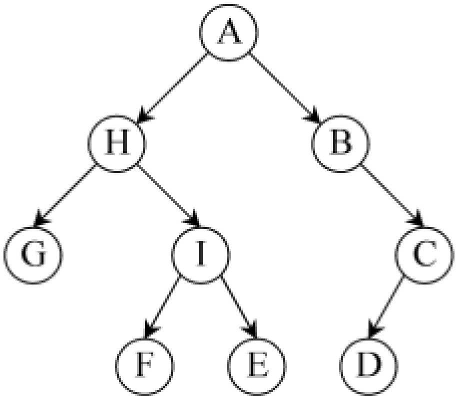
Joseph Edradan
4/18/19
CIS 279 & CIS 256

Assignment #3-A: Binary Trees and AVL Trees

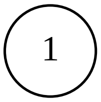
Exercise 1: Determine the Order



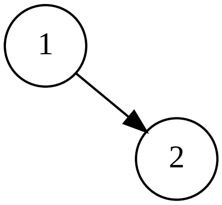
Pre-Order – A, H, G, I, F, E, B, C, D
In-Order – G, H, F, I, E, A, B, D, C
Post-Order – G, F, E, I, H, D, C, B, A

Exercise 2: Insert and Rotate

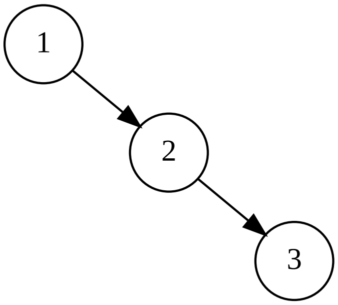
Insert 1



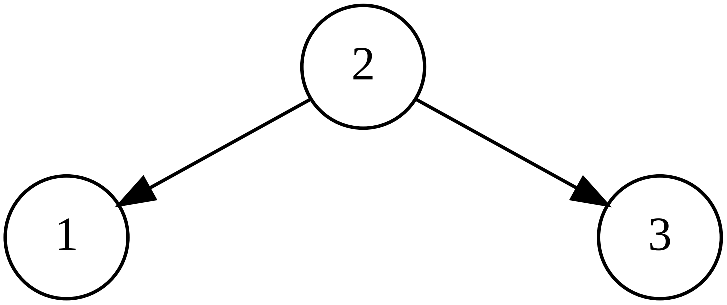
