A3 - Caleb Krauter

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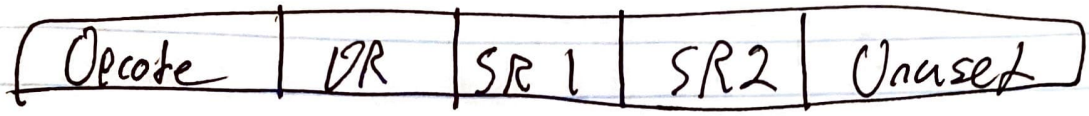

32 bits total represent the instruction.

8 opcodes
10 registers

a) $\lceil \log_2(8) \rceil = 3$, exact value is 3
The minimum amount of bits to represent the opcodes is 3 bits. This is the minimum because none of the unused bits are required to form the bits of the opcode and $\log_2$(opcodes) rounded to the ceiling is equal to the amount of bits necessary to represent the opcodes. $2^3 = 8$, so 3 is the minimum amount of bits required, $2^2 + 2^1 + 2^0 = 7$

b) $\lceil \log_2(10) \rceil = 4$, exact value ≈ 3.321928094489

There are 10 registers, to find minimum amount of bits to represent the registers, we take $\log_2$(registers) and round to its ceiling giving us 4 in this case. The amount of bits required for any of our registers, DR, SR1, SR2 are equal.
DR is represented by at minimum 4-bits
$2^4 = 16$, $2^3 = 8$, $2^2 = 4$, $2^1 = 2$, $2^0 = 1$ 4 bits is the minimum for representing 10 registers.

A5 Caleb Kramer

C. Total bits = 32 bits = T
Minimum opcode bits = 3 = op
Minimum DR Bits = 4 = r_1
Minimum SR1 Bits = 4 = r_2
Minimum SR2 Bits = 4 = r_3

$T - (Op + r_1 + r_2 + r_3) = Unused$

$32 - (3 + 4 + 4 + 4) = 17$

UNUSED = 17-bits, this is the maximum possible Amount of unused bits since all registers and opcodes are using the minimum amount of bits to calculate 17 unused bits.