

OPERATING SYSTEMS INTERNALS

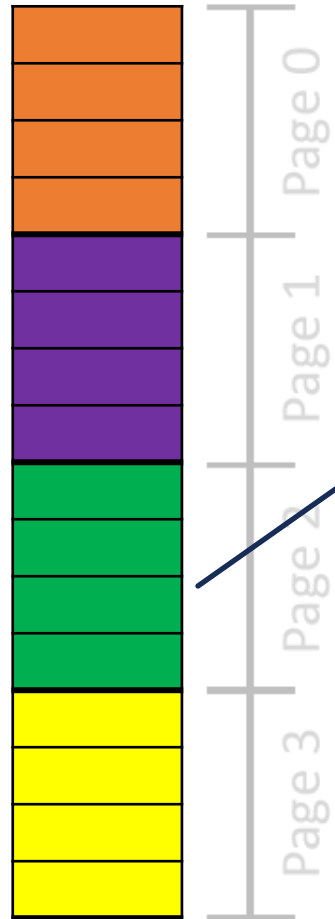
CSCI 509

PERFORMANCE ENHANCING TECHNIQUES

- Frame Buffering
- Prefetching and Superfetching
- Prepaging
- Memory Compression

FRAME BUFFERING

Logical memory



MMU / Memory Map

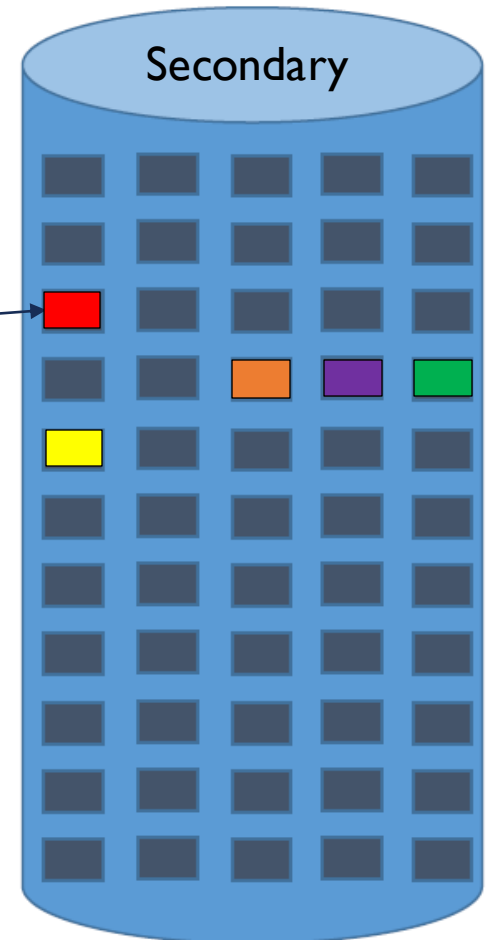
Page Table		
p	Frame	v/i
0		i
1	7	v
2		i
3	1	v
4		i
5		i
6		i
7		i



1. Select a victim frame
2. Write back to Secondary storage.

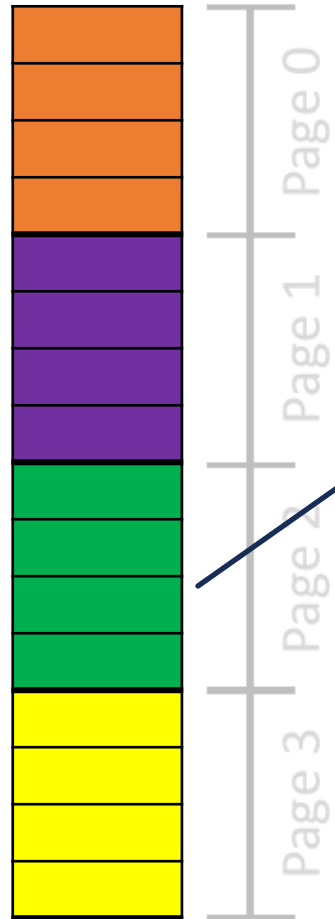
Frame	v/i
3	v
1	v
	i
	i

P2 Page Table



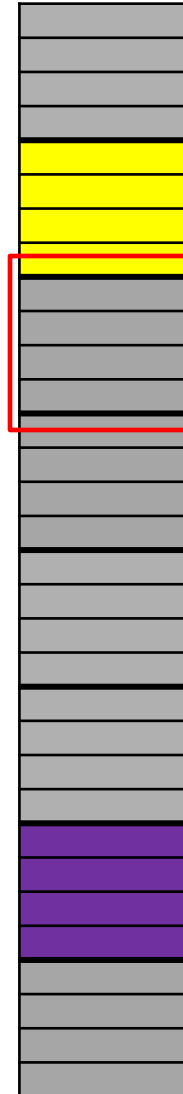
FRAME BUFFERING

Logical memory



MMU / Memory Map

Page Table		
p	Frame	v/i
0		i
1	7	v
2		i
3	1	v
4		i
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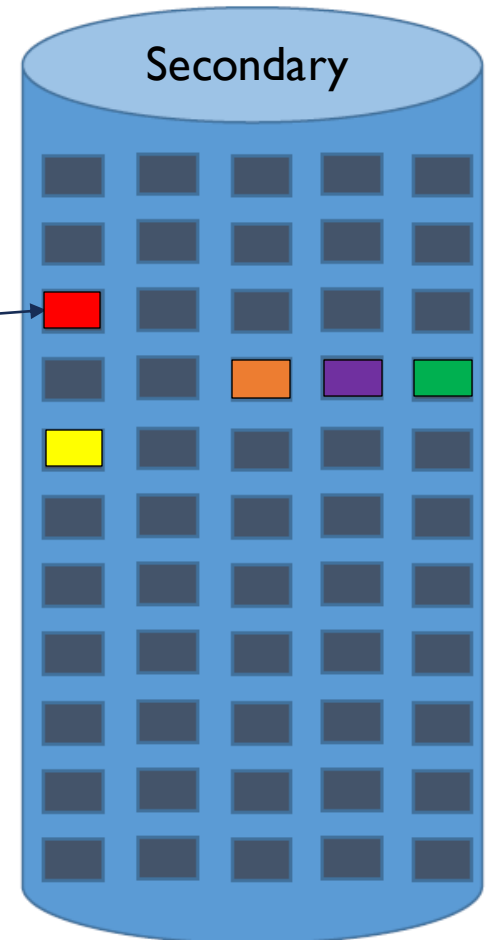


1. Select a victim frame
2. Write back to Secondary storage.

OS doesn't wait until the memory is full ...

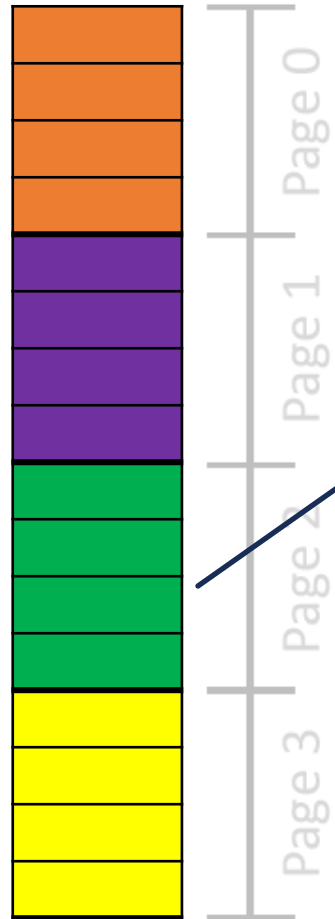
Frame	v/i
3	v
1	v
	i
	i

P2 Page Table



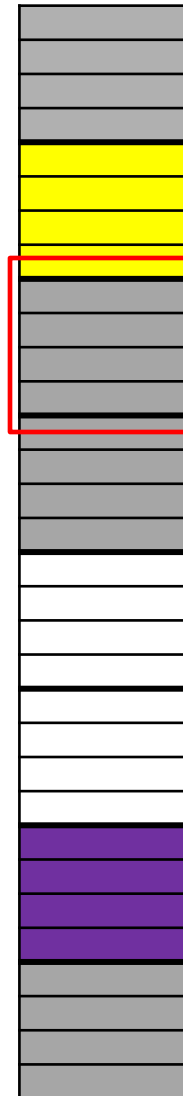
FRAME BUFFERING

Logical memory



MMU / Memory Map

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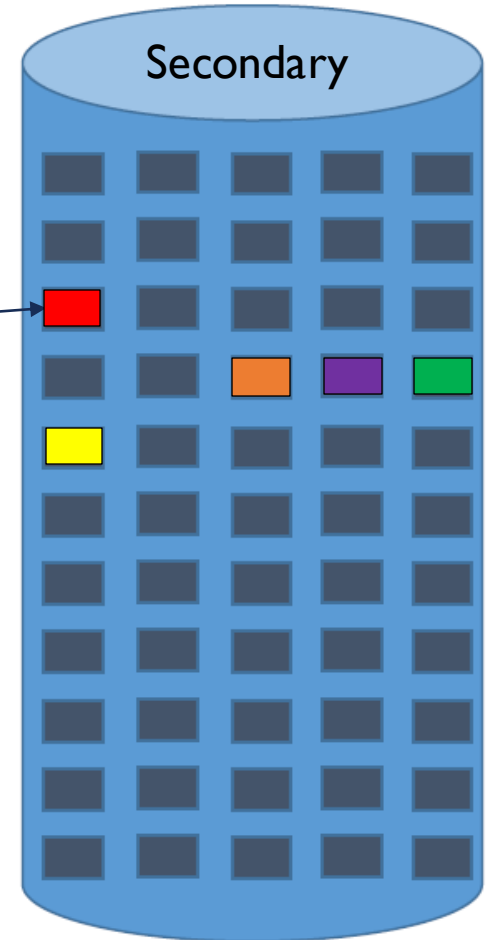


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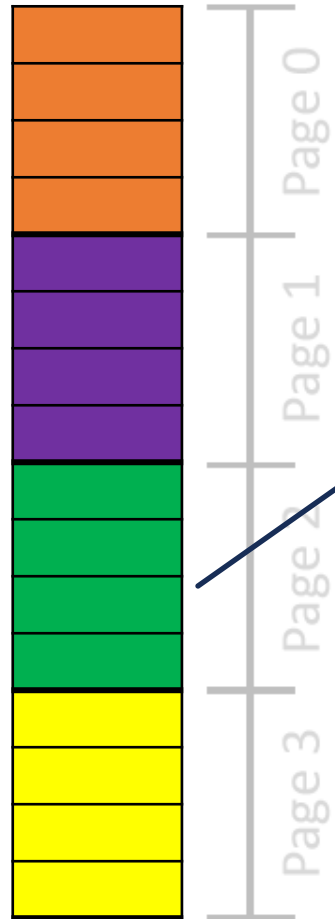
It keeps free frame available for "buffering"

