

**Name:** Hassam Ud-Din

**Roll No:** 19P-0029

**Section:** BCS 3-A

**CODE:**

.data

num: .word 4

.text

lw t0, num

jal ra, factorial

li a7, 10

ecall

factorial:

li t2, 1

mv t1, t0

sub t1, t1, t2

beq t0, t2, skip

    loopbody:

        mul t0, t0, t1

        sub t1, t1, t2

        bnez t1, loopbody

skip:

jr ra

# SINGLE STAGE PROCESSOR:

Ripes File Edit Help

100 ms

Source code

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

Processor

History

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16 mul t0, t0, t1
17 sub t1, t1, t2
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0: 10000297 auipc x5,0x10000
4: 0002a283 lw x5,0(x5)
8: 00c000ef jal x1,0x14 <factorial>
c: 00a00093 addi x17,x0,10
10: 00000073 ecall

00000014 <factorial>:
14: 00100393 addi x7,x0,1
18: 00028313 addi x6,x5,0
1c: 40730333 sub x6,x6,x7
20: 00728863 beq x5,x7,16 <skip>

00000024 <loopbody>:
24: 026282b3 mul x5,x5,x6
28: 40730333 sub x6,x6,x7
2c: fe031ce3 bne x6,x0,-8 <loopbody>

00000030 <skip>:
30: 00000067 jalr x0,x1,0
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100 ms

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3:
4: .text
5: lw t0, num
6: jal ra, factorial
7: li a7, 10
8: ecall
9:
10: factorial:
11: li t2, 1
12: mv t1, t0
13: sub t1, t1, t2
14: beq t0, t2, skip
15: loopbody:
16: mul t0, t0, t1
17: sub t1, t1, t2
18: bnez t1, loopbody
19: skip:
20: jr ra
21:

```

Input type: Assembly C Executable code

View mode: Binary Disassembled

```

0: 10000297 auipc x5 0x10000
4: 0002a283 lw x5 0(x5)
8: 00c000ef jal x1 0x14 <factorial>
c: 00a00093 addi x17 x0 10
10: 00000073 ecall

00000014 <factorial>:
14: 00100393 addi x7 x0 1
18: 00020313 addi x6 x5 0
1c: 40730333 sub x6 x6 x7
20: 00728863 beq x5 x7 16 <skip>

00000024 <loopbody>:
24: 026202b3 mul x5 x5 x6
28: 40730333 sub x6 x6 x7
2c: fe031ce3 bne x6 x0 -8 <loopbody>

00000030 <skip>:
30: 00000067 jalr x0 x1 0

```

## SINGLE STAGE PROCESSOR STAGES:

Ripes  
File Edit Help

Single Cycle RISC-V Processor

addi x7 x0 1

The diagram illustrates the internal components of a single-cycle RISC-V processor. It includes a Program Counter (PC), Instruction Memory, a Decode stage, a Register File, an ALU, a Branch unit, and Data Memory. The ALU performs operations on register values and immediates. The Branch unit checks for branch conditions. The Data Memory handles store and load instructions. The processor is currently executing the instruction 'addi x7 x0 1'.

Registers

Name	Alias	Value
x0	zero	0x00000000
x1	ra	0x0000000c
x2	sp	0x7ffffff0
x3	gp	0x10000000
x4	tp	0x00000000
x5	t0	0x00000015
x6	t1	0x00000000
x7	t2	0x00000001
x8	s0	0x00000000
x9	s1	0x00000000
x10	a0	0x00000000
x11	a1	0x00000000

Instruction memory

BP	Addr	Stage	Instruction
<input type="checkbox"/>	0x0		auipc x5 0x10000
<input type="checkbox"/>	0x4		lw x5 0(x5)
<input type="checkbox"/>	0x8		jal x1 0x14 <factorial>
<input type="checkbox"/>	0xc		addi x17 x0 10
<input type="checkbox"/>	0x10		ecall
<input type="checkbox"/>	0x14		addi x7 x0 1
<input type="checkbox"/>	0x18		addi x6 x5 0
<input type="checkbox"/>	0x1c		sub x6 x6 x7
<input type="checkbox"/>	0x20		beq x5 x7 16 <skip>
<input type="checkbox"/>	0x24		mul x5 x5 x6
<input type="checkbox"/>	0x28		sub x6 x6 x7
<input type="checkbox"/>	0x2c		bne x6 x0 -8 <loopbody>
<input type="checkbox"/>	0x30		jalr x0 x1 0

Execution info

Cycles: 19  
Instrs. retired: 19  
CPI: 1  
BPC: 1  
Clock rate: 9.26 Hz

Console

Program exited with code: 0

## 5 STAGE PROCESSOR:

Ripes File Edit Help

100 ms

Source code