Insert 2



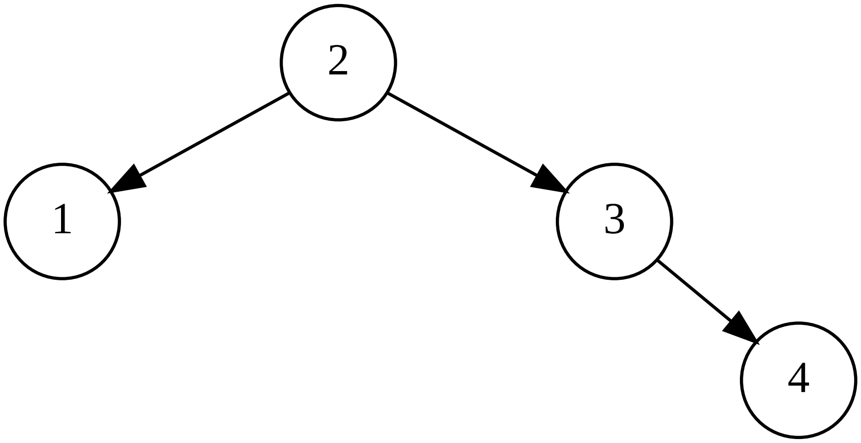
Insert 3 → Rotate Left



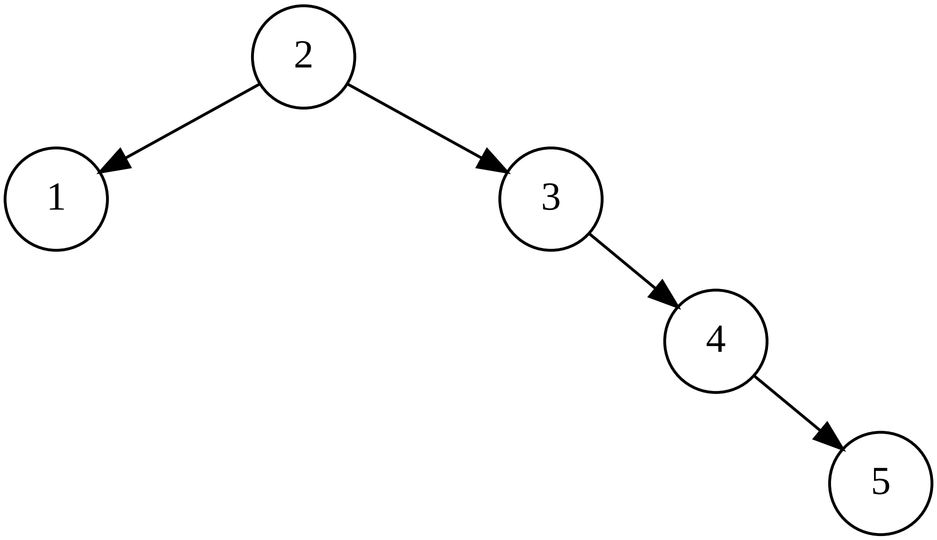
Rotate Left Result



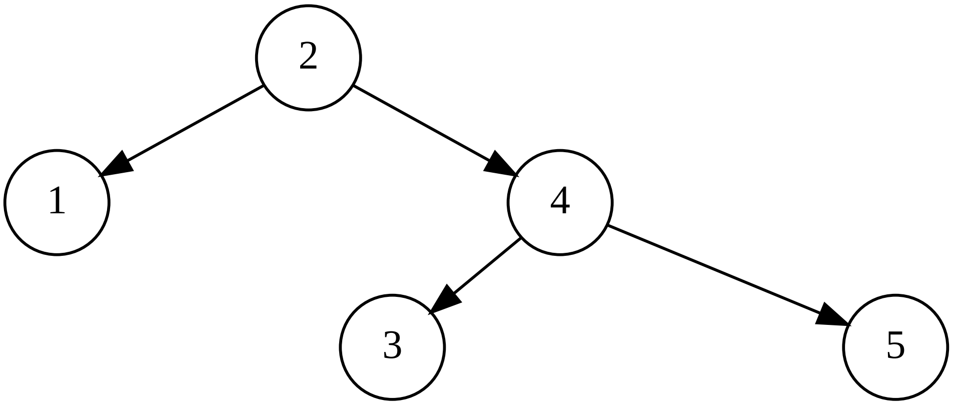
Insert 4



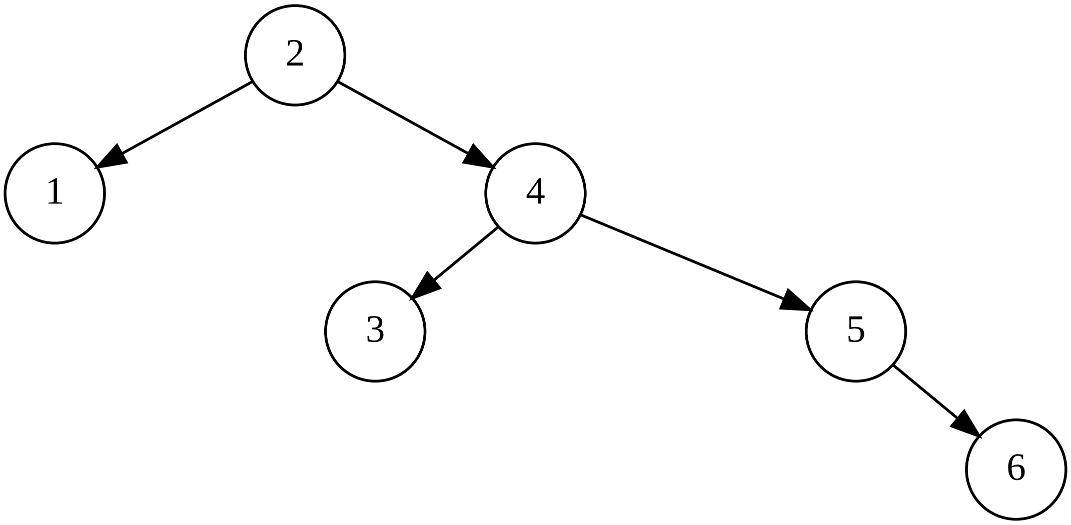
Insert 5 → Rotate Left



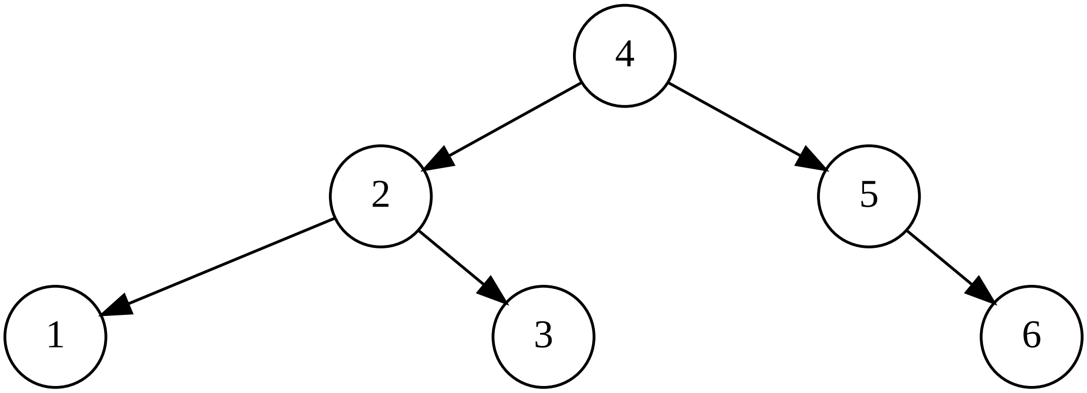
Rotate Left Result



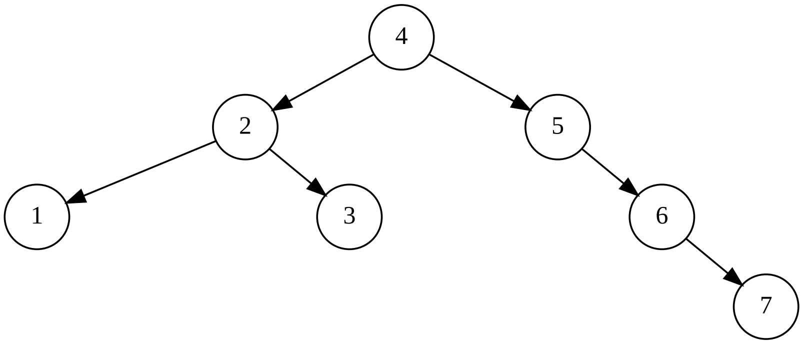
Insert 6 → Rotate Left



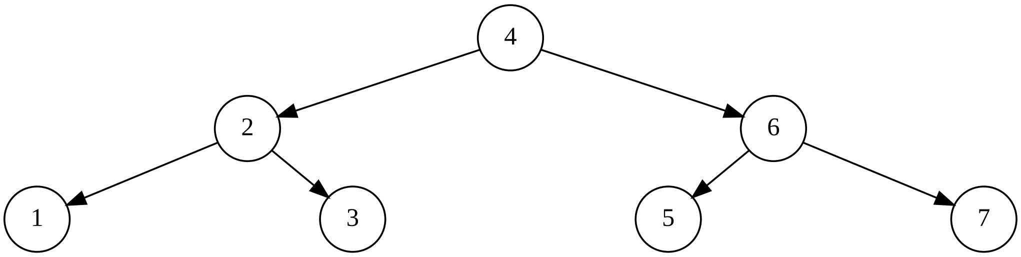
Rotate Left Result



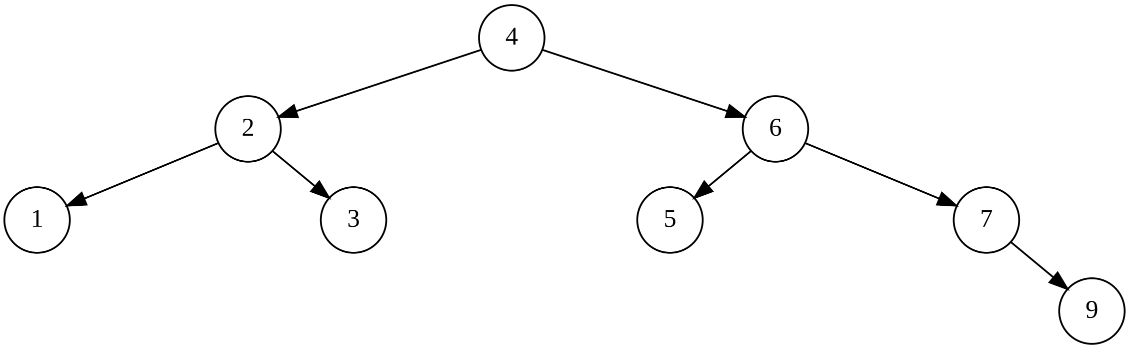
