CMPE 200
Computer Architecture & Design

Final Exam Review
Midterm Notes

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Midterm Questions

- For the following instructions:
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- Loop: sll $t1, $s3, 2
- ....
- j Loop
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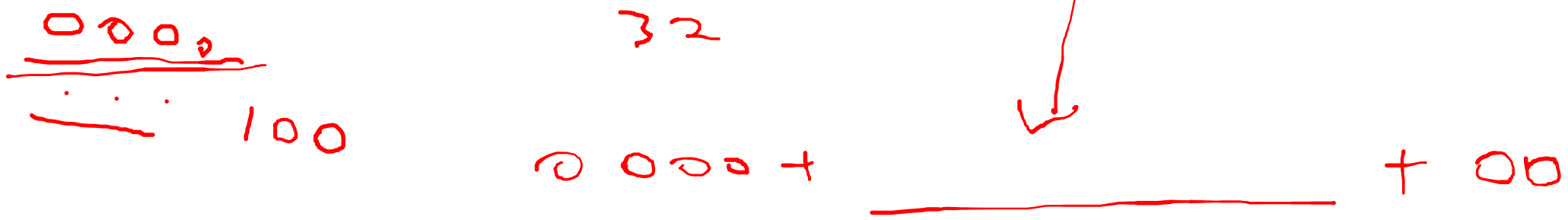
- For the last line of code, its machine code is 000010 00000000000000110000100000 and address is 0x4000. Then what is the address of the first line of code?



Midterm Questions

- **Computer A executes the MIPS ISA and computer B executes the x86 ISA. On average, programs execute 1.5 times as many MIPS instructions as x86 instructions. Computer A runs at 6GHz clock frequency and computer B runs at 4GHz clock frequency. If computer B has an average CPI of 3 for a program, what average CPI should computer A has for this program to run as fast as computer B?**

runtime_A = runtime_B

execution time = #Instr. / (#Instr. / time)

freq = cycle / time

CPI = cycle / instr.

@ x86 Instr. = X

MIP = 1.5x

freq / CPI

1.5x / (6/y) = X / (4/3)

y = 3

Midterm Questions

- Here is the binary representation of an instruction:
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- 101011 10000 01011 0000000000000100
-
- What instruction does it represent? Note that $s0 is 16, $t0 is 8, and opcode for sw is 43.

sw $t3, 4($s0)

Midterm Questions

- **Assume a complete MIPS 5-stage pipeline machine has a clock cycle of 350 ps. Which of the following total execution times are absolutely impossible for this machine to complete 30,000 random instructions? (two possible answers)**

Best : CPI = 1

worst : CPI = 5

$\frac{K+N-1}{5} = 30,004 \times 350\,ps \Rightarrow$ lower bound

$30,000 \times 5 \times 350\,ps \Rightarrow$ upper bound

Midterm Questions

- Assume the proportions of different instructions in a program is as follows:
- 20% loads, 10% stores, 10% branches, 2% jumps, 58% R-type
-
- Also, assume the following conditions when executing this program:

1. 40% of loads are used by the next instruction.
2. 50% of branches are mispredicted.
3. All jumps flush next instruction.

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- For a MIPS 5-stage-pipeline machine with full data hazard and control hazard logic, what is the average CPI when executing this program? Please include the steps.

CPI:

