# 03 Condition Codes, Jumps, Function Calls

# Register Numbers assigned

Registers	r0	r1	r2	r3	r4	r5	r6	r7
Reg_Num	0x0	0x1	0x2	0x3	0x4	0x5	0x6	0x7

Registers	r8	r9	r10	r11	r12	r13	r14	r15
Reg_Num	0x8	0x9	0xA	0xB	0xC	0xD	0xE	0xF

# **Instruction Opcodes**

Operation	Load	Store	Add	Sub	Mult	Division	Modulo	Load Imm
Instruction	lw	sw	add	sub	mul	div	mod	lw
Opcode	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07

Operation	Move	Load EA	Push	Pop	Set Less Than	Jump	Jump Reg	Branch If Eq
Instruction	mov	lea	push	рор	slt	jmp	jr	beq
Opcode	0x08	0x09	0x0A	0x0B	0x0C	0x0D	0x0E	0x0F

	Branch If	
Operation	N.Eq	Invalid
Instruction	bne	Х
Opcode	0x10	0xFF

## Instruction Format

# 1. lea reg1,regb,regi, S,D

e.g. lea r5, r4,r1,1,4

"lea" is Load Effective Address which will load the memory address in the destination register where

Reg1: Destination Register

Regb: Base register Regi: Index Register

S: Scaling Factor
D: Offset to be added

Reg1= [Regb+Regi\*S+D]

### 2. beq reg1,reg2,label

e.g. beq r1,r2,lb0

The "beq" is Branch Equal Instruction which compares the 2 register values and if they are equal then jumps to label given. The beq instruction finds the difference between reg1 and reg2 to find equality. If difference is zero then the values are equal otherwise not equal

Reg1: Register1Reg2: Register2

• Label: label to jump to

#### 3. bne reg1,reg2,label

e.g. bne r1,r2,lb0

The "bne" is Branch Not Equal Instruction which compares the 2 register values and if they are not equal then jumps to label given. The bne instruction finds the difference between reg1 and reg2 to find non-equality. If difference is zero then the values are equal otherwise not equal.

Reg1: Register1Reg2: Register2

• Label: label to jump to

#### 4. slt reg1,reg2,reg3

e.g. slt r1,r2,r3

The "slt" instruction is known as Set Less Than. The instruction will compare 2 register values and if second register value is less than third register value then it will store 1 in the destination register otherwise 0 is set in the destination register.

• Reg1: Destination Register which is set to 0 or 1

• Reg2: First Register to be compared

• Reg3: Second Register to be compared

### 5. jmp label

e.g. jmp lb0

"jmp" Instruction jumps to the assigned label name. Prior to jumping it checks at which point the label resides. The labels are given the instruction pointer value during which time it appears in the code such as

lb0: add r1,r2

• Label: label address to which the jump should be forwarded.

#### 6. jr reg1

e.g. jr r13

"jr" Instruction jumps to the assigned register memory address. Prior to jumping it checks at which point the register resides.

• Reg1: Register address to jump to

#### 7. push reg1

e.g. push r11

Push instruction pushes the register value at that point of time into the stack.

• Reg1: Register number to push into the stack.

### 8. pop reg1

e.g. pop r12

Pop instruction pops the latest value in stack to the register address.

• Reg1: Register number where stack value is popped.

# Flags

A 16-bit flag register has lower 4 bits defined as follows:

- 0<sup>th</sup> bit as Zero flag: Is set whenever the result of any ALU operation is zero.
- 1<sup>st</sup> bit as Sign Flag: A sign flag is set whenever the result is negative.
- 2<sup>nd</sup> bit as Overflow flag: A overflow is set whenever the result goes out of range or the answer is negative as we are dealing with unsigned numbers.
- 3<sup>rd</sup> bit as Carry flag: A carry flag is set whenever the addition is out of range Examples:

```
Memory loaded with initial values.
Registers loaded with initial values.
Press Enter Key to Continue...
Enter an instruction number 1. Input 2. Display 3. Exit
Load or Store Instruction can be of the format-lw/sw/lea reg,reg,reg,S,D
Load Immediate can be of the format- lw reg,$immediate
Arithmetic/Move Instruction can be of the format- add/sub/mul/div/mod/mov reg,reg
Jump Instruction can be of the format- jmp lbl_name
Jump Register Instruction can be of the format- jr reg
Stack Operation's Instruction can be of the format- push/pop reg
Set Less than Operation Instruction can be of the format- slt reg,reg,reg
Branch Operation's Instruction can be of the format- beq/bne reg,reg,lbl_name
Please find the acceptable range values:
       Reg: r0-r15
S:1,2,4,8
        D:0,1,2,3,4
Enter 'End' to start execution
Program Loaded
```

#### **Examples:**

# Zero flag:

 Mod operation lw r0,\$4294967295 lw r1,\$144 lw r2,\$2 lw r3,\$2 mod r1,r2 End

**Output:** The zero flag is set since the result is zero

```
The register values are as follows:

r0:0x0 r1:0x0 r2:0x2 r3:0x2 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0x98r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff

The flag value is:0x0001

The instruction pointer value is:0x000000098

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

2. Beq operation: lw r0,\$4294967295

lw r1,\$144 lw r2,\$2 lw r3,\$2 beq r3,r2,lb1 lb1:End

**Output:** The zero flag is set since beg operation results in zero.

3. Division operation

lw r0,\$4294967295

lw r1,\$144

lw r2,\$0

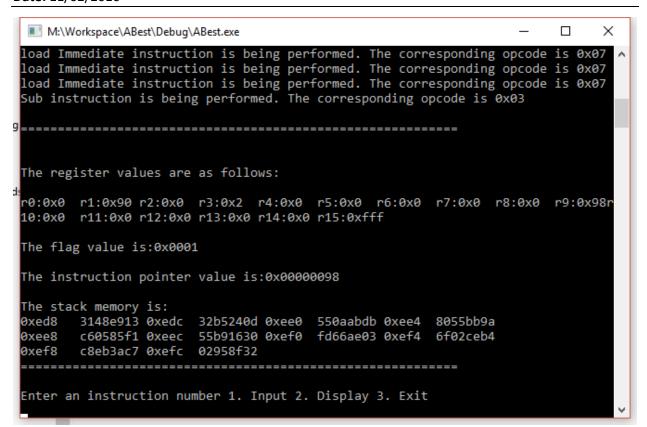
lw r3,\$2

div r2,r1,lb1

lb1:End

```
\Box
                                                                                         ×
M:\Workspace\ABest\Debug\ABest.exe
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
DIV instruction is being performed. The corresponding opcode is 0x05
divisor greater than dividend
 _____
The register values are as follows:
r0:0x0
        r1:0x90 r2:0x2 r3:0x0 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0x98r
10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff
The flag value is:0x0001
The instruction pointer value is:0x00000098
The stack memory is:
       3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
        c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
8ee8
        c8eb3ac7 0xefc 02958f32
0xef8
nter an instruction number 1. Input 2. Display 3. Exit
```

4. Subtraction operation: sub r2,r2



### 5. bne r2, r2, lb1

```
🚪 🖭 M:\Workspace\ABest\Debug\ABest.exe
                                                                              ×
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
bne instruction is being performed. The corresponding opcode is 0x10
The register values are as follows:
 r0:0x0 r1:0x90 r2:0x0 r3:0x2 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0x98r
10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff
The flag value is:0x0001
The instruction pointer value is:0x00000098
The stack memory is:
 0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
 0xee8
        c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
        c8eb3ac7 0xefc 02958f32
 0xef8
Enter an instruction number 1. Input 2. Display 3. Exit
```

6. Multiplication with 0.

lw r0,\$0 lw r1,\$144 mul r0,r1 End

## Output:

# Sign flag:

1. Subtraction of big number from small number

lw r0,\$4294967295

lw r1,\$144

lw r2,\$2

lw r3,\$2

sub r2,r1

End

Ouput: the sign and overflow are set since the result is negative

```
Sub instruction is being performed. The corresponding opcode is 0x03

The register values are as follows:

r0:0x0 r1:0x90 r2:0xffffff72 r3:0x2 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0r9:0x98 r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff

The flag value is:0x0006

The instruction pointer value is:0x00000098

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

2. subtraction operation

```
M:\Workspace\ABest\Debug\ABest.exe
                                                                                   \times
load Immediate instruction is being performed. The corresponding opcode is 0x07 \wedge
load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Sub instruction is being performed. The corresponding opcode is 0x03
 The register values are as follows:
 r0:0x0 r1:0x90 r2:0x2 r3:0xffffff77 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0r9
         r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff
 :0x98
 The flag value is:0x0006
 The instruction pointer value is:0x00000098
 The stack memory is:
         3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
        c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
         c8eb3ac7 0xefc 02958f32
 0xef8
 -----
 Enter an instruction number 1. Input 2. Display 3. Exit
```

#### 3. subtraction operation

```
M:\Workspace\ABest\Debug\ABest.exe
load Immediate instruction is being performed. The corresponding opcode is 0x07 ∧
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
Sub instruction is being performed. The corresponding opcode is 0x03
9-----
 The register values are as follows:
 °0:0x0 r1:0x90 r2:0xfffffffb r3:0x7 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0r9
      r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff
 The flag value is:0x0006
 The instruction pointer value is:0x00000098
 The stack memory is:
      3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
c8eb3ac7 0xefc 02958f32
 0xed8
 0xee8
 ------
 Enter an instruction number 1. Input 2. Display 3. Exit
```

4. sub r2. r1 M:\Workspace\ABest\Debug\ABest.exe × load Immediate instruction is being performed. The corresponding opcode is 0x07 🔥 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Sub instruction is being performed. The corresponding opcode is 0x03 -----The register values are as follows: r0:0x0 r1:0x90 r2:0xffffff72 r3:0x7 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0r9 r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff The flag value is:0x0006 The instruction pointer value is:0x00000098 The stack memory is: 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4 0xed8 0xee8 0xef8 c8eb3ac7 0xefc 02958f32 Enter an instruction number 1. Input 2. Display 3. Exit

# **Overflow Flag:**

1. addition operation out of range.