Secondary



FRAME BUFFERING

Logical memory



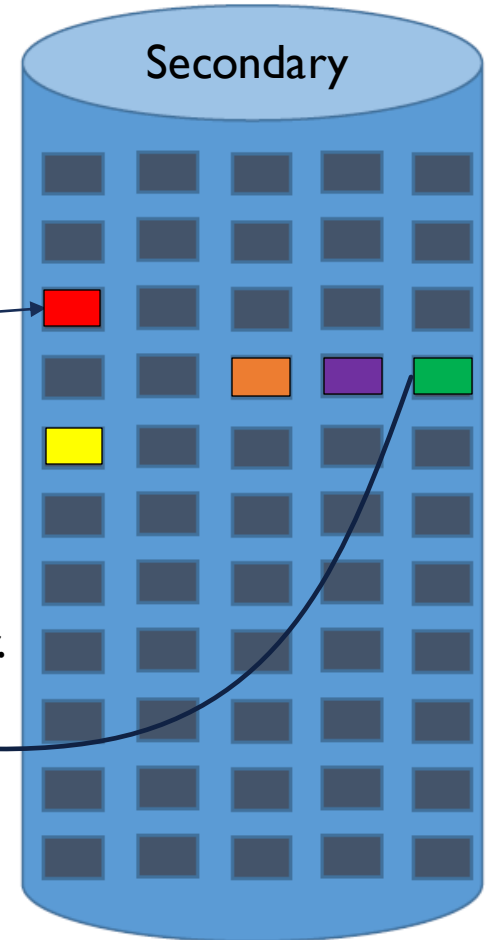
MMU / Memory Map

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0		i
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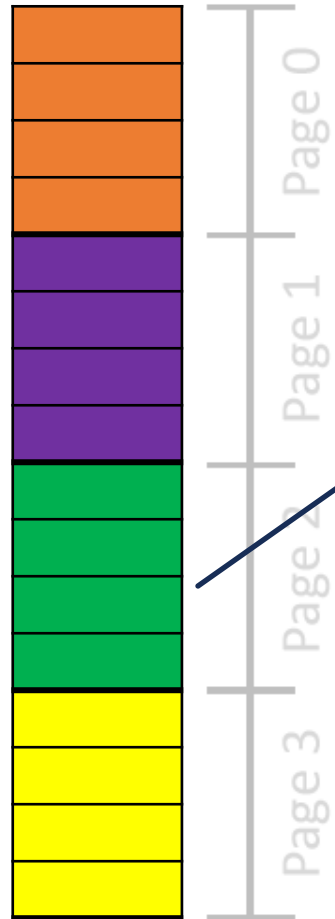
The new page is fetched to the buffer.

Secondary



FRAME BUFFERING

Logical memory



MMU / Memory Map

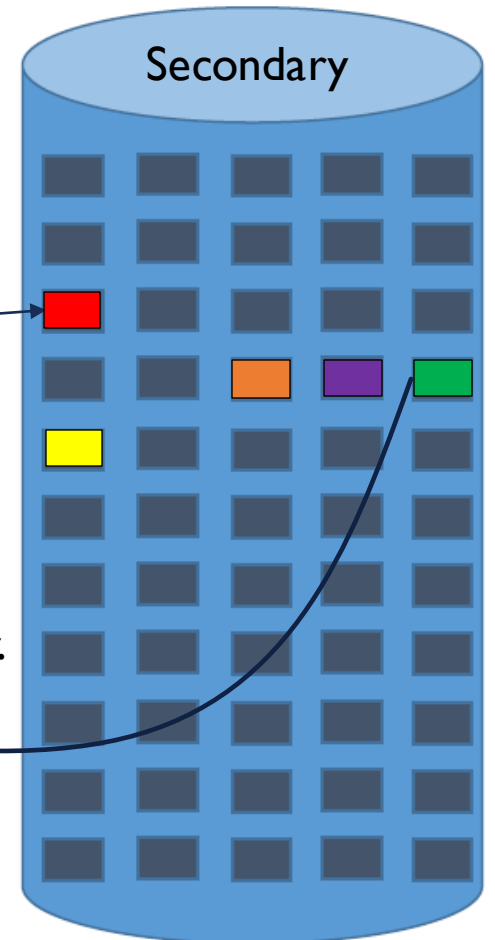
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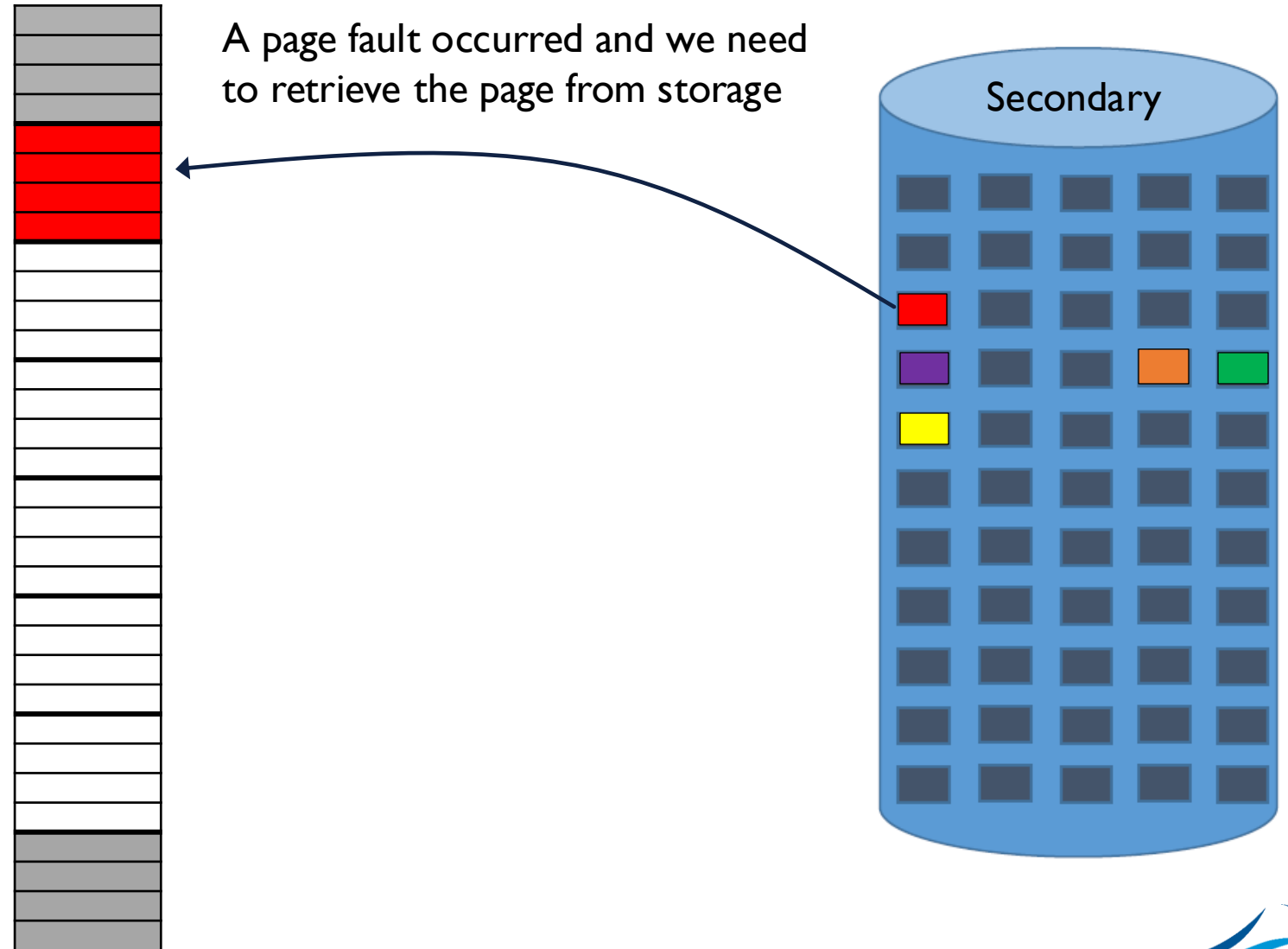
Victim frame is freed in the background.

The new page is fetched to the buffer.

