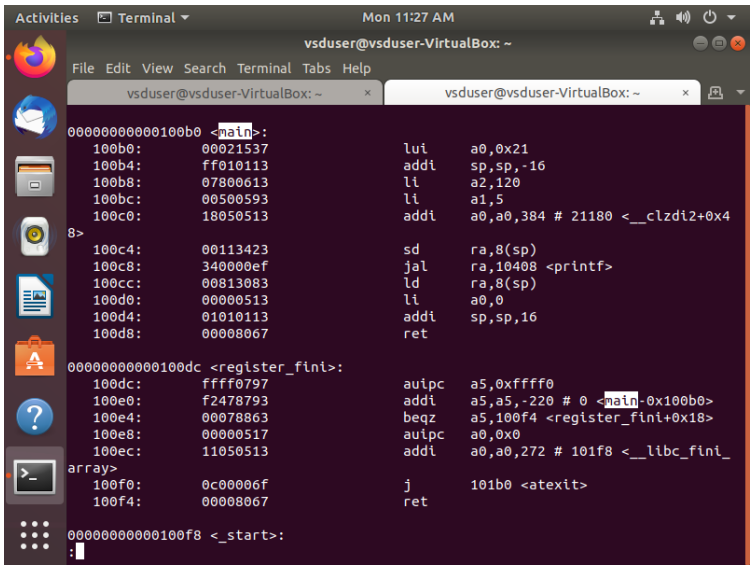
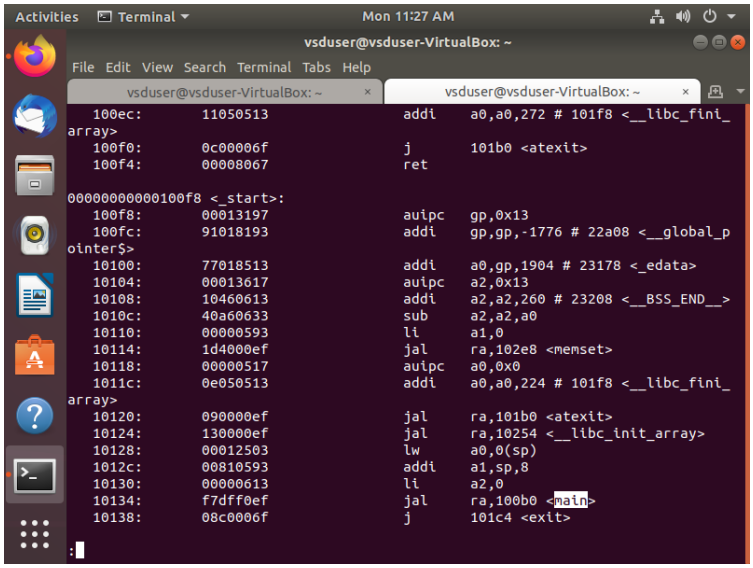
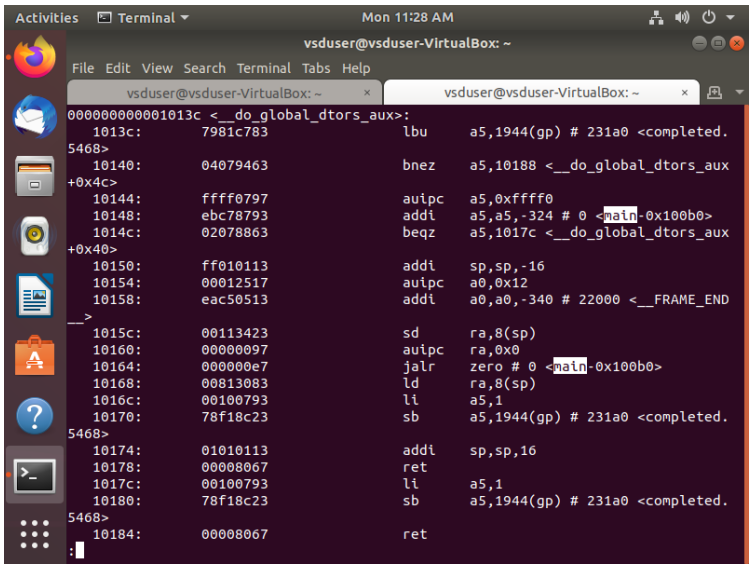
# Task 3


