This is CS50

Week 4

Today

- What are **pointers**? Why use them?
- How can we read from (and write to) **files**?
- Problem Set 4

Pointers

(And why to use them)

`calls`

A **variable** is a name for some value that can change.

Address	Value
0x50000000	...
0x50000004	...
0x50000008	...
0x5000000C	...

Address	Value
0x50000000	3
0x50000004	...
0x50000008	...
0x5000000C	...

Address	Value
0x50000000	3
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```
int calls = 3;
```

Address	Value
0x50000000	3
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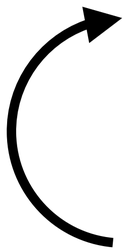

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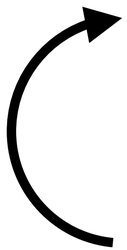

```
int calls = 3;
```

```
int *p = &calls;
```

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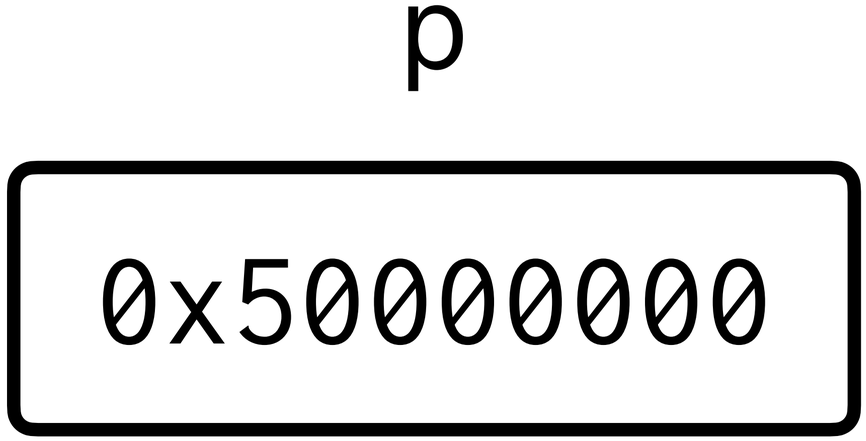
```



```
int *p = &calls;
```

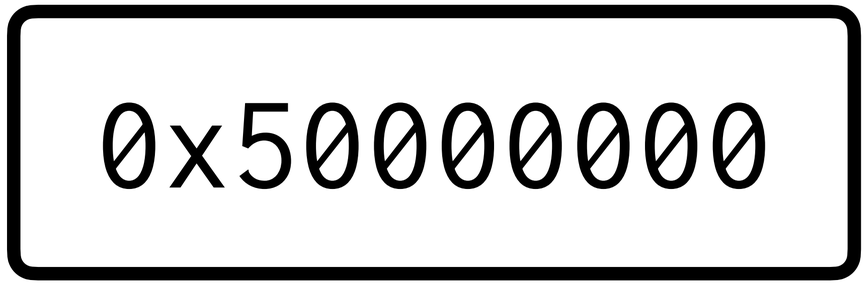
name

p

0x50000000

```
int *p = &calls;
```

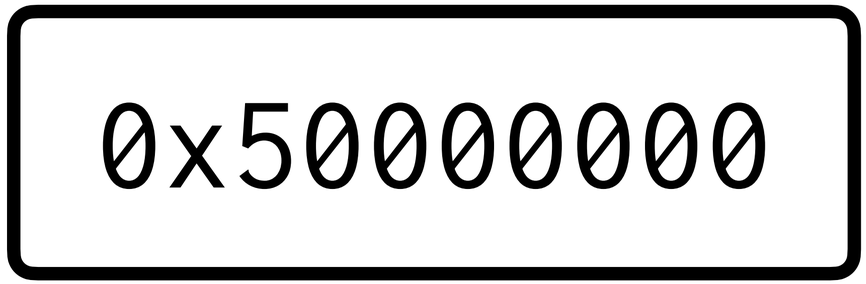
type



```
int *p = &calls;
```

value

p



Key Syntax

- **type** * is a pointer that stores the address of a **type**
- ***x** takes a pointer **x** and gets the value stored at that address.
- **&x** takes **x** and gets its address.

Reasons to Use Pointers

- You can pass variables to functions **by reference**, not just **by copy**.
- You can use **dynamic memory** (e.g., with `malloc`).

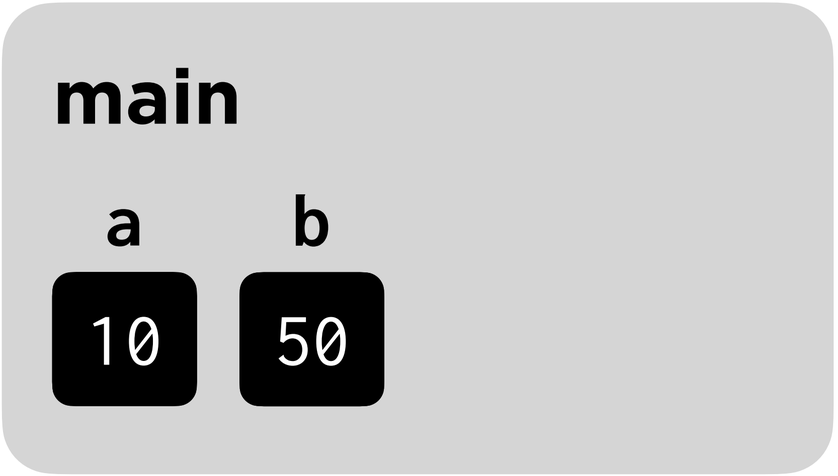
Reasons to Use Pointers

- You can pass variables to functions **by reference**, not just **by copy**. *The code you write is cleaner as a result.*
- You can use **dynamic memory** (e.g., with `malloc`). *Your programs can now scale their usage of memory according to user behavior.*

