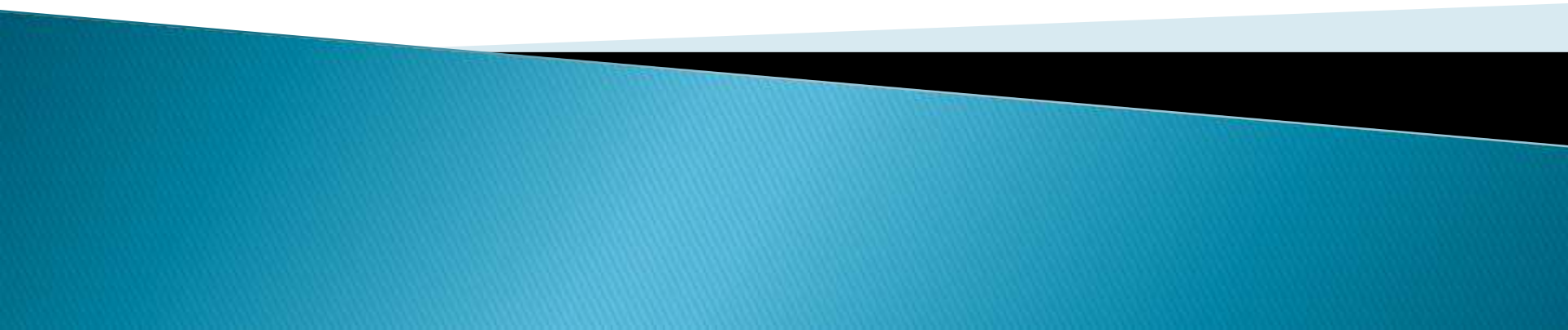
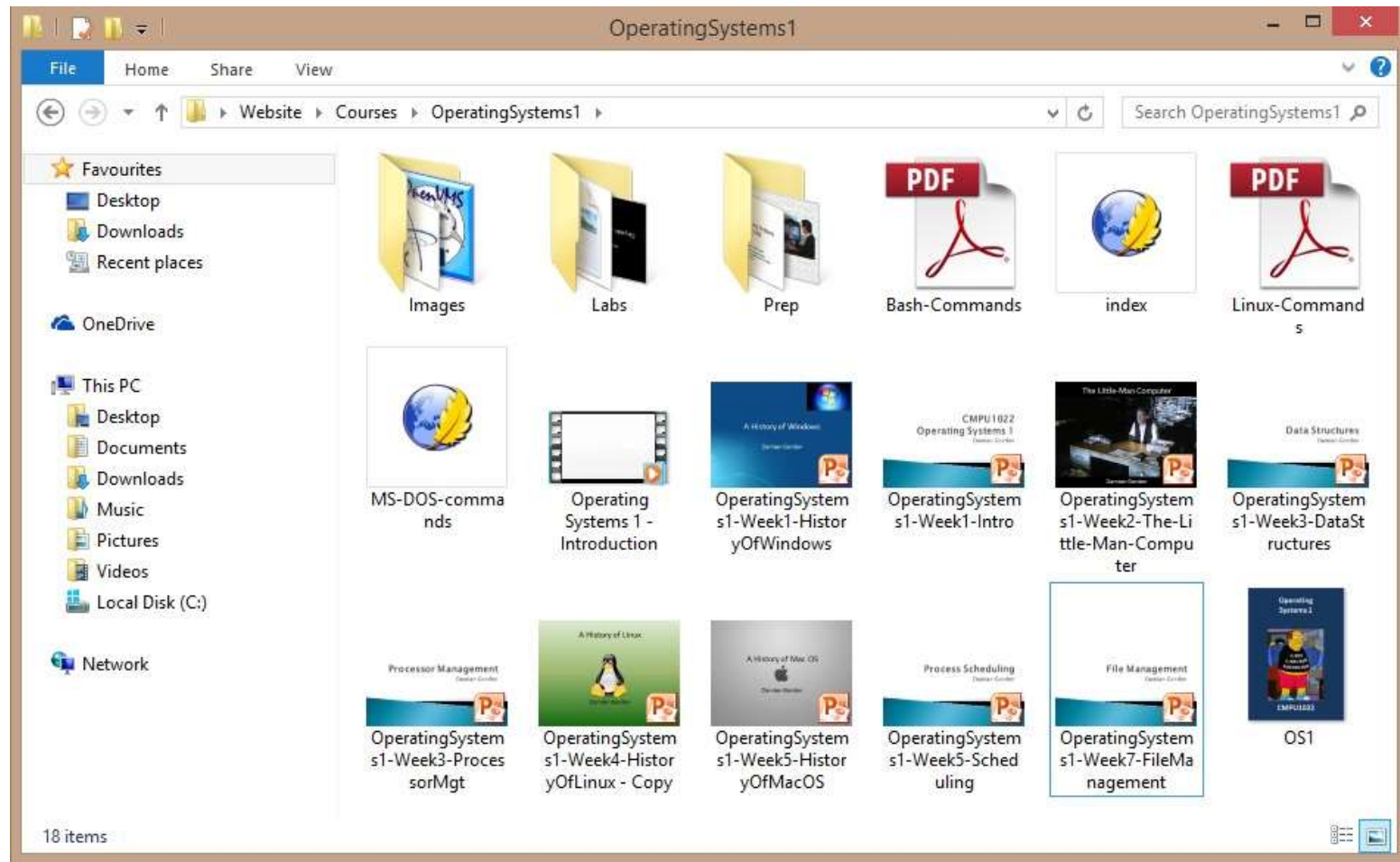


File Management

Damian Gordon



File Management



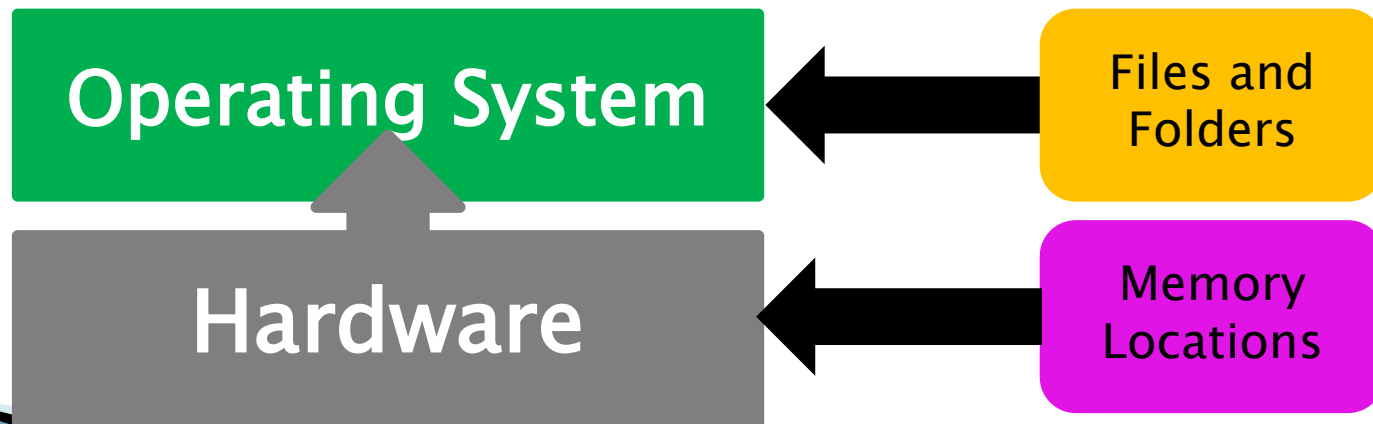
Damian's

Believe It or Not!

- ▶ BELIEVE IT OR NOT...
- ▶ From the computer's point of view, there is no such thing as a file.
- ▶ It is only because the operating system is creating the illusion of a file that they exist
- ▶ From the computer's point of view, there is only blocks of memory, either allocated or unallocated.

File Management

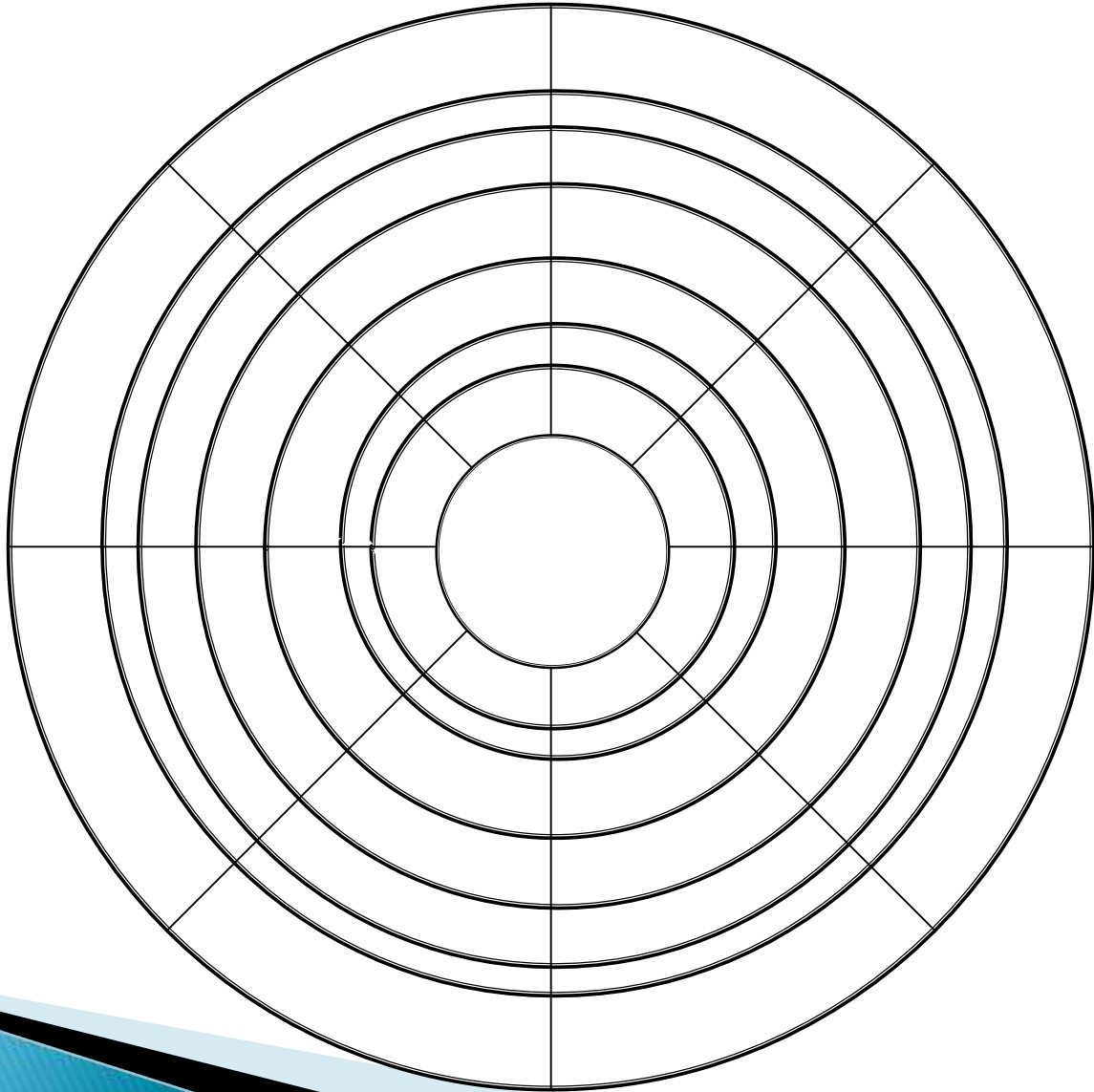
- ▶ The File Manager (or File Management System) is the manager in the Operating System that creates the illusion that there are files and folders being stored in computer memory.



