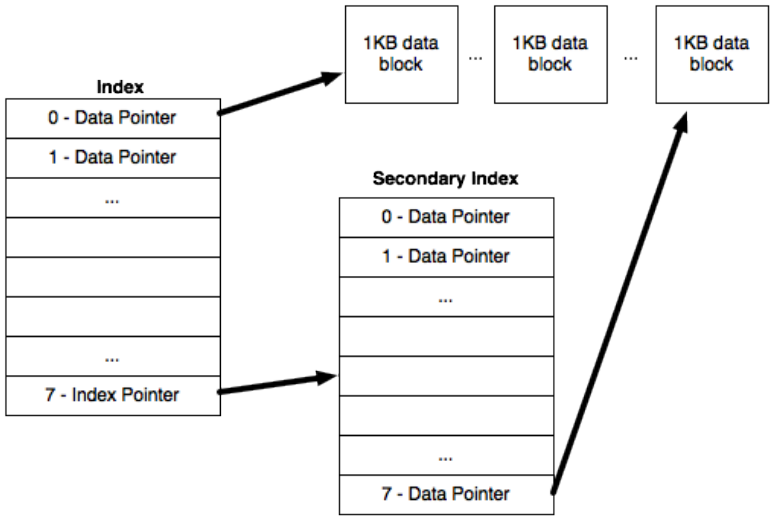
Question 1. *(20 points) Consider the file architecture shown in the following figure. For each file, there is an index structure which contains 8 entries: the first 7 entries are pointers to 1 KB data blocks and the last entry points to a secondary index (aka a single indirect block) which contains 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 without increasing the size of the primary index structure. One approach would be to replace all direct data pointers in the primary index with secondary index pointers. What would be the resulting maximum file size?*

b. *(5 points) A different approach would be to replace the direct data pointers in the secondary index with tertiary index pointers (i.e., change the secondary index structure from a single indirect block to a double indirect block). What would be the resulting maximum file size?*

c. *(10 points) Which approach would be better for storing (1) larger files, and (2) smaller files? Explain why. You can assume that all files are within the the maximize size of both architectures.*

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) 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 4. *(10 points) Explain why privileged operations present a challenge to supporting virtualization of operating systems. How can a hypervisor deal with this problem?*