RISC V Assembly Programs

Dr. Girish H
Professor
Department of ECE
Cambridge Institute of Technology
&
Kavinesh
Research Staff
CCCIR
Cambridge Institute of Technology

Hello World

```
// Header file for input output functions
#include <stdio.h>

// Main function: entry point for execution
int main() {

    // Writing print statement to print hello world
    printf("Hello World");

    return 0;
}
```

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Hello World

```
.data
msg: .string "Hello, World!\n"

.text
main:
        la a0, msg  # Load address of message
        li a7, 4    # System call for print string
        ecall

        li a7, 10   # System call for exit
        ecall
```

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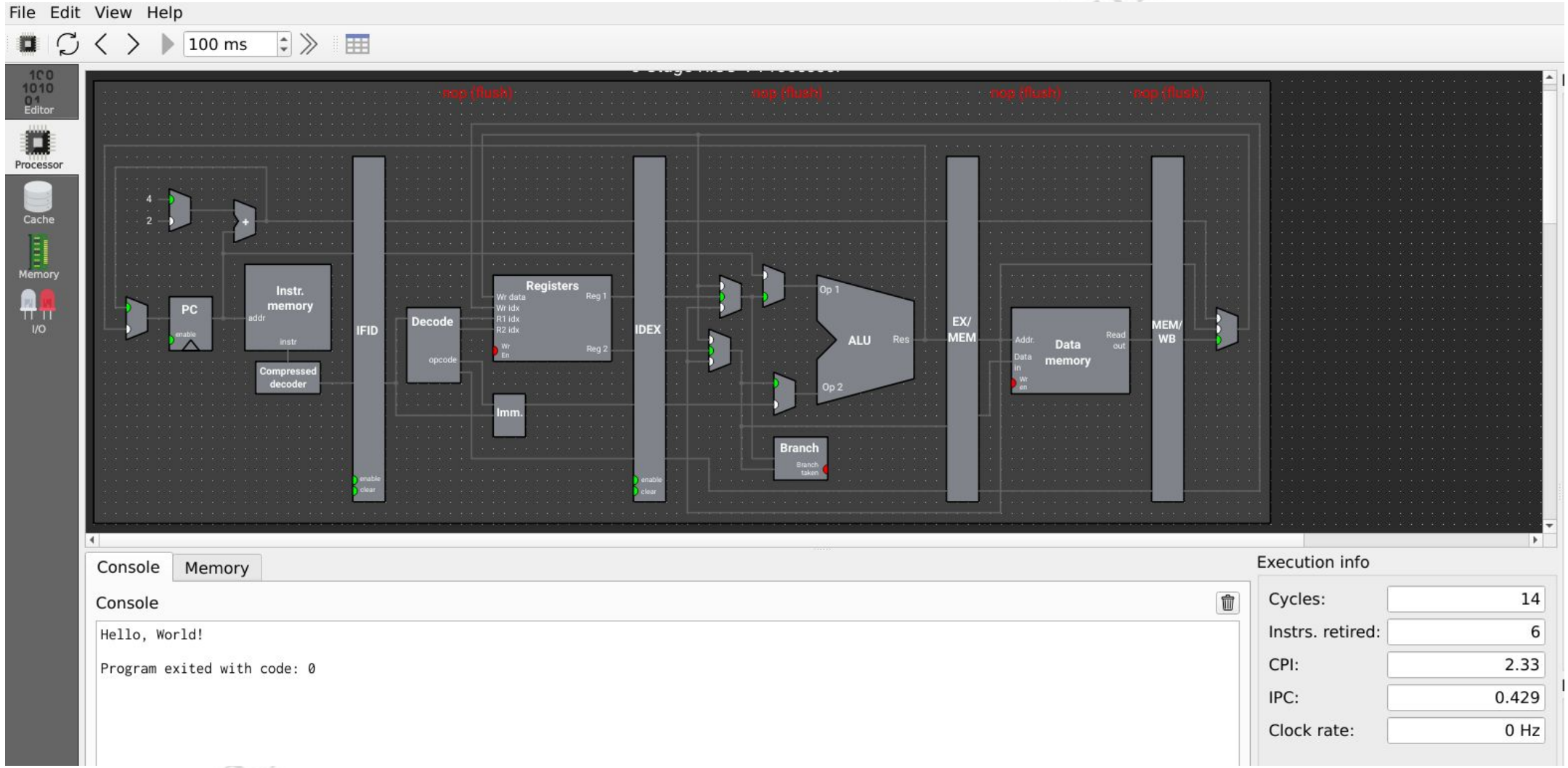
File Edit View Help
100 ms
Editor
Processor
Cache
Memory
I/O
nop (flush)
nop (flush)
nop (flush)
nop (flush)
PC
Instr. memory
Compressed decoder
IFID
Decode
Registers
Imm.
IDEX
ALU
Branch
EX/ MEM
Data memory
MEM/ WB
Console
Memory
Hello, World!
Program exited with code: 0
Execution info
Cycles: 14
Instrs. retired: 6
CPI: 2.33
IPC: 0.429
Clock rate: 0 Hz

Addition of two numbers

```
#include <stdio.h>

int main() {
    int a=10 , b = 20, sum = 0;

    // Calculate the addition of a and b
    // using '+' operator
    sum = a + b;

    printf("Sum: %d", sum);

    return 0;
}
```

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Addition of two numbers

```
.data
num1:  .word  10
num2:  .word  20
str1:  .string "Sum of "
str2:  .string " and "
str3:  .string " is "

.text
main:
        # Load numbers from static data
        lw  a0, num1
        lw  a1, num2
        # Perform addition
        add a2, a0, a1  # a2 = a0 + a1
        # Print the result to console
        mv  a1, a2
        lw  a0, num1
        jal ra, printResult
        # Exit program
        li a7, 10
        ecall

printResult:
        mv t0, a0
        mv t1, a1
        la a0, str1
        li a7, 4
        ecall
        mv a0, t0
        li a7, 1
        ecall
        la a0, str2
        li a7, 4
        ecall
        lw a0, num2
        li a7, 1
        ecall
        la a0, str3
        li a7, 4
        ecall
        mv a0, t1
        li a7, 1
        ecall
        ret
```

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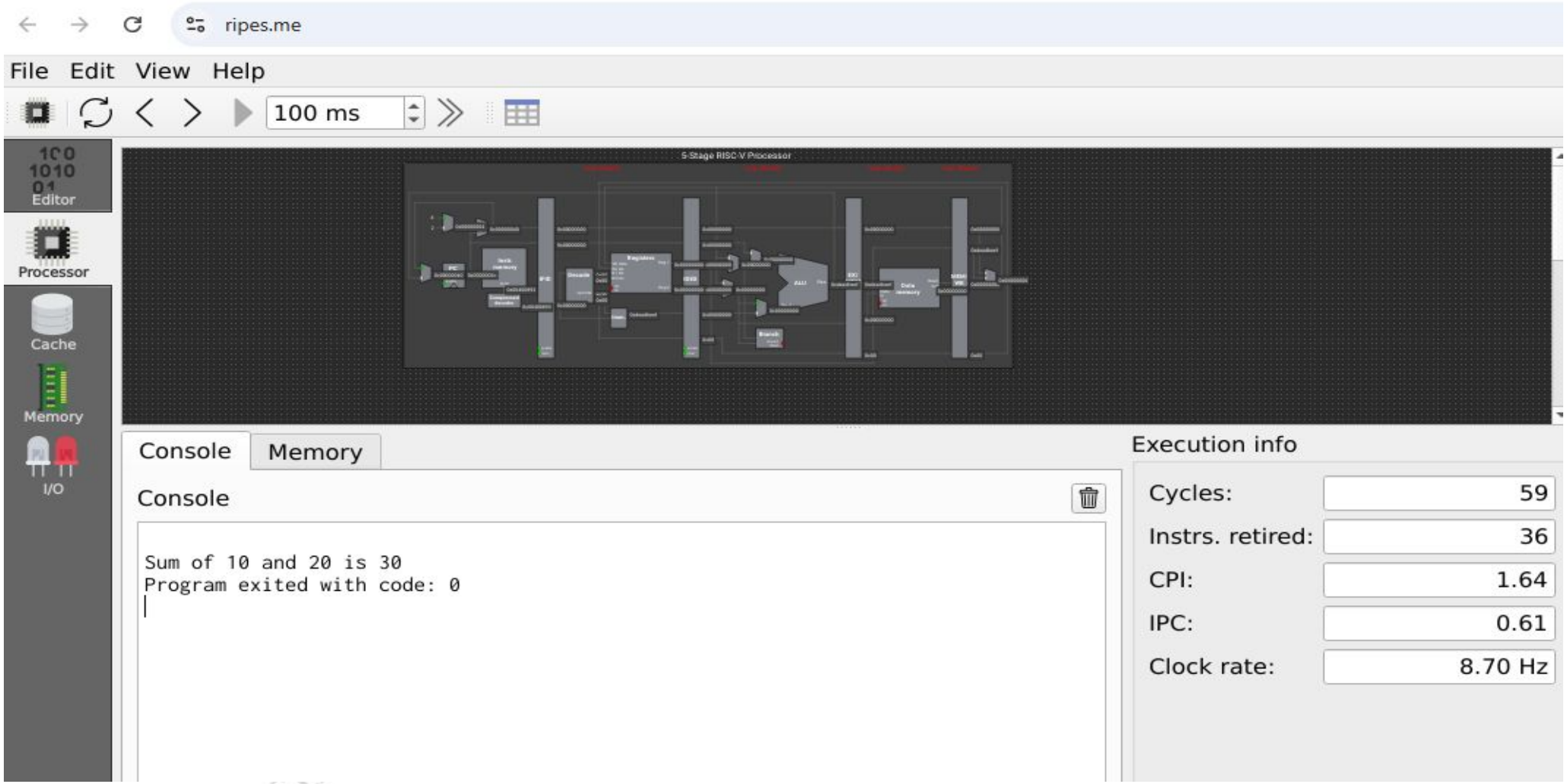
ripes.me
File Edit View Help
100 ms
Editor
Processor
Cache
Memory
I/O
5-Stage RISC-V Processor
Console
Memory
Console
Sum of 10 and 20 is 30
Program exited with code: 0
Execution info
Cycles: 59
Instrs. retired: 36
CPI: 1.64
IPC: 0.61
Clock rate: 8.70 Hz

