Programming

Telling a computer what to do (roughly)

Assembly Language

The lowest (sensible) level that you can specify ... your computer.

Definition
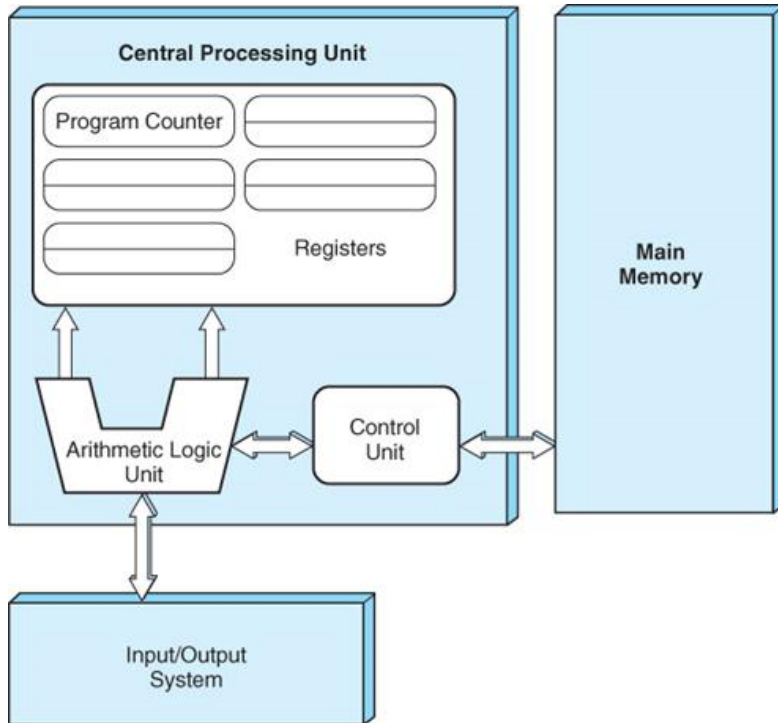
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:100410007000C0E0D0E00E9474002097E1F30E94D9
:0A0420000000F9CF0895F894FFCF13
:00000001FF

```
.ORG     0x0000
RJMP     main

main:
    LDI      r16, 0xFF
    OUT      0x04, r16

loop:
    SBI      0x05, 5
    RCALL    delay
    CBI      0x05, 5
    RCALL    delay
    RJMP     loop
delay:
    LDI r16, 61

    outer_loop:
    LDI r24, low(0)
    LDI r25, high(0)

    delay_loop:
    ADIW     r24, 1
    BRNE     delay_loop
    DEC      r16
    BRNE     outer_loop

    RET
```

High-Level Programming Languages

A higher (more sensible) level that you can specify a sequence of instructions for your computer.