Passing by Copy
vs. Passing by Reference

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

void swap(int a, int b)
{
    int temp = a;
    a = b;
    b = temp;
}
```



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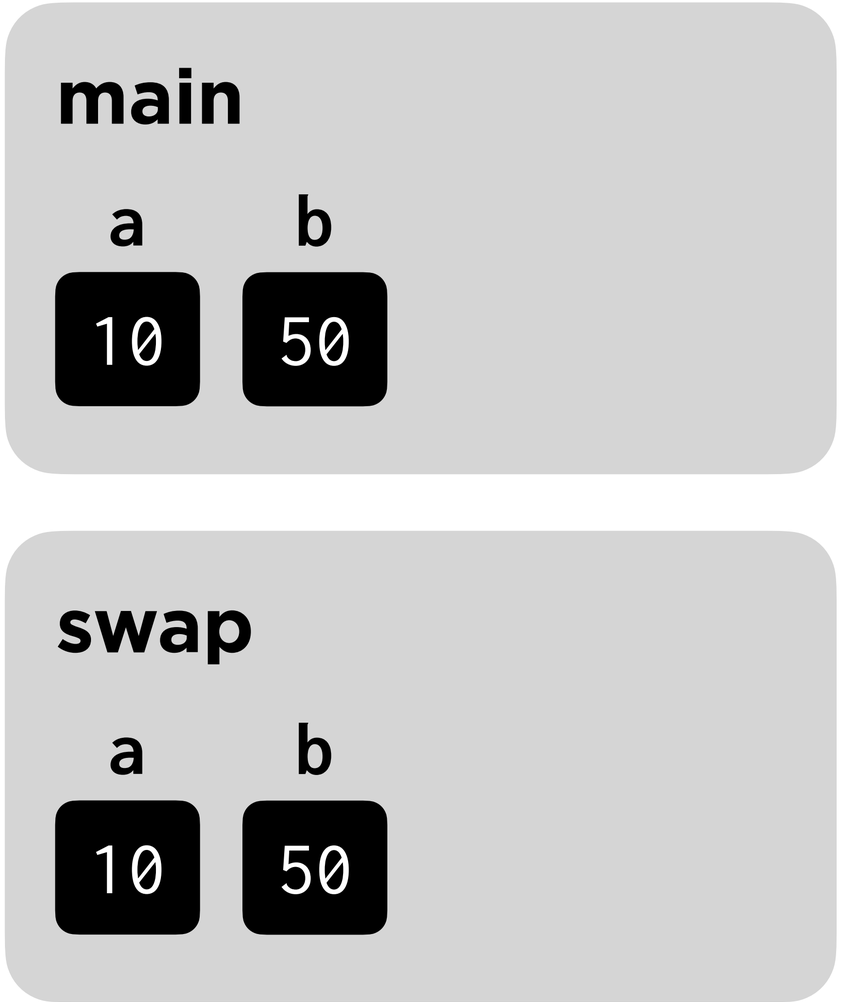

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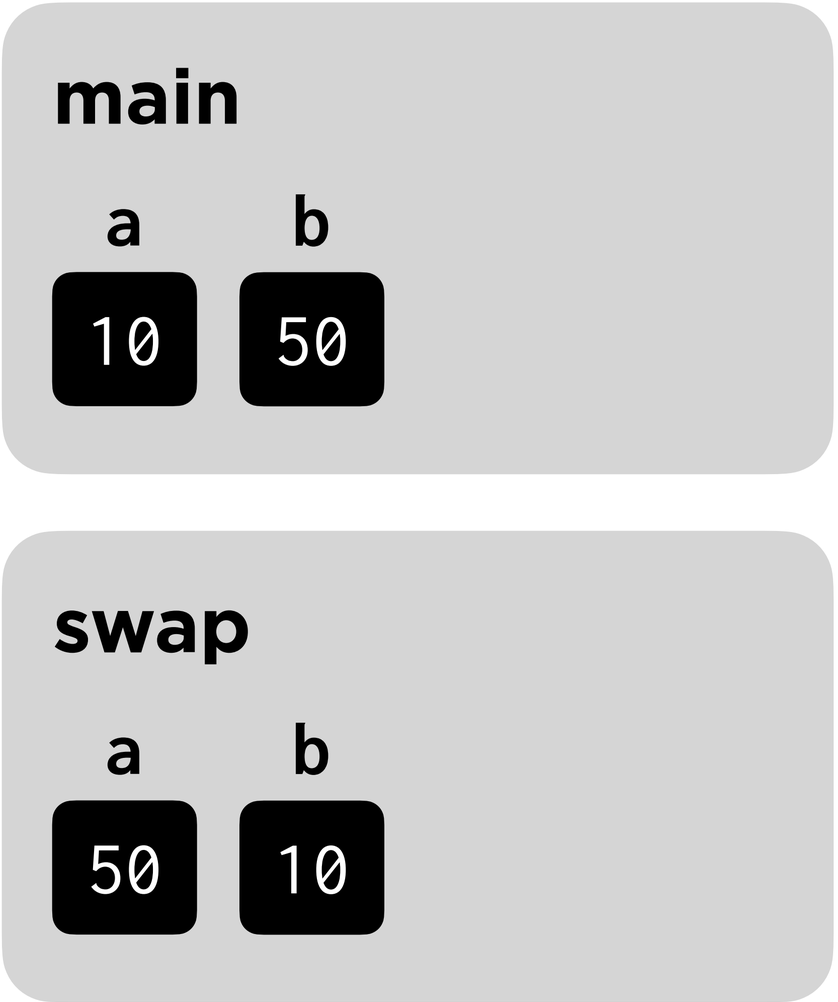

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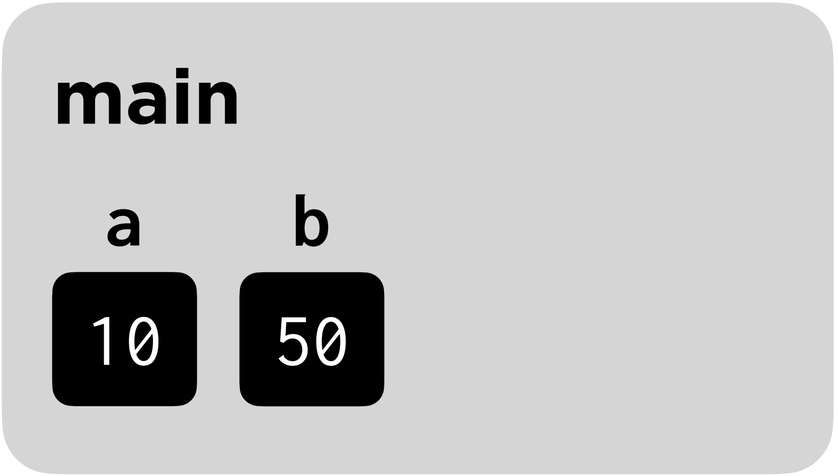

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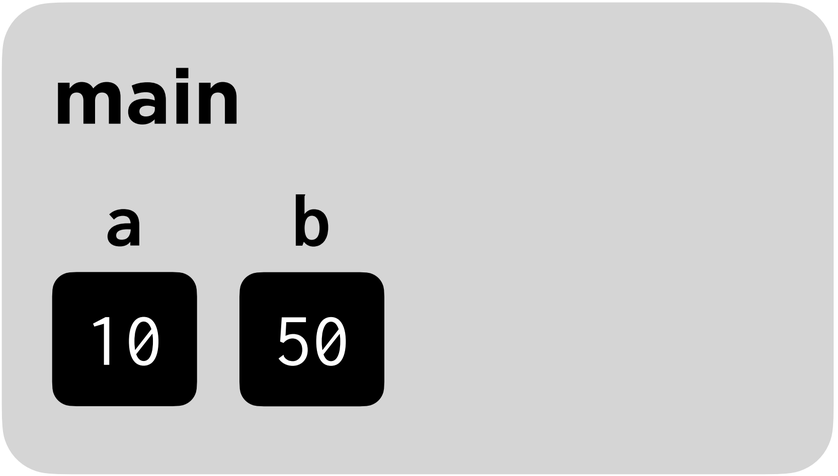

