تمرین ۳

سوال ۱

الف)

Code	Type	Addressing Method
L1 : addi t3, a2, 12	I-Type	Immediate
xori s6, a0, 14	I-Type	Immediate
jal L2	U/J-Type	PC-Relative
sw s5, 4(a0)	S/B-Type	Base
j L1	U/J-Type	PC-Relative
L2 : beq t3, a4, L3	S/B-Type	PC-Relative
lui t4, 0xFF	U/J-Type	Immediate
L3 : lw s4, 8(t1)	I-Type	Base
sub t3, t2, t1	R-Type	Register-Only
jr ra	I-Type	Base

ب)

R-Type:

hex	funct7	rs2	rs1	funct3	rd	op	Assembly
40638E33	0100000	00110	00111	000	11100	0110011	sub t3, t2, t1

I-Type:

hex	imm	rs1	funct3	rd	op	Assembly
00C60E13	000000001100	01100	000	11100	0010011	L1 : addi t3, a2, 12
00E54B13	000000001110	01010	100	10110	0010011	xori s6, a0, 14
00832A03	000000001000	00110	010	10100	0000011	lui t4, 0xFF
00008067	000000000000	00001	000	00000	1100111	jr ra

S/B-Type

hex	imm	rs2	rs1	funct3	imm	op	Assembly
01552223	0000000	10101	01010	010	00100	0100011	sw s5, 4(a0)
00EE0463	0000000	01110	11100	000	01000	1100011	L2 : beq t3, a4, L3

U/J-Type

hex	imm	rd	op	Assembly
00C000EF	00000000110000000000	00001	1101111	jal L2
FF1FF06F	11111111000111111111	00000	1101111	j L1
000FFEB7	00000000000011111111	11101	0110111	lui t4, 0xFF

سوال ۲

الف)

machine code	OP code	Type	addressing mode	Assembly instruction	Label
0x00100293	19	I-Type	Immediate	addi t0,zero,1	L0
0x00a2c463	99	S/B-Type	PC-Relative	blt t0,a0,L1	
0x00008067	103	I-Type	Base	jalr zero,ra,0	
0xff010113	19	I-Type	Immediate	addi sp,sp,-16	L1
0x00a12623	35	S/B-Type	Base	sw a0,12(sp)	
0x00112423	35	S/B-Type	Base	sw ra,8(sp)	
0x00812223	35	S/B-Type	Base	sw s0,4(sp)	
0x00912023	35	S/B-Type	Base	sw s1,0(sp)	
0xfff50513	19	I-Type	Immediate	addi a0,a0,-1	
0xfddff0ef	111	U/J-Type	PC-Relative	jal ra,L0	
0x00a00433	51	R-Type	Register-Only	add s0,zero,a0	
0x00c12503	3	I-Type	Base	lw a0,12(sp)	
0xffe50513	19	I-Type	Immediate	addi a0,a0,-2	
0xfcdff0ef	111	U/J-Type	PC-Relative	jal ra,L0	

machine code	OP code	Type	addressing mode	Assembly instruction	Label
0x00a004b3	51	R-Type	Register-Only	add s1,zero,a0	
0x00848433	51	R-Type	Register-Only	add s0,s1,s0	
0x00040533	51	R-Type	Register-Only	add a0,s0,zero	
0x00812083	3	I-Type	Base	lw ra,8(sp)	
0x00412403	3	I-Type	Base	lw s0,4(sp)	
0x00012483	3	I-Type	Base	lw s1,0(sp)	
0x01010113	19	I-Type	Immediate	addi sp,sp,16	
0x00008067	103	I-Type	Base	jalr zero,ra,0	

ب) تابع ورودی a0 را میگیرد و جمله a0 ام از دنباله فیبوناچی را برمیگرداند.

R-Type

hex	funct7	rs2	rs1	funct3	rd	op	Assembly
00A00433	0000000	01010	00000	000	01000	0110011	add x8,x0,x10
00A004B3	0000000	01010	00000	000	01001	0110011	add x9,x0,x10
00848433	0000000	01000	01001	000	01000	0110011	add x8,x9,x8
00040533	0000000	00000	01000	000	01010	0110011	add x10,x8,x0

I-Type

hex	imm	rs1	funct3	rd	op	Assembly
00100293	000000000001	00000	000	00101	0010011	addi x5,x0,1
00008067	000000000000	00001	000	00000	1100111	jalr zero,ra,0
FF010113	111111110000	00010	000	00010	0010011	addi x2,x2,-16
FFF50513	111111111111	01010	000	01010	0010011	addi x10,x10,-1
00C12503	000000001100	00010	010	01010	0000011	lw x10,12(x2)
FFE50513	111111111110	01010	000	01010	0010011	addi x10,x10,-2
00812083	000000001000	00010	010	00001	0000011	lw x1,8(x2)
00412403	000000000100	00010	010	01000	0000011	lw x8,4(x2)
00012483	000000000000	00010	010	01001	0000011	lw x9,0(x2)
01010113	000000010000	00010	000	00010	0010011	addi x2,x2,16
00008067	000000000000	00001	000	00000	1100111	jalr zero,ra,0