```
1 .data
2 num: word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21
```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	17
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	
18:	00028313	addi x6 x5 0	
1c:	40730333	sub x6 x6 x7	
20:	00728863	beq x5 x7 16 <skip>	
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	
28:	40730333	sub x6 x6 x7	
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	

Ripes File Edit Help

100 ms

Source code

```
1 .data
2 num: word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21
```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	1D
4:	0002a283	lw x5 0(x5)	1F
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	
18:	00028313	addi x6 x5 0	
1c:	40730333	sub x6 x6 x7	
20:	00728863	beq x5 x7 16 <skip>	
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	
28:	40730333	sub x6 x6 x7	
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	

Ripes  
File Edit Help

Source code

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2 num: .word 4
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4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
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13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	EX
8:	00c000ef	jal x1 0x14 <factorial>	ID
c:	00a00093	addi x17 x0 10	IF
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	
18:	00028313	addi x6 x5 0	
1c:	40730333	sub x6 x6 x7	
20:	00728863	beq x5 x7 16 <skip>	
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2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
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Ripes  
File Edit Help

Source code

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10 factorial:
11 li t2, 1
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13 sub t1, t1, t2
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15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	EX
8:	00c000ef	jal x1 0x14 <factorial>	ID
c:	00a00093	addi x17 x0 10	IF
10:	00000073	ecall	
00000014 <factorial>:			
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Ripes  
File Edit Help

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10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	VB
4:	0002a283	lw x5 0(x5)	HEH
8:	00c000ef	jal x1 0x14 <factorial>	EX
c:	00a00093	addi x17 x0 10	ID
10:	00000073	ecall	IF
00000014 <factorial>			
14:	00100393	addi x7 x0 1	
18:	0002b313	addi x6 x5 0	
1c:	40730333	sub x6 x6 x7	
20:	00728863	beq x5 x7 16 <skip>	
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24:	026282b3	mul x5 x5 x6	
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2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>			
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Ripes  
File Edit Help

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8 ecall
9
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16 mul t0, t0, t1
17 sub t1, t1, t2
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21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	VB
4:	0002a283	lw x5 0(x5)	HEH
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00000014 <factorial>			
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2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>			
30:	00000067	jalr x0 x1 0	

Ripes  
File Edit Help

Source code

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6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	WB
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	ID
18:	00026313	addi x6 x5 0	IF
1c:	40730333	sub x6 x6 x7	
20:	00728863	beq x5 x7 16 <skip>	
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	
28:	40730333	sub x6 x6 x7	
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	

Ripes  
File Edit Help

Source code

```

1 .data
2 num: .word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	EX
18:	00026313	addi x6 x5 0	ID
1c:	40730333	sub x6 x6 x7	IF
20:	00728863	beq x5 x7 16 <skip>	
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	
28:	40730333	sub x6 x6 x7	
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	

Ripes  
File Edit Help

100 1010 01  
CPU  
Processor  
Memory

Source code

```

1 .data
2 num: .word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	WB
18:	00026313	addi x6 x5 0	WB
1c:	40730333	sub x6 x6 x7	EX
20:	00728863	beq x5 x7 16 <skip>	IF
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	IF
28:	40730333	sub x6 x6 x7	
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	

Ripes  
File Edit Help

100 1010 01  
CPU  
Processor  
Memory

Source code

