

UNIX ASSIGNMENT – 4

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SECTION : A

Generate different C programs that induce a segmentation fault error, select these examples of your choice, and employ the GDB utility for debugging on Linux

1.Factorial:

```
#include <stdio.h>
int main() {
    int num;
    unsigned long long factorial = 1;
    printf("Enter a positive integer: ");
    scanf("%d", &num);
    if (num < 0) {
        printf("Factorial of a negative number is not defined.\n");
    } else {
        int i = 1;

        while(i<=num) {
            factorial *= i;
            i++;
            printf("Factorial of %d is %llu\n", num, factorial);
        }
    }
    return 0;
}
```

GNU debugger:

```
Activities Terminal Mar 13 16:09
student@ai-HP-ProDesk-600-G4-MT: ~
student@ai-HP-ProDesk-600-G4-MT:~$ gcc -g fa.c
student@ai-HP-ProDesk-600-G4-MT:~$ gdb ./a.out
GNU gdb (Ubuntu 9.2-0ubuntu1~20.04) 9.2
Copyright (C) 2020 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...
(gdb) run
Starting program: /home/student/a.out
0
1
2
3
4
5
6
7
8
9
[Inferior 1 (process 9554) exited normally]
(gdb) list
1      #include <stdio.h>
2
3      #define ARRAY_SIZE 10
4
5      int main() {
6          int array[ARRAY_SIZE];
7
8          // Initialize the array
9          for (int i = 0; i < ARRAY_SIZE; i++) {
10             array[i] = i;
11         }
12     }
```

```
Activities Terminal Mar 13 16:09
student@ai-HP-ProDesk-600-G4-MT: ~
student@ai-HP-ProDesk-600-G4-MT:~$ gdb
9      for (int i = 0; i < ARRAY_SIZE; i++) {
10         array[i] = i;
11     }
12
13     // Access array elements outside its bounds
14     for (int i = 0; i <= ARRAY_SIZE-1; i++) {
15         printf("%d\n", array[i]); // Accessing out-of-bounds element
16     }
17
18     return 0;
19 }
20
(gdb)
Line number 21 out of range; fa.c has 20 lines.
(gdb) break 8
Breakpoint 1 at 0x55555555184: file fa.c, line 9.
(gdb) run
Starting program: /home/student/a.out
Breakpoint 1, main () at fa.c:9
9      for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10         array[i] = i;
(gdb) print i
$1 = 0
(gdb) print array[i]
$2 = -134556952
(gdb) next
9      for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10         array[i] = i;
(gdb) print i
$3 = 1
(gdb) print array[i]
$4 = 32767
(gdb) break 13
Breakpoint 2 at 0x555555551a3: file fa.c, line 14.
(gdb) run
The program being debugged has been started already.
Start it from the beginning? (y or n) n
Program not restarted.
(gdb) next
9      for (int i = 0; i < ARRAY_SIZE; i++) {
```

```
Activities Terminal Mar 13 16:10
student@ai-HP-ProDesk-600-G4-MT: ~
student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6...
Start it from the beginning? (y or n) n
Program not restarted.
(gdb) next
9 for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10 array[i] = i;
(gdb) print i
$5 = 2
(gdb) print array[i]
$6 = 1431654896
(gdb) next
9 for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10 array[i] = i;
(gdb) print i
$7 = 3
(gdb) print array[i]
$8 = 21845
(gdb) next
9 for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10 array[i] = i;
(gdb) print i
$9 = 4
(gdb) print array[i]
$10 = 0
(gdb) continue
Continuing.

Breakpoint 2, main () at fa.c:14
14 for (int i = 0; i <= ARRAY_SIZE-1; i++) {
(gdb) print i
$11 = 21845
(gdb) next
15 printf("%d\n", array[i]); // Accessing out-of-bounds element
(gdb) print array[i]
$12 = 0
(gdb) continue
Continuing.
0
1
2
3
4
```

```
Activities Terminal Mar 13 16:10
student@ai-HP-ProDesk-600-G4-MT: ~
student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6... student@ai-HP-ProDesk-6...
(gdb) print array[i]
$6 = 1431654896
(gdb) next
9 for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10 array[i] = i;
(gdb) print i
$7 = 3
(gdb) print array[i]
$8 = 21845
(gdb) next
9 for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10 array[i] = i;
(gdb) print i
$9 = 4
(gdb) print array[i]
$10 = 0
(gdb) continue
Continuing.

Breakpoint 2, main () at fa.c:14
14 for (int i = 0; i <= ARRAY_SIZE-1; i++) {
(gdb) print i
$11 = 21845
(gdb) next
15 printf("%d\n", array[i]); // Accessing out-of-bounds element
(gdb) print array[i]
$12 = 0
(gdb) continue
Continuing.
0
1
2
3
4
5
6
7
8
9
[Inferior 1 (process 9558) exited normally]
(gdb)
```