Subtraction of two numbers

```
#include <stdio.h>

int main() {
    int a=10 , b = 20, sum = 0;

    // Calculate the subtraction of a and b
    // using '-' operator
    difference = a - b;

    printf("Difference: %d", difference);

    return 0;
}
```

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Difference of two numbers

```
.data
num1:  .word  20
num2:  .word  10
str1:  .string "Difference of "
str2:  .string " and "
str3:  .string " is "
.text
main:
        # Load numbers from static data
        lw  a0, num1
        lw  a1, num2
        # Perform subtraction
        sub a2, a0, a1  # a2 = a0 - a1
        # Print the result to console
        mv  a1, a2
        lw  a0, num1
        jal ra, printResult

        # Exit program
        li a7, 10
        ecall
```

```
printResult:
        mv t0, a0
        mv t1, a1
        la a0, str1
        li a7, 4
        ecall
        mv a0, t0
        li a7, 1
        ecall
        la a0, str2
        li a7, 4
        ecall
        lw a0, num2
        li a7, 1
        ecall
        la a0, str3
        li a7, 4
        ecall
        mv a0, t1
        li a7, 1
        ecall
        ret
```

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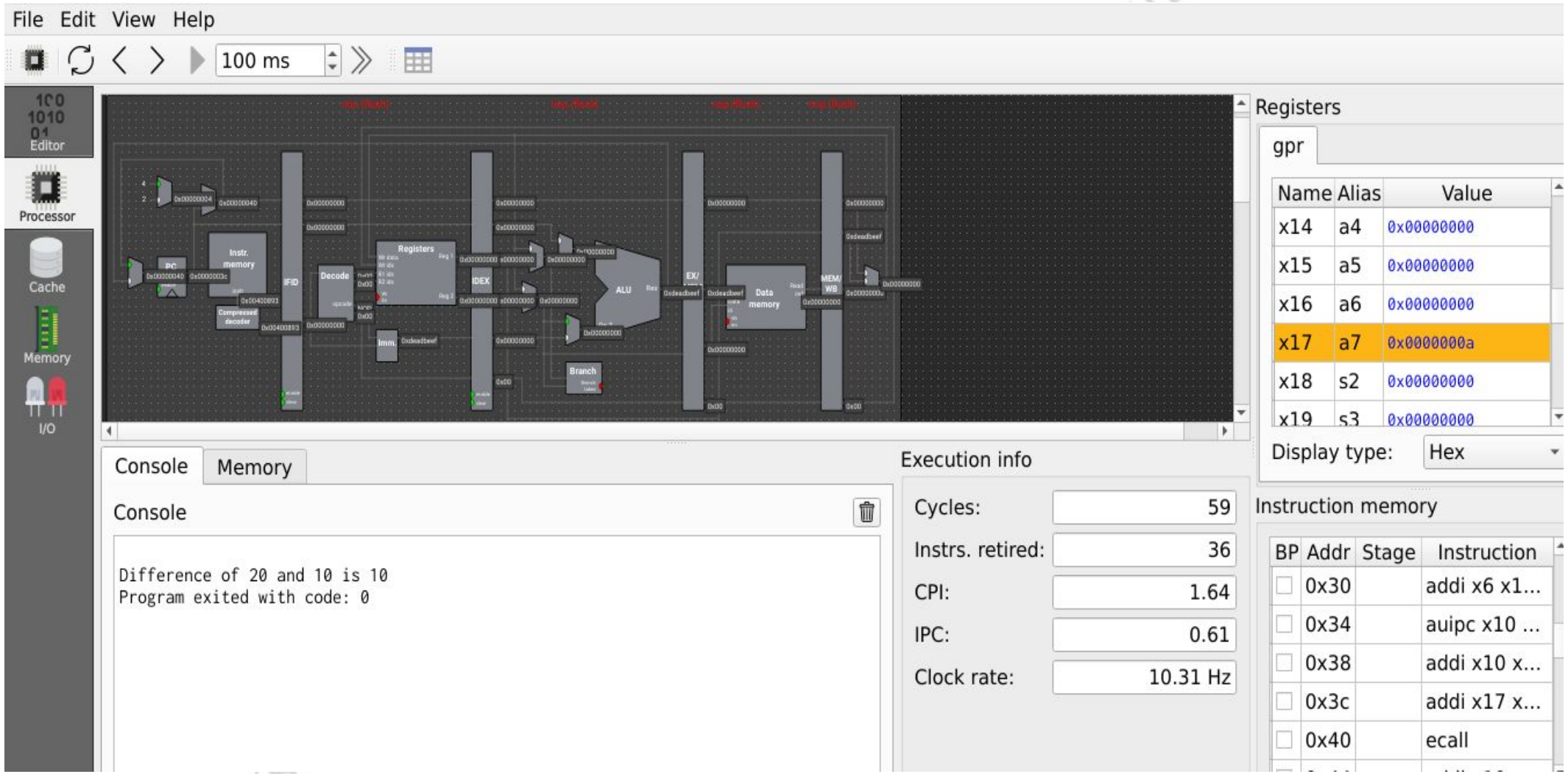
File Edit View Help
100 ms
Editor
Processor
Cache
Memory
I/O
Registers
gpr
Name Alias Value
x14 a4 0x00000000
x15 a5 0x00000000
x16 a6 0x00000000
x17 a7 0x0000000a
x18 s2 0x00000000
Display type: Hex
Console Memory
Console
Difference of 20 and 10 is 10
Program exited with code: 0
Execution info
Cycles: 59
Instrs. retired: 36
CPI: 1.64
IPC: 0.61
Clock rate: 10.31 Hz
Instruction memory
BP Addr Stage Instruction
0x30 addi x6 x1...
0x34 auipc x10 ...
0x38 addi x10 x...
0x3c addi x17 x...
0x40 ecall

Multiplication of two numbers

```
#include <stdio.h>

int main() {
    int a=10 , b = 20, sum = 0;

    // Calculate the multiplication of a and b
    // using '*' operator
    product = a * b;

    printf("product: %d", product);

    return 0;
}
```