Assemble

Compile

```
.ORG      0x0000
RJMP      main

main:
    LDI       r16, 0xFF
    OUT       0x04, r16

loop:
    SBI       0x05, 5
    RCALL     delay
    CBI       0x05, 5
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    LDI r25, high(0)

    delay_loop:
    ADIW      r24, 1
    BRNE      delay_loop
    DEC       r16
    BRNE      outer_loop

    RET
```
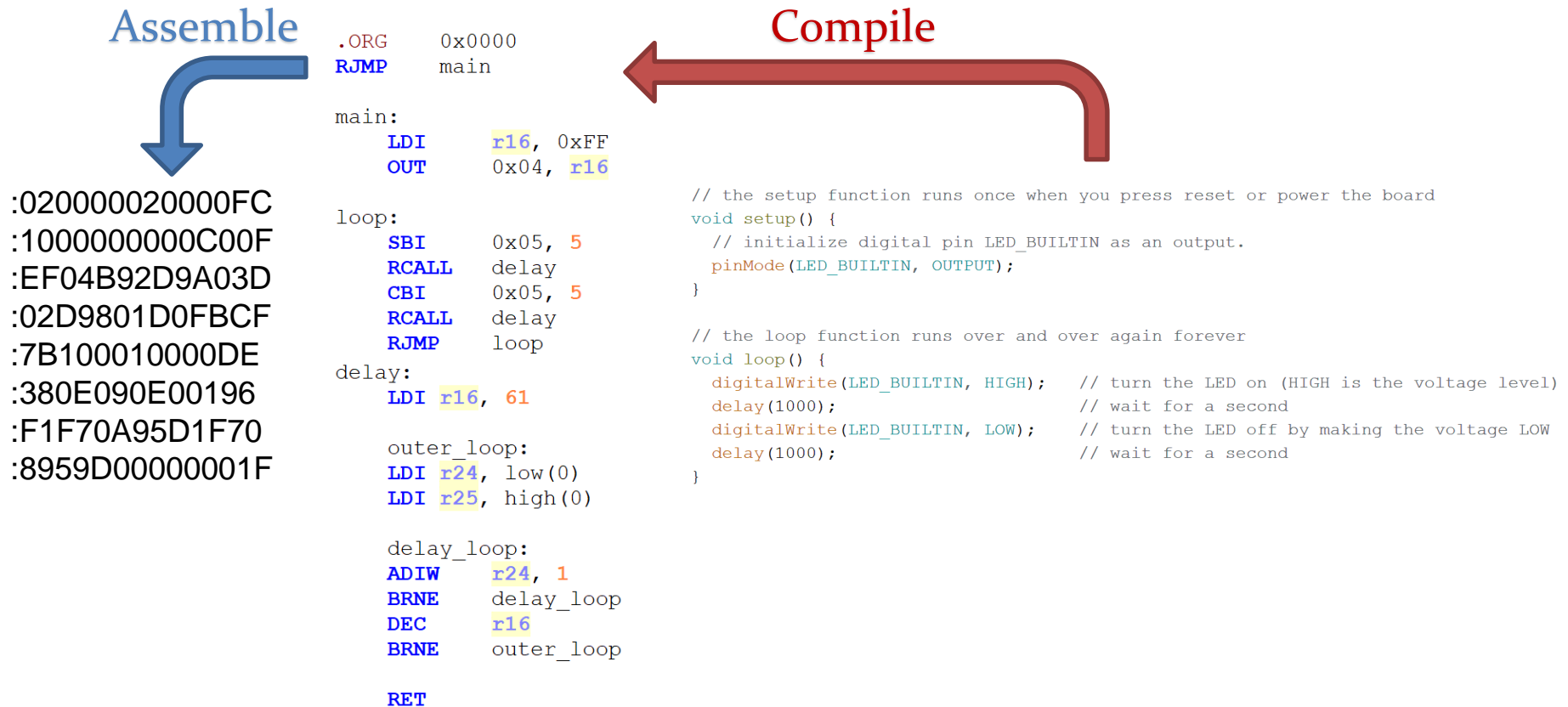
```
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:02D9801D0FBCF
:7B100010000DE
:380E090E00196
:F1F70A95D1F70
:8959D00000001F
```

```c
// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);                        // wait for a second
  digitalWrite(LED_BUILTIN, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);                        // wait for a second
}
```

Compiled vs. Interpreted Languages

When is machine code generated?

Definition

```c
// the setup function runs once when you press reset or power the board
void setup() {
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  delay(1000);                       // wait for a second
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  delay(1000);                       // wait for a second
}
```

```python
## import the serial library
import serial

## Boolean variable that will represent
## whether or not the arduino is connected
connected = False

## open the serial port that your arduino
## is connected to.
ser = serial.Serial("COM11", 9600)

## loop until the arduino tells us it is ready
while not connected:
    serin = ser.read()
    connected = True

## Tell the arduino to blink!
ser.write("1")

## Wait until the arduino tells us it
## is finished blinking
while ser.read() == '1':
    ser.read()

## close the port and end the program
ser.close()
```

Language Composition

Text? Drawing? Physical wires?

Definition