

Computer Systems Organisation (CS2.201)

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Data Movement Instructions

They are generally used to copy data from one location to another, but cannot be used to move between two memory locations. A register must be involved. Further, an immediate value cannot be the second operand.

Instruction	Effect	Description
MOV <i>S, D</i>	$D \leftarrow S$	Move
movb	Move byte	
movw	Move word	
movl	Move double word	
MOVS <i>S, D</i>	$D \leftarrow \text{SignExtend}(S)$	Move with sign extension

Figure 1: Data Movement Instructions

The character suffixes on `mov` indicates the:

- extension method: **z** for zero-extended and **s** for sign extended
- source data size: **b** for byte, **w** for word and **l** for double word
- destination location size: **as** for source.

Instruction	Effect	Description
movsbw	Move sign-extended byte to word	
movsbl	Move sign-extended byte to double word	
movswl	Move sign-extended word to double word	
MOVZ <i>S, D</i>	$D \leftarrow \text{ZeroExtend}(S)$	Move with zero extension
movzbw	Move zero-extended byte to word	
movzbl	Move zero-extended byte to double word	
movzwl	Move zero-extended word to double word	

Figure 2: Three-suffix Opcodes

When the latter two are identical, we only specify one and leave out the extension method.

In x86-64, for sign extension we have `movsbq`, `movswq` and `movslq` analogously. In the case of zero-extension, however, we only need `movzbbq` and `movzwbq`, since copying from 4 to 8 bytes automatically extends it with zeroes.

The `push` instruction takes an argument `S` and is equivalent to

```
R[%esp] <- R[%esp] - 4
M[R[%esp]] <- S
```

The `%esp` (stack pointer) register points to the memory location which is the “top” of the stack, but in reality addresses increase towards the base of the stack. Therefore we decrement the address in order to push.

The `pop` instruction, similarly, takes an argument `D` and is equivalent to

```
D <- M[R[%esp]]
R[%esp] <- R[%esp] + 4
```

Consider the C code:

```
int exchange (int *xp, int y)
{
    int x = *xp;
    *xp = y;
    return x;
}
```

It compiles to

```
-- xp at %ebp+8 and y at %ebp+12
movl 8(%ebp), %edx [Get xp]
movl (%edx), %eax [x = *xp, becomes return value]
movl 12(%ebp), %ecx [Get y]
movl %ecx, (%edx) [Store y at xp]
```