Hard Disk

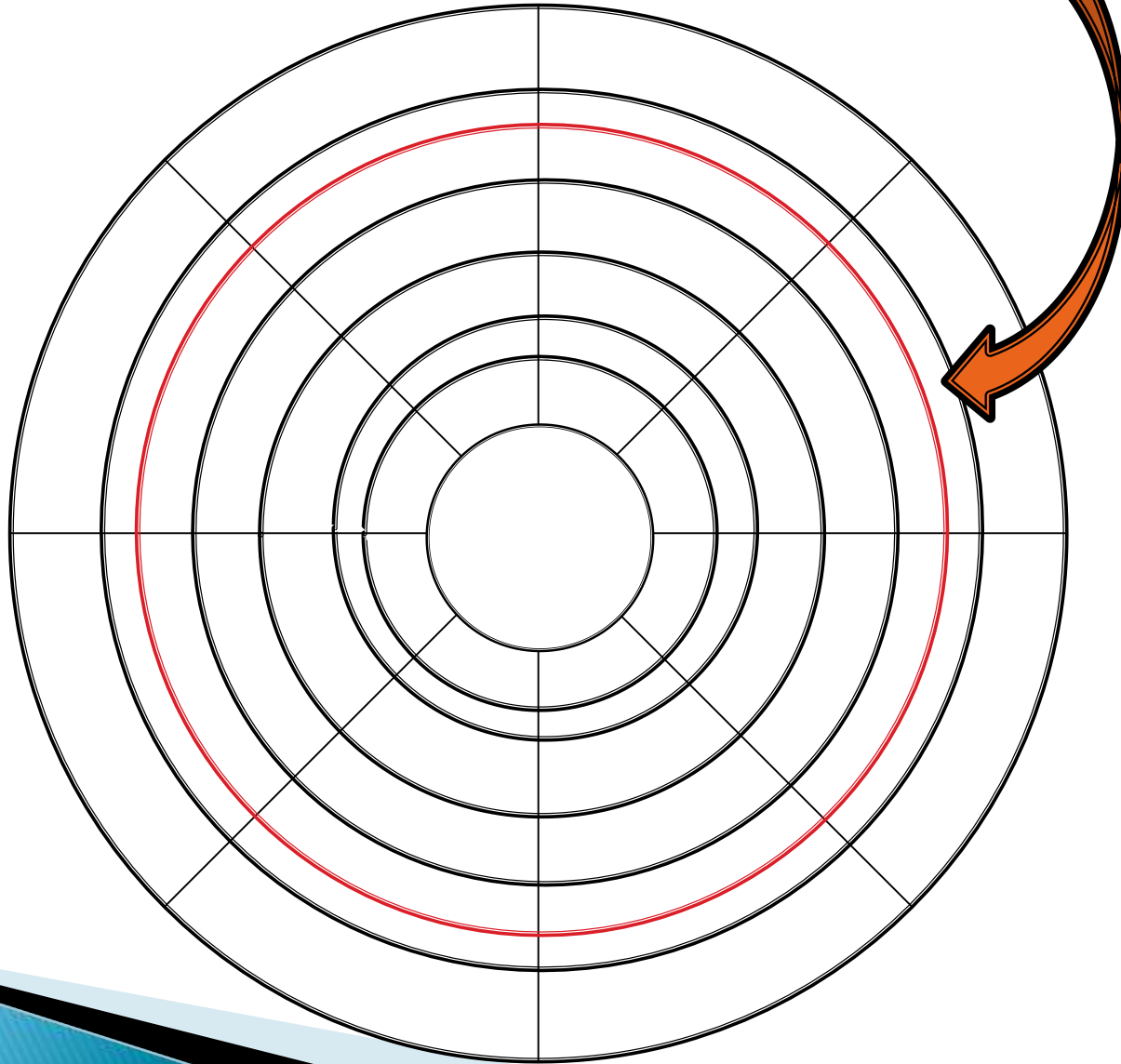


Hard Disk



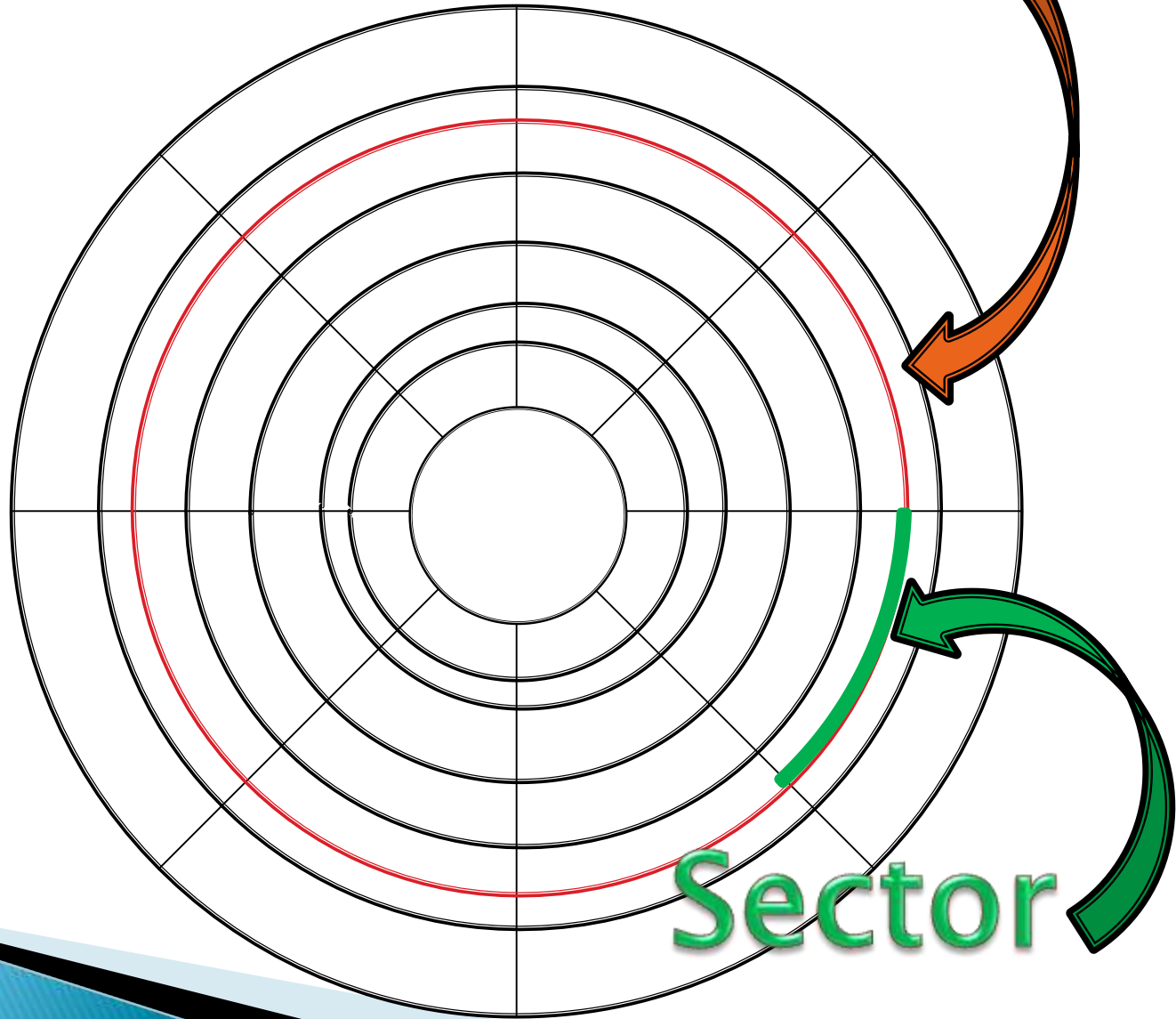
Hard Disk

Track



Hard Disk

Track

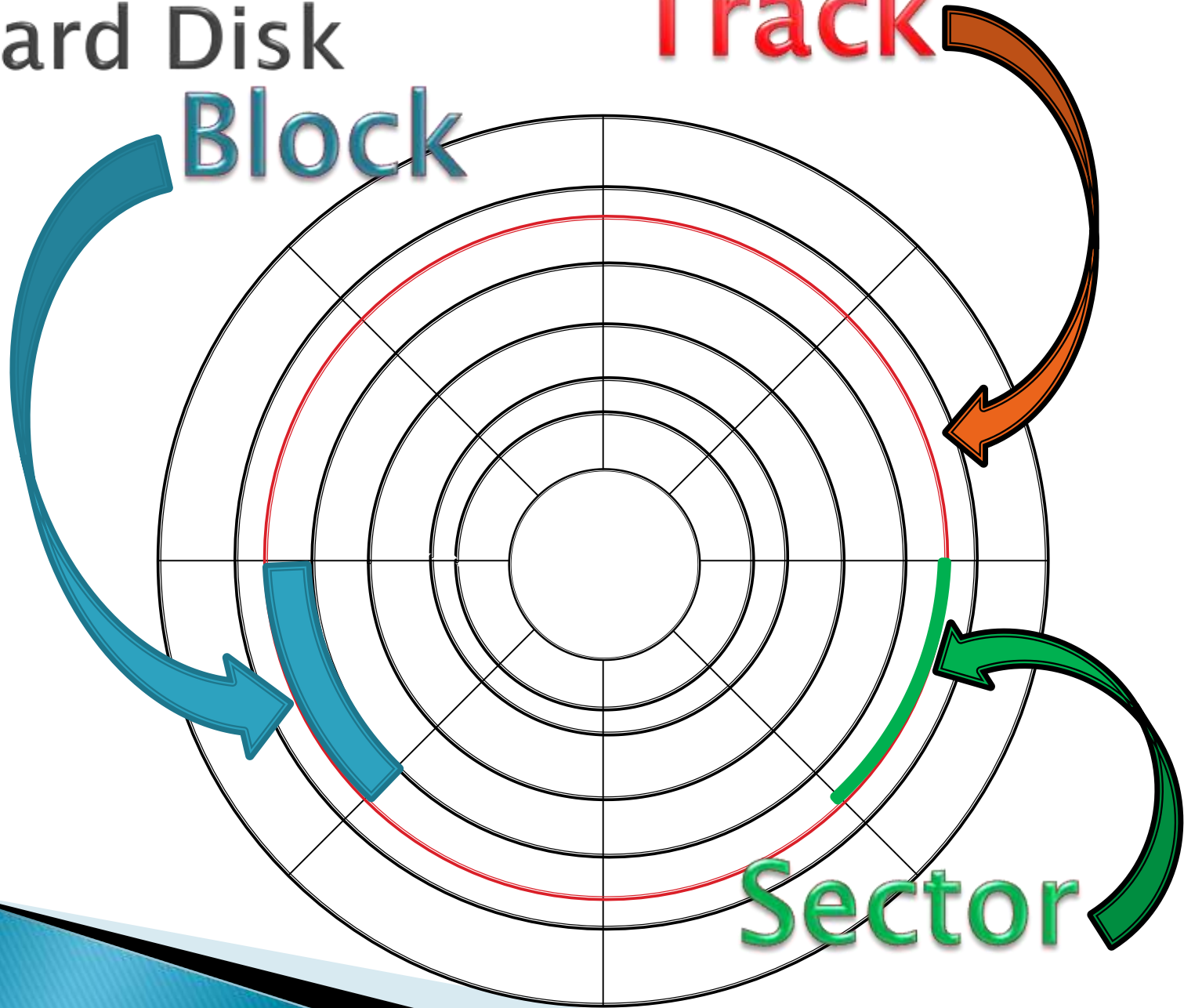


Sector

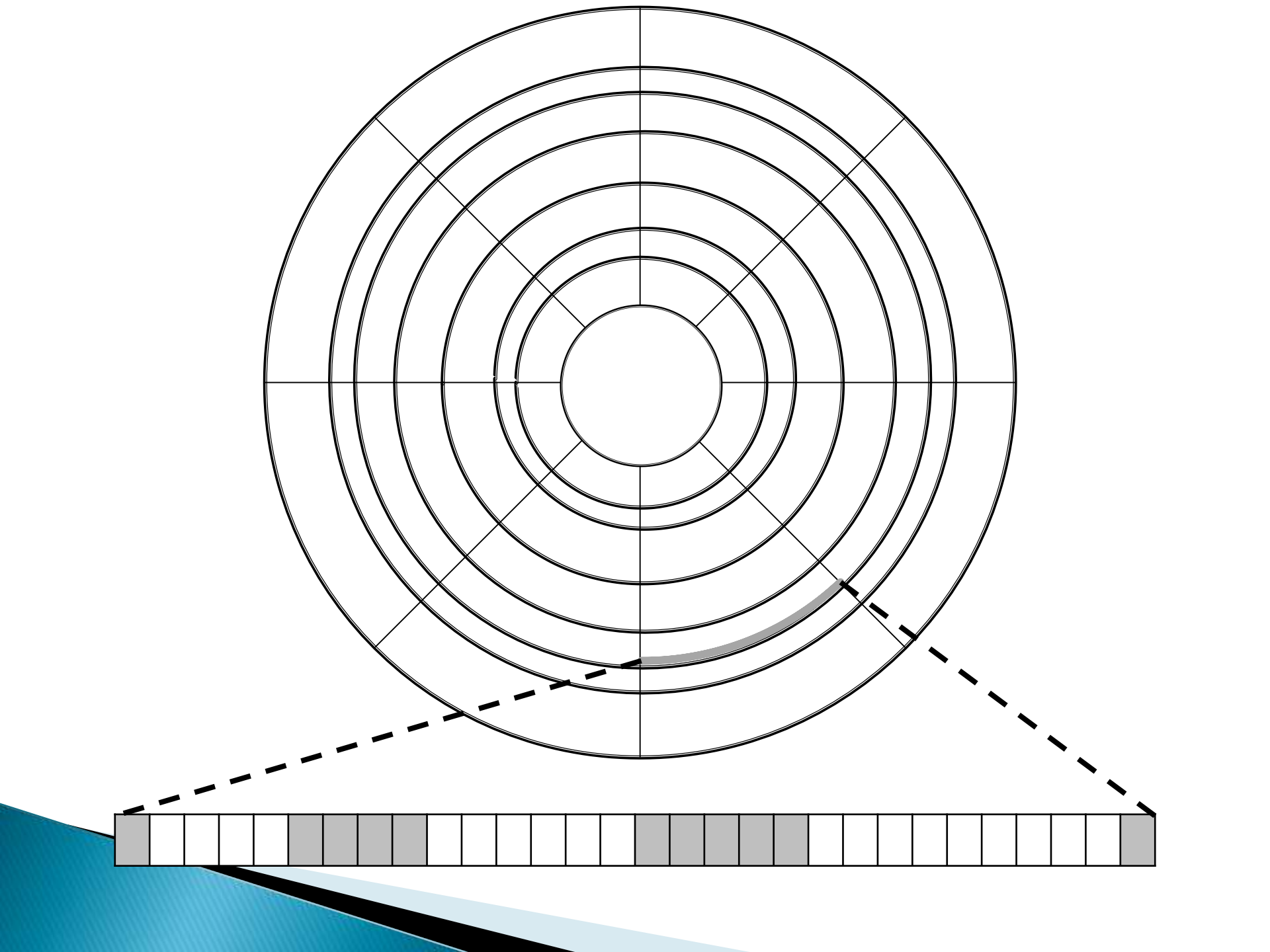
Hard Disk

Track

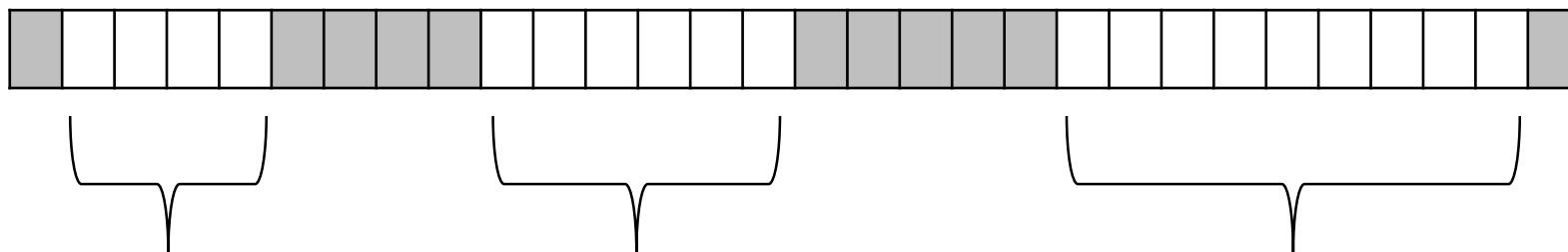
Block

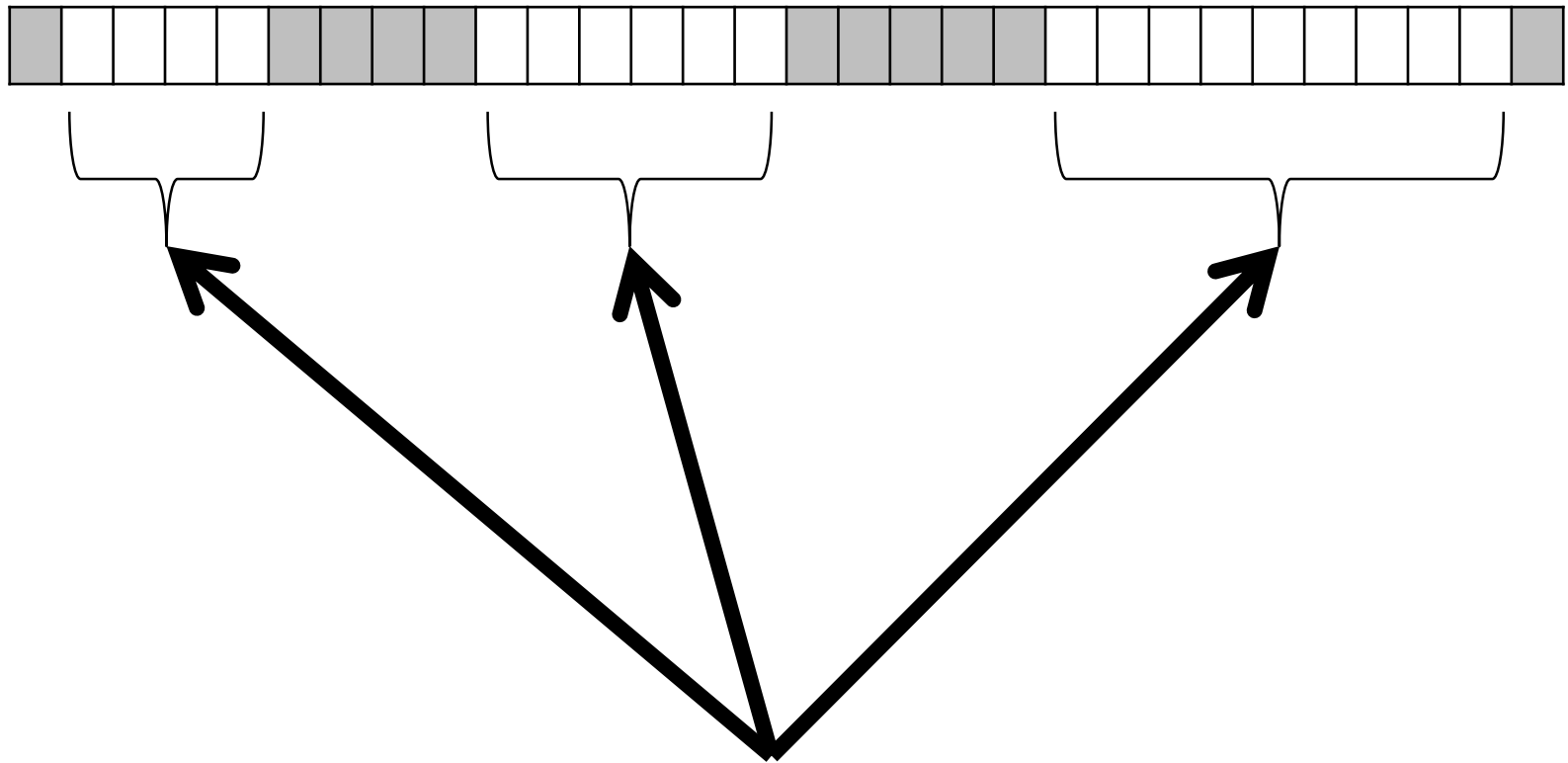


Sector

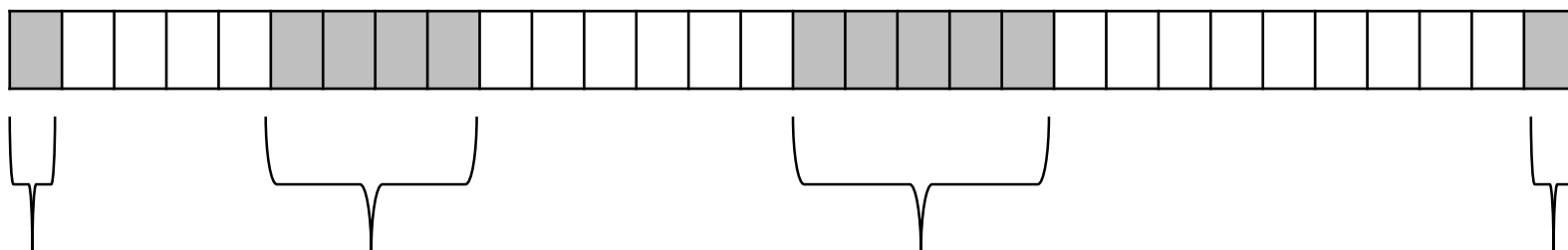


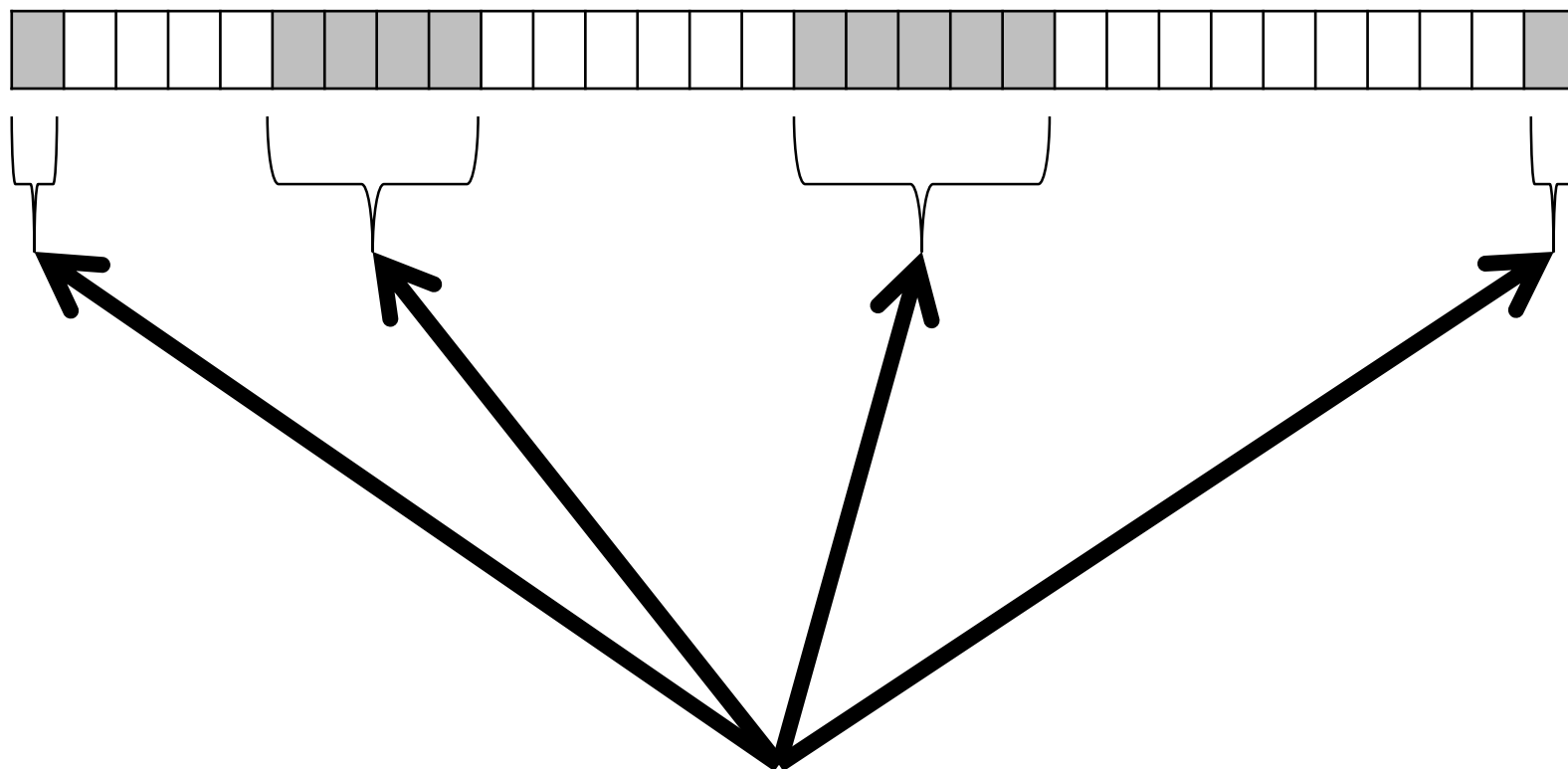






Unallocated Memory
(Available Memory)

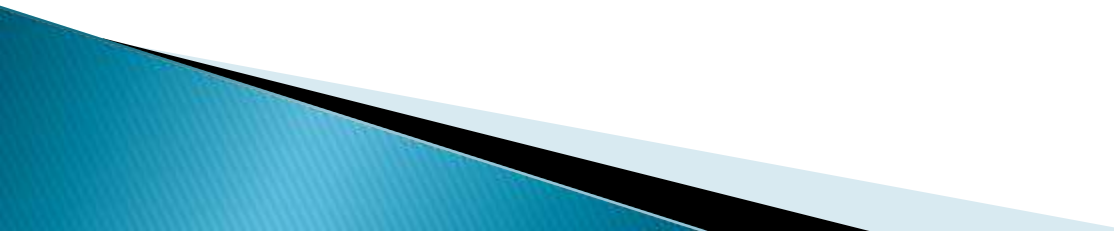




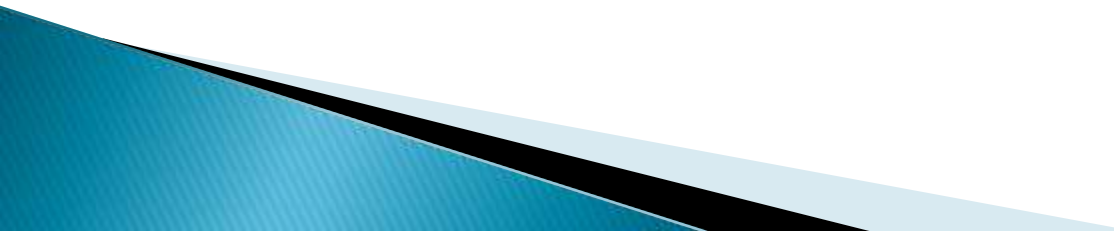
Allocated Memory
(Used Memory)

File Management

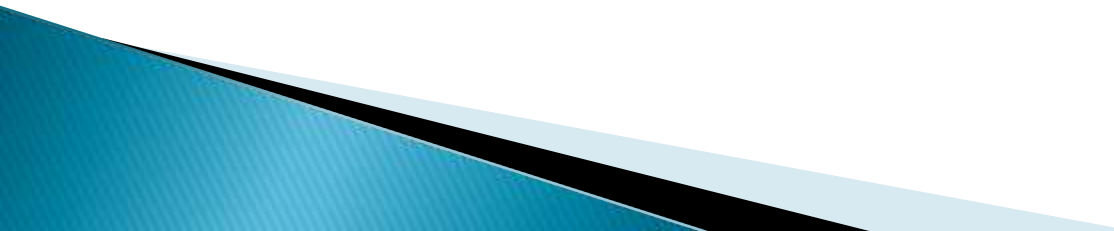
► The File Manager

- Keeps track of where files are stored
 - Determines how the files are stored
 - Follows operating system file allocation policies
 - Uses available storage space efficiently for files
 - Creates a record/log of all file usage
 - Allocates a file to a user if it is free, and if they are permitted access to it.
 - De-allocates file when user finished with it.
- 

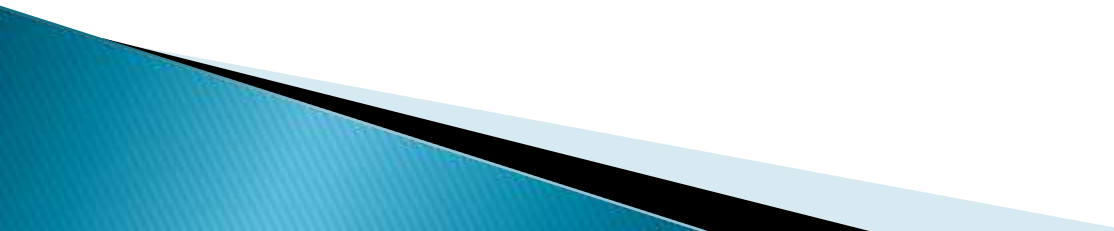
File Management

- ▶ The file manager ALLOCATES a file by reading it from the hard disk and loading it into memory while updating its record of who is using what file.
 - ▶ The file manager DEALLOCATES a file by updating the file tables and rewriting the file (if changed) to the hard disk. Any processes waiting to access the file will be notified.
- 

File Management

- ▶ Some definitions:
 - A FIELD is a collection of bytes that can be identified by a user, and has a type and size.
 - A RECORD is a collection of related FIELDS.
 - A FILE is a collection of records.
 - A DIRECTORY (or FOLDER) is a special type of file that which has lists of files and their attributes.
- 

File Management

- ▶ Typical things you can do with a file are:
 - CREATE
 - OPEN
 - DELETE
 - RENAME
 - COPY
 - etc.
- 

File Management

- ▶ The name of a file is usually in two parts:

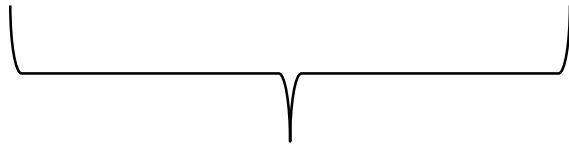
File Management

- ▶ The name of a file is usually in two parts:
 - MakeABackup.bat

File Management

- ▶ The name of a file is usually in two parts:

- MakeABackup.bat

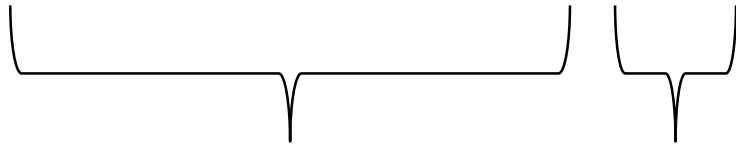


Filename

File Management

- ▶ The name of a file is usually in two parts:

- MakeABackup.bat



Filename

extension

File Management

.avi	Microsoft Video for Windows movie
.dbf	dbase II, III, IV data file
.doc(x)	Microsoft Word for Windows
.gif	Graphics Interchange Format
.htm	Hypertext Markup Language (common web page file)
.html	Hypertext Markup Language (common web page file)
.jpg	JPEG graphic file
.mpg	MPEG Video file
.mid	MIDI music file
.mov	QuickTime movie

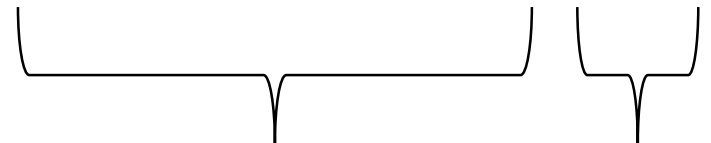
File Management

.pdf	Adobe Portable Document Format file
.ppt(x)	PowerPoint file
.psd	Photoshop file
.qxd	QuarkXPress file
.rm	Real Audio/Video streaming file
.rtf	Rich Text Format
.tif	TIFF graphic file
.txt	ASCII text file
.wav	Sound file
.xls(x)	Excel spreadsheet

File Management

- ▶ The full filename includes path information:

- ▶ `C:\WINDOWS\system32\MakeABackup.bat`



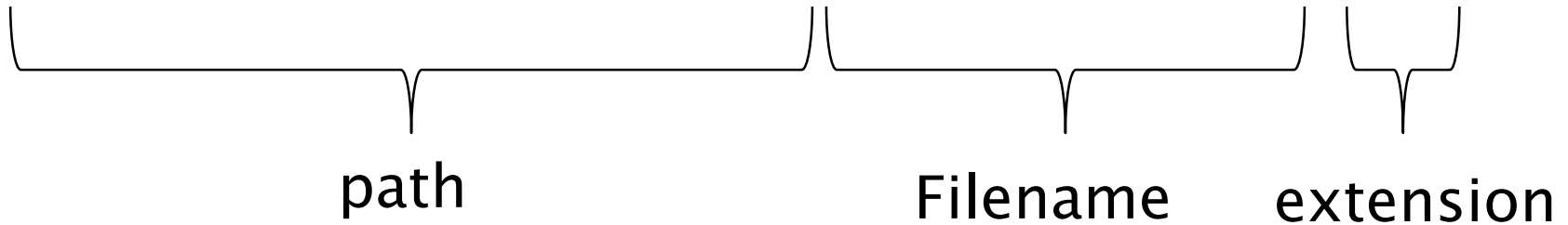
Filename

extension

File Management

- ▶ The full filename includes path information:

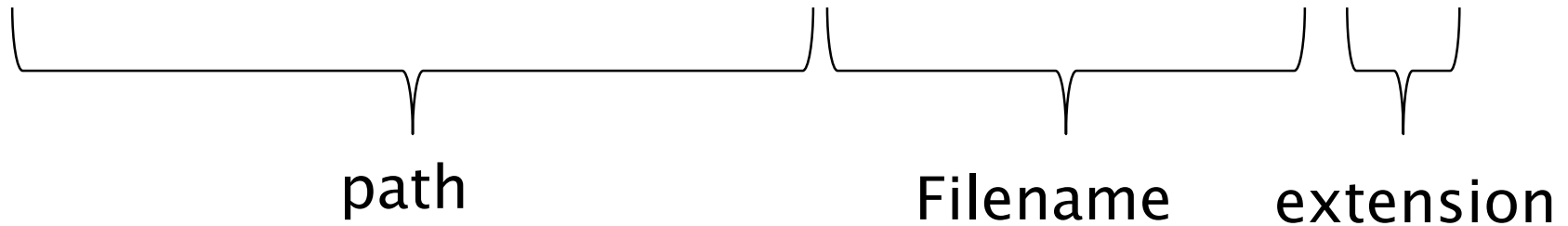
- ▶ `C:\WINDOWS\system32\MakeABackup.bat`



File Management

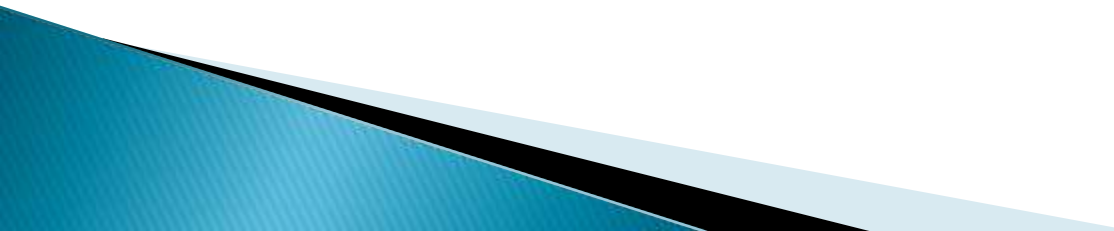
- ▶ The full filename includes path information:

- ▶ `C:\WINDOWS\system32\MakeABackup.bat`



Absolute filename

File Management

- ▶ If I am in the following folder:
 - ▶ `C:\WINDOWS\system32\BackupFolder\`
 - ▶ Then the address of the file is:
 - ▶ `..\MakeABackup.bat`
- 

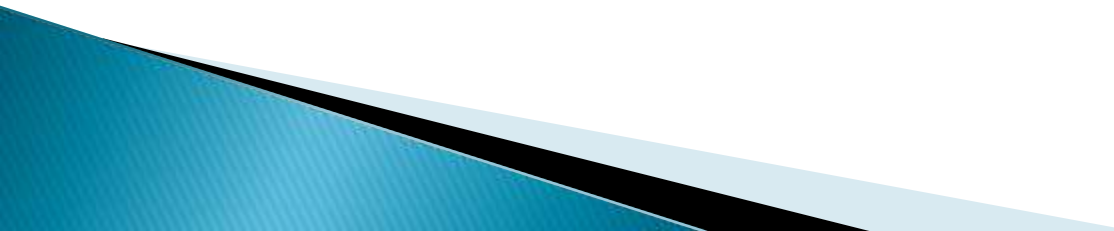
File Management

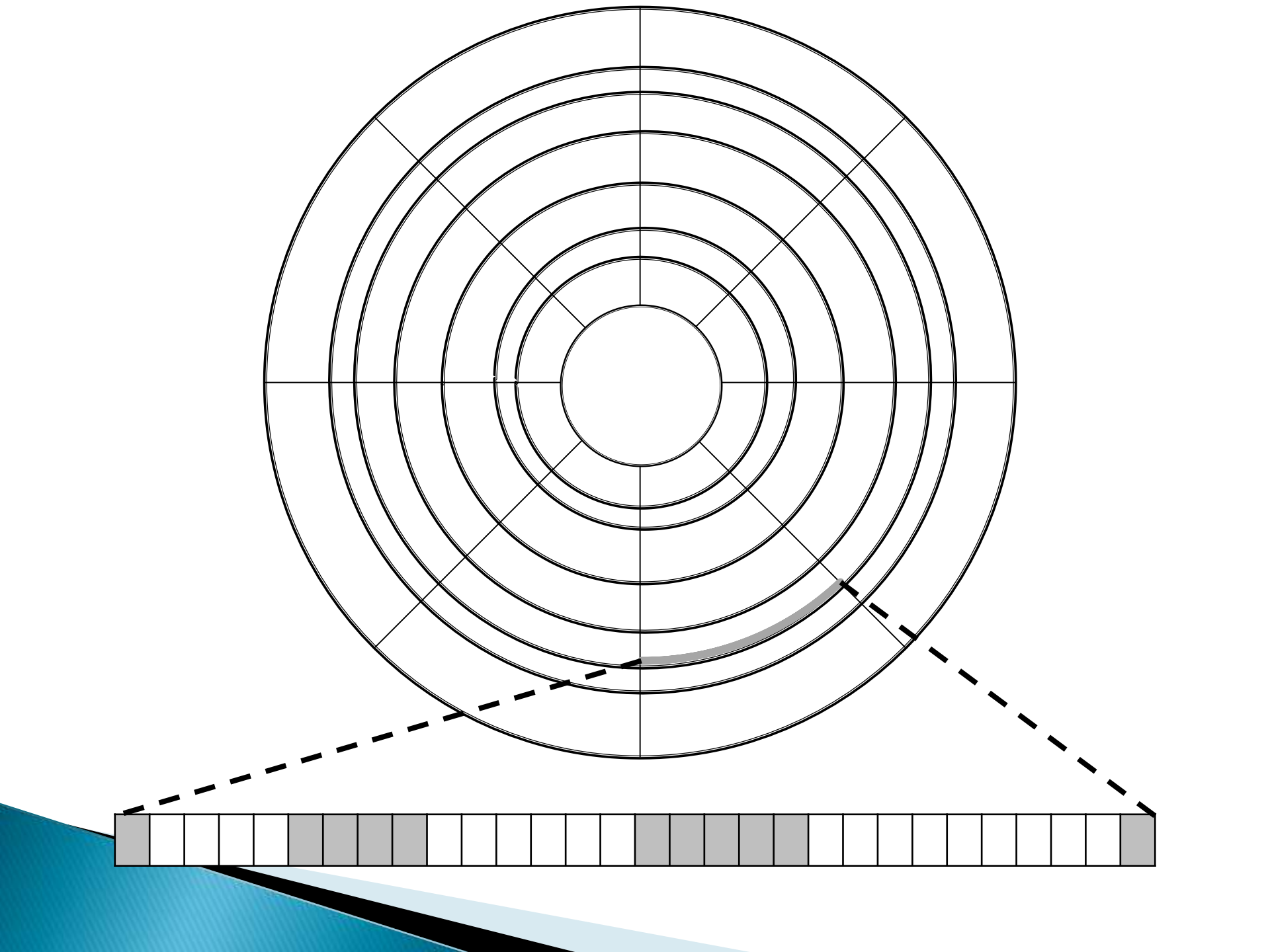
- ▶ If I am in the following folder:
- ▶ `C:\WINDOWS\system32\BackupFolder\`
- ▶ Then the address of the file is:
- ▶ `..\MakeABackup.bat`

Relative filename



Physical Storage Allocation

- ▶ The Operating System store files as records in memory, where many records make up a single file.
 - ▶ There are three main ways a file is physically stored in memory:
 - Contiguous Storage
 - Non-contiguous Storage
 - Indexed Storage
- 



Contiguous Storage

- ▶ Contiguous Storage means that records of a file are stored one after another.
- ▶ It is a very simple policy to implement, and once you have found the start of the file, it's very easy to find the rest of it.

