

## Assignment 4 Solutions

## CENG 355

1. Assume the instruction reads two operands from memory and writes one operand to memory (like a 3 operand add instruction). Therefore the following reads and writes are required:

read of the instruction  
read of 3 indirect addresses  
read of 2 operands  
write of 1 operand

The instruction will be  
2 bytes for the opcode  
3 bytes to specify the 3 registers used to generate the addresses  
6 bytes for the 3 offsets

Therefore read of instruction takes 11  
read of 3 indirect addresses takes 24 bytes  
read of 2 operands takes 16 bytes  
write of 1 operand takes 8 bytes

Therefore total number of reads and writes is 59 bytes.

2. 32 bit address space has address bits A31-----A0.

a) To address within a 32MB use A24-----A0.

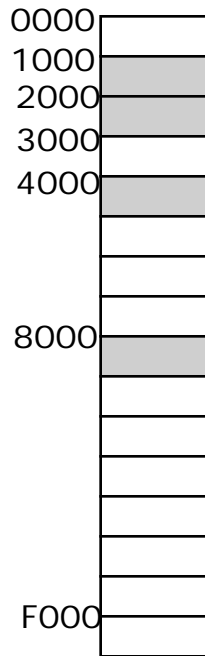
Therefore decode A31----A25 for complete address decoding. Use a 1 of 128 decoder to decode the entire 32 bit address space into 128 32MB blocks.

b) To completely decode a 32MB block into 1 MB blocks use A24--A20 and a 1 of 32 decoder.

c) To linearly decode a 1MB address space into 4KB blocks individually use A19---A12 to select 1 of 8 4KB blocks.

d) To completely decode a 4KB block into 256B blocks use A11----A8 and a 1 of 16 decoder.

3. The decoder uses A15----A12 to select four 4K blocks. The decoded blocks start at addresses 1000, 2000, 4000 and 8000 hex. Only 4 of the 16 blocks are useable.



4. Use A3, A2, A3 to address the registers. Use A23(H)----A4(H), LDS(L), and AS(L) to select the controller. Choose to locate the controller in the top 8 words of memory starting at address FFF0. Use only the lower bytes of these 8 words for the addresses of the 8 byte wide registers of the controller.

