

BUT FIRST, LET'S LEARN A BIT MORE  
ABOUT WHAT PROGRAMMING  
ACTUALLY IS...

# HOW DOES PROGRAMMING ACTUALLY MAKE A COMPUTER WORK?

High-level  
language  
program  
(in C)

```
swap(int v[], int k)
{int temp;
  temp = v[k];
  v[k] = v[k+1];
  v[k+1] = temp;
}
```

Compiler

Assembly  
language  
program  
(for MIPS)

```
swap:
    muli $2, $5, 4
    add  $2, $4, $2
    lw   $15, 0($2)
    lw   $16, 4($2)
    sw   $16, 0($2)
    sw   $15, 4($2)
    jr   $31
```

Assembler

Binary machine  
language  
program  
(for MIPS)

```
00000000101000010000000000011000
00000000000110000001100000100001
10001100011000100000000000000000
10001100111100100000000000000100
10101100111100100000000000000000
10101100011000100000000000000100
0000001111100000000000000001000
```

(for MIPS)  
 biosim  
 biosim  
 Biosim w/assembly

```

00000011111000000000000000001000
10101100011000100000000000000100
10101100111100100000000000000000
10001100111100100000000000000100
10001100011000100000000000000000
000000000000110000001100000100001
000000001010000100000000000011000
  
```



(for MIPS)  
 biosim  
 biosim  
 biosim

```

1L  131
2M  112' 4(15)
2M  110' 0(15)
1M  110' 4(15)
1M  112' 0(15)
000  15' 14'15
0011  15' 12'0
  
```