

Finding the source code line producing a “Segmentation fault” problem

I have deliberately entered a bug in my code. Here it is the function containing the bug:

- The `ComputerSystem_DebugMessage()` invocation tries to print 666

```
56 void OperatingSystem_Initialize(int daemonsIndex) {
57
58     int i, selectedProcess;
59     FILE *programFile; // For load Operating System Code
60     programFile=fopen("OperatingSystemCode", "r");
61     if (programFile==NULL){
62         // Show red message "FATAL ERROR: Missing Operating System!\n"
63         ComputerSystem_DebugMessage(99,SHUTDOWN,"FATAL ERROR: Missing Operating System!\n");
64         exit(1);
65     }
66
67     // Obtain the memory requirements of the program
68     int processSize=OperatingSystem_ObtainProgramSize(programFile);
69
70     // Load Operating System Code
71     OperatingSystem_LoadProgram(programFile, OS_address_base, processSize);
72
73     ComputerSystem_DebugMessage(101,SYSPROC,666);
74
75     // Process table initialization (all entries are free)
```

And here it is my `messagesSTD.txt` file:

- Message 101 expects a string, not an integer

```
1 // Students created messages
2 // Format: numberOfMessage,textPrintfFormattedWithColourCodes
3 //
4 // numbers of messages greather than 100 for students
5 //
6 101,This is an example message %s
7
```

So, when I run the simulator, I get the “Segmentation fault” error message and the simulator execution is aborted:

```
falvarez@DESKTOP-GDPRC10:~/mySolutions/V1/initialWithErrorToDebug$ ./Simulator programVerySimple
30 messages loaded from file messagesTCH.txt
1 messages loaded from file messagesSTD.txt
0 Assents Loaded
Segmentation fault
```

To find the source code line responsible of the problem, we must execute the simulator from inside the debugger.

Using “ddd”

- Do not set any breakpoint
- Directly enter the command to run the simulator

```
GNU DDD 3.3.12 (x86_64-pc-linux-gnu), by Dorothea LReading symbols from Simulator...done.
(gdb) run programVerySimple

Welcome to DDD 3.3.12 "Dale Head" (x86_64-pc-linux-gnu)
```

- The debugger tells us that a “Segmentation fault” problem has arisen. The simulator execution has been aborted.

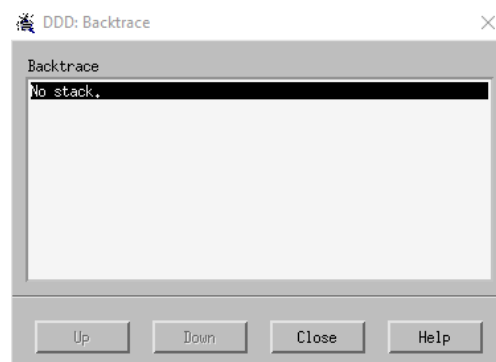
```
Program received signal SIGSEGV, Segmentation fault.
0x00007ffff7a7bdcc in _IO_vfprintf_internal (s=<optimized out>, format=<optimized out>, ap=ap@entry=0x7fffffffe6f8) at vfprintf.c:1642
rSpecified start and end are in different files.
(gdb) (gdb) I

Disassembling location 0x00007ffff7a7bdcc to 0x7ffff7a7becc...done.
```

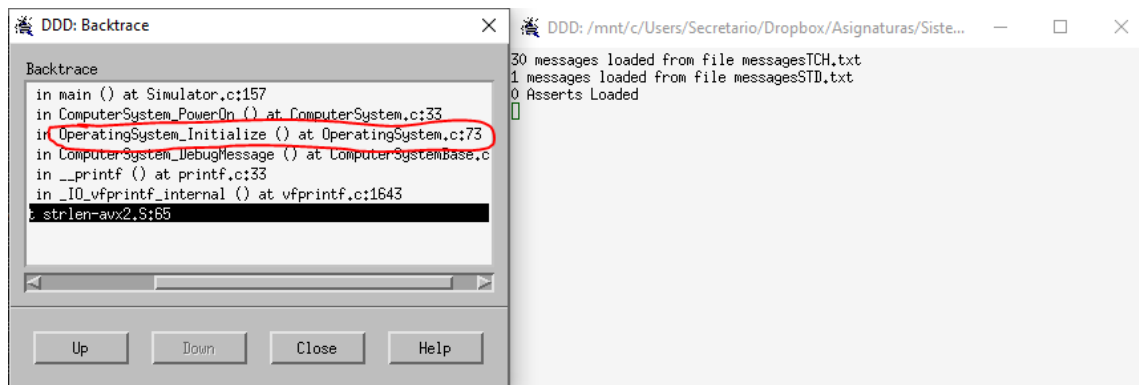
- Run the “backtrace” command. It will show you the function invocation stack (similar to what Java does when a NullPointerException is raised):

```
rSpecified start and end are in different files.
(gdb) (gdb) backtrace
#0 0x00007ffff7a7bdcc in _IO_vfprintf_internal (s=<optimized out>, format=<optimized out>, ap=ap@entry=0x7fffffffe6f8) at vfprintf.c:1642
#1 0x00007ffff7a81d89 in _printf (format=<optimized out>) at printf.c:33
#2 0x00000000040372e in ComputerSystem_DebugMessage (msgNo=101, section=112 'n') at ComputerSystemBase.c:176
#3 0x000000000404713 in OperatingSystem_Initialize (daemonsIndex=2) at OperatingSystem.c:73
#4 0x000000000403064 in ComputerSystem_PowerOn (argc=2, argv=0x7fffffffea78, paramIndex=1) at ComputerSystem.c:33
#5 0x000000000401006 in main (argc=2, argv=0x7fffffffea78) at Simulator.c:157
(gdb) I
```