2. sub operation answer negative, overflow is set

```
M:\Workspace\ABest\Debug\ABest.exe
                                                                                     Х
 load Immediate instruction is being performed. The corresponding opcode is 0x07 ^ load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Sub instruction is being performed. The corresponding opcode is 0x03
g______
 The register values are as follows:
  °0:0x0 r1:0x90 r2:0xfffffffb r3:0x7 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0r9
          r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff
 :0x98
 The flag value is:0x0006
 The instruction pointer value is:0x00000098
 The stack memory is:
 0xed8
        3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
         c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
 0xee8
          c8eb3ac7 0xefc 02958f32
 0xef8
  -----
 Enter an instruction number 1. Input 2. Display 3. Exit
```

3. addition operation, out of range

```
The register values are as follows:

r0:0x8f r1:0x90 r2:0x2 r3:0x5 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0x98r
10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0xfff

The flag value is:0x000c

The instruction pointer value is:0x000000098

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32

Enter an instruction number 1. Input 2. Display 3. Exit
```

# **Carry flag:**

1. carry and overflow set on addition operation out of range.

2. addition operation, out of range

4. Addition Operation Carry and Overflow

```
The flag value is:0x000c

The instruction pointer value is:0x000000098

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a 0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4 0xef8 c8eb3ac7 0xefc 02958f32

Enter an instruction number 1. Input 2. Display 3. Exit
```

5. lw r0,\$330000000

lw r1,\$1147481622

add r0,r1

6. lw r0,\$400000000

lw r1,\$2147481622

add r0,r1

```
The register values are as follows:
r0:0x6e6b2016
               r1:0x0 r2:0x2 r3:0x5 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0r9
       r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0x0
:0x98
The flag value is:0x000c
The instruction pointer value is:0x00000098
The stack memory is:
∂xed8
       3148e913 0xedc
                       32b5240d 0xee0 550aabdb 0xee4
                                                       8055bb9a
∂xee8
       c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4
0xef8
       c8eb3ac7 0xefc 02958f32
Enter an instruction number 1. Input 2. Display 3. Exit
```

# Loops

The loops are implemented using the instructions as explained above. Implementation of while loop, do while loop and for loop is as given below. The C code and the corresponding assembly code is provided.

The **Jump label** and the **LEA** operation is demonstrated using the loops.

#### Note:

- The instructions in our program are read through a file, hence the default file included in Line 170 of the code is "binary\_search.txt". If you want to see the demonstration of loops, then replace the file name as "whileloop.txt" OR "dowhileloop.txt" OR "forloop.txt" in line 170 of the code and rerun the program.
- The text files to be run should be placed in the folder where executable is present.

# 1. While Loop

We have implemented a program that takes number 1 to 5 and calculates the sum.

С	Assembly
int x=5;	lw r1,\$0005
int cnt=1;	lw r2,\$0001
int sum=0;	lw r3,\$0001
while(cnt<=x){	lb2:slt r0,r1,r2
sum=sum+cnt;	beq r0,r3,lb1
cnt++;	add r4,r2
}	add r2,r3
	jmp lb2
	lb1:lw r9,\$3832
	lea r11,r15,r9,1,
	End

#### Explanation:

- The sentinel value is loaded into the register r1.
- The counter is loaded into r2 and the register is incremented using register r3
- The while loop starts at lb2 label and checks for the condition that r2 does not exceed 5.
- If it exceeds then beq transfers the execution to label lb1 else the current value in r2 in added to r4 thus giving addition of numbers 1-5.

#### **Register/Stack Values before Operation**

```
The register values are as follows:

r0:0x0 r1:0x0 r2:0x0 r3:0x0 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0x0r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0x0

The flag value is:0x00000

The instruction pointer value is:0x00000080

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

#### While loop loaded from "whileloop.txt"

```
Memory loaded with initial values.
Registers loaded with initial values.
Press Enter Key to Continue...
Enter an instruction number 1. Input 2. Display 3. Exit
Load or Store Instruction can be of the format-lw/sw/lea reg,reg,reg,S,D
Load Immediate can be of the format- lw reg,$immediate
Arithmetic/Move Instruction can be of the format- add/sub/mul/div/mod/mov reg,reg
Jump Instruction can be of the format- jmp lbl_name
Jump Register Instruction can be of the format- jr reg
Stack Operation's Instruction can be of the format- push/pop reg
Set Less than Operation Instruction can be of the format- slt reg,reg,reg
Branch Operation's Instruction can be of the format- beq/bne reg,reg,lbl_name
Please find the acceptable range values:
       Reg: r0-r15
       5:1,2,4,8
       D:0,1,2,3,4
Enter 'End' to start execution
Program Loaded
```

#### **Operations Performed:**

```
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
load Immediate instruction is being performed. The corresponding opcode is 0x07
Lea instruction is being performed. The corresponding opcode is 0x09
```

#### Register values after operation:

```
The register values are as follows:

r0:0x0 r1:0x5 r2:0x6 r3:0x1 r4:0xf r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0xac r10:0x0 r11:0xa4 r12:0x0 r13:0x0 r14:0x0 r15:0x0

The flag value is:0x00000

The instruction pointer value is:0x000000ac

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

As you can see the r1 is loaded with sentinel value, r2 is incremented till 6 and the summation of first five numbers is stored in r4. ( $0xf => 15_{10}$ )

# 2. Do While Loop

We have implemented a program that takes number 1 to 6 and calculates the sum.

С	Assembly
int x=6;	lw r1,\$0005
int cnt=1;	lw r2,\$0001
int sum=0;	lw r3,\$0001
do{	lb2:add r4,r2
sum=sum+cnt;	slt r0,r1,r2
cnt++;	add r2,r3
}while(cnt<=x);	beq r0,r3,lb1
	jmp lb2
	lb1:lw r9,\$100
	End

#### Explanation:

- The sentinel value is loaded into the register r1.
- The counter is loaded into r2 and the register is incremented using register r3
- The while loop starts at lb2 label and addition is performed between current value in r2 and r4.
- Then check is performed. If it exceeds then beq transfers the execution to label lb1 else the execution is transferred to label2.
- Since the do while loop executes one time before checking for condition it adds 6 as well to the sum.

### **Register/Stack Values before Operation**

```
The register values are as follows:

r0:0x0 r1:0x0 r2:0x0 r3:0x0 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0x0r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0x0

The flag value is:0x0000

The instruction pointer value is:0x00000080

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

#### **Operations Performed**

```
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
Add instruction is being performed. The corresponding opcode is 0x02 SLT instruction is being performed. The corresponding opcode is 0x0C
Add instruction is being performed. The corresponding opcode is 0x02
beg instruction is being performed. The corresponding opcode is 0x0F
jump instruction is being performed. The corresponding opcode is 0x0D
Add instruction is being performed. The corresponding opcode is 0x02
SLT instruction is being performed. The corresponding opcode is 0x0C
Add instruction is being performed. The corresponding opcode is 0x02
beq instruction is being performed. The corresponding opcode is 0x0F
jump instruction is being performed. The corresponding opcode is 0x0D
Add instruction is being performed. The corresponding opcode is 0x02
SLT instruction is being performed. The corresponding opcode is 0x0C
Add instruction is being performed. The corresponding opcode is 0x02
beq instruction is being performed. The corresponding opcode is 0x0F
jump instruction is being performed. The corresponding opcode is 0x0D
Add instruction is being performed. The corresponding opcode is 0x02
SLT instruction is being performed. The corresponding opcode is 0x0C
Add instruction is being performed. The corresponding opcode is 0x02
beq instruction is being performed. The corresponding opcode is 0x0F jump instruction is being performed. The corresponding opcode is 0x0D
Add instruction is being performed. The corresponding opcode is 0x02
SLT instruction is being performed. The corresponding opcode is 0x0C
Add instruction is being performed. The corresponding opcode is 0x02 beq instruction is being performed. The corresponding opcode is 0x0F jump instruction is being performed. The corresponding opcode is 0x0D
Add instruction is being performed. The corresponding opcode is 0x02
SLT instruction is being performed. The corresponding opcode is 0x0C
Add instruction is being performed. The corresponding opcode is 0x02 beq instruction is being performed. The corresponding opcode is 0x0F
load Immediate instruction is being performed. The corresponding opcode is 0x07
```

#### Register values after operation

```
The register values are as follows:

r0:0x0 r1:0x5 r2:0x7 r3:0x1 r4:0x15 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0xa8 r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0x0

The flag value is:0x0000

The instruction pointer value is:0x0000000a8

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

As you can see the r1 is loaded with sentinel value, r2 is incremented till 6 and the summation of first six numbers is stored in r4 (0x15 =>  $21_{10}$ )

### 3. For Loop

We have implemented a program that takes number 1 to 5 and calculates the sum.