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Multiplication of two numbers

```
.data
num1:  .word  20
num2:  .word  10
str1:  .string "Product of "
str2:  .string " and "
str3:  .string " is "
.text
main:
        # Load numbers from static data
        lw  a0, num1
        lw  a1, num2

        # Perform multiplication
        mul a2, a0, a1  # a2 = a0 * a1
        # Print the result to console
        mv  a1, a2
        lw  a0, num1
        jal ra, printResult
        # Exit program
        li a7, 10
        ecall
printResult:
        mv t0, a0
        mv t1, a1
        la a0, str1
        li a7, 4
        ecall
        mv a0, t0
        li a7, 1
        ecall
        la a0, str2
        li a7, 4
        ecall
        lw a0, num2
        li a7, 1
        ecall
        la a0, str3
        li a7, 4
        ecall
        mv a0, t1
        li a7, 1
        ecall
        ret
```

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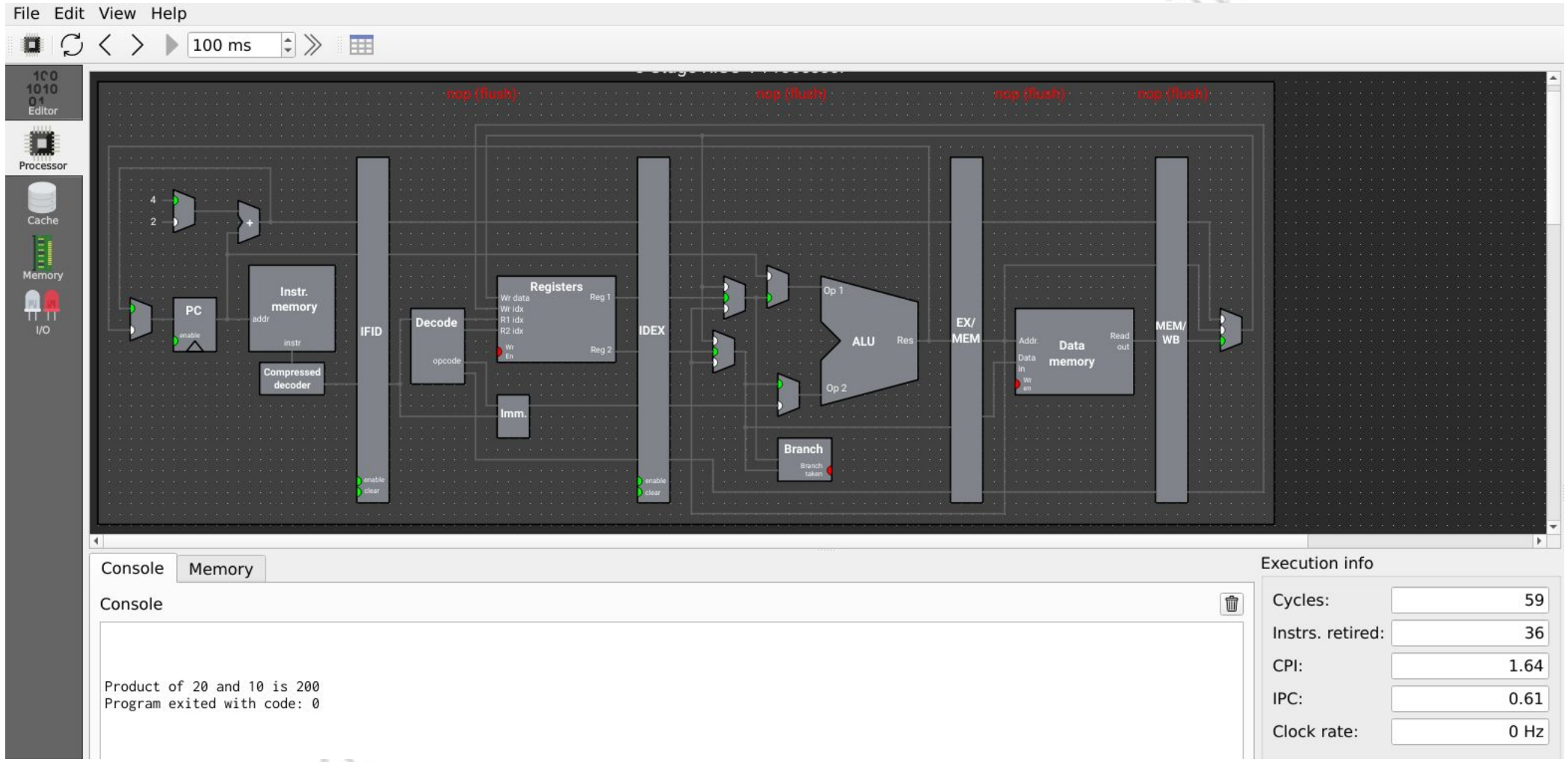
File Edit View Help
100 ms
Editor
Processor
Cache
Memory
I/O
nop (flush)
nop (flush)
nop (flush)
nop (flush)
PC
Instr. memory
Compressed decoder
IFID
Decode
Registers
Imm.
IDEX
ALU
Branch
EX/ MEM
Data memory
MEM/ WB
Console
Memory
Console
Product of 20 and 10 is 200
Program exited with code: 0
Execution info
Cycles: 59
Instrs. retired: 36
CPI: 1.64
IPC: 0.61
Clock rate: 0 Hz

Division of two numbers

```
#include <stdio.h>

int main() {
    int a=10 , b = 20, sum = 0;

    // Calculate the division of a and b
    // using '/' operator
    quotient = a / b;

    printf("quotient: %d", quotient);

    return 0;
}
```

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Division of two numbers

```
.data
num1:  .word  20
num2:  .word  10
str1:  .string "Quotient of "
str2:  .string " and "
str3:  .string " is "
.text
main:
        # Load numbers from static data
        lw  a0, num1
        lw  a1, num2
        # Perform division
        div a2, a0, a1  # a2 = a0 / a1
        # Print the result to console
        mv  a1, a2
        lw  a0, num1
        jal ra, printResult

        # Exit program
        li a7, 10
        ecall
```

```
printResult:
        mv t0, a0
        mv t1, a1
        la a0, str1
        li a7, 4
        ecall
        mv a0, t0
        li a7, 1
        ecall
        la a0, str2
        li a7, 4
        ecall
        lw a0, num2
        li a7, 1
        ecall
        la a0, str3
        li a7, 4
        ecall
        mv a0, t1
        li a7, 1
        ecall
        ret
```

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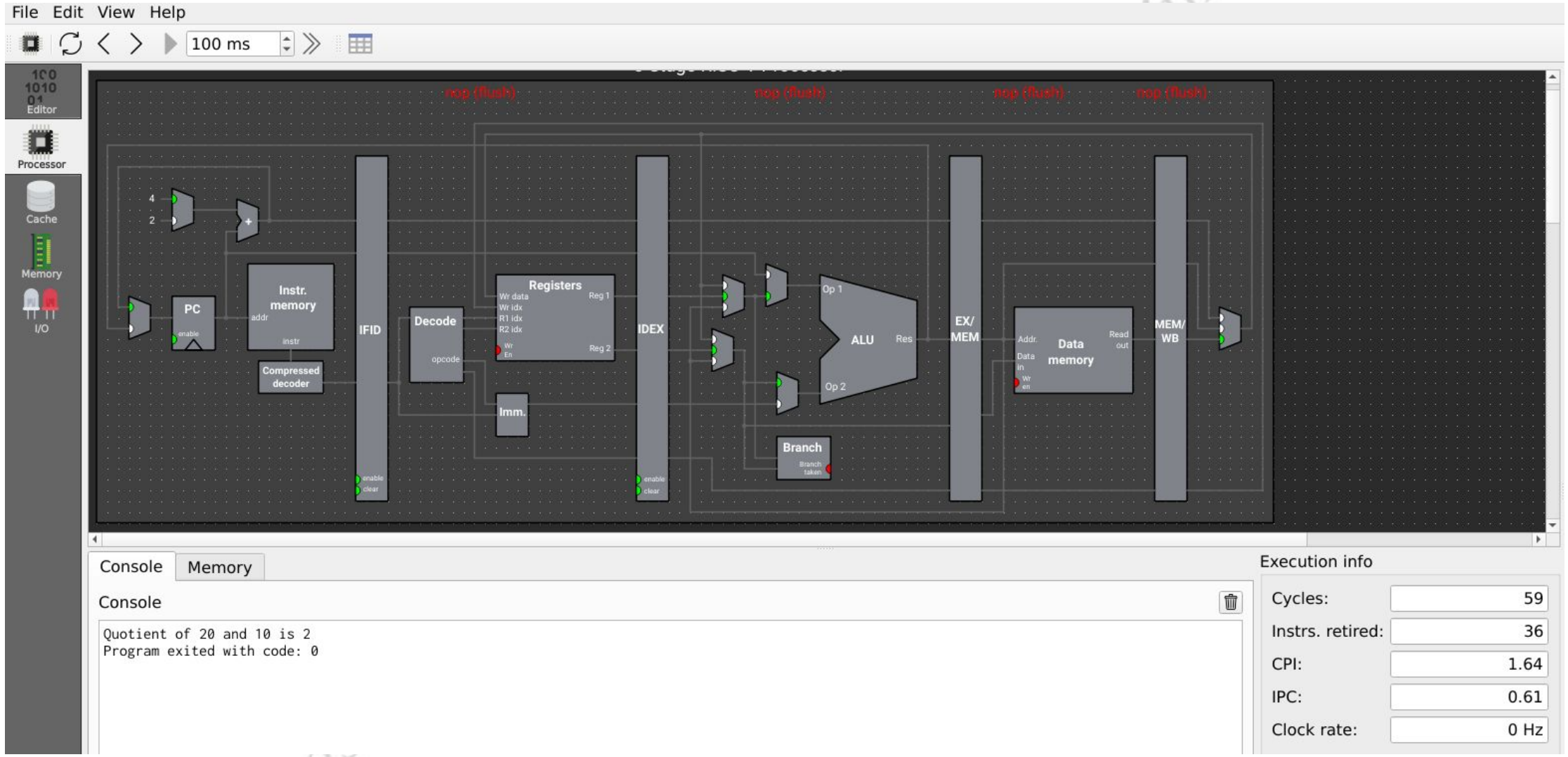

