

Commands the computer to ...

Add two numbers together

00000011

.....

Subtract one number
from another

00101011

.....

Multiply signed
numbers

01101001

.....

Test a condition, and just to
another instruction if 0

01110100

Machine Code



Commands

```

.cstring
LC0:
.ascii "Hello\0"
.text
.globl _main
_main:
    pushl    %ebp
    movl %esp, %ebp
    pushl    %ebx
    subl $20, %esp
    call ___i686.get_pc_thunk.bx
"L000001$pb":
    leal LC0-"L000001$pb"(%ebx), %eax
    movl %eax, (%esp)
    call L_printf$stub
    addl $20, %esp
    popl %ebx
    popl %ebp
    ret

```

Assembly Code

Symbolic names for the machine code instructions

Assembler converts Assembly Code to Machine Code

Assembler

Only the machine code can be executed by the computer

```

.... 0111 0111 0010 0000 0000 0110 0011
0100 1110 0101 1111 0100 0001 0101 1000
0110 0111 0111 0010 0000 0000 0111 0110
0101 1111 0101 1111 0110 1001 0101 ....

```

Machine Code



Source Code

```
void main()  
{  
    printf("Hello World");  
}
```

More "Human" readable
commands

The Compiler uses a Linker
to combine your
code with library code
and create the final
machine code file...

```
.... 0111 0111 0010  
0000 0000 0110 0011  
0101 1111 0101 1111  
0110 1001 0101 ....  
Library Machine Code
```

Compiler

Compiler converts your code
to Assembly, and then
uses an Assembler to
convert this to machine code

Assembler

```
.... 1110 0101 1111  
0100 0001 0101 1000  
0110 0111 0111 0010  
0000 0000 0111 ....  
Your Code as Machine Code
```

Linker

Your code can now be run
on the computer...



```
.... 0111 0111 0010 0000 0000 0110 0011  
0100 1110 0101 1111 0100 0001 0101 1000  
0110 0111 0111 0010 0000 0000 0111 0110  
0101 1111 0101 1111 0110 1001 0101 ....
```

A program is an executable file



It contains machine code instructions to tell the computer what to do when it is run



The program's file will exist on your computer's disk

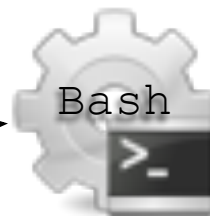
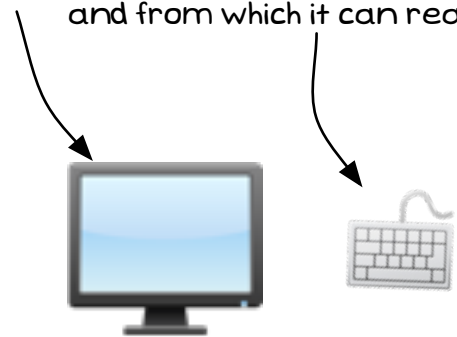


The file is loaded into memory before it can start executing

The Terminal is a program.

It creates an Window into
which programs can output tex,

and from which it can read input



Bash is a shell - a program
that interprets your commands
and commands the computer to
perform actions...

Bash is run for you when the
Terminal starts, it will show you
a command prompt where you
can type your commands

The program is started
by your Operating System



Hello World



Program: Hello World

Steps:

1: Output 'Hello World!' to the Terminal



The computer reads
the program off
the disk,



loads it into memory,
and follows its instructions



```
prompt$ HelloWorld
Hello World!
prompt$ |
```



Programs can be run
from the Terminal, and
can output to the Terminal

