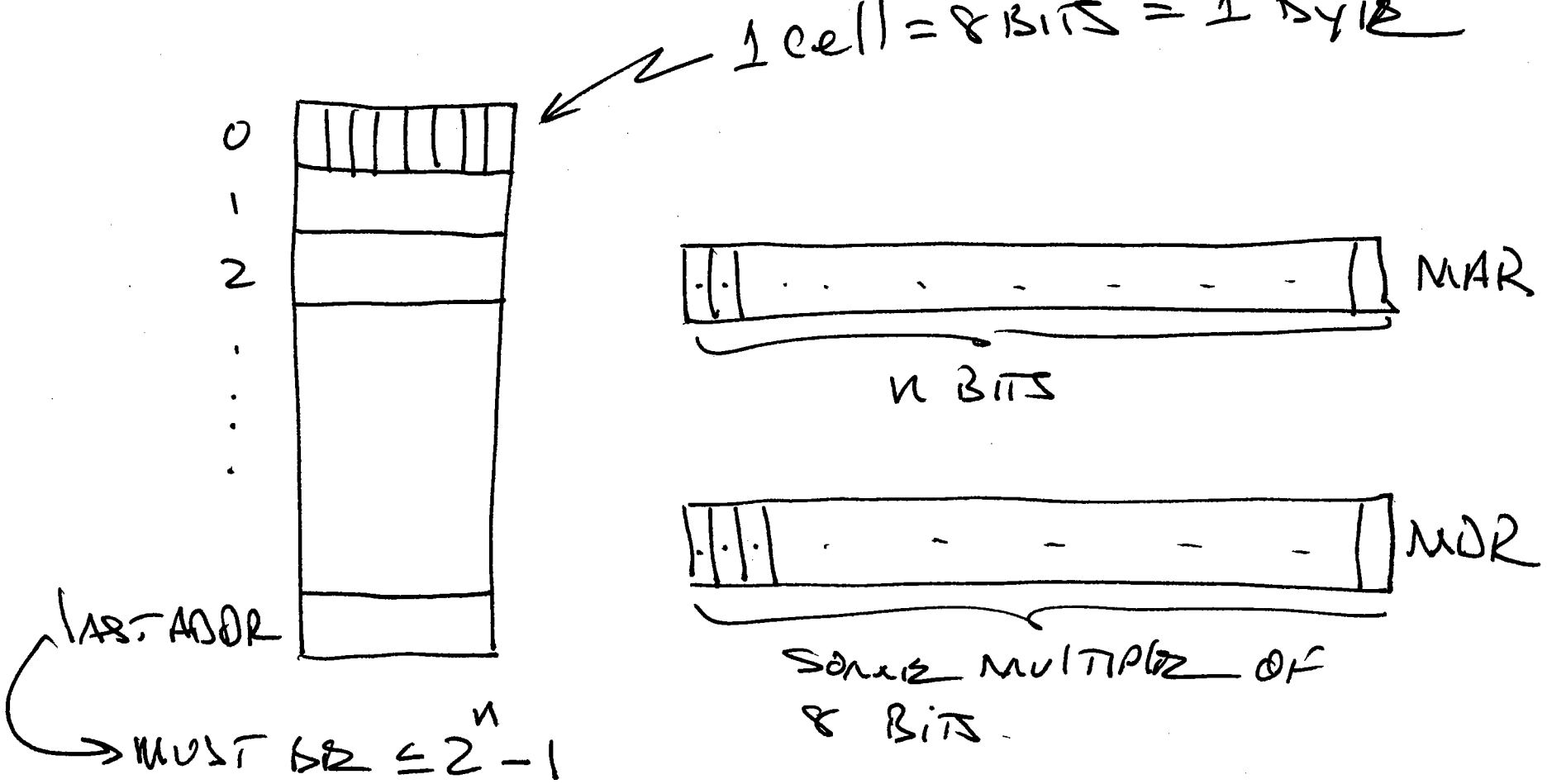
CMPS 10 2-28-08

Memory



Ex. $n = 6$ what is max memory size?

$2^6 = 64 \Rightarrow$ at most 64 cells in memory

Ex. 128 MB memory unit.

what is min # of bits in MAR.

$128\ MB = 2^7 \cdot 2^{20}$ Bytes $= 2^{27}$ cells

must have at least 2^{27} addresses.