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CAMBRIDGE INSTITUTE OF TECHNOLOGY An Autonomous Institution
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Program to Find the Factorial Using Recursion

```
#include <stdio.h>
unsigned int factorial(unsigned int n) {
    // Base Case:
    if (n == 1) {
    return 1;
    }
    // Multiplying the current N with the previous product
    // of Ns
    return n * factorial(n - 1);
}
int main() {
    int num = 5;
    printf("Factorial of %d is %d", num, factorial(num));
    return 0;
}
```

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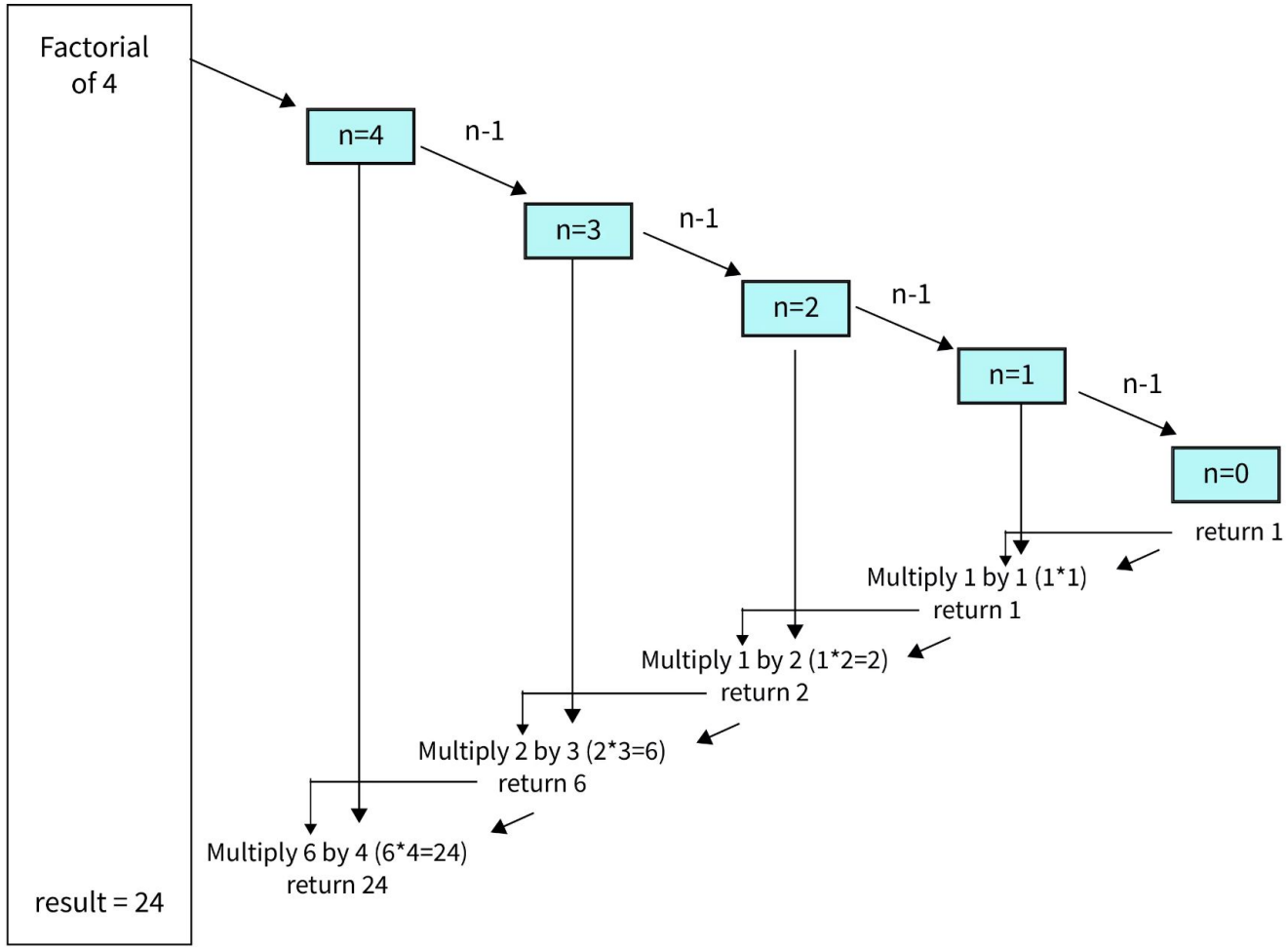

