	ADD				
CLK2	LDR	ADD			
CLK3	STR	LDR	ADD		
CLK4	—	STR	LDR	ADD	

Must wait 2 pulses before str can read registers.

Data hazard:
STR inst. trying to read register that hasn't been updated by add inst. yet.

b.) on next page:



b.) Prog. Seg.: $LDR R0, [R1, #4]$

$ADD R2, R2, #1$

$ADD R3, R3, #1$

$ADDR4, R4, #1$

Instr. Fetch	Req. Read	ALU Op.	Data Access	Req. Write
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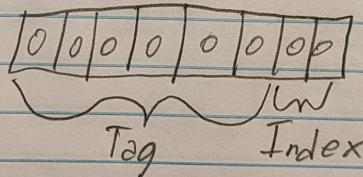
CLK1	LDR			
CLK2	ADD	LDR		
CLK3	ADD	ADD	LDR	
CLK4	ADD	ADD	ADD	LDR

Must wait 1 pulse
before next instruction
can be fetched.

Structural Hazard:
Trying to read data and fetch instruction
at the same time

3.)

a.) Address: $0|0|0|0|0|0|0|0$



Cache	0	1	2	3	4	5	6	1	2	3	4	5	6	7	8
00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
01	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X
11	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Index

Valid bit / Tag

block

b.) $4 \times 15 = 60 / 8 = 7.5 \text{ bytes} \approx 8 \text{ bytes}$

c.) on next page

P.3

		010001	BNE loop
C.)	$0x40 = 01000000$ miss	00 1 010000	MOV R0, #2
	$0x41 = 01000001$ miss	01 1 010000	ADD R2, R2
	$0x42 = 01000010$ miss	10 1 010000	STR RI, CR2, #0
	$0x43 = 01000011$ miss	11 1 010000	SUB R0, RD, 1
	$0x44 = 01000100$ miss		

$0x40$ miss $0x43$ hit $\frac{7 \text{ misses}}{10 \text{ instruc.}} = 70\% \text{ miss}$
 $0x41$ hit $0x44$ miss $0x42$ hit $70\% \text{ rate}$

d.)

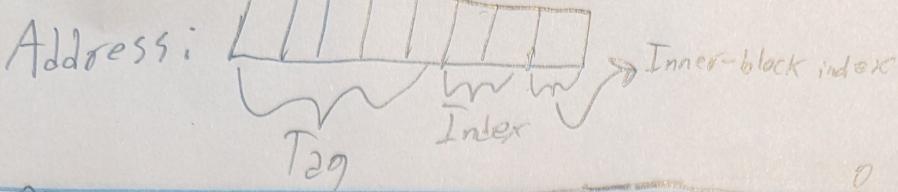
00		010001	BNE Loop
00		010000	ADD R2
00		010000	STR RI
00		010000	SUB R0

- e.) 1 Move R0 \rightarrow 2 to ovn, 100 to get from mem. 102 -
 2 ADD R2 \rightarrow 2 to run, 100 to get from mem. 102 -
 3 STR RI \rightarrow 2 to run, 100 to get instanc, 100 to write 202
 4 SUB R0 \rightarrow 2 to run, 100 to get from mem 102 -
 5 BNE loop \rightarrow 2 to run, 100 to get 102 -
 6 Move R0 \rightarrow 2 to run, 100 to get 102 -
 7 ADD R2 \rightarrow 2 to run 2
 8 STR RI \rightarrow 2 to run, 100 to write 102 -
 9 SUB R0 \rightarrow 2 to run 2
 10 BNE loop \rightarrow 0 to run (doesn't run), 100 to get 100

~~91.8 cycles per instruction~~

$$\begin{array}{r}
 612 \\
 + 306 \\
 \hline
 918 \\
 \hline
 10 \text{ instuct.}
 \end{array}$$

F.) on next page: ↓



P. 4

	0	1
0x40	01000000 miss	00
0x41	01000001 hit	01
0x42	01000010 miss	10
0x43	01000011 hit	11
0x44	01000100 miss	

Valid Tag

$$\frac{3 \text{ miss}}{10 \text{ instruc.}} = \underline{\underline{30\% \text{ miss rate}}}$$

q. See above