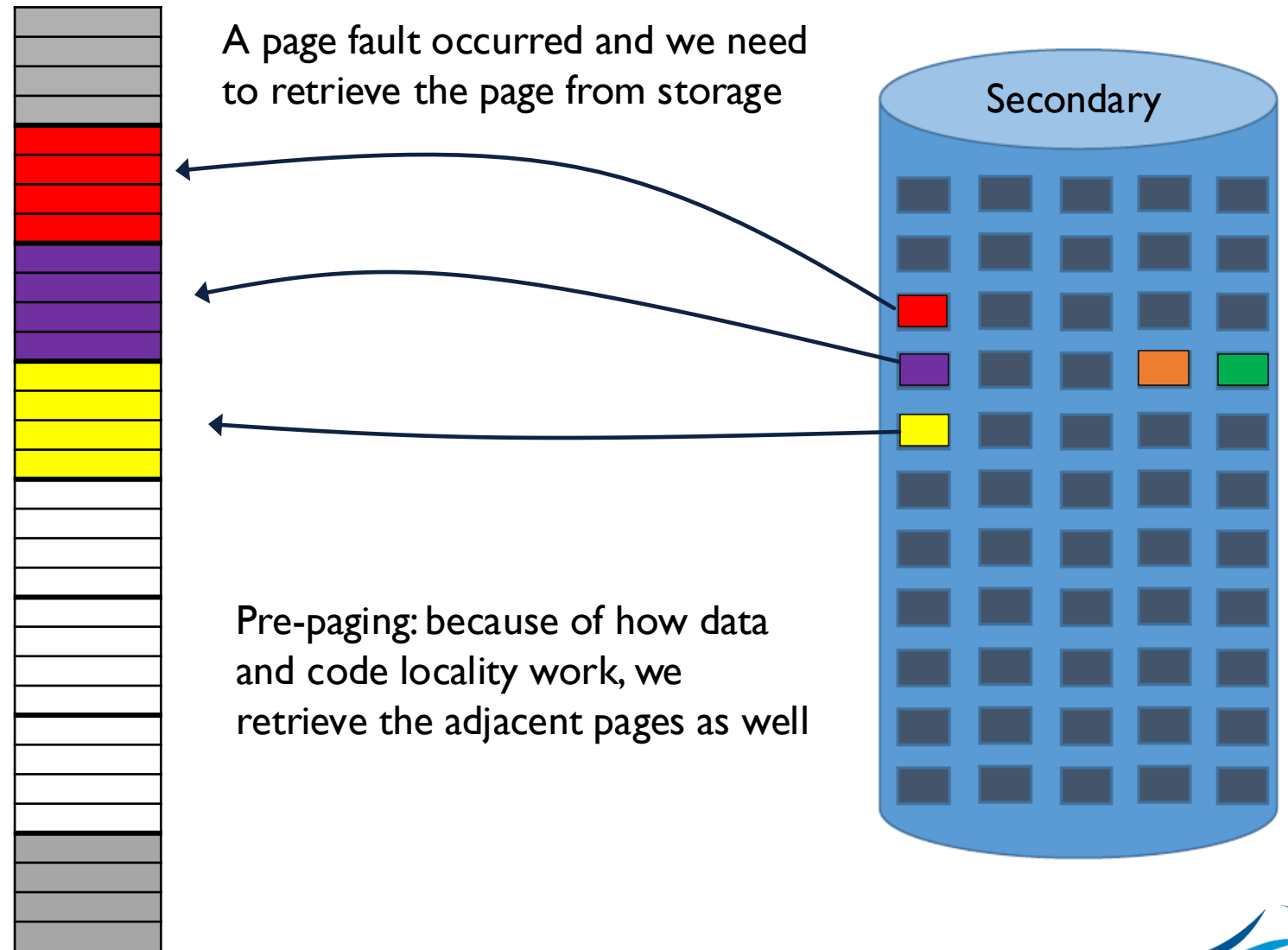
Advantage: no need to waste time on replacement algorithm like LRU, it will be done in the background.



PRE-PAGING

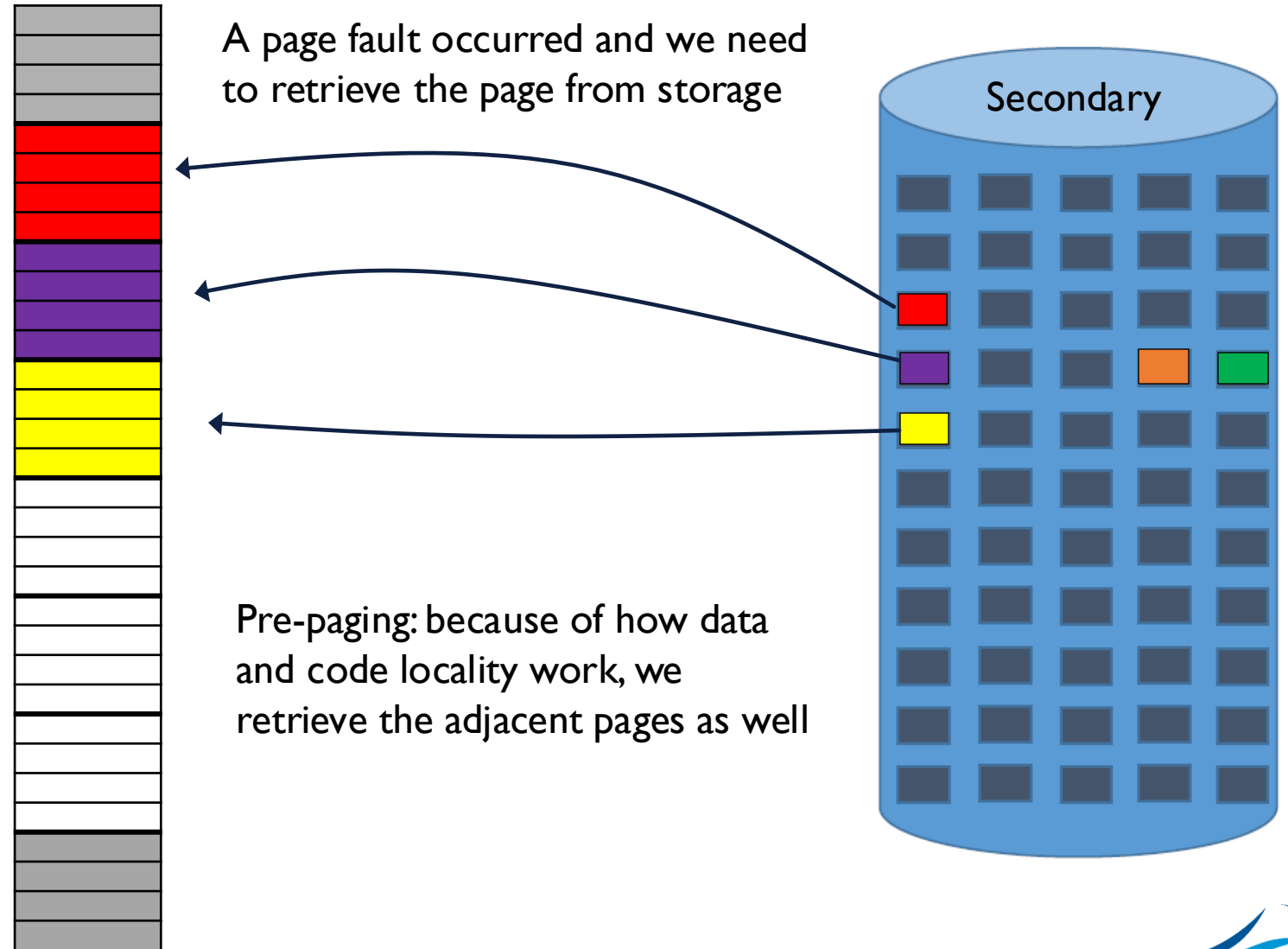


PRE-PAGING



PRE-PAGING

- Significantly reduces the page fault frequency.
- Most program code access is sequential and same for some data.
- Pre-paging is done by most operating systems instead of *demand paging* where pages are only brought on demand, one by one.

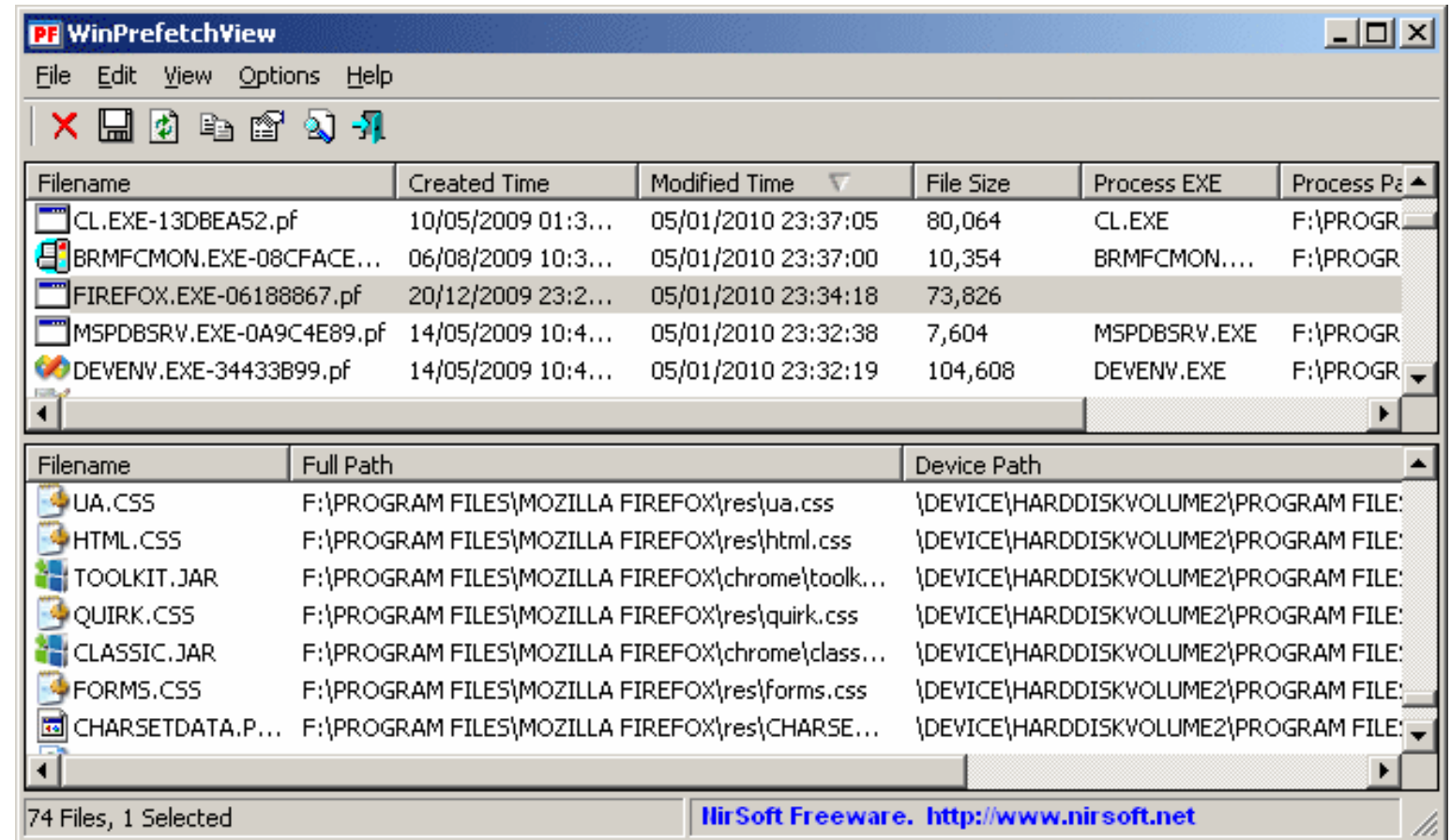


PREFETCHING AND SUPER FETCHING

- Prefetching: Windows track the files/libraries that a program use and fetch them when a program is launched, without waiting for page faults or file access.

PREFETCHING

- Prefetching: Windows track the files/libraries that a program use and fetch them when a program is launched, without waiting for page faults or file access.



