Exam Assignments V08

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1. **Delimit from each other** the following SSD parts: **Cells**, **Pages** and **Blocks**.

   - The mainstream SSD today is **NAND** based, which **stores digital bits in cells**.
   - Pages → the Smallest Read/Write Units
     A **group of cells compose a page**, which is the **smallest storage unit** to **read** or **write**
   - Blocks → the Smallest Units That Can Be Erased

2. What is the **purpose** of **garbage collection** in SSDs?

   Garbage collection reclaims obsolete blocks that have **more invalid pages than** a given **threshold**. (reclaimed blocks become available for future write operations)

3. What is the **purpose** of **wear leveling** in SSDs?

   extending the life of SSDs
   to ensure that all blocks wear out at approximately the same rate

4. Tell some **interesting things** about SSDs with an **M.2 form factor**.

   M.2 form factor is a form factor for internally mounted expansion cards

   1) **M.2 SSD can also on SATA SSD work,(also PCIe)**
   2) **An M.2 SSD is "keyed" to prevent insertion of a card connector (male) to an incompatible socket (female) on the host. The M.2 specification identifies 12 key IDs on the module card and socket interface but M.2 SSDs typically use three common keys: B, M, and B+M. You will find the key type labeled on or near the edge connector (or gold fingers) of the SSD. Before deploying M.2 SSDs, determine the type of socket on the host and check the module connector keying, as each connector should be inserted only in the appropriate socket.[1]**
   3) the stuff like this has different length, when buy a "box" should notice the size it support

5. What **influence** do **garbage collection** and **wear leveling** have on **write amplification** of an SSD?

   - **How full the disk** is, **impacts** the **write amplification** factor and the **writing performance** caused by garbage collection.
   - During garbage collection, blocks need to be erased to create free blocks. The **fuller**

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[1] M.2 Interface, Key and Socket explained (atpinc.com)

an **SSD** is, the **more blocks will be moved around** to free a block. (wear leveling)

6. **Discuss three** different **recommendations** for **writing code for SSDs**.

1) Avoid Full SSD Usage

- **How full the disk** is, **impacts** the **write amplification** factor and the **writing performance** caused by garbage collection.
- **Overprovisioning level determines how long and heavy the writes can be before the foreground garbage collection kicks in.**

2) Use Multiple Threads to Do Small IO

- **An SSD has multiple levels of internal parallelism: channel, flash-chip, die and plane. ! A single IO thread will not be able to fully utilize these parallelism.**

3) Use Few Threads to Do Big IO

- **For large IO, the SSD's internal parallelism can be taken advantage of, hence a few threads (for example, 1 or 2) should suffice to achieve maximum IO throughput**

7. **How could** the **CPU load** for **IO** be **reduced**?

- To reduce CPU load, one promising approach is to use **asynchronous** rather than blocking **IO** system calls
- **disable OS buffering** (and use O_DIRECT mode)

8. **How** could you **solve problems** that **do not fit in DRAM without major code adjustments**?

Using **memory mapped files on flash** may be in some cases an **alternative to distributed Big Data systems**.