$\therefore \quad n \geq 27$.

Two memory OPs:

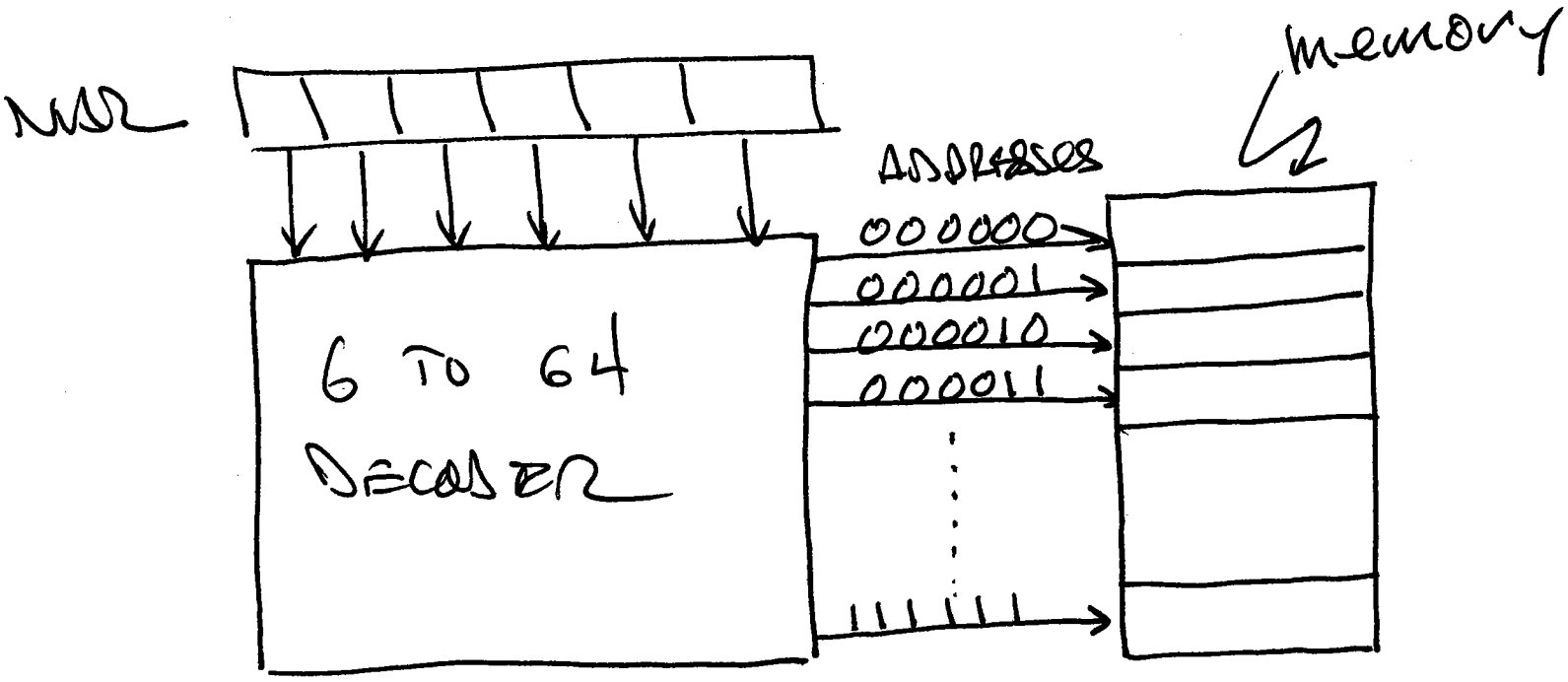
Fetch (address)

1.) load address into MAR
2.) Decode address in MAR
3.) Copy Contents of cell to MDR.

Store (address, data)

1.) load address into MAR
2.) load data INTO MDR
3.) Decode address in MAR
4.) Copy Contents of MDR to cell

Ex $n = 6 \therefore 2^6 = 64$ addressable cells.



