CS220: Computer Organization
Quiz#2 Solutions

Name:
Roll No.:

1. Consider a single-channel DIMM card. The channel has two ranks and each rank has 16 chips. The DIMM card uses x8 chips and each chip has eight banks. Each bank has 16384 rows. The capacity of each chip is 2 Gb. The DIMM card is connected to a DRAM controller which needs to respond with 64 bytes to the computer for each request. Compute the number of bits needed to encode the column address. Compute the row buffer size (in bits) per bank per chip. Compute the burst length for best performance. **(2+1+1 points)**

Solution: Number of columns per row = 2 Gb/(8 banks$\times$16384 rows per bank$\times$8 bits per column) = 2^{11}. So, the required number of address bits = 11. Row buffer size = bits per row = 2 Gb/(8 banks$\times$16384 rows per bank) = 2^{14} bits. Burst length for best performance = 64 bytes/(16 chips per rank$\times$8 bits output per chip per burst) = 4.

2. A finite state machine (FSM) having 100 states is implemented using a state sequencer, a microcode ROM, and five dispatch ROMs. The FSM takes a seven-bit input. Compute the minimum width (in bits) of the microinstructions and the number of entries in each dispatch ROM. **(1+1 points)**

Solution: Each microinstruction (stored in a row of the microcode ROM) provides the selection input of the next state selecting multiplexer. There are at least six inputs to the next state selecting multiplexer: (current state + 1) and the five dispatch ROM outputs. So the selection input needs to be at least three bits wide. The dispatch ROM is indexed using the input. Therefore, the number of entries in the dispatch ROM is 2^7.

3. Suppose the positive floating-point numbers are represented in normalized scientific notation using an eight-bit biased exponent and a 23-bit mantissa where the exponent bias is 127. We would like to represent the decimal number 9.625. Write down the decimal value of the biased exponent. Write down the 23-bit mantissa. **(2+2 points)**

Solution: 9.625 = $(1001.101)_2$ = 1.001101×2^3. Therefore, the biased exponent is 3+127 i.e., 130. The mantissa is 001101 followed by 17 zeroes.