USE YOUR IMAGINATION™

Blue Book

EXAMINATION BOOK

BOX NO. Ø

NAME Yu Cheng

SUBJECT ~~ECE~~ 695

CLASS

SECTION section B

INSTRUCTOR Azeez, Bhamagarwala

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problem 1:

1.1

Data forwarding alone doesn't suffice here because by the time the first ALU instruction completes the second ALU (execute) step, the second ALU is already in the first ALU step

i) a Nop between the 2 instructions, as well as data forwarding between the second ALU step and the decode step

1.2

	CC0	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8
APP x1x2x3	IF	ID	ALU1	ALU2	MEM	WB			
ADD x5x4x1			IF	ID	ALU1	ALU2	MEM	WB	

Problem 2:

2.1

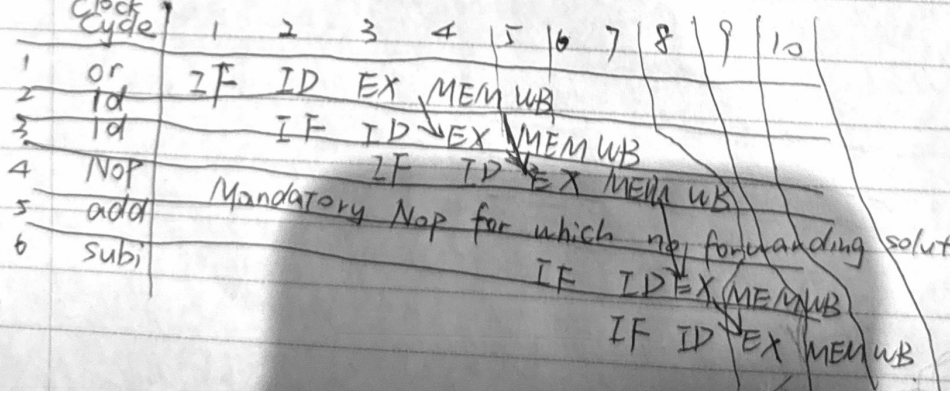
Hazards identified:

```
or   x13  x12  x11
ld   x10  0(x13)     EX to 1st RAW Hazard
ld   x11  8(x13)     EX to 2nd RAW Hazard
add  x12  x10  x11   MEM to 1st RAW [load-use-data] & MEM to 2nd Hazards
subi x15  x12  16    EX to 1st RAW Hazard
```

NOPs introduced to resolve Hazards:

```
or   x13  x12  x11
NOPs
NOPs
ld   x10  0(x13)     EX to 1st RAW Hazard resolution with 2 NOPs
ld   x11  8(x13)     EX to 2nd RAW Hazard resolved as well from above 2 NOPs
NOPs
NOPs
add  x12  x10  x11   MEM to 1st RAW [load-use-data] & MEM to 2nd Hazards resolved with 2 NOPs
NOPs
NOPs
subi x13  x12, 16    EX to 1st only RAW Hazard resolved with 2 NOPs
```

2.2



	A	B
(1)	X	X
(2)	X	X
(3)	0	0
(4)	2	0
(5)	X	X
(6)	1	0
(7)	X	X

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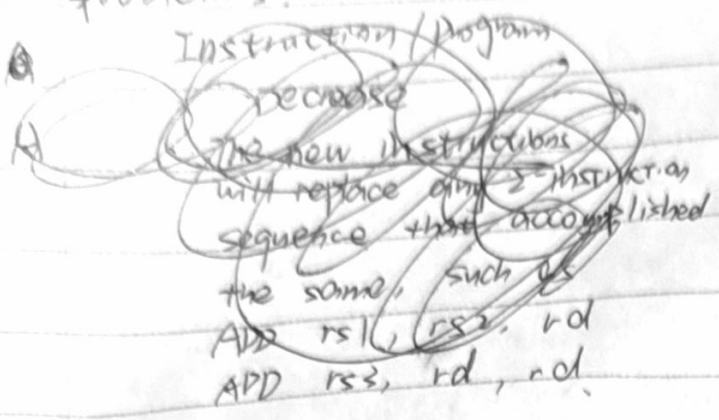
Problem 3:



	Instruction	CPI	Circuit complexity
A	Decrease The new instructions will replace any 2-instruction sequence that accomplished the same	The same The ALU will perform the 3-way addition in one cycle	Increase 3-operand ALU is more complex than a 2-operand one
B	The same No difference to instructions	Increase All instructions now use the same ALU ALU operations now have to stall	Decrease Now there is one less adder / ALU cycle
C	The same or decrease If the more registers enable the Compiler to avoid loads and stores, Decrease Otherwise, the same	~~The same~~ Does not affect the actions of each instruction	Increase More registers complicate the register file.

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problem 4:

4.1

I-Mem is read: 140p] + 2x 70p] + 60p] = 340p]

4.2

140p] + 2x 70p] + 60p] + 140p] = 480 p]

4.3

I-Mem + 2registers = 140p] + 2x 70p] = 280p]

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problem 5:

① representing -1/4:

$\frac{1}{4} = 0.25 = \frac{1}{2} \rightarrow$

$\rightarrow +127 = 125$

So the bit pattern:

Sign	Exponent	Mantissa
1	0|111|01	all zeroes since 0.25 is represented as fo

Thus in binary: 10|111|01|00000 00000 00000 00000 00000

② representing -1/3:

The sign bit is 1 because -1/3 is negative

$\frac{1}{3}$ in binary is a repeating fraction, approximating 1.0|0|0|0|0|0|0|0 in binary which can be represented as 1.0|0|0|0|0|0|0|0 multiplied by 2^{-1}

$-1 + 127 = 126$

So the bit pattern:

Sign	Exponent	Mantissa
1	0|111 1110	0|0|0|0|0|0|0|0|0|0|0 which will fill up the Mantissa

In binary: 10|111 1110|0|0|0|0|0|0|0|0|0|0|0|0|0|0|0|0|0|0|0

problem 6

	sign	Exponent	Fraction	Decimal value
The number 0	0	00000	0000000000	0
charge of an electron	0	00000	0000000000	0 (under flow)
smallest positive normalized number	0	00001	0000000000	6.10352×10^{-5}
largest positive normalized number	0	11110	1111111111	65504
smallest positive denormalized number	0	00000	0000000001	5.96×10^{-8}
largest positive denormalized number	0	00000	1111111111	6.09756×10^{-5}
distance b/w Earth and Neptune in inches	0	11111	0000000000	$+\infty$

charge of an electron is too smaller than the smallest number it can represent in half-format. Thus it will be under flow to 0 in this format.

The Decimal value of smallest positive normalized number is $2^{-14} \approx 6.10352 \times 10^{-5}$

The Decimal value of largest positive normalized number is $2^{15}(2-2^{-10}) = 65504$

The Decimal value of smallest positive denormalized number is $2^{-24} \approx 5.96 \times 10^{-8}$

The Decimal value of largest positive denormalized number is $(1-2^{-10})2^{-14} \approx 6.09756 \times 10^{-5}$

distance b/w Earth and Neptune in inches is much larger than the maximum representable number in half-precision so it will overflow to $+\infty$