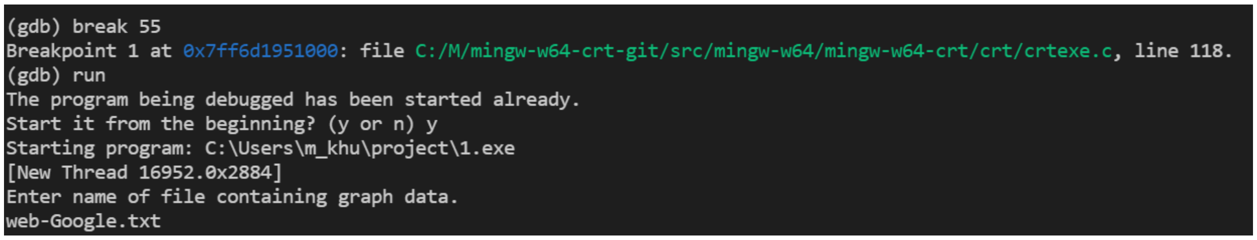
Debugging

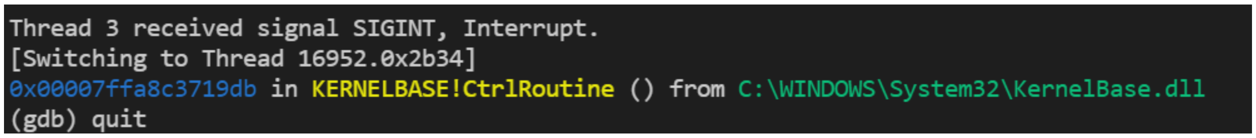
The snips and details below show the use of gdb debugger.

The program did not stop running even after a long time, so it was interrupted (Ctrl + C).

So, break points were added in the main() function starting from line 55.The program was again stuck on entering the getfromfile() function.



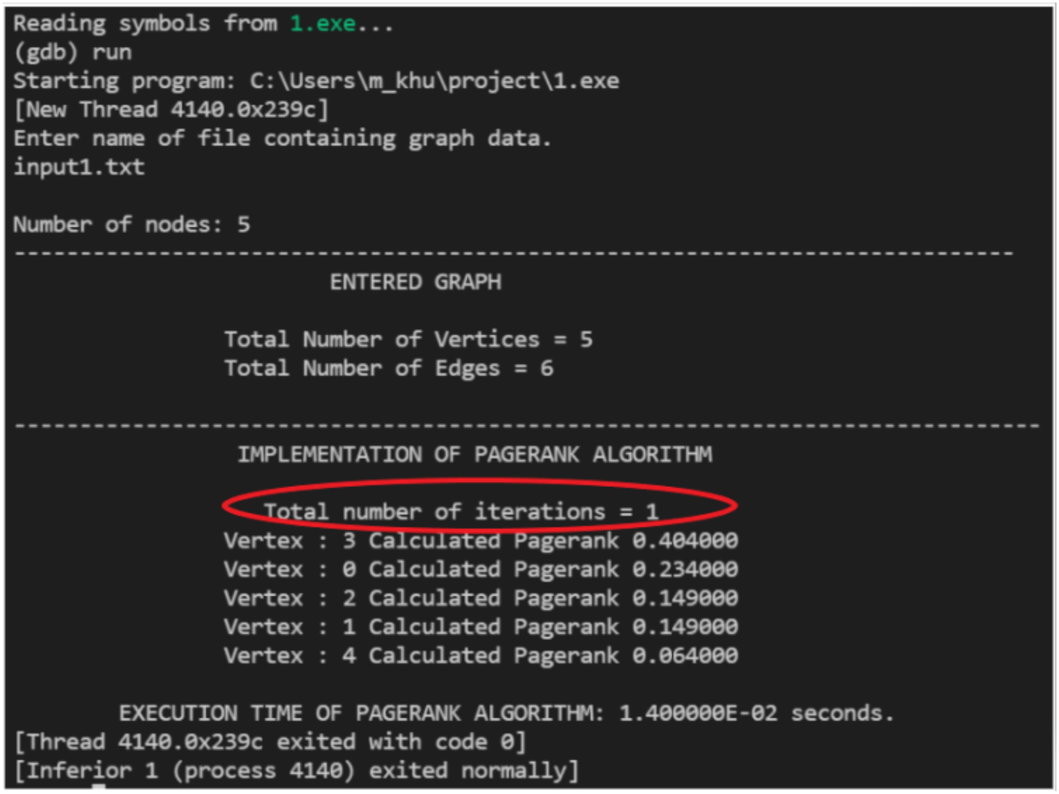
```
(gdb) break 55
Breakpoint 1 at 0x7ff6d1951000: file C:/M/mingw-w64-crt-git/src/mingw-w64/mingw-w64-crt/crt/crtexe.c, line 118.
(gdb) run
The program being debugged has been started already.
Start it from the beginning? (y or n) y
Starting program: C:\Users\m_khu\project\1.exe
[New Thread 16952.0x2884]
Enter name of file containing graph data.
web-Google.txt
```



```
Thread 3 received signal SIGINT, Interrupt.
[Switching to Thread 16952.0x2b34]
0x00007ffa8c3719db in KERNELBASE!CtrlRoutine () from C:\WINDOWS\System32\KernelBase.dll
(gdb) quit
```