The screenshot shows the WinPrefetchView application window. It has a menu bar (File, Edit, View, Options, Help) and a toolbar. The main area contains two tables. The top table lists prefetch files with columns: Filename, Created Time, Modified Time, File Size, Process EXE, and Process Pa. The bottom table lists resources with columns: Filename, Full Path, and Device Path. The status bar at the bottom indicates '74 Files, 1 Selected' and provides a link to NirSoft Freeware.

Filename	Created Time	Modified Time	File Size	Process EXE	Process Pa
CL.EXE-13DBEA52.pf	10/05/2009 01:3...	05/01/2010 23:37:05	80,064	CL.EXE	F:\PROGR
BRMFCMON.EXE-08CFACE...	06/08/2009 10:3...	05/01/2010 23:37:00	10,354	BRMFCMON....	F:\PROGR
FIREFOX.EXE-06188867.pf	20/12/2009 23:2...	05/01/2010 23:34:18	73,826		
MSPDBSRV.EXE-0A9C4E89.pf	14/05/2009 10:4...	05/01/2010 23:32:38	7,604	MSPDBSRV.EXE	F:\PROGR
DEVENV.EXE-34433B99.pf	14/05/2009 10:4...	05/01/2010 23:32:19	104,608	DEVENV.EXE	F:\PROGR

Filename	Full Path	Device Path
UA.CSS	F:\PROGRAM FILES\MOZILLA FIREFOX\res\ua.css	\DEVICE\HARDDISKVOLUME2\PROGRAM FILE:
HTML.CSS	F:\PROGRAM FILES\MOZILLA FIREFOX\res\html.css	\DEVICE\HARDDISKVOLUME2\PROGRAM FILE:
TOOLKIT.JAR	F:\PROGRAM FILES\MOZILLA FIREFOX\chrome\toolk...	\DEVICE\HARDDISKVOLUME2\PROGRAM FILE:
QUIRK.CSS	F:\PROGRAM FILES\MOZILLA FIREFOX\res\quirk.css	\DEVICE\HARDDISKVOLUME2\PROGRAM FILE:
CLASSIC.JAR	F:\PROGRAM FILES\MOZILLA FIREFOX\chrome\class...	\DEVICE\HARDDISKVOLUME2\PROGRAM FILE:
FORM5.CSS	F:\PROGRAM FILES\MOZILLA FIREFOX\res\forms.css	\DEVICE\HARDDISKVOLUME2\PROGRAM FILE:
CHARSETDATA.P...	F:\PROGRAM FILES\MOZILLA FIREFOX\res\CHARSE...	\DEVICE\HARDDISKVOLUME2\PROGRAM FILE:

74 Files, 1 Selected NirSoft Freeware. <http://www.nirsoft.net>

The list of files is saved in a Prefetch file that can be viewed

SUPERFETCHING

- Superfetching: OS keeps track of programs/libraries frequently used and keeps them in memory.

PREFETCHING AND SUPER FETCHING

- Prefetching: Windows track the files/libraries that a program use and fetch them when a program is launched, without waiting for page faults or file access.



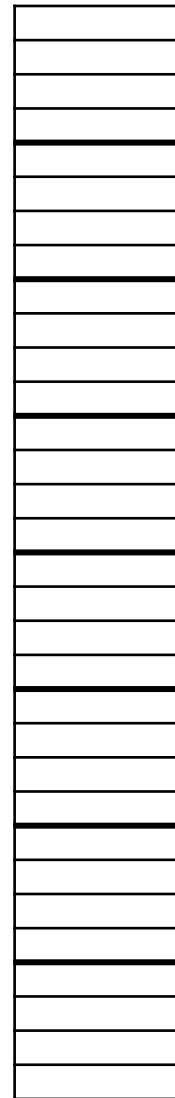
- Program runs → Prefetch files to memory.
- OS keeps a history of files frequently requested by the program.

- Superfetching: OS keeps track of programs/libraries frequently used and keeps them in memory.

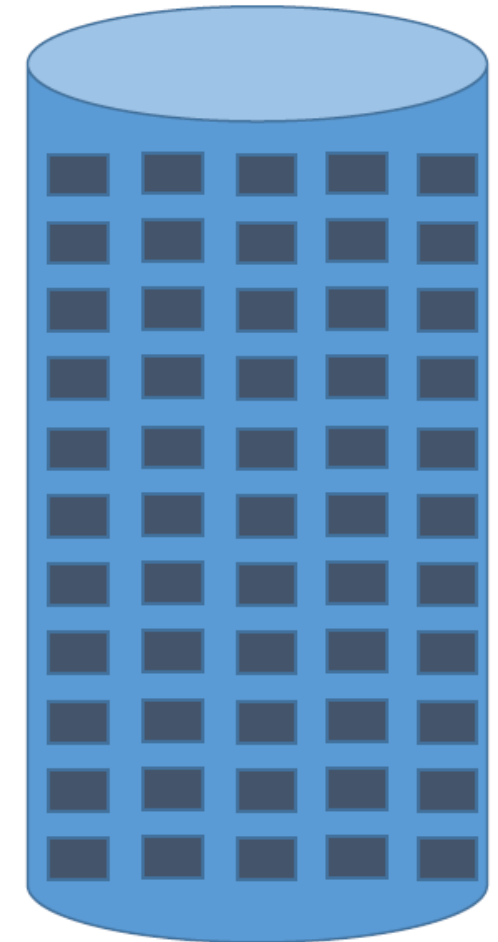


- Operating System runs → Prefetch programs and libraries that are often used.
- OS keeps a history of frequently used programs and library.

MEMORY COMPRESSION

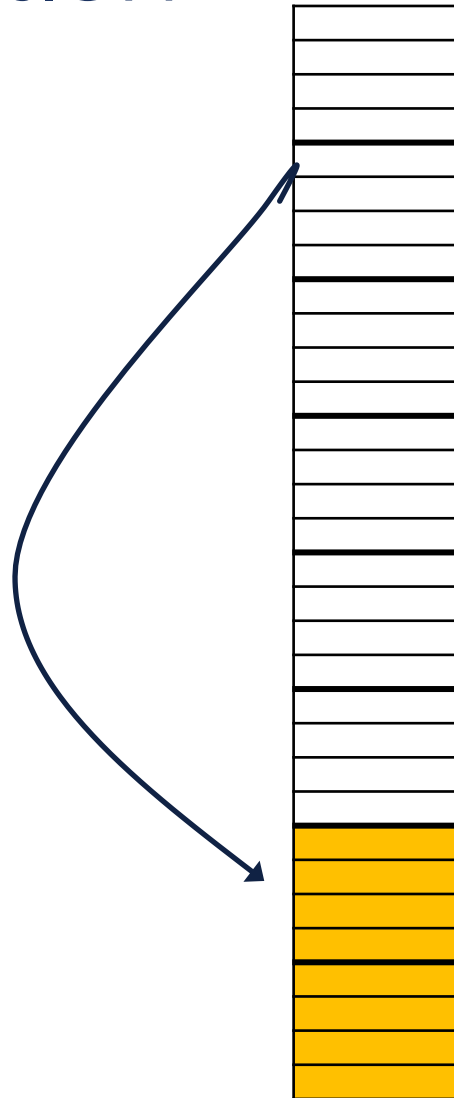


Moving pages between
memory and disk is very
slow.

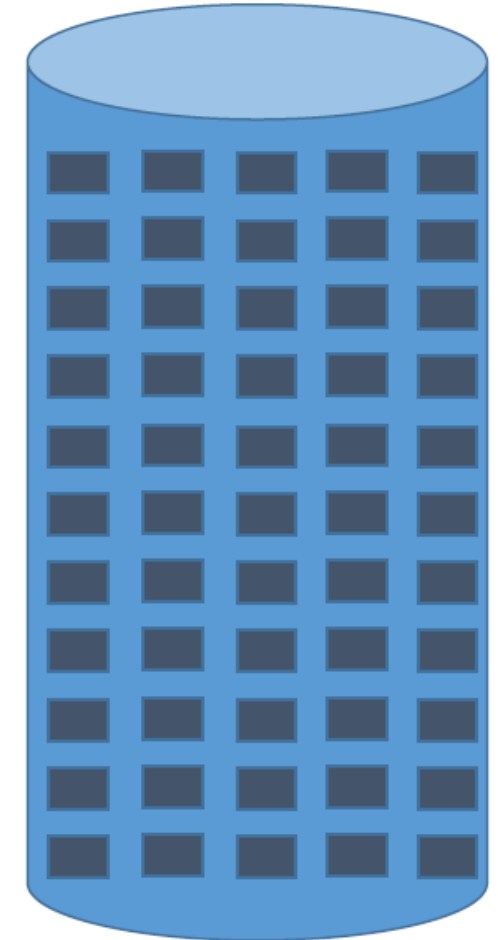


MEMORY COMPRESSION

Instead of moving to disk, we compress the pages and move them to a compressed block in memory.



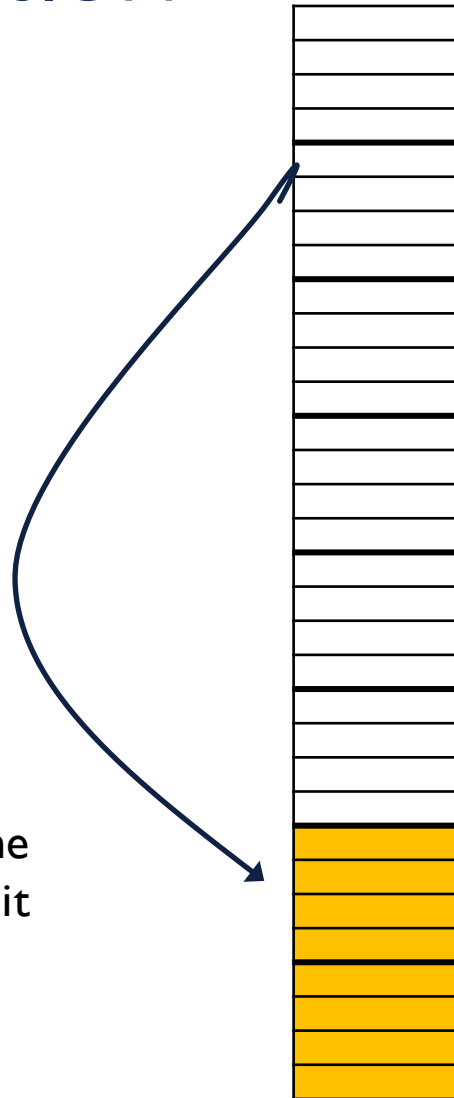
Moving pages between memory and disk is very slow.