Insert 7 → Rotate Left



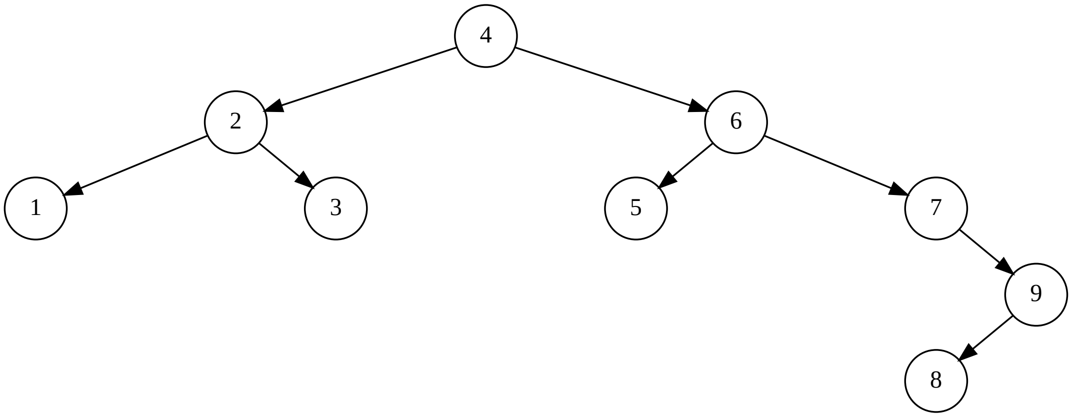
Rotate Left Result



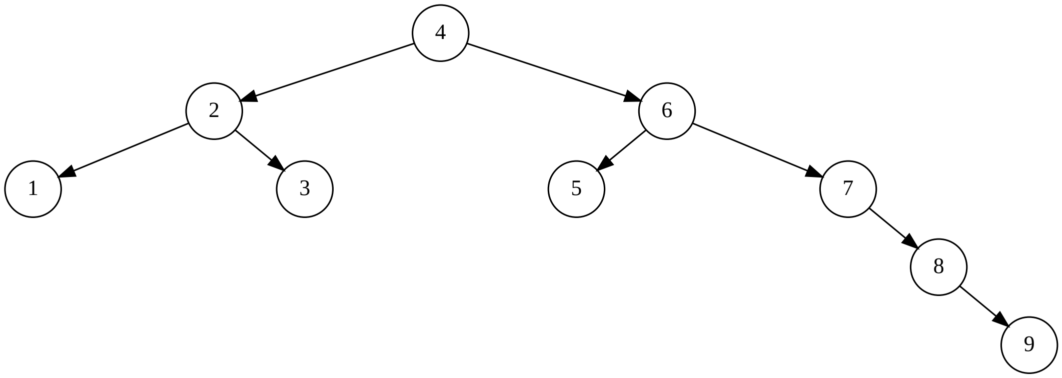
Insert 9



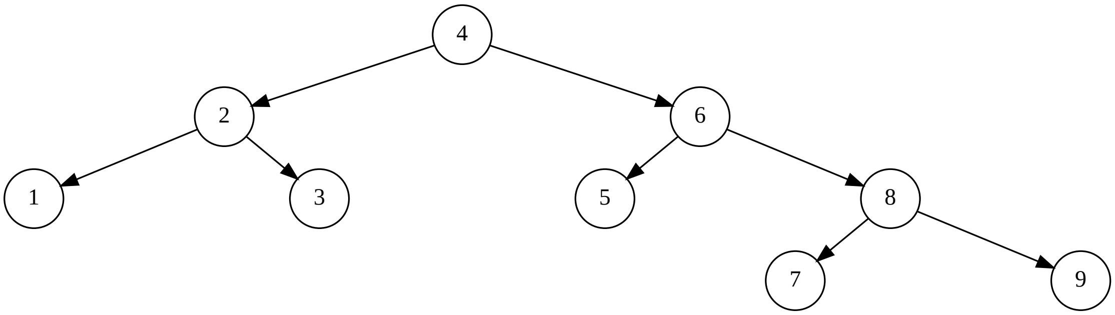
Insert 8 → (Double Rotate) Rotate Right



Rotate Right Result → Rotate Left

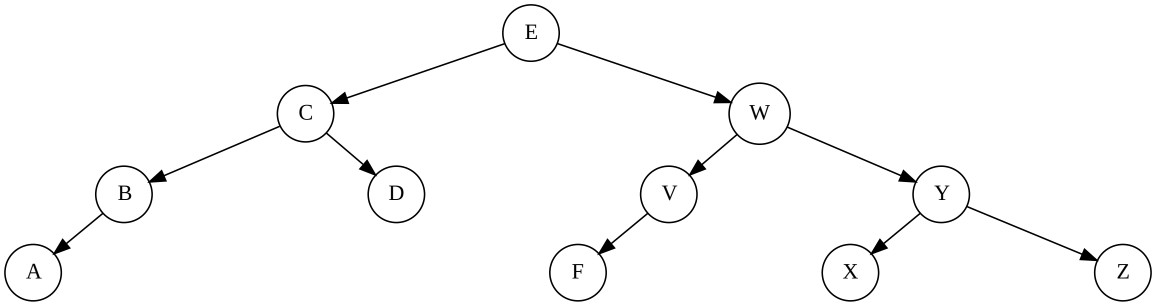


Rotate Left Result

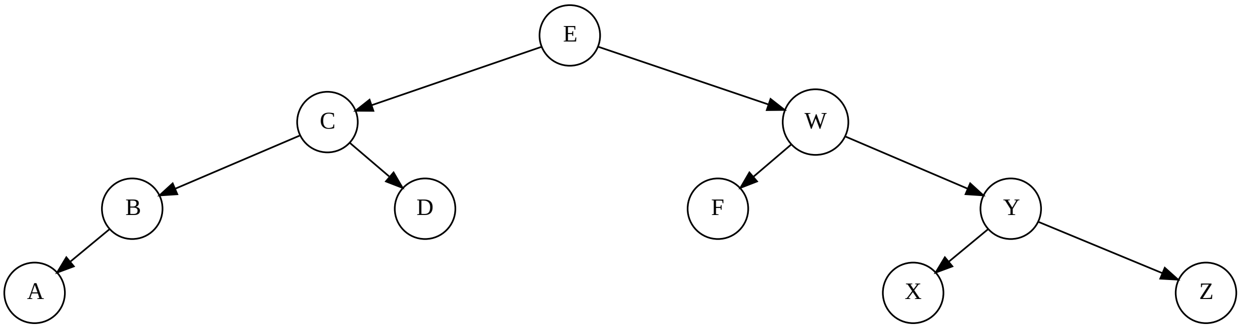


Exercise 3: Delete and Rotate

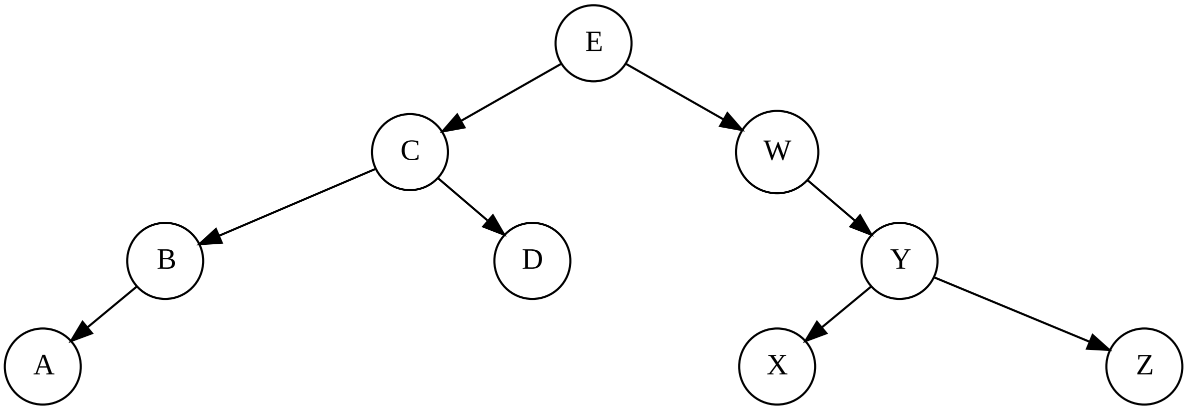
Given AVL Tree



