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Course: DSCI 551

Assignment: Week 3 Summary

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Week 3 Summary

During this week, the lecture mainly focuses on storage systems and file systems which are two very important topics to understand the mechanism of storage works in real life. This week only covers storage systems. For storage systems, I think the most learning points are studying the calculation of capacity, completion time, storage block, transfer time, latency, and rotation time. Also, it is important to understand the difference between sequential and random access pattern. I am going to use the chart to summarize the key points from the lectures about this topic after I studied.

Disk Organization:

Track	Surfaces cycles are the tracks, see how many
Sector	Sector are divided by tracks, usually 512 Bytes
Cylinder	Equal diameter, # Cylinder = # Track
Heads	It usually has 2 times of platters
Platters	This is the platters which is the disk type

Additional Definition:

Seek Time	Time to get the disk head on right track
Rotation Time	Time to wait for the right sector to rotate under the head
Transfer Time	Time to actually transfer the data

Important Calculations:

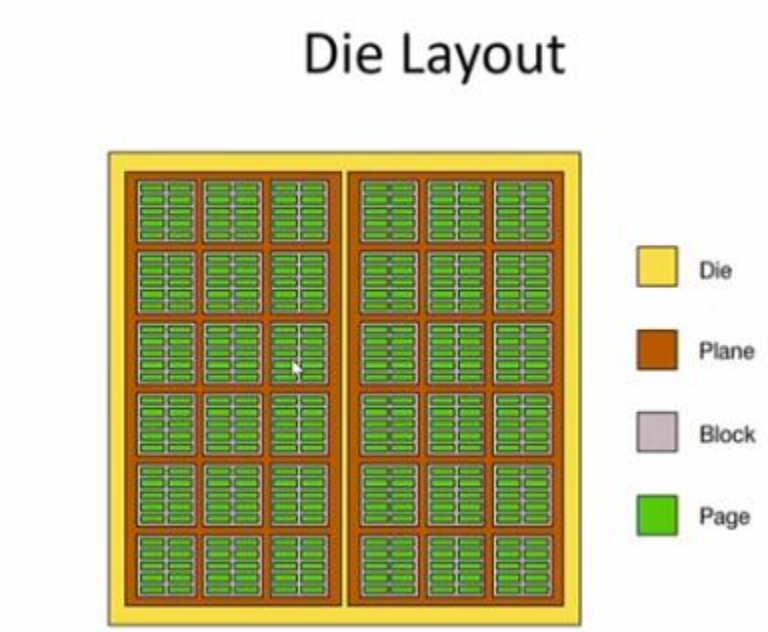
Capacity	# Cylinders * # Heads * # Sectors/Tack * # Sector Size	Notice that Sector size need to be bytes (1024)
Rotation Time	RPM = Rotation Per Minute Need to change to ms/rotation	1 minute = 60000 ms 1 second = 1000 ms
Transfer Time	# transfer / transmission bandwidth Final unit should be ms Need to find the total transfer first: #sector *Bytes/sector	Need to set the same unit if transmission bandwidth
Completion time	Tseek + Trotation + Ttransfer	Shows in multiple tacks
Average Seek	Ave. seek time = Max. Seek time / # Track	Shows in multiple

Time		tracks
Average Rotation latency	Average rotation time = Rotation Time /2	It usually divide by 2
Actual Bandwidth(OS)	Total work load/Completion time	
Random Operations transfer time	Transfer(in random operations) = #Bloack size/transfer rate = ms/block	This is to calculate transfer time per block

Sequential operations vs Random operations

Sequential Operations	Random Operations
Do not need to convert (assume block = sector)	Need to convert the workload to blocks
Calculate completion time in a normal way	Calculate total workload as block first, Use # Block * (Tseek + Trotation + Tblock)

Die layout:



Important notice for floating gate transistor

1. State = 1, if no electrons in the floating gate
2. State = 0, if there are electrons (negative charges)

Important notice for reading operations:

1. If the current is detected, gate has no electron => bit = 1

2. If no current, gate must have electrons => bit = 0

Write: 1 => 0

- Apply high POSITVE voltage (>> voltage for read) to the control gate
- Attract electrons from channel to floating gate (through quantum tunneling) •

