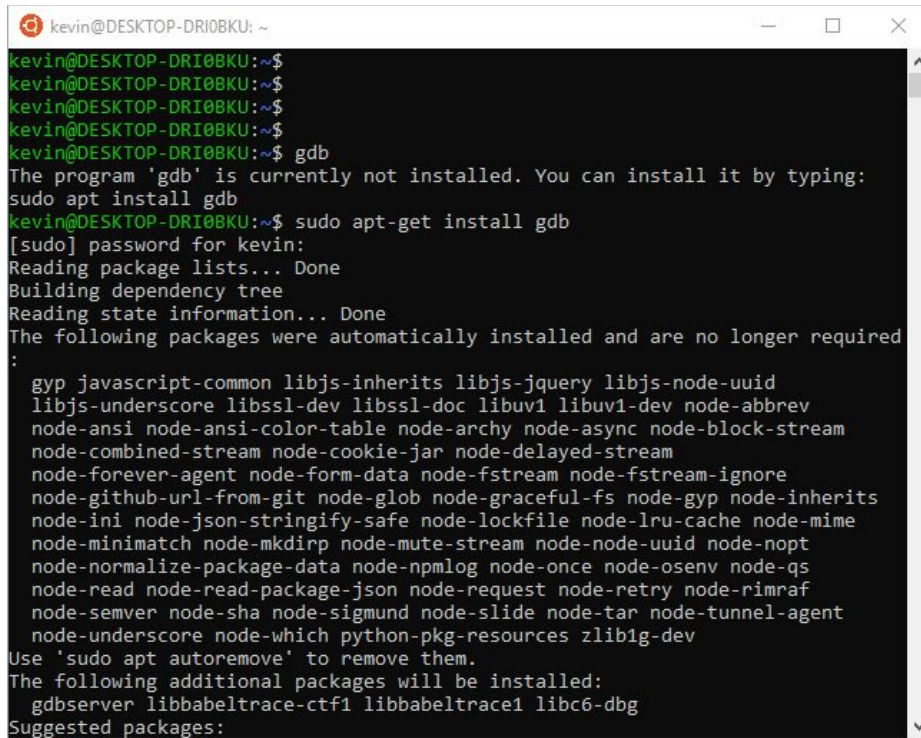


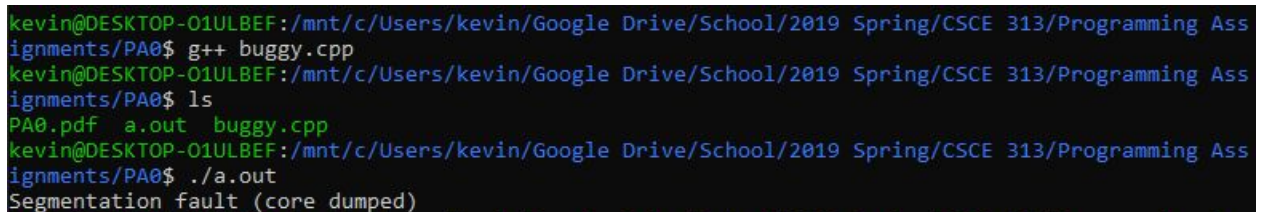
Programming Assignment 0 Report

1. I used the linux ubuntu subsystem that windows 10 provides. I installed g++ and gdb onto the subsystem.



```
kevin@DESKTOP-DRI0BKU: ~  
kevin@DESKTOP-DRI0BKU:~$  
kevin@DESKTOP-DRI0BKU:~$  
kevin@DESKTOP-DRI0BKU:~$  
kevin@DESKTOP-DRI0BKU:~$ gdb  
The program 'gdb' is currently not installed. You can install it by typing:  
sudo apt install gdb  
kevin@DESKTOP-DRI0BKU:~$ sudo apt-get install gdb  
[sudo] password for kevin:  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following packages were automatically installed and are no longer required  
:  
  gyp javascript-common libjs-inherits libjs-jquery libjs-node-uuid  
  libjs-underscore libssl-dev libssl-doc libuv1 libuv1-dev node-abbrev  
  node-ansi node-ansi-color-table node-archy node-async node-block-stream  
  node-combined-stream node-cookie-jar node-delayed-stream  
  node-forever-agent node-form-data node-fstream node-fstream-ignore  
  node-github-url-from-git node-glob node-graceful-fs node-gyp node-inherits  
  node-ini node-json-stringify-safe node-lockfile node-lru-cache node-mime  
  node-minimatch node-mkdirp node-mute-stream node-node-uuid node-nopt  
  node-normalize-package-data node-npmlog node-once node-osenv node-qs  
  node-read node-read-package-json node-request node-retry node-rimraf  
  node-semver node-sha node-sigmund node-slide node-tar node-tunnel-agent  
  node-underscore node-which python-pkg-resources zlib1g-dev  
Use 'sudo apt autoremove' to remove them.  
The following additional packages will be installed:  
  gdbserver libbabeltrace-ctf1 libbabeltrace1 libcb6-dbg  
Suggested packages:
```

