**Homework Assignment #4**

***Due Date: 11/14, 11:59 p.m. Please submit via Blackboard. Late submissions are accepted till 11/17, 11:59 p.m., with 10% penalty each day.***

***Please name your submission file starting with “LastName\_FirstName\_HW4”.***

**Q1. (8 points) (Problem 10)** Consider the directory tree of Fig. 4-8. If /usr/jim is the working directory, what is the absolute path name for the file whose relative path name is ../ast/x?

**Q2. (8 points)** Contiguous allocation can lead to disk external fragmentation, as mentioned in the text. Please explain why.

**Q3. (10 points) (Modified Problem 16)** Consider the i-node shown in Fig. 4-13. If it contains 10 direct addresses of 4 bytes each and one single indirect block. All disk blocks are 1024B (1KB). What is the largest possible file?

**Q4. (10 points) (Problem 21)** Name one advantage of hard links over symbolic links and one advantage of symbolic links over hard links.

**Q5. (12 points) (Problem 25)** The beginning of a free space bitmap looks like this after the disk partition is first formatted: 1000 0000 0000 0000 (the first block is used by the root directory). The system always searches for free blocks starting at the lowest-numbered block, so after writing file A, which uses six blocks, the bitmap looks like this: 1111 1110 0000 0000. Show the bitmap after each of the following additional actions:

(a) File B is written, using five blocks

(b) File A is deleted

(c) File C is written, using eight blocks

(d) File B is deleted.

**Q6. (10 points) (Problem 29)** Suppose that file 21 in Fig. 4-25 was not modified since the last dump. In what way would the four bitmaps of Fig. 4-26 be different?

**Q7. (8 points) (Problem 30)** It has been suggested that the first part of each UNIX file be kept in the same disk block as its i-node. What good would this do?

**Q8. (10 points) (Problem 32)** The performance of a file system depends upon the buffer cache hit rate (fraction of blocks found in the buffer cache). If it takes 1 msec to satisfy a request from the cache, but 40 msec to satisfy a request if a disk read is needed, give a formula for the mean time required to satisfy a request if the hit rate is *h*. Plot this function for values of *h* varying from 0 to 1.0.

**Q9. (12 pints) (Problem 37)** A certain file system uses 4-KB disk blocks. The median file size is 1 KB. If all files were exactly 1 KB, what fraction of the disk space would be wasted? Do you think the wastage for a real file system will be higher than this number or lower than it? Explain your answer.

**Q10. (12 points) (Problem 41)** How many disk operations are needed to fetch the i-node for a file with the path name /usr/ast/courses/os/handout.t? Assume that the i-node for the root directory is in memory, but nothing else along the path is in memory. Also assume that all directories fit in one disk block.

THE END.