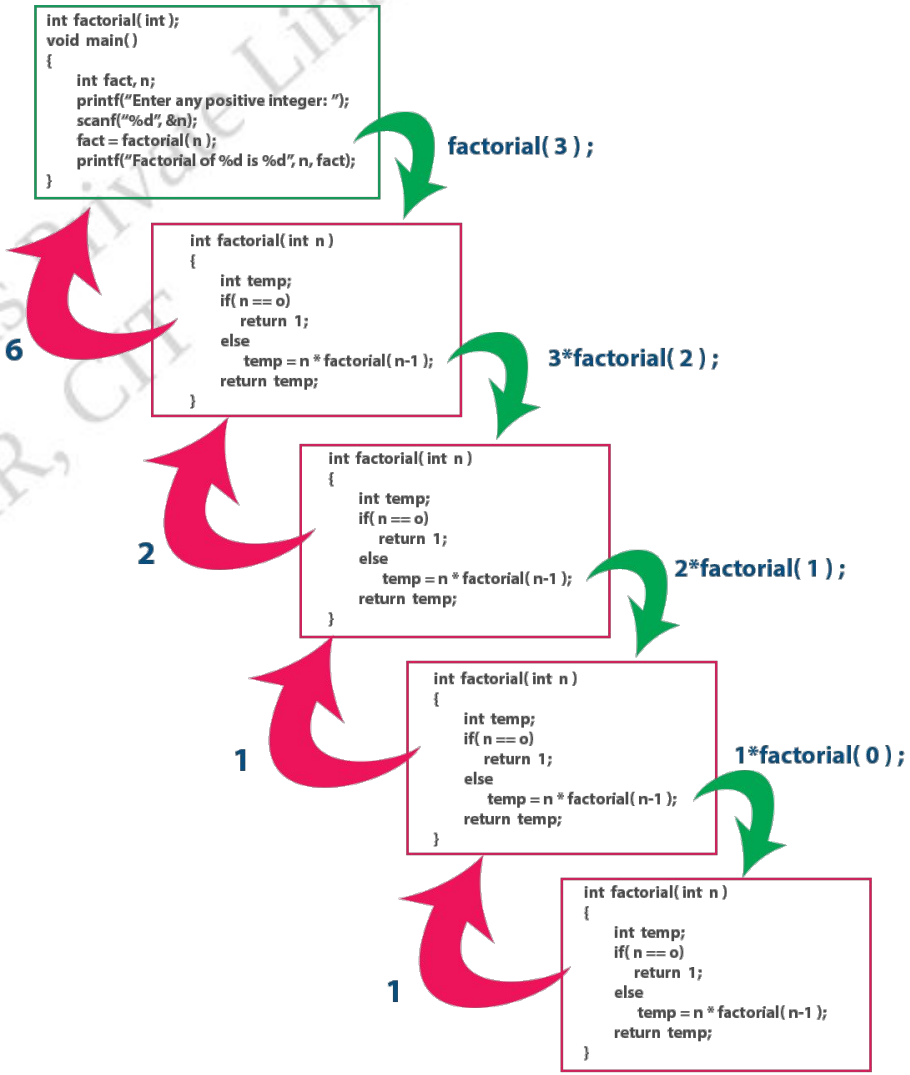

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Chips to Startup Programme

Factorial of a number with recursion

```
.data
num:   .word  5
str1:  .string "Factorial of "
str2:  .string " is "
.text
main:
        lw a0, num
        jal ra, factorial
        mv a1, a0
        j printResult
factorial:
        addi sp, sp, -8
        sw ra, 4(sp)
        sw a0, 0(sp)
        li t0, 1
        beq a0, t0, base_case  # If a0 == 1, return 1
        addi a0, a0, -1
        jal ra, factorial  # Recursive call
        lw a1, 0(sp)
        mul a0, a0, a1
base_case:
        lw ra, 4(sp)
        addi sp, sp, 8
        ret
printResult:
        la a0, str1
        li a7, 4
        ecall
        lw a0, num
        li a7, 1
        ecall
        la a0, str2
        li a7, 4
        ecall
        mv a0, a1
        li a7, 1
        ecall
        li a7, 10
        ecall
```

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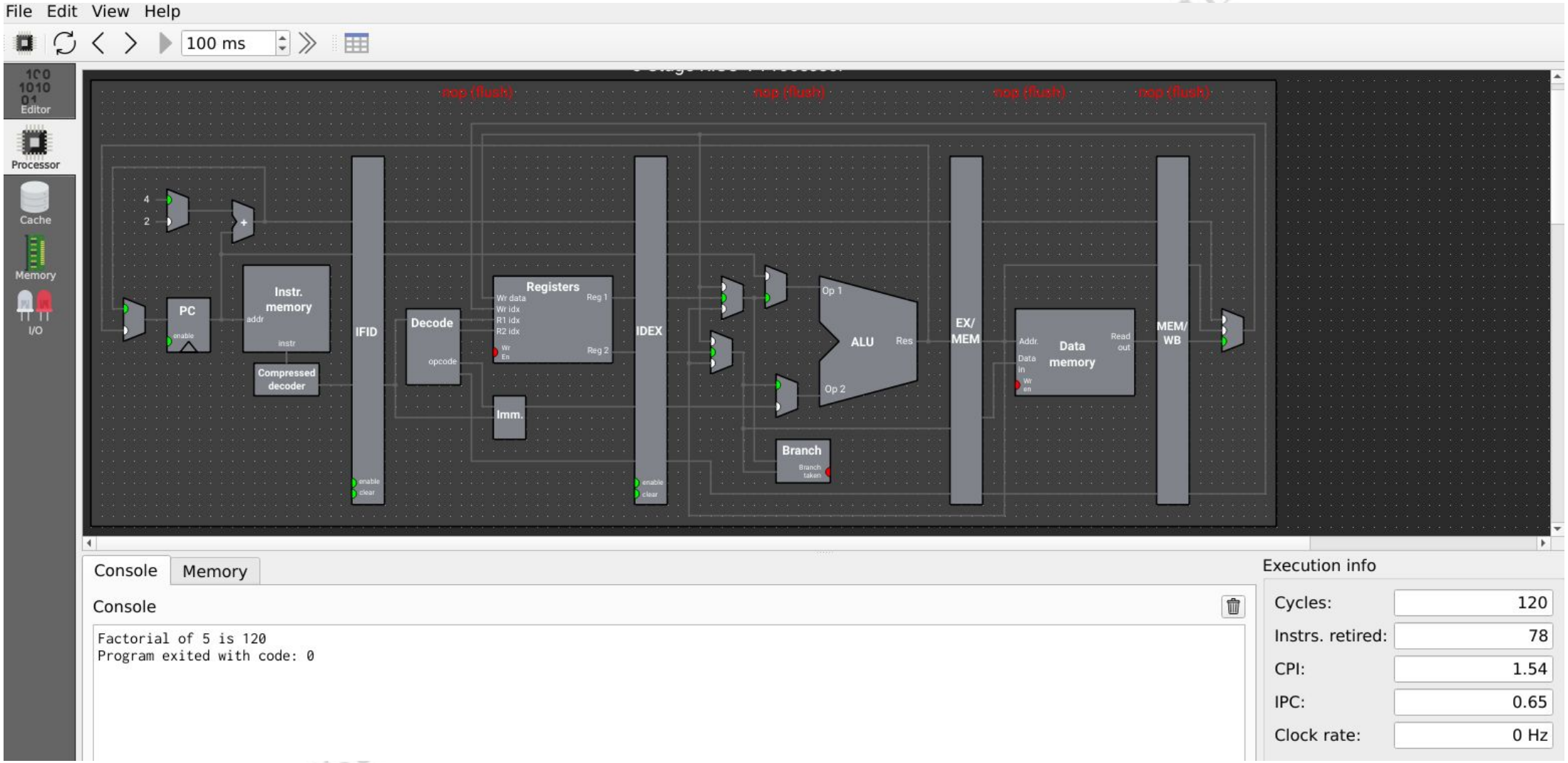
File Edit View Help
100 ms
Editor
Processor
Cache
Memory
I/O
nop (flush)
nop (flush)
nop (flush)
nop (flush)
PC
Instr. memory
Compressed decoder
IFID
Decode
Registers
Imm.
IDEX
ALU
Branch
EX/ MEM
Data memory
MEM/ WB
Console
Memory
Console
Factorial of 5 is 120
Program exited with code: 0
Execution info
Cycles: 120
Instrs. retired: 78
CPI: 1.54
IPC: 0.65
Clock rate: 0 Hz

Program to Find the Factorial without Recursion

```
#include <stdio.h>
unsigned int factorial(unsigned int N) {
    int fact = 1, i;
    // Loop from 1 to N to get the factorial
    for (i = 1; i <= N; i++) {
    fact *= i;
    }
    return fact;
}
int main() {
    int N = 5;
    int fact = factorial(N);
    printf("Factorial of %d is %d", N, fact);
    return 0;
}
```

