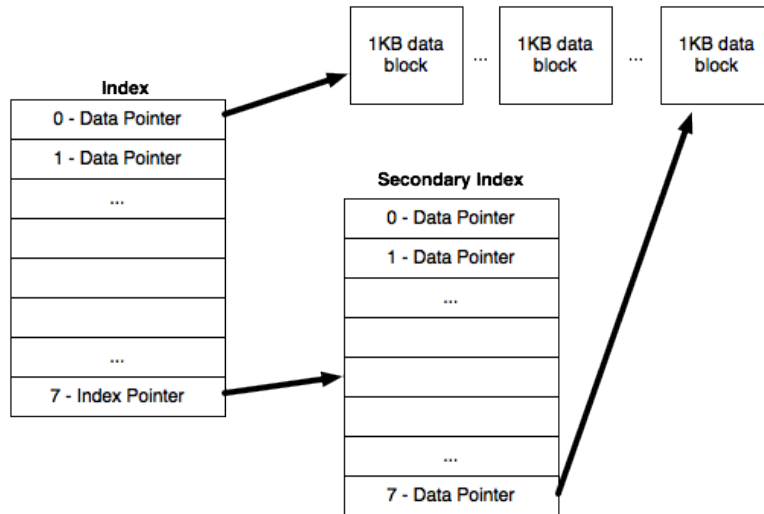


Question 1. (25 points) Consider the file architecture shown in the following figure. For each file there is an index structure which contains 8 entries: the first 7 entries are pointers to 1KB data blocks and the last entry points to a secondary index data structure which contains 8 more data pointers.



- (5 points) What is the maximum size of a file using this architecture?
- (10 points) If you increased the number of entries in both data structures from 8 to 32 (but still kept only one index pointer in the Index), how would that impact the size of allowable files? Would it impact the performance of file accesses (and if so, how)?
- (10 points) What simple change could you make to this structure to support files of infinite size? Is there any downside to this (modified) approach?

Question 2. (10 points) Explain the difference between **hard links** and **soft links** (also called symbolic links or symlinks). Why do filesystems support both types of links?

Question 3. (10 points) Using the following set of disk requests, what is the order of seeks when using the SSTF and SCAN disk scheduling algorithms? What is the total distance of seeks in each case? Assume that the disk has its head at position 45 out of 100 and that it is currently moving towards higher numbers (for SCAN).

Disk Request Queue: 44, 57, 78, 65, 46, 90

Question 4. (10 points) Suppose you are designing a filesystem to run on SSDs. Since there is no rotational delay, is there any downside to scattering blocks of individual files all over the disk, as opposed to storing them in a consecutive series of sectors? Why or why not? (hint: consider read-ahead)

Question 5. (10 points) Suppose you are operating a server on which multiple separate processes run (e.g., a database, a web server, an email server, etc). How could using virtualization enhance the security of the machine? Consider the scenario of a malicious attacker that exploits a bug in one of the processes to gain access to the server.