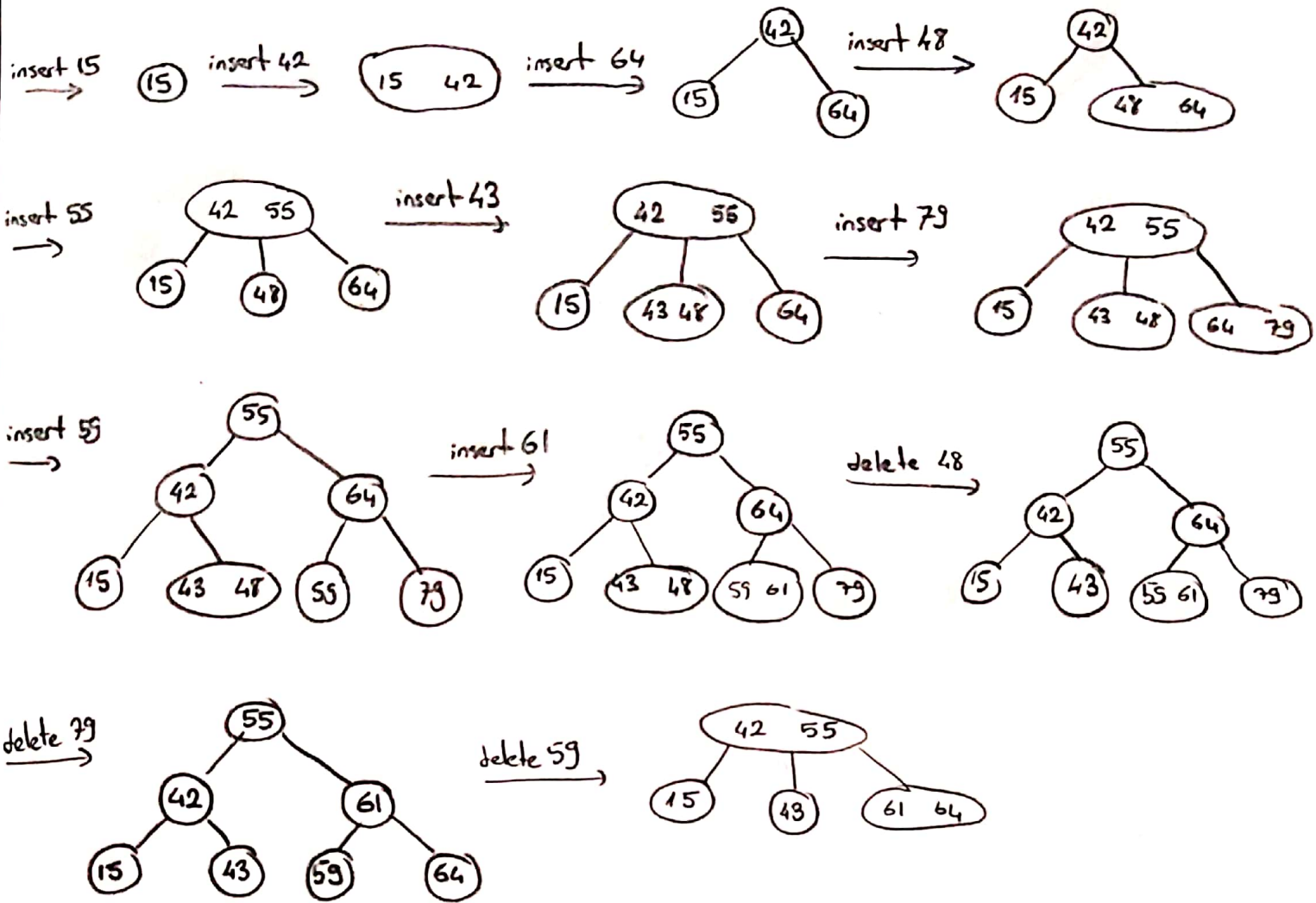
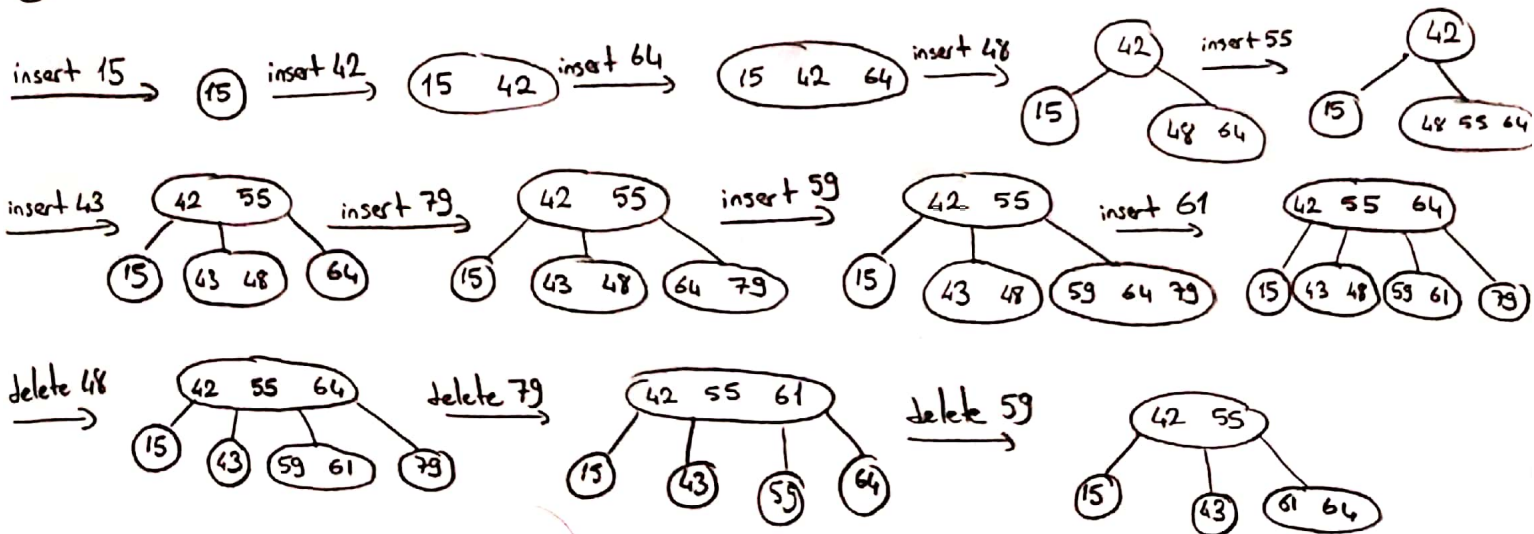