С	Assembly
int x=5;	lw r1,\$0005
int cnt;	lw r2,\$0001
int sum=0;	lw r3,\$0001
for(cnt=1;cnt<=x;cnt++){	lb2:slt r0,r1,r2
sum=sum+cnt;	beq r0,r3,lb1
}	add r4,r2
	add r2,r3
	jmp lb2
	lb1:lw r9,\$3832
	lea r11,r15,r9,1,
	End

#### Explanation:

- The FOR loop is similar to While loop in execution as the "for" operation is broken down into multiple simple operations
- The sentinel value is loaded into the register r1.
- The counter is loaded into r2 and the register is incremented using register r3
- The for loop starts at lb2 label and checks for the condition that r2 does not exceed 5.
- If it exceeds then beq transfers the execution to label lb1 else the current value in r2 in added to r4 thus giving addition of numbers 1-5.

#### **Register/Stack Values before Operation**

```
The register values are as follows:

r0:0x0 r1:0x0 r2:0x0 r3:0x0 r4:0x0 r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0x0r10:0x0 r11:0x0 r12:0x0 r13:0x0 r14:0x0 r15:0x0

The flag value is:0x00000

The instruction pointer value is:0x00000080

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

#### **Operations Performed**

```
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
SLT instruction is being performed. The corresponding opcode is 0x0C beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beg instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
beq instruction is being performed. The corresponding opcode is 0x0F
Add instruction is being performed. The corresponding opcode is 0x02
Add instruction is being performed. The corresponding opcode is 0x02
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C beq instruction is being performed. The corresponding opcode is 0x0F
load Immediate instruction is being performed. The corresponding opcode is 0x07
Lea instruction is being performed. The corresponding opcode is 0x09
```

#### Register values after operation

```
The register values are as follows:

r0:0x0 r1:0x5 r2:0x6 r3:0x1 r4:0xf r5:0x0 r6:0x0 r7:0x0 r8:0x0 r9:0xacr10:0x0 r11:0xa4 r12:0x0 r13:0x0 r14:0x0 r15:0x0

The flag value is:0x00000

The instruction pointer value is:0x0000000ac

The stack memory is:
0xed8 3148e913 0xedc 32b5240d 0xee0 550aabdb 0xee4 8055bb9a
0xee8 c60585f1 0xeec 55b91630 0xef0 fd66ae03 0xef4 6f02ceb4
0xef8 c8eb3ac7 0xefc 02958f32
```

As you can see the r1 is loaded with sentinel value, r2 is incremented till 6 and the summation of first five numbers is stored in r4.  $(0xf => 15_{10})$ 

# Binary Search using Recursive Function Call

## **Explanation**

Once the program is loaded in instruction memory, the program asks the user for the array size, the elements in the array and the element to be searched in the array. The program is loaded in "binary\_search.txt".

С	Assembly
int binarySearch(int arr[], int I, int r, int	lw r0,\$0
x)	lw r1,\$144
\ {	push r1
if (r >= I)	jmp lb0
{ ` ′	jmp lb2
int mid = $I + (r - I)/2$ ;	lb0:slt r1,r12,r11
, , ,	lw r2,\$1
// If the element is present at the	beq r1,r2,lb1
middle itself	mov r3,r11
if (arr[mid] == x) return mid;	add r3,r12
	lw r2,\$2
// If element is smaller than mid,	div r3,r2
then it can only be present	lw r5,\$4000
// in left subarray	lea r5,r5,r3,4,0
if (arr[mid] > x) return	lw r7,r0,r5,1,0
binarySearch(arr, l, mid-1, x);	mov r15,r7
	bne r15,r10,lb4
// Else the element can only be	mov r14,r3
present in right subarray	pop r13
return binarySearch(arr, mid+1, r,	jr r13
x);	lb4:slt r1,r10,r7
}	lw r2,\$1
	beq r1,r2,lb3
// We reach here when element is not	mov r11,r3
present in array	add r11,r2
return -1;	jmp lb0
}	lb3:mov r12,r3
	sub r12,r2
	jmp lb0
	lb1:sub r14,r2
	pop r13
	jr r13
	lb2:End

The screenshots for the recursive function call with all the test cases are as follows

## **Loading the Program**

```
Memory loaded with initial values.
Registers loaded with initial values.

Press Enter Key to Continue...

Enter an instruction number 1. Input 2. Display 3. Exit

Load or Store Instruction can be of the format-lw/sw/lea reg,reg,reg,S,D

Load Immediate can be of the format- lw reg,$immediate

Arithmetic/Move Instruction can be of the format- add/sub/mul/div/mod/mov reg,reg

Jump Instruction can be of the format- jmp lbl_name

Jump Register Instruction can be of the format- jr reg

Stack Operation's Instruction can be of the format- push/pop reg

Set Less than Operation Instruction can be of the format- slt reg,reg,reg

Branch Operation's Instruction can be of the format- beq/bne reg,reg,lbl_name

Please find the acceptable range values:

Reg: r0-r15

S:1,2,4,8

D:0,1,2,3,4

Enter 'End' to start execution

Program Loaded
```

### Iteration 1

No of Elements: 10

Elements: 10 12 24 29 66 94 97 151 163 522

1. Case 1: Element to be searched: 97

**Result is in r14:** 06(index value for 97 in the array)

```
Program Loaded
        *** Binary search ***
       Enter number of elements: 10
       Enter 10 elements in ascending order: 10 12 24 29 66 94 97 151 163 522
Binary search function will find 97 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
Push instruction is being performed. The corresponding opcode is 0x07
ly simple instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Instruction is being performed. The corresponding opcode is 0x07
load Instruction is being performed. The corresponding opcode is 0x08
load instruction is being performed. The corresponding opcode is 0x08
load instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediat
       Enter 'key' element you need to find: 97
  Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x03 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08
```

```
load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 mov instruction is being performed. The corresponding opcode is 0x08 Pop instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0D
   The register values are as follows:
                                                                                                         r4:0x0 r5:0xfb8
r11:0x6 r12:0x7 r13:0x90
  r0:0x0
                      r1:0xffffffff
                                                                r2:0x2 r3:0x6
                                                                                                                                                                         r6:0x0
                                                                                                                                                                                              r7:0x61r
 8:0x0
15:0x0
                      r9:0x104
                                                                r10:0x61
                                                                                                                                                                                              r14:0x6r
 The flag value is:0x0000
 The instruction pointer value is:0x00000104
The stack memory is:
Øxed8 3148e913 Øxedc
Øxee8 c60585f1 Øxeec
Øxef8 c8eb3ac7 Øxefc
                                                                                                                                                    8055bb9a
                                                               000000000 0xee0
                                                                                                          550aabdb 0xee4
                                                                55b91630 0xef0
                                                                                                          fd66ae03 0xef4
                                                                                                                                                    6f02ceb4
                                                                02958f32
```

**2.** Case **2**: Element to be searched: 12

**Result is in r14:** 01(index value for 12 in the array) **Elements:** 10 12 24 29 66 94 97 151 163 522

```
Program Loaded
    *** Binary search ***
Enter number of elements: 10
     Enter 10 elements in ascending order: 10 12 24 29 66 94 97 151 163 522
     Enter 'key' element you need to find: 12
 Binary search function will find 12 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x0A
Push instruction is being performed. The corresponding opcode is 0x0D
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x0F
beg instruction is being performed. The corresponding opcode is 0x08
mov instruction is being performed. The corresponding opcode is 0x08
   beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0E Add instruction is being performed. The corresponding opcode is 0x0E load Immediate instruction is being performed. The corresponding opcode IS 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed.
                                                                                                                                                                                                                                                                                         performed. The corresponding opcode is 0x07
The corresponding opcode is 0x05
DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x097 Load instruction is being performed. The corresponding opcode is 0x09 mov instruction is being performed. The corresponding opcode is 0x09 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 sub instruction is being performed. The corresponding opcode is 0x00 sub instruction is being performed. The corresponding opcode is 0x00 sub instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is
                                                                                                                                                                                                                                                                                         performed. The corresponding opcode is 0x07
The corresponding opcode is 0x09
```

```
load Immediate instruction is being performed. The corresponding opcode is 0x07
DIV instruction is being performed. The corresponding opcode is 0x05
divisor greater than dividend
DIV instruction is being performed. The corresponding opcode is 0x05 divisor greater than dividend load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x00 stl instruction is being performed. The corresponding opcode is 0x00 stl instruction is being performed. The corresponding opcode is 0x00 stl instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed. The corresponding opcode is 0x00 how instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load instruction is being performed. The corresponding opcode is 0x00 load instruction is being performed. The corresponding opcode is 0x00 load instruction is being performed. The 
    ______
   The register values are as follows:
    r0:0x0
                                      r1:0xffffffff
                                                                                                            r2:0x2 r3:0x1 r4:0x0 r5:0xfa4
                                                                                                                                                                                                                                                                                         r6:0x0 r7:0xcr8
                                     r9:0x104
                                                                                                           r10:0xc r11:0x1 r12:0x1 r13:0x90
                                                                                                                                                                                                                                                                                         r14:0x1 r15:0x0
   The flag value is:0x0000
   The instruction pointer value is:0x00000104
   The stack memory is:
Øxed8 3148e913 Øxedc
                                                                                                           00000000 0xee0 550aabdb 0xee4
55b91630 0xef0 fd66ae03 0xef4
                                                                                                                                                                                                                                                      8055bb9a
                                     c60585f1 0xeec
c8eb3ac7 0xefc
                                                                                                          55b91630
02958f32
    0xee8
                                                                                                                                                                                                                                                      6f02ceh4
    0xef8
      ------
```

3. Case 3: Element to be searched: 121

**Result is in r14:** -1(-1 as not found in the array) **Elements:** 10 12 24 29 66 94 97 151 163 522