- In the stack, try to find the line closest to the top corresponding to a function inside one of the files you usually modify. There it is the problem:
 - Line 73 of OperatingSystem.c, inside OperatingSystem_Initialize().
- Alternatively, the function invocation stack could be always visible, by using the “Status > Backtrace” menu option. For example, if you show it before you start the simulator execution:



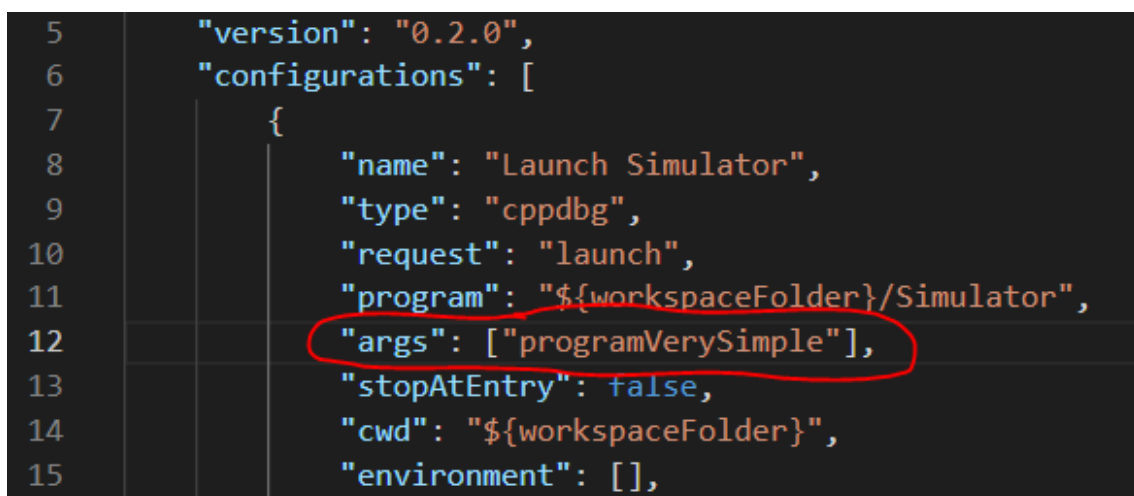
- Or, if you show it after the “segmentation fault” problem appears:



After you have found the code line presenting the problem, **it is time to determine the nature of the bug**. This is done as in any other programming language (debugging skills are always important).

Using “VSCode”

- Before anything else, setup your VSCode to debug the simulator as it is explained in a document in the eCampus.
- Prepare the “.vscode/launch.json” file to execute the simulator in the desired conditions:



- Start debugging (F5). The debugging console shows the “Segmentation fault” problem:

```
TERMINAL  CONSOLA DE DEPURACIÓN  PROBLEMAS  6  SALIDA
=cmd-param-changed,param= pagination ,value= 0TT
Stopped due to shared library event (no libraries added or removed)
Loaded '/lib64/ld-linux-x86-64.so.2'. Symbols loaded.

Breakpoint 1, main (argc=2, argv=0x7fffffffdd58) at Simulator.c:32
32      int main(int argc, char *argv[]) {
Loaded '/lib/x86_64-linux-gnu/libc.so.6'. Symbols loaded.

Program received signal SIGSEGV, Segmentation fault.
__strlen_avx2 () at ../sysdeps/x86_64/multiarch/strlen-avx2.S:65
```

- You can also see the function invocation stack:

```
count: 28
youHaveToContinue: 1
colour: 0
pos: 1
msgNo: 101
section: 112 'p'
> Registers

> INSPECCIÓN
v PILA DE LLAMADAS  EN PAUSA EN EXCEPTION  Mostrar 3 marcos de pila más
ComputerSystem_DebugMessage(int msgNo, char section)  ComputerSystemBase.c
OperatingSystem_Initialize(int daemonsIndex)  OperatingSystem.c 73:1
ComputerSystem_PowerOn(int argc, char ** argv, int paramIndex)  ComputerSyst...
main(int argc, char ** argv)  Simulator.c 157:1
```

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