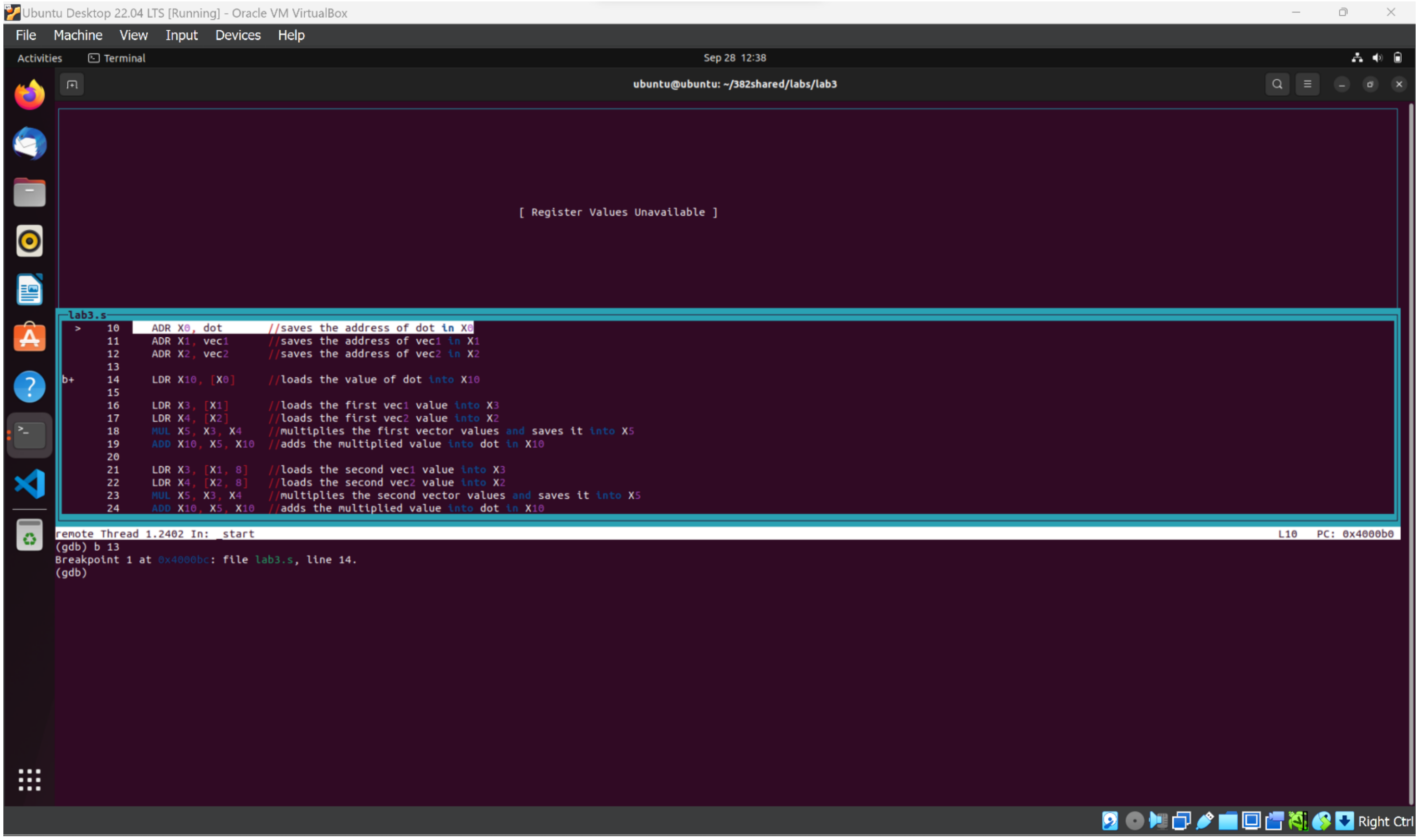
Lab 3 Report
Name: Dylan Faulhaber and Jack Patterson
Pledge: I pledge my honor that I have abided by the Stevens Honor System


Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:38
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
                    [ Register Values Unavailable ]

lab3.s
 >    10     ADR X0, dot        //saves the address of dot in X0
      11     ADR X1, vec1       //saves the address of vec1 in X1
      12     ADR X2, vec2       //saves the address of vec2 in X2
      13
b+    14     LDR X10, [X0]      //loads the value of dot into X10
      15
      16     LDR X3, [X1]       //loads the first vec1 value into X3
      17     LDR X4, [X2]       //loads the first vec2 value into X2
      18     MUL X5, X3, X4     //multiplies the first vector values and saves it into X5
      19     ADD X10, X5, X10   //adds the multiplied value into dot in X10
      20
      21     LDR X3, [X1, 8]    //loads the second vec1 value into X3
      22     LDR X4, [X2, 8]    //loads the second vec2 value into X2
      23     MUL X5, X3, X4     //multiplies the second vector values and saves it into X5
      24     ADD X10, X5, X10   //adds the multiplied value into dot in X10
remote Thread 1.2402 In: _start                                          L10   PC: 0x4000b0
(gdb) b 13
Breakpoint 1 at 0x4000bc: file lab3.s, line 14.
(gdb)
```

Set a breakpoint at line 14 to see each variable’s address loaded into its resepctive registers.

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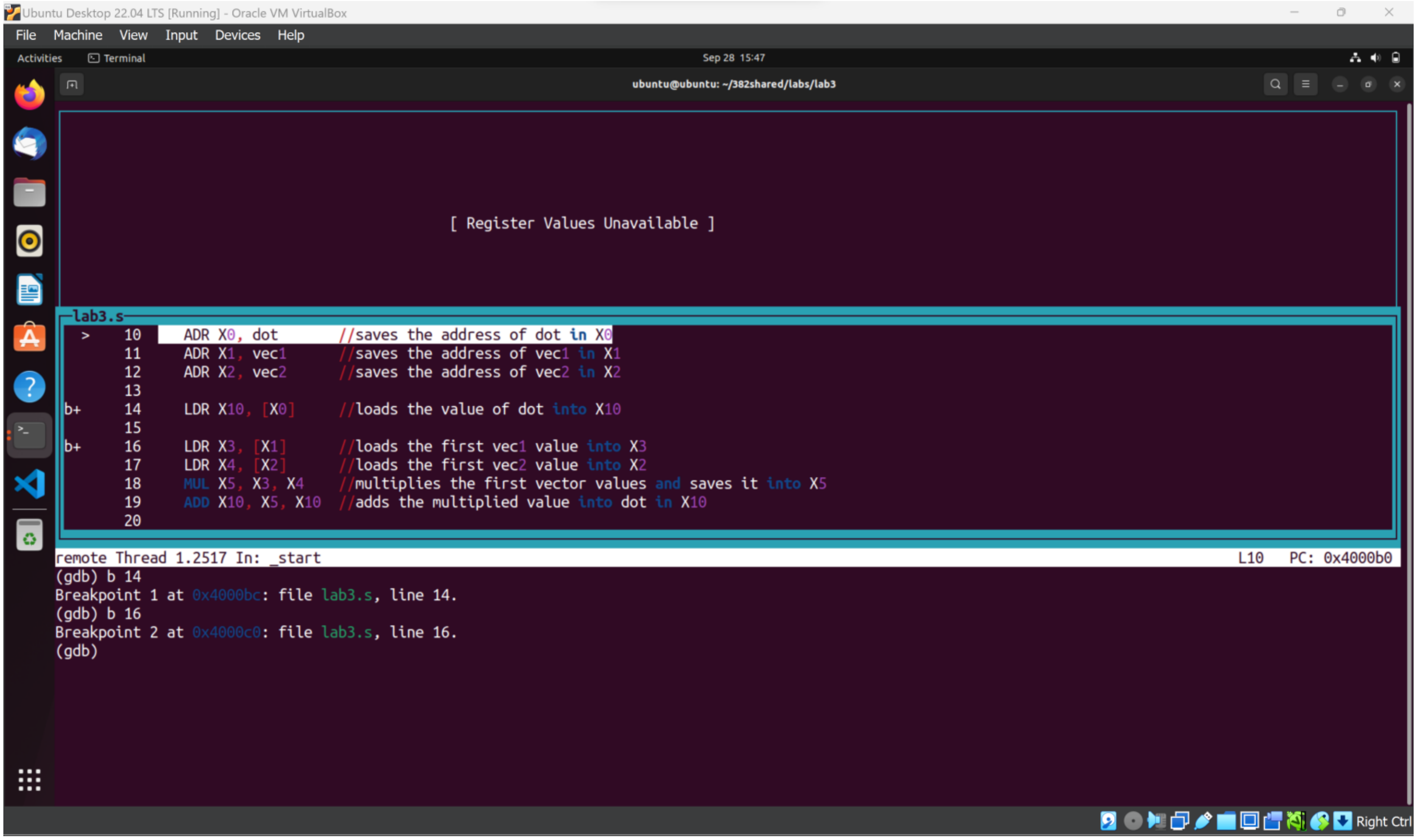
Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 15:47
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
                        [ Register Values Unavailable ]

┌lab3.s──────────────────────────────────────────────────────────────────
│ >    10     ADR X0, dot        //saves the address of dot in X0
│      11     ADR X1, vec1       //saves the address of vec1 in X1
│      12     ADR X2, vec2       //saves the address of vec2 in X2
│      13
│b+    14     LDR X10, [X0]      //loads the value of dot into X10
│      15
│b+    16     LDR X3, [X1]       //loads the first vec1 value into X3
│      17     LDR X4, [X2]       //loads the first vec2 value into X2
│      18     MUL X5, X3, X4     //multiplies the first vector values and saves it into X5
│      19     ADD X10, X5, X10   //adds the multiplied value into dot in X10
│      20
remote Thread 1.2517 In: _start                                      L10   PC: 0x4000b0
(gdb) b 14
Breakpoint 1 at 0x4000bc: file lab3.s, line 14.
(gdb) b 16
Breakpoint 2 at 0x4000c0: file lab3.s, line 16.
(gdb)
```

Set a breakpoint at line 16 to see the value of dot loaded into register X10

.