Q1

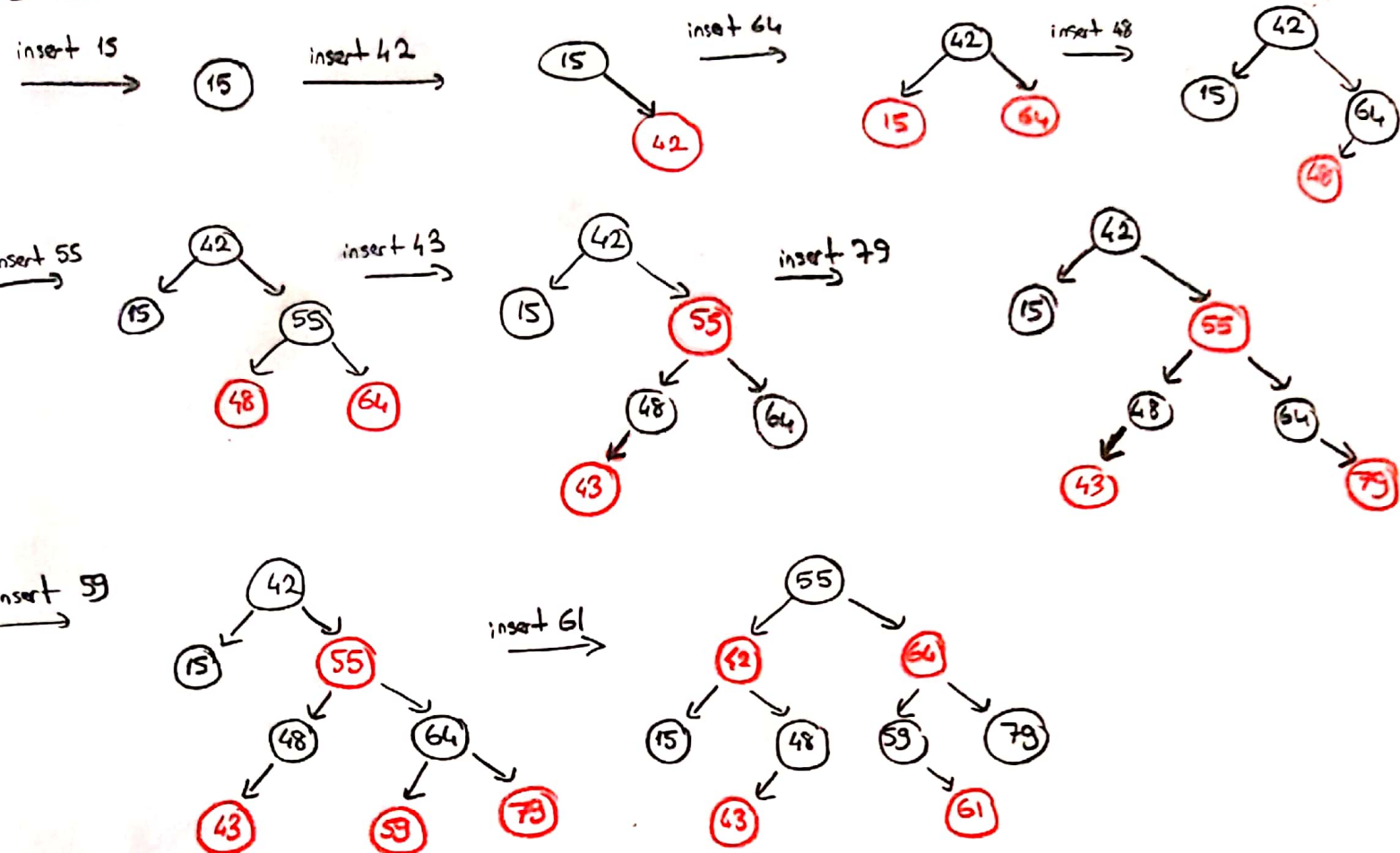
* 2-3 Tree:



* 2-3-4 Tree



* Red-black tree



Q2 |

* Open Addressing with Linear Probing

$$h(x) = x \bmod (17)$$

22 mod (17) = 5
 23 mod (17) = 6
 24 mod (17) = 7
 39 mod (17) = 5 → 6 → 7 → 8 ✓
 40 mod (17) = 6 → 7 → 8 → 9 ✓
 26 mod (17) = 9 → 10 ✓
 41 mod (17) = 7 → 8 → 9 → 10 → 11 ✓
 43 mod (17) = 9 → 10 → 11 → 12 ✓
 26 mod (17) = 9 → 10 → 11 → 12 → 13 ✓

	0
	1
	2
	3
	4
22	5
23	6
24	7
39	8
40	9
26	10
41	11
43	12
26	13
	14
	15
	16

* Open Addressing with Quadratic Probing

$$h(x) = x \bmod (17)$$

$$22 \bmod (17) \equiv 5$$

$$23 \bmod (17) \equiv 6$$

$$24 \bmod (17) \equiv 7$$

$$39 \bmod (17) \equiv 5 \rightarrow (5+1^2) = 6 \rightarrow 5+2^2 = 9 \checkmark$$

$$40 \bmod (17) \equiv 6 \rightarrow 6+1^2 = 7 \rightarrow 6+2^2 = 10 \checkmark$$

$$26 \bmod (17) \equiv 9 \rightarrow 9+1^2 = 10 \rightarrow 9+2^2 = 13 \checkmark$$

$$41 \bmod (17) \equiv 7 \rightarrow 7+1^2 = 8 \checkmark$$

$$43 \bmod (17) \equiv 9 \rightarrow 9+1^2 = 10 \rightarrow 9+2^2 = 13 \rightarrow 9+3^2 = 18 \equiv 1 \checkmark$$

$$26 \bmod (17) \equiv 9 \rightarrow 9+1^2 = 10 \rightarrow 9+2^2 = 13 \rightarrow 9+3^2 = 18 \equiv 1 \rightarrow 9+4^2 = 25 \equiv 8 \rightarrow 9+5^2 = 34 \equiv 0 \checkmark$$

26	0
43	1
:	
22	5
23	6
24	7
41	8
39	9
40	10
:	
26	13
:	
	16

* Separate Chaining

$$h(x) = x \bmod (17)$$

$$22 \bmod (17) \equiv 5$$

$$23 \bmod (17) \equiv 6$$

$$24 \bmod (17) \equiv 7$$

$$39 \bmod (17) \equiv 5$$

$$40 \bmod (17) \equiv 6$$

$$26 \bmod (17) \equiv 9$$

$$41 \bmod (17) \equiv 7$$

$$43 \bmod (17) \equiv 9$$

$$26 \bmod (17) \equiv 9$$

