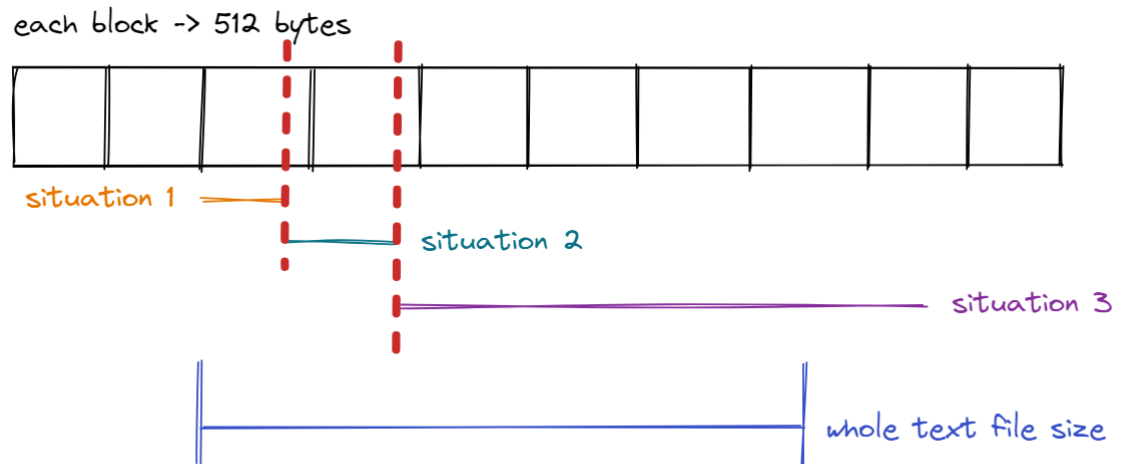# Assignment 5 – Buffered I/O Read

Description:

This assignment is to handle the input and output when we are doing the buferring. We will use the provide skeleton code frame to writeing three function: "b_io_fd b_open (char * filename, int flags); int b_read (b_io_fd fd, char * buffer, int count); int b_close (b_io_fd fd);".

Approach/What I did:

1. Git clone the assignment 5 from the Github
2. Read the README.md, understand what we need to do for each step and starting working on the assignment
3. Take a look the functions that the Professor already given in this program. Find that we are having a "fsLowSmall.h" file, and there's a structure named "fileInfo" and this structure can get the all text file's(data) information(file name, file size and the location) returned by GetFileInfo() function.
4. Trying to printout what we will get when we call b_getFCB() function. Found that it will return a number 0 and 1. I tried to delete one text file name in the Makefile, and the output number will only return a 0. Realized that it might because we're having two text file need to open, that's the reason why it will return 0 and 1. Since we're having a static array of file control blocks, I may can use this output number become the index of the array to input those two text file's data inside of the struct array.
5. Checking GetFileInfo() function will return what kind of values when I call it. By using printf to printout all of the data inside of the fileInfo struct, I found that it can output the file name, the total size of the file, and the starting location in the block. "DecOfInd.txt" starting at the third block, and the size is 8120 bytes, "CommonSense.txt" starting at the nineteenth block and the total size is 1877 bytes.
6. Since we have to hold the file information into the struct, and we also need to add other variables to track the data later, I decided to initialized pointer to hold the reaed data later and allocate memory dynamically from the heap. Base on the requirement in README, I allocated the 512 (B_CHUNK_SIZE) bytes that I may used it later for b_read() function.
7. Since I allocated memory dynamically in the b_open() function, what I did next is I used free method to dynamically de-allocate the memory, and set it becomes NULL.
8. Figure out the b_read() function. Take a look Linux counterpart read first. Then think about each parameter variable inside of this function's parameters list. "fd" is the number returned from the b_open() function, which is used to present the file descriptor of the file data inside the struct array, "buffer" is a pointer that we can hold our reading data, and "count" is a integer number that everything time we run the b_read() function, we can only ready "count" (number) bytes of the data, and input it into the buffer.
9. Take a look what does LBAread() function do(in fsLowSmall.h" file. What I understand for what this function does, it can read the number of whole blocks (lbaCound is the

number of blocks) starting at a block position we decided(lbaPosition is the starting position of the block)

10. Then, I tried to output the number of count and take a look what is the number is, and I found that the count number is a random number when each time the b_read() functions run, and the number can be bigger than 512(block size), or less than the 512(block size). I started to think about the logical we have to do in this function.

Draw an image to make the logical more clearly. "Situation" present three different of the situations when the count number is different. Situation 1 present the when the count number is less then a whole block size (512 bytes), situation 2 present a situation that when're already read some part of the data inside of this block from previous b_open() function called, we may want to set a variable in the struct to hold that how many bytes we've already read from this block, that will be easy to know where we need to start the b_read() function to read the data. The last situation is that what if the count number is bigger than two blocks or even more. We may can input whole buffer's data into our own buffer at one time, then check the rest of the data we left.