Contiguous Storage



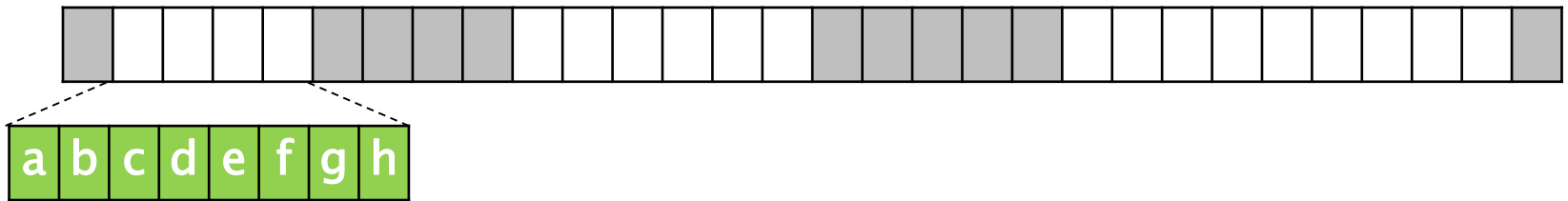
Contiguous Storage



New file:

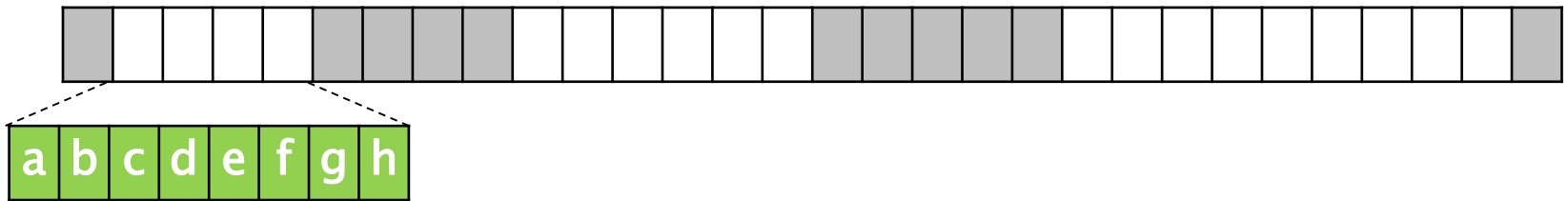
a	b	c	d	e	f	g	h
---	---	---	---	---	---	---	---

Contiguous Storage



Does it fit here?

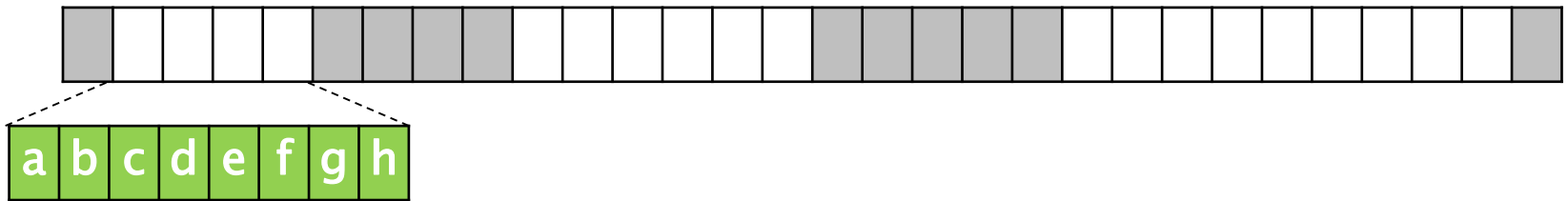
Contiguous Storage



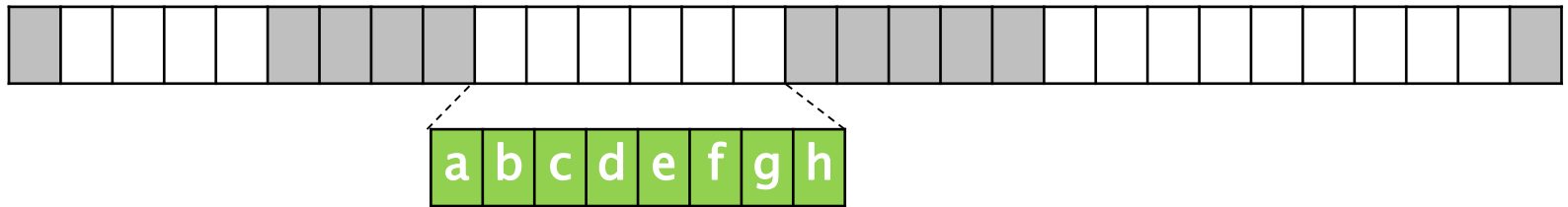
Does it fit here?

NO

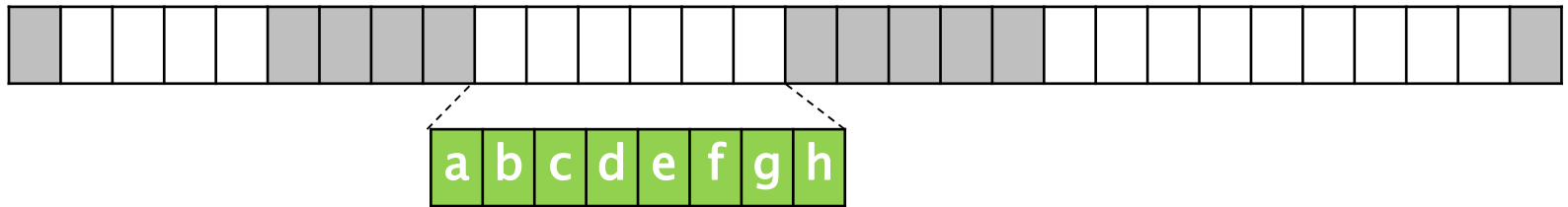
Contiguous Storage



Contiguous Storage

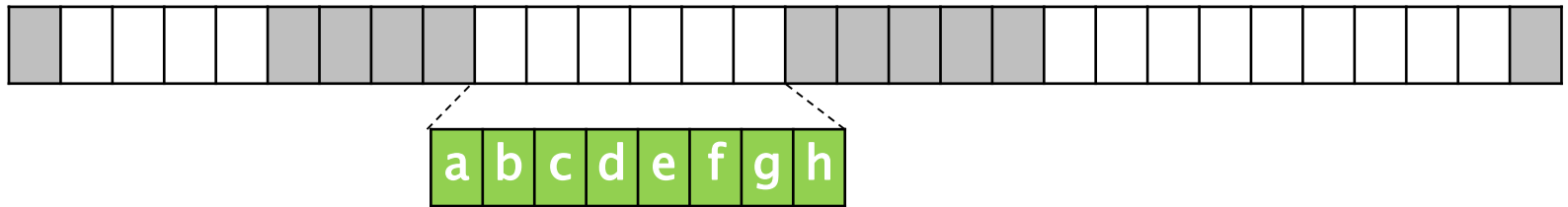


Contiguous Storage



Does it fit here?

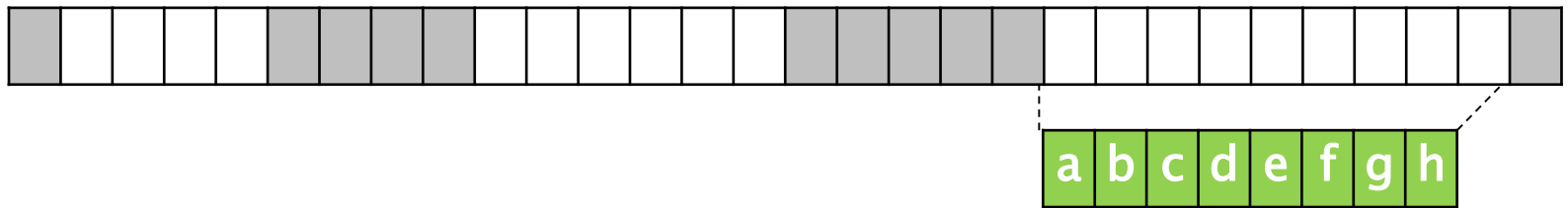
Contiguous Storage



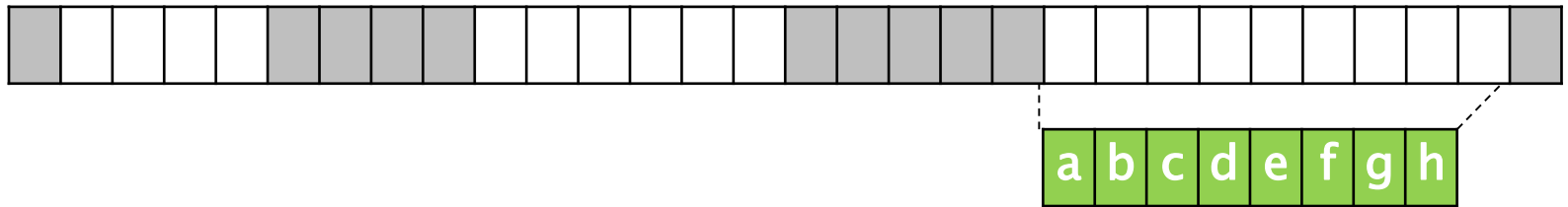
Does it fit here?

NO

Contiguous Storage

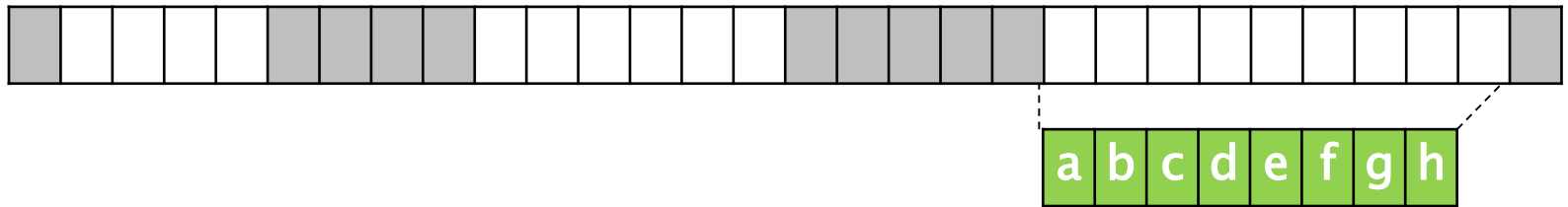


Contiguous Storage



Does it fit here?

Contiguous Storage



Does it fit here?

YES

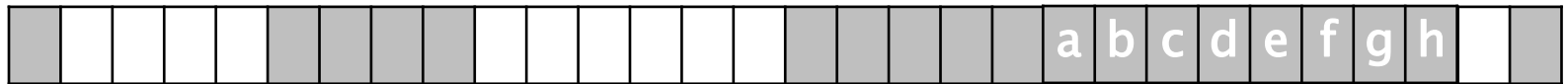
Contiguous Storage



Does it fit here?

YES

Contiguous Storage



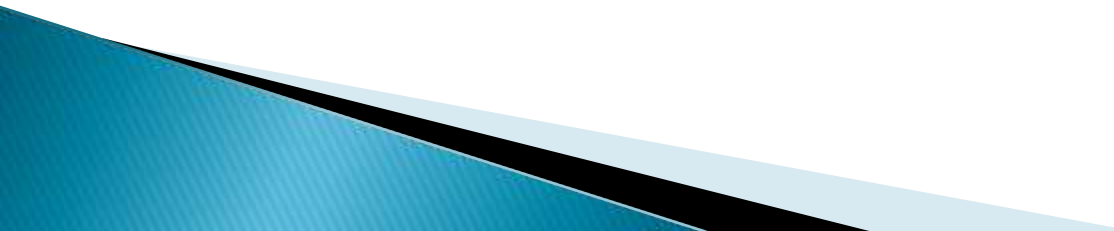
Does it fit here?

YES

Contiguous Storage

- ▶ The problem with is that if you have expand the file, you either need to have free space allocated at the end, or copy the whole file to a different location on the disk that has enough space.

Non-contiguous Storage

- ▶ Non-contiguous Storage means that records of a file are stored where ever there is free space.
 - ▶ The file manager will try to put as much of it together as possible, but there will be other part spread out over the disk.
 - ▶ These extra bits are sometimes called **extents** and these are linked together with pointers.
 - ▶ This means there is no easy way to determine the exact location of a record in a file.
- 

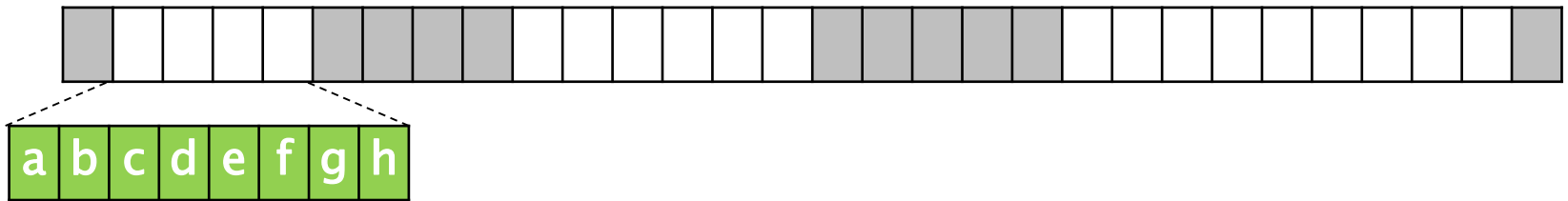
Non-contiguous Storage



New file:

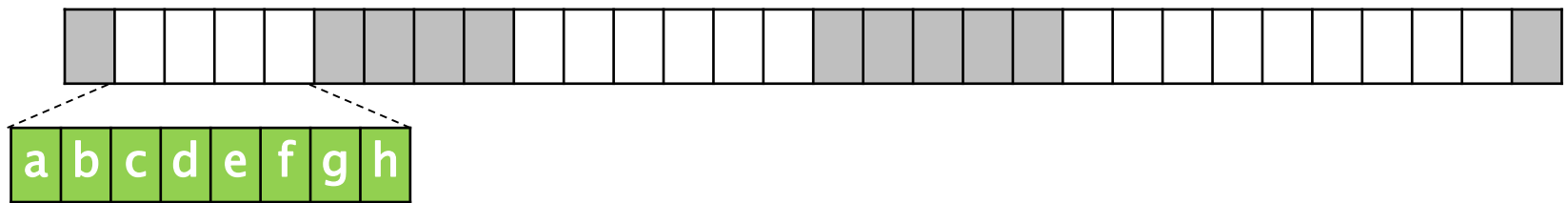
a	b	c	d	e	f	g	h
---	---	---	---	---	---	---	---

Non-contiguous Storage



Does it fit here?

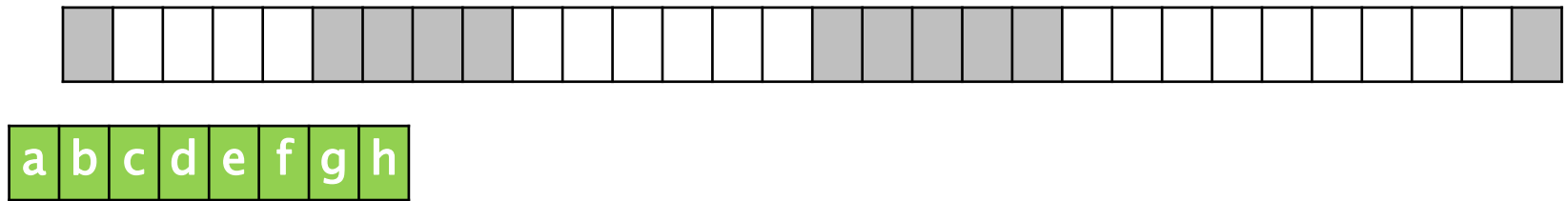
Non-contiguous Storage



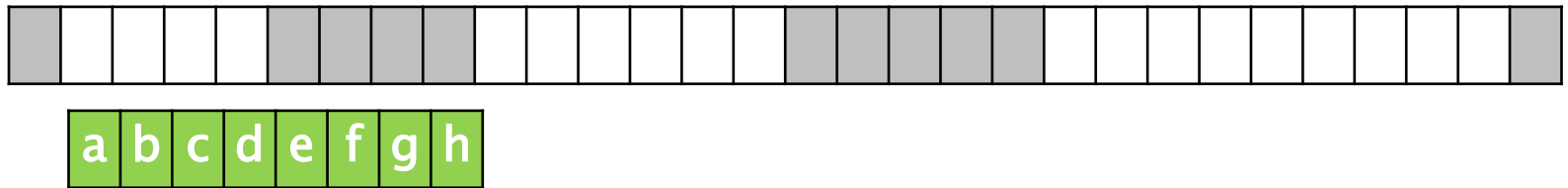
Does it fit here?

**Who cares, this is
where it is going**

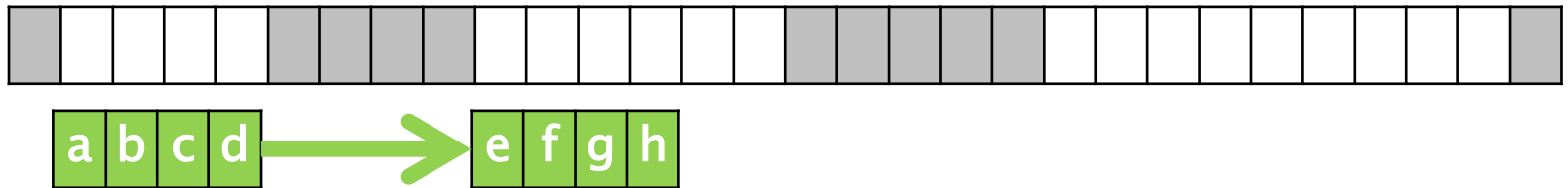
Non-contiguous Storage



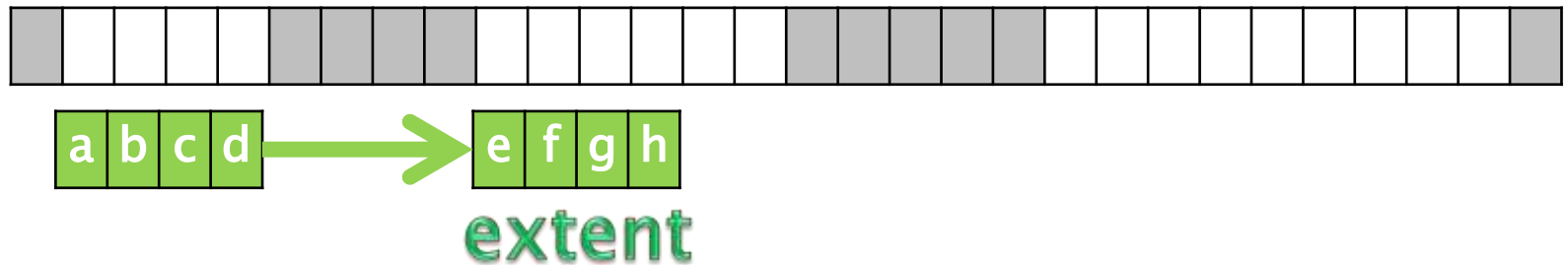
Non-contiguous Storage



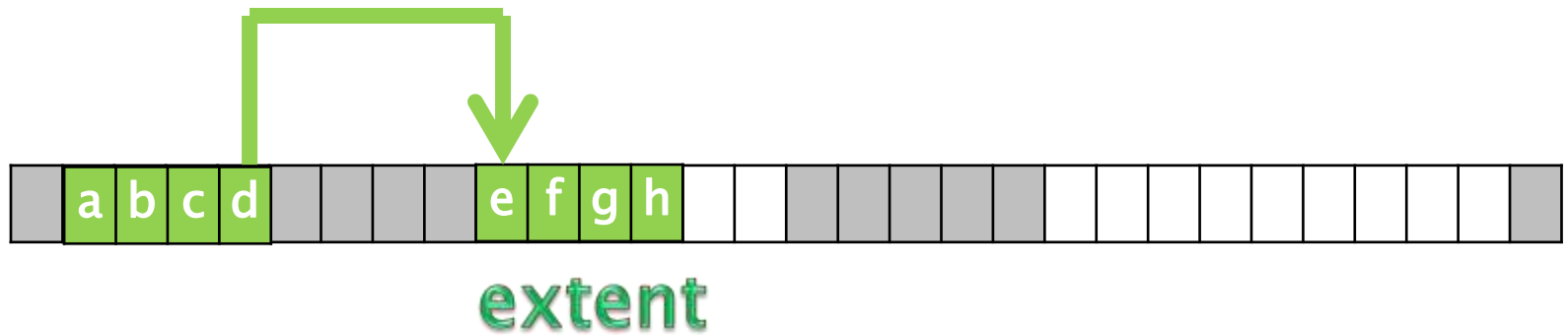
Non-contiguous Storage



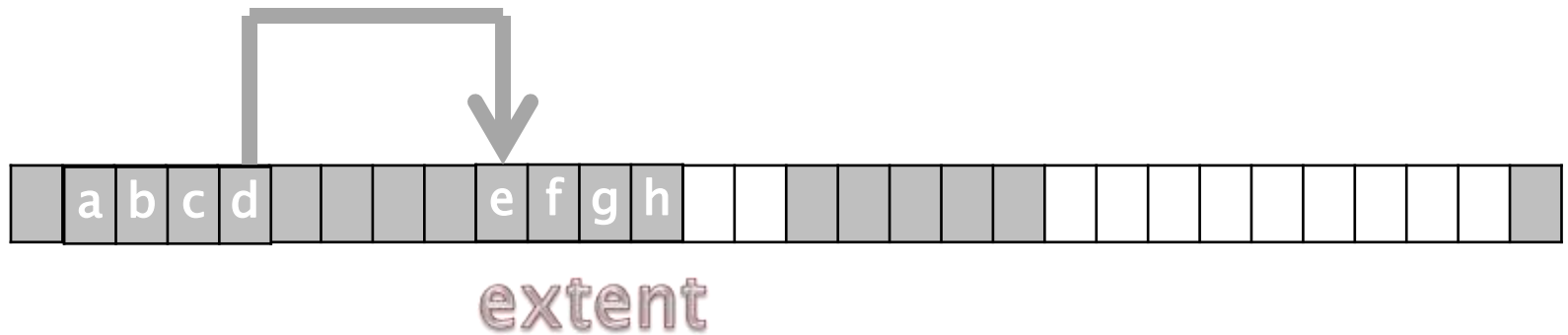
Non-contiguous Storage



Non-contiguous Storage



Non-contiguous Storage



Indexed Storage

- ▶ Indexed Storage means that as well as the records in the file, an index block is created, with pointers to each individual file.