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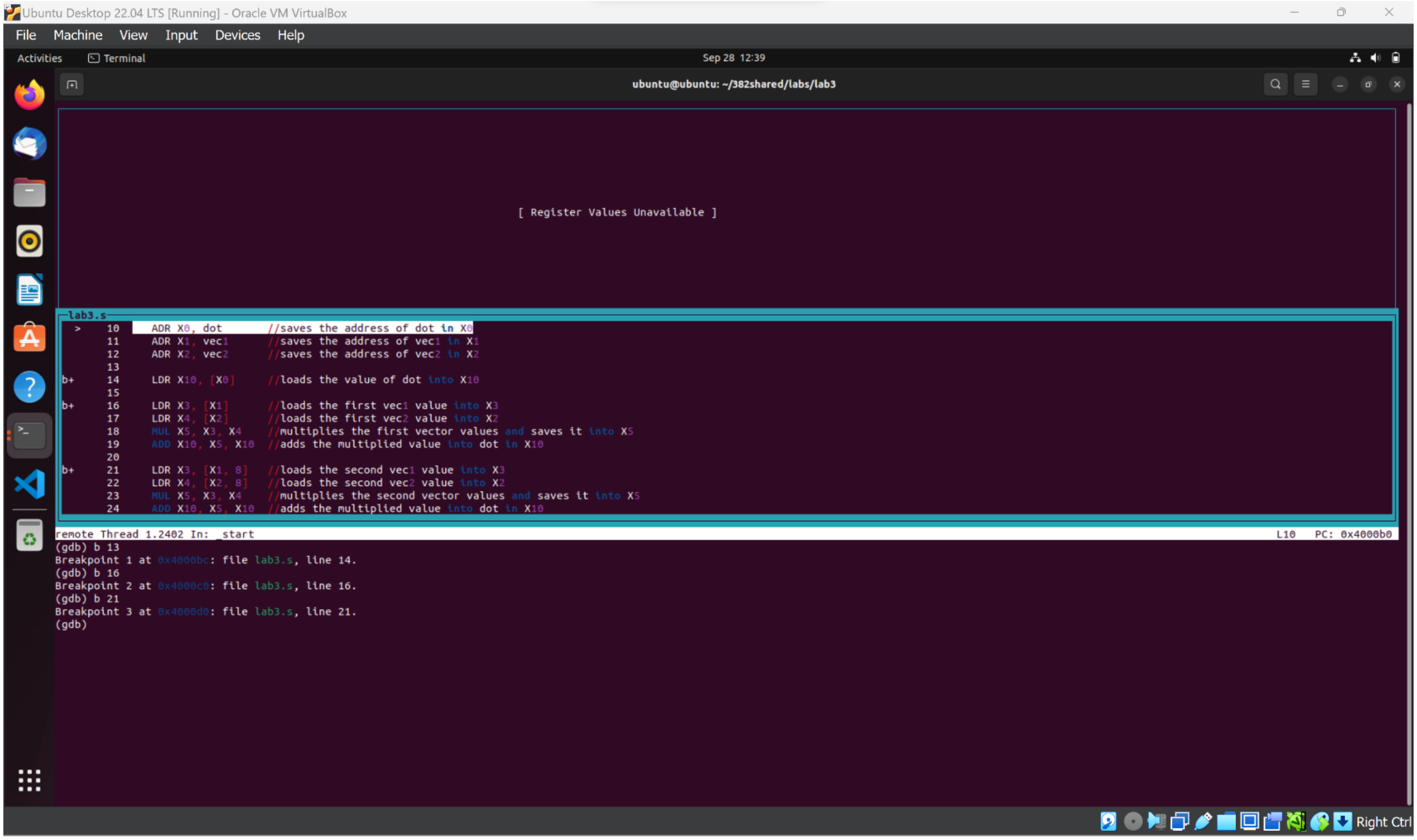
Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:39
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
                          [ Register Values Unavailable ]

lab3.s
 >    10     ADR X0, dot         //saves the address of dot in X0
      11     ADR X1, vec1        //saves the address of vec1 in X1
      12     ADR X2, vec2        //saves the address of vec2 in X2
      13
b+    14     LDR X10, [X0]       //loads the value of dot into X10
      15
b+    16     LDR X3, [X1]        //loads the first vec1 value into X3
      17     LDR X4, [X2]        //loads the first vec2 value into X2
      18     MUL X5, X3, X4      //multiplies the first vector values and saves it into X5
      19     ADD X10, X5, X10    //adds the multiplied value into dot in X10
      20
b+    21     LDR X3, [X1, 8]     //loads the second vec1 value into X3
      22     LDR X4, [X2, 8]     //loads the second vec2 value into X2
      23     MUL X5, X3, X4      //multiplies the second vector values and saves it into X5
      24     ADD X10, X5, X10    //adds the multiplied value into dot in X10
remote Thread 1.2402 In: _start                                                  L10   PC: 0x4000b0
(gdb) b 13
Breakpoint 1 at 0x4000bc: file lab3.s, line 14.
(gdb) b 16
Breakpoint 2 at 0x4000c0: file lab3.s, line 16.
(gdb) b 21
Breakpoint 3 at 0x4000d0: file lab3.s, line 21.
(gdb)
```

Set a breakpoint at line 21 to see the registers where the addition and multiplication occurred for the first numbers of the vectors.

Lab 3 Report
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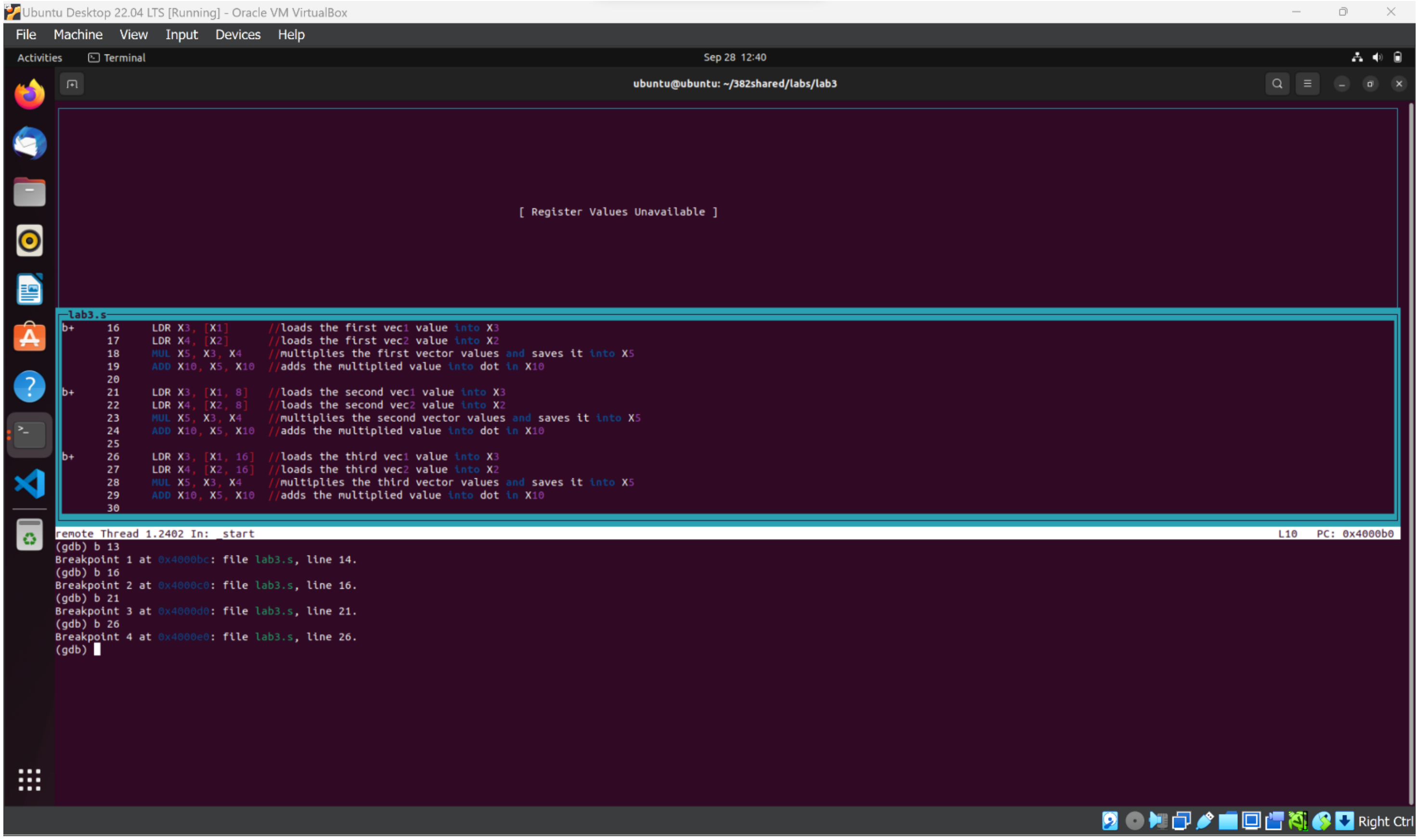
Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Sep 28 12:40
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
[ Register Values Unavailable ]

lab3.s
b+      16      LDR X3, [X1]        //loads the first vec1 value into X3
        17      LDR X4, [X2]        //loads the first vec2 value into X2
        18      MUL X5, X3, X4      //multiplies the first vector values and saves it into X5
        19      ADD X10, X5, X10    //adds the multiplied value into dot in X10
        20
b+      21      LDR X3, [X1, 8]     //loads the second vec1 value into X3
        22      LDR X4, [X2, 8]     //loads the second vec2 value into X2
        23      MUL X5, X3, X4      //multiplies the second vector values and saves it into X5
        24      ADD X10, X5, X10    //adds the multiplied value into dot in X10
        25
b+      26      LDR X3, [X1, 16]    //loads the third vec1 value into X3
        27      LDR X4, [X2, 16]    //loads the third vec2 value into X2
        28      MUL X5, X3, X4      //multiplies the third vector values and saves it into X5
        29      ADD X10, X5, X10    //adds the multiplied value into dot in X10
        30
remote Thread 1.2402 In: _start                                                        L10   PC: 0x4000b0
(gdb) b 13
Breakpoint 1 at 0x4000bc: file lab3.s, line 14.
(gdb) b 16
Breakpoint 2 at 0x4000c0: file lab3.s, line 16.
(gdb) b 21
Breakpoint 3 at 0x4000d0: file lab3.s, line 21.
(gdb) b 26
Breakpoint 4 at 0x4000e0: file lab3.s, line 26.
(gdb)
```

Set a breakpoint at line 26 to see the registers where the addition and multiplication occurred for the second numbers of the vectors.

