Linux digital assignment-2

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Gdb debugging:

Example: recursive function : gcd of two numbers

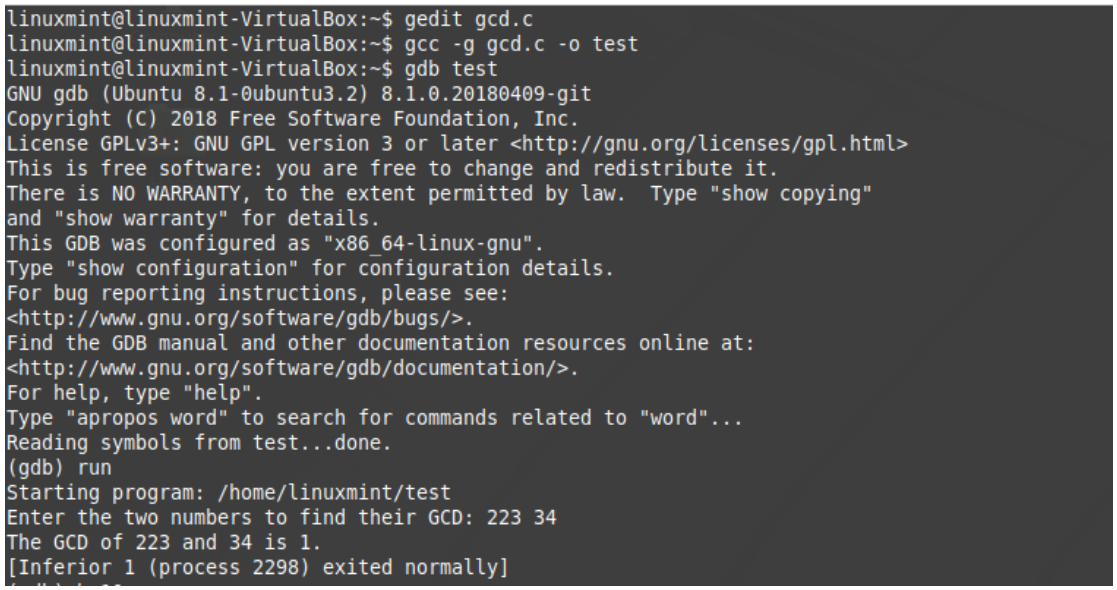
Code:

```
#include <stdio.h>
 int gcd(int, int);
 int main()
{
 int a, b, result;

    printf("Enter the two numbers to find their GCD: ");
    scanf("%d%d", &a, &b);
    result = gcd(a, b);
    printf("The GCD of %d and %d is %d.\n", a, b, result);
}

int gcd(int a, int b)
{
    while (a != b)
    {
        if (a > b)
        {
            return gcd(a - b, b);
```

```
        }
        else
        {
            return gcd(a, b - a);
        }
    }
    return a;
}
```

Output:

The compilation takes through gcc line by line and storing the output in the “test”. and later using the run command for executing the program.



The break command is used to insert a pause in between the program.

backtrace(bt) is a summary of how your program got where it is. It shows one line per frame, for many frames, starting with the currently executing frame (frame zero)

continue command is to resume normal execution by clicking “continue “ or “c” .gdb will run until your program ends, your program crashes or gdb encounters a break point.

Next command : if the line to be executed is a function call , gdb will step into that function and start executing its code one line at a time.

```
(gdb) b 10
\Breakpoint 1 at 0x555555554742: file gcd.c, line 10.
(gdb) run
Starting program: /home/linuxmint/test

Breakpoint 1, main () at gcd.c:10
10          scanf("%d%d", &a, &b);
(gdb) b gcd
Breakpoint 2 at 0x5555555547b5: file gcd.c, line 17.
(gdb) un
Ambiguous command "un": undisplay, unset, until.
(gdb) run
The program being debugged has been started already.
Start it from the beginning? (y or n) y
Starting program: /home/linuxmint/test

Breakpoint 1, main () at gcd.c:10
10          scanf("%d%d", &a, &b);
(gdb) continue
Continuing.
Enter the two numbers to find their GCD: 234
34

Breakpoint 2, gcd (a=234, b=34) at gcd.c:17
17          while (a != b)
```

```
Breakpoint 2, gcd (a=234, b=34) at gcd.c:17
17          while (a != b)
(gdb) bt
#0  gcd (a=234, b=34) at gcd.c:17
#1  0x000055555555476d in main () at gcd.c:11
(gdb) n
19              if (a > b)
(gdb) n
21                  return gcd(a - b, b);
(gdb) n
```

```
Breakpoint 2, gcd (a=200, b=34) at gcd.c:17
17          while (a != b)
(gdb) frame 1
#1  0x00005555555547d7 in gcd (a=234, b=34) at gcd.c:21
21                  return gcd(a - b, b);
(gdb) frame 2
#2  0x000055555555476d in main () at gcd.c:11
11          result = gcd(a, b);
(gdb)
```

