

L16-CS8421-InstSet-P1

Introduction to Instruction Sets

CS8421

Computing Systems

Dr. Ken Hoganson

Class

Will

Start

Momentarily...

Chapter 10 material in Stallings

Chapter 10 in Concepts in Computing

- Instruction formats
- Classic IBM 370 formats
- Instruction Set Design
- Instruction Set Analysis

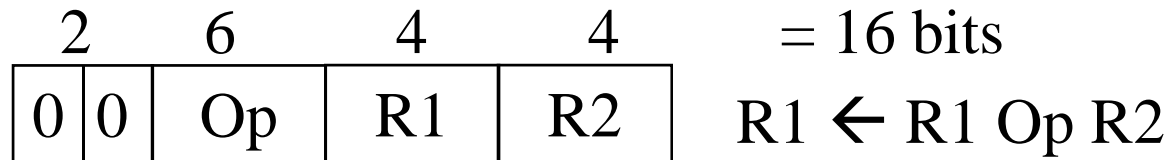
- Many computers support more than a single format for instructions
- Computers can support variable size instructions, in terms of bits required
- Relating instruction format size to data bus width:
 - Instructions that are smaller in size than the size of the data bus: 16 bit instruction on a 32 bit bus – multiple instructions in a single fetch!
 - Instructions that are wider than the data bus: requires multiple fetches for the entire instruction

- Instructions sets differ in terms of instruction formats supported.
- Instruction formats primarily differ in terms of the number and type of operands that they work with.

Operands	Symbolic Rep	Interpretation
3	OP,A,B,C	A <- B OP C
2	OP,A,B	A <- A OP B
1	OP, A	AC <- AC OP A
0	OP	Top <- Top OP (Top-1)

- Data Transfer
 - Move, store, load, push, pop
- Arithmetic
 - Add, Sub, Mult, Div, Inc, Dec, etc.
- Logical or bit operations
 - AND, OR, NOT, XOR, TEST, COMPARE, SHIFT, ROTATE
- Control
 - Jump, branch, branch on, return
- Input/Output
 - INPUT, OUTPUT, START (I/O)
- Data Conversion
 - Convert, convert between formats, binary, BCD, Packed, etc.

- RR Format (Reg to Reg)

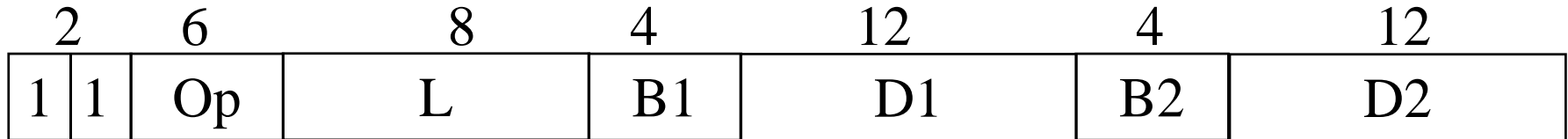


R1 and R2 are 4 bits. What does that tell us about the architecture?

Opcode is 6 bits. What does that tell us about this format?

Note: 32-bit registers

- SS Format , 48 bits!



Memory to Memory instruction. Example:

Move L bytes from location 1 to location 2

Format	Opcode Byte	Hex Digits	
RR	00XX XXXX	0-3	0-F
RX	01XX XXXX	4-7	0-F
RS	10XX XXXX	8-B	0-F
SS	11XX XXXX	C-F	0-F

If ADD=001000 and SUB=000100,
then what is (in hex):

04B3

8834CBF0

Design instruction formats for an instruction set with only the following two types of instructions:

Format A: Reg,Reg: $R1 \leftarrow R1 \text{ OP } R2$

Format B: Reg,Mem $R1 \leftarrow R1 \text{ OP Mem}$

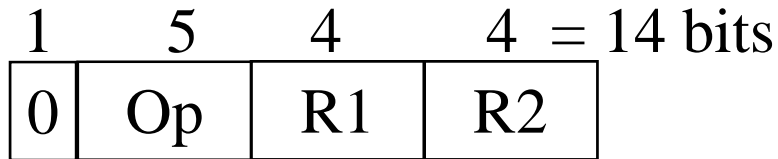
The machine has 16 registers.

There are 32 instructions of type A.

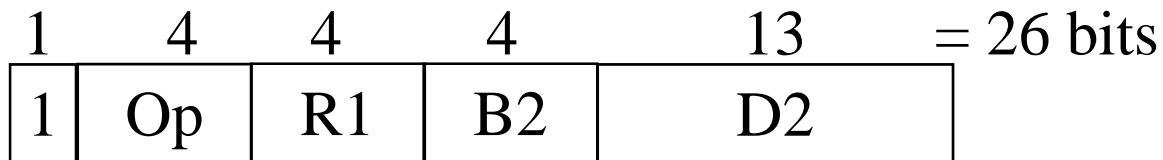
There are 16 instructions of type B.

Memory access is a displacement of 13 bits plus a base register.

Format A:



Format B:



Design instruction formats for an instruction set with only the following three types of instructions:

Format A: Reg,Reg: $R1 \leftarrow R1 \text{ OP } R2$

Format B: Reg,Mem $R1 \leftarrow R1 \text{ OP Mem}$

Format C: Reg,Reg,Mem $R1 \leftarrow R2 \text{ OP Mem}$

The machine has 32 registers.

There are 4 instructions of type A.

There are 8 instructions of type B.

There are 16 instructions of type C.

Memory access is a displacement of 8 bits plus a base register.

**End
Of
Today's
Lecture.**