Indexed Storage



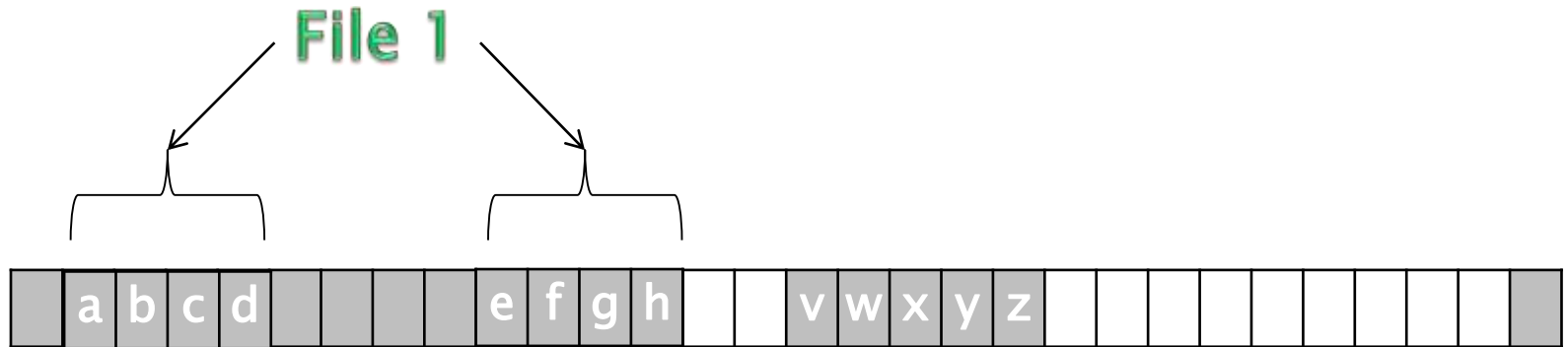
Indexed Storage



File 1: **abcdefgh**

File 2: **vwxyz**

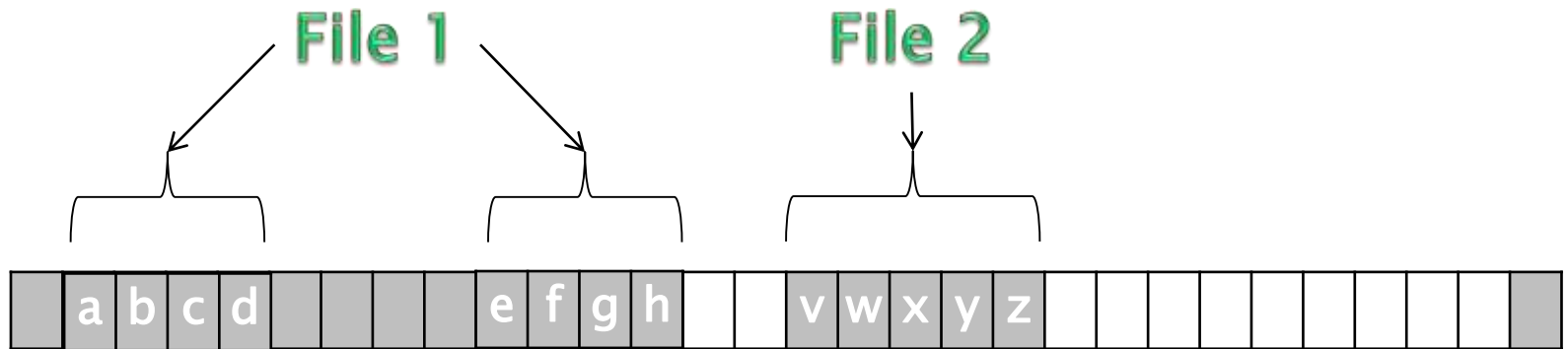
Indexed Storage



File 1: **abcdefgh**

File 2: **vwxyz**

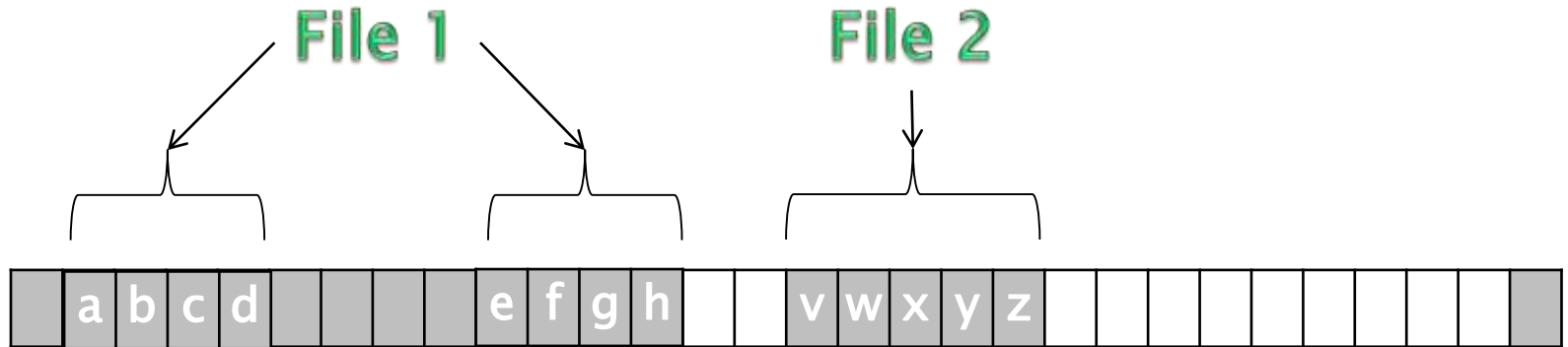
Indexed Storage



File 1: **abcdefgh**

File 2: **vwxyz**

Indexed Storage

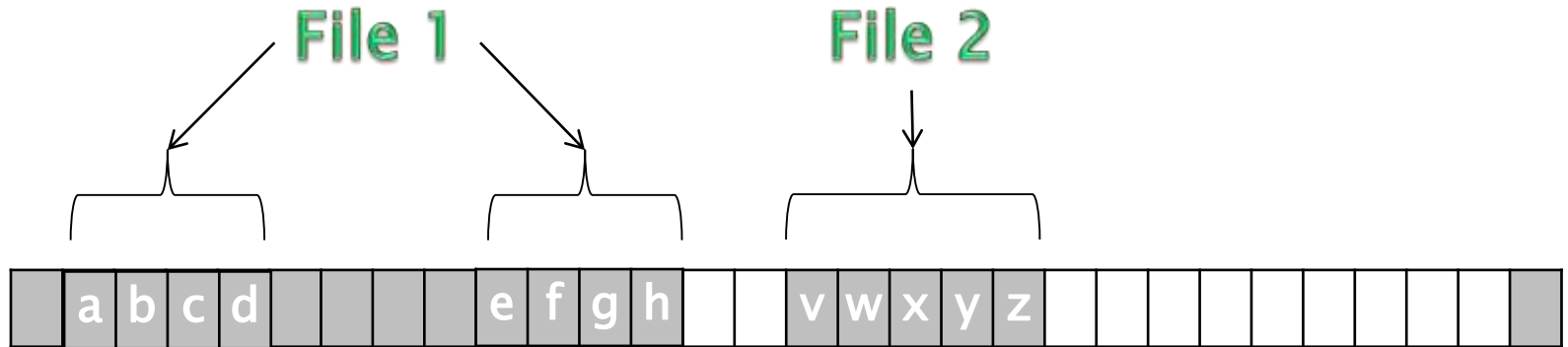


File 1: **abcdefgh**

File 2: **vwxyz**

Without an INDEX BLOCK,
how do I find file 2?

Indexed Storage



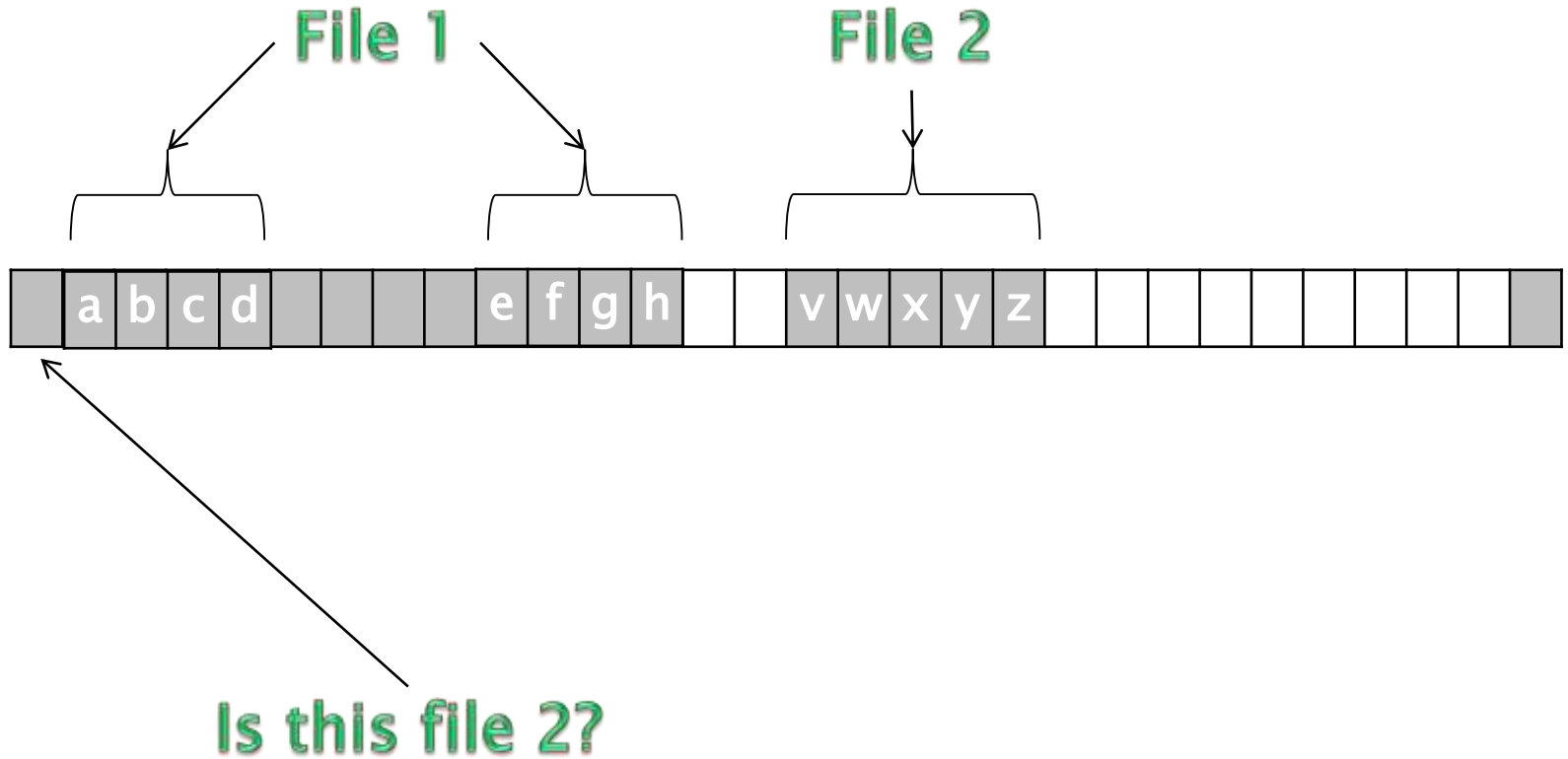
File 1: **abcdefgh**

File 2: **vwxyz**

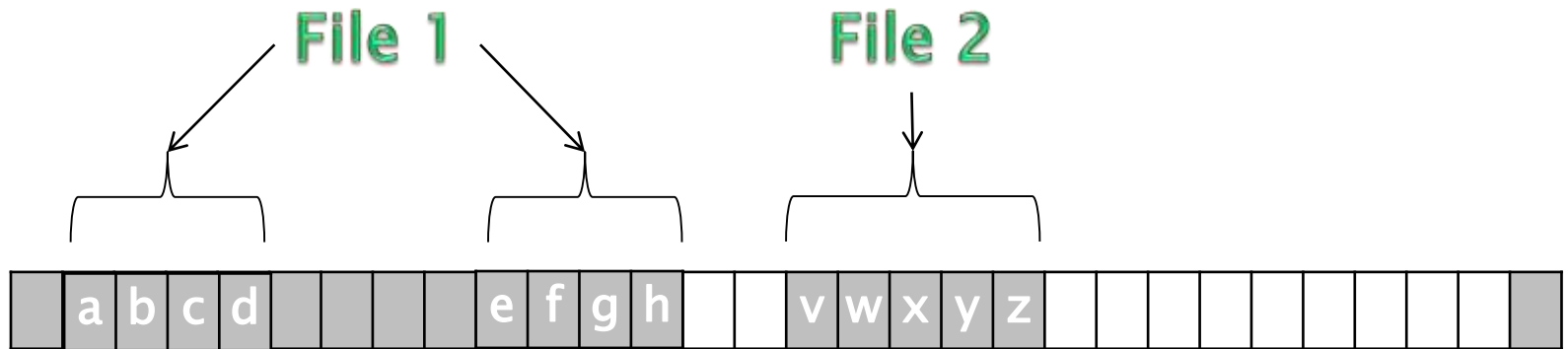
Without an INDEX BLOCK,
how do I find file 2?

We do a sequential search.

Indexed Storage



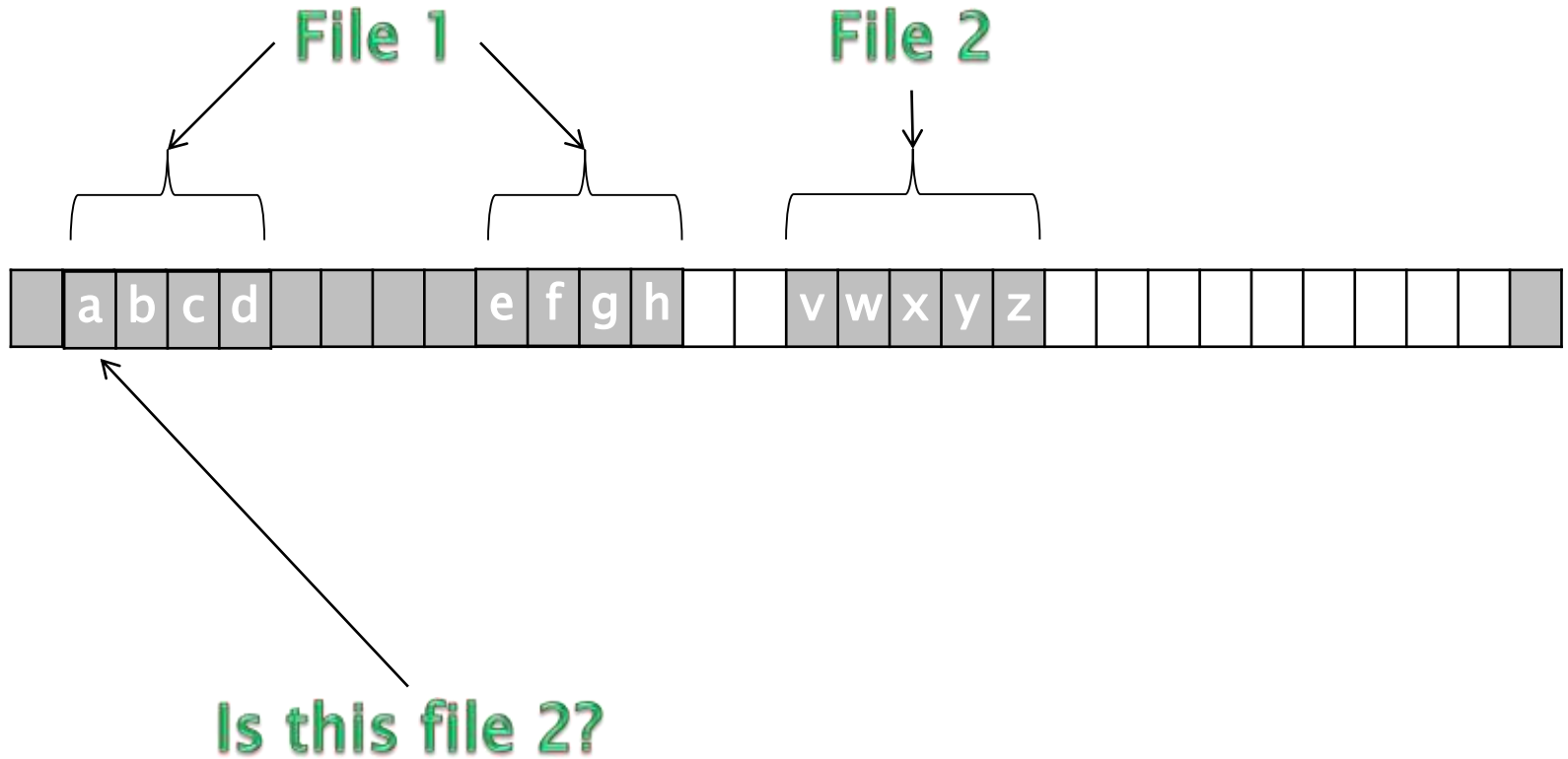
Indexed Storage



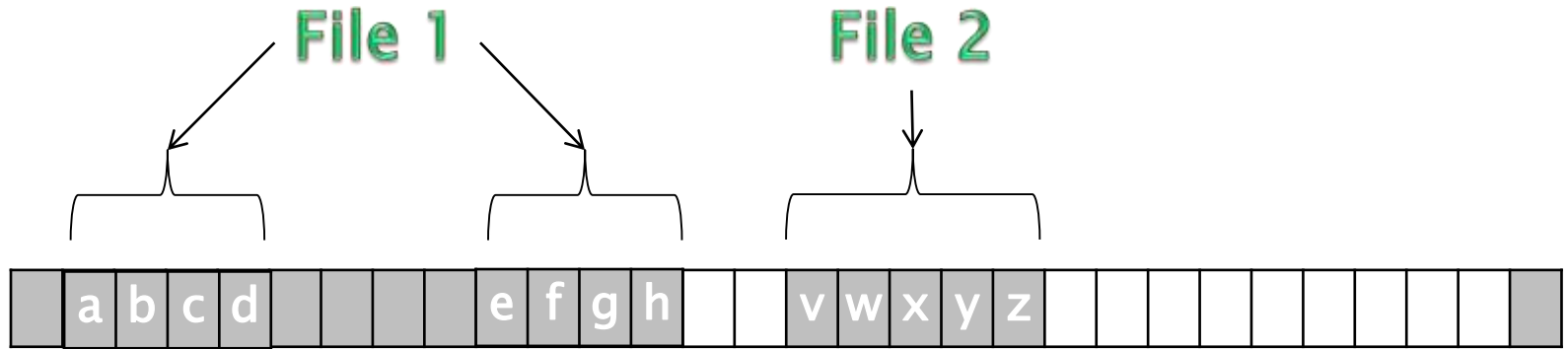
Is this File 2?

NO

Indexed Storage



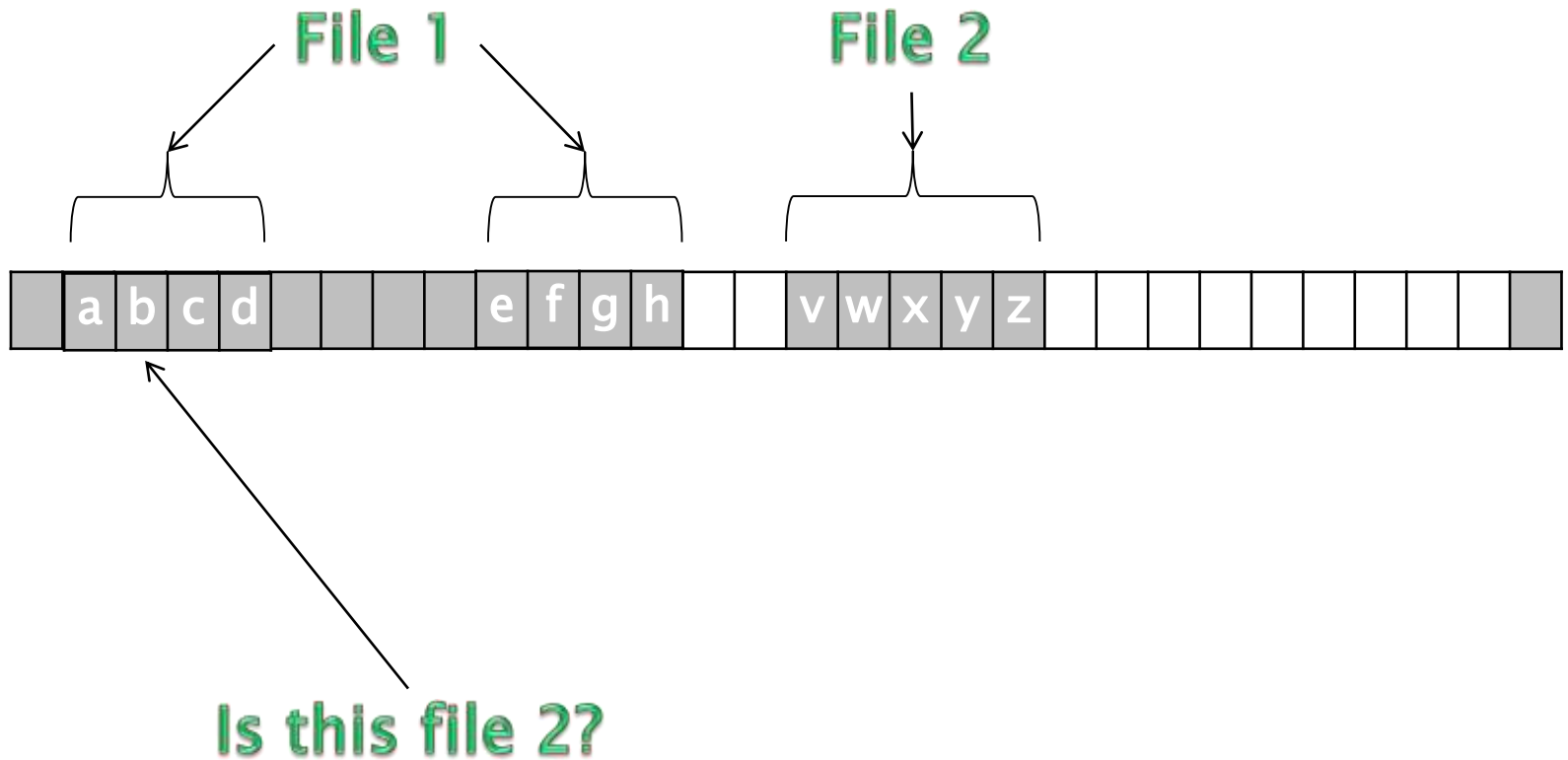
Indexed Storage



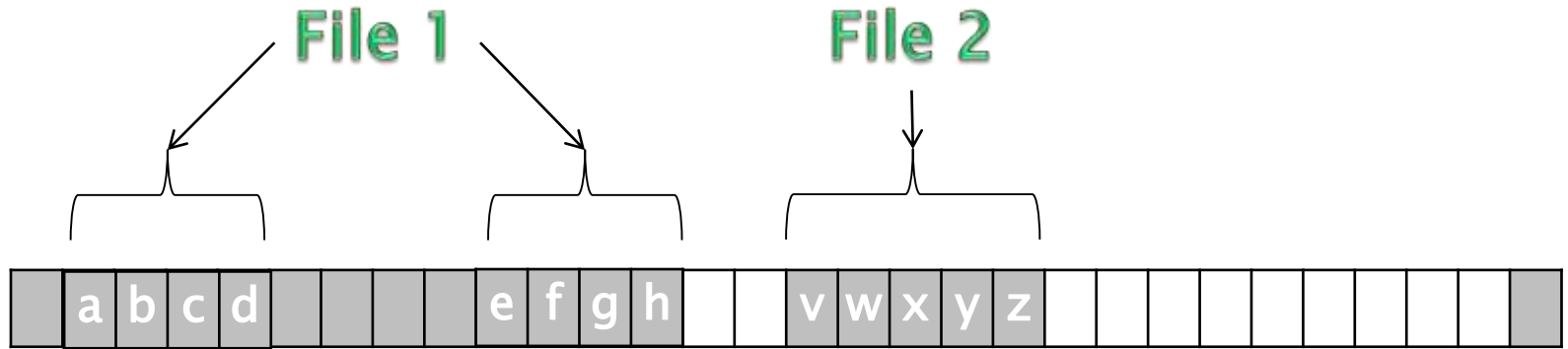
Is this File 2?

NO

Indexed Storage



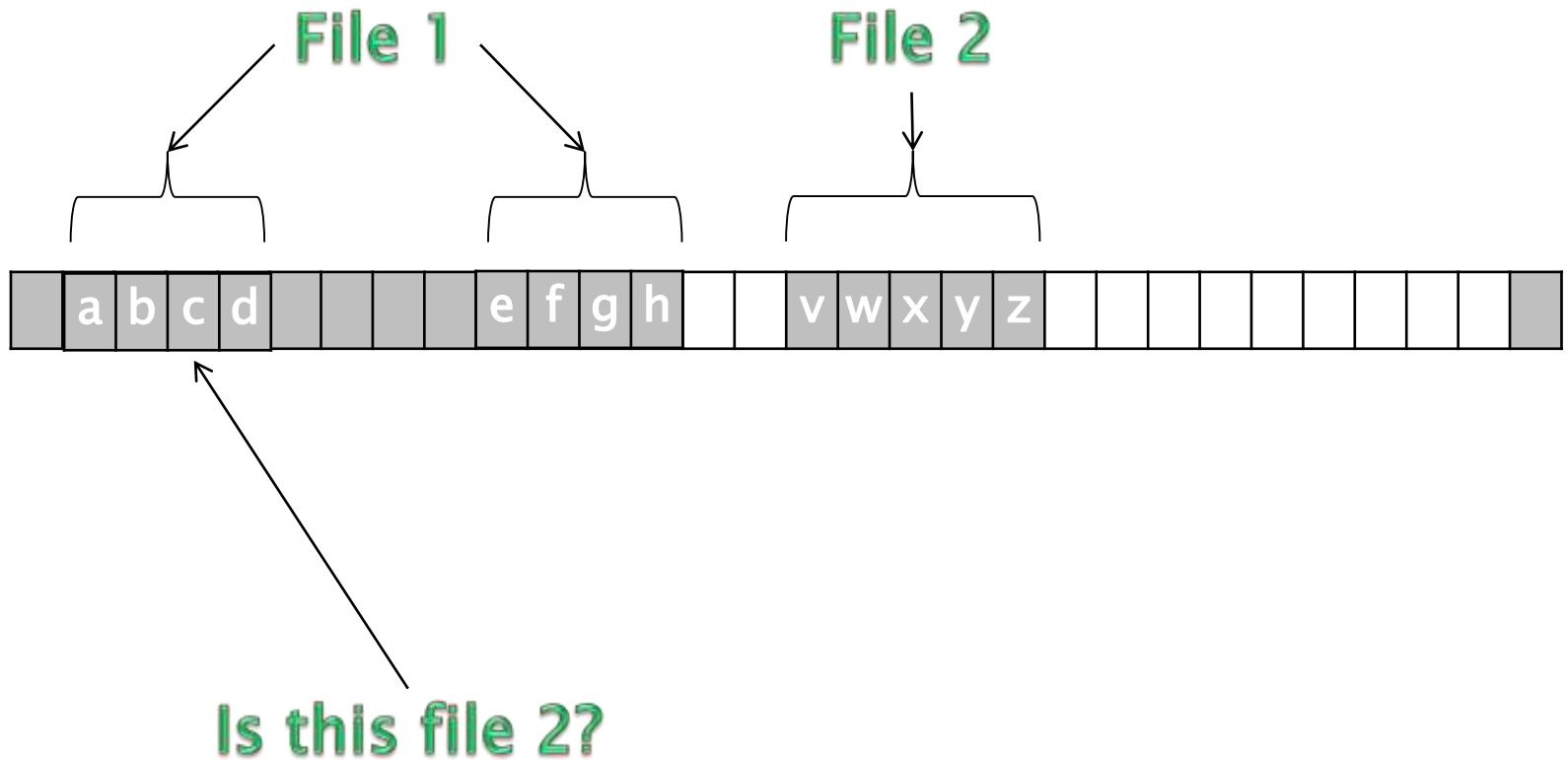
Indexed Storage



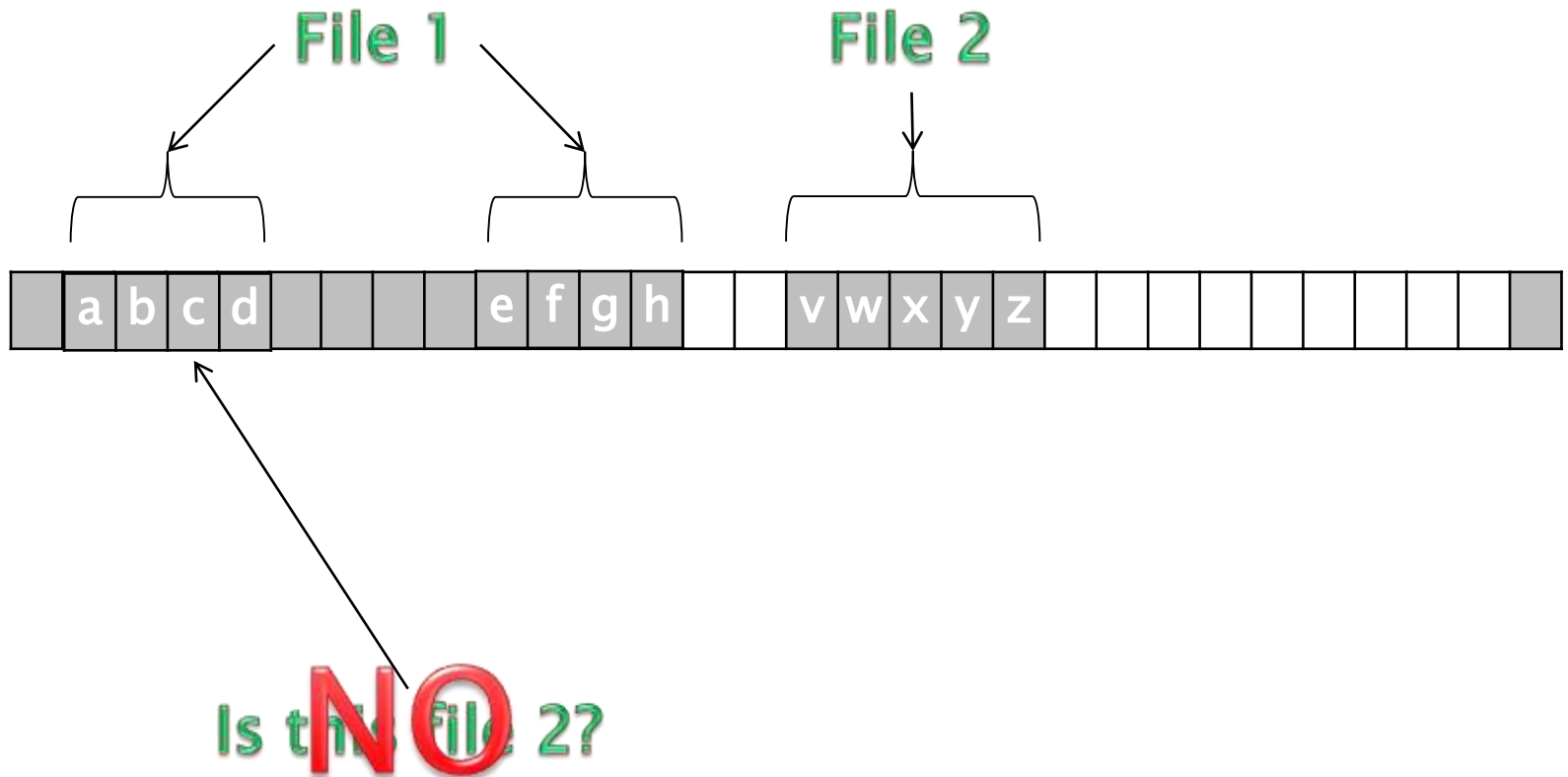
Is this File 2?

