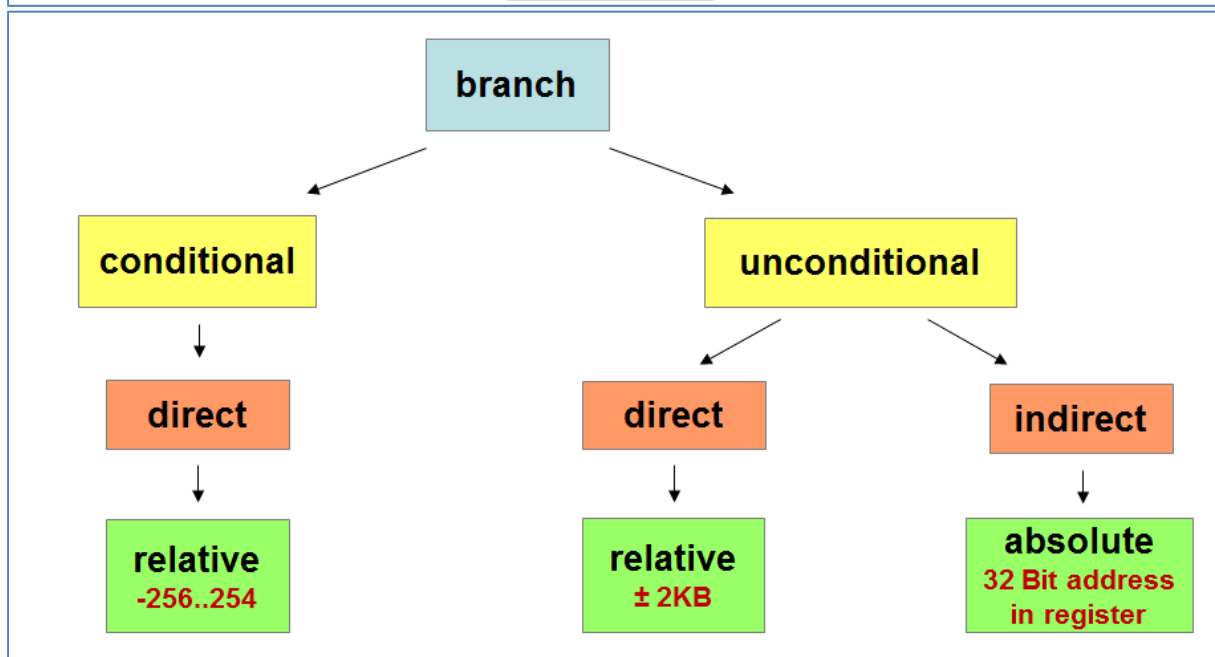
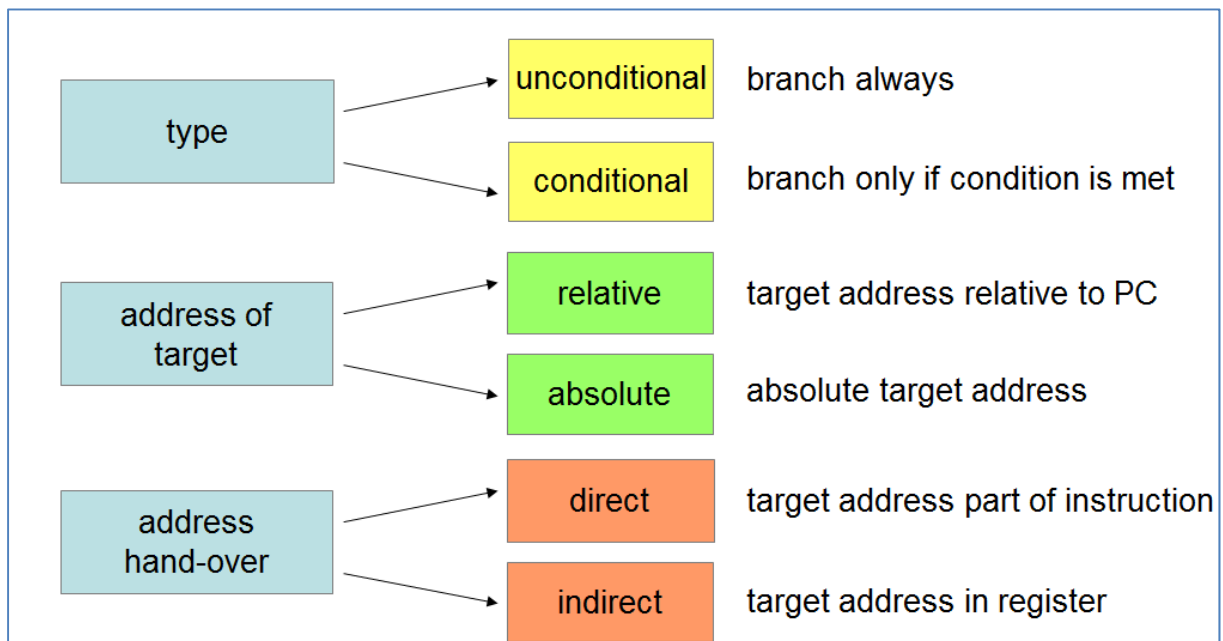


## CT1 Exercises for Branching Instructions

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## Exercise 1 – Unconditional Branches

The execution starts at line 10.

