CMPS 10 3-6-08

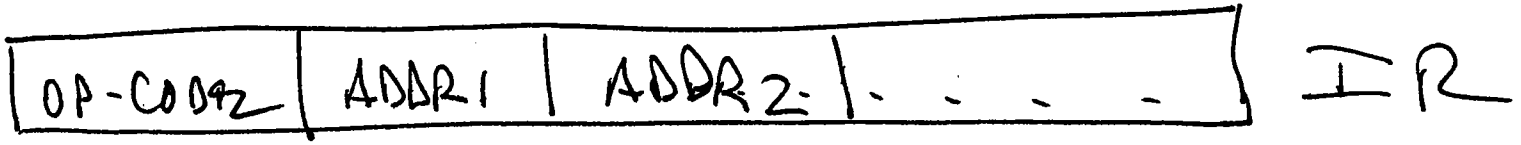
The Control Unit

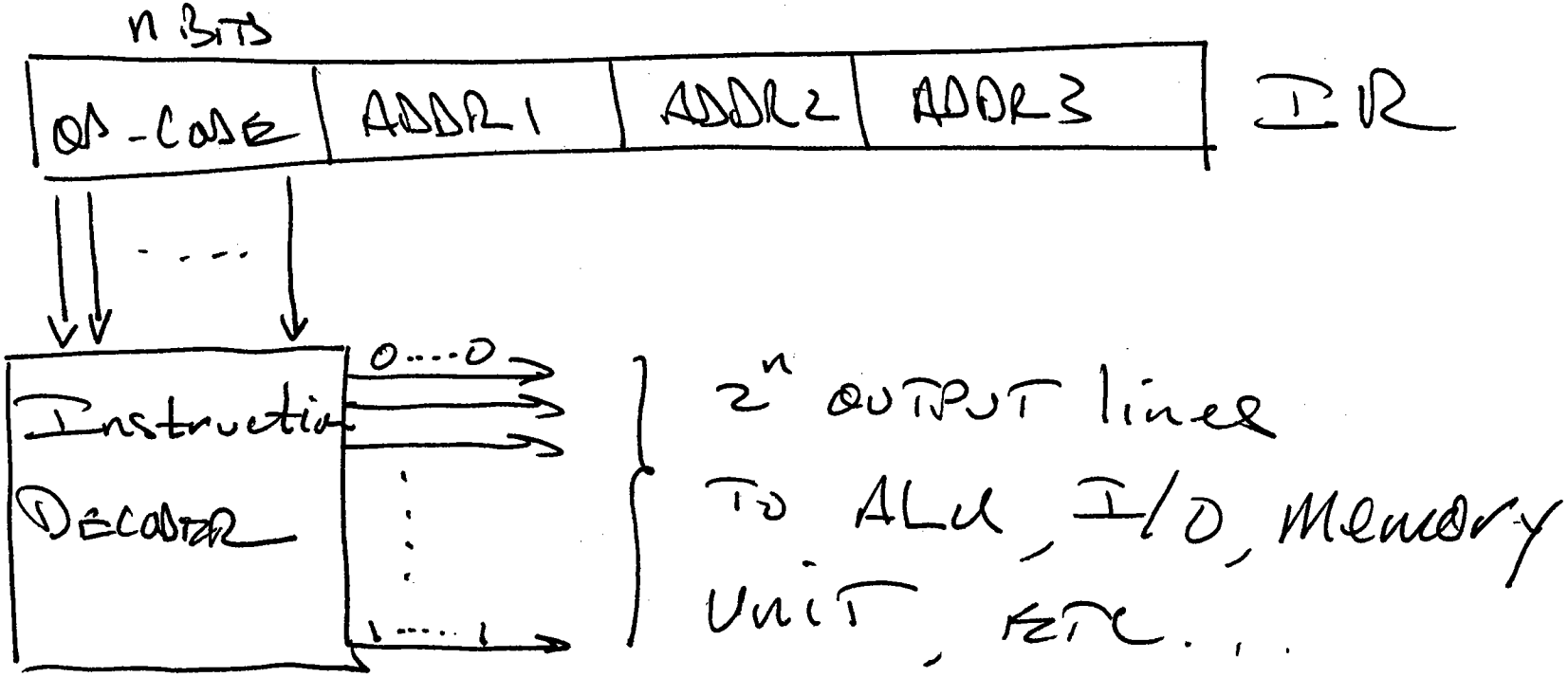
1.) Fetch next instruction from memory

2.) Decode the instruction

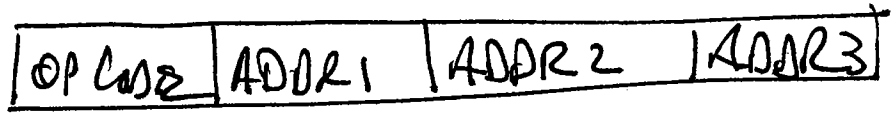
3.) Execute the instruction.