```
Program Loaded
        *** Binary search ***
    Enter number of elements: 10
     Enter 10 elements in ascending order: 10 12 24 29 66 94 97 151 163 522
      Enter 'key' element you need to find: 121
    Binary search function will find 121 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
d. The corresponding opcode is 0x07

load Immediate instruction is being performed. The corresponding opcode is 0x07

Push instruction is being performed. The corresponding opcode is 0x0A

jump instruction is being performed. The corresponding opcode is 0x0D

SLT instruction is being performed. The corresponding opcode is 0x0C

load Immediate instruction is being performed. The corresponding opcode is 0x07

beg instruction is being performed. The corresponding opcode is 0x0F

mov instruction is being performed. The corresponding opcode is 0x08

Add instruction is being performed. The corresponding opcode is 0x02

load Immediate instruction is being performed. The corresponding opcode is 0x07

DIV instruction is being performed. The corresponding opcode is 0x07

Lea instruction is being performed. The corresponding opcode is 0x09

Load instruction is being performed. The corresponding opcode is 0x09
  load Immediate instruction is being performed. The corresponding opcode IDIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x09 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode in 0x0C load Immediate instruction is being performed. The corresponding opcode in 0x0C load Immediate instruction is being performed.
 SLT instruction is being performed. The corresponding opcode is UXUC load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 opensions is being performed. The corresponding opcode is 0x08 opensions is being performed. The corresponding opcode is 0x08 opensions opensions is being performed. The corresponding opcode is 0x08 opensions open
 load Immediate instruction is being performed. The corresponding opcode beq instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode DIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x09 Lea instruction is being performed. The corresponding opcode is 0x09 Mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F beq instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F beq instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction i
                                                                                                                                                                                                                                                                                                                                                                                         The corresponding opcode is 0x02
performed. The corresponding opcode is 0x07
The corresponding opcode is 0x05
performed. The corresponding opcode is 0x07
The corresponding opcode is 0x07
The corresponding opcode is 0x07
  SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x03 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02
```

```
load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 begins performed. The corresponding opcode is 0x08
SLT instruction is being performed.

load Immediate instruction is being performed.

beg instruction is being performed. The corresponding opcode is 0x08

mov instruction is being performed. The corresponding opcode is 0x02

Add instruction is being performed. The corresponding opcode is 0x0D

SLT instruction is being performed. The corresponding opcode is 0x0C

load Immediate instruction is being performed. The corresponding opcode is 0x07

beg instruction is being performed. The corresponding opcode is 0x07

beg instruction is being performed. The corresponding opcode is 0x08
SLI instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x07 mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08 add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x07 sub instruction is being performed. The corresponding opcode is 0x08 sub instruction is being performed. The corresponding opcode is 0x08 sub instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x08 limitation is being performed. The corresponding opcode is 0x08 limitation is being performed. The corresponding opcode is 0x08 limitation is being performed. The corresponding opcode is 0x08 limitation is being performed. The corresponding opcode is 0x08 limitation is being performed. The correspon
       The register values are as follows:
                                           r1:0x0 r2:0x1 r3:0x7 r4:0x0 r5:0xfbc
r10:0x79 r11:0x7 r12:0x6 r13:0x90
                                                                                                                                                                                                                                                                                                              r6:0x0 r7:0x97 r8:0x0r9
r14:0xffffffff r15:0x1e
   r0:0x0
                                            r10:0x79
   :0x104
   The flag value is:0x0000
   The instruction pointer value is:0x00000104
  The stack memory
Øxed8 3148e913
Øxee8 c60585f1
                                                                                            is:
                                                                                             Øxedc
                                                                                                                                    00000000 0xee0
                                                                                                                                                                                                                          550aabdb 0xee4
                                                                                                                                                                                                                                                                                                                8055bb9a
                                                                                              Охеес
                                                                                                                                    55b91630 0xef0
                                                                                                                                                                                                                          fd66ae03 0xef4
                                                                                                                                                                                                                                                                                                                6f02ceb4
                                             c8eb3ac7 0xefc
                                                                                                                                    02958f32
    0xef8
```

# Iteration 2

No of Elements: 9

1. Case 1: Element to be searched: 9

**Result is in r14:** 08(index value for 9 in the array)

Elements: 123456789

```
Program Loaded
             *** Binary search ***
            Enter number of elements: 9
            Enter 9 elements in ascending order: 1 2 3 4 5 6 7 8 9
            Enter 'key' element you need to find: 9
      Binary search function will find 9 in the array!
The result will be in register r14!load Immediate instruction is being performe d. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Push instruction is being performed. The corresponding opcode is 0x0A jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Lea instruction is 0x07 Lea inst
DIU instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x09 mov instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x00 bne instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 fldd instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load
```

```
Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode
                                                                                                            performed. The corresponding opcode is 0x07
The corresponding opcode is 0x0F
The corresponding opcode is 0x08
beg instruction is being performed.
mov instruction is being performed.
mov instruction is being performed. The corresponding opcode is 0x06 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x06 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opco
                                                                                                                The corresponding opcode is 0x0D
                                                                                                           The corresponding opcode is 0x00 performed. The corresponding opcode is 0x07 The corresponding opcode is 0x08 The corresponding opcode is 0x08 The corresponding opcode is 0x02 performed. The corresponding opcode is 0x07 The corresponding opcode is 0x07 The corresponding opcode is 0x05
beg instruction is being performed.
mov instruction is being performed.
Add instruction is being performed.
load Immediate instruction is being
DIV instruction is being performed.
load Immediate instruction is being
                                                                                                            performed. The corresponding opcode is 0x07 The corresponding opcode is 0x09
load Immediate instruction is being performed. The corresponding opcode Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 mov instruction is being performed. The corresponding opcode is 0x08 Pop instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0D
     ______
 The register values are as follows:
                                                                         r2:0x2 r3:0x8 r4:0x0 r5:0xfc0
                        r1:0xffffffff
 r0:0x0
                                                                                                                                                                                                 r6:0x0 r7:0x9r8
                         r9:0x104
                                                                         r10:0x9 r11:0x8 r12:0x9 r13:0x90
  0x0
                                                                                                                                                                                                  r14:0x8 r15:0x0
 The flag value is:0x0000
 The instruction pointer value is:0x00000104
The stack memory is:
Øxed8 3148e913 Øxedc
Øxee8 c60585f1 Øxeec
Øxef8 c8eb3ac7 Øxefc
                                                                         00000000 0xee0
                                                                                                                         550aabdb 0xee4
                                                                                                                                                                         8055bb9a
                                                                        55b91630
02958f32
                                                                                                    0xef0
                                                                                                                         fd66ae03 0xef4
                                                                                                                                                                         6f02ceb4
                                                                                -----
```

2. Case 2: Element to be searched: 1

**Result is in r14:** 00(index value for 1 in the array)

Elements: 123456789

```
Program Loaded
       *** Binary search ***
       Enter number of elements: 9
       Enter 9 elements in ascending order: 1 2 3 4 5 6 7 8 9
       Enter 'key' element you need to find: 1
linary search function will find 1 in the array !

The result will be in register r14 !load Immediate instruction is being performe

1. The corresponding opcode is 0x07

Load Immediate instruction is being performed. The corresponding opcode is 0x07

Push instruction is being performed. The corresponding opcode is 0x07

Push instruction is being performed. The corresponding opcode is 0x06

Load Immediate instruction is being performed. The corresponding opcode is 0x06

Load Immediate instruction is being performed. The corresponding opcode is 0x06

Load Immediate instruction is being performed. The corresponding opcode is 0x06

Load Immediate instruction is being performed. The corresponding opcode is 0x06

Load Immediate instruction is being performed. The corresponding opcode is 0x06

Load Immediate instruction is being performed. The corresponding opcode is 0x07

Load Immediate instruction is being performed. The corresponding opcode is 0x07

Load Immediate instruction is being performed. The corresponding opcode is 0x07

Load Immediate instruction is being performed. The corresponding opcode is 0x07

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

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Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is being performed. The corresponding opcode is 0x08

Load Immediate instruction is bei
     Binary search function will find 1 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
```

