

This is CS50

reading levels

One fish. Two fish. Red fish. Blue fish.

Before Grade 1

Congratulations! Today is your day. You're off to Great  
Places! You're off and away!

Grade 3

It was a bright cold day in April, and the clocks were striking thirteen. Winston Smith, his chin nuzzled into his breast in an effort to escape the vile wind, slipped quickly through the glass doors of Victory Mansions, though not quickly enough to prevent a swirl of gritty dust from entering along with him.

Grade 10

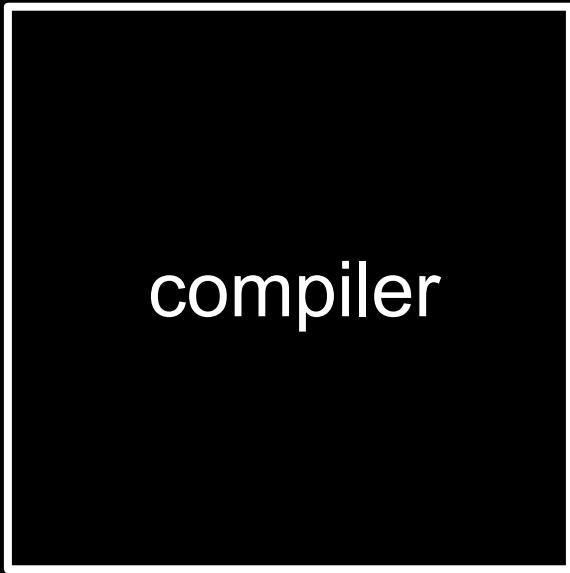
reading levels

cryptography

U I J T J T D T 5 0

T H I S I S C S 5 0

source code →



→ machine code

```
#include <stdio.h>

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

01111111 01000101 01001100 01000110 00000010 00000001 00000001 00000000  
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  
00000010 00000000 00111110 00000000 00000001 00000000 00000000 00000000  
10110000 00000101 01000000 00000000 00000000 00000000 00000000 00000000  
01000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  
11010000 00010011 00000000 00000000 00000000 00000000 00000000 00000000  
00000000 00000000 00000000 00000000 01000000 00000000 00111000 00000000  
00001001 00000000 01000000 00000000 00100100 00000000 00100001 00000000  
00000110 00000000 00000000 00000000 00000101 00000000 00000000 00000000  
01000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  
01000000 00000000 01000000 00000000 00000000 00000000 00000000 00000000  
01000000 00000000 01000000 00000000 00000000 00000000 00000000 00000000  
11111000 00000001 00000000 00000000 00000000 00000000 00000000 00000000  
11111000 00000001 00000000 00000000 00000000 00000000 00000000 00000000  
00001000 00000000 00000000 00000000 00000000 00000000 00000000 00000000  
00000011 00000000 00000000 00000000 00000100 00000000 00000000 00000000  
00111000 00000010 00000000 00000000 00000000 00000000 00000000 00000000  
...

```
make hello
```

```
./hello
```

```
clang hello.c
```

```
./a.out
```

```
clang -o hello hello.c
```

```
./hello
```

```
#include <stdio.h>

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

```
#include <cs50.h>
#include <stdio.h>

int main(void)
{
    string name = get_string("What's your name? ");
    printf("hello, %s\n", name);
}
```

```
clang -o hello hello.c -lcs50
```

```
./hello
```

```
make hello
```

```
./hello
```

compiling

preprocessing

compiling

assembling

linking

preprocessing

compiling

assembling

linking

```
#include <stdio.h>

void meow(void);

int main(void)
{
    for (int i = 0; i < 3; i++)
    {
        meow();
    }
}

void meow(void)
{
    printf("meow\n");
}
```

```
#include <stdio.h>

void meow(void);

int main(void)
{
    for (int i = 0; i < 3; i++)
    {
        meow();
    }
}

void meow(void)
{
    printf("meow\n");
}
```

```
#include <cs50.h>
#include <stdio.h>

int main(void)
{
    string name = get_string("What's your name? ");
    printf("hello, %s\n", name);
}
```

```
#include <cs50.h>
#include <stdio.h>

int main(void)
{
    string name = get_string("What's your name? ");
    printf("hello, %s\n", name);
}
```

```
string get_string(string prompt);
#include <stdio.h>

int main(void)
{
    string name = get_string("What's your name? ");
    printf("hello, %s\n", name);
}
```

```
string get_string(string prompt);
#include <stdio.h>

int main(void)
{
    string name = get_string("What's your name? ");
    printf("hello, %s\n", name);
}
```

```
string get_string(string prompt);
int printf(string format, ...);

int main(void)
{
    string name = get_string("What's your name? ");
    printf("hello, %s\n", name);
}
```

preprocessing

compiling

assembling

linking

```
string get_string(string prompt);
int printf(string format, ...);

int main(void)
{
    string name = get_string("What's your 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:                                # @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
.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
...

```

preprocessing

compiling

assembling

linking

```
...
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
...
```

1

preprocessing

compiling

assembling

linking

```
#include <cs50.h>
#include <stdio.h>

int main(void)
{
    string name = get_string("What's your name? ");
    printf("hello, %s\n", name);
}
```

hello.c

hello.c

cs50.c

hello.c

cs50.c

stdio.c

cs50.cs

stdio.c

stdio.c

|                                  |                                  |                                  |
|----------------------------------|----------------------------------|----------------------------------|
| 01111111010001010100110001000110 | 01111111010001010100110001000110 | 00101111011011000110100101100010 |
| 00000010000000010000000100000000 | 00000010000000010000000100000000 | 01100011001011100111001101101111 |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 0010111000110110001000000101111  |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 01110101011100110111001000101111 |
| 00000001000000000011110000000000 | 00000011000000000011110000000000 | 01101100011010010110001000101111 |
| 00000001000000000000000000000000 | 00000010000000000000000000000000 | 01110000011100000110110010111111 |
| 00000000000000000000000000000000 | 11000000000111100000000000000000 | 0011011000110100010110101101100  |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 0110100101101110011101010111100  |
| 00000000000000000000000000000000 | 01000000000000000000000000000000 | 00101101011001110110111001110101 |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 0010111011011000110100101100010  |
| 10100000000001000000000000000000 | 00101000011001000000000000000000 | 01100011010111110110111001101111 |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 011011001110011011010001100001   |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 01110010011001010110010000101110 |
| 01000000000000000000000000000000 | 01000000000000000000000000000000 | 0110000100100000010000001000001  |
| 00000000000000000000000000000000 | 00000111000000000100000000000000 | 01010011010111110100111001000101 |
| 00001010000000000000000000000000 | 00011100000000000110010000000000 | 01000101010001000100010101000100 |
| 0101010101001000100100111100101  | 00000001000000000000000000000000 | 0010000000101000001000000101111  |
| 01001000100001111011000010000    | 00000101000000000000000000000000 | 01101100011010010110001000101111 |
| 0011000111000001000100111000111  | 00000000000000000000000000000000 | 0111000001110000011011001011111  |
| 01001000101111100000000000000000 | 00000000000000000000000000000000 | 0011011000110100010110101101100  |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 0110100101101110011101010111100  |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 00101101011001110110111001110101 |
| 11101000000000000000000000000000 | 00000000000000000000000000000000 | 00101111011011000110010000101101 |
| 0000000010010001011111000000000  | 00000000000000000000000000000000 | 01101100011010010110111001110101 |
| 00000000000000000000000000000000 | 01011100001001000000000000000000 | 0111000001011010111100000111000  |
| 00000000000000000000000000000000 | 00000000000000000000000000000000 | 0011011000101101001101000110100  |
| ...                              | ...                              | ...                              |



preprocessing

compiling

assembling

linking

compiling

decompiling

reverse engineering



# debugging





92

9/9

0800 Antran started  
 1000 . stopped - antran ✓  
 1300 (032) MP - MC  
 (033) PRO 2  
 convt  
 1.2700 9.037 847 025  
~~1.982167000~~  
~~2.130476415~~ 9.037 846 995 convt  
 4.615 925 059 (-)

Relays 6-2 in 033 failed special speed test  
 in relay 11.000 test.