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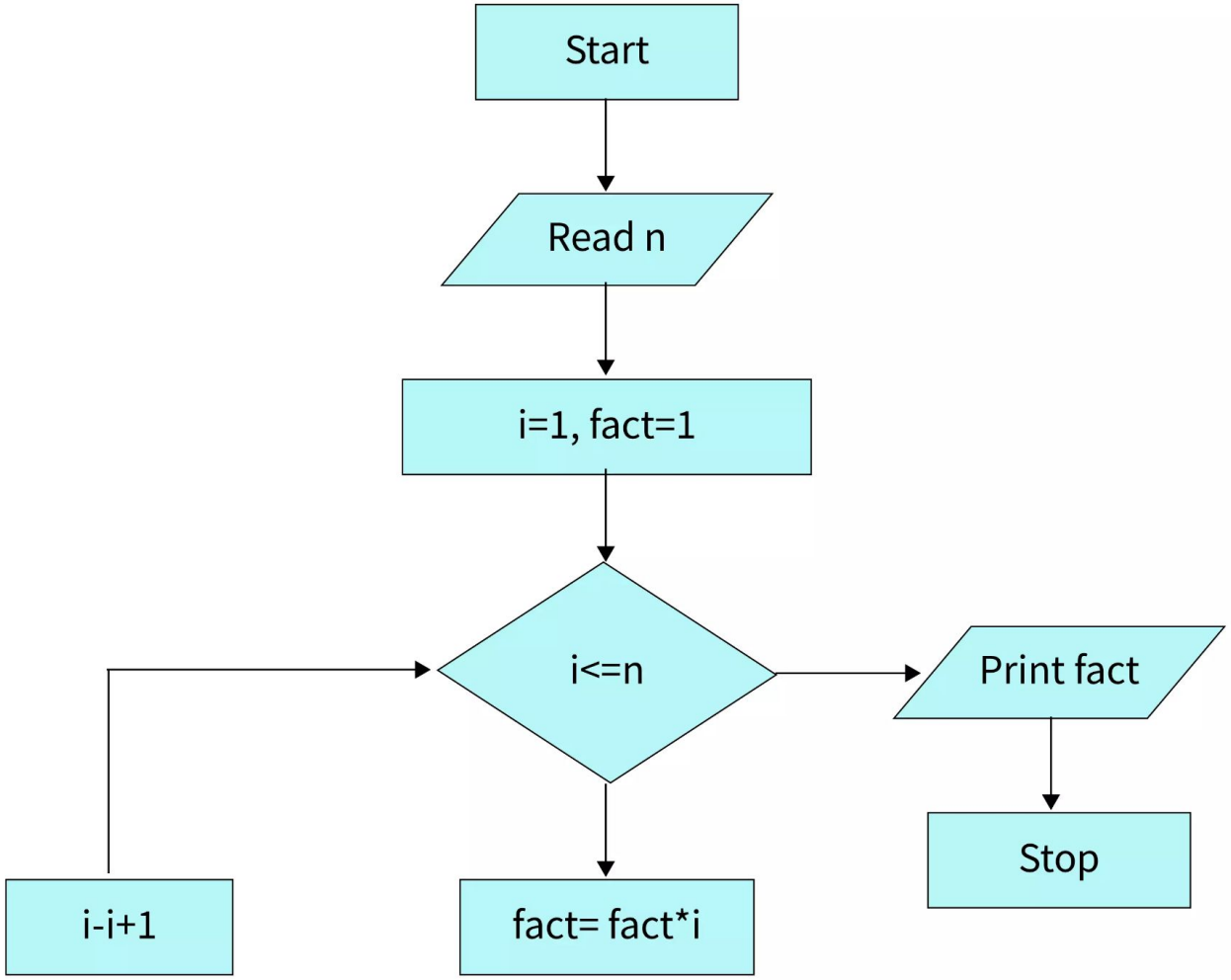
Start
Read n
i=1, fact=1
i<=n
Print fact
Stop
fact= fact*i
i-i+1

Factorial of a number without recursion

```
.data
num:   .word  5
str1:  .string "Factorial of "
str2:  .string " is "

.text
main:
        # Load number from static data
        lw  a0, num
        li  a1, 1  # Initialize factorial result to 1

        # Compute factorial iteratively
loop:
        beqz a0, printResult  # If a0 == 0, go
to printResult

        mul a1, a1, a0  # a1 = a1 * a0
        addi a0, a0, -1  # a0 = a0 - 1
        j loop
```

```
# --- printResult ---
# a1: Computed factorial
printResult:
        la a0, str1
        li a7, 4
        ecall
        lw a0, num
        li a7, 1
        ecall
        la a0, str2
        li a7, 4
        ecall
        mv a0, a1
        li a7, 1
        ecall
        li a7, 10
        ecall
```

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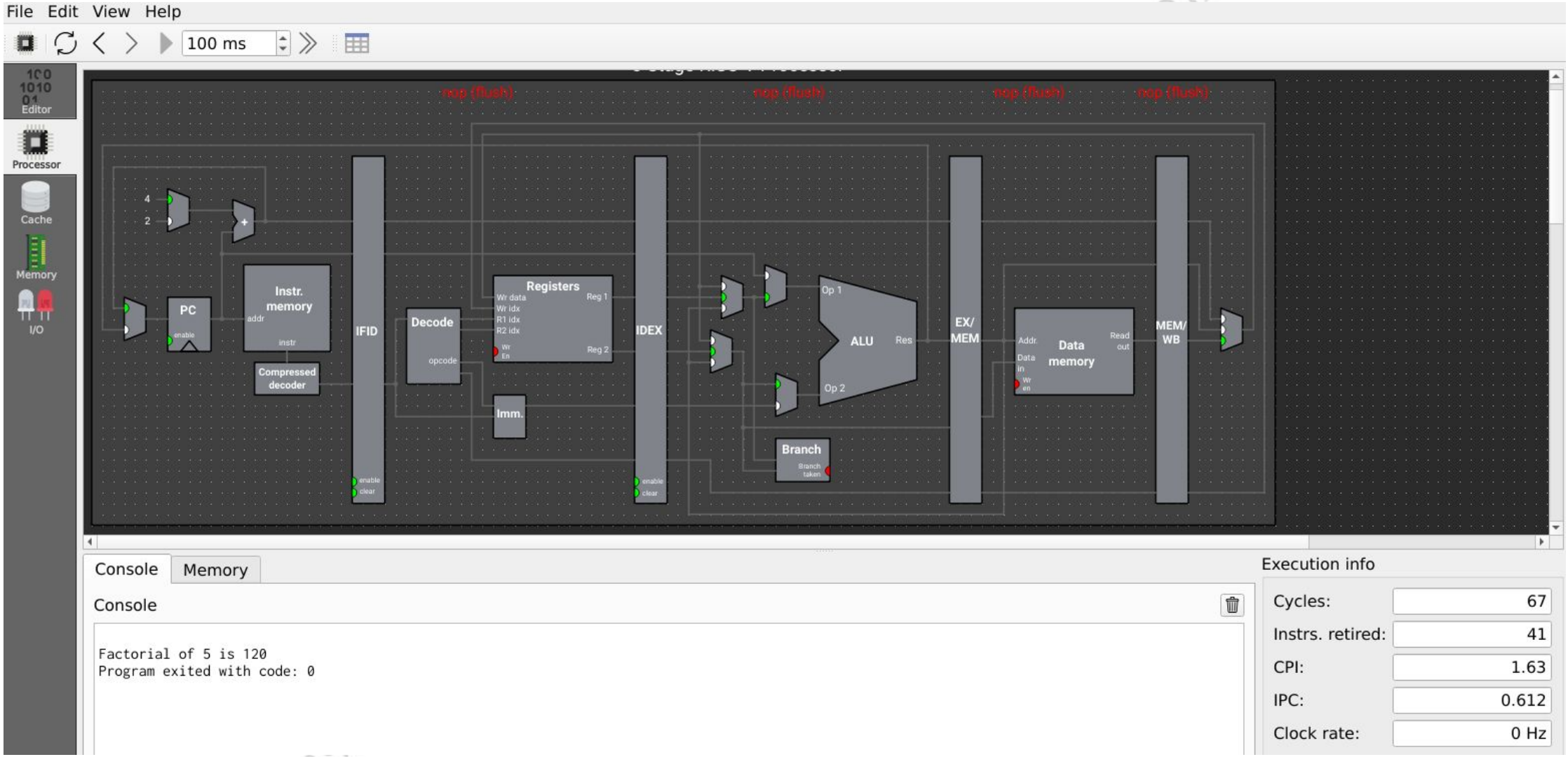
File Edit View Help
100 ms
Editor
Processor
Cache
Memory
I/O
nop (flush)
nop (flush)
nop (flush)
nop (flush)
PC
Instr. memory
Compressed decoder
IFID
Decode
Registers
Imm.
IDEX
ALU
Branch
EX/ MEM
Data memory
MEM/ WB
Console
Memory
Console
Factorial of 5 is 120
Program exited with code: 0
Execution info
Cycles: 67
Instrs. retired: 41
CPI: 1.63
IPC: 0.612
Clock rate: 0 Hz