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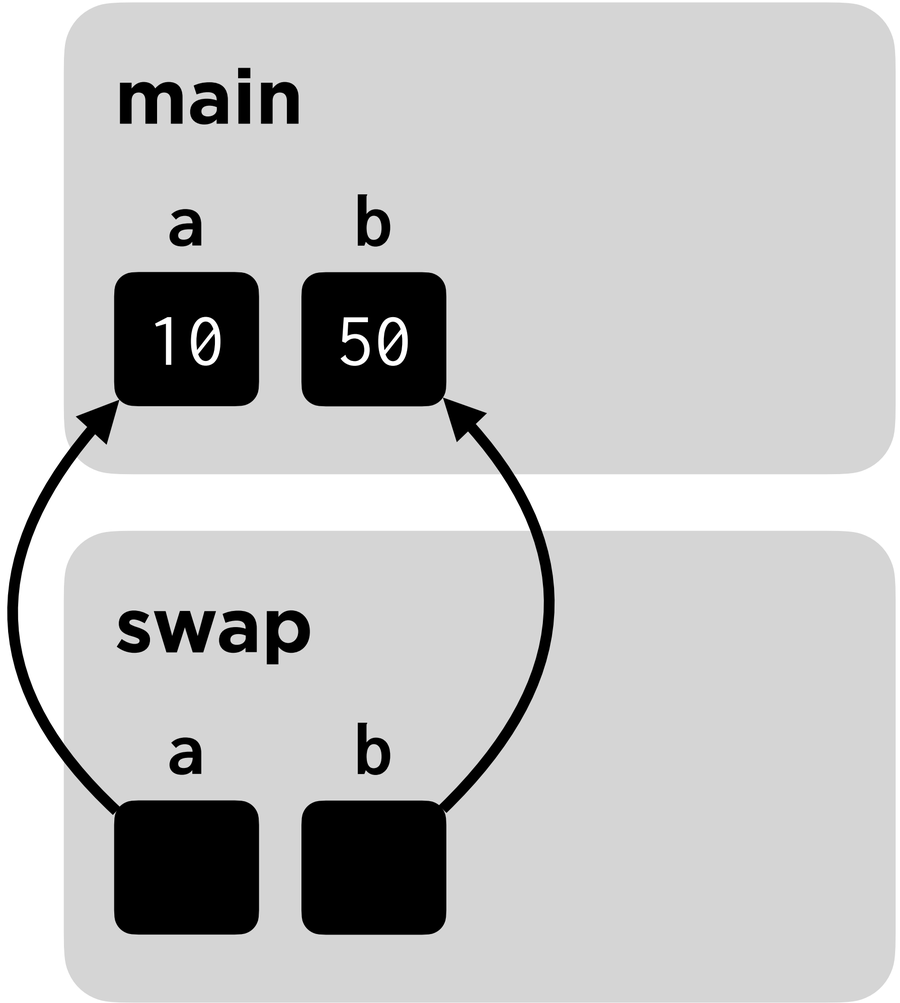

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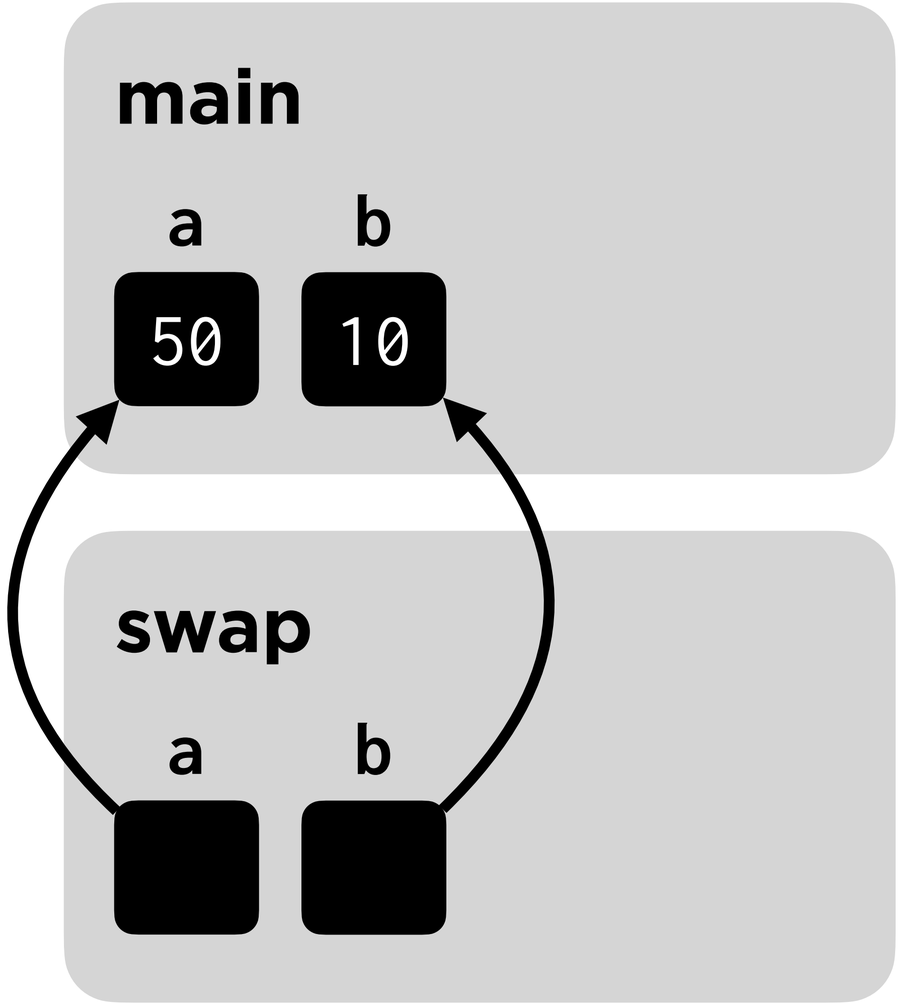


File I/O

Reading data from (and writing data to) files

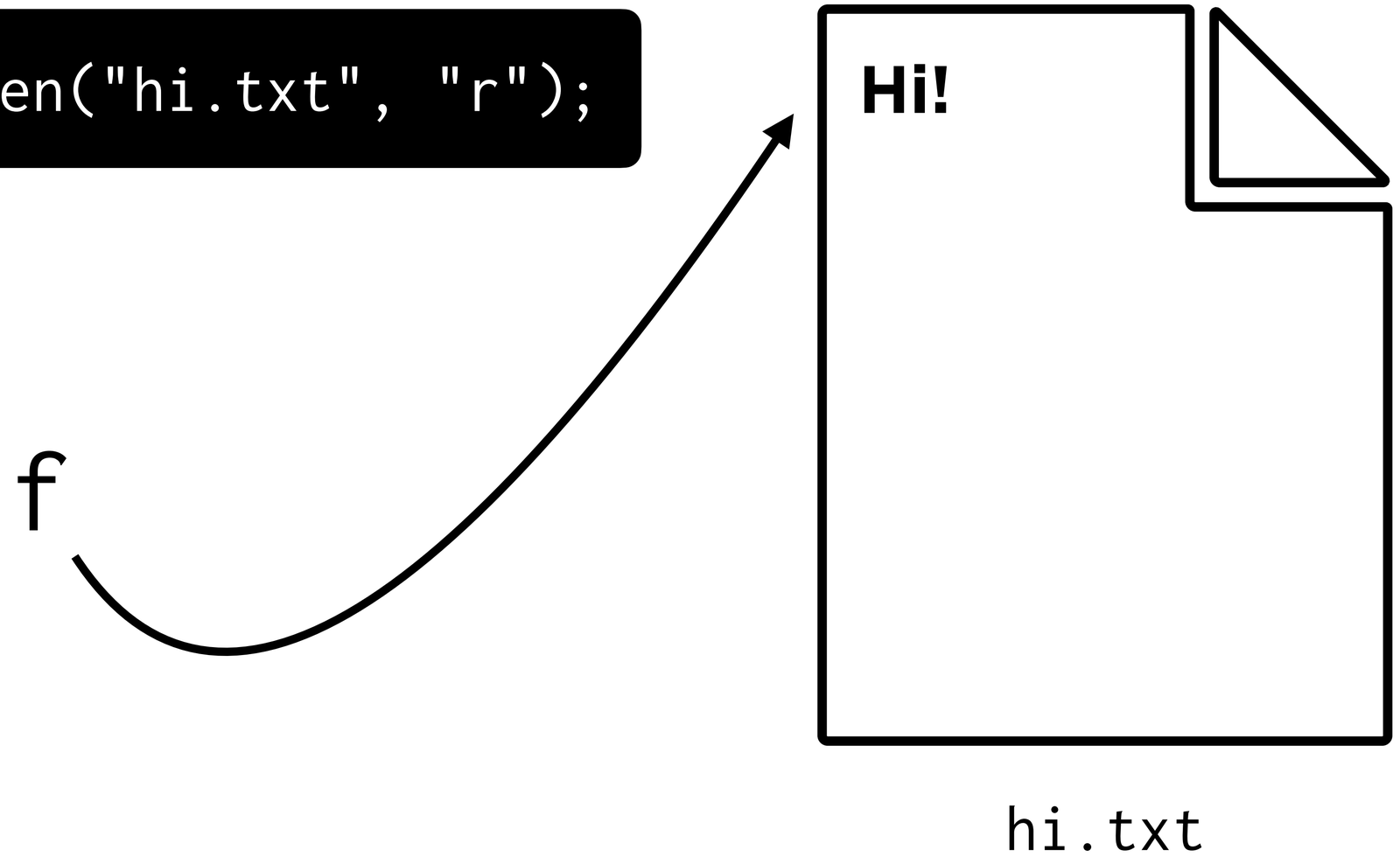
Opening and Closing Files

Key Functions

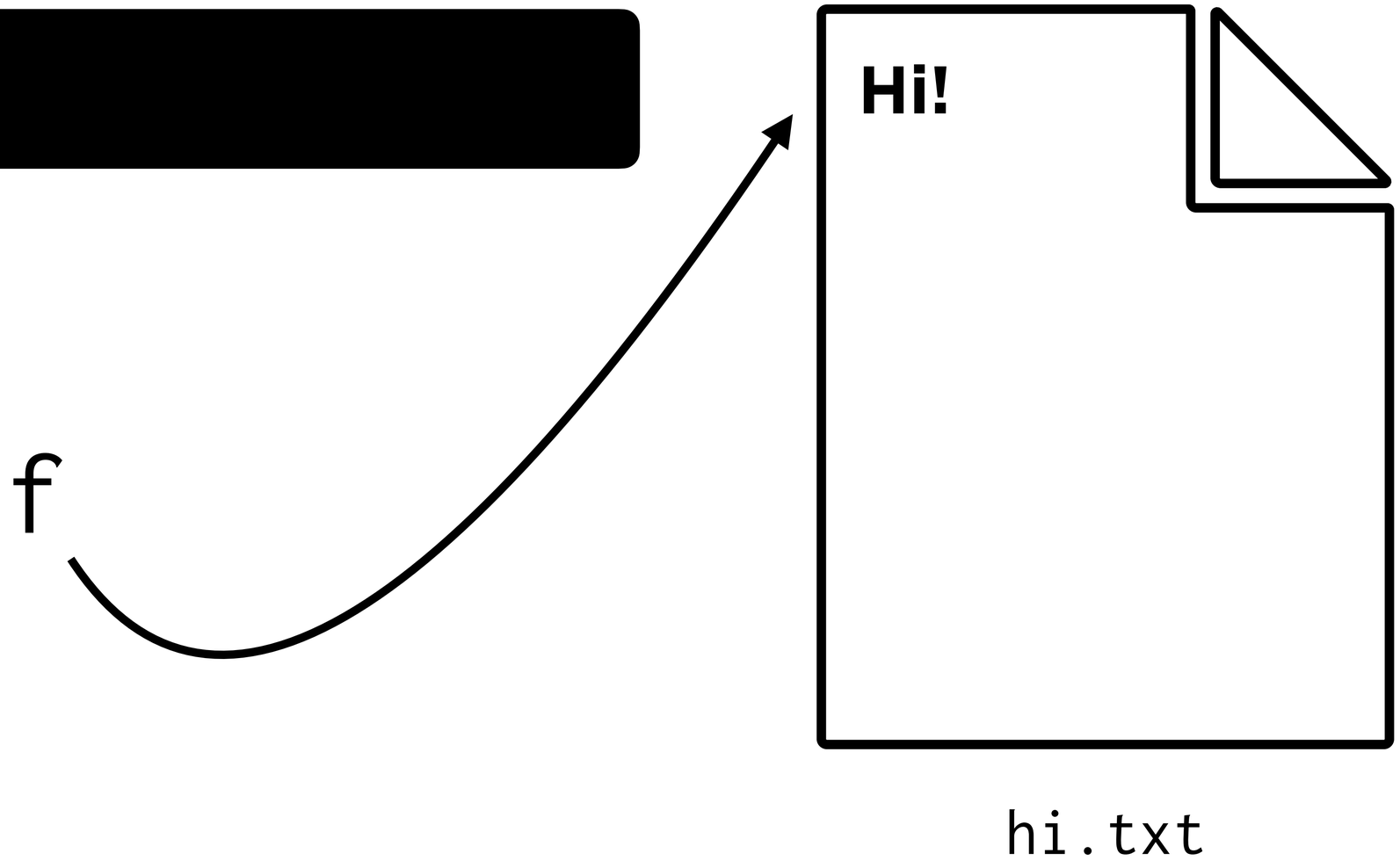
- **fopen** opens a file for future reading/writing.
- **fclose** closes a file.

Always **fclose** all files you **fopen**!