11. After draw a picture to think about the logical, I decided to add one more integer variable inside of the b_fcb struct named "byteCopied" to keep the value of the number of bytes we've already put into our buffer.

12. Starting write the b_open() function. Check if the count number is less or equal to zero first, which means if the count number is zero or negative, we don't have to store any data into our buffer.

13. Since we have to separate our count number become multiple part to store the data into the buffer (because we may already read some data in this block already), I initialized an integer named "copied" to keep tracking the total number of bytes we store into the buffer in one b_read() function. (Mention: "copied" will check with "count", but the "bytesCopied" will keep tracking all of the bytes we've already input into our buffer. These two values should be separate, that the reason why I use these two different integer variables to do my assignment)

14. Firstly, I would like to check if we've already read some part of the block, if we do, we need to check how many bytes we left in this block that we haven't into the buffer yet. "fcbArray[fd].byteCopied % B_CHUNK_SIZE" will return a reminder which means this number can present how many bytes we have already input into the buffer. So, "B_CHUNK_SIZE - fcbArray[fd].byteCopied % B_CHUNK_SIZE" is the number of remains part we didn't input into the buffer yet. Then, we need to check two situations, what if the total count is less than the number of remains, which means we can just input the total number of counts bytes into the buffer and finished the function by return the count value. Another situation is that what if the count number is larger than the remains bytes value we get, which means we need to separate the count number become two part, the first part we need to make it equal to the remains value we get before, input this part into our buffer. Then, LBAread next block's data, and input the rest of number of count bytes into the buffer. That's the reason why I did an if-else statement to do this part, I explain more detail inside my code as comments.

15. After we finish the if-statement, we are facing the situation 3 from my picture right now. Since we've already store all of the bytes in the previous blocks and put it into our buffer. What we're going to do right now is that we can check if the rest part of the count number value is larger or equal to 512 bytes, which means we can copy whole bytes in one buffer into our own buffer easily. For this situation, I using a while loop to do that. While the rest part of the count is larger or equal to 512 bytes, we will keep going read the next block, memory copy all of block size's bytes into our buffer, and update the byteCopied and the copied value each time until the rest part of the count is less than 512.

16. The last part should be the last situation that the rest part of the count bytes is less than 512. What we're going to do this part is LBAread the next block, and input the number of the rest of count bytes we left before, and input them into the buffer, then we down.

17. After I did all of the step, I run the program. And it shows error says that "*** System Error: Block number 24 with Block count 1 is invalid*** ABORT - too many Bad Block Requests (5)" (will explain in Issues and Resolutions)

Issues and Resolutions:

1. I found the error shows at the end of the output "*** System Error: Block number 24 with Block count 1 is invalid*** ABORT - too many Bad Block Requests (5)". However, I take a look the previous output, they look right. Everything in the DATA file printout each line. I realized this error may only occur at the end of the part when we input the data into the buffer. What if the last time we run the b_read() function the count size exceed the total size of the blocks? It may cause error because of the exceed. I try to edit one more if statement to check if the total bytes we copied before plus the count number is bigger than the total file size, we can set the count size become a smaller number, since we've already can input all of the data into the buffer, we don't need too many count

anymore. I set the count size become the total file size minus the size we've already copied. Error fix.

2. Another issue I met is

```
We have read 8801 characters from file DecOfInd.txt
We have read 2007 characters from file CommonSense.txt
```

Everything from the output looks good, but the characters is more than the file total bytes we get before. I started to add some printf to debug where the error is, and I take a look the output step by step trying to find the error. Then, I found that:

```
----copied a whole block in one time----

----copy the rest of the count left----
copied: 680      count: 680
organizing its powers in such form, as to them shall seem most likely to effect their S
afety and Happiness. Prudt among these are Life, Liberty and the pursuit of Happiness.-
-That to secure these rights, Governments are instituted among Men, deriving their just
 powers from the consent of the governed, --That whenever any Form of Government become
s destructive of these ends, it is the Right of the People to alter or to abolish it, a
nd to institute new Government, laying its foundation on such principles and


----count less than remian size in block----

copied: 46      count: 46
organizing its powers in such form, as to them


----count less than remian size in block----

copied: 48      count: 48
```

This part "organizing its power…." Input into the buffer again when b_read() run next time, it may some error at the end of the part I did because it shows "----copy the rest of the count left----" (I put this printf debug part at the end of my program".

```
256      copied += (count - copied);
257      fcbArray[fd].byteCopied += (count - copied);
258      // printf("----copy the rest of the count left----\n");
```

I found the error is that I update the copied variable first, then input the updated count variable into the struct array, it doesn't make sense because the "copied" variable will change after line 257, so I changed this two line become:

```
256      fcbArray[fd].byteCopied += (count - copied);
257      copied += (count - copied);
258      // printf("----copy the rest of the count left----\n");
```

And error fix.