Lab 3 Report
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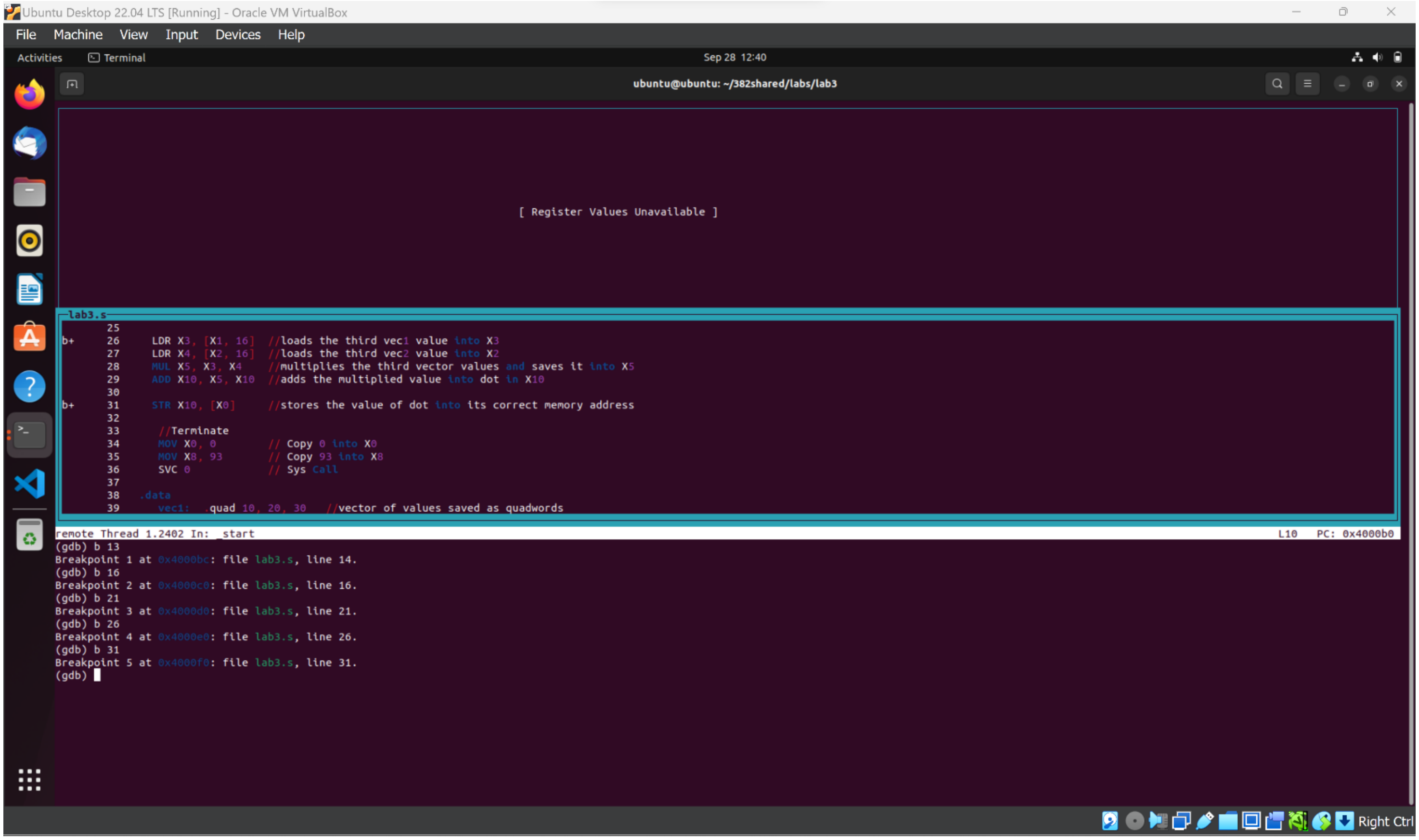
Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal
Sep 28 12:40
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
                       [ Register Values Unavailable ]

┌lab3.s─────────────────────────────────────────────────────────────────────
│      25
│b+    26     LDR X3, [X1, 16]  //loads the third vec1 value into X3
│      27     LDR X4, [X2, 16]  //loads the third vec2 value into X2
│      28     MUL X5, X3, X4    //multiplies the third vector values and saves it into X5
│      29     ADD X10, X5, X10  //adds the multiplied value into dot in X10
│      30
│b+    31     STR X10, [X0]     //stores the value of dot into its correct memory address
│      32
│      33      //Terminate
│      34      MOV X0, 0        // Copy 0 into X0
│      35      MOV X8, 93       // Copy 93 into X8
│      36      SVC 0            // Sys Call
│      37
│      38    .data
│      39      vec1:   .quad 10, 20, 30   //vector of values saved as quadwords
remote Thread 1.2402 In: _start                                          L10   PC: 0x4000b0
(gdb) b 13
Breakpoint 1 at 0x4000bc: file lab3.s, line 14.
(gdb) b 16
Breakpoint 2 at 0x4000c0: file lab3.s, line 16.
(gdb) b 21
Breakpoint 3 at 0x4000d0: file lab3.s, line 21.
(gdb) b 26
Breakpoint 4 at 0x4000e0: file lab3.s, line 26.
(gdb) b 31
Breakpoint 5 at 0x4000f0: file lab3.s, line 31.
(gdb) 
```

Set a breakpoint at line 31 to see the registers where the addition and multiplication occurred for the third numbers of the vectors.

Lab 3 Report
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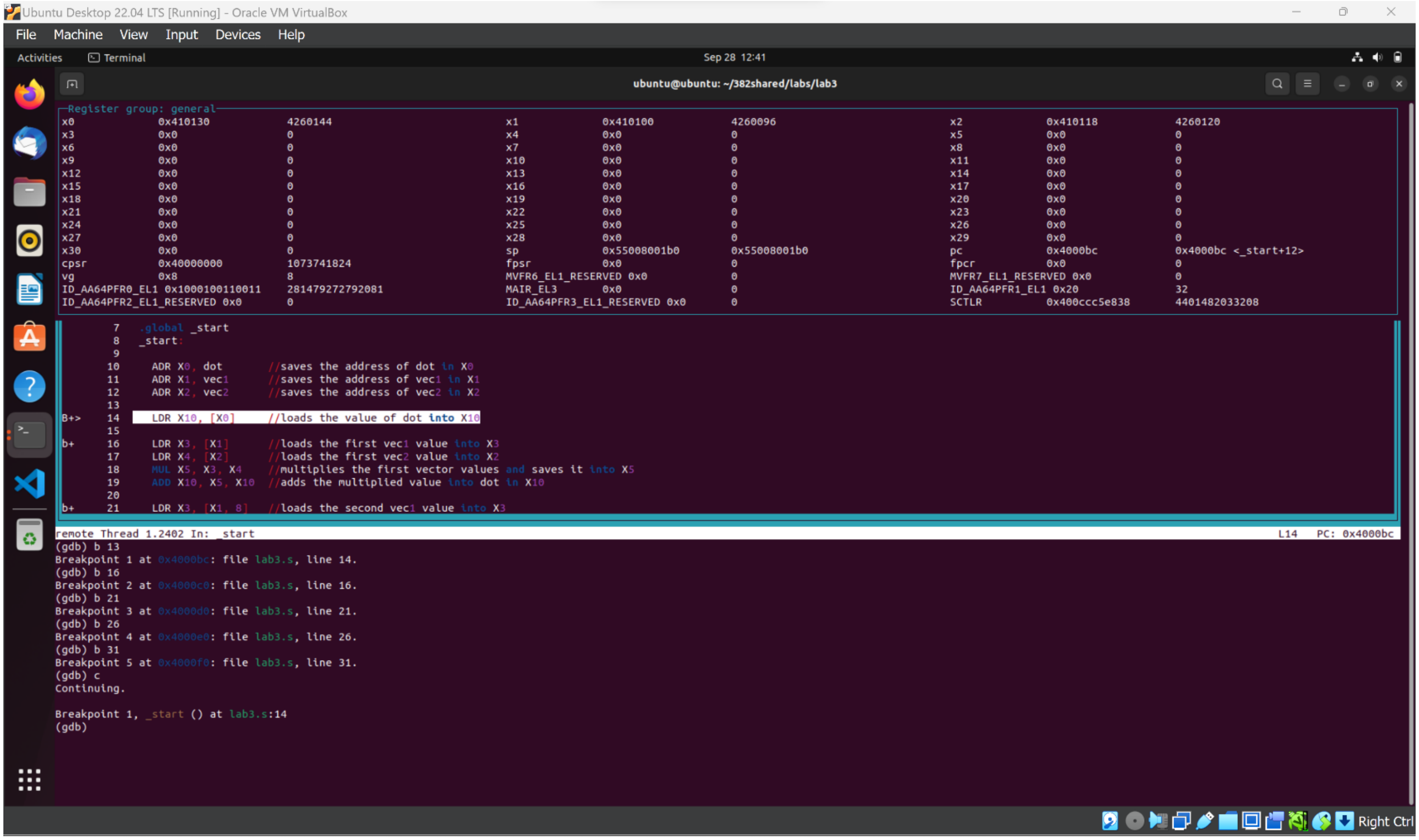
Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:41
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
┌Register group: general──────────────────────────────────────────────────────────────────────────────────────────────────────────────┐
│x0             0x410130            4260144                          x1             0x410100            4260096                          x2             0x410118            4260120               │
│x3             0x0                 0                                x4             0x0                 0                                x5             0x0                 0                     │
│x6             0x0                 0                                x7             0x0                 0                                x8             0x0                 0                     │
│x9             0x0                 0                                x10            0x0                 0                                x11            0x0                 0                     │
│x12            0x0                 0                                x13            0x0                 0                                x14            0x0                 0                     │
│x15            0x0                 0                                x16            0x0                 0                                x17            0x0                 0                     │
│x18            0x0                 0                                x19            0x0                 0                                x20            0x0                 0                     │
│x21            0x0                 0                                x22            0x0                 0                                x23            0x0                 0                     │
│x24            0x0                 0                                x25            0x0                 0                                x26            0x0                 0                     │
│x27            0x0                 0                                x28            0x0                 0                                x29            0x0                 0                     │
│x30            0x0                 0                                sp             0x55008001b0        0x55008001b0                     pc             0x4000bc            0x4000bc <_start+12>  │
│cpsr           0x40000000          1073741824                       fpsr           0x0                 0                                fpcr           0x0                 0                     │
│vg             0x8                 8                                MVFR6_EL1_RESERVED 0x0             0                                MVFR7_EL1_RESERVED 0x0             0                     │
│ID_AA64PFR0_EL1 0x1000100110011    281479272792081                  MAIR_EL3       0x0                 0                                ID_AA64PFR1_EL1 0x20               32                    │
│ID_AA64PFR2_EL1_RESERVED 0x0       0                                ID_AA64PFR3_EL1_RESERVED 0x0       0                                SCTLR          0x400ccc5e838       4401482033208         │
└─────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────┘
        7   .global _start
        8   _start:
        9
       10     ADR X0, dot        //saves the address of dot in X0
       11     ADR X1, vec1       //saves the address of vec1 in X1
       12     ADR X2, vec2       //saves the address of vec2 in X2
       13
B+>    14     LDR X10, [X0]      //loads the value of dot into X10
       15
b+     16     LDR X3, [X1]       //loads the first vec1 value into X3
       17     LDR X4, [X2]       //loads the first vec2 value into X2
       18     MUL X5, X3, X4     //multiplies the first vector values and saves it into X5
       19     ADD X10, X5, X10   //adds the multiplied value into dot in X10
       20
b+     21     LDR X3, [X1, 8]    //loads the second vec1 value into X3
remote Thread 1.2402 In: _start                                                                                                      L14   PC: 0x4000bc
(gdb) b 13
Breakpoint 1 at 0x4000bc: file lab3.s, line 14.
(gdb) b 16
Breakpoint 2 at 0x4000c0: file lab3.s, line 16.
(gdb) b 21
Breakpoint 3 at 0x4000d0: file lab3.s, line 21.
(gdb) b 26
Breakpoint 4 at 0x4000e0: file lab3.s, line 26.
(gdb) b 31
Breakpoint 5 at 0x4000f0: file lab3.s, line 31.
(gdb) c
Continuing.

Breakpoint 1, _start () at lab3.s:14
(gdb)
```