NO

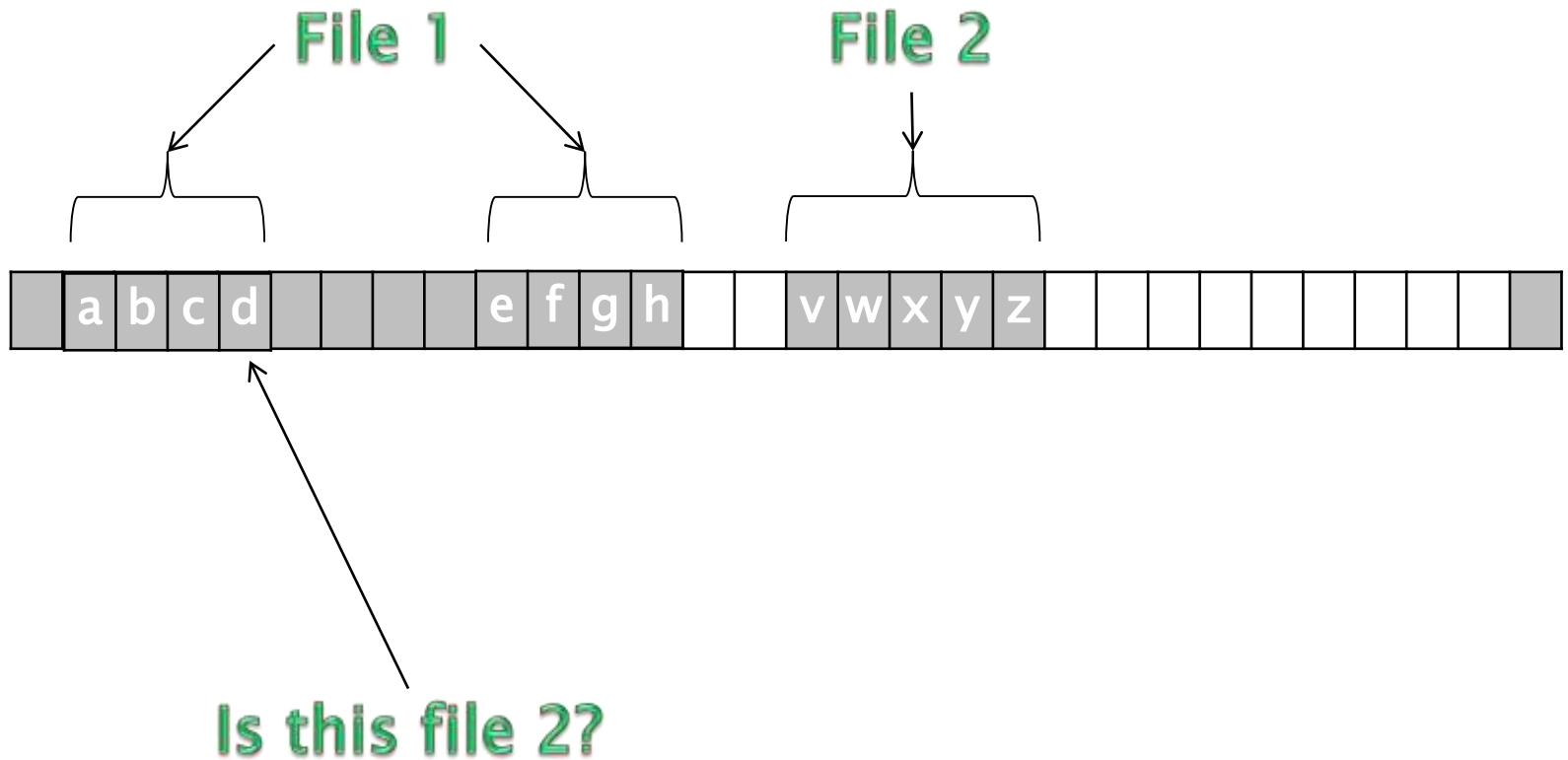
Indexed Storage



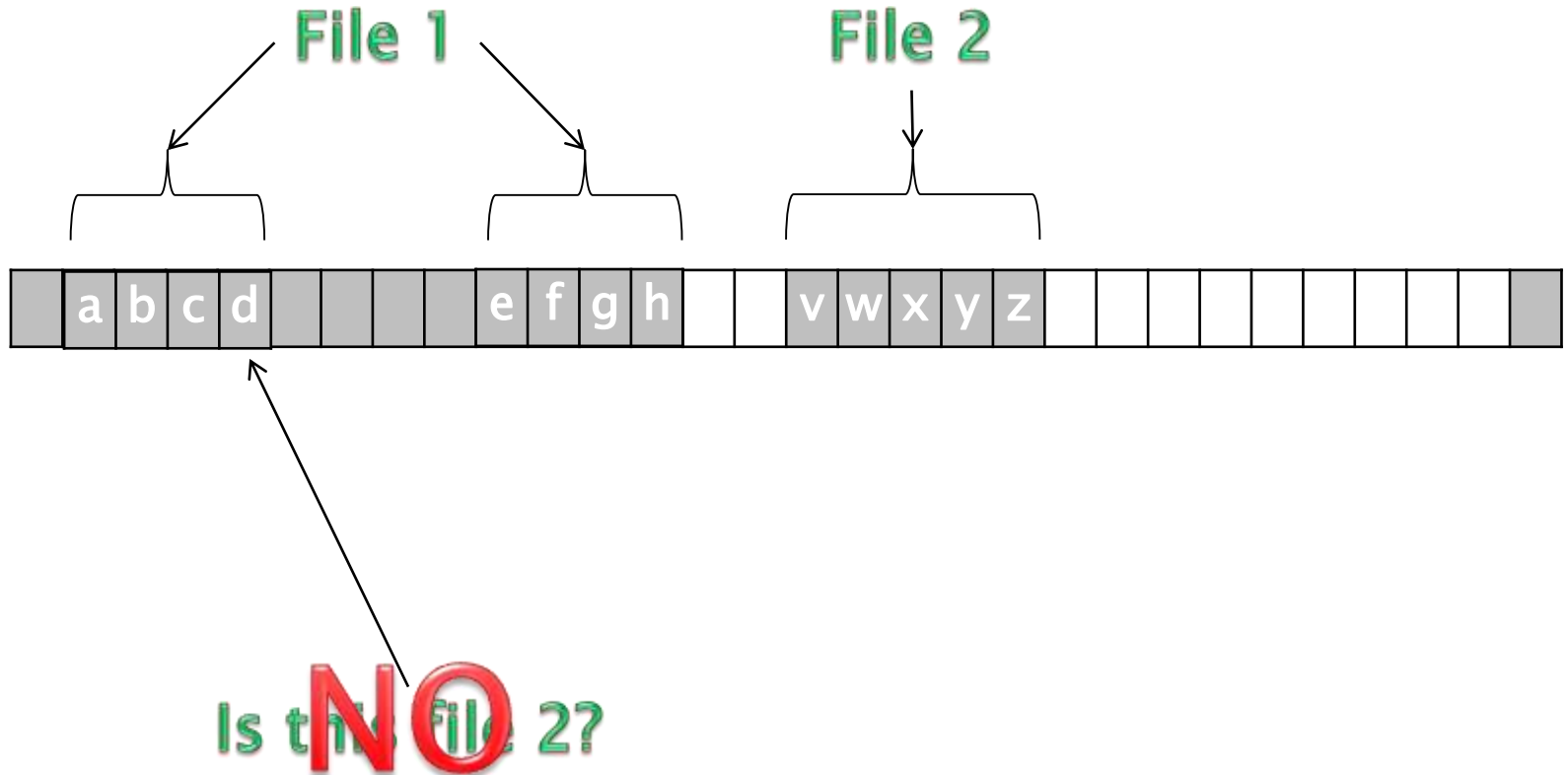
Indexed Storage



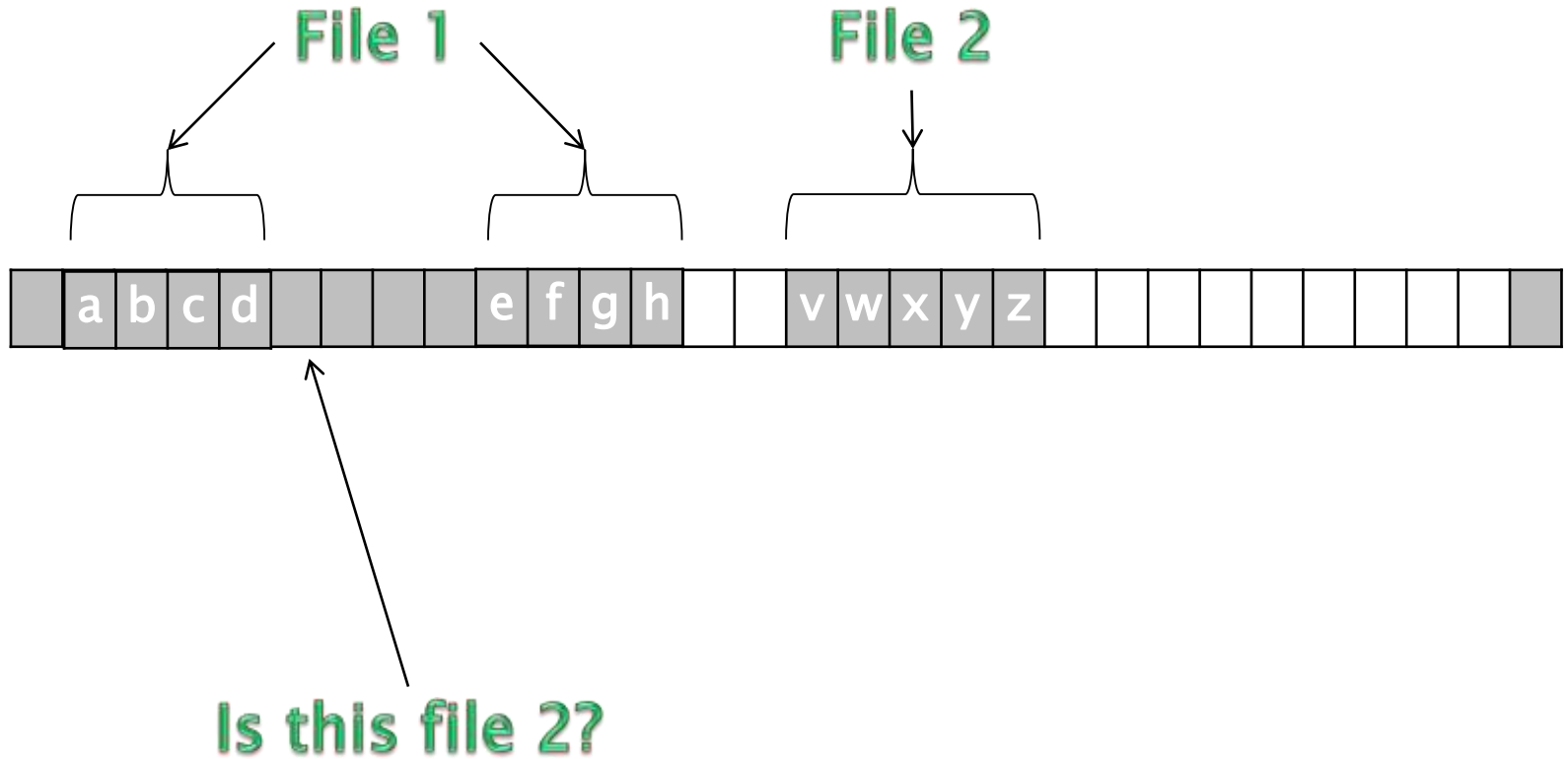
Indexed Storage



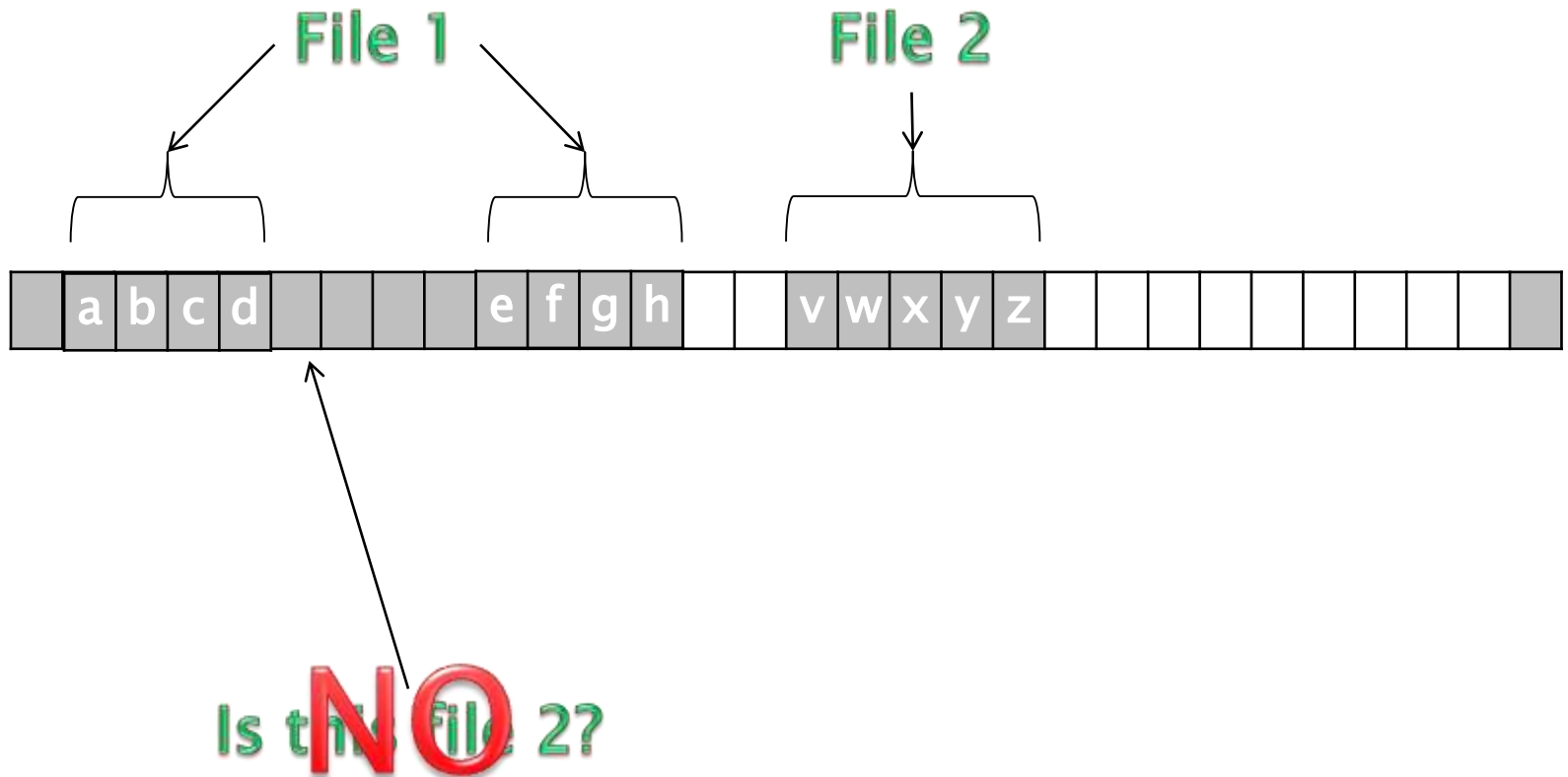
Indexed Storage



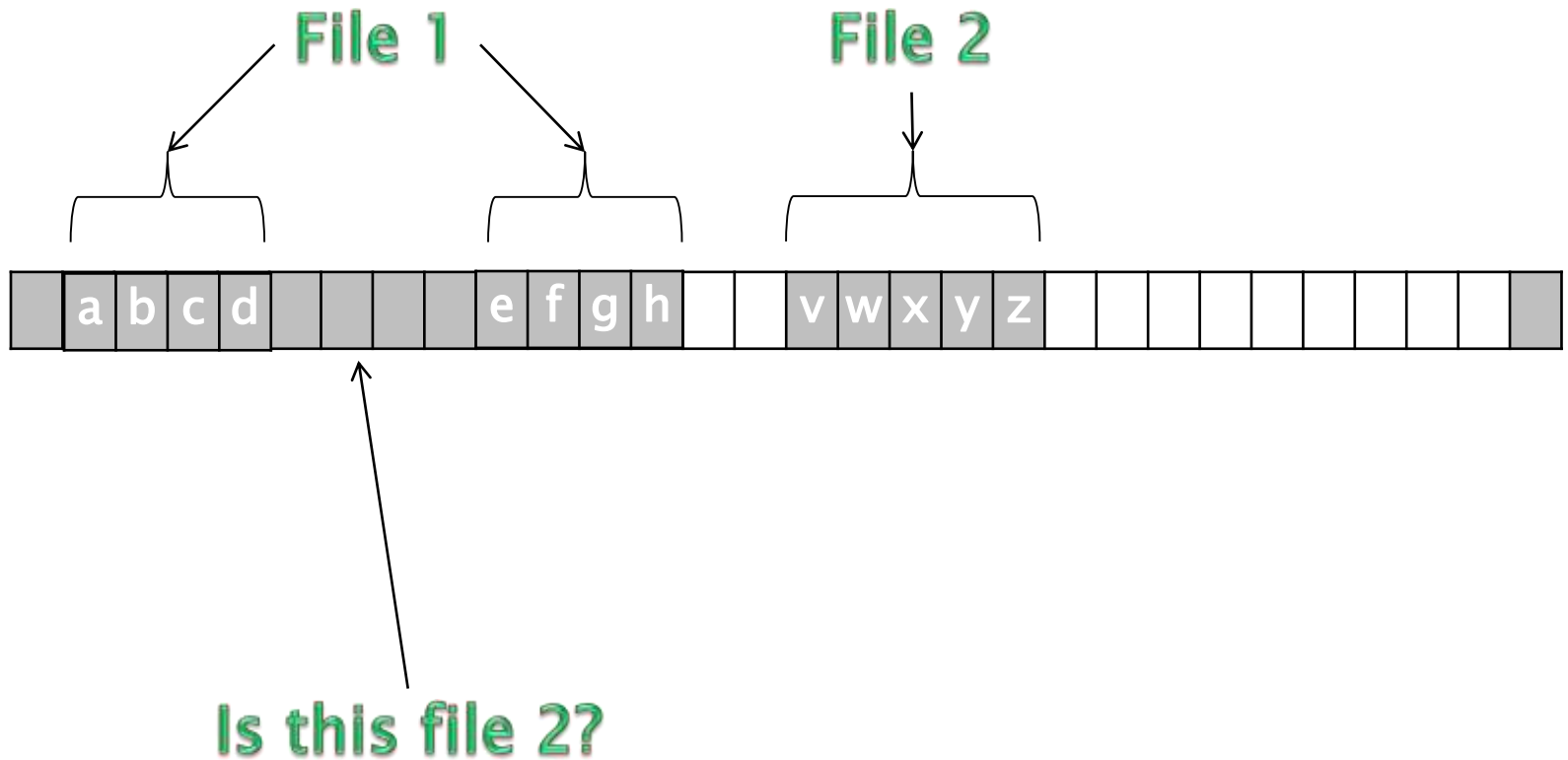
Indexed Storage



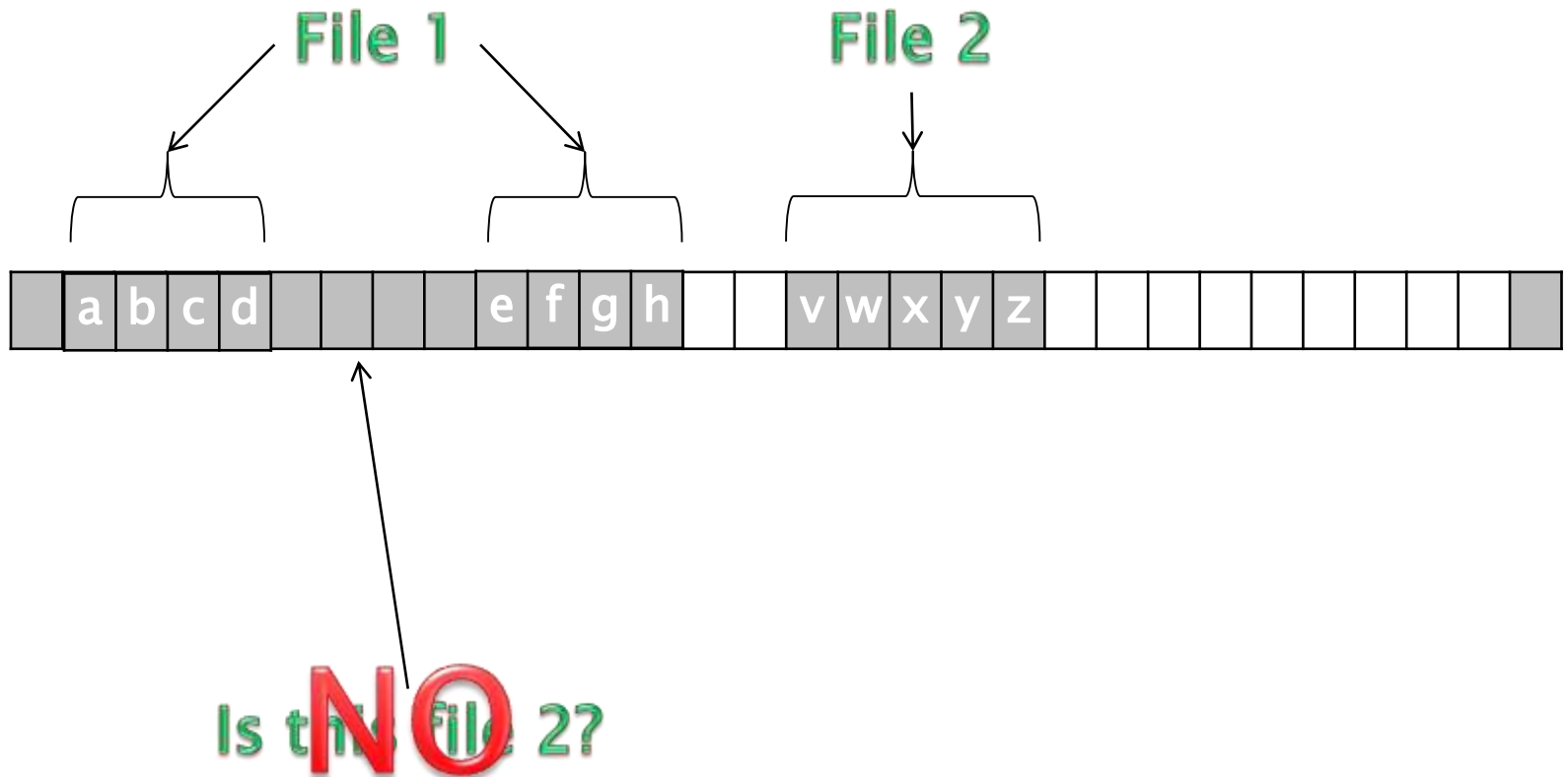
Indexed Storage



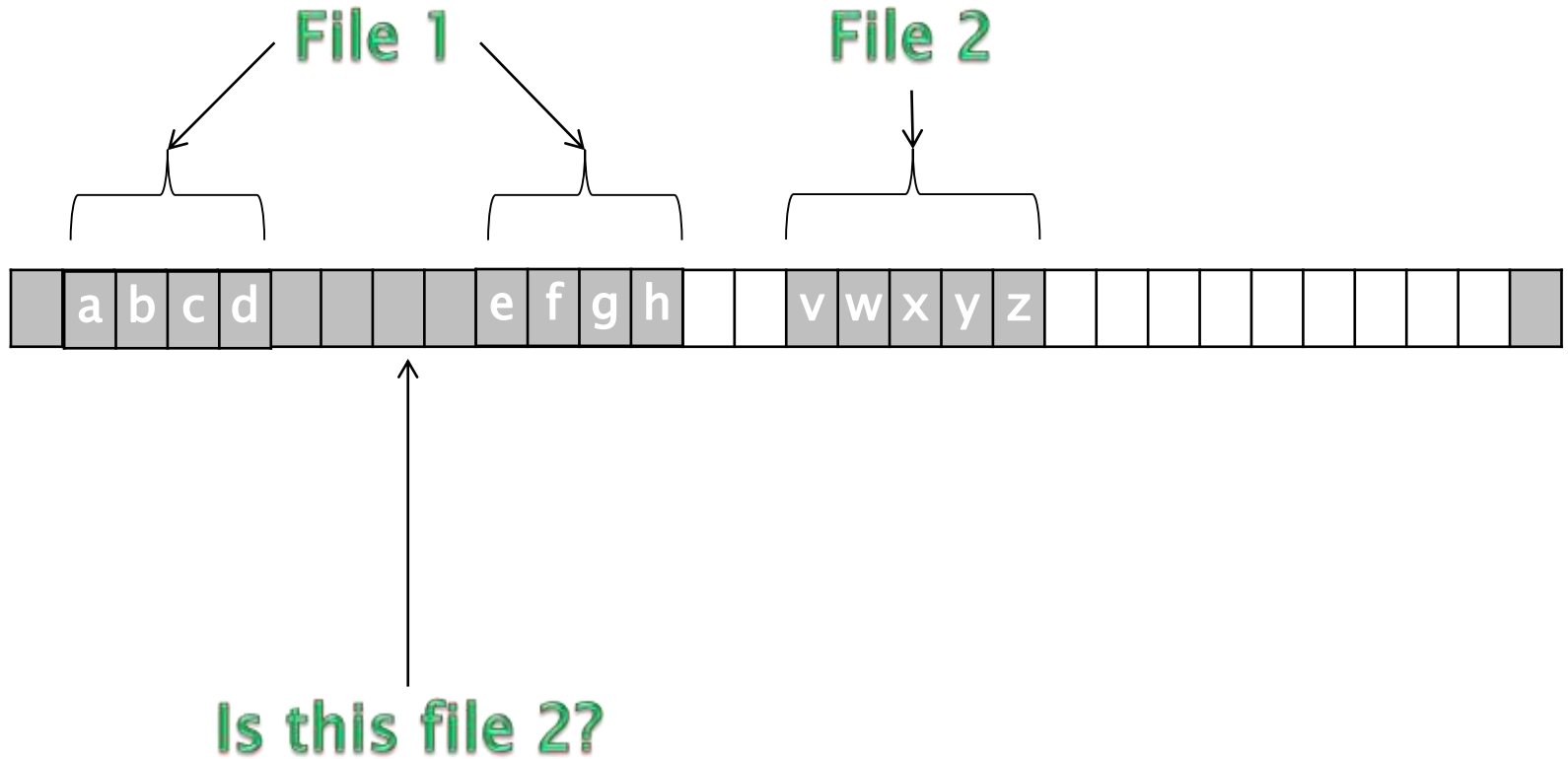
Indexed Storage



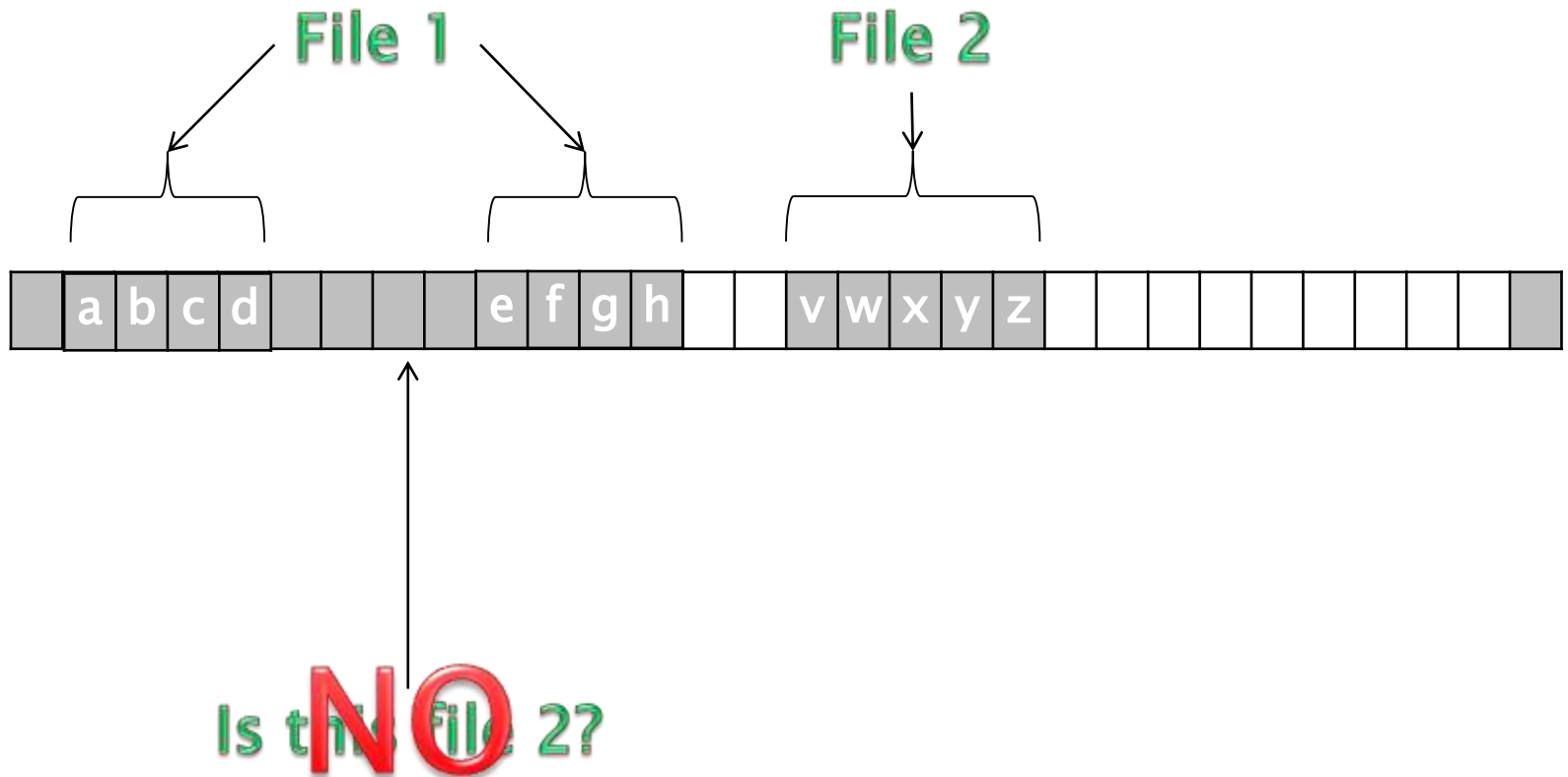
Indexed Storage



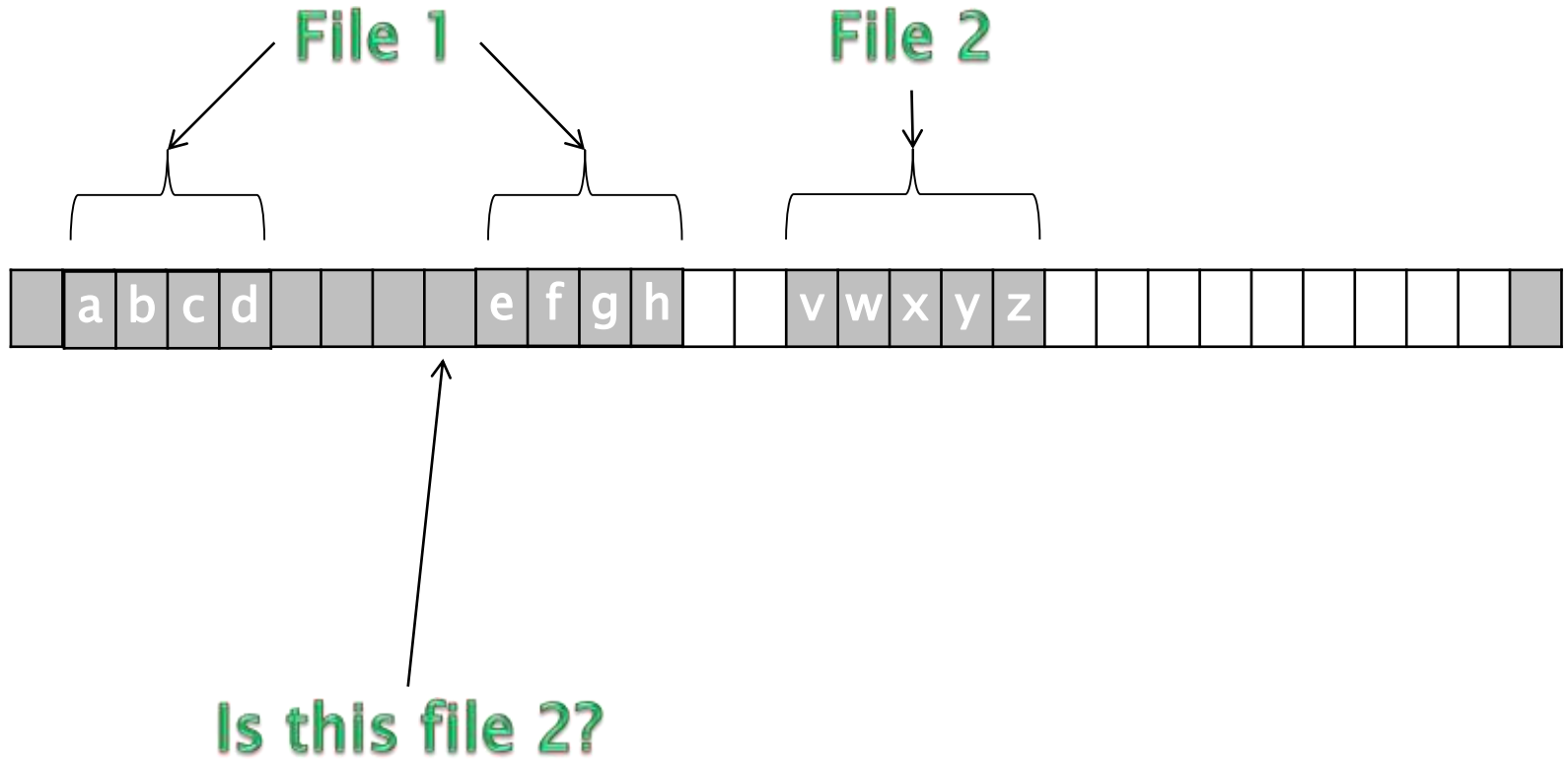
Indexed Storage



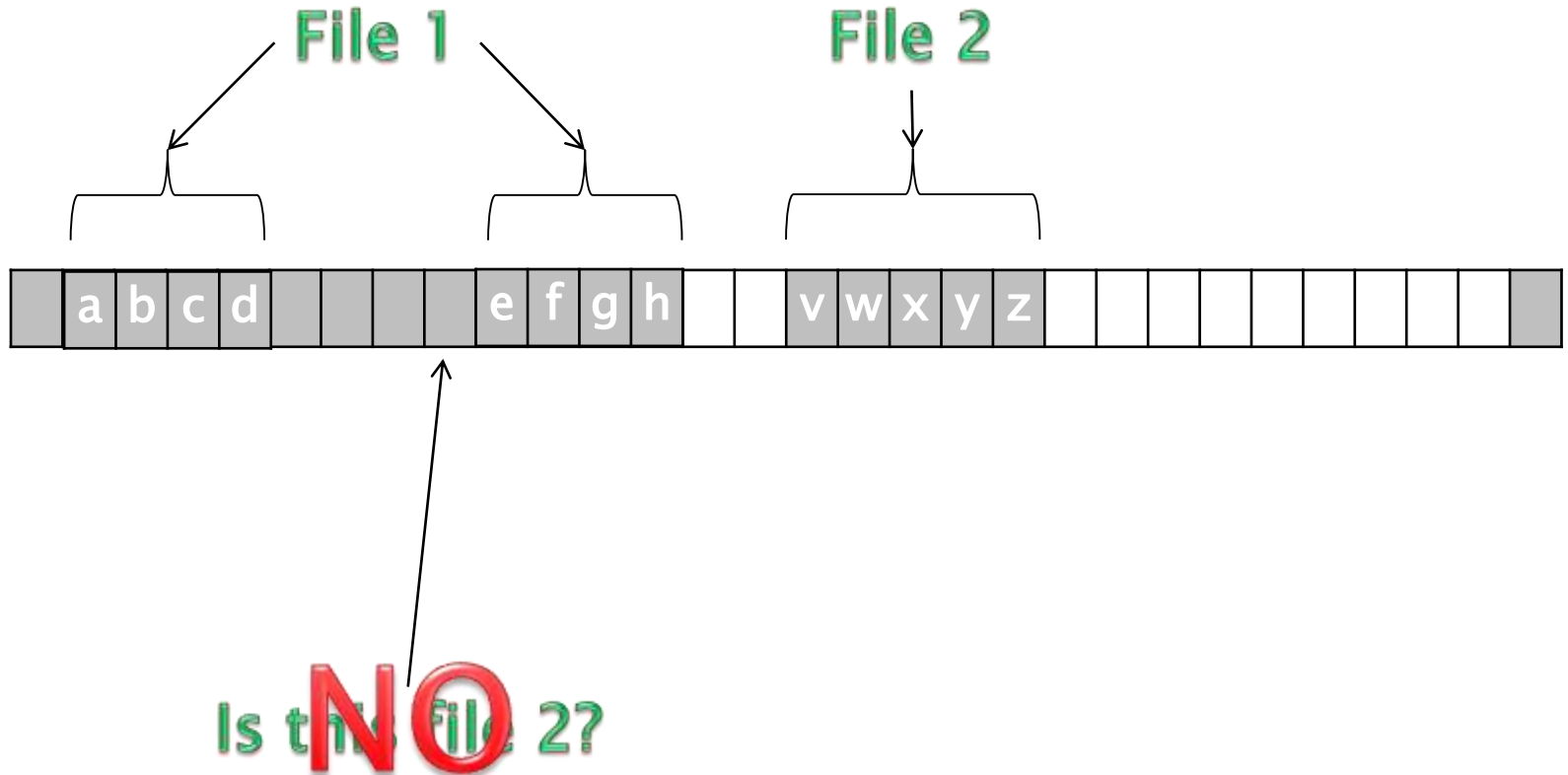