Erase: 0 => 1

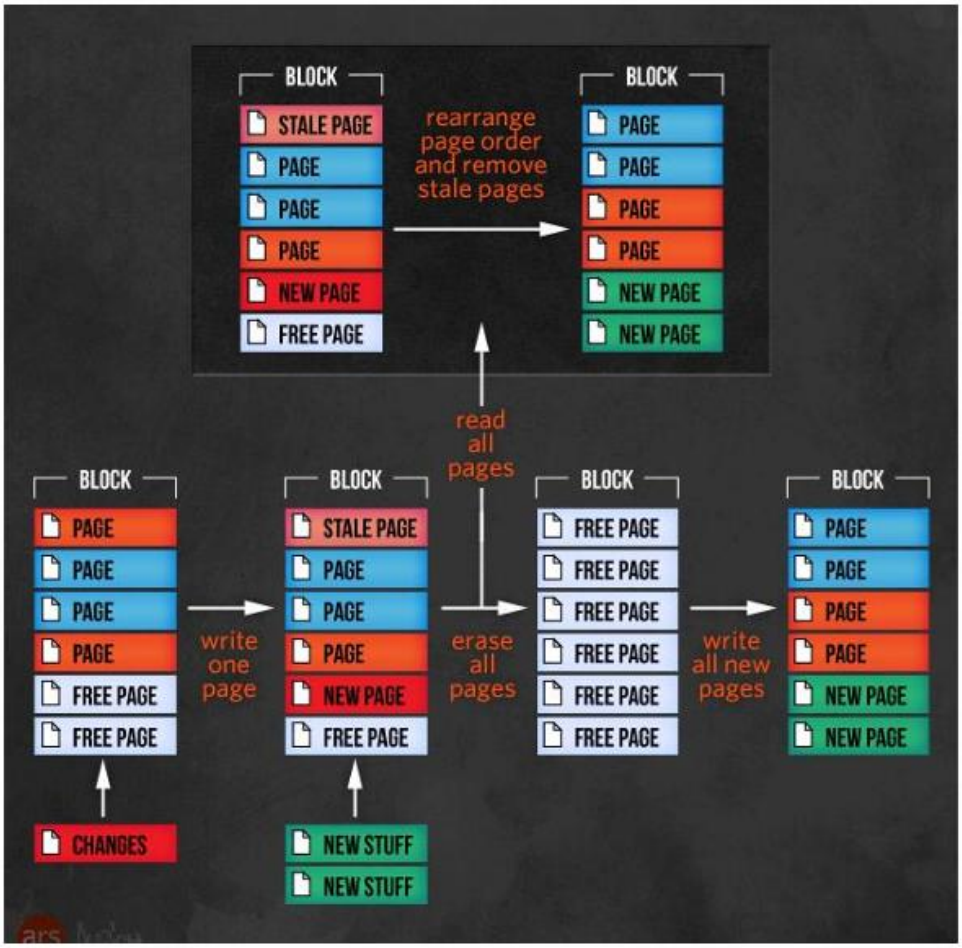
- Need to apply much higher NEGATIVE voltage
- Get rid of electrons from floating gate
- May stress surrounding cells
- So dangerous to do on individual page

Read/write units

1. Page is the smallest unit for read and write (write is also called program, 1->0)
2. Block is the smallest unit for erase (0->1)– i.e., make cells "empty" (i.e., no electrons)

SSD: example of changing the first page

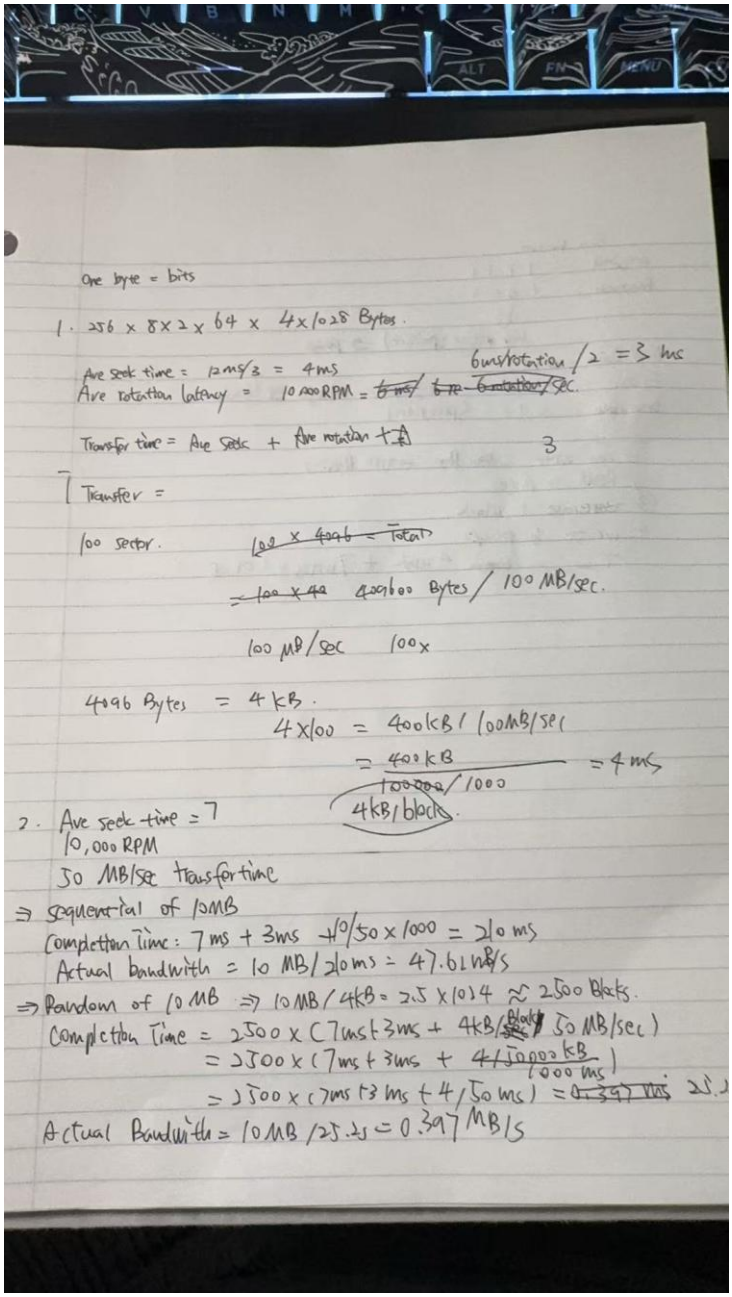
If you want to change one page, the original page will be stale page.

