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CSC-270-01

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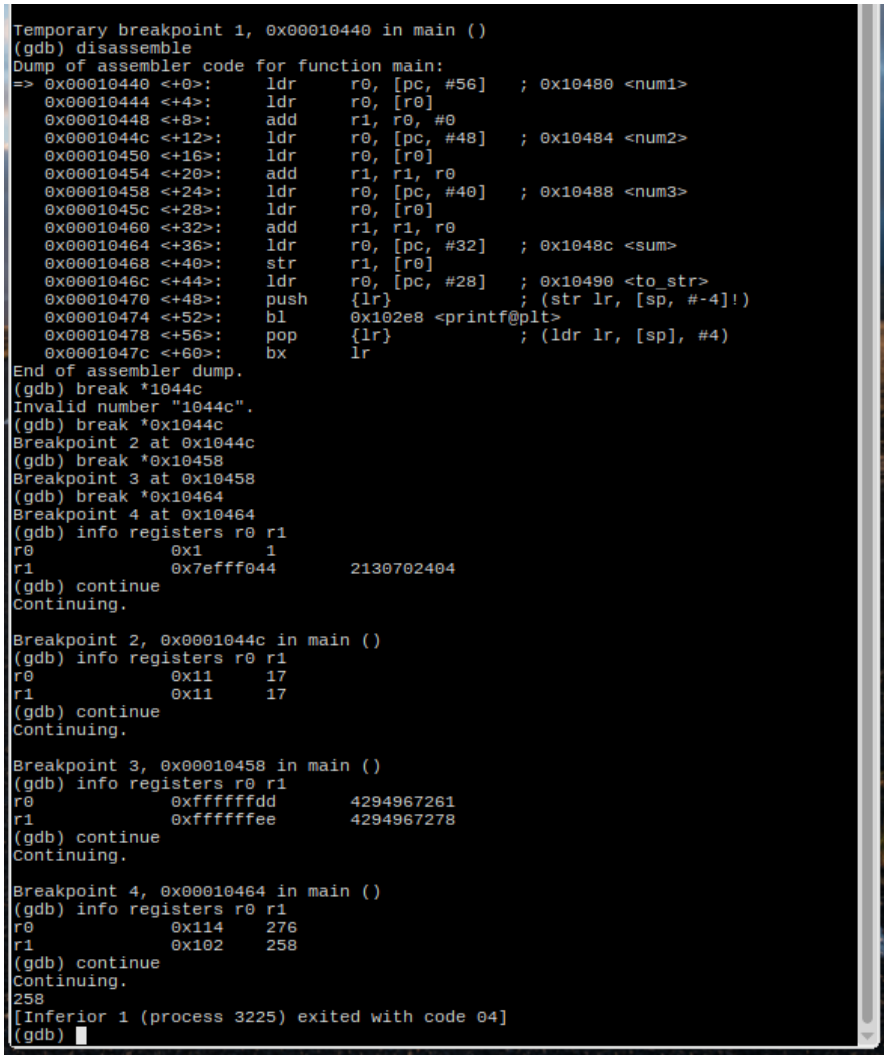
Lab 5

1. The following image shows the GDB debugger with my sum.s code loaded. The first block is the compiled code, and the subsequent blocks show the contents of registers *r0* and *r1* at a few breakpoints. The output of sum.s is the final line of the GDB output, with a sum of 258.



