This is CS50
This is CS50
when clicked

say hello, world
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}

clang hello.c

./a.out
clang -o hello hello.c

./hello
make hello

./hello
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}
#include <cs50.h>
#include <stdio.h>

int main(void)
{
    string name = get_string("Name: ");
    printf("hello, %s\n", name);
}
clang hello.c
./a.out
clang hello.c -lcs50

./a.out
clang -o hello hello.c -lcs50

./hello
make hello

./hello
preprocessing

compiling

assembling

linking
preprocessing
compiling
assembling
linking
#include <cs50.h>
#include <stdio.h>

int main(void)
{
    string name = get_string("Name: ");
    printf("hello, %s\n", name);
}
```c
#include <cs50.h>
#include <stdio.h>

int main(void)
{
    string name = get_string("Name: ");
    printf("hello, %s\n", name);
}
```
string get_string(string prompt);
#include <stdio.h>

int main(void)
{
    string name = get_string("Name: ");
    printf("hello, %s
", name);
}
string get_string(string prompt);
#include <stdio.h>

int main(void)
{
    string name = get_string("Name: ");
    printf("hello, %s\n", name);
}
string get_string(string prompt);
int printf(const char *format, ...);

int main(void)
{
    string name = get_string("Name: ");
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}
... string get_string(string prompt);
int printf(const char *format, ...);
...

int main(void)
{
    string name = get_string("Name: ");
    printf("hello, %s
", name);
}
preprocessing

compiling

assembling

linking
int main(void)
{
    string name = get_string("Name: ");
    printf("hello, %s\n", name);
}
main:                                   # @main
  .cfi_startproc
# BB#0:
  pushq %rbp
.Ltmp0:
  .cfi_def_cfa_offset 16
.Ltmp1:
  .cfi_offset %rbp, -16
  movq %rsp, %rbp
.Ltmp2:
  .cfi_def_cfa_register %rbp
  subq $16, %rsp
  xorl %eax, %eax
  movl %eax, %edi
  movabsq $.L.str, %rsi
  movb $0, %al
  callq get_string
  movabsq $.L.str.1, %rdi
  movq %rax, -8(%rbp)
  movq -8(%rbp), %rsi
  movb $0, %al
  callq printf
...
main:
    .cfi_startproc

    # BB#0:
    pushq    %rbp

.Ltmp0:
    .cfi_def_cfa_offset 16

.Ltmp1:
    .cfi_offset %rbp, -16
    movq    %rsp, %rbp

.Ltmp2:
    .cfi_def_cfa_register %rbp
    subq    $16, %rsp
    xorl    %eax, %eax
    movl    %eax, %edi
    movabsq    $.L.str, %rsi
    movb    $0, %al
    callq    get_string
    movabsq    $.L.str.1, %rdi
    movq    %rax, -8(%rbp)
    movq    -8(%rbp), %rsi
    movb    $0, %al
    callq    printf

...
main:                                   # @main
    .cfi_startproc
    # BB#0:
        pushq %rbp
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        .cfi_def_cfa_offset 16
    .Ltmp1:
        .cfi_offset %rbp, -16
        movq %rsp, %rbp
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        .cfi_def_cfa_register %rbp
        subq $16, %rsp
        xorl %eax, %eax
        movl %eax, %edi
        movabsq $.L.str, %rsi
        movb $0, %al
        callq get_string
        movabsq $.L.str.1, %rdi
        movq %rax, -8(%rbp)
        movq -8(%rbp), %rsi
        movb $0, %al
        callq printf
    ...
preprocessing
compiling
assembling
linking
main:                                   # @main
    .cfi_startproc

# BB#0:
    pushq   %rbp

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    .cfi_offset %rbp, -16
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    subq   $16, %rsp
    xorl   %eax, %eax
    movl   %eax, %edi
    movabsq   $.L.str, %rsi
    movb   $0, %al
    callq  get_string
    movabsq   $.L.str.1, %rdi
    movq   %rax, -8(%rbp)
    movq   -8(%rbp), %rsi
    movb   $0, %al
    callq  printf

...
preprocessing

compiling

assembling

linking
hello.c  cs50.c
Intel® Core™ i7 processor
help50
printf
style50
string
HI!
72 73 33
### Telegram

**To:** German Legation, Mexico City  
**From:** Western Union  
**Date:** Jan 9, 1917

Send the following telegram, subject to the terms on back hereof, which are hereby agreed to:

via Galveston

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*Beckstopf.*

*Cherche German Embassy.*
like a pall on sculpture, till another
man

took the burden from him and went up
to the house with his dead.