Use c command to continue the program and stop at line 14 breakpoint. From here we could see the addresses of dot, vec1, and vec2 in registers X0, X1, X2.

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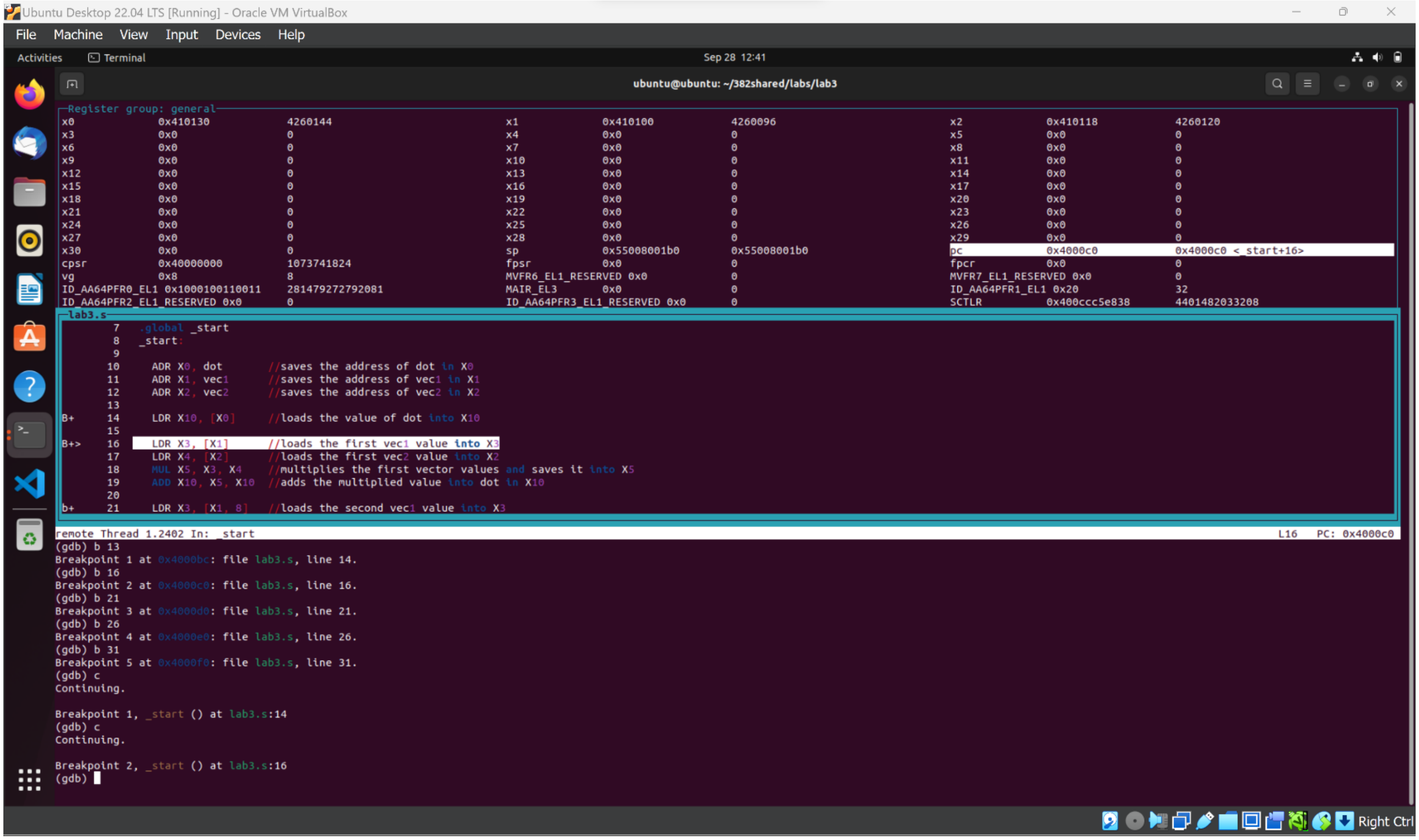
Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:41
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
Register group: general
x0             0x410130           4260144                x1             0x410100           4260096                x2             0x410118           4260120
x3             0x0                0                      x4             0x0                0                      x5             0x0                0
x6             0x0                0                      x7             0x0                0                      x8             0x0                0
x9             0x0                0                      x10            0x0                0                      x11            0x0                0
x12            0x0                0                      x13            0x0                0                      x14            0x0                0
x15            0x0                0                      x16            0x0                0                      x17            0x0                0
x18            0x0                0                      x19            0x0                0                      x20            0x0                0
x21            0x0                0                      x22            0x0                0                      x23            0x0                0
x24            0x0                0                      x25            0x0                0                      x26            0x0                0
x27            0x0                0                      x28            0x0                0                      x29            0x0                0
x30            0x0                0                      sp             0x55008001b0       0x55008001b0           pc             0x4000c0           0x4000c0 <_start+16>
cpsr           0x40000000         1073741824             fpsr           0x0                0                      fpcr           0x0                0
vg             0x8                8                      MVFR6_EL1_RESERVED 0x0            0                      MVFR7_EL1_RESERVED 0x0            0
ID_AA64PFR0_EL1 0x1000100110011   281479272792081        MAIR_EL3       0x0                0                      ID_AA64PFR1_EL1 0x20              32
ID_AA64PFR2_EL1_RESERVED 0x0      0                      ID_AA64PFR3_EL1_RESERVED 0x0      0                      SCTLR          0x400ccc5e838      4401482033208
```

```
lab3.s
         7   .global _start
         8   _start:
         9
        10     ADR X0, dot        //saves the address of dot in X0
        11     ADR X1, vec1       //saves the address of vec1 in X1
        12     ADR X2, vec2       //saves the address of vec2 in X2
        13
B+      14     LDR X10, [X0]      //loads the value of dot into X10
        15
B+>     16     LDR X3, [X1]       //loads the first vec1 value into X3
        17     LDR X4, [X2]       //loads the first vec2 value into X2
        18     MUL X5, X3, X4     //multiplies the first vector values and saves it into X5
        19     ADD X10, X5, X10   //adds the multiplied value into dot in X10
        20
b+      21     LDR X3, [X1, 8]    //loads the second vec1 value into X3
```

```
remote Thread 1.2402 In: _start                                                                                          L16   PC: 0x4000c0
(gdb) b 13
Breakpoint 1 at 0x4000bc: file lab3.s, line 14.
(gdb) b 16
Breakpoint 2 at 0x4000c0: file lab3.s, line 16.
(gdb) b 21
Breakpoint 3 at 0x4000d0: file lab3.s, line 21.
(gdb) b 26
Breakpoint 4 at 0x4000e0: file lab3.s, line 26.
(gdb) b 31
Breakpoint 5 at 0x4000f0: file lab3.s, line 31.
(gdb) c
Continuing.

Breakpoint 1, _start () at lab3.s:14
(gdb) c
Continuing.