2.Array:

```
#include <stdio.h>
```

```
#define ARRAY_SIZE 10
```

```
int main() {
    int array[ARRAY_SIZE];
```

```

// Initialize the array
for (int i = 0; i < ARRAY_SIZE; i++) {
    array[i] = i;
}

// Access array elements outside its bounds
for (int i = 0; i <= ARRAY_SIZE-1; i++) {
    printf("%d\n", array[i]); // Accessing out-of-bounds element
}

return 0;
}

```

GNU debugger:

```

student@a1-HP-ProDesk-600-G4-MT:~$ gcc -g fa.c
student@a1-HP-ProDesk-600-G4-MT:~$ gdb ./a.out
GNU gdb (Ubuntu 9.2-0ubuntu1~20.04) 9.2
Copyright (C) 2020 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...
(gdb) run
Starting program: /home/student/a.out
0
1
2
3
4
5
6
7
8
9
[Inferior 1 (process 9554) exited normally]
(gdb) list
1      #include <stdio.h>
2
3      #define ARRAY_SIZE 10
4
5      int main() {
6          int array[ARRAY_SIZE];
7
8          // Initialize the array
9          for (int i = 0; i < ARRAY_SIZE; i++) {
10             array[i] = i;
(gdb)
..

```

```

9      for (int i = 0; i < ARRAY_SIZE; i++) {
10          array[i] = i;
(gdb)
11      }
12
13      // Access array elements outside its bounds
14      for (int i = 0; i <= ARRAY_SIZE-1; i++) {
15          printf("%d\n", array[i]); // Accessing out-of-bounds element
16      }
17
18      return 0;
19  }
20
(gdb)
Line number 21 out of range; fa.c has 20 lines.
(gdb) break 8
Breakpoint 1 at 0x55555555104: file fa.c, line 9.
(gdb) run
Starting program: /hone/student/a.out

Breakpoint 1, main () at fa.c:9
9      for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10          array[i] = i;
(gdb) print i
$1 = 0
(gdb) print array[i]
$2 = -134556952
(gdb) next
9      for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10          array[i] = i;
(gdb) print i
$3 = 1
(gdb) print array[i]
$4 = 32767
(gdb) break 13
Breakpoint 2 at 0x555555551a3: file fa.c, line 14.
(gdb) run
The program being debugged has been started already.
Start it from the beginning? (y or n) n
Program not restarted.
(gdb) next
9      for (int i = 0; i < ARRAY_SIZE; i++) {

```

```

Start it from the beginning? (y or n) n
Program not restarted.
(gdb) next
9      for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10          array[i] = i;
(gdb) print i
$5 = 2
(gdb) print array[i]
$6 = 1431654896
(gdb) next
9      for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10          array[i] = i;
(gdb) print i
$7 = 3
(gdb) print array[i]
$8 = 21845
(gdb) next
9      for (int i = 0; i < ARRAY_SIZE; i++) {
(gdb) next
10          array[i] = i;
(gdb) print i
$9 = 4
(gdb) print array[i]
$10 = 0
(gdb) continue
Continuing.

Breakpoint 2, main () at fa.c:14
14      for (int i = 0; i <= ARRAY_SIZE-1; i++) {
(gdb) print i
$11 = 21845
(gdb) next
15          printf("%d\n", array[i]); // Accessing out-of-bounds element
(gdb) print array[i]
$12 = 0
(gdb) continue
Continuing.
0
1
2
3
4

```

```
Breakpoint 2, main () at fa.c:14
14      for (int i = 0; i <= ARRAY_SIZE-1; i++) {
(gdb) print i
$11 = 21845
(gdb) next
15      printf("%d\n", array[i]); // Accessing out-of-bounds element
(gdb) print array[i]
$12 = 0
(gdb) continue
Continuing.
0
1
2
3
4
5
6
7
8
9
[Inferior 1 (process 9558) exited normally]
(gdb) □
```