Instruction Register





EX. IR



#BITS	8	24	24	24	= 80 BITS
					= 10 BYTES

$\therefore$ Max # of OPERATIONS $= 2^8 = 256$

$\therefore$ Max size of memory unit $= 2^{24}$ Bytes

$= 16$ MB

(why $2^{24} = \underbrace{2^4}_{16} \cdot \underbrace{2^{20}}_{MB} = 16$ MB .)

$\therefore$ # BYTES NEEDED TO STORE 1 INSTRUCTION

$= 10$

Ex. IR

OPCODE	ADDR 1	ADDR 2
4	14	14

= 32 BITS

- max # of ADS = 16 = 2^4
- max SIZE of MEMORY = 2^{14} BYTES
  = 16 KB
- # BYTES NEEDED TO STORE ONE INSTRUCTION = 4

INSTRUCTION SET : THE SET OF ALL OPERATIONS THAT CAN BE PERFORMED BY A PROCESSOR.

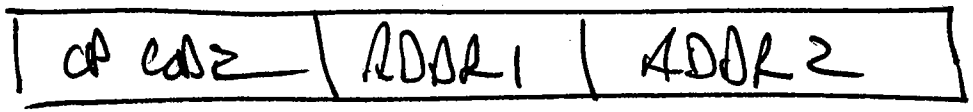
CISC : COMPLEX INSTRUCTION SET COMPUTERS

200 - 400 OPS.

RISC : REDUCED INSTRUCTION SET COMPUTERS

30 - 50 OPS

Ex

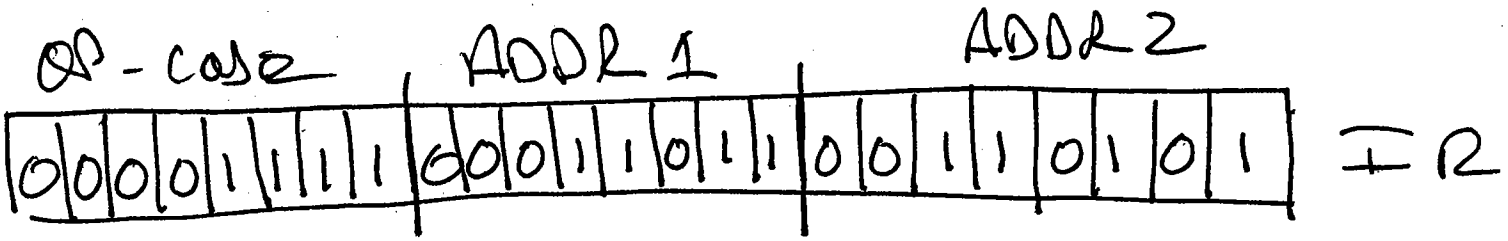


IR

8 8 8 = 24 bits

SUPPOSE WE WISH TO MOVE CONTENTS OF CELL 27 TO CELL 53, AND SUPPOSE THE OP-CODE FOR THIS DATA TRANSFER IS 15

NOTE: 15 = 1111, 27 = 11011, 53 = 110101



IR

SHORTHAND : MOVE 27 53

= = =

00001111 00011011 00110101

NOTATIONAL CONVENTIONS

- X, Y, Z, ... STAND FOR cell addresses.
- a, b, c, ... STAND FOR CELL CONTENTS.
- ASSUME ALU CONTAINS JUST ONE REGISTER : R

- WRITE CON(X) TO MEAN 'CONTENTS OF CELL X'

FOUR CLASSES OF MACHINE LANGUAGE INSTRUCTIONS

1.) DATA TRANSFER.