Breakpoint 2, _start () at lab3.s:16
(gdb) 
```

Use c command to continue the program and stop at line 16 breakpoint. From here we could see the value of dot, which is 0, loaded into X10.

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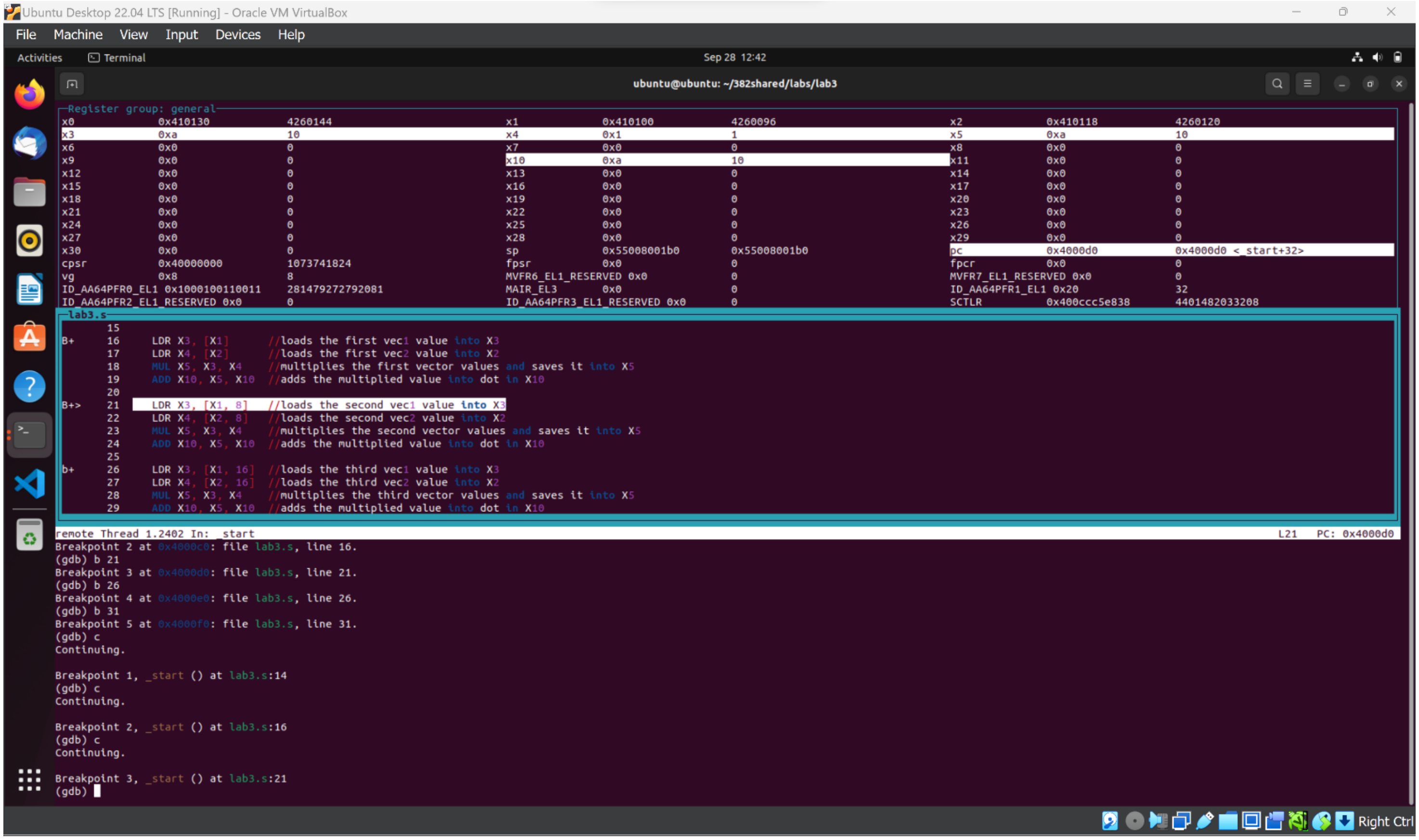
Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:42
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
Register group: general
x0             0x410130            4260144                 x1             0x410100            4260096                 x2             0x410118            4260120
x3             0xa                 10                      x4             0x1                 1                       x5             0xa                 10
x6             0x0                 0                       x7             0x0                 0                       x8             0x0                 0
x9             0x0                 0                       x10            0xa                 10                      x11            0x0                 0
x12            0x0                 0                       x13            0x0                 0                       x14            0x0                 0
x15            0x0                 0                       x16            0x0                 0                       x17            0x0                 0
x18            0x0                 0                       x19            0x0                 0                       x20            0x0                 0
x21            0x0                 0                       x22            0x0                 0                       x23            0x0                 0
x24            0x0                 0                       x25            0x0                 0                       x26            0x0                 0
x27            0x0                 0                       x28            0x0                 0                       x29            0x0                 0
x30            0x0                 0                       sp             0x55008001b0        0x55008001b0            pc             0x4000d0            0x4000d0 <_start+32>
cpsr           0x40000000          1073741824              fpsr           0x0                 0                       fpcr           0x0                 0
vg             0x8                 8                       MVFR6_EL1_RESERVED 0x0             0                       MVFR7_EL1_RESERVED 0x0             0
ID_AA64PFR0_EL1 0x1000100110011    281479272792081         MAIR_EL3       0x0                 0                       ID_AA64PFR1_EL1 0x20               32
ID_AA64PFR2_EL1_RESERVED 0x0       0                       ID_AA64PFR3_EL1_RESERVED 0x0       0                       SCTLR          0x400ccc5e838       4401482033208
lab3.s
        15
B+      16      LDR X3, [X1]        //loads the first vec1 value into X3
        17      LDR X4, [X2]        //loads the first vec2 value into X2
        18      MUL X5, X3, X4      //multiplies the first vector values and saves it into X5
        19      ADD X10, X5, X10    //adds the multiplied value into dot in X10
        20
B+>     21      LDR X3, [X1, 8]     //loads the second vec1 value into X3
        22      LDR X4, [X2, 8]     //loads the second vec2 value into X2
        23      MUL X5, X3, X4      //multiplies the second vector values and saves it into X5
        24      ADD X10, X5, X10    //adds the multiplied value into dot in X10
        25
b+      26      LDR X3, [X1, 16]    //loads the third vec1 value into X3
        27      LDR X4, [X2, 16]    //loads the third vec2 value into X2
        28      MUL X5, X3, X4      //multiplies the third vector values and saves it into X5
        29      ADD X10, X5, X10    //adds the multiplied value into dot in X10
remote Thread 1.2402 In: _start                                                                                                                  L21   PC: 0x4000d0
Breakpoint 2 at 0x4000c0: file lab3.s, line 16.
(gdb) b 21
Breakpoint 3 at 0x4000d0: file lab3.s, line 21.
(gdb) b 26
Breakpoint 4 at 0x4000e0: file lab3.s, line 26.
(gdb) b 31
Breakpoint 5 at 0x4000f0: file lab3.s, line 31.
(gdb) c
Continuing.

Breakpoint 1, _start () at lab3.s:14
(gdb) c
Continuing.

Breakpoint 2, _start () at lab3.s:16
(gdb) c
Continuing.

Breakpoint 3, _start () at lab3.s:21
(gdb) 
```

Use c command to continue the program and stop at line 21 breakpoint. From here we could see the first numbers of each vector in registers X3 and X4. We then multiply them together and add them into dot, giving X10 a value of 10.

Lab 3 Report
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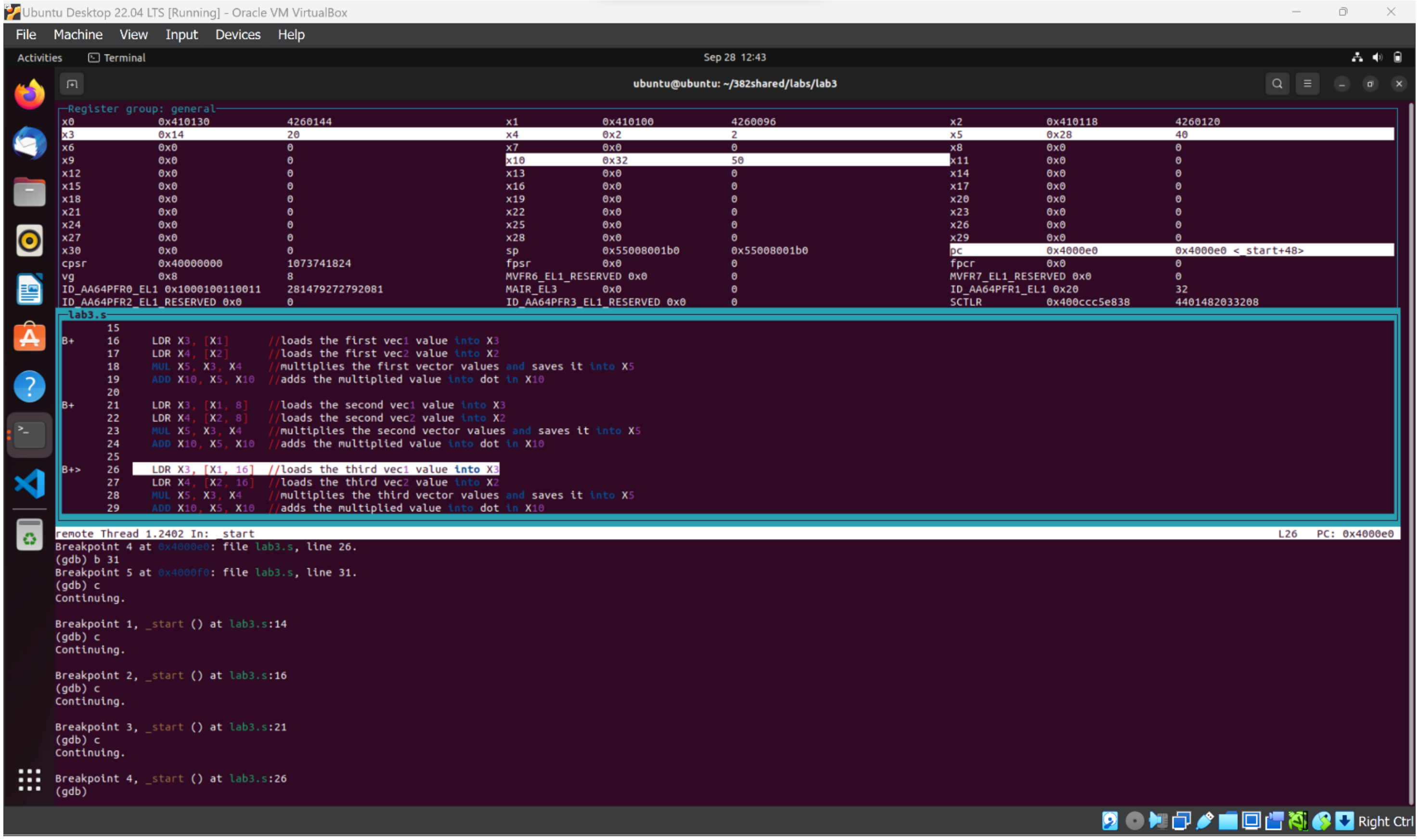
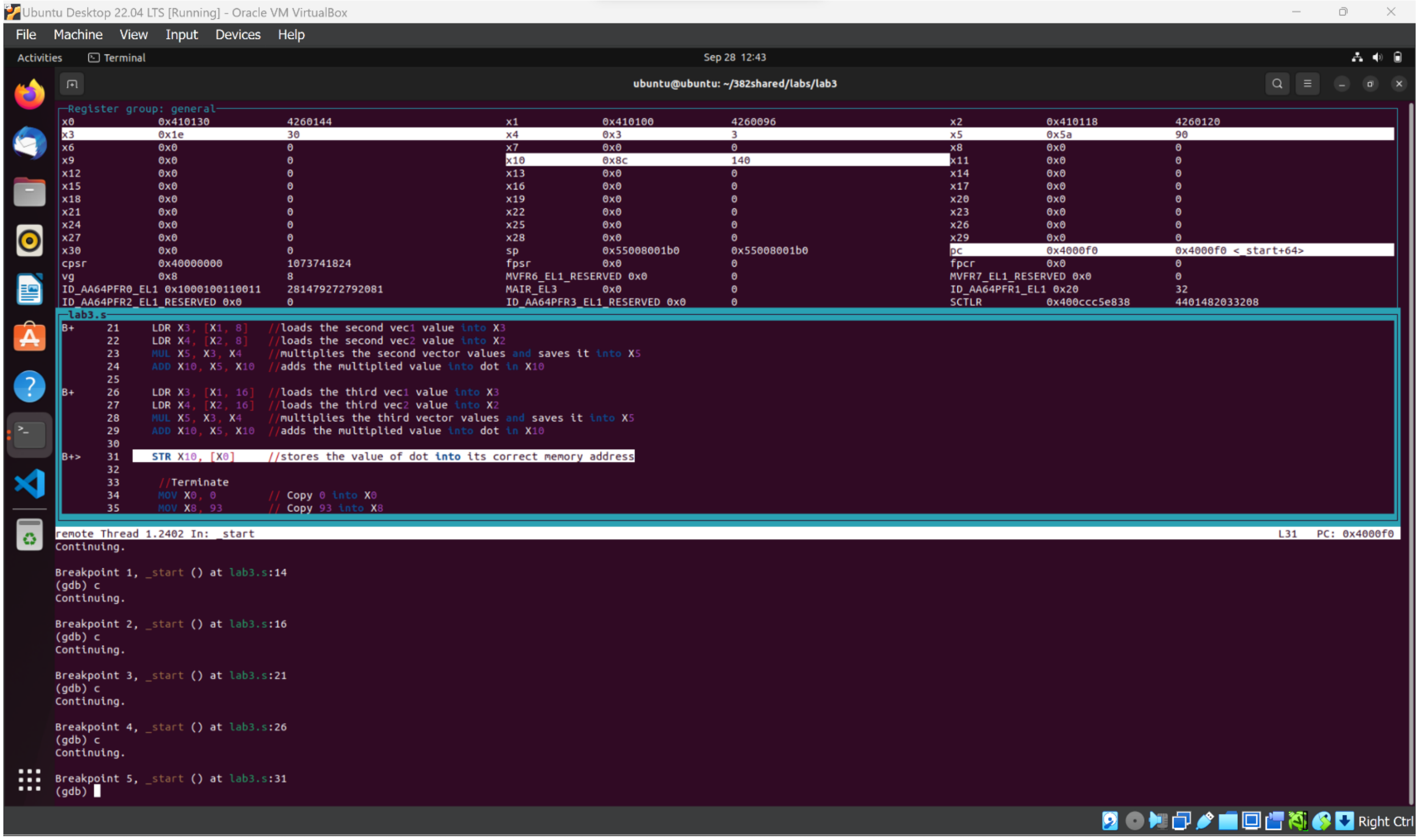

Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal
Sep 28 12:43
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
-Register group: general-
x0             0x410130            4260144                  x1             0x410100            4260096                  x2             0x410118            4260120
x3             0x14                20                       x4             0x2                 2                        x5             0x28                40
x6             0x0                 0                        x7             0x0                 0                        x8             0x0                 0
x9             0x0                 0                        x10            0x32                50                       x11            0x0                 0
x12            0x0                 0                        x13            0x0                 0                        x14            0x0                 0
x15            0x0                 0                        x16            0x0                 0                        x17            0x0                 0
x18            0x0                 0                        x19            0x0                 0                        x20            0x0                 0
x21            0x0                 0                        x22            0x0                 0                        x23            0x0                 0
x24            0x0                 0                        x25            0x0                 0                        x26            0x0                 0
x27            0x0                 0                        x28            0x0                 0                        x29            0x0                 0
x30            0x0                 0                        sp             0x55008001b0        0x55008001b0             pc             0x4000e0            0x4000e0 <_start+48>
cpsr           0x40000000          1073741824               fpsr           0x0                 0                        fpcr           0x0                 0
vg             0x8                 8                        MVFR6_EL1_RESERVED 0x0             0                        MVFR7_EL1_RESERVED 0x0             0
ID_AA64PFR0_EL1 0x1000100110011    281479272792081          MAIR_EL3       0x0                 0                        ID_AA64PFR1_EL1 0x20               32
ID_AA64PFR2_EL1_RESERVED 0x0       0                        ID_AA64PFR3_EL1_RESERVED 0x0       0                        SCTLR          0x400ccc5e838       4401482033208
-lab3.s-
        15
B+      16      LDR X3, [X1]        //loads the first vec1 value into X3
        17      LDR X4, [X2]        //loads the first vec2 value into X2
        18      MUL X5, X3, X4      //multiplies the first vector values and saves it into X5
        19      ADD X10, X5, X10    //adds the multiplied value into dot in X10
        20
B+      21      LDR X3, [X1, 8]     //loads the second vec1 value into X3
        22      LDR X4, [X2, 8]     //loads the second vec2 value into X2
        23      MUL X5, X3, X4      //multiplies the second vector values and saves it into X5
        24      ADD X10, X5, X10    //adds the multiplied value into dot in X10
        25
B+>     26      LDR X3, [X1, 16]    //loads the third vec1 value into X3
        27      LDR X4, [X2, 16]    //loads the third vec2 value into X2
        28      MUL X5, X3, X4      //multiplies the third vector values and saves it into X5
        29      ADD X10, X5, X10    //adds the multiplied value into dot in X10
remote Thread 1.2402 In: _start                                                                  L26   PC: 0x4000e0
Breakpoint 4 at 0x4000e0: file lab3.s, line 26.
(gdb) b 31
Breakpoint 5 at 0x4000f0: file lab3.s, line 31.
(gdb) c
Continuing.

Breakpoint 1, _start () at lab3.s:14
(gdb) c
Continuing.

Breakpoint 2, _start () at lab3.s:16
(gdb) c
Continuing.

Breakpoint 3, _start () at lab3.s:21
(gdb) c
Continuing.

Breakpoint 4, _start () at lab3.s:26
(gdb)
```

Use c command to continue the program and stop at line 26 breakpoint. From here we could see the second numbers of each vector in registers X3 and X4. We then multiply them together and add them into dot, giving X10 a value of 50.

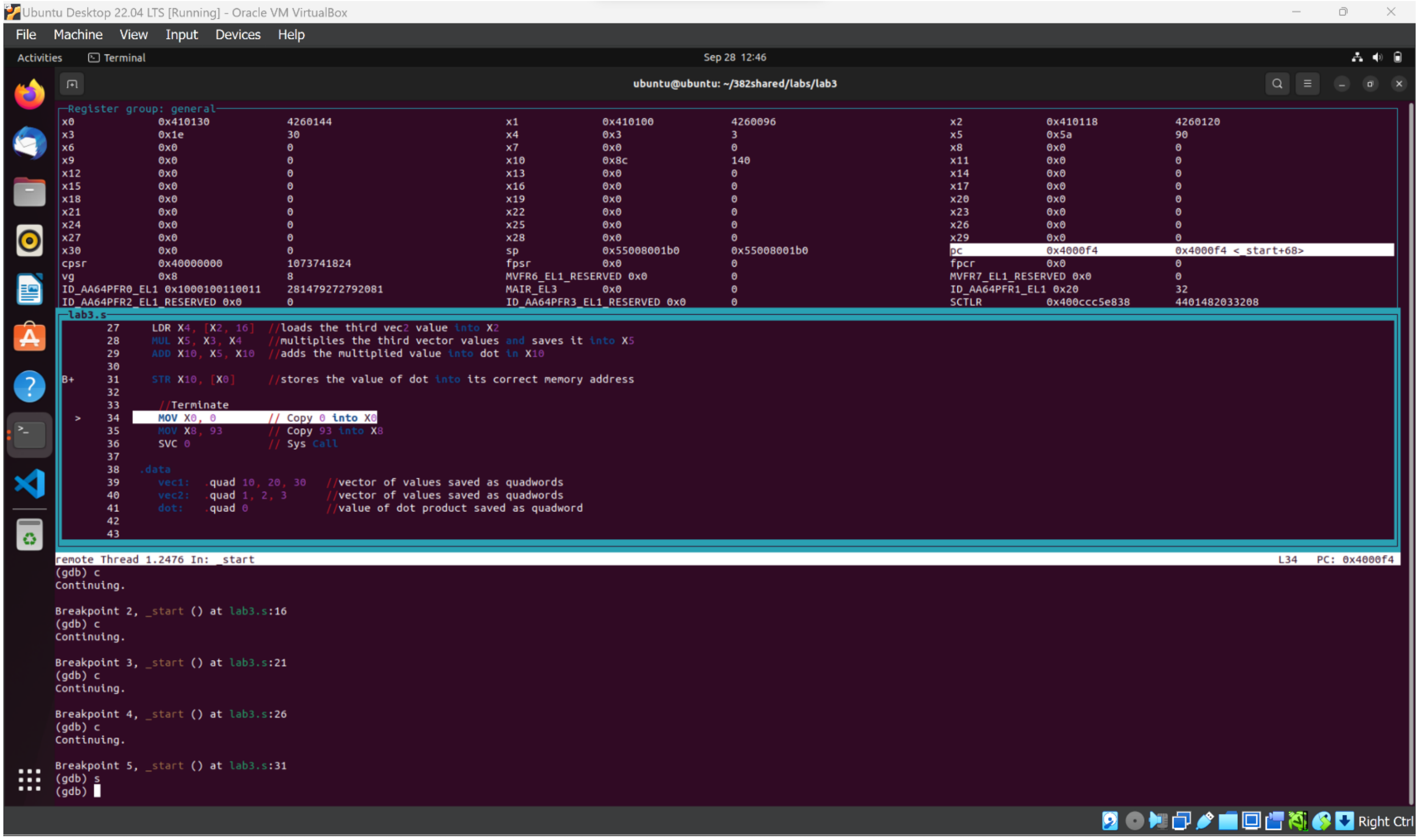
Lab 3 Report
Name: Dylan Faulhaber and Jack Patterson
Pledge: I pledge my honor that I have abided by the Stevens Honor System


Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:43
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
┌─Register group: general──────────────────────────────────────────────────────────────────────────────────
x0             0x410130            4260144            x1             0x410100            4260096            x2             0x410118            4260120
x3             0x1e                30                 x4             0x3                 3                  x5             0x5a                90
x6             0x0                 0                  x7             0x0                 0                  x8             0x0                 0
x9             0x0                 0                  x10            0x8c                140                x11            0x0                 0
x12            0x0                 0                  x13            0x0                 0                  x14            0x0                 0
x15            0x0                 0                  x16            0x0                 0                  x17            0x0                 0
x18            0x0                 0                  x19            0x0                 0                  x20            0x0                 0
x21            0x0                 0                  x22            0x0                 0                  x23            0x0                 0
x24            0x0                 0                  x25            0x0                 0                  x26            0x0                 0
x27            0x0                 0                  x28            0x0                 0                  x29            0x0                 0
x30            0x0                 0                  sp             0x55008001b0        0x55008001b0       pc             0x4000f0            0x4000f0 <_start+64>
cpsr           0x40000000          1073741824         fpsr           0x0                 0                  fpcr           0x0                 0
vg             0x8                 8                  MVFR6_EL1_RESERVED 0x0             0                  MVFR7_EL1_RESERVED 0x0             0
ID_AA64PFR0_EL1 0x1000100110011    281479272792081    MAIR_EL3       0x0                 0                  ID_AA64PFR1_EL1 0x20               32
ID_AA64PFR2_EL1_RESERVED 0x0       0                  ID_AA64PFR3_EL1_RESERVED 0x0       0                  SCTLR          0x400ccc5e838       4401482033208
┌─lab3.s───────────────────────────────────────────────────────────────────────────────────────────────────
│B+      21      LDR X3, [X1, 8]    //loads the second vec1 value into X3
│        22      LDR X4, [X2, 8]    //loads the second vec2 value into X2
│        23      MUL X5, X3, X4     //multiplies the second vector values and saves it into X5
│        24      ADD X10, X5, X10   //adds the multiplied value into dot in X10
│        25
│B+      26      LDR X3, [X1, 16]   //loads the third vec1 value into X3
│        27      LDR X4, [X2, 16]   //loads the third vec2 value into X2
│        28      MUL X5, X3, X4     //multiplies the third vector values and saves it into X5
│        29      ADD X10, X5, X10   //adds the multiplied value into dot in X10
│        30
│B+>     31      STR X10, [X0]      //stores the value of dot into its correct memory address
│        32
│        33       //Terminate
│        34       MOV X0, 0          // Copy 0 into X0
│        35       MOV X8, 93         // Copy 93 into X8
remote Thread 1.2402 In: _start                                                                          L31   PC: 0x4000f0
Continuing.

Breakpoint 1, _start () at lab3.s:14
(gdb) c
Continuing.

Breakpoint 2, _start () at lab3.s:16
(gdb) c
Continuing.

Breakpoint 3, _start () at lab3.s:21
(gdb) c
Continuing.

Breakpoint 4, _start () at lab3.s:26
(gdb) c
Continuing.

Breakpoint 5, _start () at lab3.s:31
(gdb) █
```