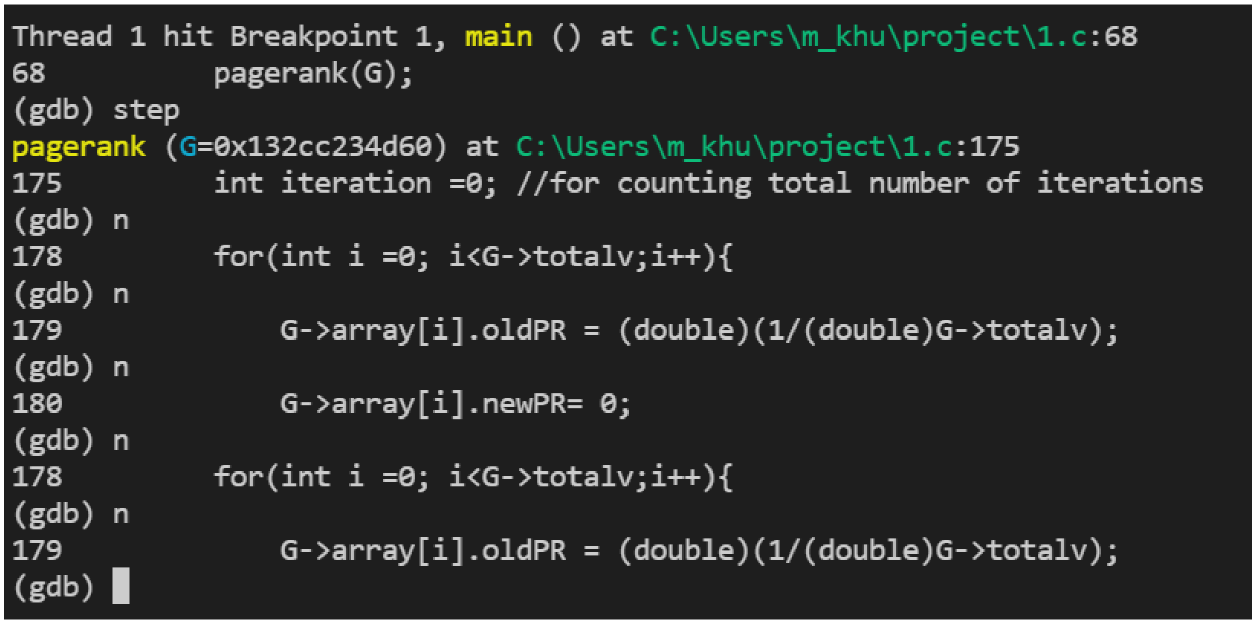
We then checked the input data and found that some vertex points were greater than the input number of nodes (n). So as to keep a check for this, a condition was added to check that the input number is always less than n and also greater than or equal to 0

On further running the code:

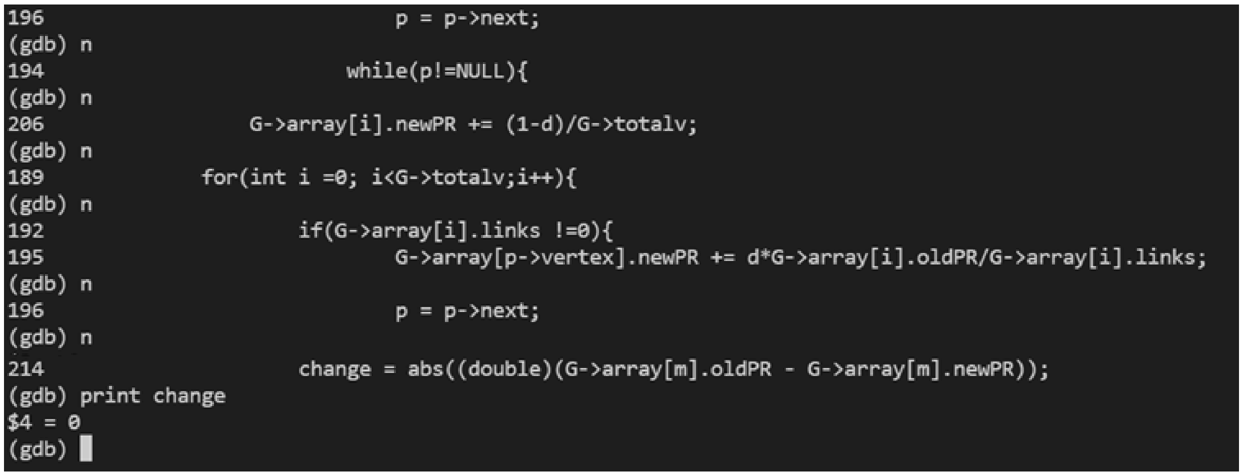


```
Reading symbols from 1.exe...
(gdb) run
Starting program: C:\Users\m_khu\project\1.exe
[New Thread 4140.0x239c]
Enter name of file containing graph data.
input1.txt

Number of nodes: 5
----------------------------------------------------------------------------
                        ENTERED GRAPH

                Total Number of Vertices = 5
                Total Number of Edges = 6

------------------------------------------------------------------------------
                 IMPLEMENTATION OF PAGERANK ALGORITHM

                   Total number of iterations = 1
                Vertex : 3 Calculated Pagerank 0.404000
                Vertex : 0 Calculated Pagerank 0.234000
                Vertex : 2 Calculated Pagerank 0.149000
                Vertex : 1 Calculated Pagerank 0.149000
                Vertex : 4 Calculated Pagerank 0.064000

        EXECUTION TIME OF PAGERANK ALGORITHM: 1.400000E-02 seconds.
[Thread 4140.0x239c exited with code 0]
[Inferior 1 (process 4140) exited normally]
```

