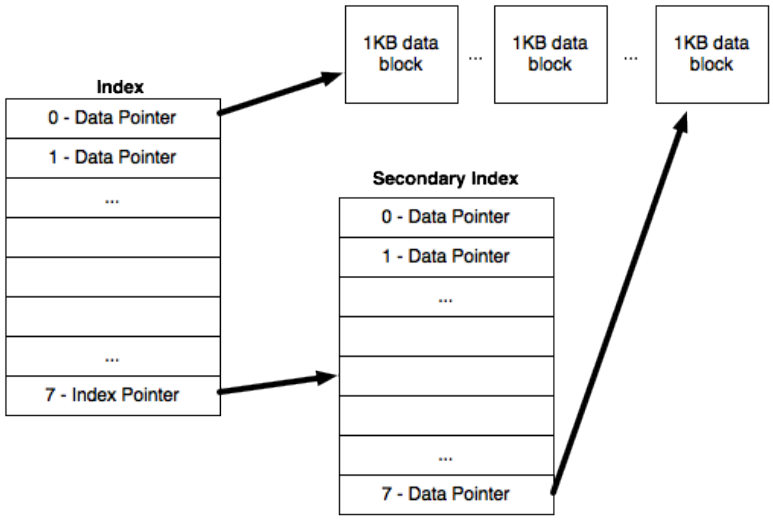
Question 1. *(20 points) Consider the file architecture shown in the following figure. For each file there is an index structure which contains 8 entries: the first 7 entries are pointers to 1 KB data blocks and the last entry points to a secondary index data structure which contains 8 more data pointers. Thus, the maximum file size supported by this architecture is 15 KB.*



a. *(5 points) Suppose you wanted to increase the maximum file size beyond 15 KB. One approach would be to replace the direct data pointers in the primary index with secondary index pointers. What would be the maximum resulting file size?*

b. *(15 points) A different approach would be to replace the direct data pointers in the secondary index with tertiary index pointers. What would be the pros and cons of this approach versus the first 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) A simple filesystem design statically maps file blocks directly onto disk sectors (or sets of contiguous sectors). E.g., disk block 0 might span sectors 0-3, disk block 1 spans sectors 4-7, and so forth. Why is this design bad for a solid state drive (i.e., a static map of file blocks onto SSD pages)? Give two reasons.*

Question 5. *(10 points) Explain why privileged operations present a challenge to supporting virtualization of operating systems. How can a hypervisor deal with this problem?*