```
FILE *f = fopen("hi.txt", "r");
```

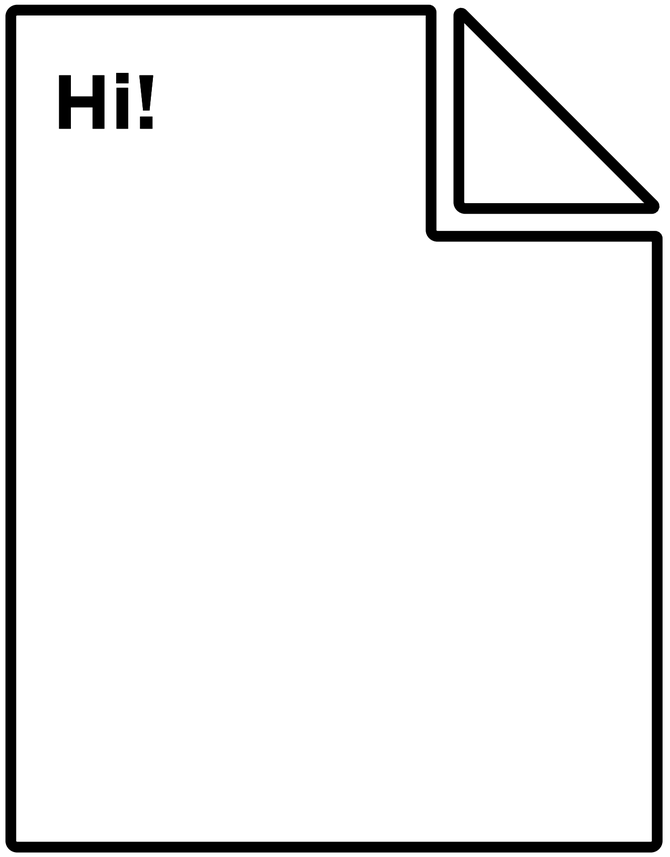