For instance: if MAR contains 001101 = 13

Ex MORE REALISTIC:

256 MB $= 2^8 \cdot 2^{20}$ cells

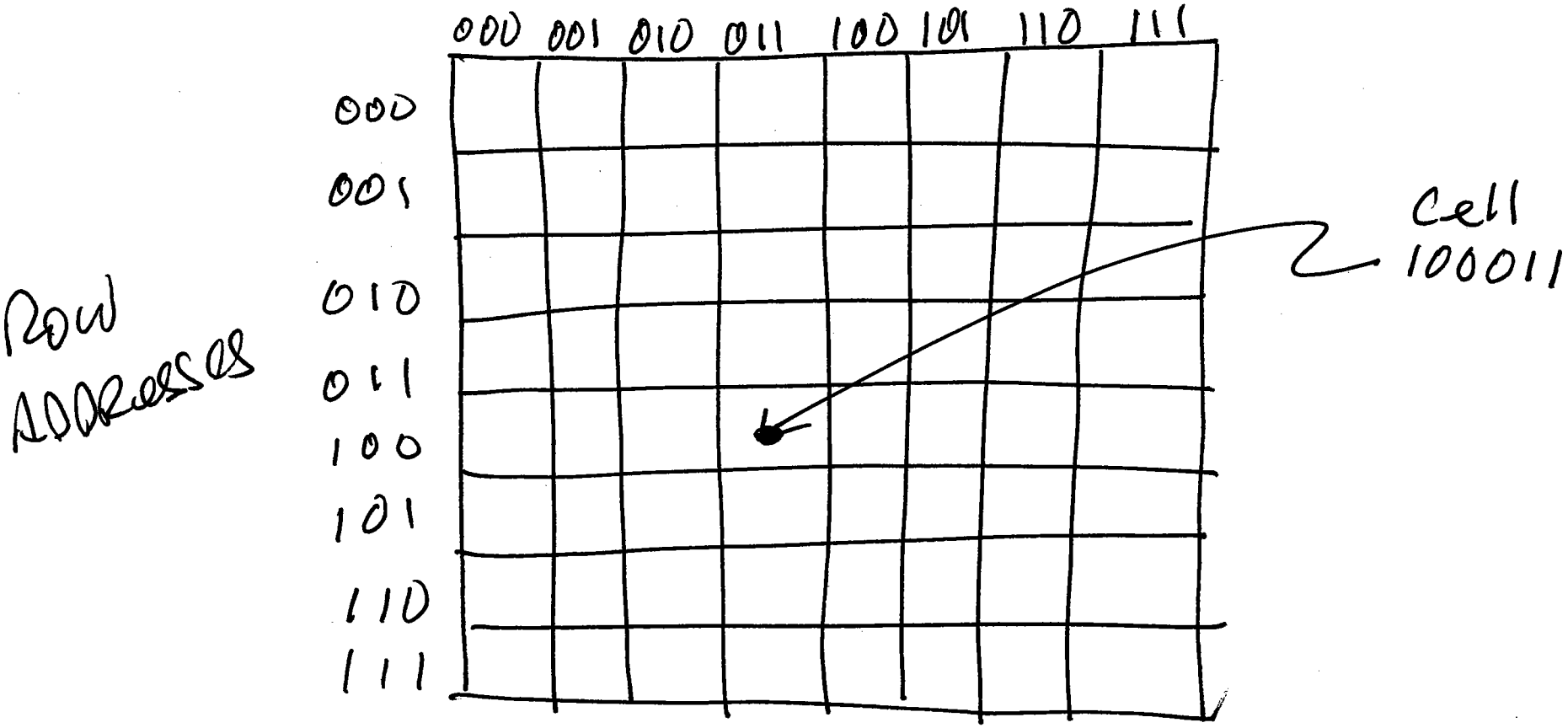
$= 2^{28}$ cells

SO WE NEED A 2^{28} TO 2^{28} DECODER.