Indexed Storage



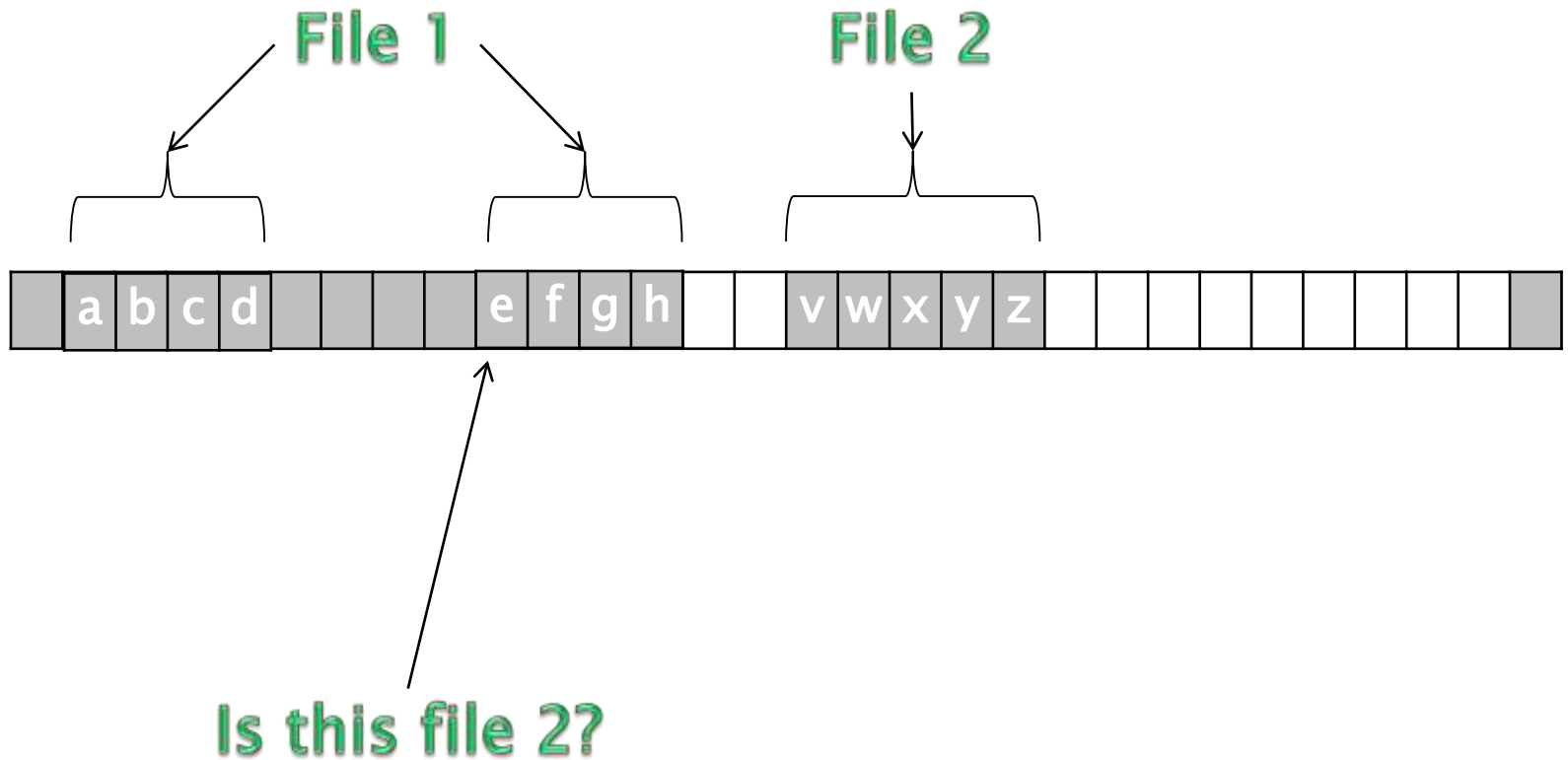
Indexed Storage



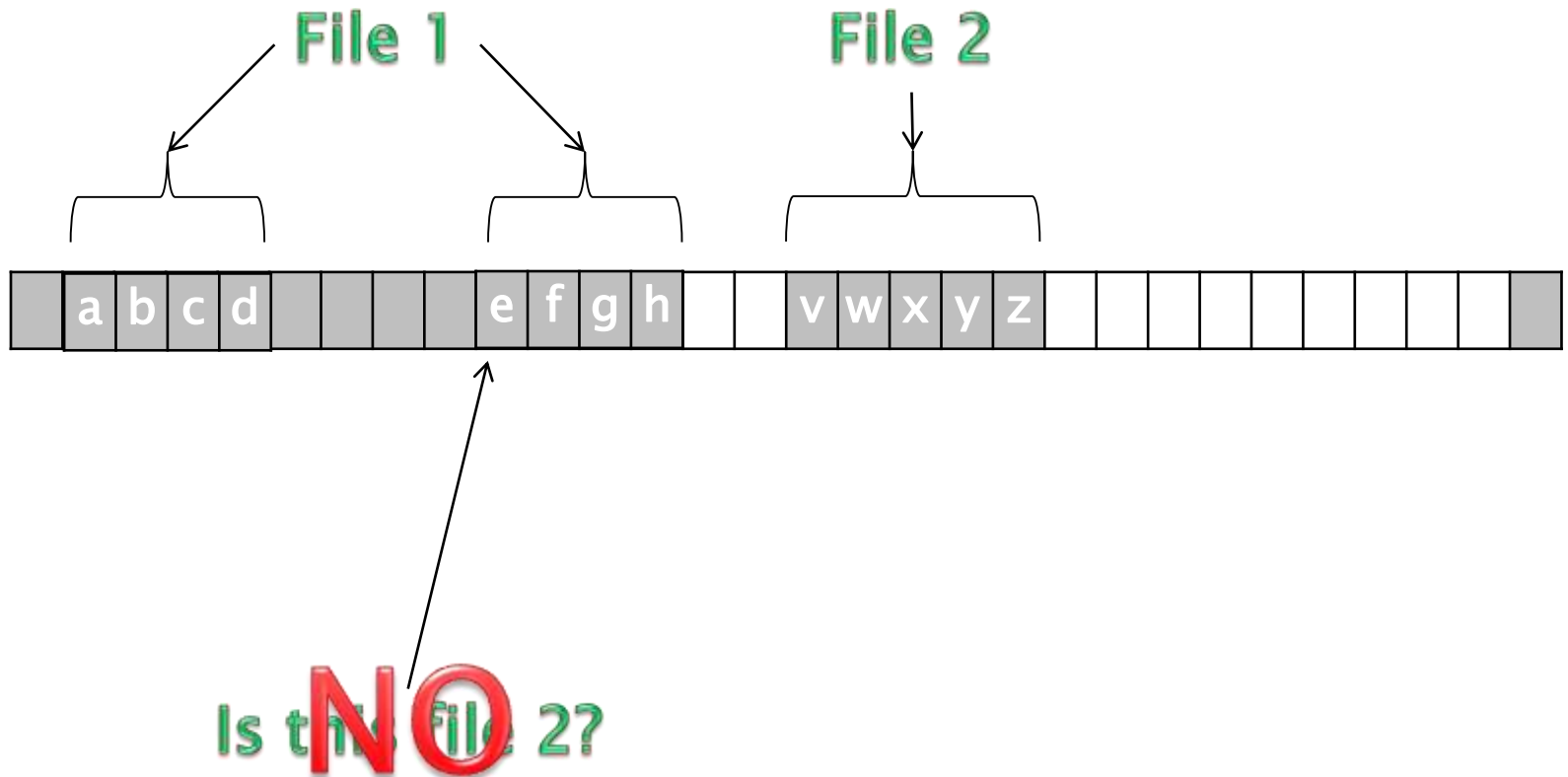
Indexed Storage



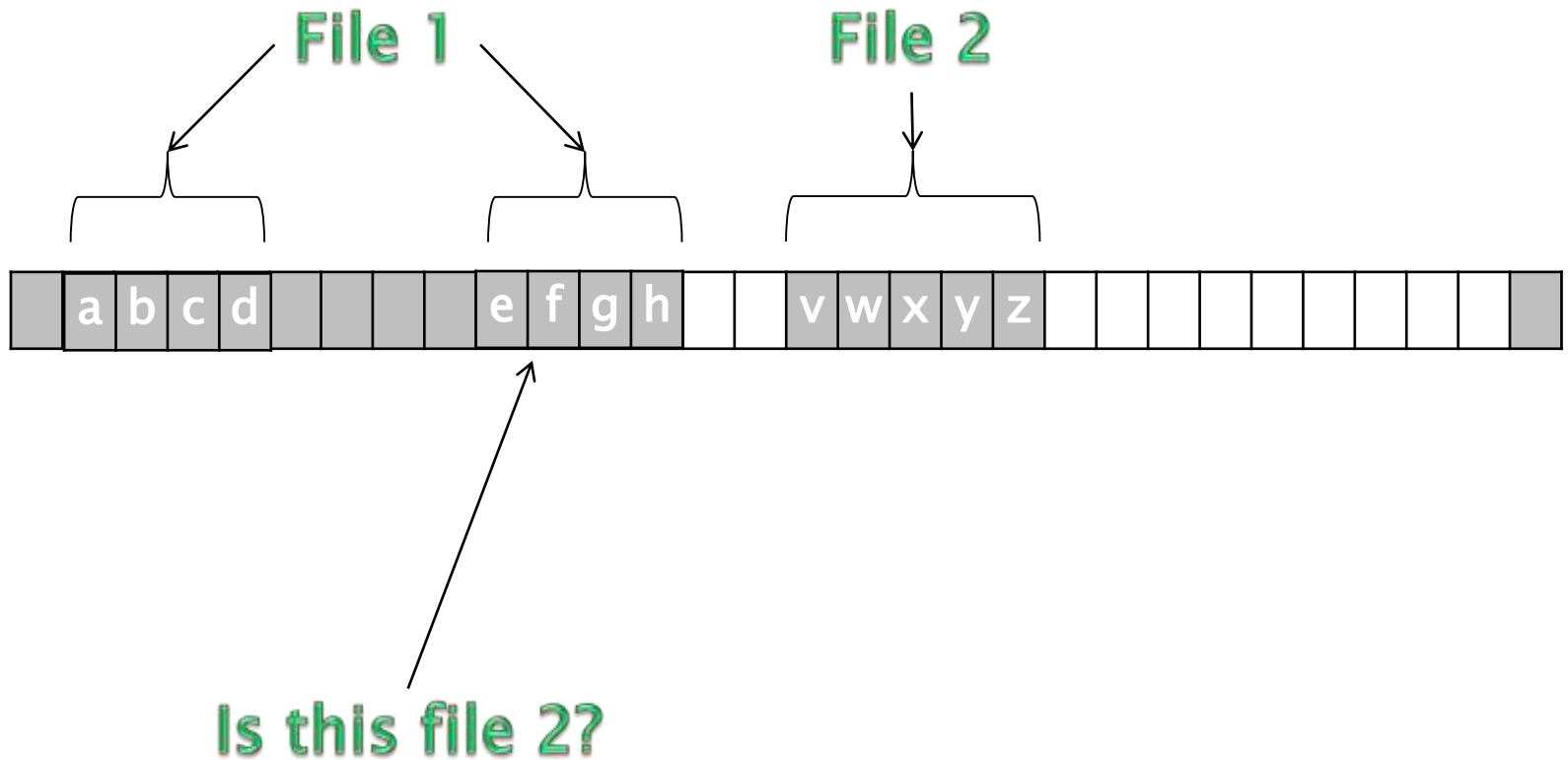
Indexed Storage



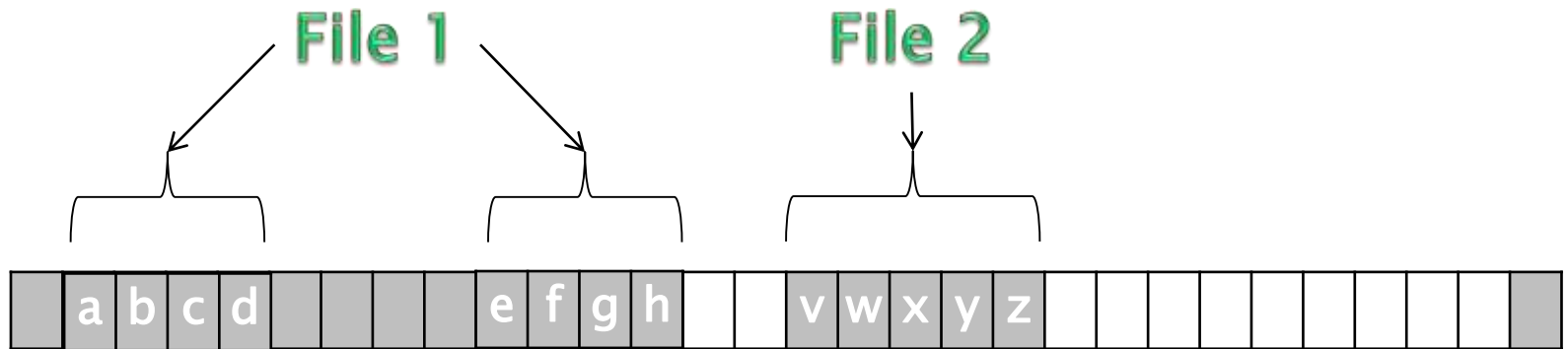
Indexed Storage



Indexed Storage

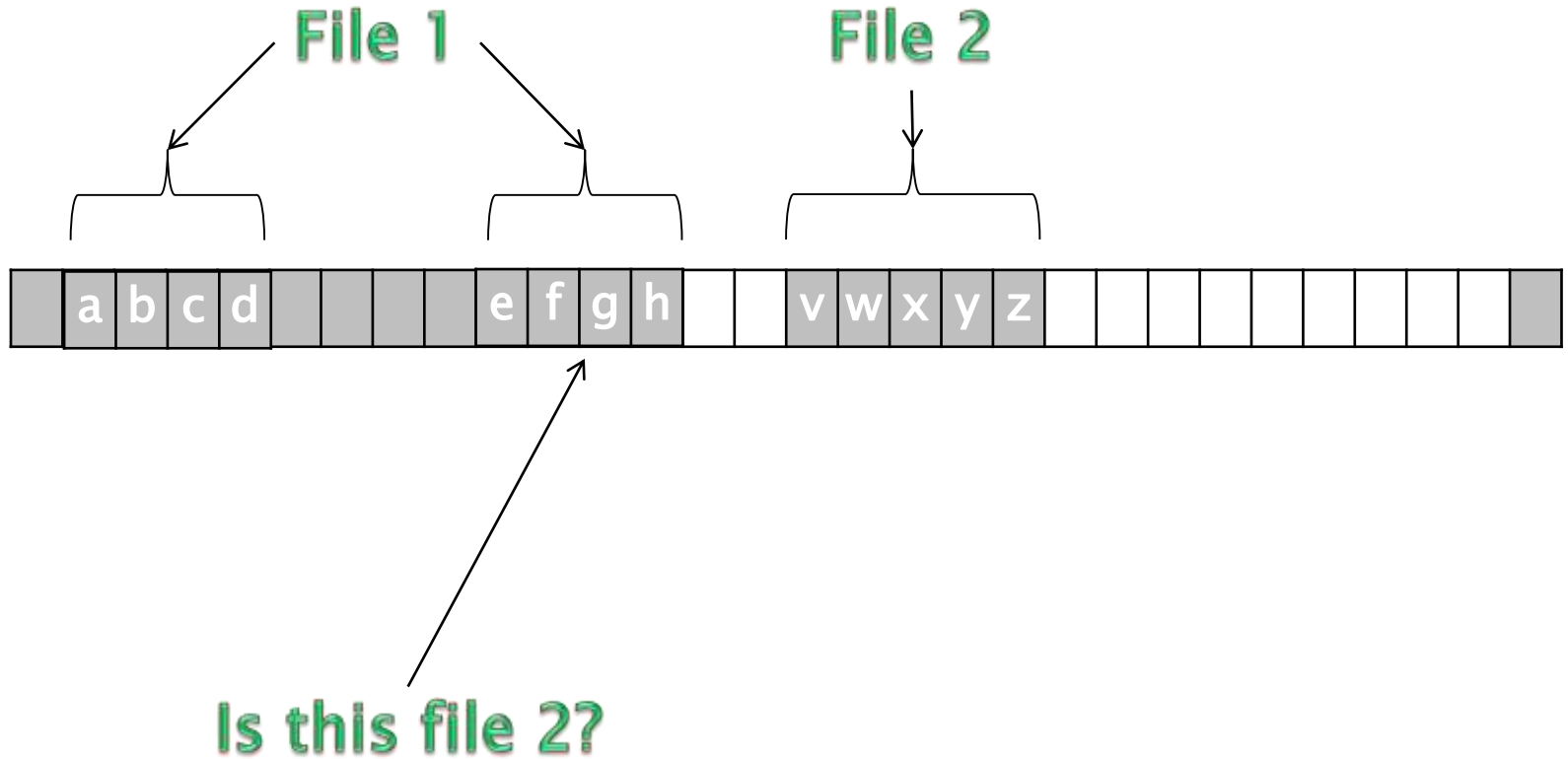


Indexed Storage

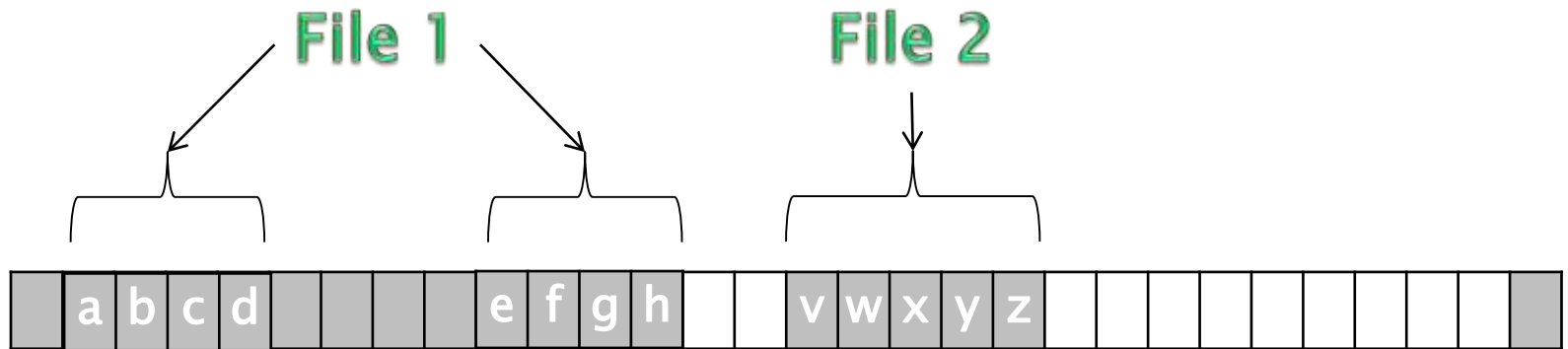


Is this File 2?
NO

Indexed Storage



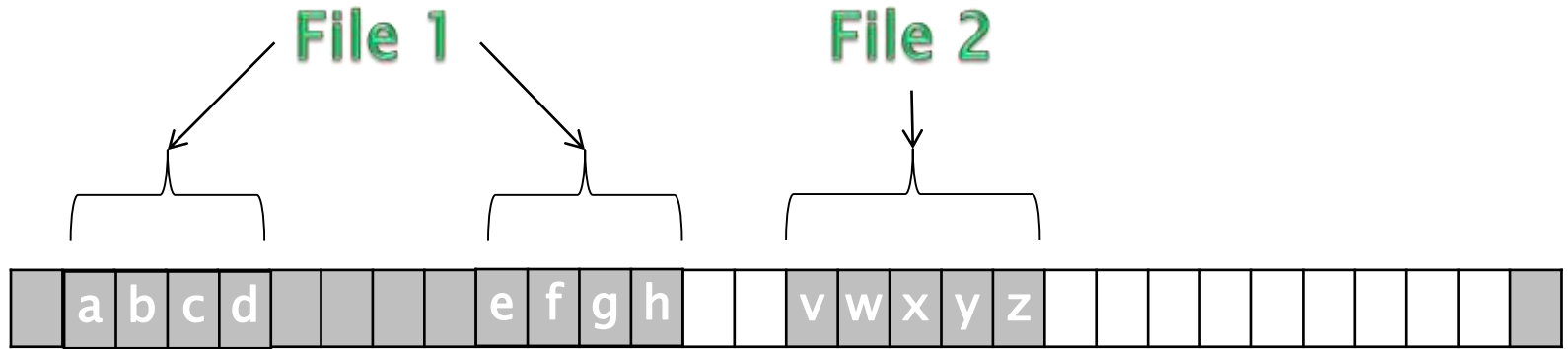
Indexed Storage



Is this File 2?

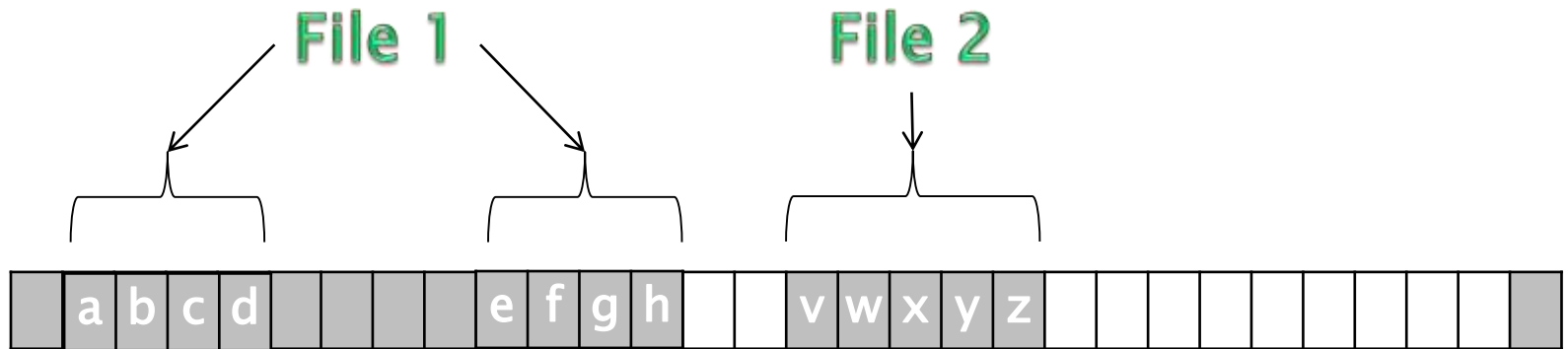
NO

Indexed Storage