Screen shot of complication:

```
student@student-VirtualBox:~/Desktop/CSC415-01/csc415-assignment5-bufferedio-Jiayi079$ clear

student@student-VirtualBox:~/Desktop/CSC415-01/csc415-assignment5-bufferedio-Jiayi079$ make
gcc -c -o b_io.o b_io.c -g -I.
student@student-VirtualBox:~/Desktop/CSC415-01/csc415-assignment5-bufferedio-Jiayi079$ ▮
```

Screen shot(s) of the execution of the program:

```
student@student-VirtualBox:~/Desktop/CSC415-01/csc415-assignment5-bufferedio-Jiayi079$ make run
./Gu_Jiayi_HW5_main DATA QUITE DecOfInd.txt CommonSense.txt
The unanimous Declaration of the thirteen united States of America, When in the
Perhaps the sentiments contained in the following pages, are no
Course of human events, it becomes necessary
t yet
sufficiently fashionable to procure them general favor; a long
for one people to dissolve the political bands which have connected them with a
 habit
of not thinking a thing wrong, gives it a superficial app
nother, and to assume among the powers of the earth, the separate and equal station to whi
earance of
being right, and raises at first a formidable outcry i
ch the Laws of Nature and of Nature's God entitle them, a dec
n defense of
custom. But the tumult soon subsides. Time makes more converts
ent respect to the opinions of mankind requires that they
 than
reason.

As a long and violent abuse of po
 should declare the causes which impel them t
```

```
wer, is generally the Means of calling
t
organizing its powers in such form, as to them shall seem most likely to effect their Safety and Happi
ness. Prhat among these are Life, Liberty and the pursuit of Happiness.--That to secure these rights,
Governments are instituted among Men, deriving their just powers from the consent of the governed, --T
hat whenever any Form of Government becomes destructive of these ends, it is the Right of the People t
o alter or to abolish it, and to institute new Government, laying its foundation on such principles an
d
 as censure to
individuals make no part thereof. The wise, and the worthy, neef England hath undertaken in his own Ri
ght, to support
the Parliament in what he calls Theirs, and as the good people of this
country are grievously oppressed by the combination, they have an undoubted
privilege to inquire into the pretensions of both, and equally to reject the
usurpation of either.

In the following sheets, the author hath studiously avoided every thing
which is personal among ourselves. Compliments as well
udence, indeed, will dictate that Governments lon
d not the
triumph of a pamphlet; and those whose sentiments are injudicious, or
unfr
g established should not be changed for light and transient causes; and accor
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iendly, will cease of themselves unless too much pains are
dingly all experience hath shewn, that mankind are mo
bestowed
upon their conversion.

The cause of America is in a great measure
re disposed to suffer, while evils are sufferable, than to right thems
the cause of all mankind. Many
circumsta
elves by abolishing the forms to which they are accustomed. But when a long train
nces hath, and will arise, which are not local, but universal, and
through which
 of abuses and usurpations, pursuing invariably the same O
the principles of all Lovers of Mankind are affected, and
a design to reduce them under absolute Dere affected, a
Affectionsvent of which, their bsolute De
spotism, it is their right, it is their duty, to throw off such Government
 are interested. The laying a Country
desolate with Fire and Sword,
, and to provide new Guards for their future security.--Such has
declaring War against the natural rights of all
Mank
 been the patient sufferance of these Colonies;
ind, and extirpating the Defenders thereof from the Face of the Earth,
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is the
and such is now the necessity which constrains them to alter their former Syste
 Concern of every Man to whom Nature hath given
ms of Government. The history of the present King of
 the Power of feeling;
of which Class, regardless of Party Censure, is th
Great Britain is a history of repeated injuries and usurp
e

AUTHOR
ations, all having in direct object the establishment of an absolute Tyranny over t
To prove this, let Facts be submitted to a candid world.

n absolute Ty
He has refused his Assent to Laws, the most wholesome and n
ecessary for the public good.

He has forbidden his
Governors to pass Laws of immediate and pressing
 importance, unless suspended in their operation till his
 Assent should be obtained; and when so suspended, he has utterly
 neglected to attend to them.

He has refuse
```

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d to pass other Laws for the accommodation of large districts of people, unless those peo
entation in the Legislature, a right inestimf large districts of people, unless thos
able to them and formidable to tyrants only.

He has called to
gether legislative bodies at places unusual, uncomfortable, and distant from the depos
itory of their public Records, for the sole purpose of fatiguing them
into compliance with his measures.

He has dissolve
d Representative Houses repeatedly, for opposing with manly firmness his invasions
 on the rights of the people.