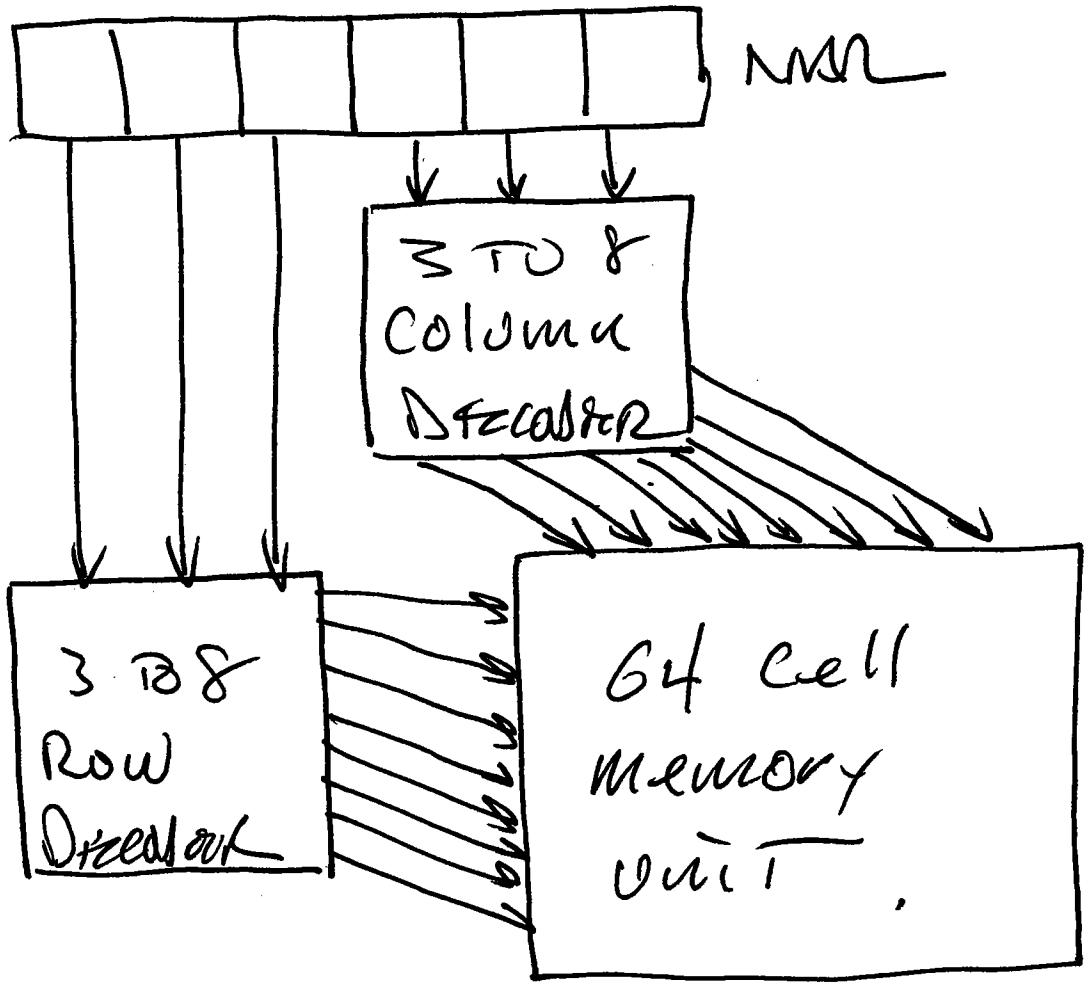
FORTUNATELY MEMORY DECODERS ARE 2-dimensional

More Realistic Pictures:

Ex. $n = 6$, 2^6 cells $= 2^{3}$ rows $\times 2^{3}$ columns



INSTEAD OF A 6 TO 64 DECODER, BUILD TWO 3 TO $2^3=8$ DECODERS



Ex. $256\ MB = 2^8 \cdot 2^{20}$ cells

$= 2^{28}$ cells

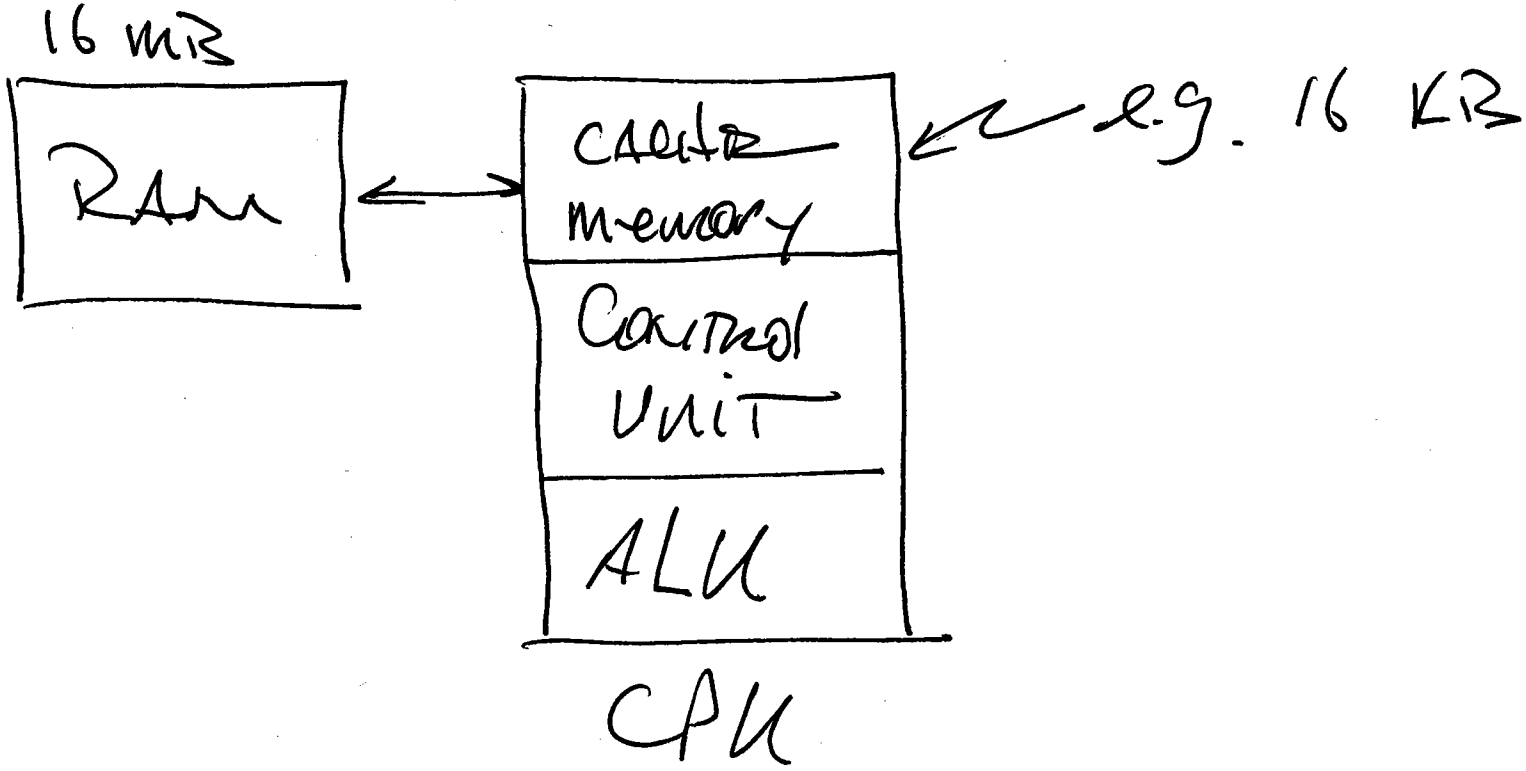
$= (2^{14}$ rows$) \times (2^{14}$ columns$)$.

So we build two 14 to 2^{14} decoders

Cache Memory

Very fast memory directly on the CPU

e.g.



EX. Suppose item requested is in cache 70% of the time. (This is the CACHE HIT RATE.)