```

1 .data
2 num: .word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	WB
18:	00026313	addi x6 x5 0	WB
1c:	40730333	sub x6 x6 x7	EX
20:	00728863	beq x5 x7 16 <skip>	IF
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	IF
28:	40730333	sub x6 x6 x7	
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	



Ripes  
File Edit Help

Source code

```

1 .data
2 num: .word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	
18:	0002b313	addi x6 x5 0	WD
1c:	40730333	sub x6 x6 x7	HEM
20:	00728863	beq x5 x7 16 <skip>	EX
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	ID
28:	40730333	sub x6 x6 x7	IF
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	

Ripes  
File Edit Help

Source code

```

1 .data
2 num: .word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
10:	00000073	ecall	
00000014 <factorial>:			
14:	00100393	addi x7 x0 1	
18:	0002b313	addi x6 x5 0	
1c:	40730333	sub x6 x6 x7	WD
20:	00728863	beq x5 x7 16 <skip>	HEM
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	EX
28:	40730333	sub x6 x6 x7	ID
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	IF
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	

Ripes  
File Edit Help

Source code

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1 .data
2 num: .word 4
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5 lw t0, num
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```

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View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
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18:	0002b313	addi x6 x5 0	
1c:	40730333	sub x6 x6 x7	
20:	00728863	beq x5 x7 16 <skip>	VB
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	VB
28:	40730333	sub x6 x6 x7	HEM
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	EX
00000030 <skip>:			
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Ripes  
File Edit Help

Source code

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1 .data
2 num: .word 4
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5 lw t0, num
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13 sub t1, t1, t2
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21

```

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View mode: ☐ Binary ☒ Disassembled

0:	10000297	auipc x5 0x10000	
4:	0002a283	lw x5 0(x5)	
8:	00c000ef	jal x1 0x14 <factorial>	
c:	00a00093	addi x17 x0 10	
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00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	VB
28:	40730333	sub x6 x6 x7	HEM
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	EX
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	ID

Ripes  
File Edit Help

Source code

```

1 .data
2 num: .word 4
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4 .text
5 lw t0, num
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13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

```

0: 10000297 auipc x5 0x10000
4: 0002a283 lw x5 0(x5)
8: 00c000ef jal x1 0x14 <factorial>
c: 00a00093 addi x17 x0 10
10: 00000073 ecall

00000014 <factorial>:
14: 00100393 addi x7 x0 1
18: 00028313 addi x6 x5 0
1c: 40730333 sub x6 x6 x7
20: 00728863 beq x5 x7 16 <skip>

00000024 <loopbody>:
24: 026282b3 mul x5 x5 x6
28: 40730333 sub x6 x6 x7
2c: fe031ce3 bne x6 x0 -8 <loopbody>

00000030 <skip>:
30: 00000067 jalr x0 x1 0

```

Ripes  
File Edit Help

Source code

```

1 .data
2 num: .word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
7 li a7, 10
8 ecall
9
10 factorial:
11 li t2, 1
12 mv t1, t0
13 sub t1, t1, t2
14 beq t0, t2, skip
15 loopbody:
16 mul t0, t0, t1
17 sub t1, t1, t2
18 bnez t1, loopbody
19 skip:
20 jr ra
21

```

Input type: ☒ Assembly ☐ C Executable code

View mode: ☐ Binary ☒ Disassembled

```

0: 10000297 auipc x5 0x10000
4: 0002a283 lw x5 0(x5)
8: 00c000ef jal x1 0x14 <factorial>
c: 00a00093 addi x17 x0 10
10: 00000073 ecall

00000014 <factorial>:
14: 00100393 addi x7 x0 1
18: 00028313 addi x6 x5 0
1c: 40730333 sub x6 x6 x7
20: 00728863 beq x5 x7 16 <skip>

00000024 <loopbody>:
24: 026282b3 mul x5 x5 x6
28: 40730333 sub x6 x6 x7
2c: fe031ce3 bne x6 x0 -8 <loopbody>

00000030 <skip>:
30: 00000067 jalr x0 x1 0

