Systems Programming (Fall, 2021)
Assignment 1 (Due on 10/6)

1. File Redirection.

The Bourne shell notation, *digit1*>&*digit2*, says to redirect descriptor *digit1* to the same file as descriptor *digit2*. For example, the command

```
./a.out > outfile 2>&1
```

sets "standard output" to "outfile" and then redirects "standard error" to "standard output." Note that the shell processes its command line from left to right. The result is that "standard output" and "standard error" are set to the same file.

(a) Please give the meaning of the command:

```
./a.out < infile 2>&1 > outfile
```

(b) Please use *dup()* or *dup2()* to do the redirections of the command

```
./a.out < infile 2>&1 > outfile
```

in the following program fragment. Error checking could be ignored.

```
int main(int argc, char *argv[])
{
      int fd1, fd2;

      fd1  = open (infile,O_RDONLY );
      fd2 = open (outfile, O_WRONLY | O_CREAT, 0666);




      // do the redirections here




      execlp("./a.out", "./a.out", (char *)0);
  return 0;
}
```

2. Atomic operation.

To randomly write a file, a student develops two functions *write_to_fd()* and *write_to_fn()* by which users can write data to a given position in the file. The only difference between the two functions is the first parameter. One accepts a file descriptor while the other accepts a file name. Here are the two functions. Assume that system calls are atomic.

!

```
ssize_t write_to_fd ( int fd, void *buf, size_t nbytes,
                      off_t offset )
{
  if ( lseek( fd, offset, SEEK_SET) < 0 ) return -1;
  return (write( fd, buf, nbytes) );
}

ssize_t write_to_fn ( char filename, void *buf, size_t nbytes,
                       off_t offset )
{
  int fd;
  ssize_t retval;
  if ( ( fd = open( filename, O_WRONLY ) )<0 ) return -1;
  if ( lseek( fd, offset, SEEK_SET) < 0 ) return -1;
  retval = write( fd, buf, nbytes );
  close( fd );
  return retval;
}
```

(a) Should the *write_to_fd()* function be an atomic operation? Please give an example to clearly explain your answer.

(b) Should the *write_to_fn()* function be an atomic operation? Please give an example to clearly explain your answer.