Program to Find the Fibonacci with Recursion

```
#include <stdio.h>
void calculateFibonacci(int n, int firstTerm, int
secondTerm) {
if (n < 3) {
return;
}
 // Calculate the next Fibonacci term
int nextTerm = firstTerm + secondTerm;
printf("%d ", nextTerm);  // Print the current term
// Recursive call with updated terms for the next iteration
calculateFibonacci(n - 1, secondTerm, nextTerm);
}
// Function to handle the first two terms and call the
recursive function
void printFibonacci(int n) {
// Handle edge cases for invalid input
if (n < 1) {
printf("Invalid input: Number of terms should be greater
than or equal to 1\n");
return;
}
// Handle the case when only one term is requested
if (n == 1) {
printf("0 ");
return;
}// Handle the case when two terms are requested
if (n == 2) {
printf("0 1 ");
return;
}
// Print the first two terms and then call the recursive
function for the rest
printf("0 1 ");
calculateFibonacci(n, 0, 1);  // Start the recursive calculation
}
int main() {
int n = 9;  // Set the number of terms in the Fibonacci series
printFibonacci(n);  // Print the Fibonacci series up to the nth
term
return 0;
}
```

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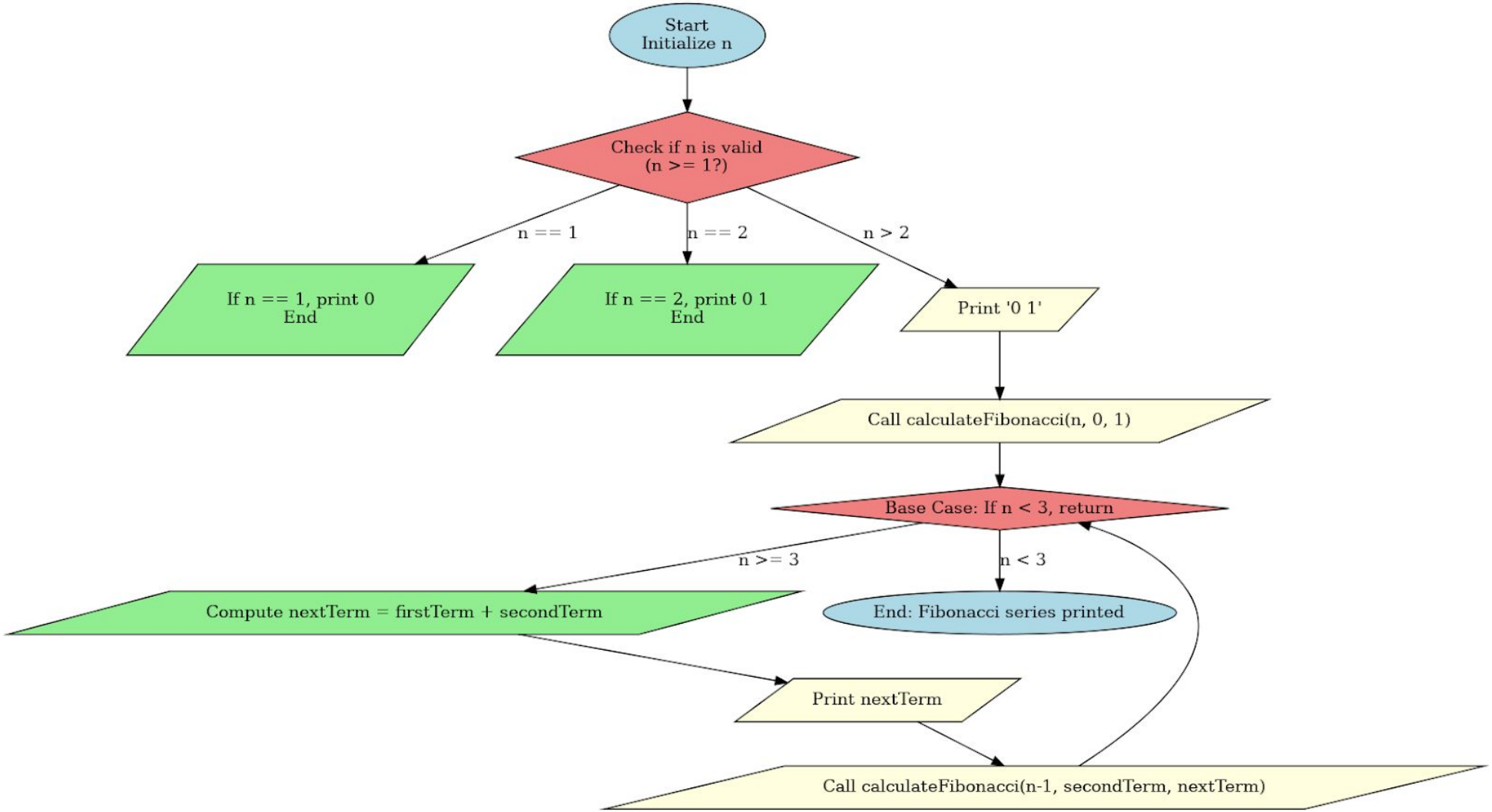
Start
Initialize n
Check if n is valid
(n >= 1?)
n == 1
n == 2
n > 2
If n == 1, print 0
End
If n == 2, print 0 1
End
Print '0 1'
Call calculateFibonacci(n, 0, 1)
Base Case: If n < 3, return
n >= 3
n < 3
Compute nextTerm = firstTerm + secondTerm
End: Fibonacci series printed
Print nextTerm
Call calculateFibonacci(n-1, secondTerm, nextTerm)

Fibonacci series with recursion

```
.data
num:   .word  5
str1:  .string "Fibonacci series up to "
str2:  .string " terms: "
space: .string " "
.text
main:
        lw a0, num
        li a1, 0   # First term
        li a2, 1   # Second term
        li a3, 0   # Counter
        jal ra, fibonacci_series
        li a7, 10  # Exit
        ecall
# --- Recursive Fibonacci Series ---
fibonacci_series:
        addi sp, sp, -12
        sw ra, 8(sp)
        sw a0, 4(sp)
        sw a3, 0(sp)
        lw t0, num
        bge a3, t0, end_recursion  # If counter >= num, return
        mv a0, a1
        li a7, 1  # Print Fibonacci number
        ecall
        la a0, space
        li a7, 4  # Print space
        ecall
        mv t1, a1
        mv a1, a2
        add a2, a2, t1
        addi a3, a3, 1
        jal ra, fibonacci_series
end_recursion:
        lw ra, 8(sp)
        lw a0, 4(sp)
        lw a3, 0(sp)
        addi sp, sp, 12
        ret
```

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Program to Find the Fibonacci without Recursion

```
#include <stdio.h>
int main() {
int n, t1 = 0, t2 = 1, nextTerm;
                                        // Get the number of terms from the user
printf("Enter the number of terms: ");
scanf("%d", &n);
printf("Fibonacci Series: ");
for (int i = 1; i <= n; i++) {
printf("%d ", t1);
nextTerm = t1 + t2;                     // Compute the next term
t1 = t2; // Update previous term
t2 = nextTerm;                          // Move to the next term
}
return 0;
}
```