```
fclose(f);
```



Reading and Writing

text

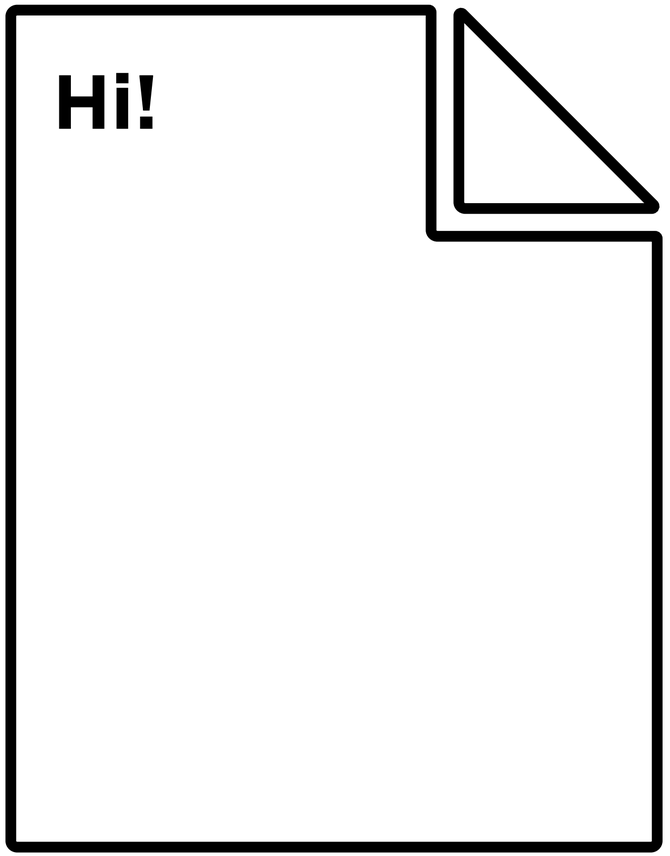


hi.txt

Reading data

text

Hi!

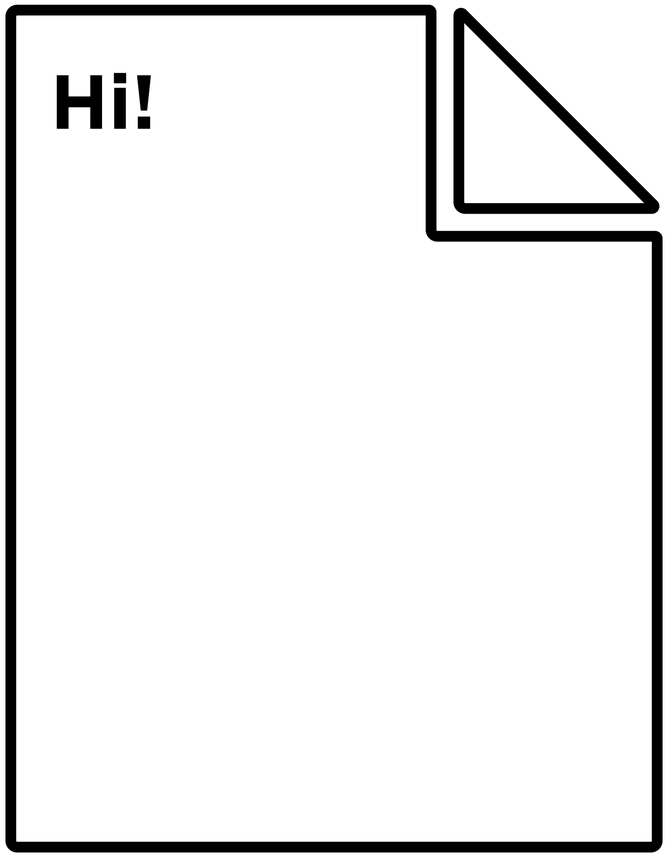


hi.txt

Reading data

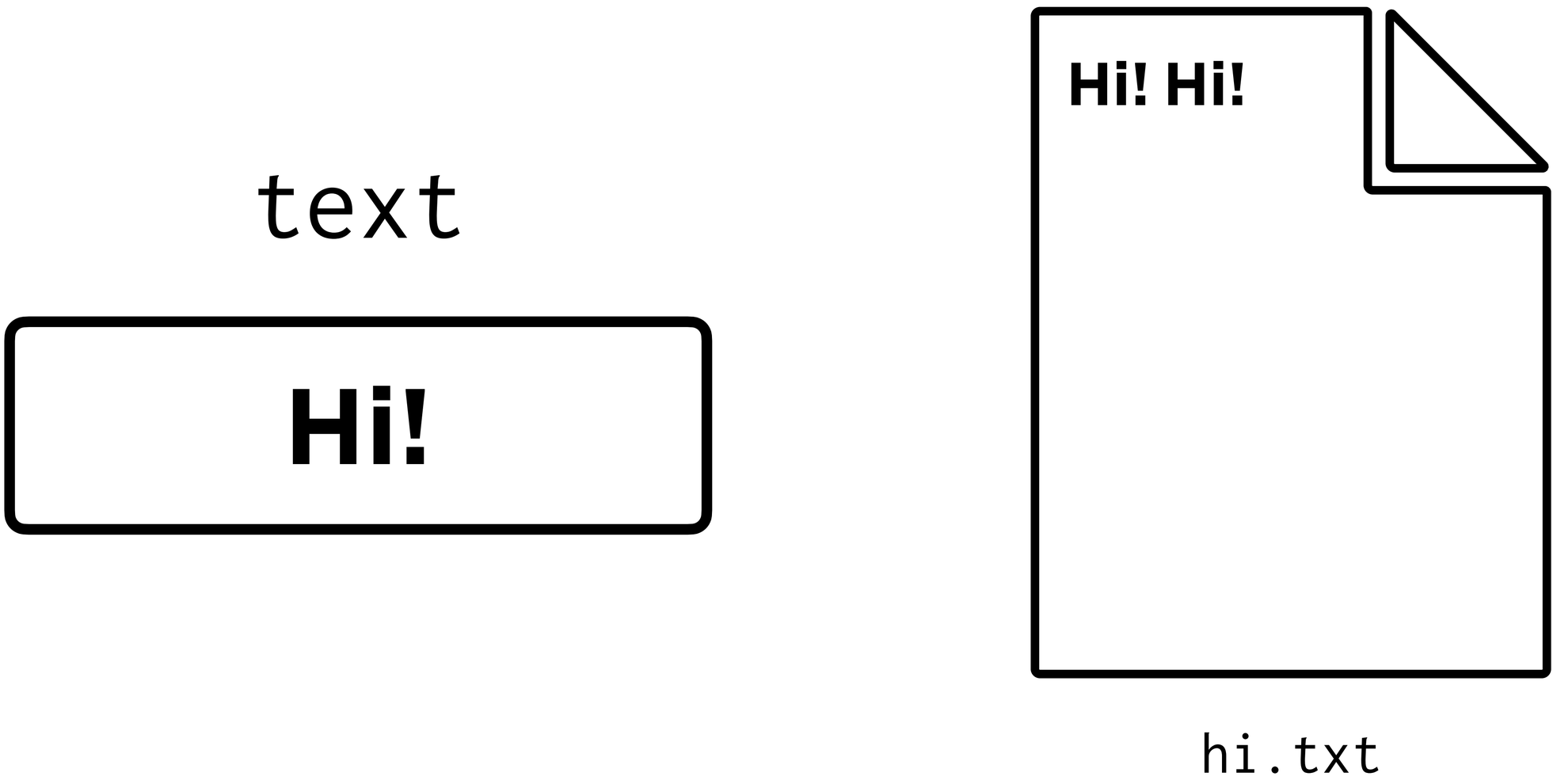
text

Hi!



hi.txt

Writing data



Writing data

Key Functions

- **fread** reads data from a file into a buffer*.
- **fwrite** writes data from a buffer* to a file.

*a buffer is a chunk of memory that can temporarily store some data from the file.

Thought Question

- If we want to read an entire file, why use a buffer?

Thought Question

- If we want to read an entire file, why use a buffer?
- Or, why might you *not* want to read the entire file into memory at once?

Reading from a File

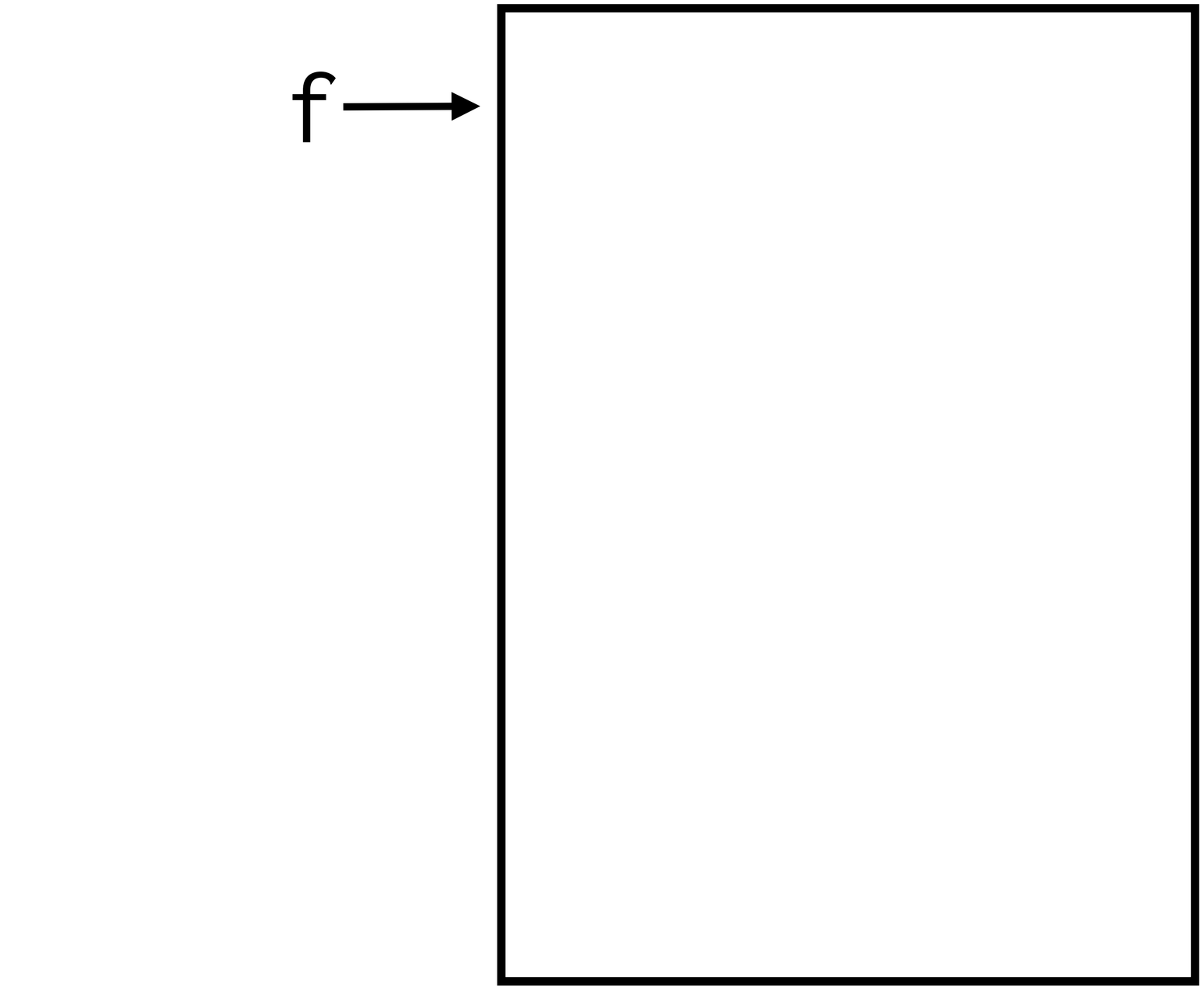
Questions to Answer

- **From where** are you reading?
- **To where** are you reading?