Relay 214  
Relay 337

1100 Started Cosine Tape (Sine check)  
 1525 Started Multi+ Adder Test.

1545



Relay #70 Panel F  
 (moth) in relay.

First actual case of bug being found.  
 1600 Antran started.

1700 closed down.

In relay

11.00 test

Relay's changed

1100 Started Cosine Tape (Sine check)  
1525 Started Mult + Adder Test.

1545



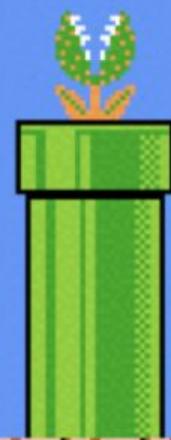
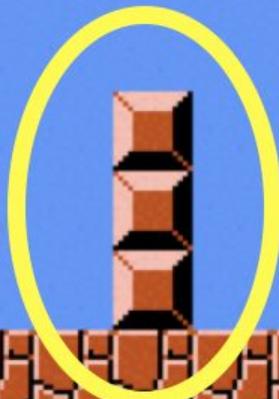
Relay #70 Panel F  
(moth) in relay.

First actual case of bug being found.  
~~1630~~

1630 Antenna started.

1700 closed down.

0 0 0 0





# CS50 Duck

cs50.ai

printf

printf

debug50

printf

debug50

rubber duck

types

**bool**

**int**

**long**

**float**

**double**

**char**

**string**

...

**bool** 1 byte

**int** 4 bytes

**long** 8 bytes

**float** 4 bytes

**double** 8 bytes

**char** 1 byte

**string** ? bytes

...