Activities
Terminal
Mon 11:27 AM
vsduser@vsduser-VirtualBox: ~
File Edit View Search Terminal Tabs Help
vsduser@vsduser-VirtualBox: ~
vsduser@vsduser-VirtualBox: ~
00000000000100b0 <main>:
100b0: 00021537 lui a0,0x21
100b4: ff010113 addi sp,sp,-16
100b8: 07800613 li a2,120
100bc: 00500593 li a1,5
100c0: 18050513 addi a0,a0,384 # 21180 <__clzdi2+0x48>
100c4: 00113423 sd ra,8(sp)
100c8: 340000ef jal ra,10408 <printf>
100cc: 00813083 ld ra,8(sp)
100d0: 00000513 li a0,0
100d4: 01010113 addi sp,sp,16
100d8: 00008067 ret
00000000000100dc <register_fini>:
100dc: ffff0797 auipc a5,0xffff0
100e0: f2478793 addi a5,a5,-220 # 0 <main-0x100b0>
100e4: 00078863 beqz a5,100f4 <register_fini+0x18>
100e8: 00000517 auipc a0,0x0
100ec: 11050513 addi a0,a0,272 # 101f8 <__libc_fini_array>
100f0: 0c00006f j 101b0 <atexit>
100f4: 00008067 ret
00000000000100f8 <_start>:


Activities
Terminal
Mon 11:27 AM
vsduser@vsduser-VirtualBox: ~
File Edit View Search Terminal Tabs Help
vsduser@vsduser-VirtualBox: ~
vsduser@vsduser-VirtualBox: ~
100ec: 11050513 addi a0,a0,272 # 101f8 <__libc_fini_array>
100f0: 0c00006f j 101b0 <atexit>
100f4: 00008067 ret
00000000000100f8 <_start>:
100f8: 00013197 auipc gp,0x13
100fc: 91018193 addi gp,gp,-1776 # 22a08 <__global_pointer$>
10100: 77018513 addi a0,gp,1904 # 23178 <_edata>
10104: 00013617 auipc a2,0x13
10108: 10460613 addi a2,a2,260 # 23208 <__BSS_END__>
1010c: 40a60633 sub a2,a2,a0
10110: 00000593 li a1,0
10114: 1d4000ef jal ra,102e8 <memset>
10118: 00000517 auipc a0,0x0
1011c: 0e050513 addi a0,a0,224 # 101f8 <__libc_fini_array>
10120: 090000ef jal ra,101b0 <atexit>
10124: 130000ef jal ra,10254 <__libc_init_array>
10128: 00012503 lw a0,0(sp)
1012c: 00810593 addi a1,sp,8
10130: 00000613 li a2,0
10134: f7dff0ef jal ra,100b0 <main>
10138: 08c0006f j 101c4 <exit>


Activities
Terminal
Mon 11:28 AM
vsduser@vsduser-VirtualBox: ~
File Edit View Search Terminal Tabs Help
vsduser@vsduser-VirtualBox: ~
vsduser@vsduser-VirtualBox: ~
000000000001013c <__do_global_dtors_aux>:
1013c: 7981c783 lbu a5,1944(gp) # 231a0 <completed.5468>
10140: 04079463 bnez a5,10188 <__do_global_dtors_aux+0x4c>
10144: ffff0797 auipc a5,0xffff0
10148: ebc78793 addi a5,a5,-324 # 0 <main-0x100b0>
1014c: 02078863 beqz a5,1017c <__do_global_dtors_aux+0x40>
10150: ff010113 addi sp,sp,-16
10154: 00012517 auipc a0,0x12
10158: eac50513 addi a0,a0,-340 # 22000 <__FRAME_END__>
1015c: 00113423 sd ra,8(sp)
10160: 00000097 auipc ra,0x0
10164: 000000e7 jalr zero # 0 <main-0x100b0>
10168: 00813083 ld ra,8(sp)
1016c: 00100793 li a5,1
10170: 78f18c23 sb a5,1944(gp) # 231a0 <completed.5468>
10174: 01010113 addi sp,sp,16
10178: 00008067 ret
1017c: 00100793 li a5,1
10180: 78f18c23 sb a5,1944(gp) # 231a0 <completed.5468>
10184: 00008067 ret

**Types of Instruction sets in objdump:**

1. lui a0,0x21
    - Opcode: 0110111 (7 bits)
    - Immediate: 0x21 (20 bits)
    - Destination Register(rd): a0 (×15, 5 bits)

    Breakdown:
    - Opcode: 0110111
    - Immediate: 0000 0000 0000 0010 0001 (20 bits)
    - rd (a0×=15): 01010 (5 bits)