- 1) List the sequence of branch instructions that end in an infinite loop.  
Do this by stating the branches in tabular form: *from – to*.  
E.g. the first branch is **11 – 16** (branch unconditionally from line 11 to line 16).
- 2) At which line does the execution sequence finally loop forever?

10	Label1	LDR	R0, =Label5
11	Label2	BX	R0
12	Jumptable	DCD	Case0
13		DCD	Case1
14		DCD	Case2
15		DCD	Case3
16	Label5	LDR	R0, =Label6
17		B	Label2
18	Label6	LDR	R2, =Jumptable
19		ADDS	R2, R2, #4
20	Label4	LDR	R2, [R2]
21		BX	R2
22	Case0	B	Case0
23	Case1	LDR	R2, =Jumptable
24		MOVS	R1, #3
25		LSLS	R1, R1, #2
26		ADDS	R2, R2, R1
27		B	Label4
28	Case2	B	Label1
29	Case3	B	Case0

Your solution (the number of cells below is no hint)

1) 

11-16								
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2) .....

## Exercise 2 – Conditional Branches

The execution starts at line 10.

- 1) List which branch instructions jump to the given label.  
Do this by stating the branches in tabular form: *from – to*.
- 2) What is the final value in R0 as hexadecimal value?

10		LDR R1, =0xFFFFFFFF-5	
11		LDR R2, =10	
12		LDR R3, =0x2341	
13			
14		MOVS R0, #0	; mask of branches that are not taken
15			
16	Label11	ADDS R1, R1, #5	
17		BCS Label12	
18		ADDS R0, R0, #0x01	; set flag if no branch
19	Label12	ADDS R1, R1, #1	
20		BCS Label13	
21		ADDS R0, R0, #0x02	; set flag if no branch
22	Label13	LDR R5, =0x0F18C	
23		ANDS R1, R1, R5	
24		BEQ Label21	
25		ADDS R0, R0, #0x04	; set flag if no branch
26			
27	Label21	LDR R5, =2000	
28		SUBS R2, R2, R5	
29		BVS Label22	
30		ADDS R0, R0, #0x08	; set flag if no branch
31	Label22	LDR R5, =0x7FFFFFFF	
32		SUBS R2, R2, R5	
33		BVS Label23	
34		ADDS R0, R0, #0x10	; set flag if no branch
35	Label23	ADDS R2, R2, #1	
36		BMI Label31	
37		ADDS R0, R0, #0x20	; set flag if no branch
38			
39	Label31	LSRS R3, R3, #1	
40		BCS Endless	
41		ADDS R0, R0, #0x40	; set flag if no branch
42			
43	Endless	B Endless	

Your solution (the number of cells below is no hint)

1) 

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2) R0 = 0x.....

### Exercise 3 – Comparison Instructions

The execution starts at line 10.

- 1) List which branch instructions jump to the given label.  
Do this by stating the branches in tabular form: *from – to*.
- 2) What is the final value in R0 as hexadecimal value?

10		LDR	R1, =0xFFFFFFFF	
11		LDR	R2, =0x80000000	
12		LDR	R3, =0x9CFA0000	
13		LDR	R4, =0xC2350000	
14				
15		MOVS	R0, #0	; mask of branches that are not taken
16				
17	Label11	CMP	R1, #1	
18		BLT	Label12	
19		ADDS	R0, R0, #0x01	; set flag if no branch
20	Label12	CMP	R1, #1	
21		BLO	Label21	
22		ADDS	R0, R0, #0x02	; set flag if no branch
23				
24	Label21	LDR	R5, =0x7FFFFFFF	
25		CMP	R2, R5	
26		BGT	Label22	
27		ADDS	R0, R0, #0x04	; set flag if no branch
28	Label22	LDR	R5, =0x7FFFFFFF	
29		CMP	R2, R5	
30		BHI	Label31	
31		ADDS	R0, R0, #0x08	; set flag if no branch
32				
33	Label31	LDR	R5, =0x0040FFFF	
34		TST	R3, R5	
35		BNE	Label32	
36		ADDS	R0, R0, #0x10	; set flag if no branch
37	Label32	TST	R3, R5	
38		BEQ	Label41	
39		ADDS	R0, R0, #0x20	; set flag if no branch
40				
41	Label41	LDR	R5, =0x02100000	
42		TST	R4, R5	
43		BEQ	Label42	
44		ADDS	R0, R0, #0x40	; set flag if no branch
45	Label42	LDR	R5, =0x10080000	
46		TST	R4, R5	
47		BEQ	Endless	
48		ADDS	R0, R0, #0x80	; set flag if no branch
49				
50	Endless	B	Endless	

Your solution (the number of cells below is no hint)

1) 

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2) R0 = 0x.....

## Solutions

Exercise 1:

- 1) 10 – 16, 17 – 11, 11 – 18, 21 – 23, 27 – 20, 21 – 29, 29 – 22, 22 – 22 ...
- 2) Loops at line 22

Exercise 2:

- 1) 20 – 22, 24 – 27, 33 – 35, 40 – 43
- 2) 0x29 (binary 0010'1001)

Exercise 3:

- 1) 18 – 20, 30 – 33, 35 – 37, 47 – 50
- 2) 0x66 (binary 0110'0110)