```

Ripes  
File Edit Help

Source code

```
1 .data
2 num: .word 4
3 |
4 .text
5 lw t0, num
6 jal ra, factorial
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00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	EX
28:	40730333	sub x6 x6 x7	ID
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	IF
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Ripes  
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24:	026282b3	mul x5 x5 x6	HEM
28:	40730333	sub x6 x6 x7	EX
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	ID
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	IF

Ripes  
File Edit Help

100 1010 01  
CPU  
Processor  
Memory

Source code

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28:	40730333	sub x6 x6 x7	WB
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	EX
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Ripes  
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100 1010 01  
CPU  
Processor  
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Ripes  
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```

Ripes  
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Ripes  
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20:	00728863	beq x5 x7 16 <skip>	
00000024 <loopbody>:			
24:	026282b3	mul x5 x5 x6	MEM
28:	40730333	sub x6 x6 x7	EX
2c:	fe031ce3	bne x6 x0 -8 <loopbody>	ID
00000030 <skip>:			
30:	00000067	jalr x0 x1 0	IF

Ripes  
File Edit Help

Source code

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2c:	fe031ce3	bne x6 x0 -8 <loopbody>	EX
00000030 <skip>:			
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Ripes  
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2c: fe031ce3 bne x6 x0 -8 <loopbody> WD
HEH

00000030 <skip>:
30: 00000067 jalr x0 x1 0 EX

```

Ripes  
File Edit Help

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```



Ripes  
File Edit Help

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00000030 <skip>:			
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Ripes  
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Ripes  
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Ripes  
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c: 00a00093 addi x17 x0 10
10: 00000073 ecall
11:
00000014 <factorial>:
14: 00100393 addi x7 x0 1
18: 00020313 addi x5 x5 0
1c: 40730333 sub x5 x6 x7
20: 00728863 beq x5 x7 16 <skip>
21:
00000024 <loopbody>:
24: 02620203 mul x5 x5 x6
28: 40730333 sub x5 x6 x7
2c: fe031ce3 bne x5 x0 -8 <loopbody>
2d:
00000030 <skip>:
30: 00000067 jalr x0 x1 0
31:

```

## 5 STAGE PROCESSOR STAGES:

Ripes  
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5-Stage RISC-V Processor

Diagram illustrating the 5-Stage RISC-V Processor architecture:

- IFID** (Instruction Fetch): Receives instructions from memory and sends them to the Decode stage.
- Decode**: Decodes the instruction and sends the opcode to the ALU and the immediate value to the Register File.
- Registers**: The Register File stores the values of the registers. It receives the register number from the Decode stage and sends the value to the ALU.
- IDEX** (Instruction Decode): Receives the instruction from the Decode stage and sends the register number to the Register File.
- ALU** (Arithmetic Logic Unit): Performs the arithmetic or logical operation specified by the instruction. It receives the register number from the Register File and the immediate value from the Decode stage.
- EX/MEM** (Execute/Memory): Receives the result from the ALU and sends it to the Data Memory.
- Data Memory**: Stores data and sends it back to the EX/MEM stage.
- MEM/WB** (Memory/Write Back): Receives the result from the Data Memory and sends it back to the Register File.

Registers:

Name	Alias	Value
x0	zero	0x00000000
x1	ra	0x0000000c
x2	sp	0x7ffffff0
x3	gp	0x10000000
x4	tp	0x00000000
<b>x5</b>	<b>t0</b>	<b>0x00000015</b>
x6	t1	0x00000000
x7	t2	0x00000001
x8	s0	0x00000000
x9	s1	0x00000000
x10	a0	0x00000000
x11	a1	0x00000000

Execution info:

- Cycles: 31
- Insts. retired: 19
- CPI: 1.74
- IPC: 0.576
- Clock rate: 9.62 Hz

Console:

```

Program exited with code: 0
Program exited with code: 0

```