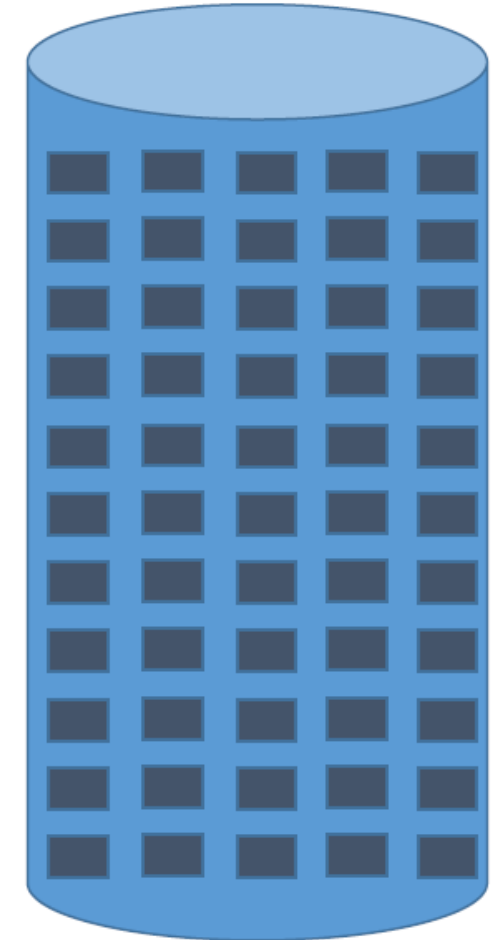
MEMORY COMPRESSION

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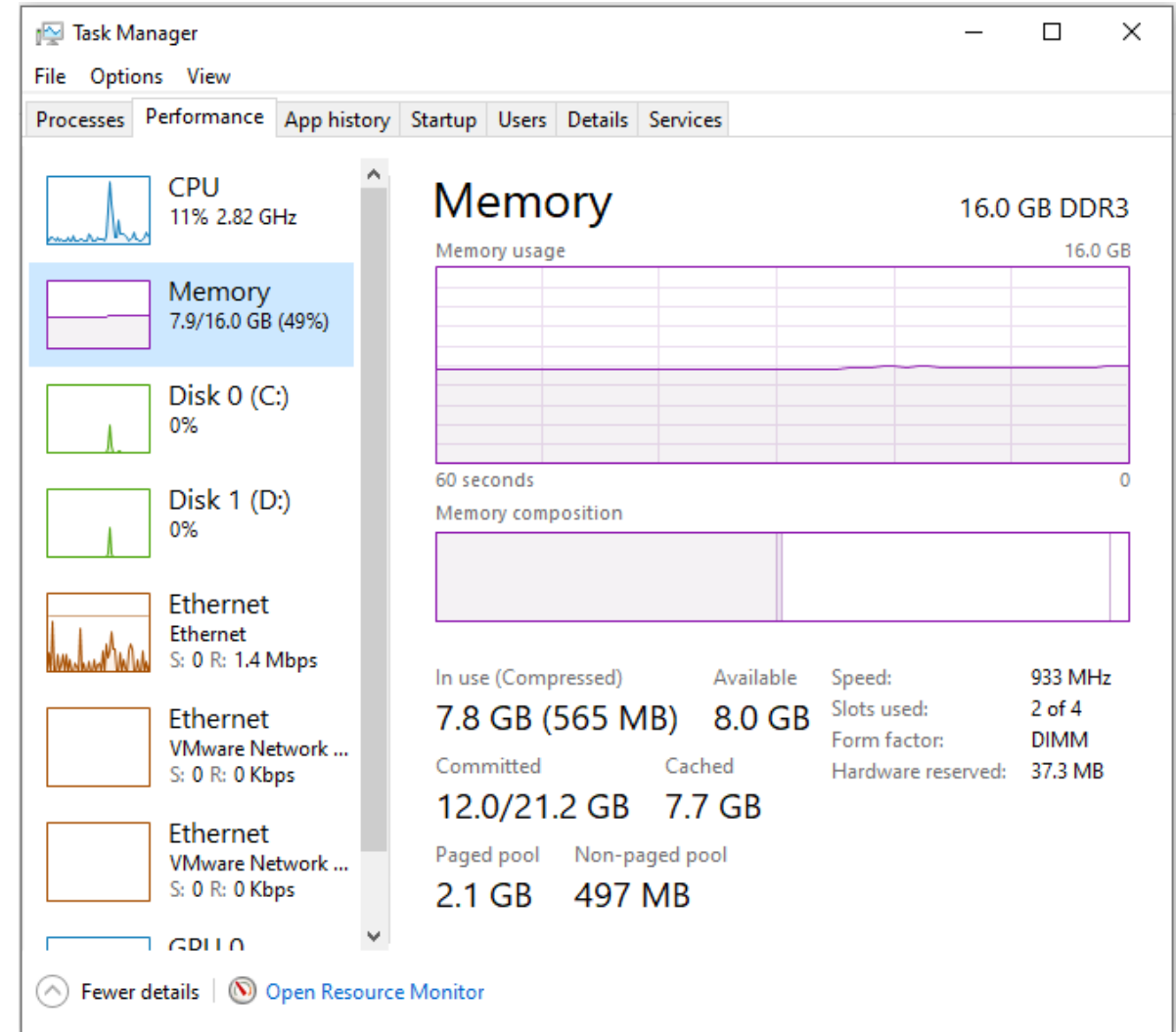
Compressing and Decompressing the pages is much faster than retrieving it from disk.



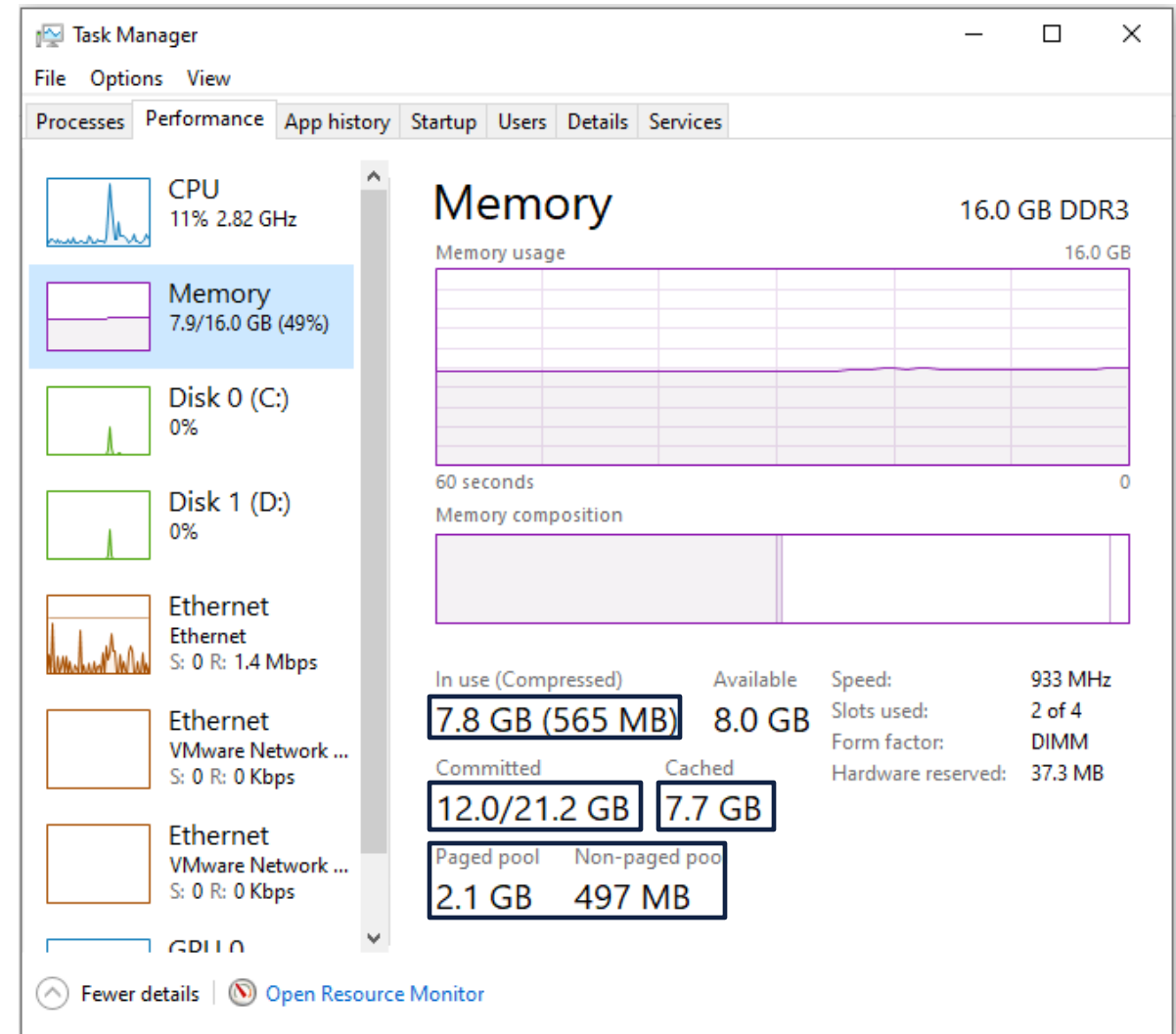
Moving pages between memory and disk is very slow.