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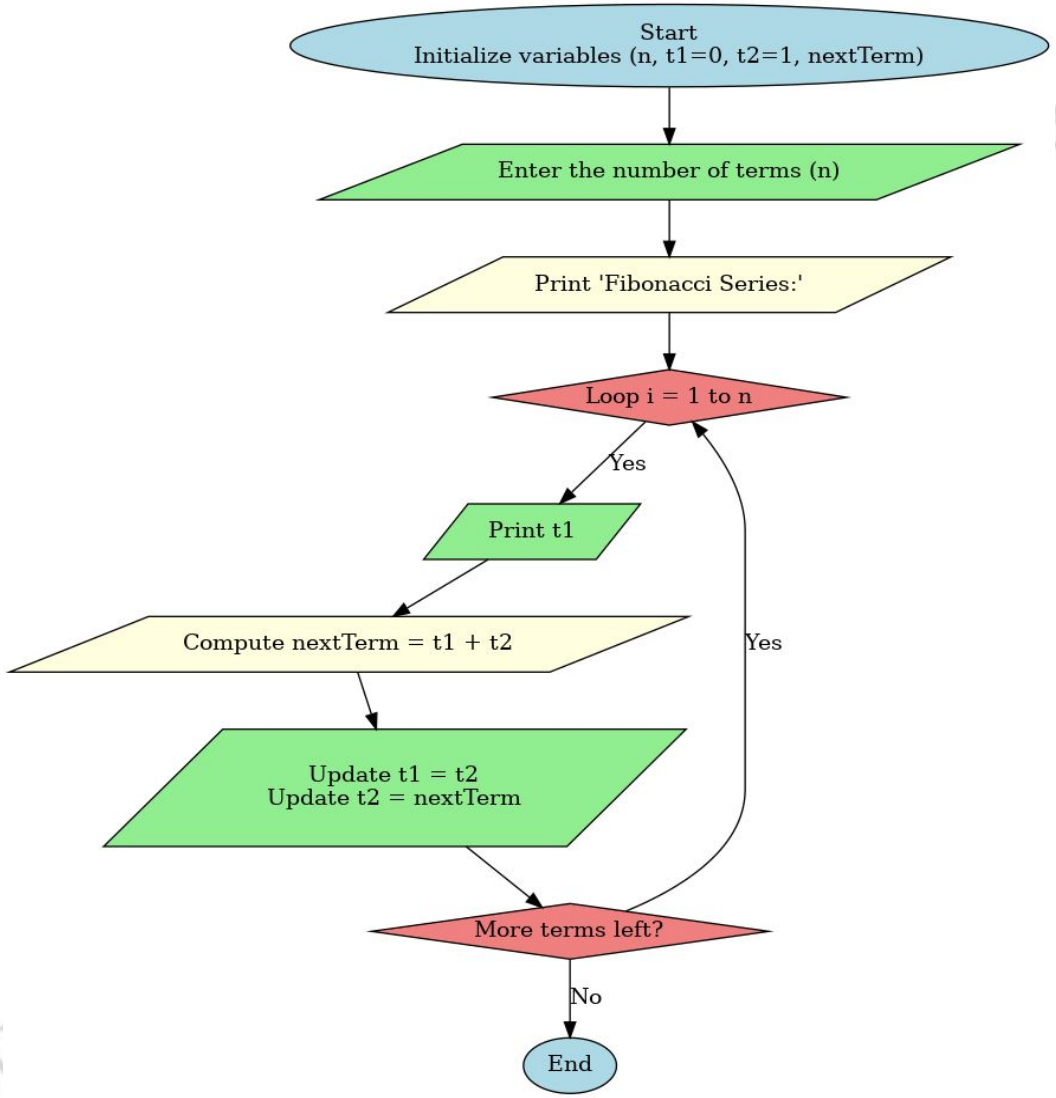
Start
Initialize variables (n, t1=0, t2=1, nextTerm)
Enter the number of terms (n)
Print 'Fibonacci Series:'
Loop i = 1 to n
Yes
Print t1
Compute nextTerm = t1 + t2
Update t1 = t2
Update t2 = nextTerm
Yes
More terms left?
No
End

Fibonacci series without recursion

```
.data
num:   .word  5
str1:  .string "Fibonacci series up to "
str2:  .string " terms: "
space: .string " "
.text
main:
        lw a0, num
        li a1, 0   # First term
        li a2, 1   # Second term
        li a3, 2   # Counter(first two terms are known)
        j print_first_two
loop:
        add a4, a1, a2   # Compute next Fibonacci number
        mv a1, a2        # Update previous terms
        mv a2, a4
        mv a0, a4
        li a7, 1         # Print integer
        ecall
        la a0, space
        li a7, 4         # Print space
        ecall
        addi a3, a3, 1
        lw t0, num
        bge a3, t0, exit # If counter >= num,
exit loop
        j loop
print_first_two:
        mv a0, a1
        li a7, 1         # Print first term
        ecall
        la a0, space
        li a7, 4         # Print space
        ecall
        mv a0, a2
        li a7, 1         # Print second term
        ecall
        la a0, space
        li a7, 4         # Print space
        ecall
        j loop
exit:
        li a7, 10
        ecall
```

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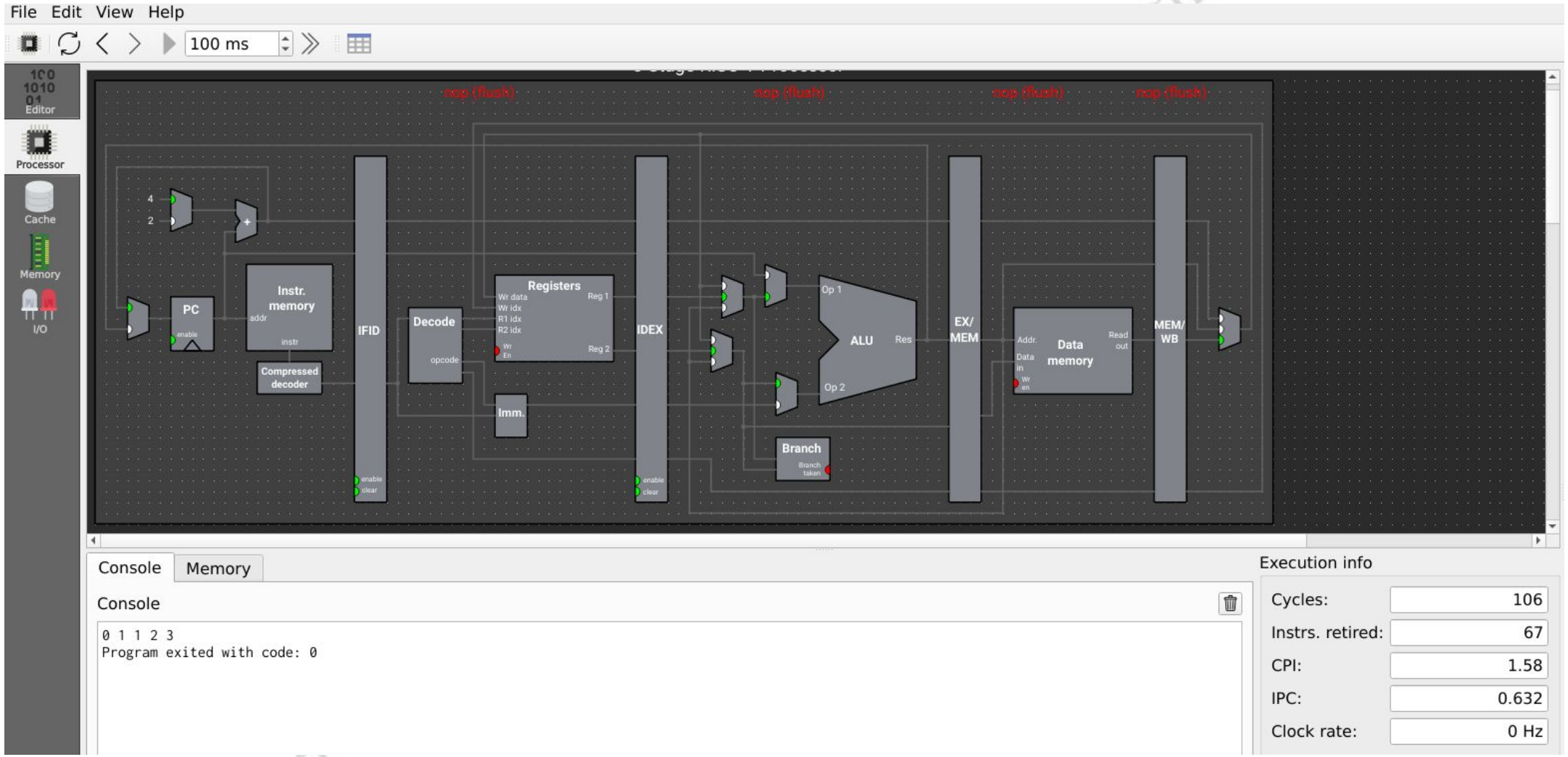
File Edit View Help
100 ms
Editor
Processor
Cache
Memory
I/O
nop (flush)
nop (flush)
nop (flush)
nop (flush)
4
2
PC
enable
Instr. memory
addr
instr
Compressed decoder
IFID
enable
clear
Decode
opcode
Registers
Wr data
Wr idx
R1 idx
R2 idx
Wr En
Reg 1
Reg 2
Imm.
IDEX
enable
clear
Op 1
ALU
Res
Op 2
Branch
Branch taken
EX/ MEM
Addr.
Data in
Wr en
Data memory
Read out
MEM/ WB
Console
Memory
Console
0 1 1 2 3
Program exited with code: 0
Execution info
Cycles: 106
Instrs. retired: 67
CPI: 1.58
IPC: 0.632
Clock rate: 0 Hz

Thank you

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