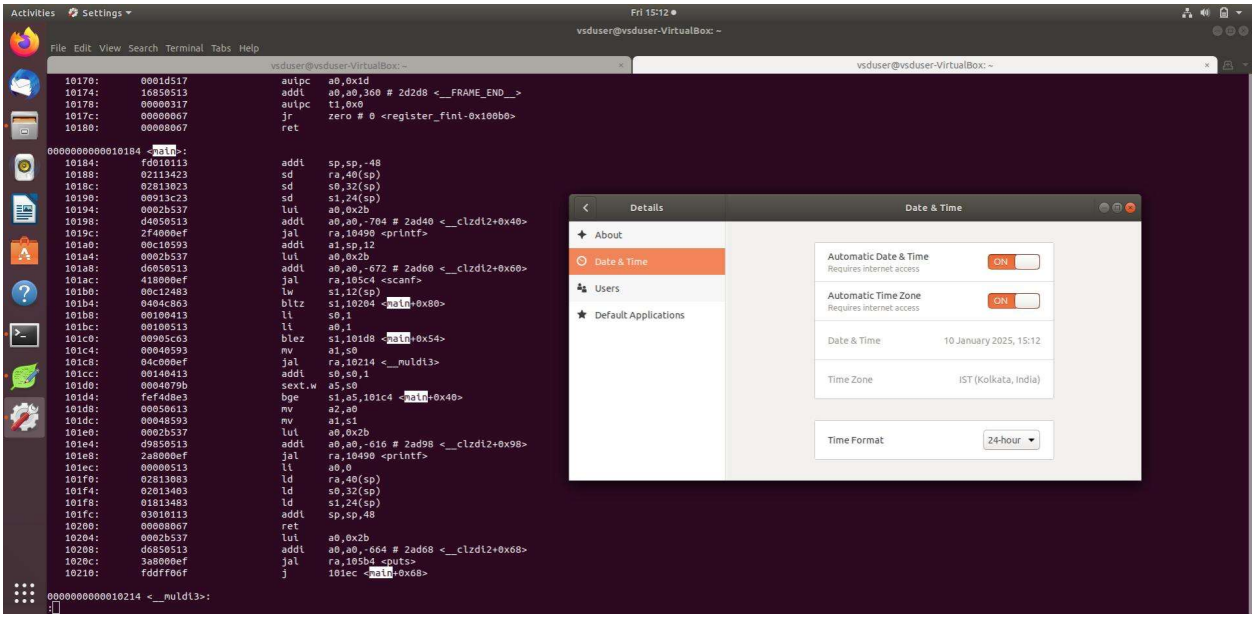
TASK-3



Using factorial of a number(RISC-V)

Instruction Types and Fields:-

The RISC-V instructions are categorized into types based on their field organization. Each type has specific fields like opcode, func3, func7, immediate values, and register numbers. The types include:

R-type: Register type

I-type: Immediate type

S-type: Store type

B-type: Branch type

U-type: Upper immediate type

J-type: Jump type

32-bit RISC-V Instruction Formats

Instruction Formats	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Register/register	funct7							rs2					rs1					funct3			rd					opcode						
Immediate	imm[11:0]												rs1					funct3			rd					opcode						
Upper Immediate	imm[31:12]																				rd					opcode						
Store	imm[11:5]							rs2					rs1					funct3			imm[4:0]					opcode						
Branch	[12]	imm[10:5]						rs2					rs1					funct3			imm[4:1]				[11]	opcode						
Jump	[20]	imm[10:1]										[11]	imm[19:12]								rd					opcode						

- **opcode (7 bit):** partially specifies which of the 6 types of *instruction formats*
- **funct7 + funct3 (10 bit):** combined with **opcode**, these two fields describe what operation to perform
- **rs1 (5 bit):** specifies register containing first operand
- **rs2 (5 bit):** specifies second register operand
- **rd (5 bit):**: Destination register specifies register which will receive result of computation

Fig:- RISC-V instruction types

10184:-

Instruction: addi sp, sp, -48

Type: I-type

Opcode: 0010011 (7 bits)

Immediate: 1111111111000000 (12 bits)