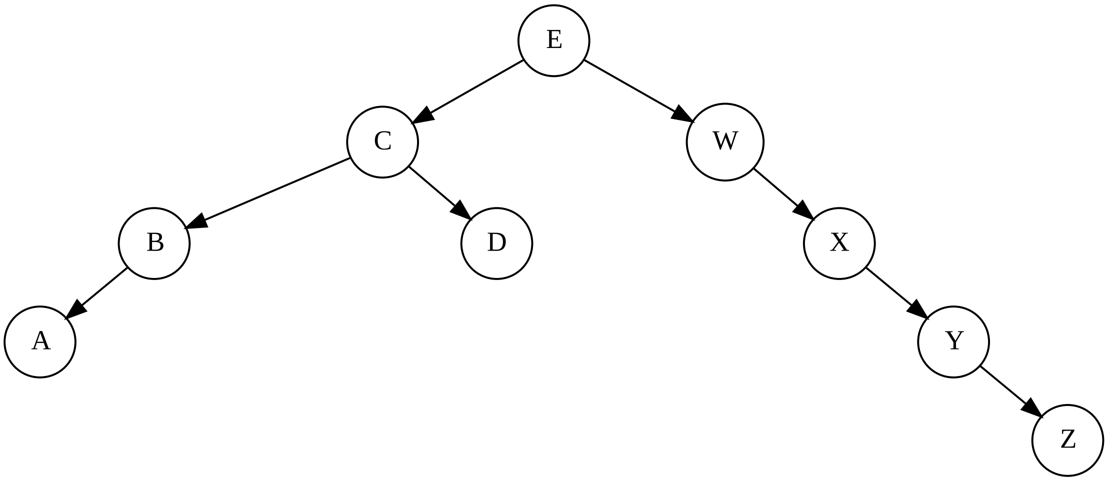
Delete V



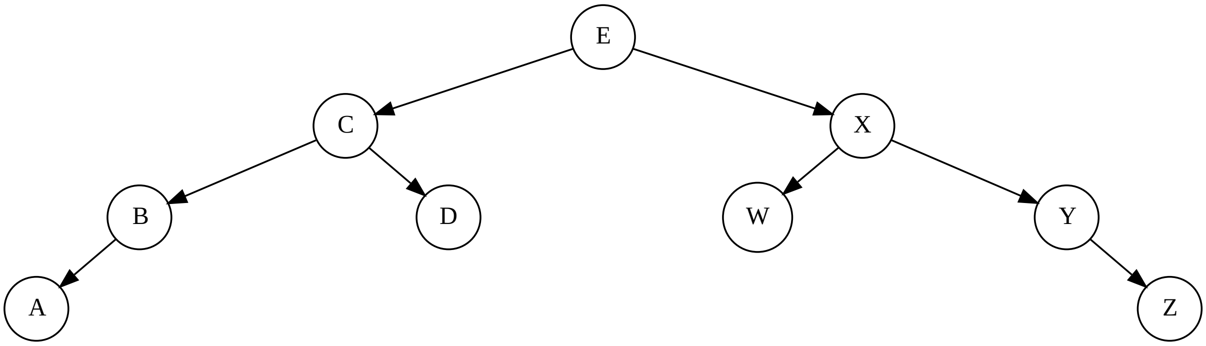
Delete F → (Double Rotate could have been one Left Rotate instead) Rotate Right



Rotate Right Result → Rotate Left



Rotate Left Result



Assignment #3-B: Hash Functions & Hash Tables

Given input { 66, 28, 43, 29, 44, 69, 19 } and a hash $h(\mathrm{x}) = \mathrm{x} \bmod 10$, show the resulting hash table:

1. Using Separate Chaining

Function	Index	Index	Element		
h(66) =	6	0			
h(28) =	8	1			