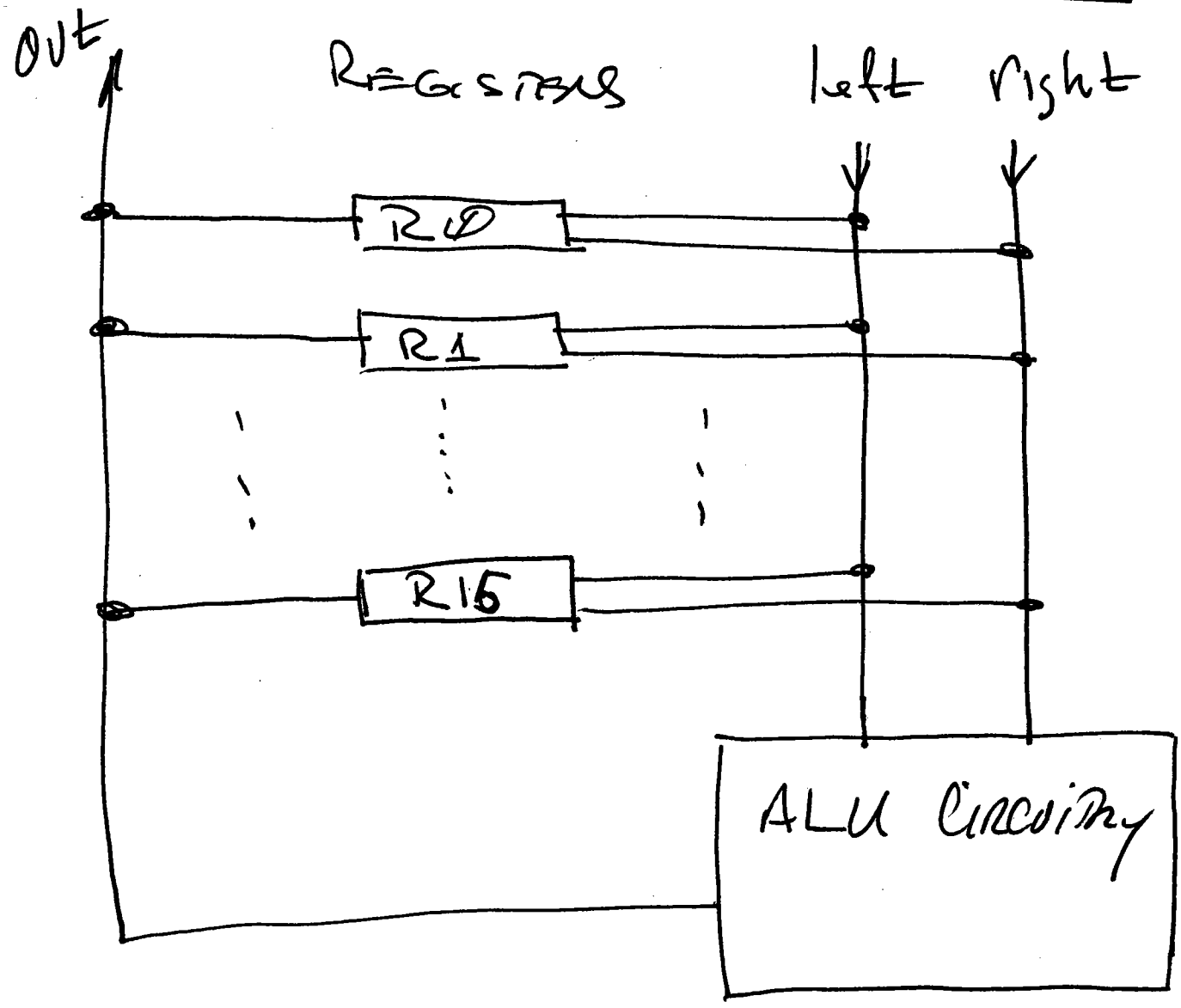
SUPPOSE CACHE ACCESS TIME IS 10 NS, WHILE RAM TAKES 50 NS TO ACCESS. THEN THE AVERAGE ACCESS TIME IS