```
fread(..., ..., ..., ...);
```

```
fread(..., ..., ..., ...);
```

From where?


f

```
fread(..., ..., ..., f);
```

```
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```
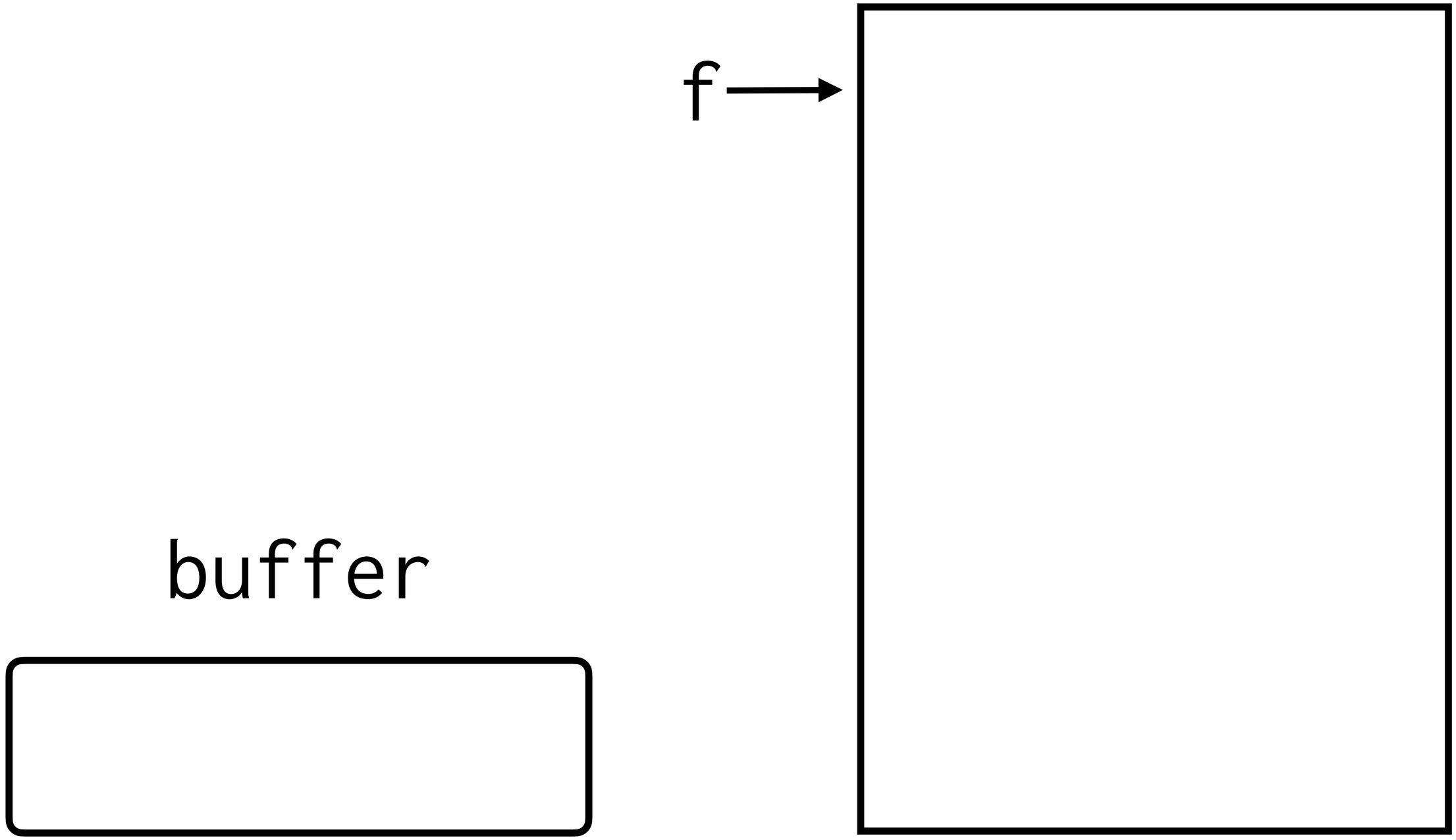
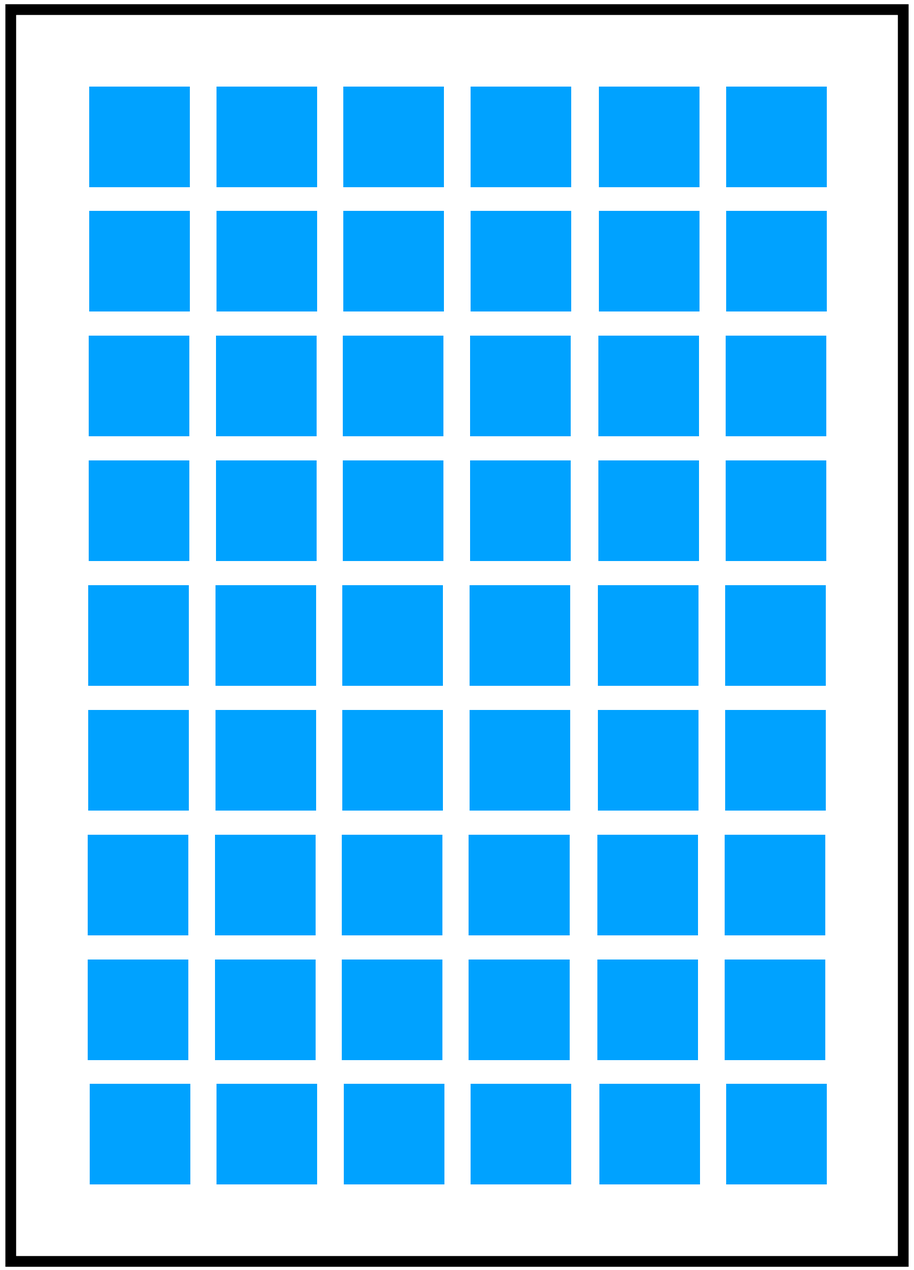

To where?