8BB12  
D9HXT

8BB12  
D9HXT

4G85

4G85

8BB12  
D9HXT

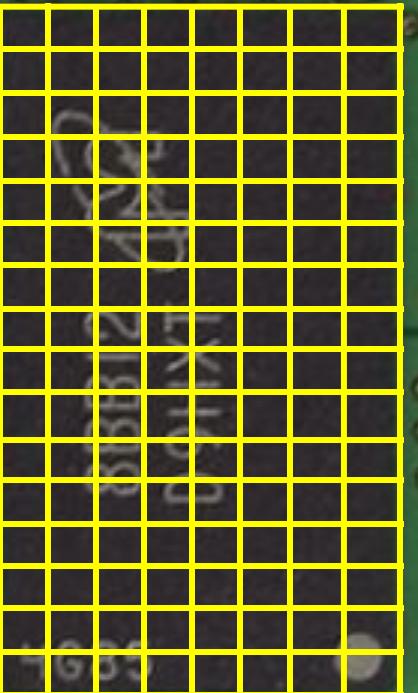
8BB12  
D9HXT

4G85

4G85

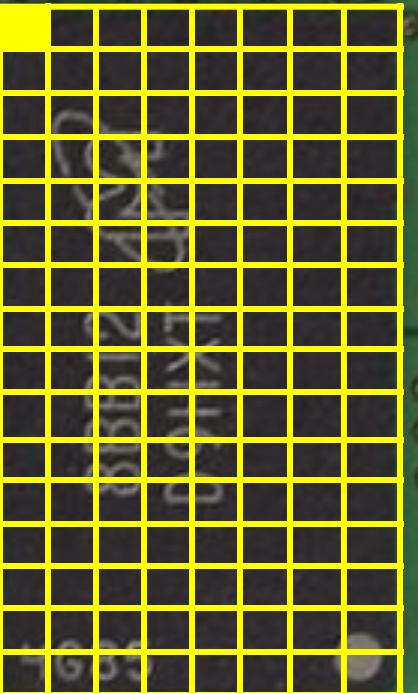
8BB12  
D9HXT

4G85



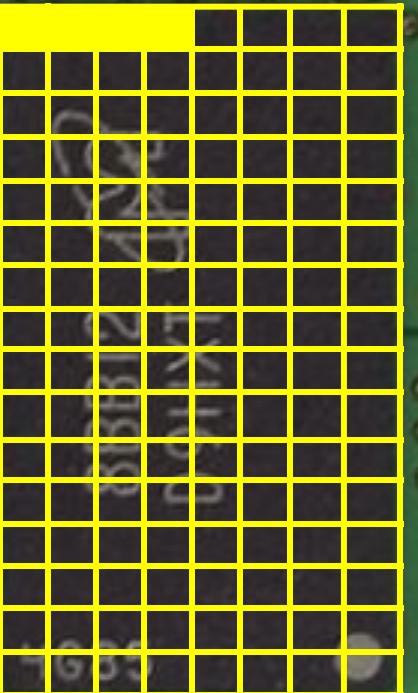
8BB12  
D9HXT

4G85



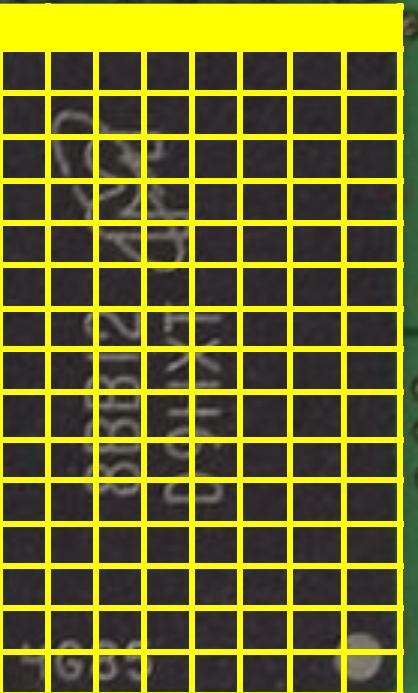
8BB12  
D9HXT

4G85



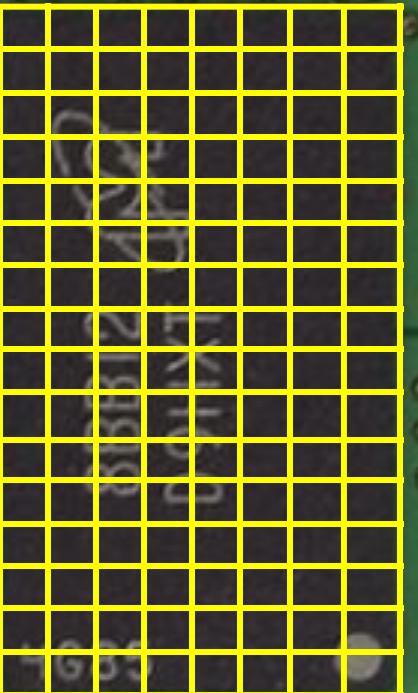
8BB12  
D9HXT

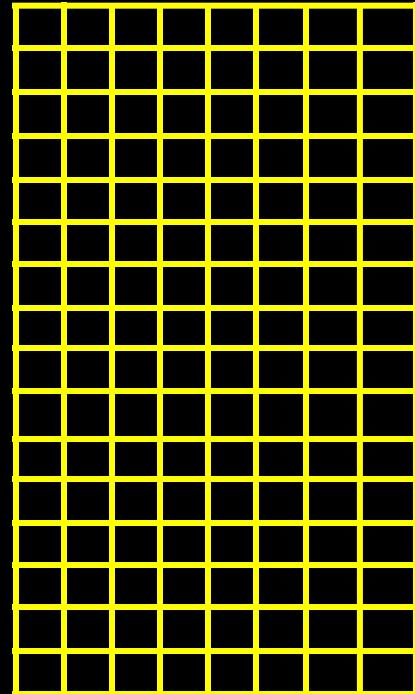
4G85

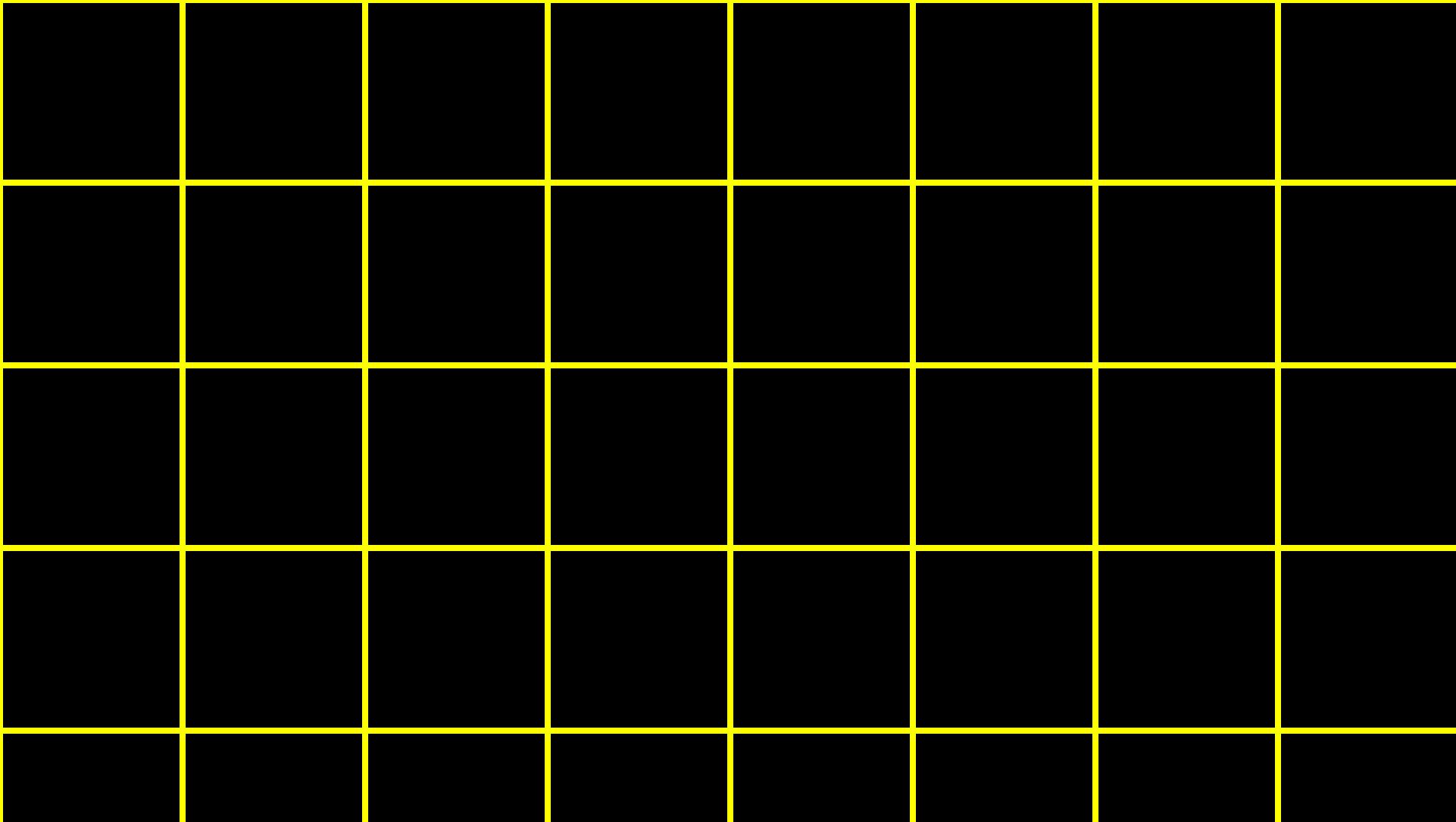


8BB12  
D9HXT

4G85



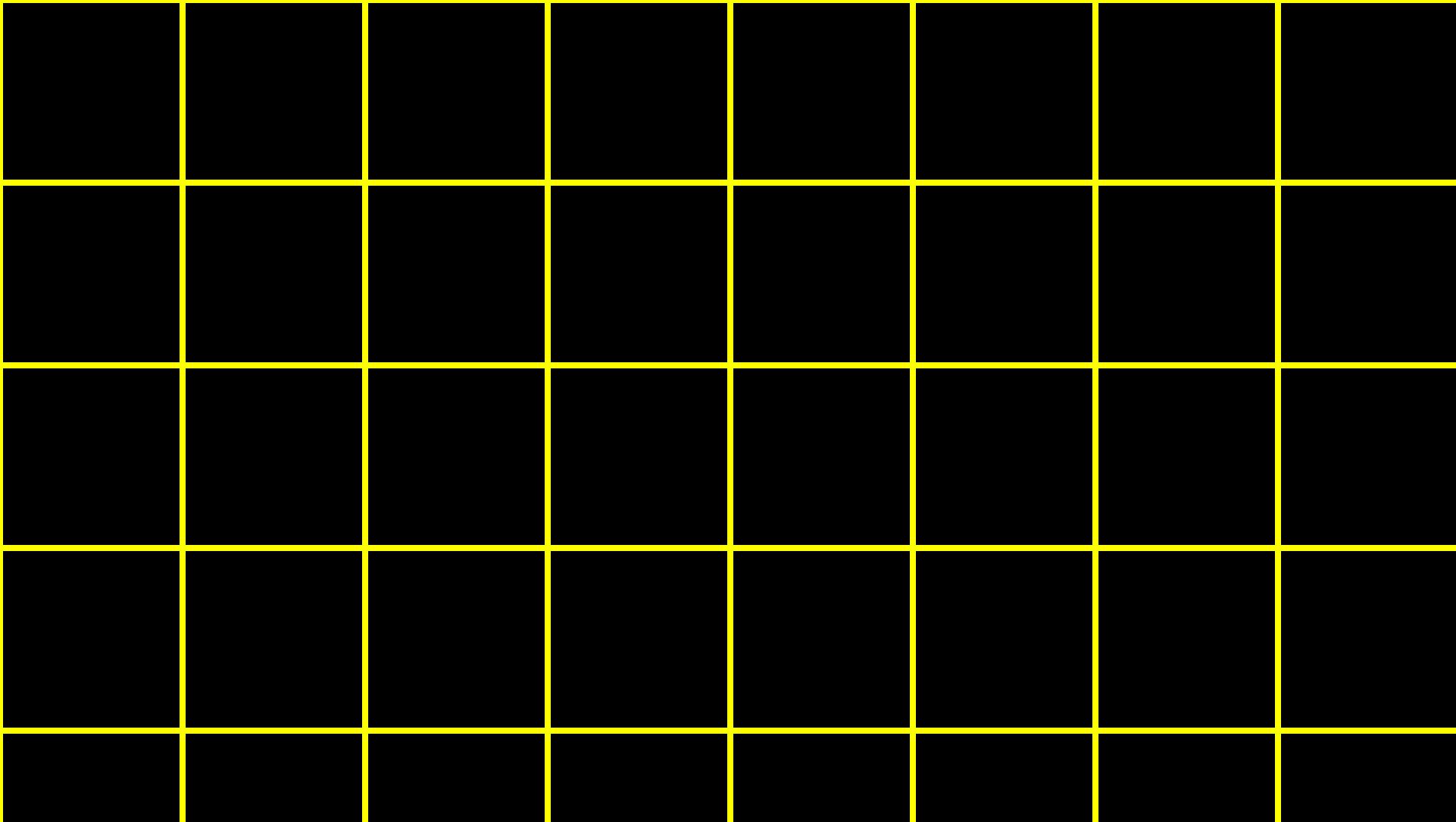




```
int score1 = 72;
```

```
int score2 = 73;
```

```
int score3 = 33;
```