Use c command to continue the program and stop at line 31 breakpoint. From here we could see the second numbers of each vector in registers X3 and X4. We then multiply them together and add them into dot, giving X10 a value of 140.

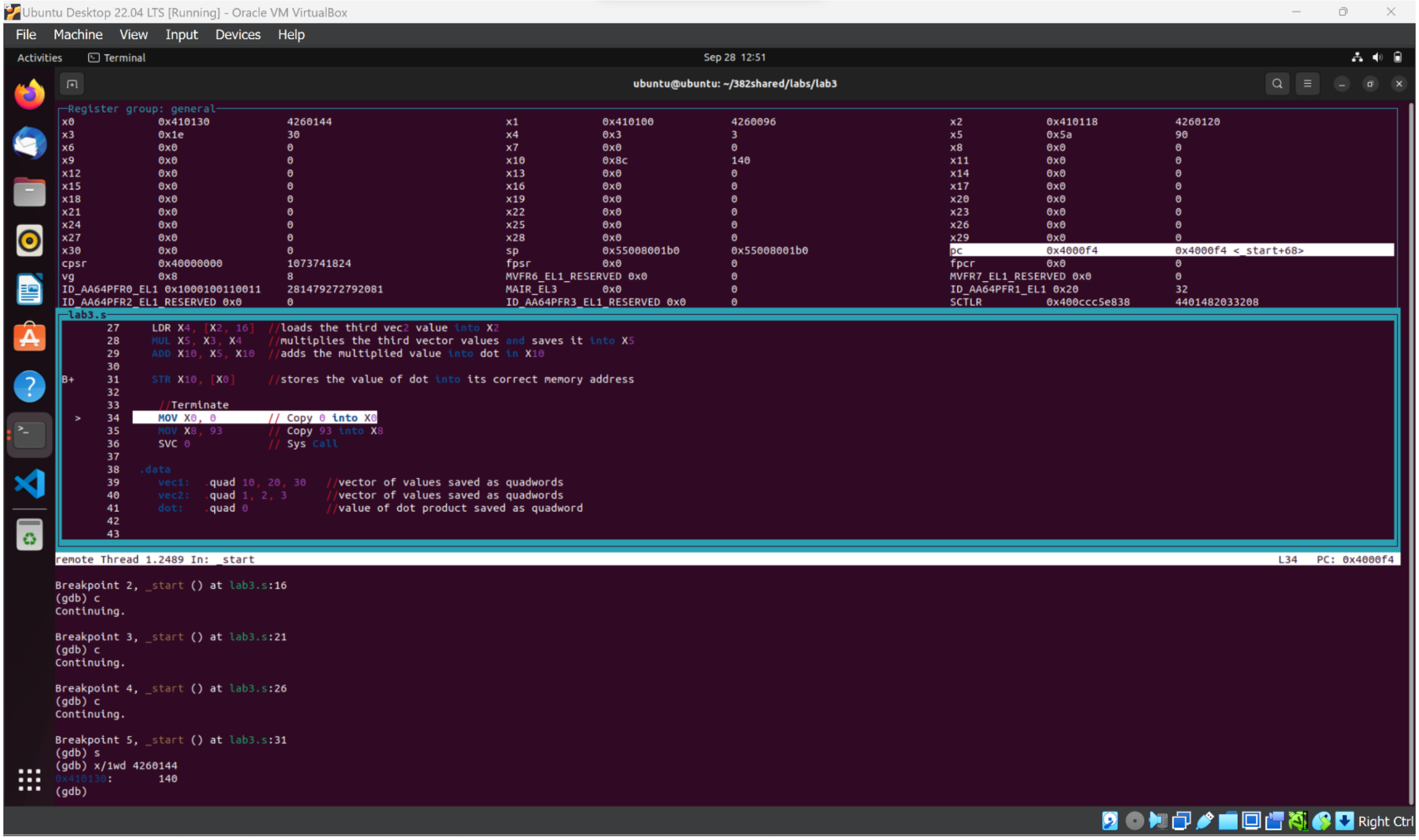
Lab 3 Report
Name: Dylan Faulhaber and Jack Patterson
Pledge: I pledge my honor that I have abided by the Stevens Honor System


Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:46
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
┌Register group: general──────────────────────────────────────────────────────────────────────────────────────────────────────────────────┐
│x0             0x410130            4260144                   x1             0x410100            4260096                   x2             0x410118            4260120                 │
│x3             0x1e                30                        x4             0x3                 3                         x5             0x5a                90                      │
│x6             0x0                 0                         x7             0x0                 0                         x8             0x0                 0                       │
│x9             0x0                 0                         x10            0x8c                140                       x11            0x0                 0                       │
│x12            0x0                 0                         x13            0x0                 0                         x14            0x0                 0                       │
│x15            0x0                 0                         x16            0x0                 0                         x17            0x0                 0                       │
│x18            0x0                 0                         x19            0x0                 0                         x20            0x0                 0                       │
│x21            0x0                 0                         x22            0x0                 0                         x23            0x0                 0                       │
│x24            0x0                 0                         x25            0x0                 0                         x26            0x0                 0                       │
│x27            0x0                 0                         x28            0x0                 0                         x29            0x0                 0                       │
│x30            0x0                 0                         sp             0x55008001b0        0x55008001b0              pc             0x4000f4            0x4000f4 <_start+68>    │
│cpsr           0x40000000          1073741824                fpsr           0x0                 0                         fpcr           0x0                 0                       │
│vg             0x8                 8                         MVFR6_EL1_RESERVED 0x0             0                         MVFR7_EL1_RESERVED 0x0             0                       │
│ID_AA64PFR0_EL1 0x1000100110011    281479272792081           MAIR_EL3       0x0                 0                         ID_AA64PFR1_EL1 0x20               32                      │
│ID_AA64PFR2_EL1_RESERVED 0x0       0                         ID_AA64PFR3_EL1_RESERVED 0x0       0                         SCTLR          0x400ccc5e838       4401482033208           │
┌lab3.s───────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────┐
│       27      LDR X4, [X2, 16]  //loads the third vec2 value into X2
│       28      MUL X5, X3, X4    //multiplies the third vector values and saves it into X5
│       29      ADD X10, X5, X10  //adds the multiplied value into dot in X10
│       30
│B+     31      STR X10, [X0]     //stores the value of dot into its correct memory address
│       32
│       33       //Terminate
│  >    34      MOV X0, 0         // Copy 0 into X0
│       35      MOV X8, 93        // Copy 93 into X8
│       36      SVC 0             // Sys Call
│       37
│       38    .data
│       39      vec1:   .quad 10, 20, 30    //vector of values saved as quadwords
│       40      vec2:   .quad 1, 2, 3       //vector of values saved as quadwords
│       41      dot:    .quad 0             //value of dot product saved as quadword
│       42
│       43
└─────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────┘
remote Thread 1.2476 In: _start                                                                                              L34   PC: 0x4000f4
(gdb) c
Continuing.

Breakpoint 2, _start () at lab3.s:16
(gdb) c
Continuing.

Breakpoint 3, _start () at lab3.s:21
(gdb) c
Continuing.

Breakpoint 4, _start () at lab3.s:26
(gdb) c
Continuing.

