S T Q Q S S D

__/__/__

① Considere os seguintes registradores para cada variável

a = $s0, b = $s1, c = $s2, d = $s3, e = $s4, f = $s5

-> Calcule e apresente os 4 passos de conversão apresentados no slide 26

1. a = b - c

(i) Converter a instrução de alto nível para linguagem de montagem

=> SUB $s0, $s1, $s2

(ii) Converter a instrução na linguagem de montagem para linguagem de máquina

=> SUB $16, $17, $18

(iii) Fazer a representação correspondente da linguagem de maquina

=>

OP	rs	rt	rd	shamt	funct
0	17	18	16	0	34

(IV) Converter para código de máquina

=> 00000010001100101000000000100010

S T Q Q S S D

__/__/__

① 2. b = a + c

(i) ADD $s1, $s0, $s2

(ii) ADD $17, $16, $18

(iii)

OP	rs	rt	rd	shamt	funct
0	16	18	17	0	32

(iv) 000000 10000 10010 10001 00000 100000

3. d = (a + b - c)

(i) ADD $T1, $s0, $s1
SUB $s3, $T1, $s2

(ii) ADD $9, $16, $17
SUB $19, $9, $18

(iii)

OP	rs	rt	rd	shamt	funct
0	16	17	9	0	32
0	9	18	19	0	34

(iv) 000000 10000 10001 01001 00000
000000 01001 10010 10011 00010

S T Q Q S S D

__/__/__

④. f = (a + b) - d

(I) ADD $t1, $s0, $s1
SUB $s5, $t1, $s3

(II) ADD $9, $16, $17
SUB $21, $9, $19

(III)

OP	rs	rt	rd	shamt	funct
0	16	17	9	0	32
0	9	19	21	0	34

(IV) 000000 10000 10001 01001 00000 100000
000000 01001 10011 01010 00000 100010

5. c = a - (b + d)

(I) ADD $t1, $s1, $s3
SUB $s2, $s0, $t1

(II) ADD $9, $17, $19
SUB $18, $16, $9

(III)

OP	rs	rt	rd	shamt	funct
0	17	19	9	0	32
0	16	9	18	0	34

(IV) 000000 10001 10011 01001 00000 100000
000000 10000 01001 10010 00000 100010

7. e = (a - (b - c) + f)

(I) SUB $t1, $s1, $s2
SUB $t1, $s0, $t1
ADD $s4, $t1, $s5

(II) SUB $9, $17, $18
SUB $9, $16, $9
ADD $20, $9, $21

(III)

OP	rs	rt	rd	shamt	funct
0	17	18	9	0	34
0	16	9	9	0	34
0	9	21	20	0	32

(IV) 000000 10001 10010 01001 00000 100010
000000 10000 01001 01001 0000 100010
000000 01001 10101 10100 00000 100000

6. e = (a - (b - c))

(I) SUB $t1, $s1, $s2
SUB $s4, $s0, $t1

(II) SUB $9, $17, $18
SUB $20, $16, $9

(III)

OP	rs	rt	rd	shamt	funct
0	17	18	9	0	34
0	16	9	20	0	34

(IV) 000000 10001 10010 01001 00000 100010
000000 10000 01001 10100 00000 100010

S T Q Q S S D

__/__/__

f = e - (a - b) + (b - c)

(I)
```
SUB $t1, $s0, $s4
SUB $t2, $s1, $s2
SUB $t1, $s4, $t1
ADD $s5, $t1, $t2
```

(II)
```
SUB $9, $16, $17
SUB $10, $17, $18
SUB $9, $20, $9
ADD $21, $9, $10
```

(III)

OP	rs	rt	rd	shamt	funct
0	17	9	16	0	34
0	18	10	17	0	34
0	9	9	20	0	34
0	10	21	9	0	32

(IV)
```
00000010001100011000000000100010
00000010010010100011000000100010
00000001001100110100000000100010
00000001010101010010000000100000
```

S T Q Q S S D

__/__/__

② Converta as instruções abaixo

1. a = b[15] - c
2. b = a[5] + c[3]
3. c = b - a[21]

→ Use $s0 para "a", $s1 para b e $s2 para c

1 a = b[15] - c

(i) LW $t0, 15($s1)
SUB $s0, $t0, $s1

(ii) LW $8, 15($17)
SUB $16, $8, $17

(III)

OP	rs	rt	rd	shamt	funct
35	8	17	15		
0	8	17	16	0	34

(IV) 100011010001000100000 00000 001111
000000010001000110000 00000 100010

S T Q Q S S D

__/__/__

② 2. b = a[5] + c[3]

(I) LW $t0, 5($s0)
LW $t1, 3($s2)
ADD $s1, $t0, $t1

(II) LW $8, 5($16)
LW $9, 3($18)
ADD $17, $8, $9

(III)