72

score1

72

score1

73

score2

72

score1

73

score2

33

score3

score1

score2

score3

```
int score1 = 72;
```

```
int score2 = 73;
```

```
int score3 = 33;
```

arrays

```
int scores[3];
```

```
int scores[3];  
  
scores[0] = 72;  
  
scores[1] = 73;  
  
scores[2] = 33;
```

72

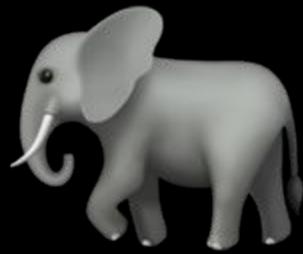
scores[0]

73

scores[1]

33

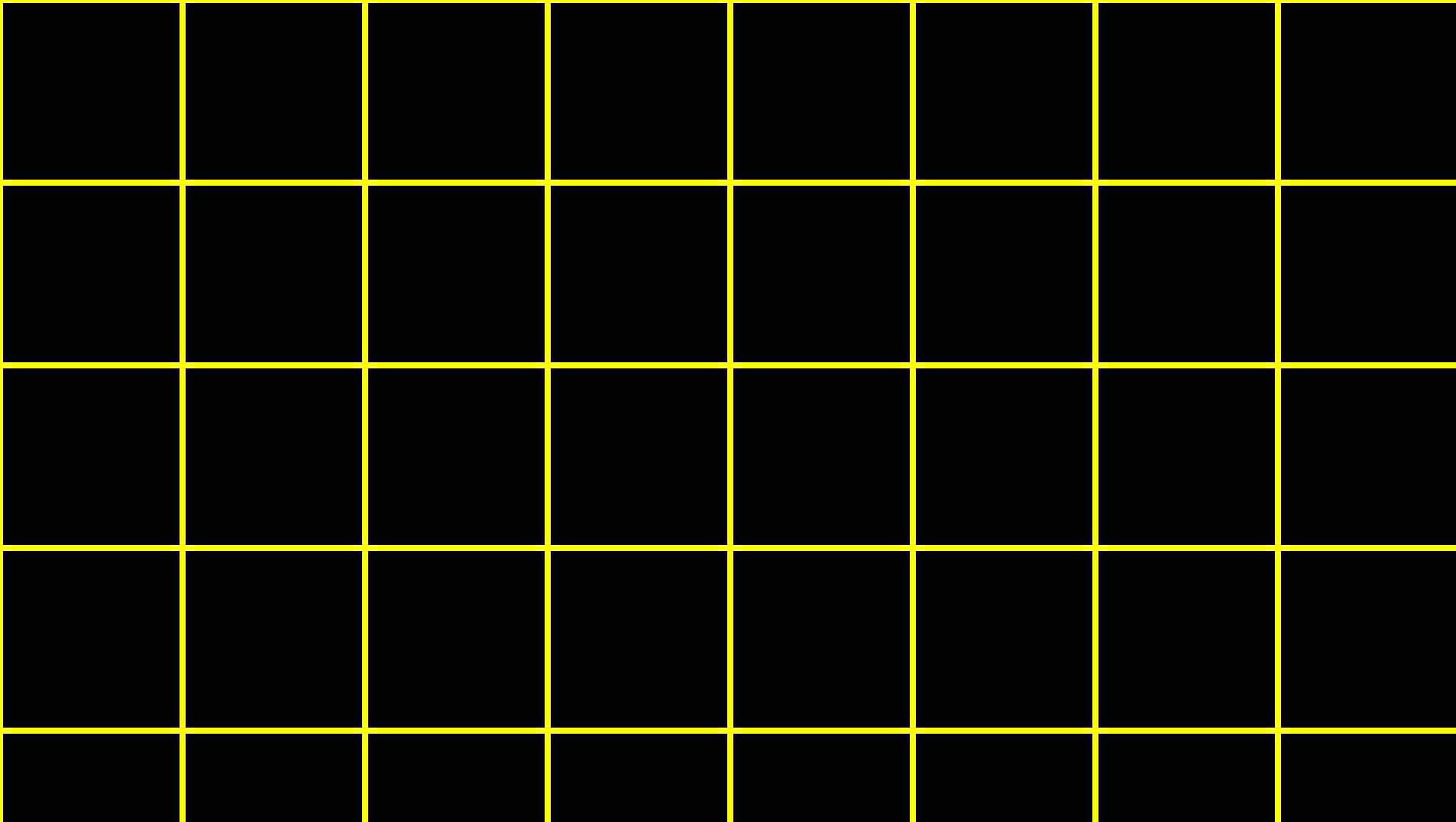
scores[2]



```
char c1 = 'H';
```

```
char c2 = 'I';
```

```
char c3 = '!';
```



H

c1

I

c2

!