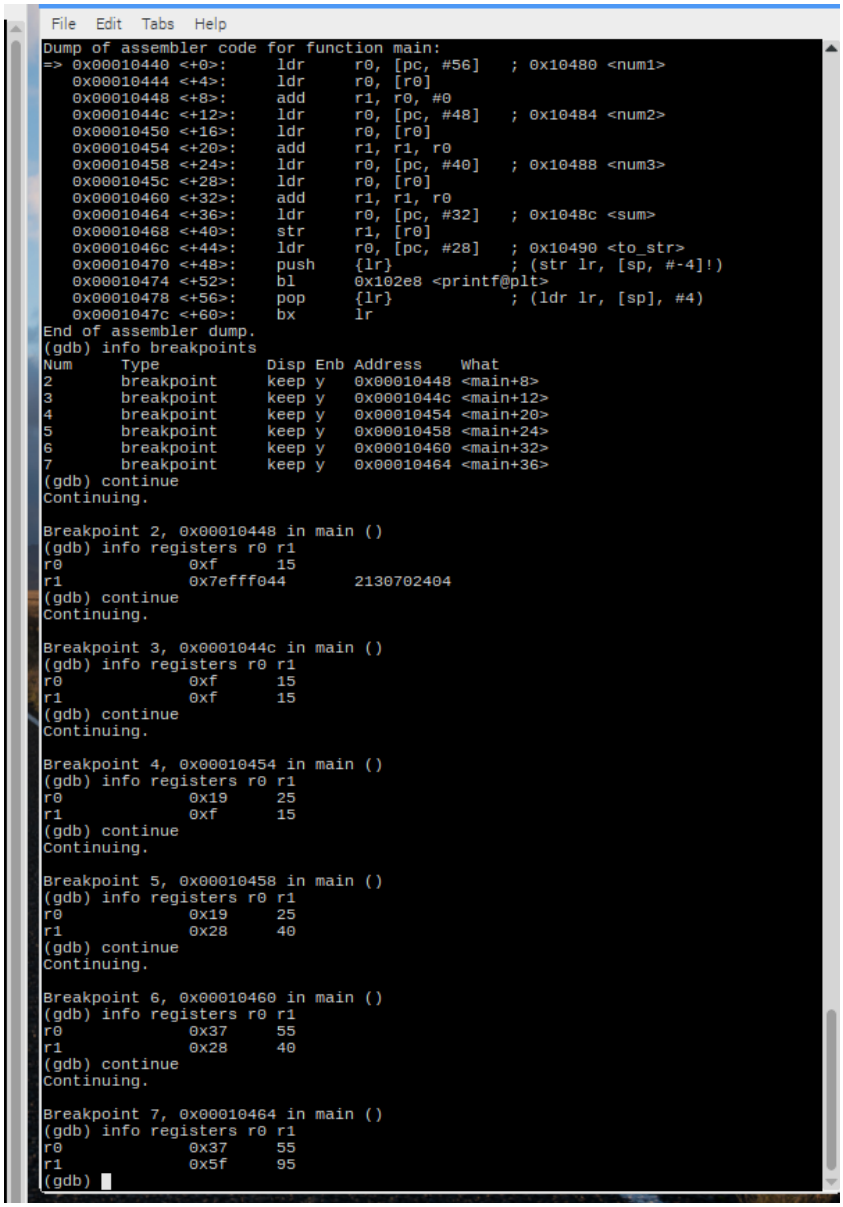
```
Temporary breakpoint 1, 0x00010440 in main ()
(gdb) disassemble
Dump of assembler code for function main:
=> 0x00010440 <+0>:     ldr     r0, [pc, #56]   ; 0x10480 <num1>
   0x00010444 <+4>:     ldr     r0, [r0]
   0x00010448 <+8>:     add     r1, r0, #0
   0x0001044c <+12>:    ldr     r0, [pc, #48]   ; 0x10484 <num2>
   0x00010450 <+16>:    ldr     r0, [r0]
   0x00010454 <+20>:    add     r1, r1, r0
   0x00010458 <+24>:    ldr     r0, [pc, #40]   ; 0x10488 <num3>
   0x0001045c <+28>:    ldr     r0, [r0]
   0x00010460 <+32>:    add     r1, r1, r0
   0x00010464 <+36>:    ldr     r0, [pc, #32]   ; 0x1048c <sum>
   0x00010468 <+40>:    str     r1, [r0]
   0x0001046c <+44>:    ldr     r0, [pc, #28]   ; 0x10490 <to_str>
   0x00010470 <+48>:    push    {lr}            ; (str lr, [sp, #-4]!)
   0x00010474 <+52>:    bl      0x102e8 <printf@plt>
   0x00010478 <+56>:    pop     {lr}            ; (ldr lr, [sp], #4)
   0x0001047c <+60>:    bx      lr
End of assembler dump.
(gdb) break *1044c
Invalid number "1044c".
(gdb) break *0x1044c
Breakpoint 2 at 0x1044c
(gdb) break *0x10458
Breakpoint 3 at 0x10458
(gdb) break *0x10464
Breakpoint 4 at 0x10464
(gdb) info registers r0 r1
r0             0x1      1
r1             0x7efff044       2130702404
(gdb) continue
Continuing.

Breakpoint 2, 0x0001044c in main ()
(gdb) info registers r0 r1
r0             0x11     17
r1             0x11     17
(gdb) continue
Continuing.

Breakpoint 3, 0x00010458 in main ()
(gdb) info registers r0 r1
r0             0xfffffffd       4294967261
r1             0xfffffffe       4294967278
(gdb) continue
Continuing.

Breakpoint 4, 0x00010464 in main ()
(gdb) info registers r0 r1
r0             0x114    276
r1             0x102    258
(gdb) continue
Continuing.
258
[Inferior 1 (process 3225) exited with code 04]
(gdb)
```

2. The following images show the GDB debugger with my sum2.s program loaded. The first block of output is the compiled ARM code, with memory addresses on the left-hand-side corresponding to the instruction address. I use these to set breakpoint locations which I had GDB output in the next block. The subsequent calls to *continue* and *info registers r0 r1* show the change in these registers. I have only shown these two, because they are the only ones my program uses. The output of the program is included in the next image as it did not fit in the first



```
File  Edit  Tabs  Help
pi@rpi5:~ $ cd Desktop/Lab5
bash: cd: Desktop/Lab5: No such file or directory
pi@rpi5:~ $ cd Desktop/Lab_5
pi@rpi5:~/Desktop/Lab_5 $ ./sum2
95
pi@rpi5:~/Desktop/Lab_5 $
```

3. The following image shows the swap.s program when loaded into the GDB debugger. Following the loading prompt, the first block shows the compiled program with instruction memory addresses for reference. The second block shows the contents of data memory at the address of the array before the swap, with entries of data memory that are no in the array crossed out. The final block shows the contents of data memory after the swap has been performed, with arrows indicating the elements that have been swapped. All data not in the array has been crossed out.