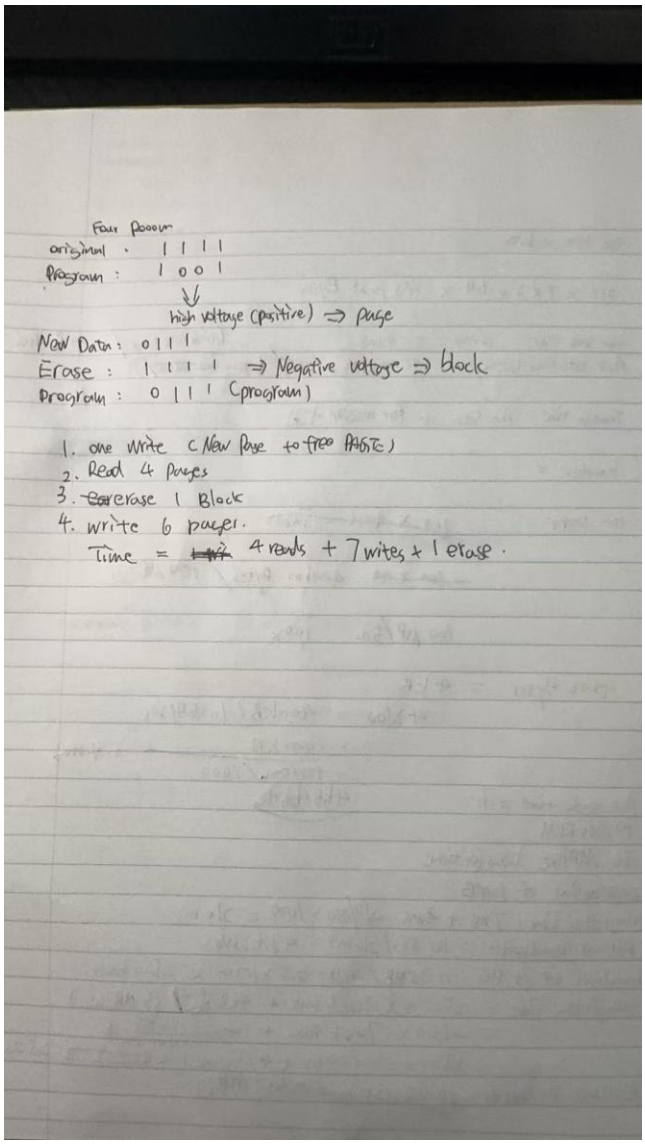


order:

1. Write 1 page, this will change the original page to stale page
2. If want to overwrite the page, need to first read all the current pages (exclude stale page). In this case, read 4 pages
3. Then ease 1 block, notice that erase count for one because smallest unit is block
4. Then read 6 pages, remove stale page, and rearrange

Showcases of in-class example calculations:





Showcase of in-class technical operations:

```
carlos — ubuntu@ip-172-31-8-201: ~ — ssh -i dsci551.pem ubuntu@ec2-...
 * Ubuntu Pro delivers the most comprehensive open source security and
   compliance features.

   https://ubuntu.com/aws/pro

Expanded Security Maintenance for Applications is not enabled.

64 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status


*** System restart required ***
Last login: Thu Jan 30 00:02:45 2025 from 3.16.146.5
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-8-201:~$ ls
config.json
ubuntu@ip-172-31-8-201:~$ cat config.json
{'name': 'john','age': 25}
ubuntu@ip-172-31-8-201:~$
```