Lw = 1 × 0.6 + 2 × 0.4 = 1.4

ST = 1

Beq = 0.5 × 1 + 0.5 × 2 = 1.5

J = 2 R = 1

Avg CPI =

1.4 × 0.2 + 1 × 0.1 +

1.5 × 0.1 + 2 × 0.02

+ 1 × 0.58 = 1.15

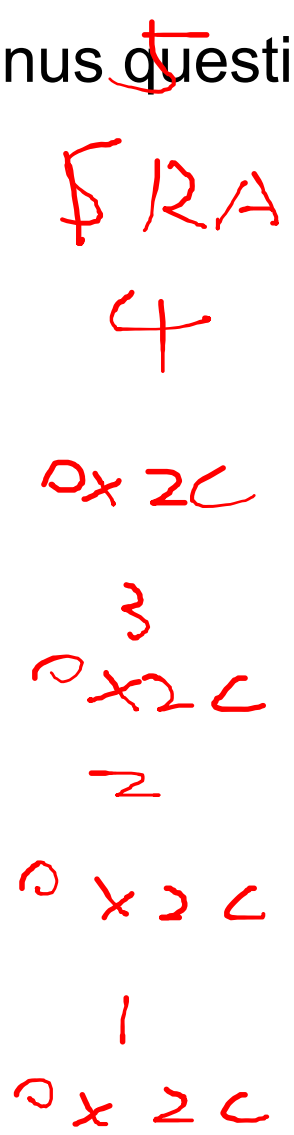
Midterm Questions

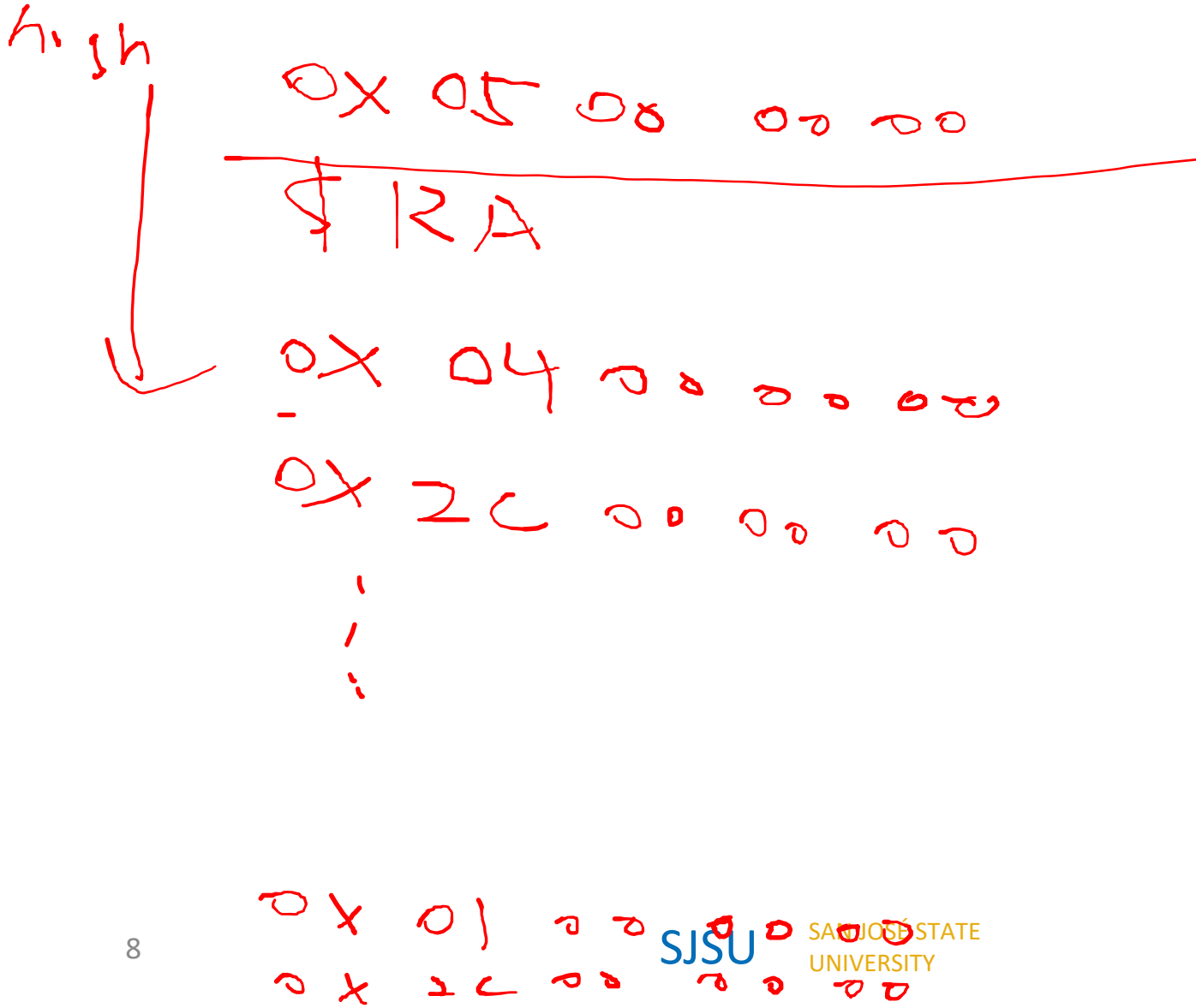
- For a branch instruction, assume it has an exclusive prediction table entry and its actual outcome is as follows (T = Taken, N = Not Taken):

- NTTNNNTNNTNTTT
- 1) Assuming the initial state is 0, what is the rate of correct prediction with a 1-bit dynamic branch predictor? (You should list all the prediction results. For example, if you think all predictions are Taken, you should write TTTTTTTTTTTTT.)
- 2) Is the 1-bit dynamic predictor performing better than a static predictor in this case? Please explain.

Midterm Questions

- Bonus question





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