c3

72

c1

73

c2

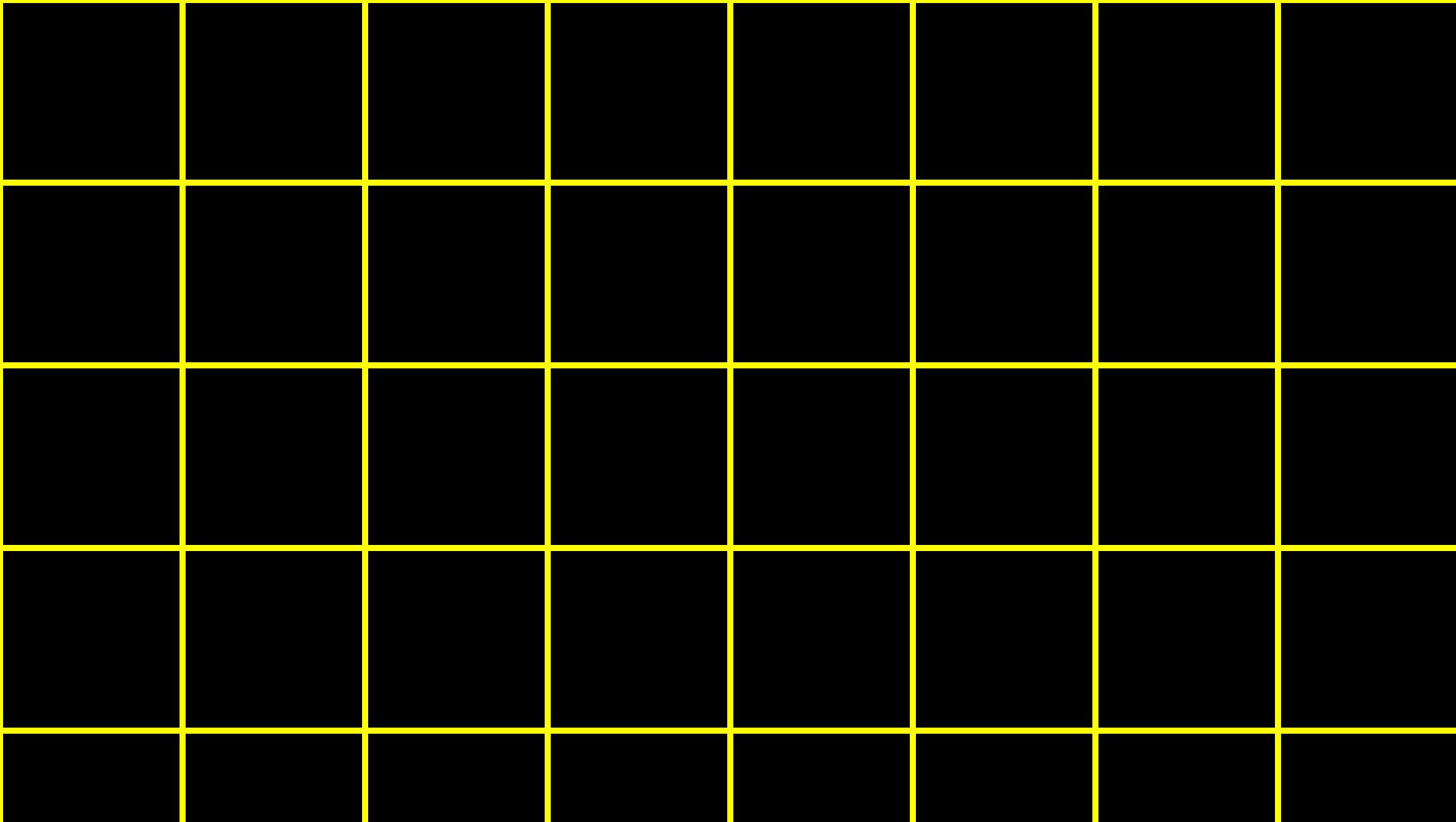
33

c3

|          |          |          |  |  |  |  |  |
|----------|----------|----------|--|--|--|--|--|
| 01001000 | 01001001 | 00100001 |  |  |  |  |  |
| c1       | c2       | c3       |  |  |  |  |  |
|          |          |          |  |  |  |  |  |
|          |          |          |  |  |  |  |  |

string

```
string s = "HI!";
```



H

I

!

s

H

s[0]

I

s[1]

!

s[2]

H

s[0]

I

s[1]

!

00000000

s[3]

H

s[0]

I

s[1]

!

s[2]

Ø

s[3]

H

s[0]

I

s[1]

!

s[2]

\theta

s[3]

72

s[0]

73

s[1]

33

s[2]

0

s[3]

H

I

!