He has refused for a long time, after such dissolutions,
; whereby the Legislative powers, incapable of Annihilation, , after such dissolutions,
have returned to the People at large for their exercise; the State
 remaining in the mean time exposed to all the dangers of
 invasion from without, and convulsions within.

He has endeavoured to prevent the popul
ation of these States; for that purpose obstructing
the Laws for Naturalization of Foreigners; refusing to pass others to encoura
ge their migrations hither, and raising the conditions of new Appropriations of Lands.
dministration of Ju the Ar, and raising the
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stice, by refusing his Assent to Laws for establishing Judiciary powers.


He has made Judges dependent on his Will
alone, for the tenure of their offices, and the amount
and payment of their salaries.

He has erected a m
ultitude of New Offices, and sent hither swarms of Officers to harrass
 our people, and eat out their substance.

He has k
ept among us, in times of peace, Standing Armies without the Consent of our legislatures.


He has affected to render the Military ind
erior to the Civil power.

He haMilitary ind
s combined with others to subject us to a jurisdiction foreign to our constituti
on, and unacknowledged by our laws; giving his Assent to their Acts of pretended Leg
islation:
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For Quartering large bodies of
 armed troops among us:

For protecting them, by a mock Trial, fro
m punishment for any Murders which they should commit on
the Inhabitants of these States:

For cutti
ng off our Trade with all parts of the world:

For impo
s in Taxes on us without our Consent:

For depriving uo
many cases, of the benefits of Trial by Jury:

For transporting us beyond Seas to
be tried for pretended offences

For abolishing the
 free System of English Laws in a neighbou
ring Province, establishing therein an Arbitrary government, and enlarging its Boundaries
 so as to render it at once an example and fit instrument for introducing th
```

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e same absolute rule into these Colonies:

For taking away ou
r Charters, abolishing our most valuable Laws, and altering
or suspending our own Legislatures, anments:

Fand altering
d declaring themselves invested with power to le
gislate for us in all cases whatsoever.

He has abdicated Go
vernment here, by declaring us out of his Protection and waging War against us.

He
 has plundered our seas, ravaged our Coasts, burnt our towns,
 and destroyed the lives of our people.

He is at this ti
me transporting large Armies of foreign Mercenaries to compleat the wo
rks of death, desolation and tyranny, already begu
rcely paralleled in the most barbarous agesca begu
s, and totally unworthy the Head of a civilize
d nation.
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```
He has constrained our fellow C
itizens taken Captive on the high Seas to bear Arms against their Country, to become the
 executioners of their friends and Brethren, or to fall themselves by their Hands.

He
 has excited domestic insurrections amongst us, and has endeavoured to bring on the inh
abitants of our frontiers, the merciless Indian Savages, whose known rule of warfare, i
f all ages, sexes and conditions.

In every stage of ts, whose known rule of warfare, i
hese Oppressions We have Petitioned for Redress in the most hu
mble terms: Our repeated Petitions have been answered only by repeat
ed injury. A Prince whose character is thus marked by every act which may defin
e a Tyrant, is unfit to be the ruler of a free people.

Nor have We been wanti
ng in attentions to our Brittish brethren. W
e have warned them from time to time of attempts by their legislature to
extend an unwarrantable jurisdiction over us. We
reminded them of the circumstances of our emigration and settlement e to
here. We have appealed to their native justice and magnanimity, and we have conjure
d them by the ties of our common kindred to disavow these usurpations, which,
 would inevitably interrupt our connections and correspondence. They too have been deaf
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 would inevitably interrupt our connections and correspondence. They too have been deaf
 to the voice of justice and of consanguinity. We must, therefore, acquiesce in the n
ecessity, which denounces our Separation, and hold them
e Friends.

We,e rest of mankind, Enemies in War, in Peacherefore, acqui
 therefore, the Representatives of the united States of America, in Ge
neral Congress, Assembled, appealing to th
e Supreme Judge of the world for the rectitude of our intentions, do, in
the Name, and by Authority of the good People of these Colonies, solemnly publish an
d declare, That these United Colonies ar
e, and of Right ought to be Free and Indepen
dent States; that they are Absolved from all Allegiance to the British Cro
wn, and that all political connection between them a
eat Britain, is and oughal connection betw
t to be totally dissolved; and that as Free and Independent St
ates, they have full Power to levy War, conclude Peace, contract Alliance
s, establish Commerce, and to do all other Acts and Things which Independent Sta
tes may of right do. And for the support of this Declaration, with a firm reliance
 on the protection of divine Providence, we mutually pledge
 to each other our Lives, our Fortunes and our sacred Honor.
We have read 8120 characters from file DecOfInd.txt
We have read 1877 characters from file CommonSense.txt
student@student-VirtualBox:~/Desktop/CSC415-01/csc415-assignment5-bufferedio-Jiayi079$
```