- MOVE X Y : CON(Y) ← CON(X)
- LOAD X : CON(R) ← CON(X)
- STORE X : CON(X) ← CON(R)

2.) ARITHMETIC

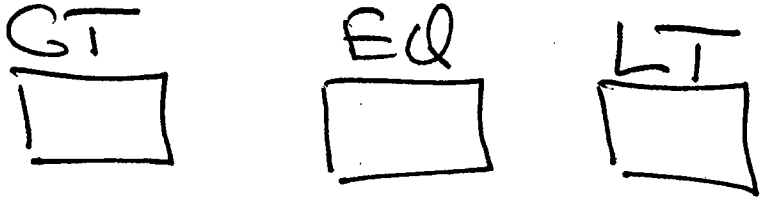
- ADD_1 X : CON(R) ← CON(X) + CON(R)
- ADD_2 X Y : CON(Y) ← CON(X) + CON(Y)
- ADD_3 X Y Z : CON(Z) ← CON(X) + CON(Y)

⋮

3.) COMPARISON

SET VALUES OF SPECIAL BIT CALLED CONDITION CODES : GT, EQ, LT

In ALK:



- COMPARE X Y : COMPARES CON(X) TO CON(Y) AND SET CONDITION CODES AS FOLLOWS:

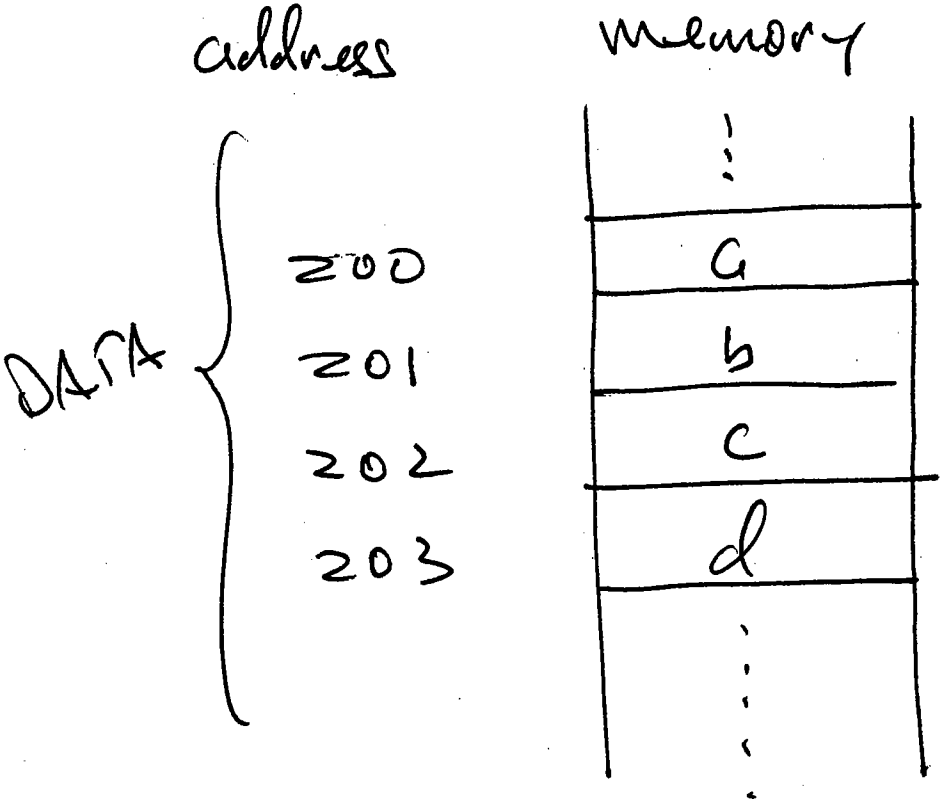
IF	GT	EQ	LT
CON(X) > CON(Y)	1	0	0
CON(X) = CON(Y)	0	1	0
CON(X) < CON(Y)	0	0	1

4.) BRANCHING (ALTER NORMAL SEQ. FLOW OF PROGRAM EXECUTION)

- JUMP X : TAKE NEXT INSTRUCTION FROM CELL X.
- JUMPGT X : IF GT = 1, TAKE NEXT INSTR. FROM CELL X, OTHERWISE FOLLOW SEQUENTIAL FLOW OF EXECUTION.
- JUMPEQ X
- JUMPLT X
- JUMPLE X
- JUMPGE X
- JUMPNEQ X

- HALT : Quit Fetch-Decode-Execute.

In following examples assume:



Also assume program instructions begin at cell 100