\theta

s

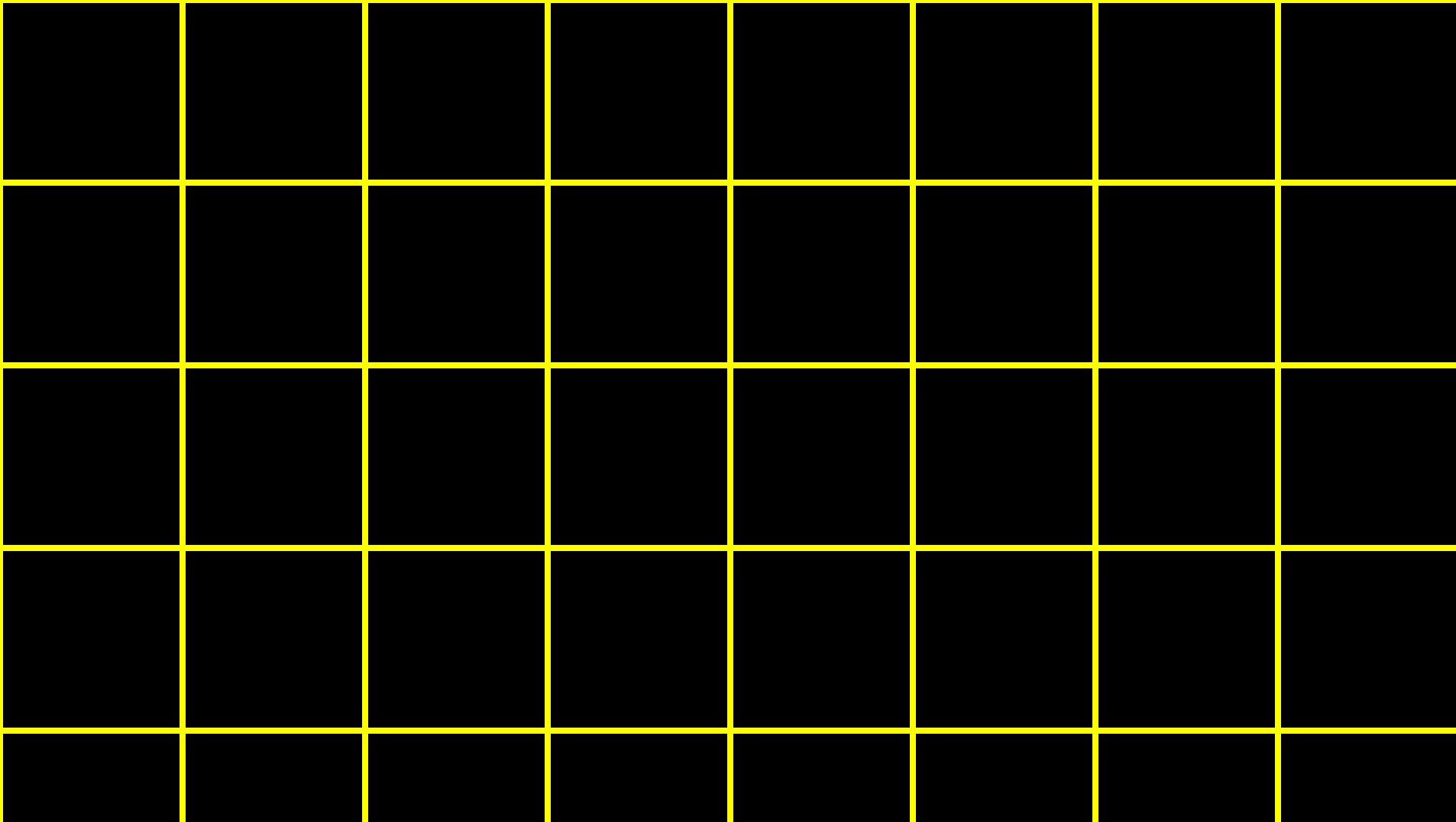
NUL

|    |            |    |            |    |           |    |   |    |   |    |   |     |   |     |            |
|----|------------|----|------------|----|-----------|----|---|----|---|----|---|-----|---|-----|------------|
| 0  | <u>NUL</u> | 16 | <u>DLE</u> | 32 | <u>SP</u> | 48 | 0 | 64 | @ | 80 | P | 96  | ` | 112 | p          |
| 1  | <u>SOH</u> | 17 | <u>DC1</u> | 33 | !         | 49 | 1 | 65 | A | 81 | Q | 97  | a | 113 | q          |
| 2  | <u>STX</u> | 18 | <u>DC2</u> | 34 | "         | 50 | 2 | 66 | B | 82 | R | 98  | b | 114 | r          |
| 3  | <u>ETX</u> | 19 | <u>DC3</u> | 35 | #         | 51 | 3 | 67 | C | 83 | S | 99  | c | 115 | s          |
| 4  | <u>EOT</u> | 20 | <u>DC4</u> | 36 | \$        | 52 | 4 | 68 | D | 84 | T | 100 | d | 116 | t          |
| 5  | <u>ENQ</u> | 21 | <u>NAK</u> | 37 | %         | 53 | 5 | 69 | E | 85 | U | 101 | e | 117 | u          |
| 6  | <u>ACK</u> | 22 | <u>SYN</u> | 38 | &         | 54 | 6 | 70 | F | 86 | V | 102 | f | 118 | v          |
| 7  | <u>BEL</u> | 23 | <u>ETB</u> | 39 | '         | 55 | 7 | 71 | G | 87 | W | 103 | g | 119 | w          |
| 8  | <u>BS</u>  | 24 | <u>CAN</u> | 40 | (         | 56 | 8 | 72 | H | 88 | X | 104 | h | 120 | x          |
| 9  | <u>HT</u>  | 25 | <u>EM</u>  | 41 | )         | 57 | 9 | 73 | I | 89 | Y | 105 | i | 121 | y          |
| 10 | <u>LF</u>  | 26 | <u>SUB</u> | 42 | *         | 58 | : | 74 | J | 90 | Z | 106 | j | 122 | z          |
| 11 | <u>VT</u>  | 27 | <u>ESC</u> | 43 | +         | 59 | ; | 75 | K | 91 | [ | 107 | k | 123 | {          |
| 12 | <u>FF</u>  | 28 | <u>FS</u>  | 44 | ,         | 60 | < | 76 | L | 92 | \ | 108 | l | 124 |            |
| 13 | <u>CR</u>  | 29 | <u>GS</u>  | 45 | -         | 61 | = | 77 | M | 93 | ] | 109 | m | 125 | }          |
| 14 | <u>SO</u>  | 30 | <u>RS</u>  | 46 | .         | 62 | > | 78 | N | 94 | ^ | 110 | n | 126 | ~          |
| 15 | <u>SI</u>  | 31 | <u>US</u>  | 47 | /         | 63 | ? | 79 | O | 95 | _ | 111 | o | 127 | <u>DEL</u> |

|    |            |    |            |    |           |    |   |    |   |    |   |     |   |     |            |
|----|------------|----|------------|----|-----------|----|---|----|---|----|---|-----|---|-----|------------|
| 0  | <u>NUL</u> | 16 | <u>DLE</u> | 32 | <u>SP</u> | 48 | 0 | 64 | @ | 80 | P | 96  | ` | 112 | p          |
| 1  | <u>SOH</u> | 17 | <u>DC1</u> | 33 | !         | 49 | 1 | 65 | A | 81 | Q | 97  | a | 113 | q          |
| 2  | <u>STX</u> | 18 | <u>DC2</u> | 34 | "         | 50 | 2 | 66 | B | 82 | R | 98  | b | 114 | r          |
| 3  | <u>ETX</u> | 19 | <u>DC3</u> | 35 | #         | 51 | 3 | 67 | C | 83 | S | 99  | c | 115 | s          |
| 4  | <u>EOT</u> | 20 | <u>DC4</u> | 36 | \$        | 52 | 4 | 68 | D | 84 | T | 100 | d | 116 | t          |
| 5  | <u>ENQ</u> | 21 | <u>NAK</u> | 37 | %         | 53 | 5 | 69 | E | 85 | U | 101 | e | 117 | u          |
| 6  | <u>ACK</u> | 22 | <u>SYN</u> | 38 | &         | 54 | 6 | 70 | F | 86 | V | 102 | f | 118 | v          |
| 7  | <u>BEL</u> | 23 | <u>ETB</u> | 39 | '         | 55 | 7 | 71 | G | 87 | W | 103 | g | 119 | w          |
| 8  | <u>BS</u>  | 24 | <u>CAN</u> | 40 | (         | 56 | 8 | 72 | H | 88 | X | 104 | h | 120 | x          |
| 9  | <u>HT</u>  | 25 | <u>EM</u>  | 41 | )         | 57 | 9 | 73 | I | 89 | Y | 105 | i | 121 | y          |
| 10 | <u>LF</u>  | 26 | <u>SUB</u> | 42 | *         | 58 | : | 74 | J | 90 | Z | 106 | j | 122 | z          |
| 11 | <u>VT</u>  | 27 | <u>ESC</u> | 43 | +         | 59 | ; | 75 | K | 91 | [ | 107 | k | 123 | {          |
| 12 | <u>FF</u>  | 28 | <u>FS</u>  | 44 | ,         | 60 | < | 76 | L | 92 | \ | 108 | l | 124 |            |
| 13 | <u>CR</u>  | 29 | <u>GS</u>  | 45 | -         | 61 | = | 77 | M | 93 | ] | 109 | m | 125 | }          |
| 14 | <u>SO</u>  | 30 | <u>RS</u>  | 46 | .         | 62 | > | 78 | N | 94 | ^ | 110 | n | 126 | ~          |
| 15 | <u>SI</u>  | 31 | <u>US</u>  | 47 | /         | 63 | ? | 79 | O | 95 | _ | 111 | o | 127 | <u>DEL</u> |

```
string s = "HI!";
```

```
string t = "BYE!";
```



H

I

!

\theta

s

H

I

!

\theta

s

B

Y

E

!

t

\theta

H

s[0]

I

s[1]

!

s[2]

\theta

s[3]

B

t[0]

Y

t[1]

E

t[2]

!

t[3]

\theta

t[4]

```
string words[2];  
  
words[0] = "HI!";  
  
words[1] = "BYE!";
```

H I ! \θ B Y E !

words[0]

words[1]

\θ

H

I

!

\0

B

Y

E

!

words[0][0]

words[0][1]

words[0][2]

words[0][3]

words[1][0]

words[1][1]

words[1][2]

words[1][3]

\0

words[1][4]

string

string.h

[manual.cs50.io/#string.h](https://manual.cs50.io/#string.h)

**strlen**

ctype.h

[manual.cs50.io/#ctype.h](https://manual.cs50.io/#ctype.h)

|    |            |    |            |    |           |    |   |    |   |    |   |     |   |     |            |
|----|------------|----|------------|----|-----------|----|---|----|---|----|---|-----|---|-----|------------|
| 0  | <u>NUL</u> | 16 | <u>DLE</u> | 32 | <u>SP</u> | 48 | 0 | 64 | @ | 80 | P | 96  | ` | 112 | p          |
| 1  | <u>SOH</u> | 17 | <u>DC1</u> | 33 | !         | 49 | 1 | 65 | A | 81 | Q | 97  | a | 113 | q          |
| 2  | <u>STX</u> | 18 | <u>DC2</u> | 34 | "         | 50 | 2 | 66 | B | 82 | R | 98  | b | 114 | r          |
| 3  | <u>ETX</u> | 19 | <u>DC3</u> | 35 | #         | 51 | 3 | 67 | C | 83 | S | 99  | c | 115 | s          |
| 4  | <u>EOT</u> | 20 | <u>DC4</u> | 36 | \$        | 52 | 4 | 68 | D | 84 | T | 100 | d | 116 | t          |
| 5  | <u>ENQ</u> | 21 | <u>NAK</u> | 37 | %         | 53 | 5 | 69 | E | 85 | U | 101 | e | 117 | u          |
| 6  | <u>ACK</u> | 22 | <u>SYN</u> | 38 | &         | 54 | 6 | 70 | F | 86 | V | 102 | f | 118 | v          |
| 7  | <u>BEL</u> | 23 | <u>ETB</u> | 39 | '         | 55 | 7 | 71 | G | 87 | W | 103 | g | 119 | w          |
| 8  | <u>BS</u>  | 24 | <u>CAN</u> | 40 | (         | 56 | 8 | 72 | H | 88 | X | 104 | h | 120 | x          |
| 9  | <u>HT</u>  | 25 | <u>EM</u>  | 41 | )         | 57 | 9 | 73 | I | 89 | Y | 105 | i | 121 | y          |
| 10 | <u>LF</u>  | 26 | <u>SUB</u> | 42 | *         | 58 | : | 74 | J | 90 | Z | 106 | j | 122 | z          |
| 11 | <u>VT</u>  | 27 | <u>ESC</u> | 43 | +         | 59 | ; | 75 | K | 91 | [ | 107 | k | 123 | {          |
| 12 | <u>FF</u>  | 28 | <u>FS</u>  | 44 | ,         | 60 | < | 76 | L | 92 | \ | 108 | l | 124 |            |
| 13 | <u>CR</u>  | 29 | <u>GS</u>  | 45 | -         | 61 | = | 77 | M | 93 | ] | 109 | m | 125 | }          |
| 14 | <u>SO</u>  | 30 | <u>RS</u>  | 46 | .         | 62 | > | 78 | N | 94 | ^ | 110 | n | 126 | ~          |
| 15 | <u>SI</u>  | 31 | <u>US</u>  | 47 | /         | 63 | ? | 79 | O | 95 | _ | 111 | o | 127 | <u>DEL</u> |