Is this file 2?

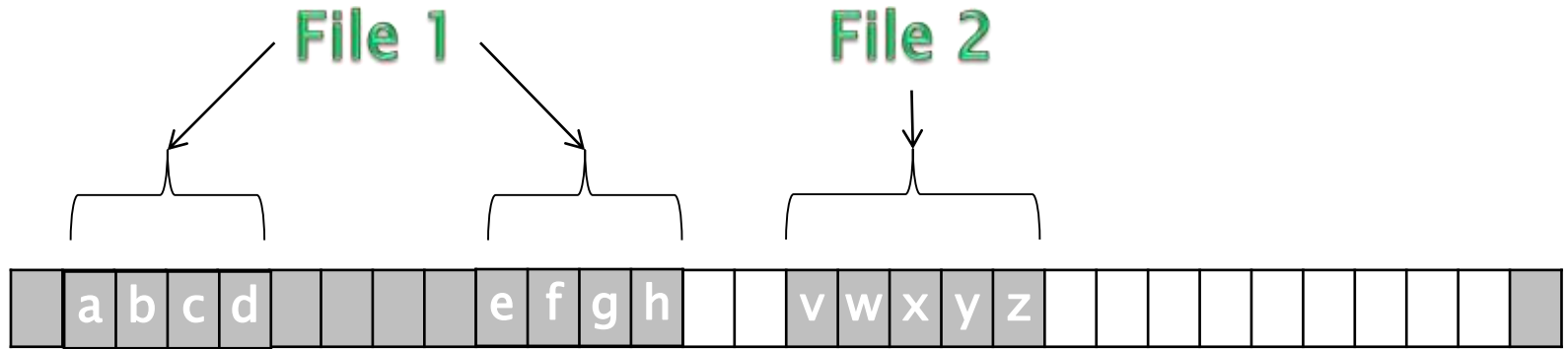
Indexed Storage



Is this File 2?

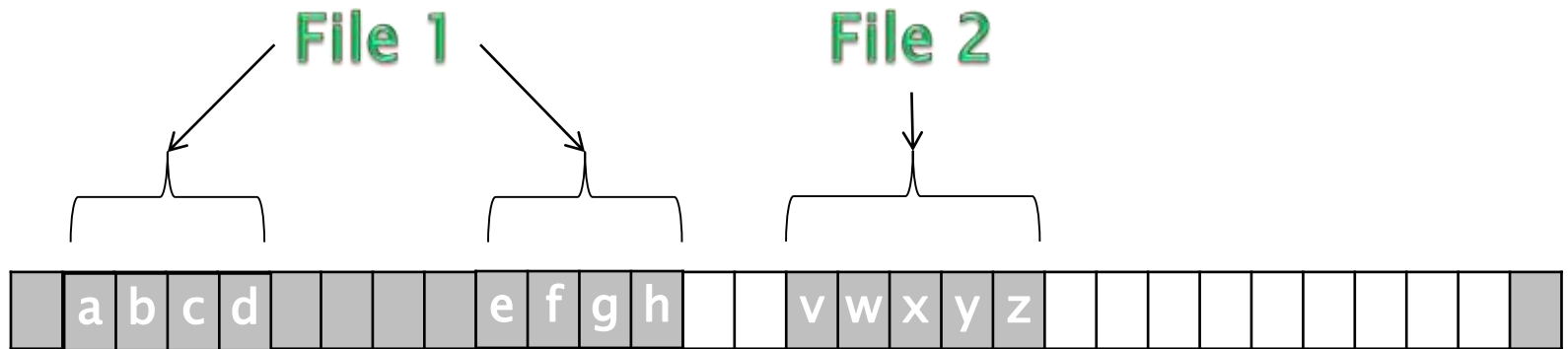
NO

Indexed Storage



Is this file 2?

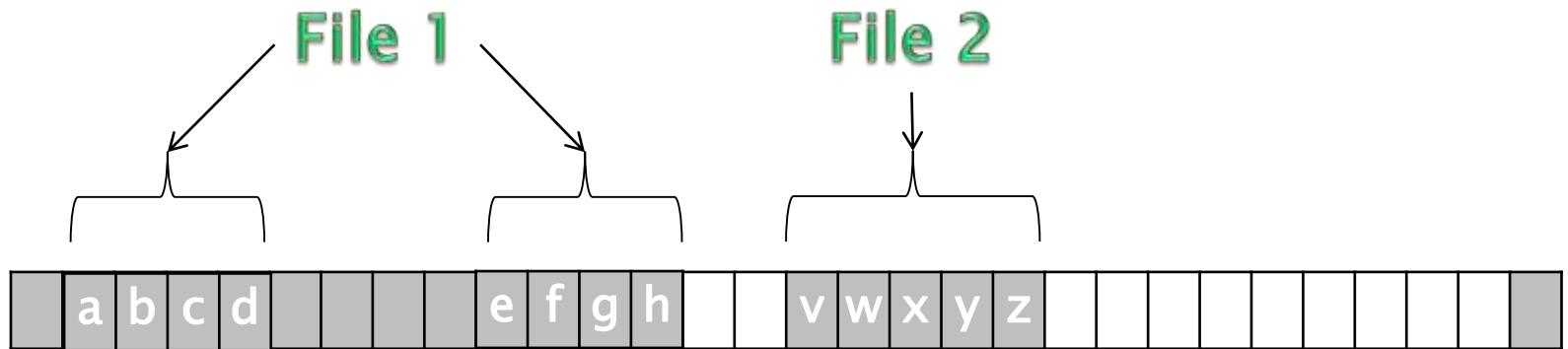
Indexed Storage



Is this File 2?

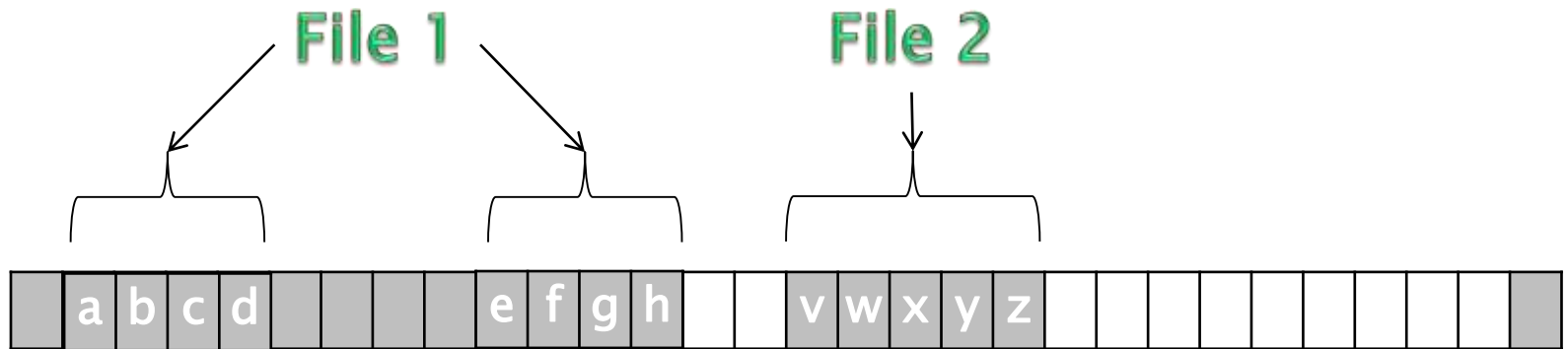
NO

Indexed Storage



Is this file 2?

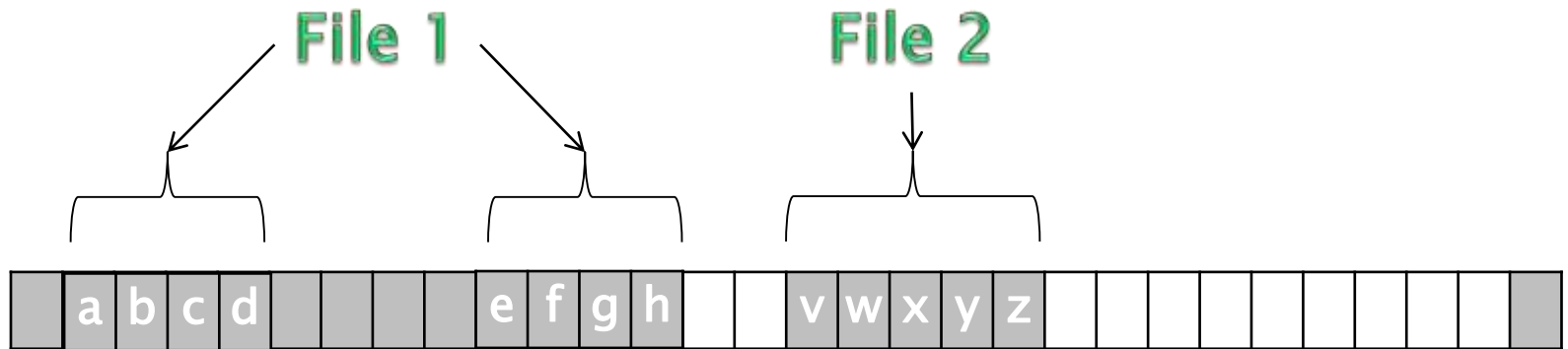
Indexed Storage



Is this File 2?

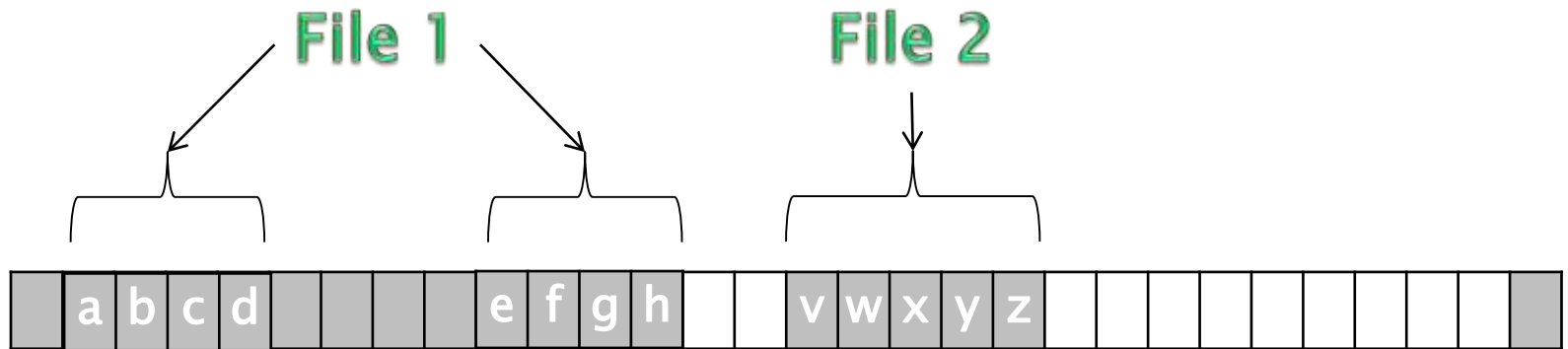
NO

Indexed Storage



Is this file 2?

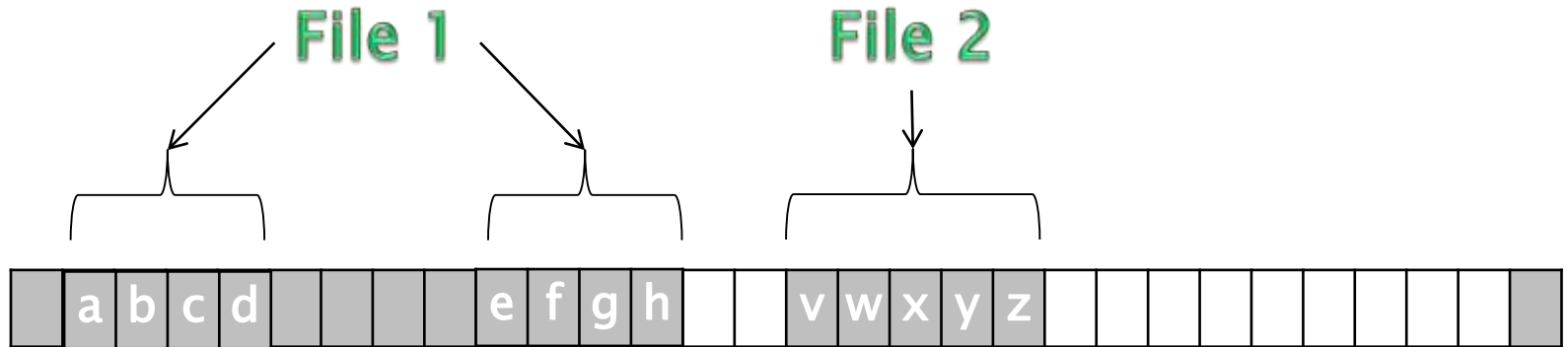
Indexed Storage



YES

Is this file 2?