Memory debugging:

syntax: x/nfu address

n- Number Of Lines

f- Format

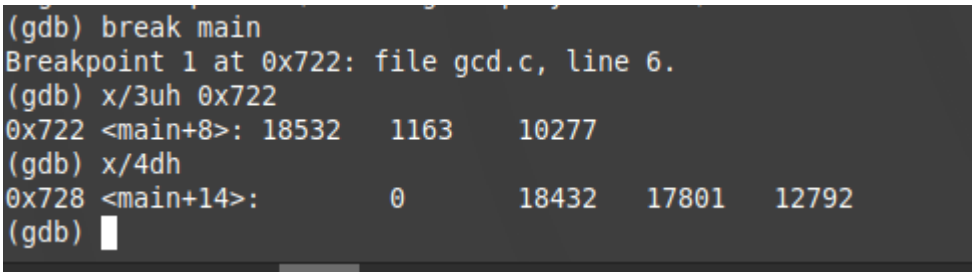
u- byte/word

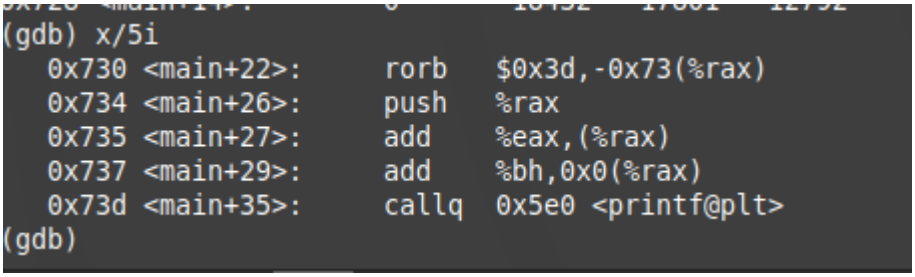
the values for u can be in unsigned,hexadecimal,gaintwords,bytes.

The values for format are binary,octal,unsigned,string,float,unsigned etc.

Example: in the above code:

x/3uh : requesting to display three halfwords(h) of memory,formatted as unsigned decimal integers('u') starting address at 0x722.





Strace for program and finding the system calls:

Code:

#include<stdio.h>

#include<fcntl.h>

#include<errno.h>

#include<stdlib.h>

extern int errno;

int main()

{

```
int fd = open("/home/linuxmint/yy.c",    O_RDONLY );

printf("fd = %d/n", fd);

if (fd ==-1)

 {

 printf("Error Number % d\n", errno);

 perror("Program");

     }

     int ret;

 char buff="tony"

     ret = write(fd,buff, sizeof(buff));

     if (sz == -1 && errno != EINTR) {

                perror("Write to output file");

                exit(EXIT_FAILURE);

           }

     return 0;

}
```