|    |            |    |            |    |           |    |   |    |   |    |   |     |   |     |            |
|----|------------|----|------------|----|-----------|----|---|----|---|----|---|-----|---|-----|------------|
| 0  | <u>NUL</u> | 16 | <u>DLE</u> | 32 | <u>SP</u> | 48 | 0 | 64 | @ | 80 | P | 96  | ` | 112 | p          |
| 1  | <u>SOH</u> | 17 | <u>DC1</u> | 33 | !         | 49 | 1 | 65 | A | 81 | Q | 97  | a | 113 | q          |
| 2  | <u>STX</u> | 18 | <u>DC2</u> | 34 | "         | 50 | 2 | 66 | B | 82 | R | 98  | b | 114 | r          |
| 3  | <u>ETX</u> | 19 | <u>DC3</u> | 35 | #         | 51 | 3 | 67 | C | 83 | S | 99  | c | 115 | s          |
| 4  | <u>EOT</u> | 20 | <u>DC4</u> | 36 | \$        | 52 | 4 | 68 | D | 84 | T | 100 | d | 116 | t          |
| 5  | <u>ENQ</u> | 21 | <u>NAK</u> | 37 | %         | 53 | 5 | 69 | E | 85 | U | 101 | e | 117 | u          |
| 6  | <u>ACK</u> | 22 | <u>SYN</u> | 38 | &         | 54 | 6 | 70 | F | 86 | V | 102 | f | 118 | v          |
| 7  | <u>BEL</u> | 23 | <u>ETB</u> | 39 | '         | 55 | 7 | 71 | G | 87 | W | 103 | g | 119 | w          |
| 8  | <u>BS</u>  | 24 | <u>CAN</u> | 40 | (         | 56 | 8 | 72 | H | 88 | X | 104 | h | 120 | x          |
| 9  | <u>HT</u>  | 25 | <u>EM</u>  | 41 | )         | 57 | 9 | 73 | I | 89 | Y | 105 | i | 121 | y          |
| 10 | <u>LF</u>  | 26 | <u>SUB</u> | 42 | *         | 58 | : | 74 | J | 90 | Z | 106 | j | 122 | z          |
| 11 | <u>VT</u>  | 27 | <u>ESC</u> | 43 | +         | 59 | ; | 75 | K | 91 | [ | 107 | k | 123 | {          |
| 12 | <u>FF</u>  | 28 | <u>FS</u>  | 44 | ,         | 60 | < | 76 | L | 92 | \ | 108 | l | 124 |            |
| 13 | <u>CR</u>  | 29 | <u>GS</u>  | 45 | -         | 61 | = | 77 | M | 93 | ] | 109 | m | 125 | }          |
| 14 | <u>SO</u>  | 30 | <u>RS</u>  | 46 | .         | 62 | > | 78 | N | 94 | ^ | 110 | n | 126 | ~          |
| 15 | <u>SI</u>  | 31 | <u>US</u>  | 47 | /         | 63 | ? | 79 | O | 95 | _ | 111 | o | 127 | <u>DEL</u> |

# command-line arguments

```
#include <stdio.h>

int main(void)
{
    ...
}
```

```
#include <stdio.h>

int main(void)
{
    ...
}
```

```
#include <stdio.h>

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

# ASCII art

cowsay

exit status



Zoom



## An unknown error occurred

Error code: 1132

[Report Problem](#)

OK

# 404

This is not the  
web page you  
are looking for.



```
#include <stdio.h>

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

```
#include <stdio.h>

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

