Exam ECEN 651 Zhenlei Song 20.12.2

1. DADDI R4, R0, 0xFFFF

(a)
```
DSRL   R5, R4, 16
LW     R8, 1000(R10)
AND    R9, R8, R5
SW     R9, 1000(R10)
LW     R6, 2000(R10)
SW     R6, 1004(R10)
OR     R7, R6, R5
```

(b) 2 stalls are still necessary

1.
```
LW   R8, 1000(R10)   ①
AND  R9, R8, R5      ②
```
① F D X M W
② F D s X M W

R8 in ② needs to wait till the end of MEM phase in ①

2.
```
LW   R6, 2000(R10)   ③
SW   R6, 1004(R10)   ④
```
F D X M W
F D s X M W

for same reason, R6, in ④ needs to wait till the end of MEM phase. So a stall is needed.

2.

```
        DSLL   R2, R2, #2      (A)     R2 = 400
        DADD   R3, R1, R2      (B)     R3 = R1 + 400
L1:     LW     R4, 0(R1)       (1)
        DSUB   R4, R0, R4      (2)
        SW     R4, 0(R1)       (3)
        DADDI  R1, R1, #4      (4)
        SLT    R5, R1, R3      (5)
        BNE    R5, R0, L1      (6)
        DSUB   R2, R0, R0      (7)
```

iteration times : 100

```
          1 2 3 4 5 6 7 8 9 10 11 12 13
(a) (1) F D X M W
    (2)   F D S X M W
    (3)     F S D X M W
    (4)       F D X M W
    (5)         F D X M W
    (6)           F S D X M W
                    F S S S S ; or (1) F D X M W
incorrect
    (1)             F D X M W
```

in first 99 loops: 9 cycles each

last loop: 13 cycles

```
      1 2 3
(A)   F D X M W
(B)     F D X M W
(1)       F D X M W
```

before loop : 2 cycles

Total : $2 + (9 \times 99) + 13 = 906$ cycles

(b)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	F	D	X	M	W										
B		F	D	X	M	W									
1			F	D	X	M	W								
2				F	D	X	M	W							
3					F	D	X	M	W						
4						F	D	X	M	W					
5							F	D	X	M	W				
6								F	D	X	M	W			
1									F	D	X	M	W		
or 7									F	D	X	M	W		

$99 \times 8 + 15$

$= 807$ cycles

3.

(a) $-0.625 = (-0.101)_2 = -1.01 \times 2^1$

$s = 1$, $e = 1$, $f = 01$

$127 + 1 = 128 = 1000\ 0000$

single precission :

1 10000000 010 0000 0000 0000 0000 0000

(b) (i) 1.010101 0000

rounding up 1.010 110 0000

rounding down 1.010 100 0000

nearest even 1.010 100 0000

(ii) 1.0011 100001

up 1.0011110000

down 1.0011100000

nearest even 1.0011100000

(iii) 1.01001 0000

up 1.0101000000

down 1.0100100000

nearesteven 1.010100 0000

(iv) 1.00110 0001

up 1.0011100000

down 1.0011000000

nearest even 1.0011~~01~~ 0000

4.

(a) 2 way set

set						
0	m_0	m_4	m_8	m_{12}	m_{16}	8 ×
0	m_0	m_4	〃	〃	〃	
1	m_1	m_5	m_9	m_{13}	m_{17}	
1	m_1	m_5	〃	〃	〃	
2	m_2	m_6	m_{10}	m_{14}	m_{18}	
2	m_2	m_6	〃	〃	〃	
3	m_3	m_7	m_{11}	m_{15}	m_{19}	11 ✗ 3 × 15 × 15 ✓ 11 ×
3	m_3	m_7	〃	〃	〃	7 × 11 ✗ 19 × 3 ×

1 hit in 10 times

miss rate ~~80%~~ 90%

(b)

addr	set	h/m	compulsory	capacity	conflict
11	3	miss	✓		
7	3	miss	✓		
3	3	miss		✓	
11	3	miss			✓
15	3	miss		✓	
19	3	miss		✓	
15	3	hit			
3	3	miss			✓
8	0	miss	✓		
11	3	miss			✓

5.

(a) write back

~~bandwidth of read hit~~

~~read miss~~

read hit : $0.9 \times 0.8 \times 4 \times 10^8$

$= 2.88 \times 10^8$

read miss ~~$0.9 \times$~~ $0.1 \times 0.8 \times 4 \times 10^8 =$ ~~0.32~~ 3.2×10^7

write hit : $= 0$

write miss $= 0.1 \times 0.2 \times (4 \times 0.3 + 4) \times 10^8$

$= 1.04 \times 10^7$

total : $2.88 \times 10^8 + 3.2 \times 10^7 + 1.04 \times 10^7$

$= 3.304 \times 10^8$

(b) write through