```
load Immediate instruction is being performed. The corresponding opcode is 0x07
Lea instruction is being performed. The corresponding opcode is 0x07
Load instruction is being performed. The corresponding opcode is 0x00
mov instruction is being performed. The corresponding opcode is 0x00
mov instruction is being performed. The corresponding opcode is 0x00
SLT instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x07
mov instruction is being performed. The corresponding opcode is 0x07
mov instruction is being performed. The corresponding opcode is 0x03
jump instruction is being performed. The corresponding opcode is 0x00
SLT instruction is being performed. The corresponding opcode is 0x00
SLT instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x07
mov instruction is being performed. The corresponding opcode is 0x08
Add instruction is being performed. The corresponding opcode is 0x02
load Immediate instruction is being performed. The corresponding opcode is 0x02
load Immediate instruction is being performed. The corresponding opcode is 0x07
DIV instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
  divisor greater than dividend load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Lea instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 mov instruction is being performed. The corresponding opcode is 0x08 Pop instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0D
     ______
    The register values are as follows:
                                                                                                                       r2:0x2 r3:0x0 r4:0x0 r5:0xfa0
r10:0x1 r11:0x0 r12:0x0 r13:0x90
                                                                                                                                                                                                                                                                                                                          r6:0x0 r7:0x1r8
r14:0x0 r15:0x0
                                         r1:0xffffffff
     r0:0x0
    :0x0
                                           r9:0x104
    The flag value is:0x0000
    The instruction pointer value is:0x000<u>0</u>0104
   The stack memory is:
0xed8 3148e913 0xedc
0xee8 c60585f1 0xeec
0xef8 c8eb3ac7 0xefc
                                                                                                                        00000000 0xee0
                                                                                                                                                                                                      550aabdb 0xee4
                                                                                                                                                                                                                                                                                    8055bb9a
                                                                                                                        55Ъ91630
                                                                                                                                                                  0xef0
                                                                                                                                                                                                      fd66ae03 0xef4
                                                                                                                                                                                                                                                                                    6f02ceb4
                                                                                                                        02958f32
```

3. Case 3: Element to be searched: 56

**Result is in r14:** -1(-1 as not found in the array)

Elements: 123456789

```
Program Loaded
       *** Binary search ***
       Enter number of elements: 9
       Enter 9 elements in ascending order: 1 2 3 4 5 6 7 8 9
       Enter 'key' element you need to find: 56
  Binary search function will find 56 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
Push instruction is being performed. The corresponding opcode is 0x00
jump instruction is being performed. The corresponding opcode is 0x00
SLT instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
beg instruction is being performed. The corresponding opcode is 0x08
mov instruction is being performed. The corresponding opcode is 0x08
odd instruction is being performed. The corresponding opcode is 0x02
Jump instruction is being performed. The corresponding opcode is 8x80 SLI instruction is being performed. The corresponding opcode is 8x87 beq instruction is being performed. The corresponding opcode is 8x87 mov instruction is being performed. The corresponding opcode is 8x88 Add instruction is being performed. The corresponding opcode is 8x82 load Immediate instruction is being performed. The corresponding opcode is 8x82 load Immediate instruction is being performed. The corresponding opcode is 8x89 load Immediate instruction is being performed. The corresponding opcode is 8x89 load Immediate instruction is being performed. The corresponding opcode is 8x89 load instruction is being performed. The corresponding opcode is 8x88 mov instruction is being performed. The corresponding opcode is 8x88 lone instruction is being performed. The corresponding opcode is 8x88 lone instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The correspond
```

```
DIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 dinstruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed. The corresponding opcode is 0x00
Idd instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x00 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 and instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed.
load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x03 iumn instruction is being performed. The corresponding opcode is 0x00 iumn instruction is being performed. The corresponding opcode is 0x00
Sub instruction is being performed. The corresponding opcode is 0x03 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F Sub instruction is being performed. The corresponding opcode is 0x03 Pop instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0D
    ._____
  The register values are as follows:
                                                                                                                                   r3:0x9 r4:0x0 r5:0xfc4 r6:0x0 r
r10:0x38 r11:0x9 r12:0x8 r13:0x90
   r0:0x0
                                            r1:0x0 r2:0x1
                                                                                                                                                                                                                                                                                                                  r6:0x0 r7:0x234e1f06r8:
                                                        :0x104
    fffff
                                           r15:0x234e1ece
     he flag value is:0x0000
  The instruction pointer value is:0x00000104
  The stack memory is:
dxed8 3148e913 0xedc
dxee8 c60585f1 0xeec
dxef8 c8eb3ac7 0xefc
                                                                                                                                   000000000 0xee0
                                                                                                                                                                                                                         550aabdb 0xee4
                                                                                                                                                                                                                                                                                                                  8055bb9a
                                                                                                                                    55b91630 0xef0
                                                                                                                                                                                                                           fd66ae03 0xef4
                                                                                                                                   02958f32
    .-----
```

# Iteration 3

No of Elements: 11

1. Case 1: Element to be searched: 39

**Result is in r14:** 02(index value for 39 in the array) **Elements:** 10 27 39 44 52 88 120 156 212 300 314

```
Program Loaded
 *** Binary search ***
Enter number of elements: 11
  Enter 11 elements in ascending order: 10 27 39 44 52 88 120 156 21<u>2 300 314</u>
   Enter 'key' element you need to find: 39
 Binary search function will find 39 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
  load Immediate instruction is being performed. The corresponding opcode is 0x07 Push instruction is being performed. The corresponding opcode is 0x04 jump instruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed.
 jump instruction is being performed. The corresponding opcode is 0x00 SLT instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10
  bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opc
bne instruction is being period.

SLT instruction is being performed.

Load Immediate instruction is being performed. The corresponding opcode is 0x08 beg instruction is being performed. The corresponding opcode is 0x03 sub instruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed. The corresponding opcode is 0x00 SLT instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 formed is being performed. The corresponding opcode is 0x08 formed is being performed. The corresponding opcode is 0x02
 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 Pop instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0E
     The register values are as follows:
    r0:0x0 r1:0xffffffff
8:0x0 r9:0x104
                                                                                                                                                                                                                                                                                                      r6:0x0
                                                                                                                                                                                                                                                                                                                                           r7:0x27r
                                                                                                                r2:0x2 r3:0x2
                                                                                                                                                                                        r4:0x0 r5:0xfa8
  8:0x0
                                                                                                                r10:0x27
                                                                                                                                                                                         r11:0x0 r12:0x4 r13:0x90
                                                                                                                                                                                                                                                                                                                                           r14:0x2r
```

2. Case 2: Element to be searched: 212

**Result is in r14:** 08(index value for 212 in the array) **Elements:** 10 27 39 44 52 88 120 156 212 300 314

```
Program Loaded
    *** Binary search ***
    Enter number of elements: 11
    Enter 11 elements in ascending order: 10 27 39 44 52 88 120 156 212 300 314
    Enter 'key' element you need to find: 212
Binary search function will find 212 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
Push instruction is being performed. The corresponding opcode is 0x0A
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x07
beg instruction is being performed. The corresponding opcode is 0x08
mov instruction is being performed. The corresponding opcode is 0x08
0dd instruction is being performed. The corresponding opcode is 0x02
La instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08 Inmediate instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Load instruction is being performed. The corresponding opcode is 0x09 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 SLI instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x07 mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08 SLI instruction is being performed. The corresponding opcode is 0x08 SLI instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x00 SLI instruction is being performed. The corresponding opcode is 0x00 SLI instruction is being performed. The corresponding opcode is 0x00 SLI instruction is being performed. The corresponding opcode is 0x00 November of the corresponding opcode is 0x01 November of the corresponding opcode is 0x02 November of the corresponding opcode is 0x01 November of the corresponding opcode is 0x02 November of the corresponding opcode is 0x01 November of the corresponding opcode is 0x02 November of the corresponding opcode is 0x02 November of the corresponding opcode is 0x01 November of the corresponding opcode is 0x02 November of the co
 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 mov instruction is being performed. The corresponding opcode is 0x08 Pop instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0D
       -----
    The register values are as follows:
     r0:0x0 r1:0xffffffff
                                                                                                                                                         r2:0x2 r3:0x8
                                                                                                                                                                                                                                                            r4:0x0 r5:0xfc0
                                                                                                                                                                                                                                                                                                                                                                                                                r6:0x0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                   r7:0xd4r
    8:0x0
                                                    r9:0x104
                                                                                                                                                         r10:0xd4
                                                                                                                                                                                                                                                            r11:0x6
                                                                                                                                                                                                                                                                                                            r12:0xb r13:0x90
                                                                                                                                                                                                                                                                                                                                                                                                                                                                    r14:0x8r
```

Case 3: Element to be searched: 254

**Result is in r14:** -1(-1 as not found in the array) Elements: 10 27 39 44 52 88 120 156 212 300 314

```
Program Loaded
      *** Binary search ***
Enter number of elements: 11
      Enter 11 elements in ascending order: 10 27 39 44 52 88 120 156 212 300 314
      Enter 'key' element you need to find: 254
     Binary search function will find 254 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
The result will be in register r14 !load Immediate Instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed. The corresponding opcode is 0x00 SLT instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load instruction is being performed. The corresponding opcode is 0x00 load instruction is being performed. The corresponding opcode is 0x00 load instruction is being performed.
  Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x00 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08
   mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08
```

```
beg instruction is being performed. The corresponding opcode is 8x8F mov instruction is being performed. The corresponding opcode is 8x82 load Immediate instruction is being performed. The corresponding opcode is 8x82 load Immediate instruction is being performed. The corresponding opcode is 8x87 load Immediate instruction is being performed. The corresponding opcode is 8x87 load Immediate instruction is being performed. The corresponding opcode is 8x89 load instruction is being performed. The corresponding opcode is 8x89 load instruction is being performed. The corresponding opcode is 8x89 load instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x88 load instruction is being performed. The corresponding opcode is 8x89 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being pe
       The register values are as follows:
     r0:0x0
                                               r1:0x0 r2:0x1 r3:0x9
                                                                                                                                                                               r4:0x0
                                                                                                                                                                                                                                                                                                                r6:0x0 r7:0x12cr8:0x0r9
                                                                                                                                                                                                                         r5:0xfc4
                                                                                                                                    r11:0x9 r12:0x8 r13:0x90
                                                                                                                                                                                                                                                                                                                r14:0xffffffff r15:0x2e
     :0x104
                                              r10:0xfe
    The flag value is:0x0000
    The instruction pointer value is:0x00000104
    The stack memory is:
Oxed8 3148e913 Oxedc 00000000 Oxee0 550aabdb Oxee4 8055bb9a
```

# Iteration 4

No of Elements: 12 elements

1. Case 1: Element to be searched: 136

**Result is in r14:** 03(index value for 136 in the array)

Elements: 26 85 99 136 247 278 319 357 387 532 571 613

