

Systems Programming (Fall, 2017)

Hand-written Assignment 2 (Due on 11/1, in class)

1. **Blocking modes & CPU time.** The *cp* utility copies the content of a source file to a target file. When *cp* is implemented with unbuffered I/O system calls, the following four factors (A)~(D) would significantly affect its execution time.

- (A) The number of the while loops
 - Each loop copies partial file content with *read()* or *write()*
- (B) The time to wait for data ready in memory
- (C) The time to copy data from kernel's buffer cache to user's buffer and vice versa
 - User's buffer denotes the buffer specified in *read()* and *write()*
- (D) The time to move data from kernel's buffer cache to disk and vice versa

Please answer the questions.

(a) What factor(s) will significantly affect user CPU time?

(b) What factor(s) will significantly affect system CPU time?

(c) What factor(s) will significantly affect clock/response time?

(d) What factor(s) will be significantly affected when nonblocking I/O is taken into account, compared with blocking I/O?

(e) What time (user CPU time, system CPU time, and clock/response time) will be significantly affected by system call *fsync()*?

2. **Directories and files.** Given a UNIX file system, in which

- (a) an i-node has 12 direct pointers, 1 singly-indirect pointer, 1 doubly-indirect pointer, and 1 triply-indirect pointer;
- (b) a disk block is 4096 bytes long;
- (c) a block pointer is 4 bytes long;
- (d) all of the directories are a single disk block long,

how many i-nodes and disk blocks would need to be accessed if we want to read the entire file of `/home/user/alice.txt`? Suppose `alice.txt` is 5242880 bytes long. Explain your calculation.