The above program terminates in only 1 iteration and incorrect pagerank values are obtained. Hence, there is something wrong in the Pagerank function due to which incorrect page rank values are obtained. Thus a breakpoint at line 68 was put to analyze the mistake in the function.

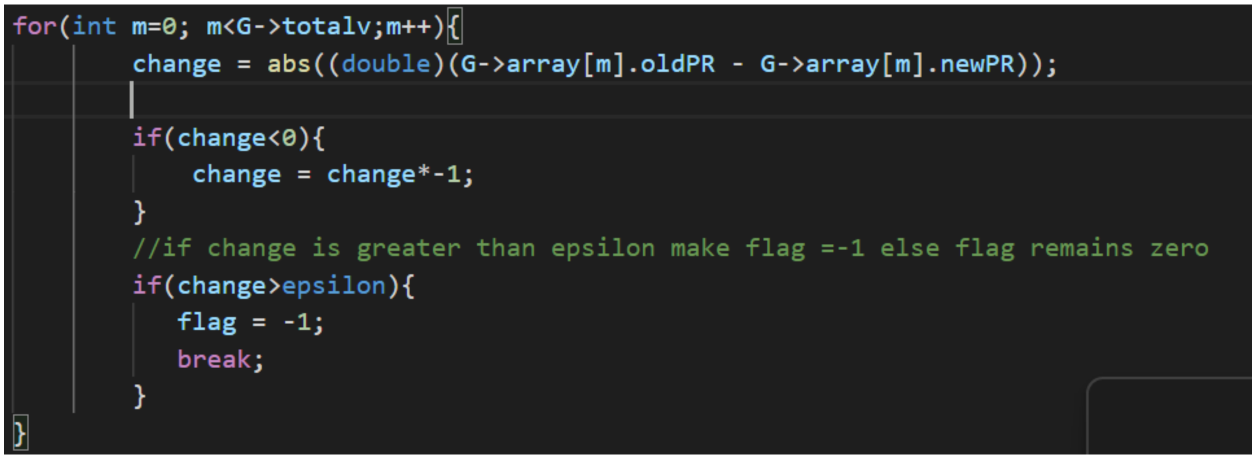


```
Thread 1 hit Breakpoint 1, main () at C:\Users\m_khu\project\1.c:68
68          pagerank(G);
(gdb) step
pagerank (G=0x132cc234d60) at C:\Users\m_khu\project\1.c:175
175         int iteration =0; //for counting total number of iterations
(gdb) n
178         for(int i =0; i<G->totalv;i++){
(gdb) n
179             G->array[i].oldPR = (double)(1/(double)G->totalv);
(gdb) n
180             G->array[i].newPR= 0;
(gdb) n
178         for(int i =0; i<G->totalv;i++){
(gdb) n
179             G->array[i].oldPR = (double)(1/(double)G->totalv);
(gdb)
```



```
196                             p = p->next;
(gdb) n
194                         while(p!=NULL){
(gdb) n
206                 G->array[i].newPR += (1-d)/G->totalv;
(gdb) n
189             for(int i =0; i<G->totalv;i++){
(gdb) n
192                     if(G->array[i].links !=0){
195                             G->array[p->vertex].newPR += d*G->array[i].oldPR/G->array[i].links;
(gdb) n
196                             p = p->next;
(gdb) n
214                     change = abs((double)(G->array[m].oldPR - G->array[m].newPR));
(gdb) print change
$4 = 0
(gdb)
```

Here we obtained that change is 0, which should not be the case as the value has changed. So, on brainstorming for a while it was realized that the abs() function was type casting the obtained difference into int. Thus, the code was changed to explicitly check if change is negative and make it positive in that case, as follows:



```c
for(int m=0; m<G->totalv;m++){
        change = abs((double)(G->array[m].oldPR - G->array[m].newPR));
        
        if(change<0){
            change = change*-1;
        }
        //if change is greater than epsilon make flag =-1 else flag remains zero
        if(change>epsilon){
           flag = -1;
           break;
        }
}
```

More such cases were solved with the use of debugging tool.