```
Program Loaded
        *** Binary search ***
       Enter number of elements: 12
        Enter 12 elements in ascending order: 26 85 99 136 247 278 319 357 387 532 571 6
Enter 'key' element you need to find: 136

Binary search function will find 136 in the array!
The result will be in register r14 fload Immediate instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x08
Jump instruction is being performed. The corresponding opcode is 0x08
SLT instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x08
Add instruction is being performed. The corresponding opcode is 0x02
Load Immediate instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x07
Load instruction is being performed. The corresponding opcode is 0x07
Load instruction is being performed. The corresponding opcode is 0x08
Load instruction is being performed. The corresponding opcode is 0x08
Load instruction is being performed. The corresponding opcode is 0x08
Load instruction is being performed. The corresponding opcode is 0x08
Load Immediate instruction is being performed. The corresponding opcode is 0x08
Load Immediate instruction is being performed. The corresponding opcode is 0x08
SLT instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x08
SLT instruction is being performed. The corresponding opcode is 0x08
SLT instruction is being performed. The corresponding opcode is 0x08
SLT instruction is being performed. The corresponding opcode is 0x08
SLT instruction is being performed. The corresponding opcode is 0x08
Load Immediate instruction is being performed. The corresponding opcode is 0x08
Load Immediate instruction is being performed. The co
      Enter 'key' element you need to find: 136
```

```
beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x09
 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F
SLT instruction is being personnes.

Load Immediate instruction is being performed. The corresponding opcode is 0x08 beginstruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x03 sub instruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed. The corresponding opcode is 0x00 SLT instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 beginstruction is being performed. The corresponding opcode is 0x08 fine is being performed. The corresponding opcode is 0x02
 mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 Pop instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0E
     The register values are as follows:
   r0:0x0
                                       r1:0xffffffff
                                                                                                                 r2:0x2 r3:0x3
                                                                                                                                                                                          r4:0x0
                                                                                                                                                                                                                            r5:0xfac
                                                                                                                                                                                                                                                                                                       r6:0x0
                                                                                                                                                                                                                                                                                                                                            r7:0x88r
                                       r9:0x104
                                                                                                                 r10:0x88
                                                                                                                                                                                          r11:0x3 r12:0x3 r13:0x90
    8:0x0
                                                                                                                                                                                                                                                                                                                                            r14:0x3r
    15:0x0
   The flag value is:0x0000
   The instruction pointer value is:0x00000104
  The stack memory is:
0xed8 3148e913 0xedc
0xee8 c60585f1 0xeec
0xef8 c8eb3ac7 0xefc
                                                                                                                 000000000 0xee0
                                                                                                                                                                                          550aabdb 0xee4
                                                                                                                                                                                                                                                                   8055bb9a
                                                                                                                55b91630
02958f32
                                                                                                                                                          0xef0
                                                                                                                                                                                          fd66ae03 0xef4
                                                                                                                                                                                                                                                                   6f02ceb4
```

2. Case 2: Element to be searched: 532

**Result is in r14:** 09(index value for 532 in the array)

Elements: 26 85 99 136 247 278 319 357 387 532 571 613

```
*** Binary search ***
    Enter number of elements: 12
     Enter 12 elements in ascending order: 26 85 99 136 247 278 319 357 387 532 571 6
Binary search function will find 532 in the array!
The result will be in register ri4!load Immediate instruction is being performed. The corresponding opcode is 8x87
load Immediate instruction is being performed. The corresponding opcode is 8x88
jump instruction is being performed. The corresponding opcode is 8x80
limp instruction is being performed. The corresponding opcode is 8x80
SLT instruction is being performed. The corresponding opcode is 8x80
load Immediate instruction is being performed. The corresponding opcode is 8x80
load Immediate instruction is being performed. The corresponding opcode is 8x80
mov instruction is being performed. The corresponding opcode is 8x80
load Immediate instruction is being performed. The corresponding opcode is 8x80
load Inmediate instruction is being performed. The corresponding opcode is 8x80
load instruction is being performed. The corresponding opcode is 8x87
DIV instruction is being performed. The corresponding opcode is 8x87
Load instruction is being performed. The corresponding opcode is 8x80
mov instruction is being performed. The corresponding opcode is 8x80
mov instruction is being performed. The corresponding opcode is 8x80
she instruction is being performed. The corresponding opcode is 8x80
load instruction is being performed. The corresponding opcode is 8x80
load Inmediate instruction is being performed. The corresponding opcode is 8x80
load Inmediate instruction is being performed. The corresponding opcode is 8x80
load Inmediate instruction is being performed. The corresponding opcode is 8x80
load instruction is being performed. The corresponding opcode is 8x80
load instruction is being performed. The corresponding opcode is 8x80
load instruction is being performed. The corresponding opcode is 8x80
load instruction is being performed. The corresponding opcode is 8x80
load Immediate instruction is being performed. The corresponding opcode is 8x80
load Immediate instruction is being performed. The corresponding opcode is 8x80
load Immediate instruction is being 
    Enter 'key' element you need to find: 532
     The register values are as follows:
        ·0:0x0 r1:0xffffffff
                                                                                                                                            r2:0x2 r3:0x9 r4:0x0 r5:0xfc4
                                                                                                                                                                                                                                                                                                                                                                                  r6:0x0 r7:0x214
                                                  r8:0x0 r9:0x104
                                                                                                                                                                                                                                                                                       r11:0x7 r12:0xc r13:0x90r14:0x9r
                                                                                                                                                                                            r10:0x214
```

### 3. Case 3: Element to be searched: 322

**Result is in r14:** -1(-1 as not found in the array)

Elements: 26 85 99 136 247 278 319 357 387 532 571 613

```
Program Loaded
     *** Binary search ***
    Enter number of elements: 12
     Enter 12 elements in ascending order: 26 85 99 136 247 278 319 357 387 532 571 6
    Enter 'key' element you need to find: 322
   Binary search function will find 322 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
The result will be in register r14 !load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x08 jump instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 how instruction is being performed. The corresponding opcode is 0x07 $\text{Add}$ instruction is being performed. The corresponding opcode is 0x08 $\text{Add}$ instruction is being performed. The corresponding opcode is 0x07 $\text{DIU}$ instruction is being performed. The corresponding opcode is 0x07 $\text{Lea}$ instruction is being performed. The corresponding opcode is 0x07 $\text{Lea}$ instruction is being performed. The corresponding opcode is 0x09 $\text{Load}$ instruction is being performed. The corresponding opcode is 0x00 $\text{mov}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $\text{SLT}$ instruction is being performed. The corresponding opcode is 0x00 $
  beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07
                                                                                                                                                                                                                                                                                 performed. The corresponding opcode is 0x07
The corresponding opcode is 0x09
 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x03 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08
```

```
load Immediate instruction is being
beg instruction is being performed.
                                                                                                                        performed. The corresponding opcode is 0x07 The corresponding opcode is 0x0F
 mov instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x08 jump instruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed. The corresponding opcode is 0x00
 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x07
 beg instruction is being performed.
mov instruction is being performed.
Add instruction is being performed.
load Immediate instruction is being
                                                                                                                        The corresponding opcode is 0x08
The corresponding opcode is 0x02
performed. The corresponding opcode is 0x07
The corresponding opcode is 0x05
 DIV instruction is being performed.
load Immediate instruction is being
load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 mov instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x03 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F Sub instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x03 Pop instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0B jump instruction is being performed. The corresponding opcode is 0x0B
                                                                                                                        performed. The corresponding opcode is 0x07
The corresponding opcode is 0x09
   The register values are as follows:
                                                                                                                                                                                          r6:0x0 r7:0x165r8:0x0r9
r14:0xffffffff r15:0x23
                                                                                r3:0x7 r4:0x0 r5:0xfbc
r11:0x7 r12:0x6 r13:0x90
   0x0:0x
                            r1:0x0 r2:0x1
  :0x104
                           r10:0x142
 The flag value is:0x0000
 The instruction pointer value is:0x00000104
  The stack memory
Øxed8 3148e913
                                                          is:
                                                         0xedc
                                                                                 00000000 0xee0
                                                                                                                                     550aabdb 0xee4
                                                                                                                                                                                           8055bb9a
                                                                                55b91630 0xef0
02958f32
                            c60585f1
                                                                                                                                     fd66ae03 0xef4
  0xee8
                                                         Охеес
                                                                                                                                                                                           6fØ2ceh4
                            c8eb3ac7 0xefc
  Øxef8
                                                                                                           -----
```

# Iteration 5

No of Elements: 8 elements

1. Case 1: Element to be searched: -283

**Result is in r14:** 02(index value for -283 in the array) **Elements:** -390 -310 -283 -127 -38 45 188 658