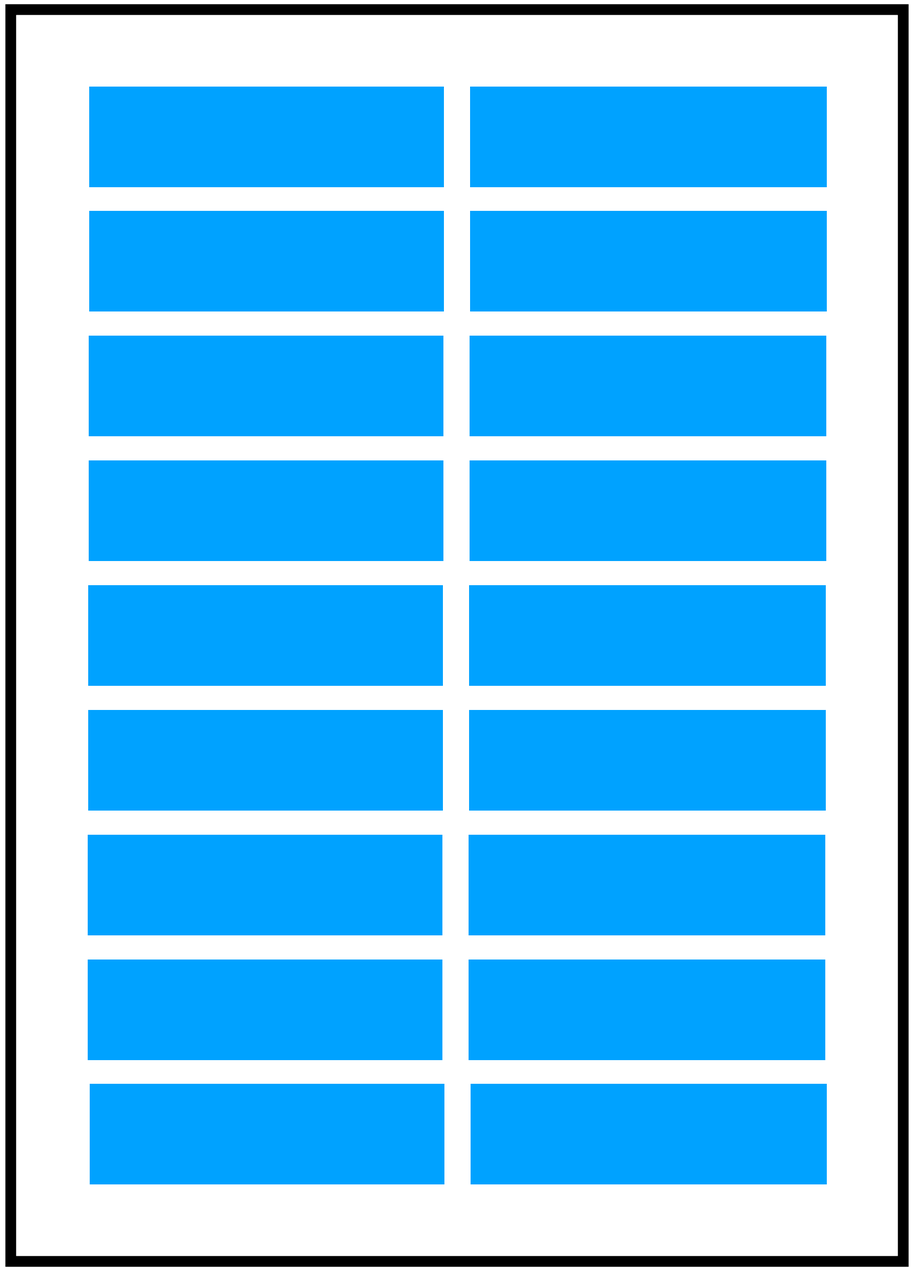

f
buffer

```
fread(buffer, ..., ..., f);
```

Questions to Answer

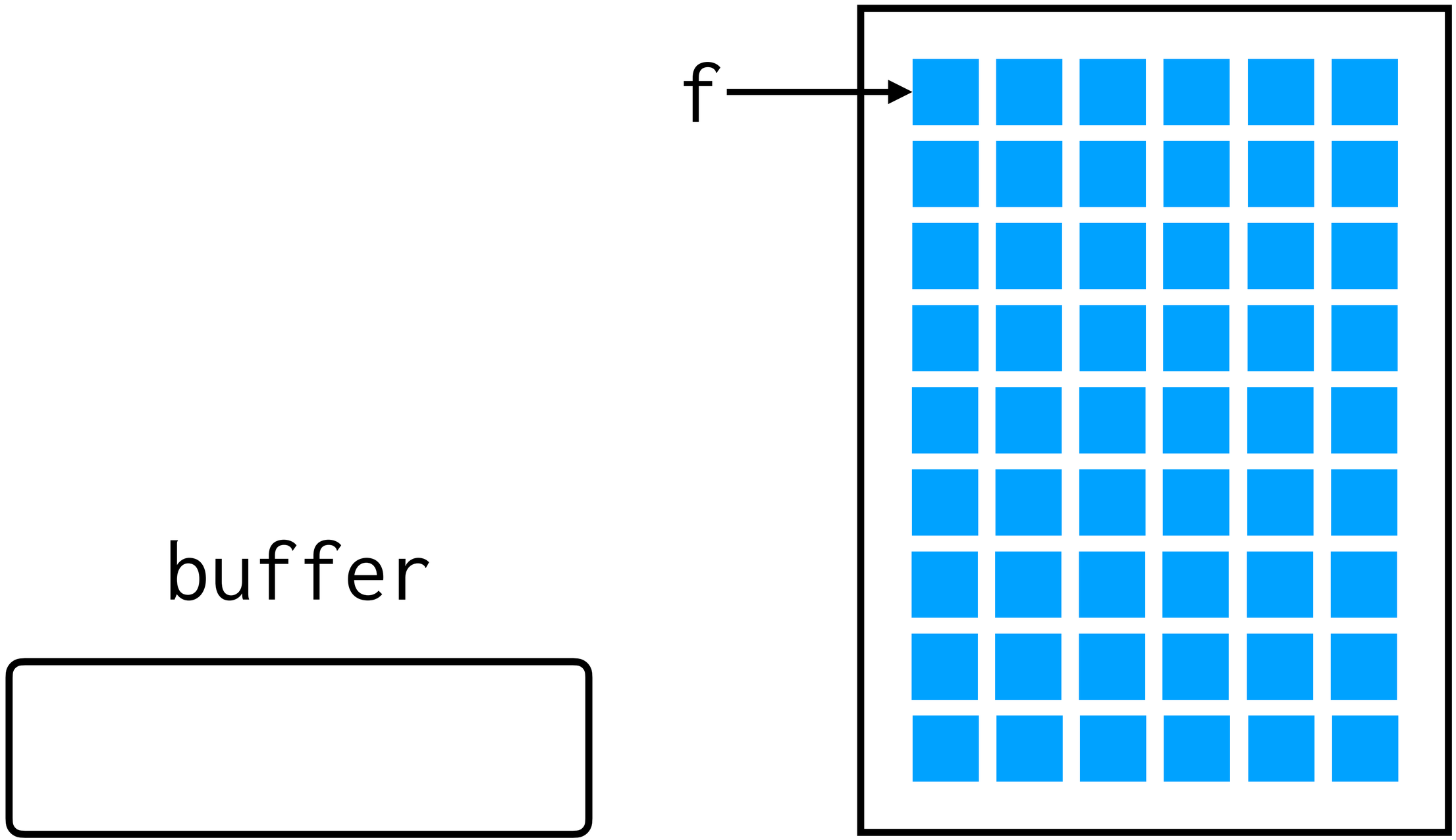
- **What size** is each block of data you want to read?
- **How many** blocks do you want to read?





```
fread(buffer, ..., ..., f);
```