Output:

```
linuxmint@linuxmint-VirtualBox:~$ strace ./test
execve("./test", ["./test"], 0x7ffe2ad5f2d0 /* 49 vars */) = 0
brk(NULL)                               = 0x55c784cc1000
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
access("/etc/ld.so.preload", R_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=107352, ...}) = 0
mmap(NULL, 107352, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f5353a97000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\34\2\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=2030544, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f5353a95000
mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f535349a000
mprotect(0x7f5353681000, 2097152, PROT_NONE) = 0
mmap(0x7f5353881000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7f5353881000
mmap(0x7f5353887000, 15072, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f5353887000
close(3)                                = 0
arch_prctl(ARCH_SET_FS, 0x7f5353a964c0) = 0
mprotect(0x7f5353881000, 16384, PROT_READ) = 0
mprotect(0x55c7836e7000, 4096, PROT_READ) = 0
mprotect(0x7f5353ab2000, 4096, PROT_READ) = 0
munmap(0x7f5353a97000, 107352)          = 0
openat(AT_FDCWD, "/home/linuxmint/test2.c", O_RDONLY|O_CREAT, 001) = -1 EACCES (Permission denied)
write(-1, 0x7c, 1)                      = -1 EBADF (Bad file descriptor)
exit_group(0)                           = ?
+++ exited with 0 +++
linuxmint@linuxmint-VirtualBox:~$
```

```
linuxmint@linuxmint-VirtualBox:~$ gedit ii.c
linuxmint@linuxmint-VirtualBox:~$ gcc -g ii.c -o test
ii.c: In function ‘main’:
ii.c:23:11: warning: initialization makes integer from pointer without a cast [-Wint-conversion]
 char buff="tony";
           ^~~~~
ii.c:24:11: warning: implicit declaration of function ‘write’; did you mean ‘fwrite’? [-Wimplicit-function-declaration]
     ret = write(fd,buff,sizeof(buff));
           ^~~~~
           fwrite
linuxmint@linuxmint-VirtualBox:~$ strace -e trace=write ./test
write(3, 0x3d, 1)                       = -1 EBADF (Bad file descriptor)
write(4, "Write to output file: Bad file d"..., 42Write to output file: Bad file descriptor
) = 42
write(1, "fd = 3/n", 8fd = 3/n)                 = 8
+++ exited with 1 +++
linuxmint@linuxmint-VirtualBox:~$
```

```
linuxmint@linuxmint-VirtualBox:~$ strace -e trace=open,read ls
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\20b\0\0\0\0\0\0"..., 832) = 832
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\34\2\0\0\0\0"..., 832) = 832
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0 \25\0\0\0\0\0\0"..., 832) = 832
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P\16\0\0\0\0\0\0"..., 832) = 832
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0000b\0\0\0\0\0\0"..., 832) = 832
read(3, "nodev\tsysfs\nnodev\trootfs\nnodev\tr"..., 1024) = 390
read(3, "", 1024)                       = 0
 @#0.txt        gg          log.txt     out         test2.c     userlist
 a.out          gg.c        maggi       Pictures    test4       uu.c
 cc.c           hello.sh    maggi.txt   pp.c        testing     uu.sh
 debug.sh       he.sh       magi        Public      testing1    val.c
 Desktop        hh2.c       magii.txt   rr.c        test.txt    vamsi
 Documents      hh.c        megha.txt   rr.sh       try1.c      Videos
 Downloads      ii.c        meghu       sahi.sh     try1.txt    ww.c
 ee.c           ii.sh       meghu1      she.sh      try2.txt    yy
 ex2            lin.c       meghu.txt   shreya      try3.txt    yy.c
 example        linux.c     mm.c        ss.sh       try.txt     yyy
 file1.txt      linux.sh    Music       Templates   tt
 file.c         lirt.txt    myip        tes         tt.c
 filename.txt   lisst.txt   new.c       test        tt.sh
 file.txt       list        num.txt     test1       tt.txt
 gcd.c          list.txt    oo.c        test2      '$.txt'
+++ exited with 0 +++
```

```
linuxmint@linuxmint-VirtualBox:~$ gedit hh.c
linuxmint@linuxmint-VirtualBox:~$ gcc -g hh.c -o test
hh.c:4:1: warning: return type defaults to ‘int’ [-Wimplicit-int]
 main()
 ^~~~
hh.c: In function ‘main’:
hh.c:9:11: warning: initialization makes integer from pointer without a cast [-Wint-conversion]
 char buff="I love myself";
           ^~~~~~~~~~~~~~
hh.c:10:5: warning: implicit declaration of function ‘write’ [-Wimplicit-function-declaration]
 ret=write(fd,buff,sizeof(buff));
     ^~~~~
linuxmint@linuxmint-VirtualBox:~$ strace -e trace=write ./test
write(-1, 0x7c, 1)                      = -1 EBADF (Bad file descriptor)
+++ exited with 0 +++
```

Valgrind:

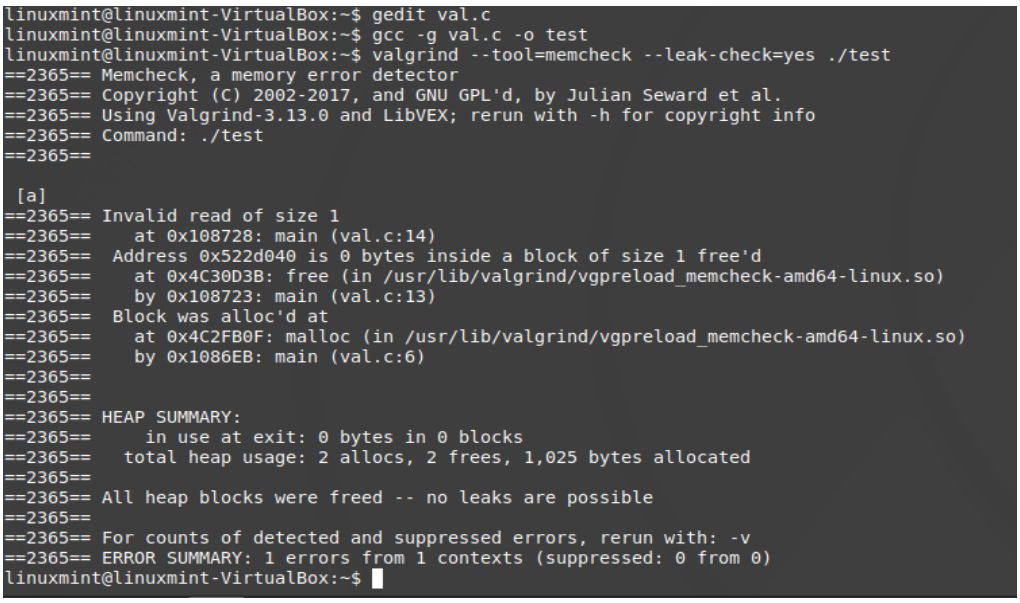
It is a memory mismanagement detector. It shows you memory leaks, deallocation errors, etc. Actually, Valgrind is a wrapper around a collection of tools that do many other things (e.g., cache profiling); however, here we focus on the default tool, memcheck. Memcheck can detect:

- Use of uninitialised memory
- Reading/writing memory after it has been free'd
- Reading/writing off the end of malloc'd blocks
- Reading/writing inappropriate areas on the stack
- Memory leaks -- where pointers to malloc'd blocks are lost forever
- Mismatched use of malloc/new/new [] vs free/delete/delete []
- Overlapping src and dst pointers in memcpy() and related functions

Example:

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

int main(void)
{
char *p = malloc(1);
      *p = 'a';

char c = *p;

printf("\n [%c]\n",c);

free(p);
      c = *p;
return 0;
}
```

Output:



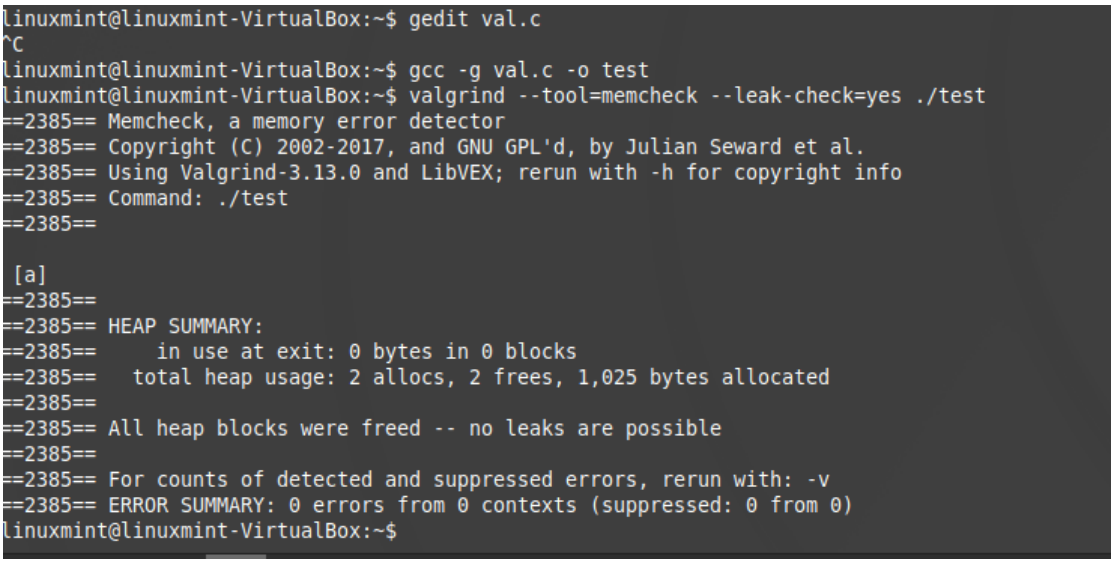
The error summary is provided with 1 error because of calling the pointer after free function of that pointer.

Corrected code:

```
#include <stdio.h>

#include <stdlib.h>


int main(void)
```

```
{
char *p = malloc(1);
      *p = 'a';

char c = *p;

printf("\n [%c]\n",c);

free(p);
return 0;
}
```

Output:



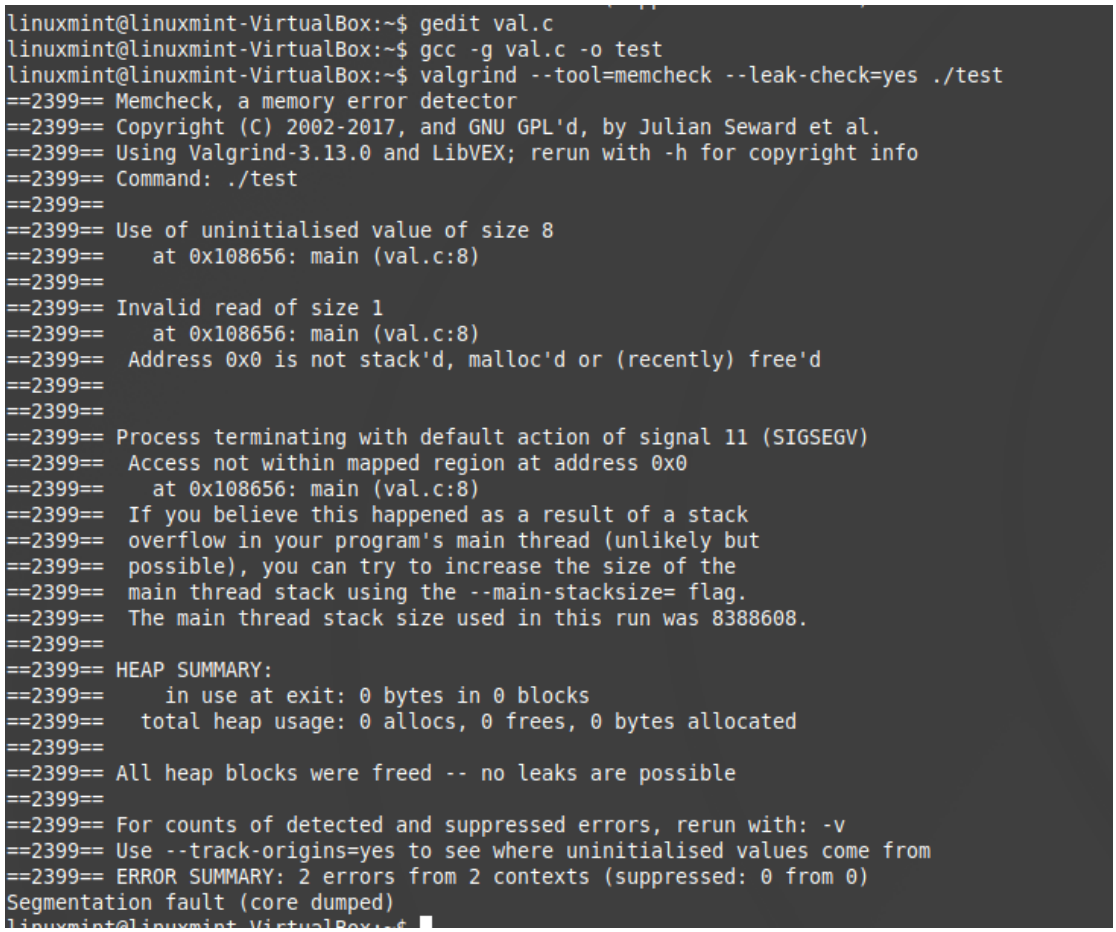
Example:2

Code:

```
#include <stdio.h>
#include <stdlib.h>
int main(void)
{
```

```
char *p;

char c = *p;

printf("\n [%c]\n",c);

return 0;

}
```

Output:



Here the error is the malloc allocation is not done for the pointer and calling through the character.