```
Program Loaded
     *** Binary search ***
Enter number of elements: 8
       Enter 8 elements in ascending order: -390 -310 -283 -127 -38 45 188 658
     Enter 'key' element you need to find: -283
Binary search function will find -283 in the array!
The result will be in register r14!load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
Push instruction is being performed. The corresponding opcode is 0x0A
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x07
beg instruction is being performed. The corresponding opcode is 0x08
Add instruction is being performed. The corresponding opcode is 0x02
load Immediate instruction is being performed. The corresponding opcode is 0x07
DIV instruction is being performed. The corresponding opcode is 0x07
Load Immediate instruction is being performed. The corresponding opcode is 0x07
Load instruction is being performed. The corresponding opcode is 0x07
Load instruction is being performed. The corresponding opcode is 0x07
Load instruction is being performed. The corresponding opcode is 0x09
Load instruction is being performed. The corresponding opcode is 0x00
mov instruction is being performed. The corresponding opcode is 0x08
Lea instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x03 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x0F load Immediate instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x07 Load instruction is being performed. The corresponding opcode is 0x09 mov instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x08 long instruction is being performed. The corresponding opcode is 0x09 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opc
  bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08
```

```
performed. The corresponding opcode is 0x07 The corresponding opcode is 0x0F The corresponding opcode is 0x08 The corresponding opcode is 0x02
 load Immediate instruction is being
beg instruction is being performed, beg instruction is being performed, mov instruction is being performed. Add instruction is being performed load Immediate instruction is being DIV instruction is being load Immediate instruction is being load Immediate instruction is being
                                                                                                                        performed. The corresponding opcode is 0x07
The corresponding opcode is 0x05
                                                                                                                         performed. The corresponding opcode is 0x07
Lea instruction is being performed. T
Load instruction is being performed. T
mov instruction is being performed. T
bne instruction is being performed. T
SLT instruction is being performed. T
load Immediate instruction is being p
                                                                                                                        The corresponding opcode is 0x09
The corresponding opcode is 0x00
                                                                                                                        The corresponding opcode is 0x08
The corresponding opcode is 0x10
The corresponding opcode is 0x0C
                                                                                                                         performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x0F
beg instruction is being performed. The corresponding opcode is 0x0F
mov instruction is being performed. The corresponding opcode is 0x08
Add instruction is being performed. The corresponding opcode is 0x02
jump instruction is being performed. The corresponding opcode is 0x0D
SLT instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x09 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 mov instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x08 jump instruction is being performed. The corresponding opcode is 0x08
                                                                                                                        performed. The corresponding opcode is 0x07 The corresponding opcode is 0x05
                                                                                                                        performed. The corresponding opcode is 0x07
  ______
 The register values are as follows:
                                                                                                          r3:0x2 r4:0x0
r10:0xfffffee5
                           r1:0xffffffff
                                                                               r2:0x2
  r0:0x0
                                                                                                                                                                r5:0xfa8
                                                                                                                                                                                                                      r6:0x0 r7:0xfff
                           r8:0x0 r9:0x104
                                                                                                                                                                r11:0x2 r12:0x3 r13:0x90r14:0x2
  ffee5
 15:0x0
 The flag value is:0x0000
 The instruction pointer value is:0x00000104
The stack memory is:
Øxed8 3148e913 Øxedc
Øxee8 c60585f1 Øxeec
                                                                                 00000000 0xee0
                                                                                                                                      550aabdb 0xee4
                                                                                                                                                                                           8055bb9a
                                                        Охеес
                                                                                 55b91630 0xef0
                                                                                                                                      fd66ae03 0xef4
                                                                                                                                                                                           6fИ2ceh4
                           c8eb3ac7 Øxefc
                                                                                 02958f32
 Øxef8
```

2. Case 2: Element to be searched: 188

**Result is in r14:** 06(index value for 188 in the array)

Elements: -390 -310 -283 -127 -38 45 188 658

```
Program Loaded
     *** Binary search ***
     Enter number of elements: 8
    Enter 8 elements in ascending order: -390 -310 -283 -127 -38 45 188 658
    Enter 'key' element you need to find: 188
Binary search function will find 188 in the array!

The result will be in register r14! load Immediate instruction is being performed. The corresponding opcode is 0x07

load Immediate instruction is being performed. The corresponding opcode is 0x07

Push instruction is being performed. The corresponding opcode is 0x00

jump instruction is being performed. The corresponding opcode is 0x00

SLT instruction is being performed. The corresponding opcode is 0x00

load Immediate instruction is being performed. The corresponding opcode is 0x07

beg instruction is being performed. The corresponding opcode is 0x08

Add instruction is being performed. The corresponding opcode is 0x02

load Immediate instruction is being performed. The corresponding opcode is 0x07

DIV instruction is being performed. The corresponding opcode is 0x07

load Immediate instruction is being performed. The corresponding opcode is 0x07

Load instruction is being performed. The corresponding opcode is 0x07

Load instruction is being performed. The corresponding opcode is 0x00

mov instruction is being performed. The corresponding opcode is 0x00

mov instruction is being performed. The corresponding opcode is 0x08

bne instruction is being performed. The corresponding opcode is 0x08

bne instruction is being performed. The corresponding opcode is 0x08

bne instruction is being performed. The corresponding opcode is 0x08
Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0P beq instruction is being performed. The corresponding opcode is 0x0P mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x0P DIV instruction is being performed. The corresponding opcode is 0x0P load Immediate instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding opcode is 0x0P Load instruction is being performed. The corresponding o
          The register values are as follows:
          0:0x0
                                                       r1:0xffffffff
                                                                                                                                                                          r2:0x2 r3:0x6
                                                                                                                                                                                                                                                                                       r4:0x0 r5:0xfb8
                                                                                                                                                                                                                                                                                                                                                                                                                                                              r6:0x0
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      r7:0xbcr
                                                                                                                                                                                                                                                                                         r11:0x5 r12:0x8 r13:0x90
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        r14:0x6r
    8:0x0
                                                           r9:0x104
```

3. Case 3: Element to be searched: 540

**Result is in r14:** -1(-1 as not found in the array) **Elements:** -390 -310 -283 -127 -38 45 188 658

```
Program Loaded
           *** Binary search ***
        Enter number of elements: 8
        Enter 8 elements in ascending order: -390 -310 -283 -127 -38 45 188 658
Binary search function will find 540 in the array !
The result will be in register r14 !load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 Push instruction is being performed. The corresponding opcode is 0x00 jump instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 add instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x09 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x07 load Immediate instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The co
        Enter 'key' element you need to find: 540
   mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x02
```

```
mov instruction is being performed. The corresponding opcode is UXUF mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x00 SLT instruction is being performed. The corresponding opcode is 0x00 load Immediate instruction is being performed. The corresponding opcode is 0x00 beg instruction is being performed.
                                                                                                                             performed. The corresponding opcode is 0x07 The corresponding opcode is 0x0F
load Immediate Instruction is being beginstruction is being performed. mov instruction is being performed. Add instruction is being performed. load Immediate instruction is being
                                                                                                                              The corresponding opcode is 0x08
                                                                                                                             The corresponding opcode is 0x02
performed. The corresponding opcode is 0x07
The corresponding opcode is 0x05
performed. The corresponding opcode is 0x07
The corresponding opcode is 0x07
 DIV instruction is being performed.
load Immediate instruction is being
Lea instruction is being performed. The corresponding opcode is 0x09 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x00 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode
SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Sub instruction is being performed. The corresponding opcode is 0x03 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F Sub instruction is being performed. The corresponding opcode is 0x03 Pop instruction is being performed. The corresponding opcode is 0x0B jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0D
  The register values are as follows:
                                                                                                                                                                                                   r6:0x0 r7:0x292r8:0x0r9
r14:0xffffffff r15:0x76
                           r1:0x0 r2:0x1 r3:0x7 r4:0x0 r5:0xfbc
  ьЙ:Й×Й
                                                                                    r11:0x7 r12:0x6 r13:0x90
                            r10:0x21c
 :0x104
 The flag value is:0x0000
 The instruction pointer value is:0x00000104
The stack memory is:
Øxed8 3148e913 Øxedc
Øxee8 c60585f1 Øxeec
Øxef8 c8eb3ac7 Øxefc
                                                                                    00000000 0xee0
                                                                                                                                            550aabdb 0xee4
                                                                                                                                                                                                   8055bb9a
                                                                                     55591630
                                                                                                                   0xef0
                                                                                                                                            fd66ae03 0xef4
                                                                                    02958f32
                                                                                                       _____
```

## Iteration 6

No of Elements: 9 elements

1. Case 1: Element to be searched: -455

**Result is in r14:** 01(index value for -455 in the array) **Elements:** -670 -455 -308 -111 244 351 493 555 850