OP	rs	rt	rd	shamt	funct
35	8	16	5		
35	9	18	3		
0	8	9	17	0	32

(IV) 100 011 01000 10000 0000000000000101
100 011 01001 10010 0000000000000011
000 00010000100 11000 100000 100000

3. c = b - a[21]

(I) LW $t0, 21($s0)
SUB $s2, $s1, $t0

(II) LW $8, 21($16)
SUB $18, $17, $8

(III)

OP	rs	rt	rd	shamt	funct
35	8	16	21		
0	17	8	18	0	34

(IV) 100011 01000 10000 0000000000010101
000000 10001 01000 10010 00000 100010

spiral

S T Q Q S S D

__/__/__

③ Converta as instruções abaixo

1. a[10] = b - c
2. b[245] = a + c
3. c[0] = b - a

→ Use $s0 para a, $s1 para b e $s2 para c

1. a[10] = b - c

(I) SUB $t0, $s1, $s2
SW $t0, 10($s0)

(II) SUB $8, $17, $18
SW $8, 10($16)

(III)

	OP	rs	rt	rd	shamt	funct
	0	17	18	8	0	34
	43	8	16	10		

(IV) 000000 10001 10010 01000 00000 100010
10101 01000 10000 0000 0000 001010

S T Q Q S S D

__/__/__

③ 2. b[245] = a + c

(I) ADD $to, $s0, $s2
SW $to, 245($s1)

(II) ADD $8, $16, $18
SW $8, 245($17)

(III)

OP	rs	rt	rd	shamt	funct
0	16	18	8	0	32
43	8	17	245		

(IV) 000 000 10000 10010 01000 00000 100000
10101101000 1000 100000 0001111 01 01

3. c[0] = b - a

(I) SUB $to, $s1, $s0
SW $to, 0($s2)

(II) SUB $8, $17, $16
SW $8, 0($18)

(III)

OP	rs	rt	rd	shamt	funct
0	17	16	8	0	34
43	8	18	0		

(IV) 000000 10001 10000 01000 00000 100010
10110 10001 0000 10010 00000 00000 00000

S T Q Q S S D

__/__/__

④ Converta as seguintes instruções considerando a = $s0, b = $s1, c = $s2, d = $s3

a) a[34] = b[3] + c - d

(i) LW $t0, 3($s1)
ADD $t1, $t0, $s2
SUB $t1, $t1, $s3
SW $t1, 34($s0)

(ii) LW $8, 3($17)
ADD $9, $8, $18
SUB $9, $9, $19
SW $9, 34($16)

(iii)

OP	rs	rt	rd	shamt	funct
35	3	17	3		
0	3	18	9	0	32
0	9	19	9	0	34
43	9	16	34		

(iv) 100011 01000 10001 00000 00000 000011
000000 01000 10010 01001 00000 100000
000000 01001 10011 01001 00000 100010
101011 01001 10000 00000 00000 100010

④ b. a[45] = b - c + a[67]

(I) LW $t0, 67($s3)
SUB $t1, $s1, $s2
ADD $t1, $t1, $t0
SW $t1, 45($s0)

(II) LW $s, 67($19)
SUB $9, $17, $18
ADD $9, $9, $8
SW $9, 45($16)

(III)

	OP	rs	rt	rd	shamt	funct
	35	8	19	67		
	0	17	13	9	0	34
	0	9	8	9	0	32
	43	9	16	45		

(IV) 10001101000100110000000000100011
00000010001100101001000000100010
00000001001010000100100000100000
10101101001100000000000000101101

S T Q Q S S D

__/__/__

④ c) a[79] = b - c[18] + d

(I)
LW $t0, 18($s2)
SUB $t1, $s1, $t0
ADD $t1, $t1, $s3
SW $t1, 79($s0)

(II)
LW $8, 18($18)
SUB $9, $17, $8
ADD $9, $9, $19
SW $9, 79($16)

(III)

OP	rs	rt	rd	shamt	funct
35	8	18	18		
0	17	8	9	0	34
0	9	19	9	0	32
43	9	16	79		

(IV) 100011 01000 10010 00000 00000 100011
000000 10001 01000 01001 00000 100010
000000 01001 10011 01001 00000 100000
101011 01001 10000 00000 00010 1111

S T Q Q S S D

__/__

④ a) a[32] = b[2] - c[4]

(I)
```
LW $t0, 2($s1)
LW $t1, 4($s2)
SUB $t2, $t0, $t1
SW $t2, 32($s0)
```

(II)
```
LW $s, 2($17)
LW $9, 4($18)
SUB $10, $s, $9
SW $10, 32($16)
```

(III)

OP	rs	rt	rd	shamt	funct
35	s	17	2		
35	9	18	4		
0	9	10	8	0	34
43	10	16	32		

(IV)
```
100 011 01000 00000000000000010
100 011 01001 00000000000000100
000 000 01001 01000 00000 100010
101 011 01010 00000 00001 000010
```