WINDOWS MEMORY



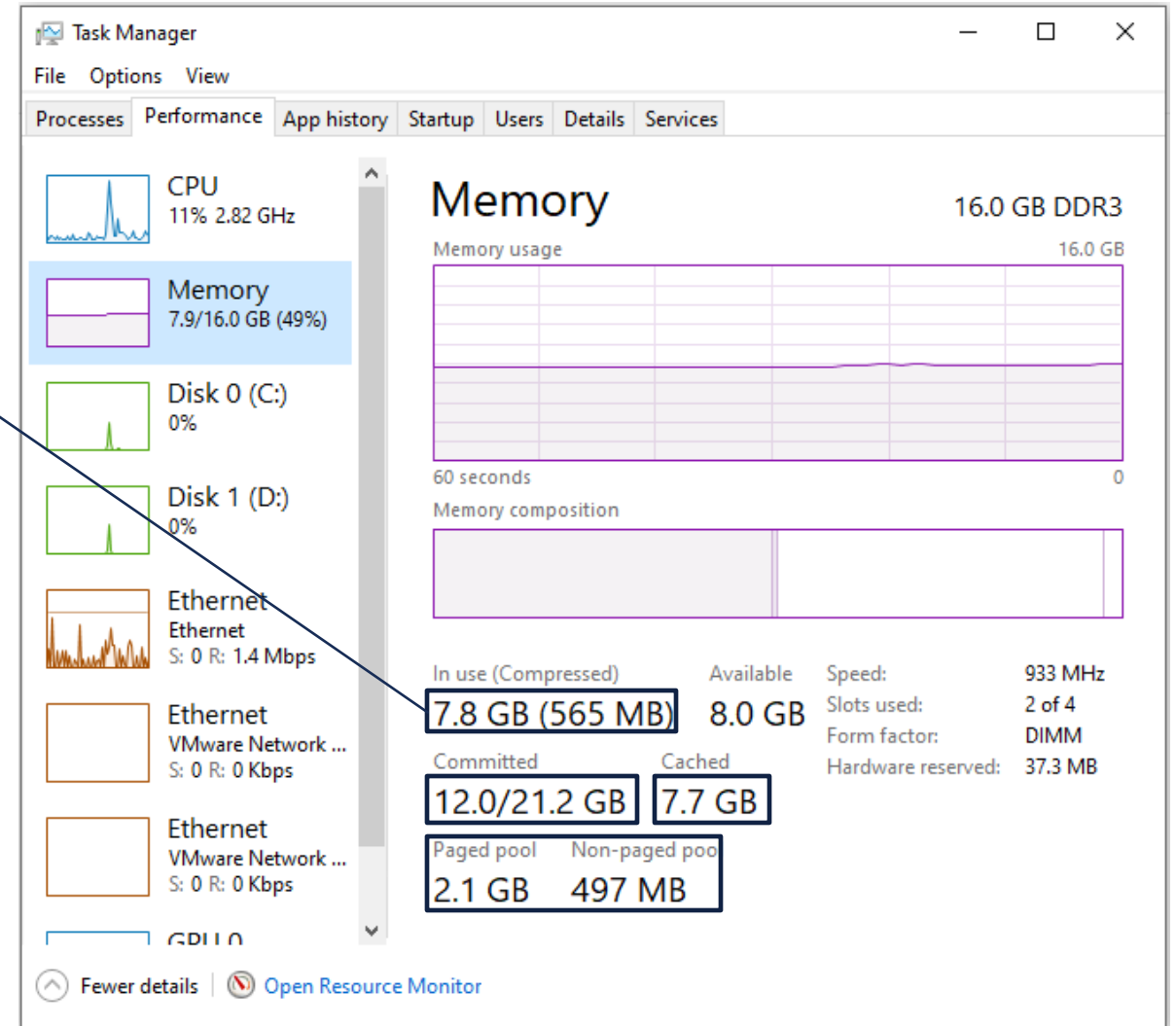
WINDOWS MEMORY



WINDOWS MEMORY

Physical Memory occupied by both paged and non-paged memory.

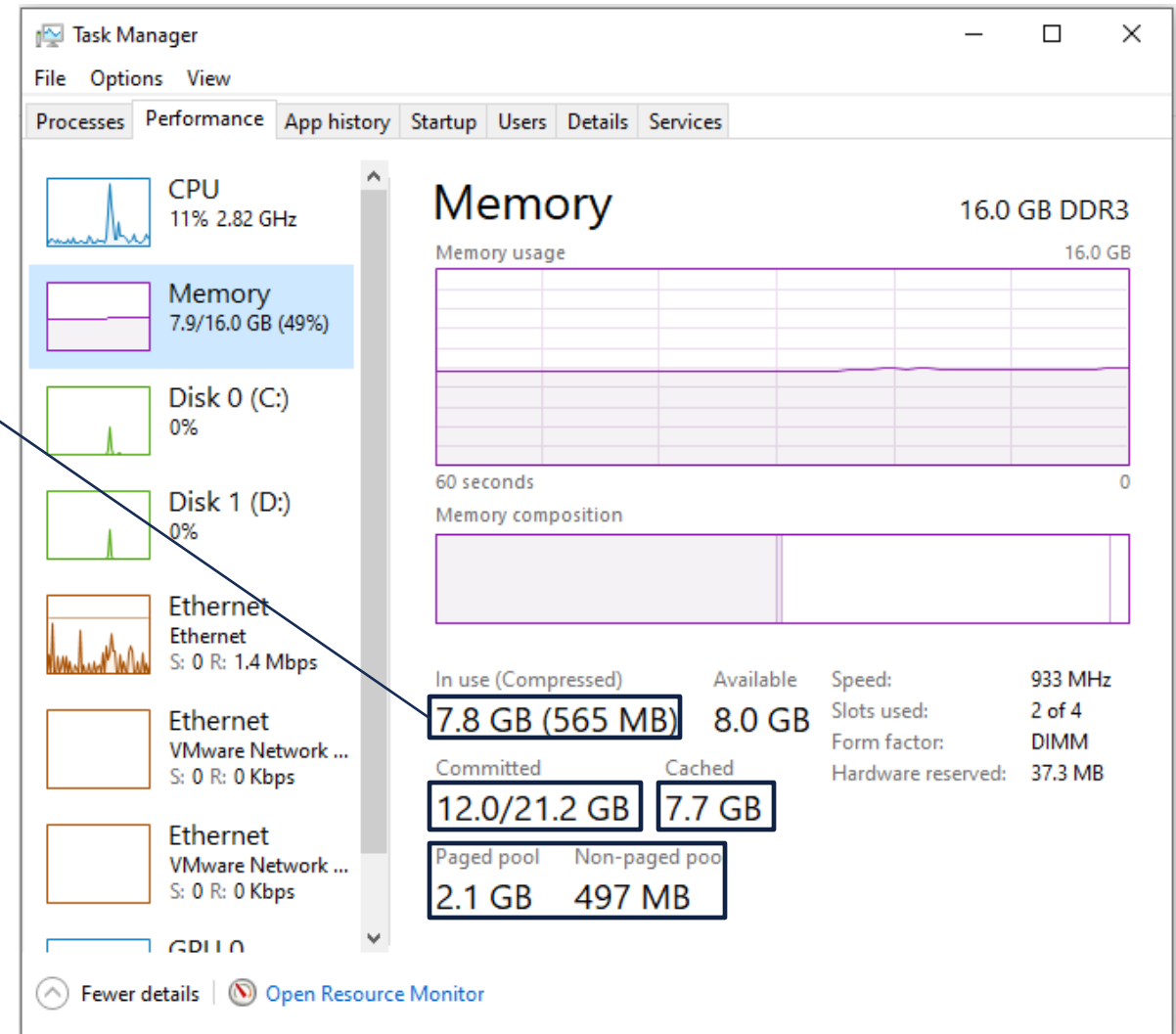
How much of that is compressed memory?



WINDOWS MEMORY

Physical Memory occupied by both paged and non-paged memory.

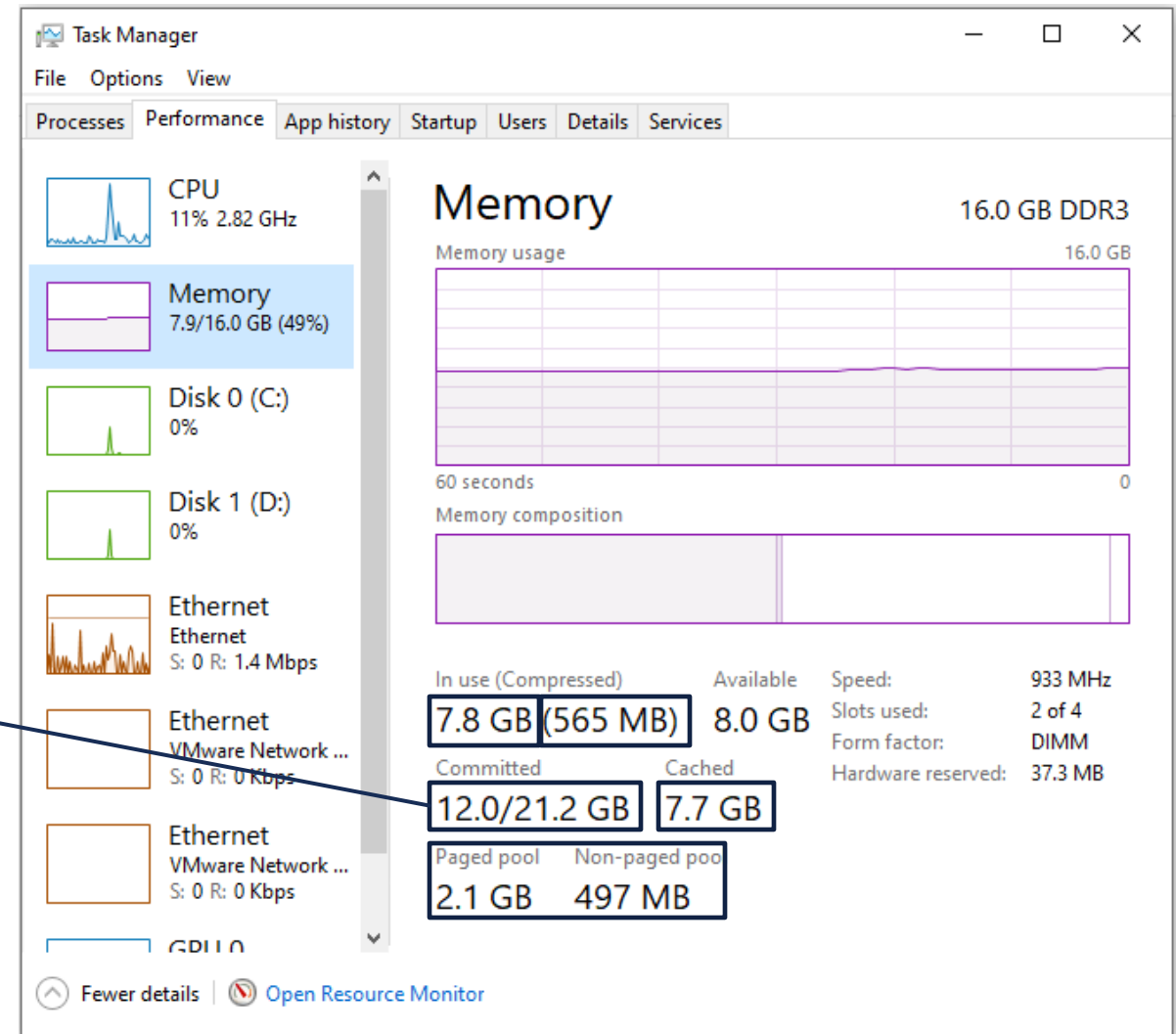
How much of that is compressed memory? 565 MB



WINDOWS MEMORY

Virtual Memory
allocated/requested.