Source Register (rs1): 00000 (x0, 5 bits)

Destination Register (rd): 00000 (x0, 5 bits)

Function (funct3): 000 (3 bits)

10188:

Instruction: sd ra, 40(sp)

Type: S-type

Opcode: 0100011 (7 bits)

Immediate: 0000000001010000 (12 bits)

Source Register (rs1): 10010 (x18, 5 bits)

Destination Register (rd): 10001 (x17, 5 bits)

Function (funct3): 010 (3 bits)

1018C:

Instruction: sd s0, 32(sp)

Type: S-type

Opcode: 0100011 (7 bits)

Immediate: 0000000001000000 (12 bits)

Source Register (rs1): 10000 (x16, 5 bits)

Destination Register (rd): 10001 (x17, 5 bits)

Function (funct3): 010 (3 bits)

10190:

Instruction: sd s1, 24(sp)

Type: S-type

Opcode: 0100011 (7 bits)

Immediate: 0000000000110000 (12 bits)

Source Register (rs1): 10001 (x17, 5 bits)

Destination Register (rd): 10001 (x17, 5 bits)

Function (funct3): 010 (3 bits)

10194:

Instruction: lui a0, 0x2b

Type: U-type

Opcode: 0110111 (7 bits)

Immediate: 0000000001011011 (20 bits)

Source Register (rs1): N/A

Destination Register (rd): 01000 (x10, 5 bits)

10198:

Instruction: addi a0, a0, -704

Type: I-type

Opcode: 0010011 (7 bits)

Immediate: 1111111111000000 (12 bits)

Source Register (rs1): 01000 (x10, 5 bits)

Destination Register (rd): 01000 (x10, 5 bits)

Function (funct3): 000 (3 bits)

1019C:

Instruction: jal ra, 10490 <printf>

Type: J-type

Opcode: 1101111 (7 bits)

Immediate: 00000000010001001111010000000000 (20 bits)

Source Register (rs1): N/A

Destination Register (rd): 10010 (x18, 5 bits)

101A0:

Instruction: addi a1, sp, 12

Type: I-type

Opcode: 0010011 (7 bits)

Immediate: 0000000000001100 (12 bits)

Source Register (rs1): 00000 (x0, 5 bits)

Destination Register (rd): 01001 (x11, 5 bits)

Function (funct3): 000 (3 bits)

101A4:

Instruction: lui a0, 0x2b

Type: U-type

Opcode: 0110111 (7 bits)

Immediate: 0000000001011011 (20 bits)

Source Register (rs1): N/A

Destination Register (rd): 01000 (x10, 5 bits)

101A8:

Instruction: addi a0, a0, -672

Type: I-type

Opcode: 0010011 (7 bits)

Immediate: 1111111111001100 (12 bits)

Source Register (rs1): 01000 (x10, 5 bits)

Destination Register (rd): 01000 (x10, 5 bits)

Function (funct3): 000 (3 bits)

Machine Code: 1111111111001100

101AC:

Machine Code: 418000ef

Instruction: jal ra, 105c4 <scanf>

Type: J-type

Function: Jump to the address 105c4 (which corresponds to the scanf function) and save the current program counter (PC) in register ra for later return.

101B0:

Machine Code: 00c12483

Instruction: lw s1, 12(sp)

Type: I-type

Function: Load the word-sized value from the memory location 12 bytes above the current stack pointer into register s1.

101B4:

Machine Code: 0404c863

Instruction: bltz s1, 10204 <main+0x80>

Type: B-type

Function: Branch to the address 10204 (which corresponds to the label main+0x80) if the value in register s1 is less than zero.

101B8:

Machine Code: 00100413

Instruction: li s0, 1

Type: I-type

Function: Load the immediate value 1 into register s0.

101BC:

Machine Code: 00100513

Instruction: li s1, 1

Type: I-type

Function: Load the immediate value 1 into register s1.

101C0:

Machine Code: 00905c63

Instruction: blez s1, 101D8 <main+0x54>

Type: B-type

Function: Branch to the address 101D8 (which corresponds to the label main+0x54) if the value in register s1 is less than or equal to zero.