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*2 problems. 40 points. 30 minutes Closed book. Closed notes. No electronic device. Write your name above.*

**1. [20 points]** A computer has an FFS filesystem in which each directory's data fits in one block. Starting from a state where the only block in memory is the superblock, give the sequence of blocks to read in order to read the last byte of the file at  $/x/y$ , in each of the following cases.

a. The file has only 5 blocks of data.

b. The file has the maximum amount of data allowed in FFS.

**2. [20 points]** Augment the FAT filesystem to provide hard-links (to files only). Do not modify the FAT or the data region (so a traditional FAT-filesystem OS can still use your augmented filesystem). Assume that the FAT region (which holds the FAT) has some free space which you can use.

Your answer should briefly state

- the new information to be stored in the FAT region
- how this information is updated when: creating a file, linking to an existing file, deleting a file