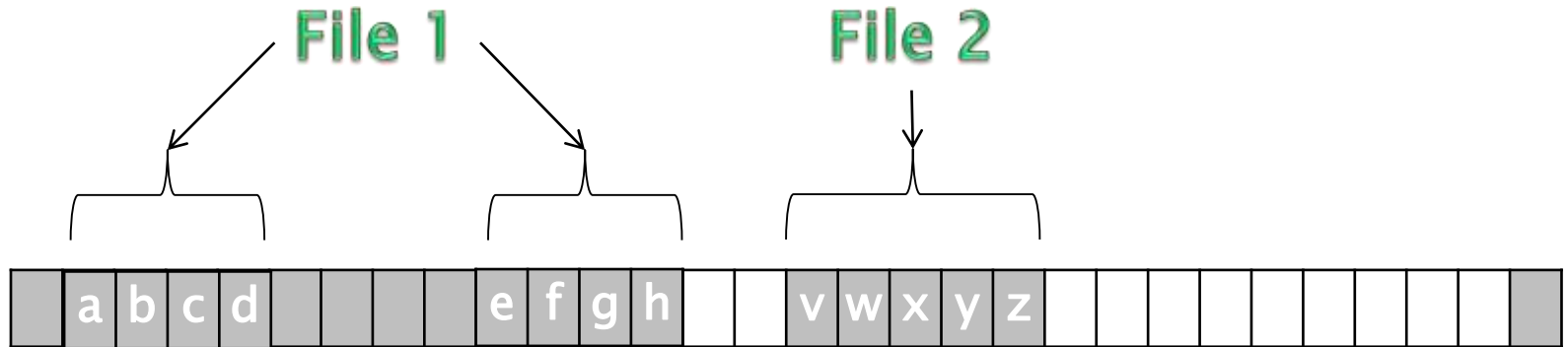
Indexed Storage



File 1: **abcdefgh**

File 2: **vwxyz**

Indexed Storage

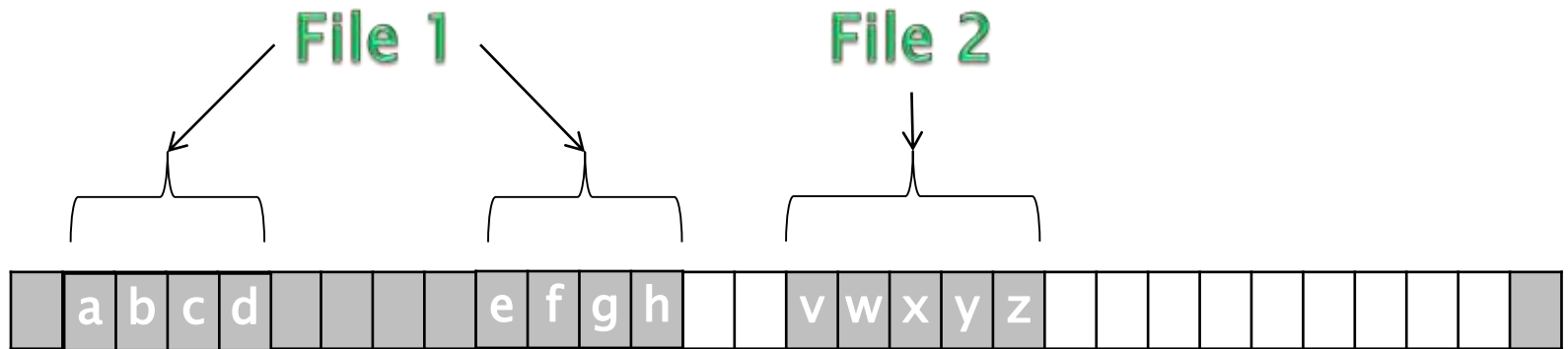


File 1: **abcdefgh**

File 2: **vwxyz**

So how does it work with
an INDEX BLOCK?

Indexed Storage



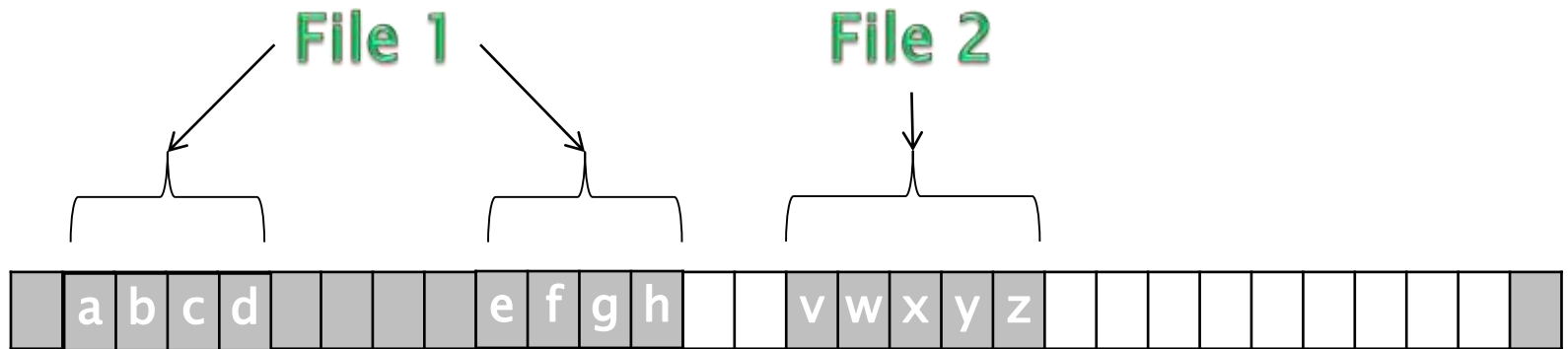
File 1: **abcdefgh**

File 2: **vwxyz**

INDEX BLOCK:

File	Address	Size	Next
File 1	1	4	9
File 1	9	4	–
File 2	15	5	–

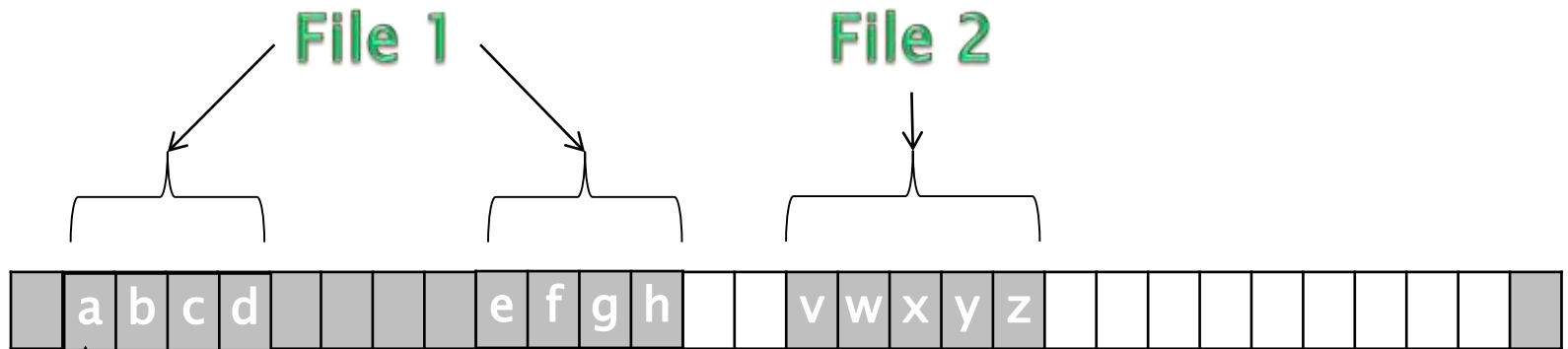
Indexed Storage



INDEX BLOCK:

File	Address	Size	Next
File 1	1	4	9
File 1	9	4	–
File 2	15	5	–

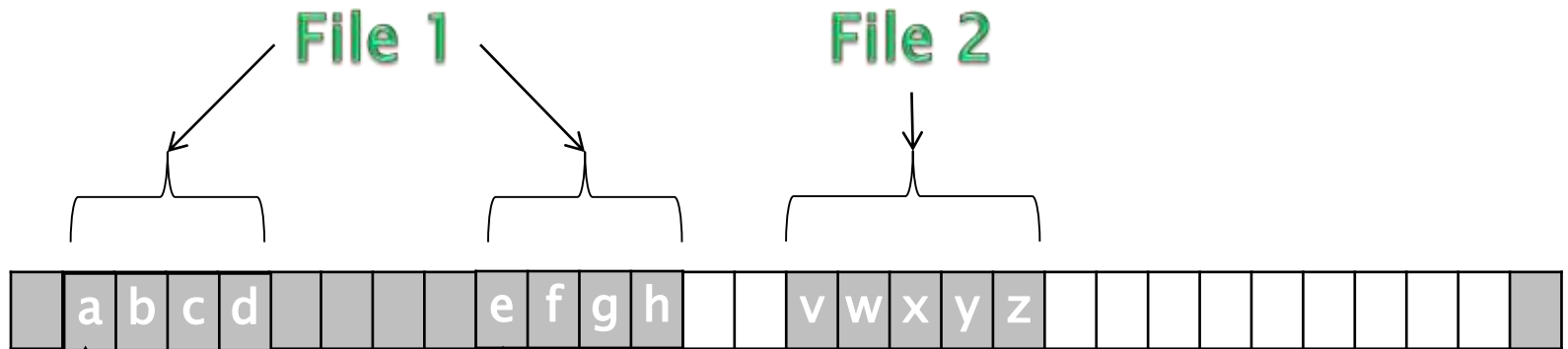
Indexed Storage



INDEX BLOCK:

File	Address	Size	Next
File 1	1	4	9
File 1	9	4	–
File 2	15	5	–

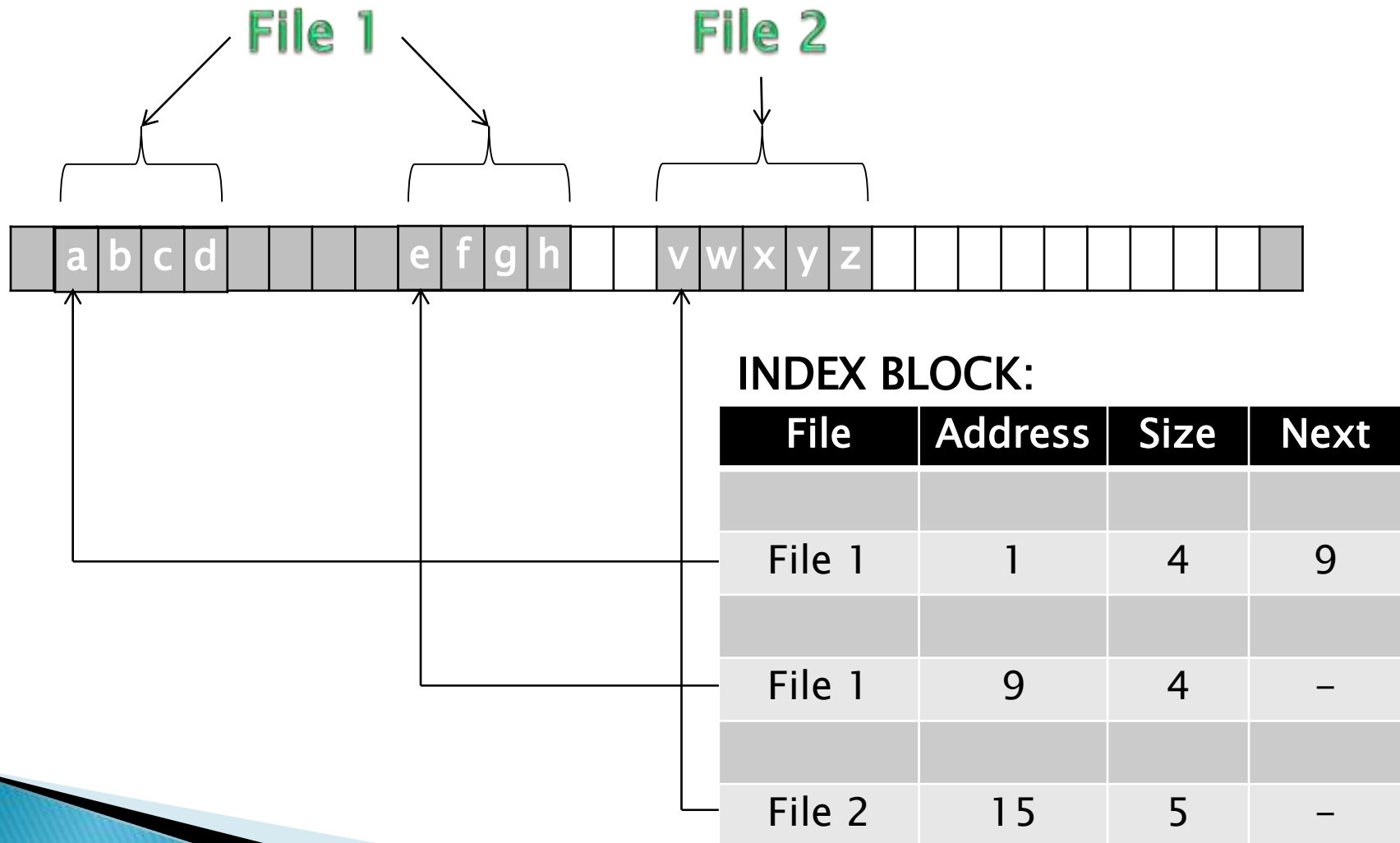
Indexed Storage



INDEX BLOCK:

File	Address	Size	Next
File 1	1	4	9
File 1	9	4	–
File 2	15	5	–

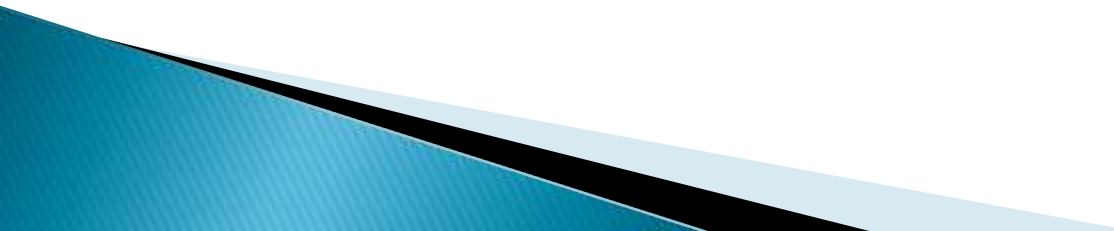
Indexed Storage



Indexed Storage

- ▶ This support both sequential and direct access to records, and for larger files there can be multiple indexes.

Access Control Matrix

- ▶ The Access Control Matrix shows the access that each user has for each file on the system. The possible accesses are:
 - **R: Read**
 - **W: Write**
 - **E: Execute**
 - **D:Delete**
- 

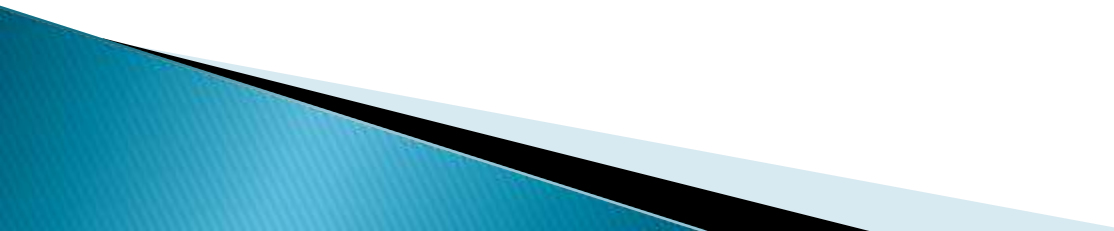
Access Control Matrix

	<i>User 1</i>	<i>User 2</i>	<i>User 3</i>	<i>User 4</i>	<i>User 5</i>
File 1	RWED	--E-	--E-	RWED	R----
File 2	-----	R-E-	R-E-	R----	RWE-
File 3	R-E-	RW--	R-E-	R-E-	R--D
File 4	R----	RWE-	R----	RWED	--E-

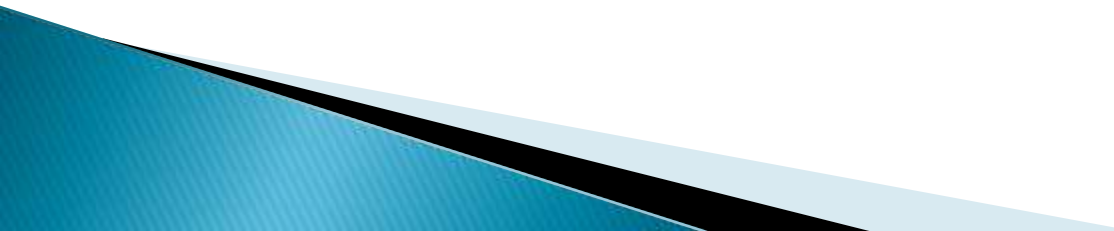
Access Control Matrix

	<i>Mary</i>	<i>Anne</i>	<i>Tom</i>	<i>Bob</i>	<i>Lyn</i>
Word. exe	RWED	--E-	--E-	RWED	R-E-
Lect1. ppt	-----	R-E-	R-E-	R----	RWE-
Scan. Exe	R-E-	RW--	R-E-	R-E-	R-ED
Chrome. exe	R-E-	RWE-	R-E-	RWED	--E-

Access Control Matrix

- ▶ In DOS the Access Controls are:
 - R: Read
 - W: Write
 - C: Change
 - F: Full Control
- 

Access Control Matrix

- ▶ In DOS access to a file can assigned to one of two groups:
 - ▶ User
 - ▶ User Group
- 

Access Control Matrix

- ▶ In DOS if we want to grant permissions to file, e.g. MakeABackup.bat, we do:
- ▶ **cac1s**

Access Control Matrix

- ▶ In DOS if we want to grant permissions to file, e.g. MakeABackup.bat, we do:
- ▶ `cac1s filename arguments`

Access Control Matrix

- ▶ In DOS if we want to grant permissions to file, e.g. MakeABackup.bat, we do:
- ▶ **cac1s** filename [/T] [/M] [/L] [/S[:SDDL]] [/E] [/C] [/G user:?] [/R user [...]] [/P user:? [...]] [/D user [...]]

Access Control Matrix

- ▶ In DOS cacls works as follows:

Argument	Description
filename	Display access control lists (ACLs) of file
/T	Changes ACLs of specified files in the current directory and all subdirectories.
/M	Changes ACLs of volumes mounted to a directory.
/L	Work on the Symbolic Link itself versus the target.
/S	Displays the SDDL string for the DACL.
/S:SDDL	Replaces the ACLs with those specified in the SDDL string (not valid with /E, /G, /R, /P, or /D).

Access Control Matrix

- ▶ In DOS cacs works as follows:

Argument	Description
/E	Edit ACL instead of replacing it.
/C	Continue on access denied errors.
/G user:?	Grant specified user access rights. ? can be: R, W, C, or F
/R user	Revoke specified user's access rights (only valid with /E).
/P user:?	Replace specified user's access rights. ? can be: R, W, C, or F
/D user	Deny specified user access.

Access Control Matrix

- ▶ **Add Read-Only permission to a single file**

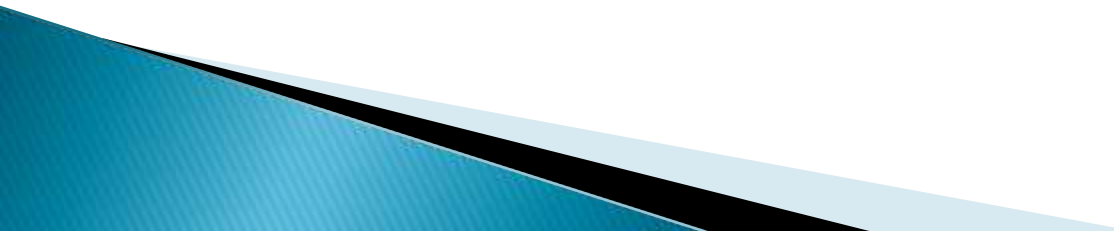
```
CACLS MakeABackup.bat /E /G "Power Users":R
```

- ▶ **Add Full Control permission to a second group of users**

```
CACLS MakeABackup.bat /E /G "FinanceUsers":F
```

- ▶ **Now revoke the Read permissions from the first group**

```
CACLS MakeABackup.bat /E /R "Power Users"
```



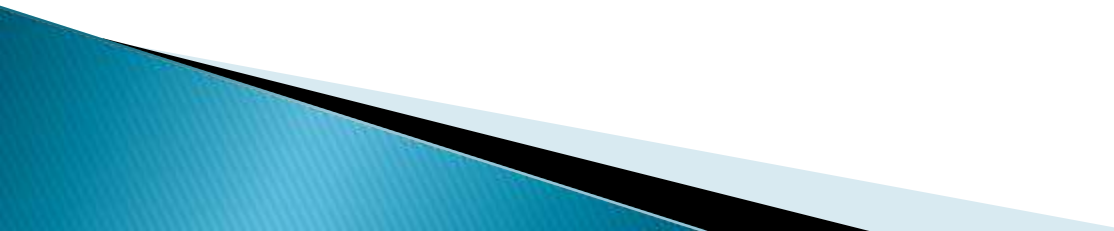
Access Control Matrix

- ▶ Now give the first group Full Control

```
CACLS MakeABackup.bat /E /G "Power Users":F
```

- ▶ Give Finance group Full Control of folder and all sub-folders

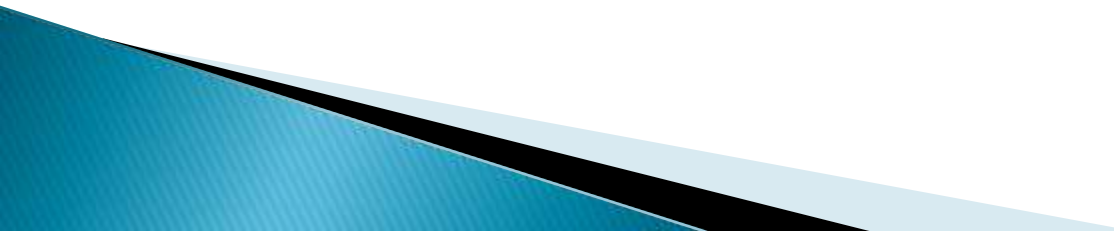
```
CACLS c:\docs\work /E /T /C /G "FinanceUsers":F
```



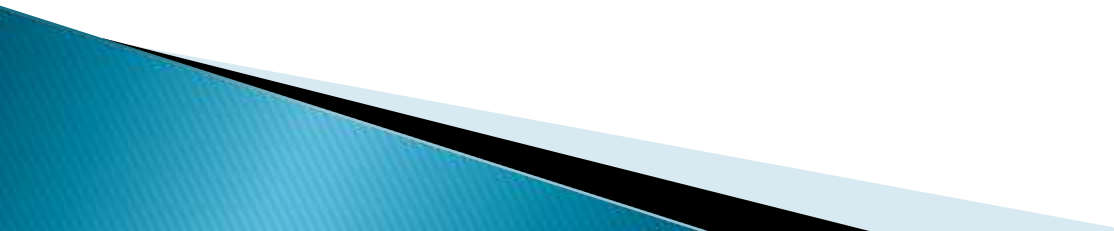
Access Control Matrix

- ▶ In Linux/Unix the Access Controls are:
 - R: Read
 - W: Write
 - X: Execute

Access Control Matrix

- ▶ In Linux/Unix access to a file can assigned to one of three groups:
 - ▶ User
 - ▶ User Group
 - ▶ World
- 

Access Control Matrix

- ▶ In Linux/Unix access to a file can assigned to one of three groups:
 - ▶ User –you
 - ▶ User Group – everyone in your group
 - ▶ World – everyone with a login to the system
- 

Access Control Matrix

- ▶ In Linux/Unix access to a file can be assigned to one of three groups:

-rwXrwXrwX

User User Group World

Access Control Matrix

- ▶ In Linux/Unix access to a file can assigned to one of three groups:
- ▶ **-rwxrwxrwx**
- ▶ **-11111111**

Access Control Matrix

- ▶ In Linux/Unix access to a file can assigned to one of three groups:
- ▶ **-rwxr-xr-x**
- ▶ **-111101101**

Access Control Matrix

- ▶ In Linux/Unix access to a file can assigned to one of three groups:
- ▶ **-rwx--x--x**
- ▶ **-101001001**

Access Control Matrix

- ▶ In Linux/Unix access to a file can be assigned to one of three groups:

- ▶ **-rwxrwxrwx**

- ▶ **-11111111**

- ▶ **- 7 7 7**

Access Control Matrix

- ▶ In Linux/Unix access to a file can assigned to one of three groups:
- ▶ **-rwxr-xr-x**
- ▶ **-111101101**
- ▶ **- 7 5 5**

Access Control Matrix

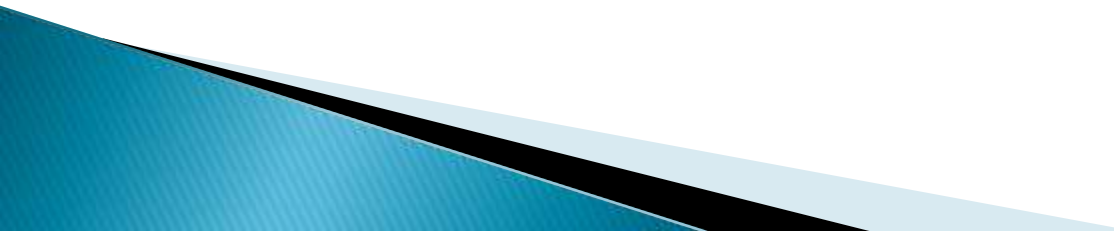
- ▶ In Linux/Unix access to a file can be assigned to one of three groups:

- ▶ **-rwx---x--x**

- ▶ **-111001001**

- ▶ **- 7 1 1**

Access Control Matrix

- ▶ If we want to grant permissions to file, e.g. MakeABackup.bat, we do:
 - ▶ `chmod 755 MakeABackup.sh`
 - ▶ `chmod 777 MakeABackup.sh`
 - ▶ `chmod 700 MakeABackup.sh`
- 

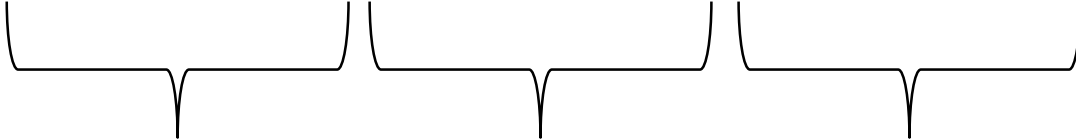
Access Control Matrix

- ▶ In Linux/Unix, access to a file can assigned to one of three groups:

▶ **-rwXrwXrwX**
 ▶ User User Group World

Access Control Matrix

- ▶ In Linux/Unix, access to a folder/directory can assigned to one of three groups:

- ▶ **drwxrwxrwx**

User User Group World

Access Control Matrix

```
Terminal ready.  
SANTA WEB LINUX - The JavaScript virtual OS and terminal application for the web.  
Type "info" for site information. Type "help" for available commands.  
-----  
[guest@freelinuxconsole.info:2]$ ls  
  
[guest@freelinuxconsole.info:2]$ ls -la  
drwxr-x---  2  guest    wheel    -----  2015/03/01 22:20:03  .  
drwxrwxrwx  2  root     wheel    -----  2015/03/01 22:20:03  ..  
-rw-----  1  guest    users      8  2015/03/01 22:20:03  .history  
[guest@freelinuxconsole.info:2]$
```