When Mr. Raleigh entered the house
again, it was at break of dawn. Some
one opened the library-door and beckon-
ed him in. Marguerite sprang into his
arms.

"What if she had died?" said Mrs.
Purcell, with her swift saucy breath, and
flicking a web of muslin over her arm.
"See! I had got out the shroud. As it
is, we drink shill and say grace at break-
dast. The funeral bade—meats shall
coldly furnish forth the marriage-feast.
You men are all alike. Le Roi est mort!
Vive le Reine!"

---

PAUL REVERE'S RIDE.

Listen, my children, and you shall hear
Of the midnight ride of Paul Revere,
On the eighteenth of April, in Seventy-Five:
Hardly a man is now alive
Who remembers that famous day and year.

He said to his friend,—"If the British march
By land or sea from the town to-night,
Hang a lantern aloft in the belfry-arch
Of the North-Church-tower, as a signal-light,—
One if by land, and two if by sea;
And I on the opposite shore will be,
Ready to ride and spread the alarm
Through every Middlesex village and farm,
For the country-folk to be up and to arm."

Then he said good-night, and with muffled ear
Silently rowed to the Charlestown shore,
Just as the moon rose over the bay,
Where swinging wide at her moorings lay
The Somerset, British man-of-war;
A phantom ship, with each mast and spar
Across the moon, like a prison-bar,
And a huge, black hulk, that was magnified
By its own reflection in the tide.

Meanwhile, his friend, through alley and street
Wandered and watched with eager ears,
Till in the silence around him he hears
The muster of men at the barrack-door,
The sound of arms, and the tramp of foot,
And the measured tread of the grenadiers
Marching down to their boats on the shore.

Then he climbed to the tower of the church,
Up the wooden stairs, with stealthy tread,
key → plaintext → ciphertext
plaintext → ciphertext
I LOVE YOU
73 LOVE YOU
73 76 O V E Y O U
```c
#include <stdio.h>

int main(void)
{
    ...
}
```
#include <stdio.h>

int main(void)
{
    ...
}

#include <stdio.h>

int main(int argc, string argv[])
{
    ...
}

#include <stdio.h>

int main(int argc, string argv[]) {
    ...
}
#include <stdio.h>

int main(int argc, string argv[]) {
    ...
}
#include <stdio.h>

int main(void)
{
    ...
}

Bubble Sort
repeat until no swaps
  for i from 0 to n-2
    if i'th and i+1' th elements out of order
      swap them
Selection Sort
for i from 0 to n-1
    find smallest element between i'th and n-1'th
    swap smallest with i'th element
\[(n - 1)\]
\[(n - 1) + (n - 2)\]
\[(n - 1) + (n - 2) + \ldots + 1\]
\[(n - 1) + (n - 2) + ... + 1\]

\[n(n - 1)/2\]
$(n - 1) + (n - 2) + \ldots + 1$

$n(n - 1)/2$

$(n^2 - n)/2$
(n - 1) + (n - 2) + ... + 1
\[n(n - 1)/2\]
\[(n^2 - n)/2\]
\[n^2/2 - n/2\]
\[ \frac{n^2}{2} - \frac{n}{2} \]
\[ n^2/2 - n/2 \]

\[ 1,000,000^2/2 - 1,000,000/2 \]
\( \frac{n^2}{2} - \frac{n}{2} \)

1,000,000\(^2/2\) – 1,000,000/2

500,000,000,000 – 500,000
\[ \frac{n^2}{2} - \frac{n}{2} \]
\[ 1,000,000^2/2 - 1,000,000/2 \]
\[ 500,000,000,000 - 500,000 \]
\[ 499,999,500,000 \]
\( \frac{n^2}{2} - \frac{n}{2} \)

\( 1,000,000^2/2 - 1,000,000/2 \)

\( 500,000,000,000 - 500,000 \)

\( 499,999,500,000 \)

\( O(n^2) \)
$O(n^2)$

$O(n \log n)$

$O(n)$

$O(\log n)$

$O(1)$
\(\Omega(n^2)\)
\(\Omega(n \log n)\)
\(\Omega(n)\)
\(\Omega(\log n)\)
\(\Omega(1)\)
$\Theta(n^2)$

$\Theta(n \log n)$

$\Theta(n)$

$\Theta(n)$

$\Theta(1)$
Merge Sort
on input of n elements
    if n < 2
        return
    else
        sort left half of elements
        sort right half of elements
        merge sorted halves
This is CS50