2. addi sp,sp,-16
    - Opcode: 0010011
    - Immediate: -16 (12 bits,2's complement)
    - Source Register (rs1): sp (x2, 5 bits)
    - Destination register (rd): sp (x2, 5bits)
    - Function (funct3): 000 (3 bits)

    Breakdown:
    - Opcode: 0010011
    - Immediate: 1111 1111 0000 (12 bits)
    - rs1: 00010 (5 bits)
    - rd: 00010 (5 bits)
    - funct3: 000 (3 bits)

3. li a2,120
    - Machine Code: 07800613

    Breakdown:
    - Immediate: 0000 0111 1000 (12 bits)
    - Source Register (rs1): 00000 (5 bits)
    - Function (funct3): 000 (3 bits)
    - Destination Register (rd): 01100 (5 bits)
    - Opcode: 0010011 (7 bits)

4. sd ra,8(sp)
    - Machine Code: 00113423

Breakdown:

- Immediate (imm[11:5]): 0000000 (7 bits)
- Source Register (rs2): 00001 (5 bits)
- Source Register (rs1): 00010 (5 bits)
- Function (funct3): 011 (3 bits)
- Immediate (imm[4:0]): 01000 (5 bits)
- Opcode: 0100011 (7 bits)

5. jal ra,10408
    - Machine Code: 340000EF

   Breakdown:
    - Immediate: 0100 0000 0000 0000
    - Destination Register (rd): 00001
    - Opcode: 1101111

6. ld ra,8(sp)
    - Opcode: 0000011
    - Immediate: 000000000100 (8 in decimal)
    - Source Register (rs1): 00010 (for sp)
    - Destination Register (rd): 00001 (for ra)
    - Function (funct3): 011

7. auipc a5, 0xfffff0 (0x100dc)
    - Type: U-Type (Add Upper Immediate to PC).

   Fields:
    - opcode: 0010111 (AUIPC).
    - rd: a5.
    - imm[31:12]: 0xfffff0.
    - Function: Sets a5 = PC + (imm << 12)

8. beqz a5, 100f4 (0x100e4)
    - Type: B-Type (Branch).

Fields:

- opcode: 1100011.
- funct3: 000 (BEQ).
- rs1: a5.
- rs2: zero.
- imm: Offset to 100f4.
- Function: Branches to 100f4 if a5 == 0.

9. sub a2, a2, a0
   - Type: R-Type (Register Arithmetic).

   Fields:
   - opcode: 0110011.
   - funct3: 000 (SUB).
   - rd: a2.
   - rs1: a2.
   - rs2: a0.
   - Function: Subtracts a0 from a2 and stores the result in a2

10. lw a0, 0(sp)
    - Type: I-Type (Load).

    Fields:
    - opcode: 0000011.
    - funct3: 010 (LW).
    - rd: a0.
    - rs1: sp.
    - imm[11:0]: 0.
    - Function: Loads the value from the memory address sp + 0 into a0.

11. lbu a5, 1944(gp)
    - Type: I-Type (Load Unsigned Byte).

    Fields:
    - opcode: 0000011 (LB).
    - funct3: 100 (LBU - Load Unsigned Byte).
    - rd: a5.
    - rs1: gp.

- imm[11:0]: 1944.
- Function: Loads an unsigned byte from memory at gp + 1944 into register a5.

12. bnez a5, 10188 <__do_global_dtors_aux>
    - Type: B-Type (Branch).

    Fields:
    - opcode: 1100011.
    - funct3: 001 (BNE - Branch if Not Equal).
    - rs1: a5.
    - rs2: zero.
    - imm[12|10:5|4:1|11]: Relative offset to 10188.
    - Function: Branches to 10188 if a5 != 0.

13. bnez a5, 10188 <__do_global_dtors_aux>
    - Type: B-Type (Branch).

    Fields:
    - opcode: 1100011.
    - funct3: 001 (BNE - Branch if Not Equal).
    - rs1: a5.
    - rs2: zero.
    - imm[12|10:5|4:1|11]: Relative offset to 10188.
    - Function: Branches to 10188 if a5 != 0.

14. Ret
    - Pseudo-instruction: jalr zero, 0(ra).
    - Function: Returns from the function by jumping to the address in ra.

15. sb a5, 1944(gp)
    - Type: S-Type (Store Byte).

    Fields:
    - opcode: 0100011.
    - funct3: 000 (SB - Store Byte).

- rs2: a5.
- rs1: gp.
- imm[11:5|4:0]: 1944.
- Function: Stores the byte value of a5 (1) into memory at gp + 1944.