Q: Why is it greater than the “In use”
memory?

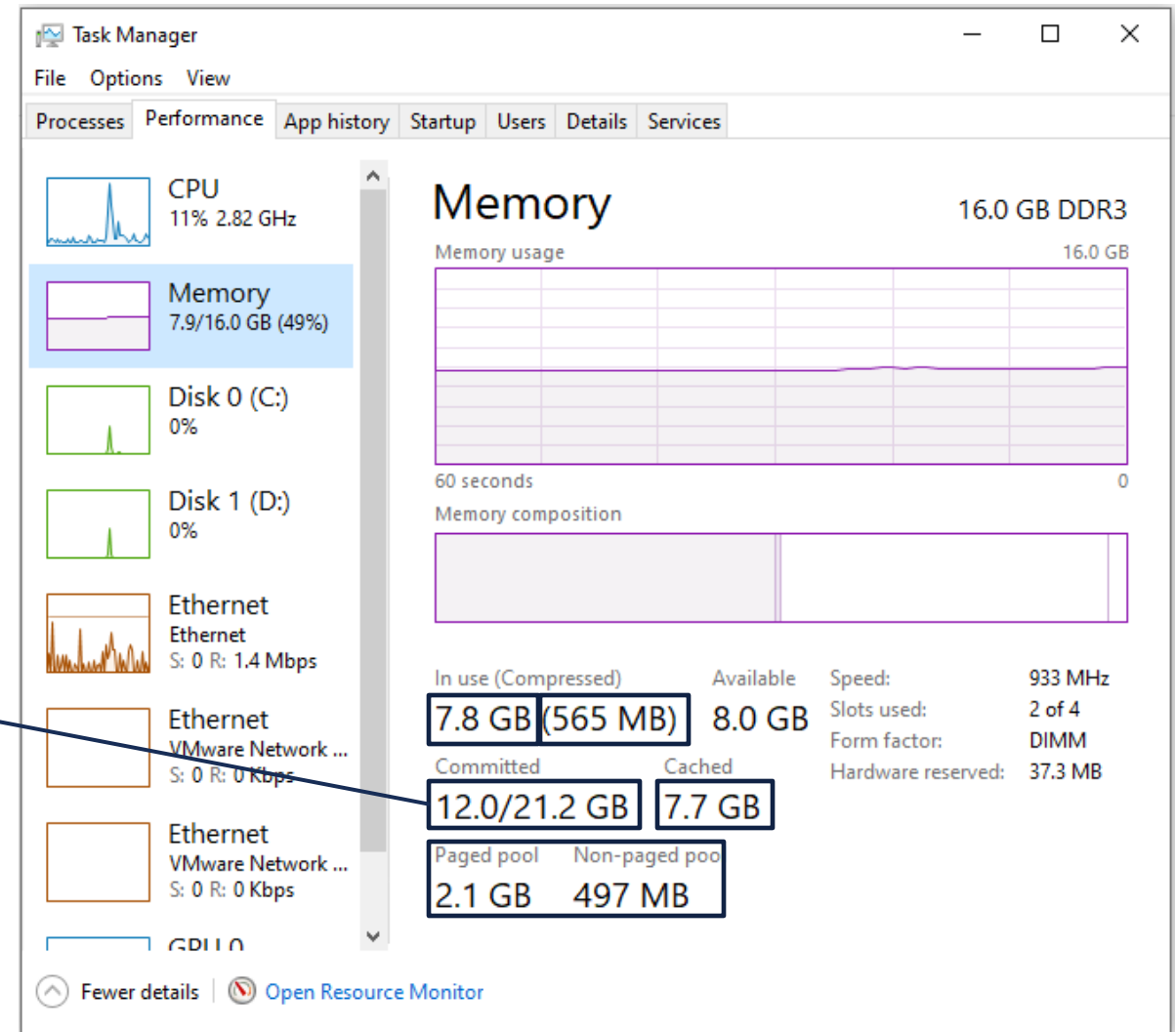


WINDOWS MEMORY

Virtual Memory
allocated/requested.

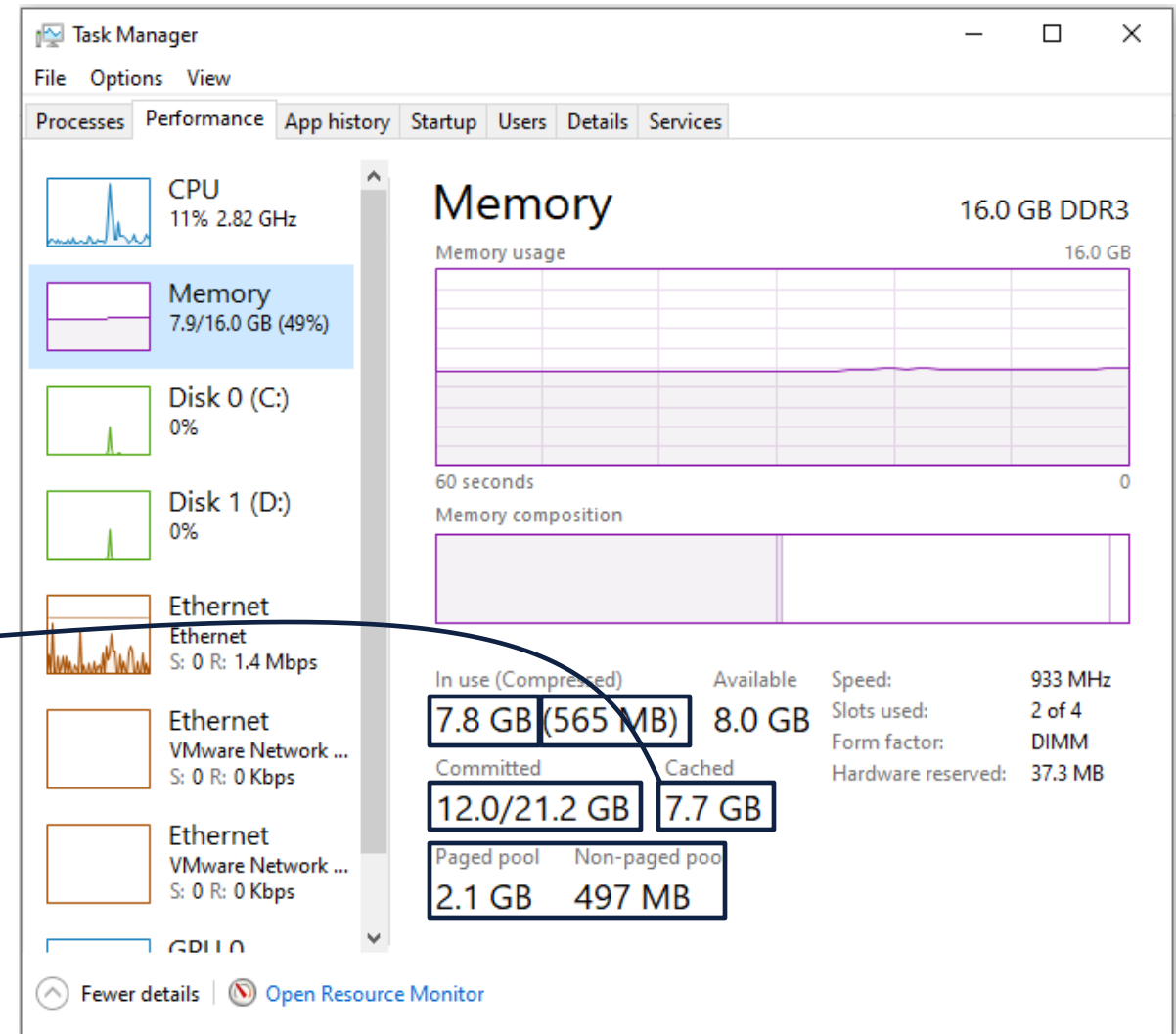
Q: Why is it greater than the “In use”
memory?

This is virtual, some of the pages are on disk
and not in memory.