2. g++ buggy.cpp
3. Compile time error bugs:
 - a. #include<vector> needs to be at the top of the program
 - b. Add “using namespace std” so that the namespace is std by default
 - c. Made all member variables public by add “public:” in the class definition
 - d. Need to change “.” to “->” when accessing member variables of pointers



```
kevin@DESKTOP-01ULBEF:/mnt/c/Users/kevin/Google Drive/School/2019 Spring/CSCE 313/Programming Ass  
ignments/PA0$ g++ buggy.cpp  
kevin@DESKTOP-01ULBEF:/mnt/c/Users/kevin/Google Drive/School/2019 Spring/CSCE 313/Programming Ass  
ignments/PA0$ ls  
PA0.pdf a.out buggy.cpp  
kevin@DESKTOP-01ULBEF:/mnt/c/Users/kevin/Google Drive/School/2019 Spring/CSCE 313/Programming Ass  
ignments/PA0$ ./a.out  
Segmentation fault (core dumped)
```

5. g++ -g buggy.cpp

```

kevin@DESKTOP-01ULBEF:/mnt/c/Users/kevin/Google Drive/School/2019 Spring/CSCE 313/Programming Assignments/PA0$ g++ -g buggy.cpp
kevin@DESKTOP-01ULBEF:/mnt/c/Users/kevin/Google Drive/School/2019 Spring/CSCE 313/Programming Assignments/PA0$ gdb ./a.out
GNU gdb (Ubuntu 8.1-0ubuntu3) 8.1.0.20180409-git
Copyright (C) 2018 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law. Type "show copying"
and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<http://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
<http://www.gnu.org/software/gdb/documentation/>.
For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./a.out...done.
(gdb)
(gdb) ./a.out
Undefined command: "". Try "help".
(gdb) run
Starting program: /mnt/c/Users/kevin/Google Drive/School/2019 Spring/CSCE 313/Programming Assignments/PA0/a.out

Program received signal SIGSEGV, Segmentation fault.
0x000000008000bb4 in create_LL (mylist=std::vector of length 3, capacity 3 = {...}, node_num=3)
    at buggy.cpp:25
25             mylist[i]->val = i;
(gdb) where
#0  0x000000008000bb4 in create_LL (mylist=std::vector of length 3, capacity 3 = {...},
    node_num=3) at buggy.cpp:25
#1  0x000000008000cbc in main (argc=1, argv=0x7fffffff3a8) at buggy.cpp:48
(gdb) print(mylist[i])
$1 = (node *) 0x0
(gdb)

```

6.

```

(gdb) break 25
Breakpoint 1 at 0x8000b99: file buggy.cpp, line 25.
(gdb) run
The program being debugged has been started already.
Start it from the beginning? (y or n) y
Starting program: /mnt/c/Users/kevin/Google Drive/School/2019 Spring/CSCE 313/Programming Assignments/PA0/a.out

Breakpoint 1, create_LL (mylist=std::vector of length 3, capacity 3 = {...}, node_num=3)
    at buggy.cpp:25
25             mylist[i]->val = i;
(gdb) print(mylist[i])
$2 = (node *) 0x0

```

7.

8. Fixed the segmentation error by assigning new node to the list and allocated memory
9. The segmentation fault is caused by accessing memory in the vector passed it's size. This can be fixed in the for loop by making it loop until myList.size - 1.
10. This can be done by creating a for loop and deleting every node memory that was allocated to the linked list.

Summary

The compile time issues were easily resolved because they were mostly syntax. The compiler gave a good description on what the exact problem was and why it was causing a compile time issue. Run time issues were more challenging and required gdb. For the first run time bug that caused a segmentation fault, running a backtrace and printing the `list[i]` object showed that it was a null pointer. This made it clear that there was no memory allocated to that object so it gave seg faults for trying to assign member variables of the null pointer. For the second run time bug, I suspected that the create linked list was accessing nodes in `mylist` past its size. The for loop made this clear and after a backtrace, I noticed that it was setting the `mylist[i].next` (the last node) to `mylist[i+1]` which is past the list size. I changed the for loop so that it would terminate when `i = node_num - 1`. Overall these bugs were easy to find using the gdb functions.