```
Program Loaded
     *** Binary search ***
    Enter number of elements: 9
    Enter 9 elements in ascending order: -670 -455 -308 -111 244 351 493 555 850
Binary search function will find -455 in the array !
The result will be in register r14 !load Immediate instruction is being performe d. The corresponding opcode is 8x87 load Immediate instruction is being performed. The corresponding opcode is 8x88 jump instruction is being performed. The corresponding opcode is 8x80 startuction is being performed. The corresponding opcode is 8x80 startuction is being performed. The corresponding opcode is 8x80 startuction is being performed. The corresponding opcode is 8x80 startuction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load Immediate instruction is being performed. The corresponding opcode is 8x80 load I
    Enter 'key' element you need to find: -455
      -----
    The register values are as follows:
     r0:0x0
                                          r1:0xffffffff
                                                                                                                        r2:0x2
                                                                                                                                                                r3:0x1
                                                                                                                                                                                                     r4:0x0
                                                                                                                                                                                                                                            r5:0xfa4
                                                                                                                                                                                                                                                                                                                           r6:0x0 r7:0xfff
                                         r8:0x0 r9:0x104
    ffe39
                                                                                                                                                               r10:0xffffffe39 r11:0x0 r12:0x3 r13:0x90r14:0x1r
```

2. Case 2: Element to be searched: 850

**Result is in r14:** 08(index value for 850 in the array) **Elements:** -670 -455 -308 -111 244 351 493 555 850

```
Program Loaded
   *** Binary search ***
  Enter number of elements: 9
   Enter 9 elements in ascending order: -670 -455 -308 -111 244 351 493 555 850
   Enter 'key' element you need to find: 850
  Binary search function will find 850 in the array !
The result will be in register r14 !load Immediate instruction is being performe
d. The corresponding opcode is 0x07
d. The corresponding opcode is 0x07

load Immediate instruction is being performed. The corresponding opcode is 0x07

Push instruction is being performed. The corresponding opcode is 0x0A

jump instruction is being performed. The corresponding opcode is 0x0D

SLT instruction is being performed. The corresponding opcode is 0x0C

load Immediate instruction is being performed. The corresponding opcode is 0x0F

mov instruction is being performed. The corresponding opcode is 0x0F

Add instruction is being performed. The corresponding opcode is 0x08

Add instruction is being performed. The corresponding opcode is 0x02

load Immediate instruction is being performed. The corresponding opcode is 0x07

load Immediate instruction is being performed. The corresponding opcode is 0x07

Lea instruction is being performed. The corresponding opcode is 0x09

Load instruction is being performed. The corresponding opcode is 0x08

mov instruction is being performed. The corresponding opcode is 0x08

bne instruction is being performed. The corresponding opcode is 0x08

bne instruction is being performed. The corresponding opcode is 0x10

SLT instruction is being performed. The corresponding opcode is 0x0C

load Immediate instruction is being performed. The corresponding opcode is 0x0C

load Immediate instruction is being performed. The corresponding opcode is 0x0C
  beg instruction is being performed.
mov instruction is being performed.
                                                                                                                                                                                                                                   The corresponding opcode is 0x0F
The corresponding opcode is 0x08
mov instruction is being performed. The corresponding opcode is 0x08
Add instruction is being performed. The corresponding opcode is 0x02
jump instruction is being performed. The corresponding opcode is 0x00
SLT instruction is being performed. The corresponding opcode is 0x00
load Immediate instruction is being performed. The corresponding opcode is 0x07
beg instruction is being performed. The corresponding opcode is 0x06
mov instruction is being performed. The corresponding opcode is 0x08
Add instruction is being performed. The corresponding opcode is 0x02
load Immediate instruction is being performed. The corresponding opcode is 0x07
DIV instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
Lea instruction is being performed. The corresponding opcode is 0x09
Load instruction is being performed. The corresponding opcode is 0x00
mov instruction is being performed. The corresponding opcode is 0x08
bne instruction is being performed. The corresponding opcode is 0x08
SLT instruction is being performed. The corresponding opcode is 0x00
SLT instruction is being performed. The corresponding opcode is 0x00
    SLT instruction is being performed. The corresponding opcode is 0x0C
SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x02
```

```
load Immediate instruction is being performed. The corresponding opcode is 0x07
Lea instruction is being performed. The corresponding opcode is 0x09
Load instruction is being performed. The corresponding opcode is 0x00
mov instruction is being performed. The corresponding opcode is 0x08
bne instruction is being performed. The corresponding opcode is 0x10
SLT instruction is being performed. The corresponding opcode is 0x0C
load Immediate instruction is being performed. The corresponding opcode is 0x0F
mov instruction is being performed. The corresponding opcode is 0x0F
beq instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beq instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 bill instruction is being performed. The corresponding opcode is 0x07 bill instruction is being performed. The corresponding opcode is 0x07
Hdd instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 DIV instruction is being performed. The corresponding opcode is 0x05 load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 mov instruction is being performed. The corresponding opcode is 0x08 Pop instruction is being performed. The corresponding opcode is 0x08 jr instruction is being performed. The corresponding opcode is 0x0E jump instruction is being performed. The corresponding opcode is 0x0D
     The register values are as follows:
                                  r1:0xffffffff
r8:0x0 r9:0x104
                                                                                                   r2:0x2
                                                                                                                                                                                                      r5:0xfc0
                                                                                                                                                                                                                                                                        r6:0x0 r7:0x352
  r0:0x0
                                                                                                                                     r3:0x8 r4:0x0
                                                                                                                                                                                                      r11:0x8 r12:0x9 r13:0x90r14:0x8r
                                                                                                                                     r10:0x352
  15:0x0
  The flag value is:0x0000
  The instruction pointer value is:0x00000104
 The stack memory
Øxed8 3148e913
                                                                       0xedc
                                                                                                    00000000 0xee0
                                                                                                                                                                     550aabdb 0xee4
                                                                                                                                                                                                                                       8055bb9a
                                   c60585f1
                                                                      Охеес
                                                                                                   55b91630
02958f32
                                                                                                                                                                     fd66ae03 0xef4
   Øxee8
                                                                                                                                         0xef0
                                                                                                                                                                                                                                      6f02ceb4
                                   c8eb3ac7 0xefc
   0xef8
```

#### 3. Case 3: Element to be searched: 86

**Result is in r14**: -1(-1 as not found in the array) **Elements:** -670 -455 -308 -111 244 351 493 555 850

```
Program Loaded
       *** Binary search ***
       Enter number of elements: 9
      Enter 9 elements in ascending order: -670 -455 -308 -111 244 351 493 555 850
Binary search function will find 86 in the array !
The result will be in register ri4 !load Immediate instruction is being performe
d. The corresponding opcode is 0x08?
Load Immediate instruction is being performed. The corresponding opcode is 0x07
Push instruction is being performed. The corresponding opcode is 0x07
jump instruction is being performed. The corresponding opcode is 0x06
jump instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
beg instruction is being performed. The corresponding opcode is 0x07
beg instruction is being performed. The corresponding opcode is 0x08
Add instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x07
load instruction is being performed. The corresponding opcode is 0x07
load instruction is being performed. The corresponding opcode is 0x08
load instruction is being performed. The corresponding opcode is 0x08
load instruction is being performed. The corresponding opcode is 0x08
load instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x06
load Immediate instruction is being performed. The corresponding opcode is 0x07
beg instruction is being performed. The corresponding opcode is 0x07
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Inmediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
load Immediate instruction is being performed. The corresponding opcode is 0x08
l
       Enter 'key' element you need to find: 86
  Load instruction is being performed. The corresponding opcode is 0x00 mov instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x10 SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x0D SLT instruction is being performed. The corresponding opcode is 0x0C load Immediate instruction is being performed. The corresponding opcode is 0x0F beg instruction is being performed. The corresponding opcode is 0x0F mov instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08 Add instruction is being performed. The corresponding opcode is 0x08
```

```
load Immediate instruction is being performed. The corresponding opcode is 0x07 DIU instruction is being performed. The corresponding opcode is 0x05 Load Immediate instruction is being performed. The corresponding opcode is 0x07 Lea instruction is being performed. The corresponding opcode is 0x09 Load instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x08 bne instruction is being performed. The corresponding opcode is 0x06 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 mou instruction is being performed. The corresponding opcode is 0x08 load instruction is being performed. The corresponding opcode is 0x08 load instruction is being performed. The corresponding opcode is 0x02 jump instruction is being performed. The corresponding opcode is 0x02 load Immediate instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x07 beg instruction is being performed. The corresponding opcode is 0x08 load Immediate instruction is being performed. The corresponding opcode is 0x08 load instruction is being performed. The corresponding opcode is 0x09 load Immediate instruction is being performed. The corresponding opcode is 0x09 load Immediate instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x09 load instruction is being performed. The corresponding opcode is 0x09 load Immediate instruction is being performed. The corresponding opcode is 0x09 load Immediate instruction is being performed. The corresponding opcode is 0x09 load I
        The register values are as follows:
       r0:0x0
                                           r1:0x0
                                                                                r2:0x1
                                                                                                                         r3:0x3 r4:0x0 r5:0xfac
                                                                                                                                                                                                                                                                                    r6:0x0 r7:0xfffffff91r8:
                                           r9:0x104
                                                                                                                         r10:0x56
                                                                                                                                                                                                      r11:0x4 r12:0x3 r13:0x90
                                                                                                                                                                                                                                                                                                                                                                   r14:0xff
                                           r15:0xffffff3b
     ffffff
     The flag value is:0x0000
     The instruction pointer value is:0x00000104
     The stack memory is:
Øxed8 3148e913 Øxedc
                                                                                                                         00000000 0xee0
                                                                                                                                                                                                      550aabdb 0xee4
                                                                                                                                                                                                                                                                                     8055bb9a
                                          c60585f1 0xeec
c8eb3ac7 0xefc
                                                                                                                        55b91630 0xef0
02958f32
     0xee8
                                                                                                                                                                                                       fd66ae03 0xef4
                                                                                                                                                                                                                                                                                     6f02ceh4
     Øxef8
```