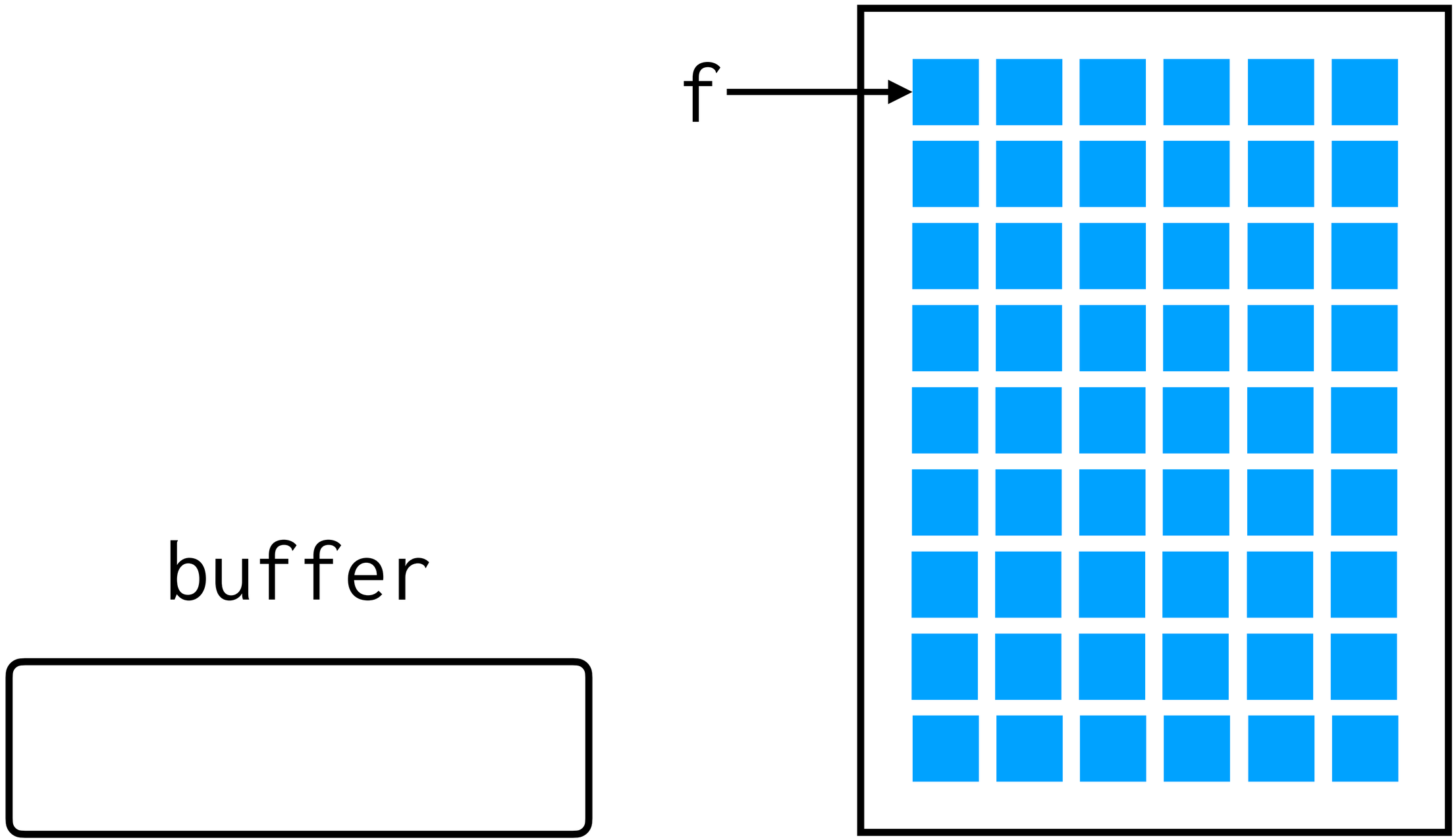
What size?


f
buffer

```
fread(buffer, 1, ..., f);
```

```
fread(buffer, 1, ..., f);
```

How many?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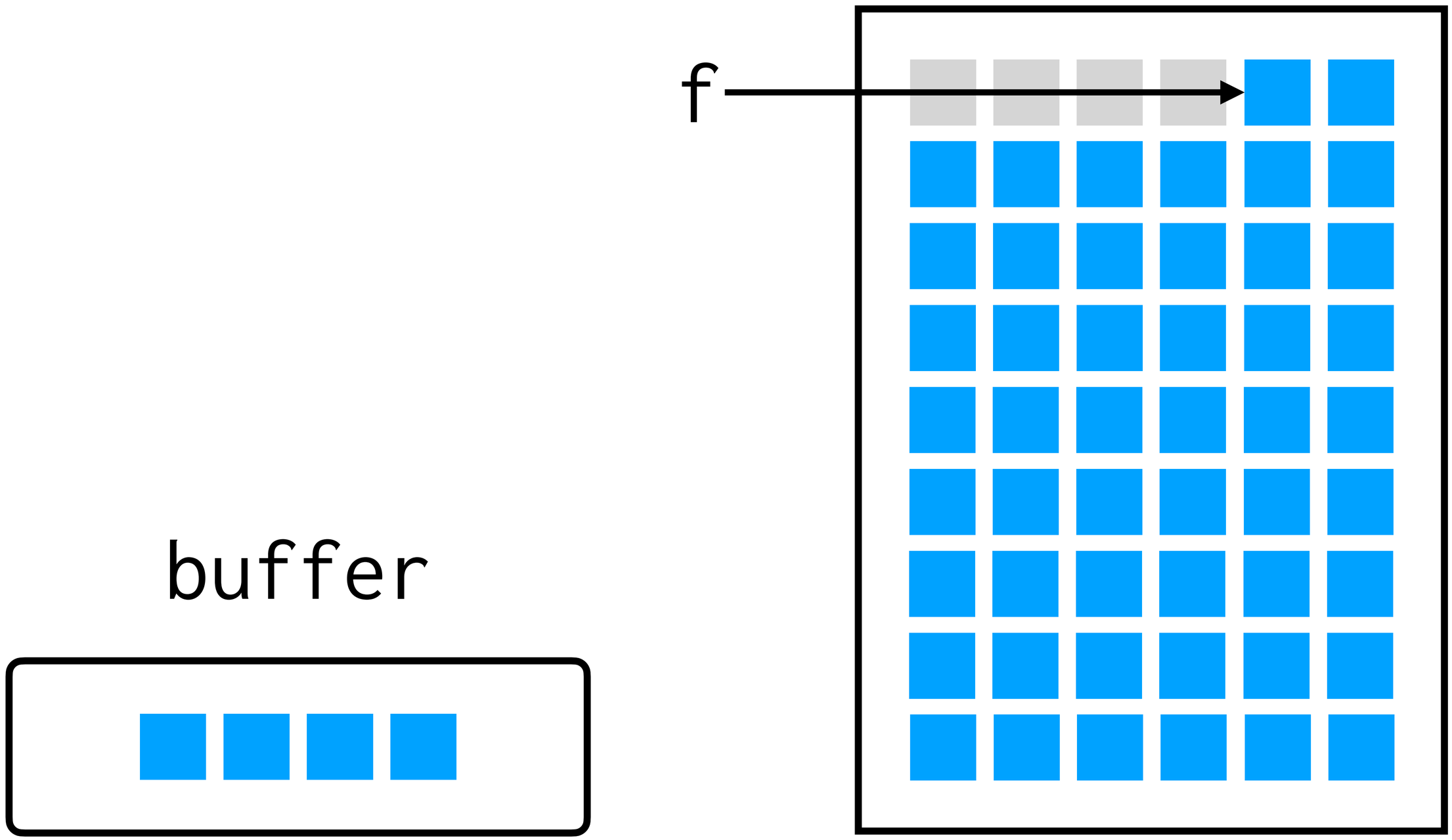
f
buffer

```
fread(buffer, 1, 4, f);
```

Writing to a File

Questions to Answer

- **From where** are you reading?
- **To where** are you reading?
- **What size** is each block of data you want to read?
- **How many** blocks do you want to read?

```
fwrite(buffer, 1, 4, f);
```

Practice with Reading

- Create a program, **pdf.c**, that opens a file given as a command-line argument.
- Check if that file is a PDF. A PDF always begins with a four-byte sequence, corresponding to these integers:
  - `37, 80, 68, 70`

This is CS50

Week 4