Breakpoint 5, _start () at lab3.s:31
(gdb) s
(gdb) █
```

Use s command to step to the next line of the program. From here we can verify that the correct value of dot in X10, which is 140, is stored in the correct memory address of dot.

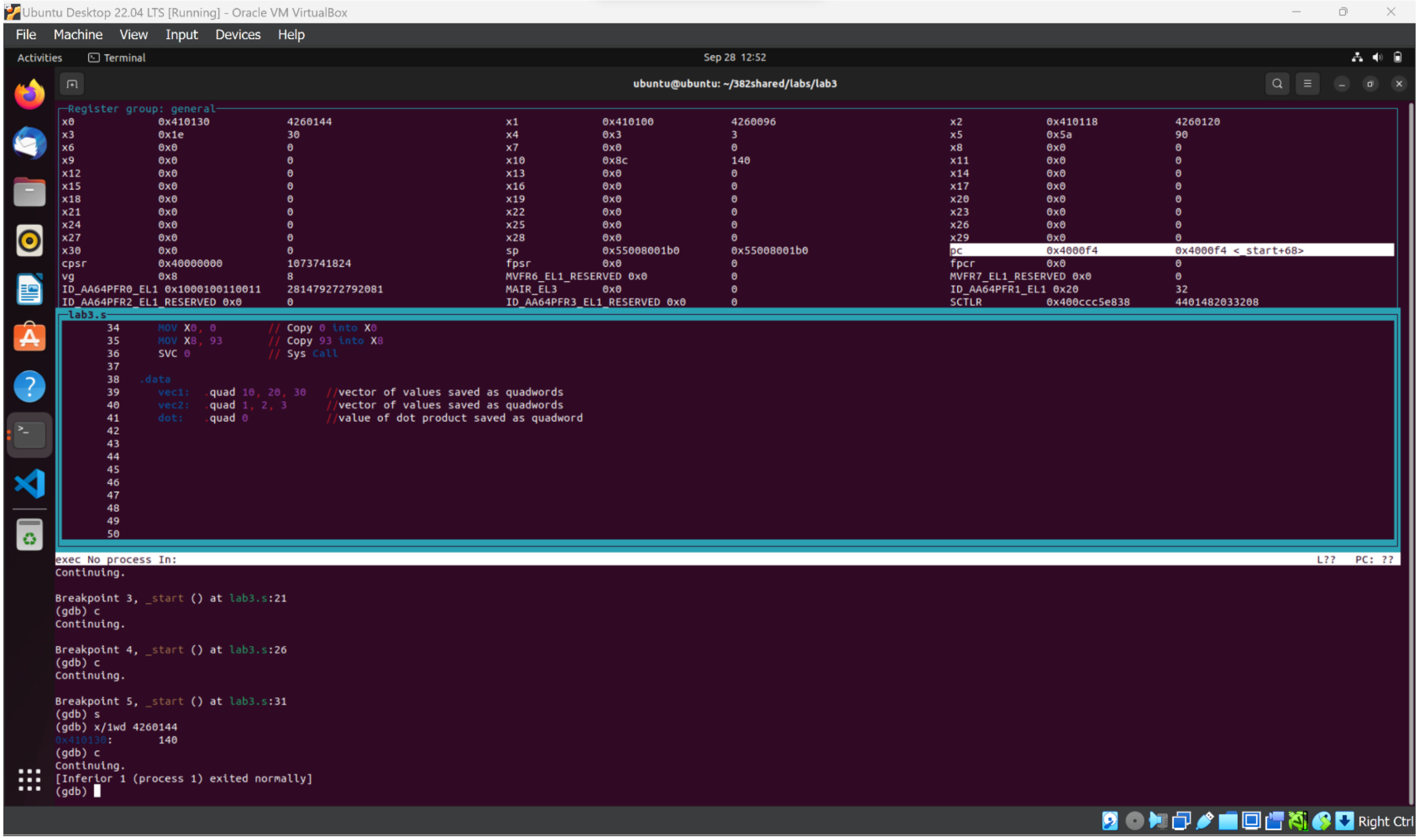
Lab 3 Report
Name: Dylan Faulhaber and Jack Patterson
Pledge: I pledge my honor that I have abided by the Stevens Honor System


Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File
Machine
View
Input
Devices
Help
Activities
Terminal
Sep 28 12:51
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
┌─Register group: general──────────────────────────────────────────────────────────────────────────────────────────────────────────
│x0             0x410130            4260144                            x1             0x410100            4260096                            x2             0x410118            4260120
│x3             0x1e                30                                 x4             0x3                 3                                  x5             0x5a                90
│x6             0x0                 0                                  x7             0x0                 0                                  x8             0x0                 0
│x9             0x0                 0                                  x10            0x8c                140                                x11            0x0                 0
│x12            0x0                 0                                  x13            0x0                 0                                  x14            0x0                 0
│x15            0x0                 0                                  x16            0x0                 0                                  x17            0x0                 0
│x18            0x0                 0                                  x19            0x0                 0                                  x20            0x0                 0
│x21            0x0                 0                                  x22            0x0                 0                                  x23            0x0                 0
│x24            0x0                 0                                  x25            0x0                 0                                  x26            0x0                 0
│x27            0x0                 0                                  x28            0x0                 0                                  x29            0x0                 0
│x30            0x0                 0                                  sp             0x55008001b0        0x55008001b0                       pc             0x4000f4            0x4000f4 <_start+68>
│cpsr           0x40000000          1073741824                         fpsr           0x0                 0                                  fpcr           0x0                 0
│vg             0x8                 8                                  MVFR6_EL1_RESERVED 0x0             0                                  MVFR7_EL1_RESERVED 0x0             0
│ID_AA64PFR0_EL1 0x1000100110011    281479272792081                    MAIR_EL3       0x0                 0                                  ID_AA64PFR1_EL1 0x20               32
│ID_AA64PFR2_EL1_RESERVED 0x0       0                                  ID_AA64PFR3_EL1_RESERVED 0x0       0                                  SCTLR          0x400ccc5e838       4401482033208
┌─lab3.s──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
│            LDR X4, [X2, 16]  //loads the third vec2 value into X2
│            MUL X5, X3, X4    //multiplies the third vector values and saves it into X5
│            ADD X10, X5, X10  //adds the multiplied value into dot in X10
│
│B+          STR X10, [X0]     //stores the value of dot into its correct memory address
│
│             //Terminate
│  >          MOV X0, 0         // Copy 0 into X0
│             MOV X8, 93        // Copy 93 into X8
│             SVC 0             // Sys Call
│
│           .data
│             vec1:   .quad 10, 20, 30   //vector of values saved as quadwords
│             vec2:   .quad 1, 2, 3      //vector of values saved as quadwords
│             dot:    .quad 0            //value of dot product saved as quadword
│
│
└──────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────────
remote Thread 1.2489 In: _start                                                                                          L34   PC: 0x4000f4

Breakpoint 2, _start () at lab3.s:16
(gdb) c
Continuing.

Breakpoint 3, _start () at lab3.s:21
(gdb) c
Continuing.

Breakpoint 4, _start () at lab3.s:26
(gdb) c
Continuing.

Breakpoint 5, _start () at lab3.s:31
(gdb) s
(gdb) x/1wd 4260144
0x410130:       140
(gdb)
```

Use *x/1wd 4260144* to view the value in decimal format of the memory address that is saved in X0. This should be the value of dot which is correct since it is 140. This is because 1(10) + 2(20) +3(30) = 140.

Lab 3 Report
Name: Dylan Faulhaber and Jack Patterson
Pledge: I pledge my honor that I have abided by the Stevens Honor System


Ubuntu Desktop 22.04 LTS [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Sep 28 12:52
ubuntu@ubuntu: ~/382shared/labs/lab3
Right Ctrl

```
┌Register group: general──────────────────────────────────────────────────────────────────────────────────────────────
│x0             0x410130            4260144                              x1             0x410100            4260096                              x2             0x410118            4260120
│x3             0x1e                30                                   x4             0x3                 3                                    x5             0x5a                90
│x6             0x0                 0                                    x7             0x0                 0                                    x8             0x0                 0
│x9             0x0                 0                                    x10            0x8c                140                                  x11            0x0                 0
│x12            0x0                 0                                    x13            0x0                 0                                    x14            0x0                 0
│x15            0x0                 0                                    x16            0x0                 0                                    x17            0x0                 0
│x18            0x0                 0                                    x19            0x0                 0                                    x20            0x0                 0
│x21            0x0                 0                                    x22            0x0                 0                                    x23            0x0                 0
│x24            0x0                 0                                    x25            0x0                 0                                    x26            0x0                 0
│x27            0x0                 0                                    x28            0x0                 0                                    x29            0x0                 0
│x30            0x0                 0                                    sp             0x55008001b0        0x55008001b0                         pc             0x4000f4            0x4000f4 <_start+68>
│cpsr           0x40000000          1073741824                           fpsr           0x0                 0                                    fpcr           0x0                 0
│vg             0x8                 8                                    MVFR6_EL1_RESERVED 0x0             0                                    MVFR7_EL1_RESERVED 0x0             0
│ID_AA64PFR0_EL1 0x1000100110011    281479272792081                      MAIR_EL3       0x0                 0                                    ID_AA64PFR1_EL1 0x20               32
│ID_AA64PFR2_EL1_RESERVED 0x0       0                                    ID_AA64PFR3_EL1_RESERVED 0x0       0                                    SCTLR          0x400ccc5e838       4401482033208
┌lab3.s───────────────────────────────────────────────────────────────────────────────────────────────────────────────
│         MOV X0, 0           // Copy 0 into X0
│         MOV X8, 93          // Copy 93 into X8
│         SVC 0               // Sys Call
│
│     .data
│         vec1:   .quad 10, 20, 30    //vector of values saved as quadwords
│         vec2:   .quad 1, 2, 3       //vector of values saved as quadwords
│         dot:    .quad 0             //value of dot product saved as quadword
│
exec No process In:                                                                                                             L??   PC: ??
Continuing.

Breakpoint 3, _start () at lab3.s:21
(gdb) c
Continuing.

Breakpoint 4, _start () at lab3.s:26
(gdb) c
Continuing.

Breakpoint 5, _start () at lab3.s:31
(gdb) s
(gdb) x/1wd 4260144
0x410130:       140
(gdb) c
Continuing.
[Inferior 1 (process 1) exited normally]
(gdb) 
```

Lastly, I then use c to continue the program to the end and have it terminate.