$$\text{AVG.} = (.70)\,10\text{ ns} + (.30)(10+50)\text{ ns}$$

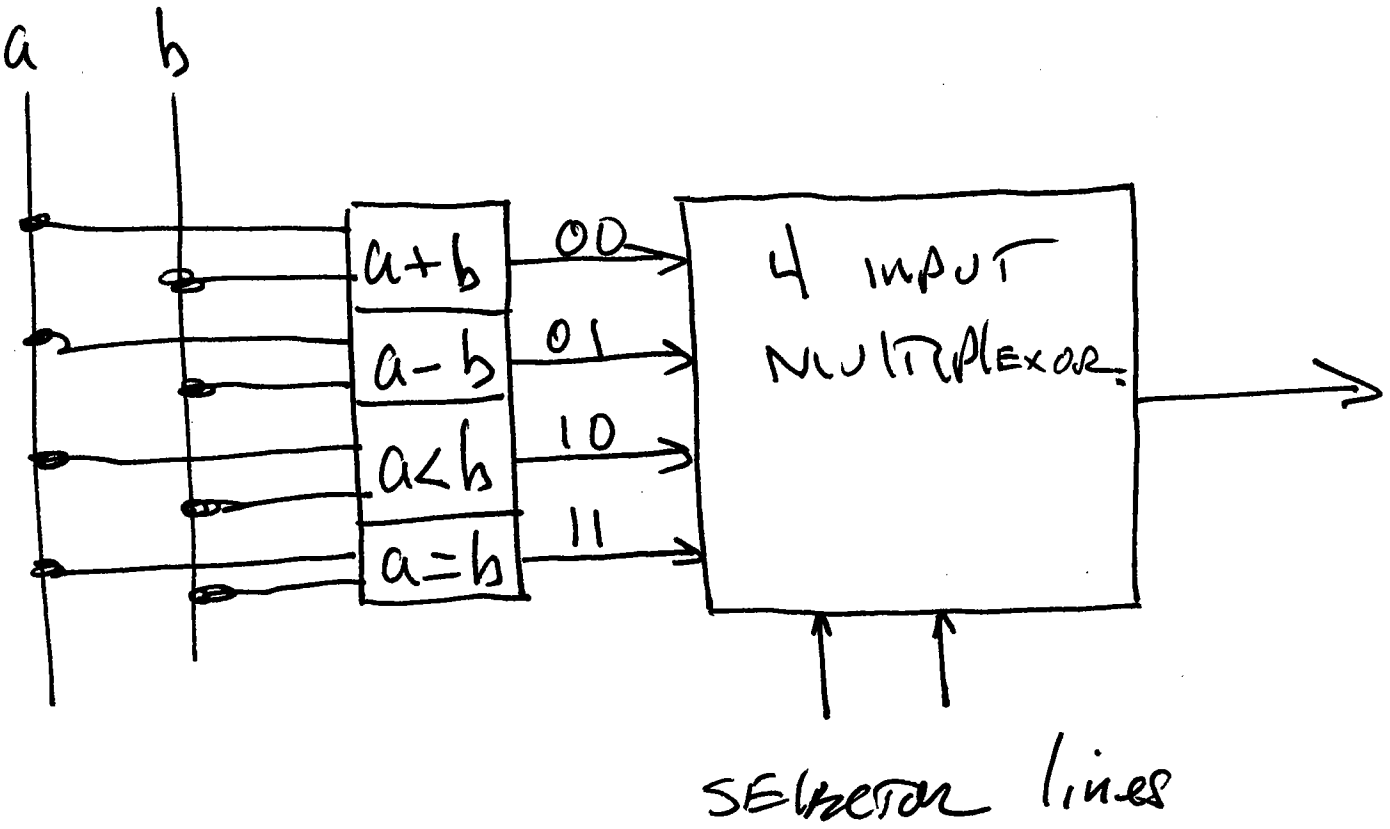
$$= 25\text{ ns}.$$

THIS IS TWICE AS FAST AS THE 50 NS TIME WITH NO CACHE.

Arithmetic Logic Unit (ALU)



Ex. Suppose ALU does cost 4 ops $a+b$, $a-b$, $a<b$, $a=b$. How do we select which op. is performing by ALU.



THE CONTROL UNIT

FETCH - DECODE - EXECUTE CYCLE

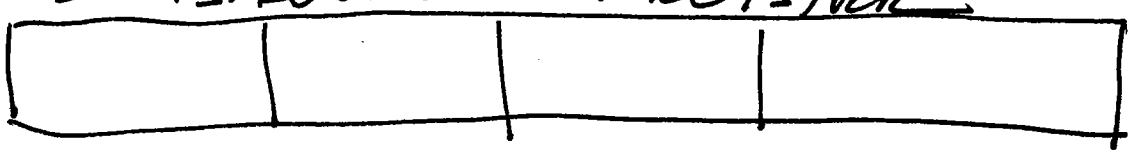
1.) Fetch next instruction from memory

2.) Decode instruction

3.) Execute instructions

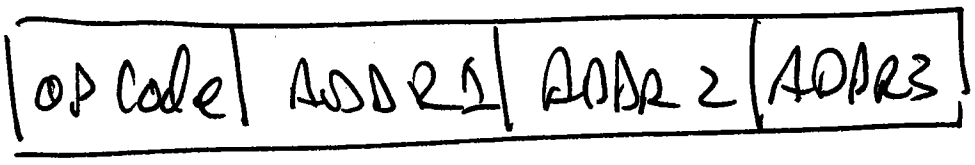
CONTINUE UNTIL A SPECIAL INSTRUCTION CALLED HALT IS ENCOUNTERED.

INSTRUCTION REGISTER



INSTRUCTIONS ARE ENCODED IN A FORMAT CALLED 'MACHINE LANGUAGE'.

EX.



IR

#BITS 8 24 24 24