WINDOWS MEMORY

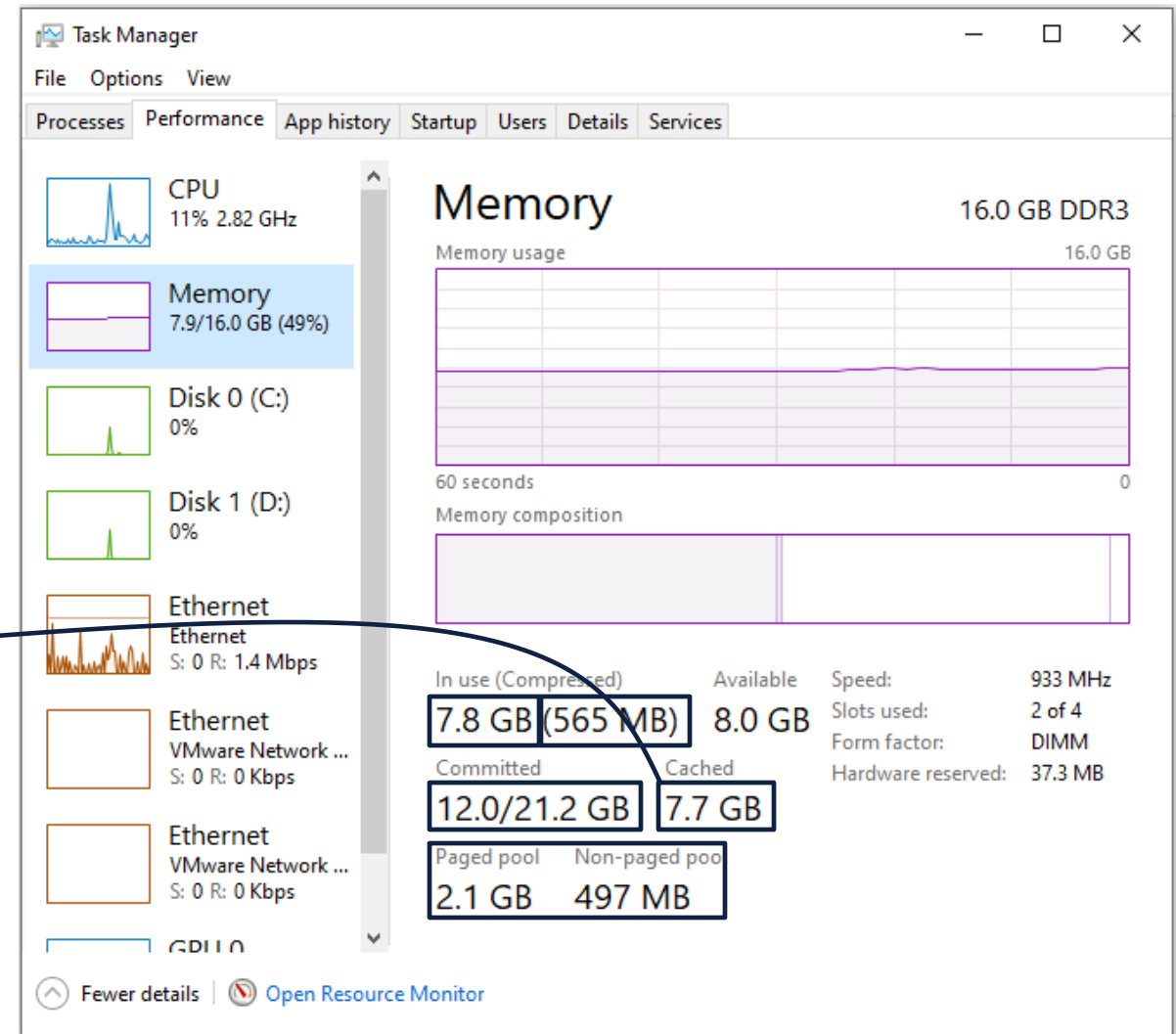
Cached memory
(prefetch/superfetch).



WINDOWS MEMORY

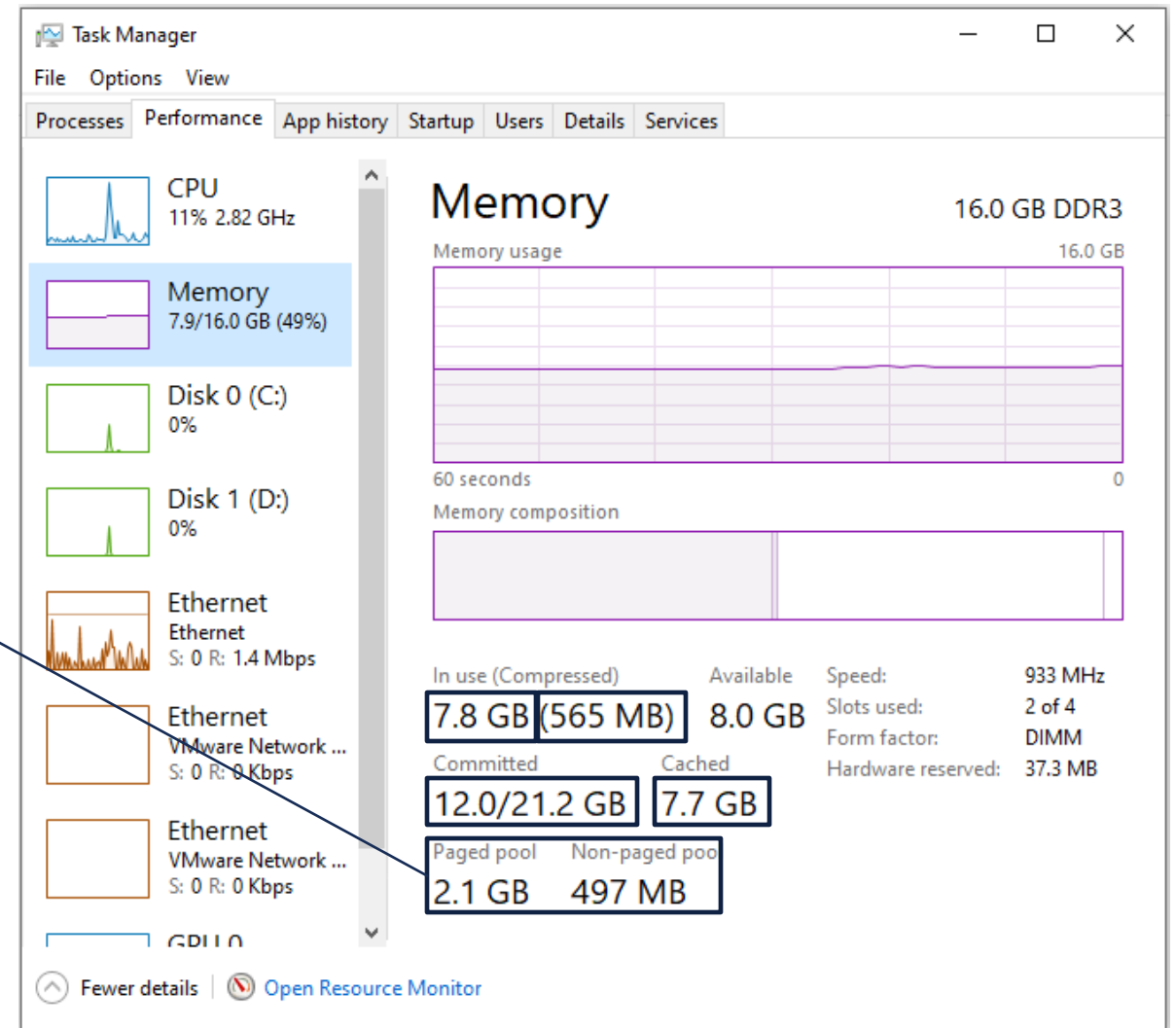
Cached memory
(prefetch/superfetch).

Utilize free frames ...
Cached pages can be overwritten
without need for replacement or write
back.



WINDOWS MEMORY

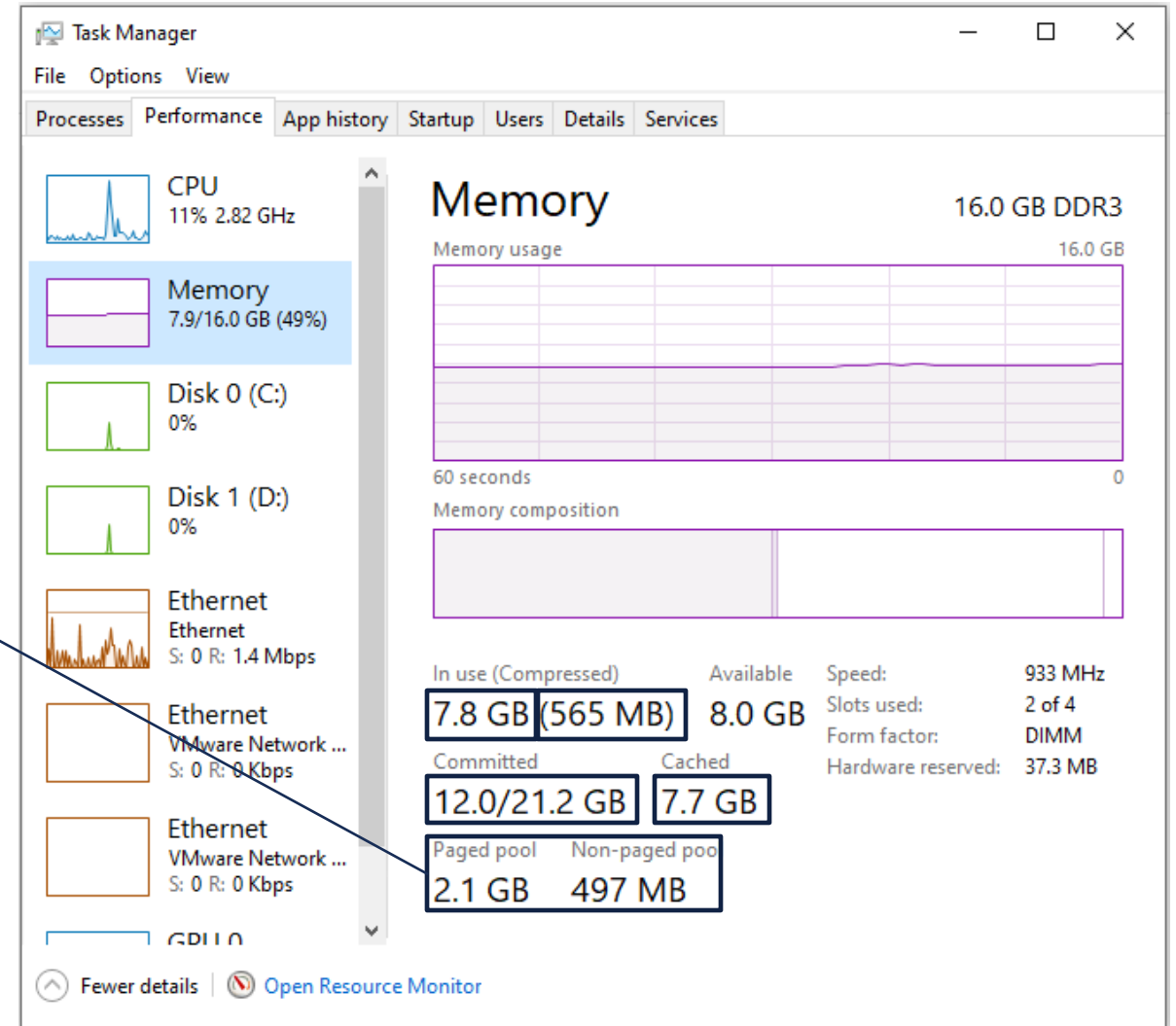
Kernel Memory
Paged and non-paged.



WINDOWS MEMORY

Kernel Memory
Paged and non-paged.

Q: Why does the kernel need direct memory access (non-paged)?



WINDOWS MEMORY

Kernel Memory
Paged and non-paged.

Q: Why does the kernel need direct memory access (non-paged)?

- Kernel needs non-paged memory for critical services like interrupt handling.
- You can't have a page fault while servicing a page fault ...