```
#include <stdio.h>

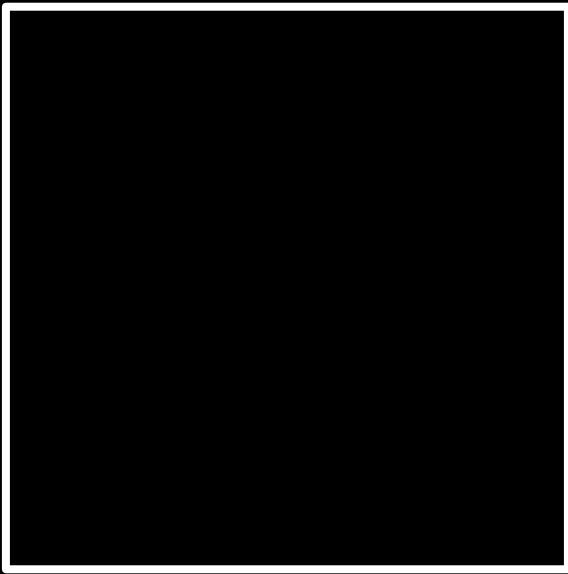
int main(void)
{
    ...
}
```

echo \$?

cryptography

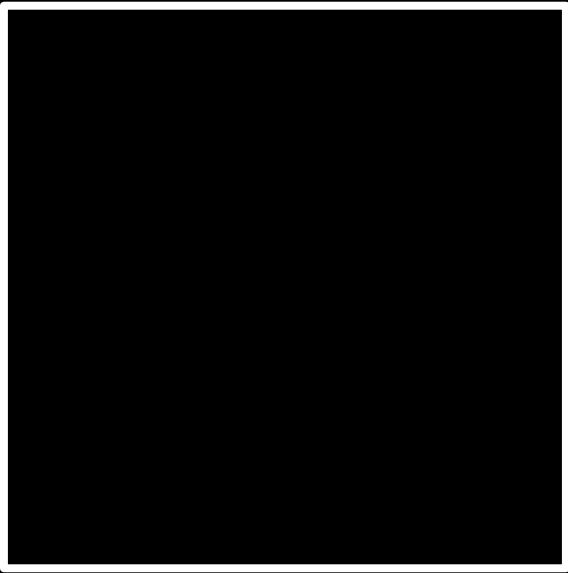
encryption

input →



→ output

plaintext →



→ ciphertext

plaintext →

cipher

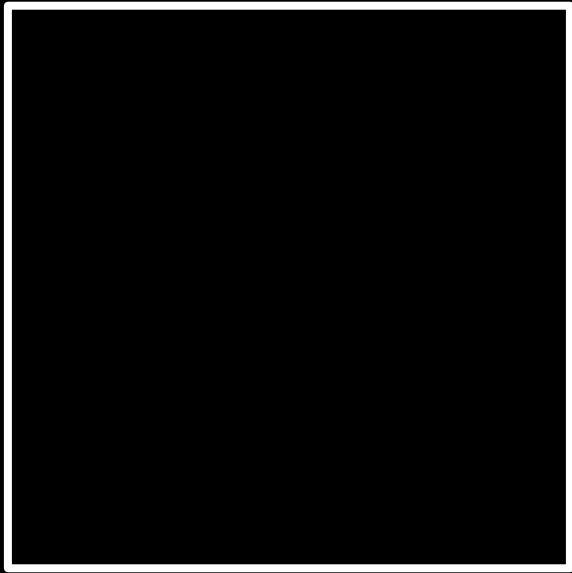
→ ciphertext

key →

plaintext → cipher → ciphertext

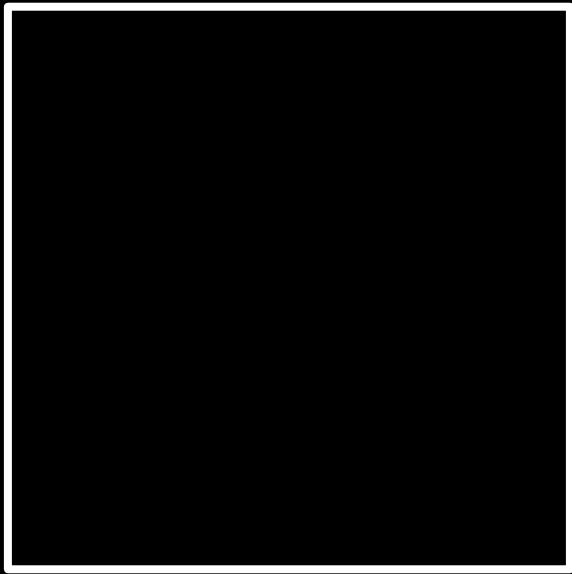
1 →

HI! →



$1 \rightarrow$

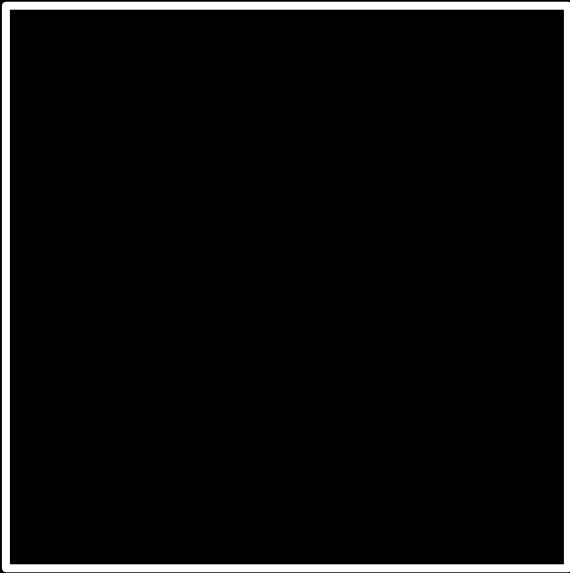
$H! \rightarrow$



$\rightarrow IJ!$

13 →

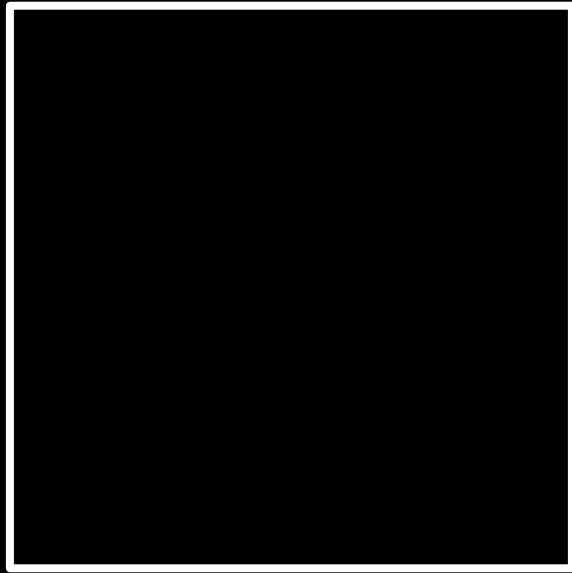
H! →



→ UV!

13 →

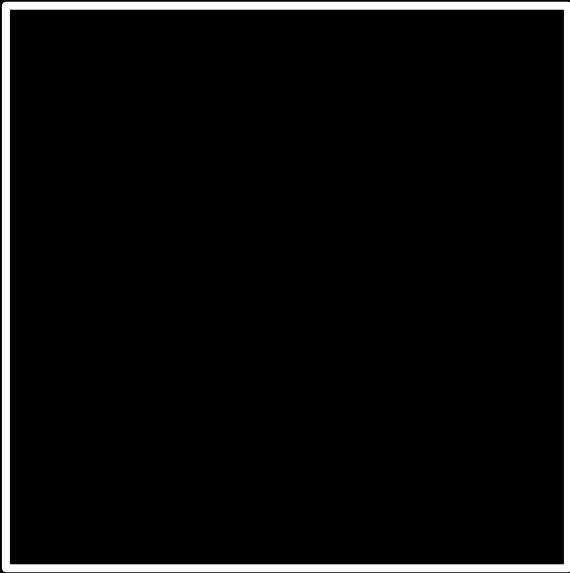
I LOVE YOU →



→ V YBIR LBH

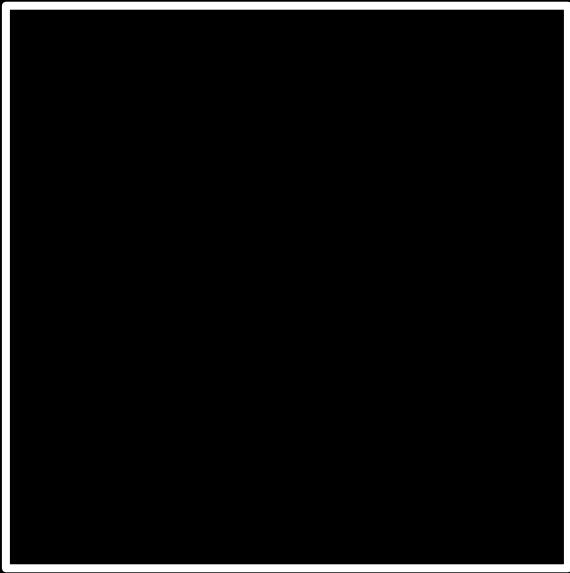
26 →

I LOVE YOU →



26 →

I LOVE YOU →

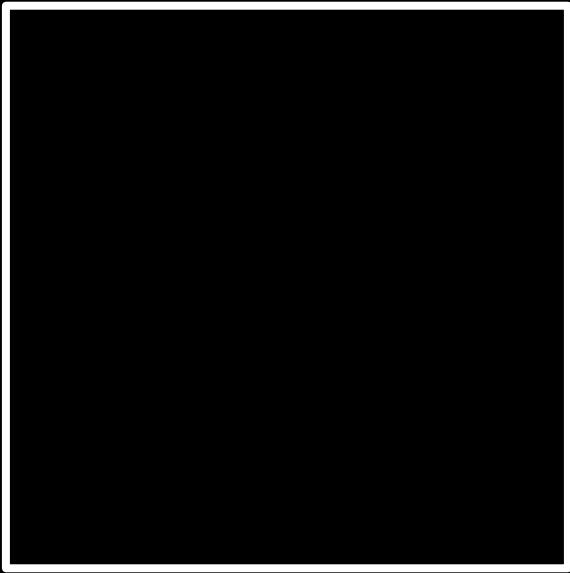


→ I LOVE YOU

decryption

-1 →

UIJT XBT DT50 →



U I J T X B T D T 5 θ

T I J T X B T D T 5 θ

T H J T X B T D T 5 θ

T H I T X B T D T 5 0

T H I S X B T D T 5 0

T H I S W B T D T 5 0

T H I S W A T D T 5 0

T H I S W A S D T 5 0

T H I S W A S C T 5 0

T H I S W A S C S 5 0



This is CS50