

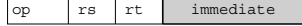
Assembly Language Wrap-up

Assembly language is the medium for directly programming the ISA. It reveals the beauty and the quirks of the computer's design

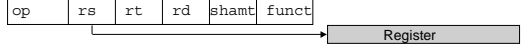
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Addressing Modes

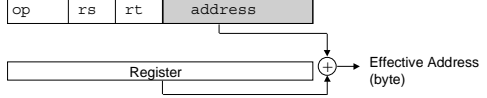
Immediate



Register Addressing



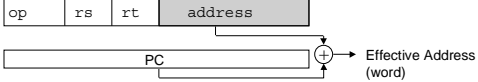
Base Addressing



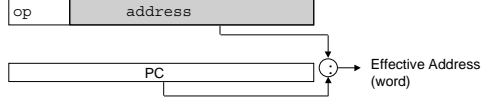
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Addressing Modes (Continued)

PC-relative Addressing



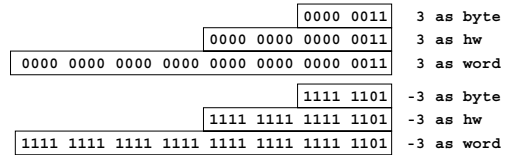
Pseudo-direct Addressing



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Signed Arithmetic

- Most operations involving integers are signed
- When a number is loaded into a larger field, it is sign extended, which preserves its sign



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Unsigned Operations

- Sometimes, the bit sequences are not numbers, and then an unsigned load is desired
 - lbu load byte unsigned
- There are unsigned arithmetic operations
 - addu add unsigned
 - subu subtract unsigned
 - addiu add immediate unsigned
 - sltu set less than unsigned
 - sltiu set less than immediate unsigned

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ASCII

- American Standard Code for Information Interchange -- now known redundantly as "US-ASCII"
- A 7-bit code for the keyboard characters and certain "control characters"
- When bytes became 8-bits, the coding became extended or 8-bit ASCII

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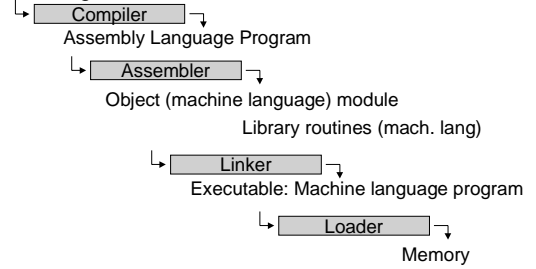
8-bit ASCII

| ASCII | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
|-------|---|---|---|----|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| 0001 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | |
| 0010 | ! | " | # | \$ | % | & | ' | (|) | * | + | , | - | . | / | |
| 0011 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | . | < | = | > | ? | |
| 0100 | @ | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
| 0101 | P | Q | R | S | T | U | V | W | X | Y | Z | [| \ |] | ^ | _ |
| 0110 | ` | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 0111 | p | q | r | s | t | u | v | w | x | y | z | { | | } | ~ | ` |
| 1000 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 1001 | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N | N |
| 1010 | N | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | . | < | = | > | ? | |
| 1011 | ` | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 1100 | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A | A |
| 1101 | 0 | R | O | O | O | O | O | O | O | O | O | O | O | O | O | O |
| 1110 | a | a | a | a | a | a | a | a | a | a | a | a | a | a | a | a |
| 1111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

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Program Forms

- C Program



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