S/B-Type

hex	imm	rs2	rs1	funct3	imm	op	Assembly
00A2C463	0000000	01010	00101	100	01000	1100011	blt x5,x10,8
00A12623	0000000	01010	00010	010	01100	0100011	sw x10,12(x2)
00112423	0000000	00001	00010	010	01000	0100011	sw x1,8(x2)
00812223	0000000	01000	00010	010	00100	0100011	sw x8,4(x2)
00912023	0000000	01001	00010	010	00000	0100011	sw x9,0(x2)

U/J-Type

hex	imm	rd	op	Assembly
FDDFF0EF	11111101110111111111	00001	1101111	jal ra,-36
FCDFF0EF	11111100110111111111	00001	1101111	jal ra,-52

ASSEMBLY:

```
 addi a0,zero,4
L0: addi t0,zero,1
blt t0,a0,L1
jalr zero,ra,0
L1: addi sp,sp,-16
sw a0,12(sp)
sw ra,8(sp)
sw s0,4(sp)
sw s1,0(sp)
addi a0,a0,-1
jal ra,L0
add s0,zero,a0
lw a0,12(sp)
addi a0,a0,-2
jal ra,L0
add s1,zero,a0
add s0,s1,s0
add a0,s0,zero
lw ra,8(sp)
lw s0,4(sp)
lw s1,0(sp)
addi sp,sp,16
jalr zero,ra,0
```

C:

```
int nth_fibo(int n)
{
  int t1 = 0, t2 = 1, nextTerm = 0, i;
  if(n == 0 || n == 1)
    return n;
  else
    nextTerm = t1 + t2;
  for (i = 3; i <= n; ++i)
  {
    t1 = t2;
    t2 = nextTerm;
    nextTerm = t1 + t2;
  }

  return t2;
}
```

سوال ۳

کد اسمبلی:

```
addi s0,zero,10  # arr_size
addi sp,sp,-40

# array initiation: {10,9,8,7,6,5,4,3,2,1}

addi t2,zero,1
sw t2,36(sp)
addi t2,zero,2
sw t2,32(sp)
addi t2,zero,3
sw t2,28(sp)
addi t2,zero,4
sw t2,24(sp)
addi t2,zero,5
sw t2,20(sp)
addi t2,zero,6
sw t2,16(sp)
addi t2,zero,7
sw t2,12(sp)
addi t2,zero,8
sw t2,8(sp)
addi t2,zero,9
sw t2,4(sp)
addi t2,zero,10
sw t2,0(sp)

add s3,zero,sp # to store the address of arr[]
addi s1,zero,1 # to check n with one

MAIN:

    addi s2,zero,2   # i = 2
FOR:
    bge s2,s0,DONE  # branch if i >= arr_size
    lw a0,8(s3)  # a0 = arr[i]
    jal ra,IS_EVEN
IF: beq a0,zero,ELSE
    lw a0,8(s3)  # a0 = arr[i]
    lw a1,0(s3)  # a1 = arr[i-2]
    add t3,a0,a1  # t3 = arr[i] + arr [i-2]
    sw t3,8(s3)  # arr[i] += arr[i-2]
    j FI
ELSE:
    lw a0,8(s3)  # a0 = arr[i]
    add t5,zero,a0
    lw a1,4(s3)  # a1 = arr[i-1]
    addi t4,a1,-1  # i = a1-1
    FOR_2:   # for (int i=a1-1 ; i > 0 ; i++ ) a0+=a0;
        ble t4,zero,ROF_2
        add a0,a0,t5
        addi t4,t4,-1
        j FOR_2
    ROF_2:
    sw a0,8(s3)  # arr[i]*arr[i-1] => arr[i]
FI:
    addi s3,s3,4
    addi,s2,s2,1
    j FOR
DONE:

j END


IS_EVEN:

    bne a0,zero,E_CHECK_ONE
    addi a0,zero,1
    jr ra

    E_CHECK_ONE:
    bne a0,s1,E_NONE
    addi a0,zero,0
    jr ra

    E_NONE:
    addi a0,a0,-1
    addi sp,sp,-4
    sw ra,0(sp)
    jal ra,IS_ODD
    lw ra,0(sp)
    addi sp,sp,4
    jr ra
```

```
IS_ODD:

    bne a0,zero,O_CHECK_ONE
    addi a0,zero,0
    jr ra

    O_CHECK_ONE:
    bne a0,s1,O_NONE
    addi a0,zero,1
    jr ra

    O_NONE:
    addi a0,a0,-1
    addi sp,sp,-4
    sw ra,0(sp)
    jal ra,IS_EVEN
    lw ra,0(sp)
    addi sp,sp,4
    jr ra

END:
```

خروجی نهایی: شروع ارایه از 0x7fffffec تا 0x7fffffc8