h(43) =	3	2	43		
h(29) =	9	3	44		
h(44) =	4	4			
h(69) =	9	5	66		
h(19) =	9	6			
		7			
		8	28		
		9	19	69	29

2. Using Linear Probing

Where $f(\mathrm{y}) = \mathrm{y}$

Function	Index	Index	Element
h(66 + f(0)) =	6	0	69
h(28 + f(0)) =	8	1	19
h(43 + f(0)) =	3	2	
h(29 + f(0)) =	9	3	43
h(44 + f(0)) =	4	4	44
h(69 + f(0)) =	9	5	
h(69 + f(1)) =	0	6	66
h(19 + f(0)) =	9	7	
h(19 + f(1)) =	0	8	28
h(19 + f(2)) =	1	9	29

3. Using Quadratic Probing

Where $f(y) = y^2$

Function	Index
h(66 + f(0)) =	6
h(28 + f(0)) =	8
h(43 + f(0)) =	3
h(29 + f(0)) =	9
h(44 + f(0)) =	4
h(69 + f(0)) =	9
h(69 + f(1)) =	0
h(19 + f(0)) =	9
h(19 + f(1)) =	0
h(19 + f(2)) =	3
h(19 + f(3)) =	8
h(19 + f(3)) =	5

Index	**Element**
0	69
1	
2	
3	43
4	44
5	19
6	66
7	
8	28
9	29

4. Starting with the following hash function: $h_2(x) = 7 - (x \; mod \; 7)$, apply Rehashing as described in the primary course slides.

Since load factor is

$$\lambda = \frac{(Number\ of\ elements\ in\ Table)}{(Size\ of\ Table)} = \frac{7}{7} = 1 > .5$$

The equation must be rehashed using the next prime number that is greater than the new table size where the table size is doubled to 14.

$$h_3(x) = 7 - (x \; mod \; 17), \qquad where\ \lambda \approx .411764$$

If we are changing the hashing function, why not remove the "7 − " portion to not deal with negatives due to the range of mod 17 being from 0 to 16. Why make a hashing function unnecessarily complicated?

$$h_4(x) = (x \; mod \; 17)$$

Function	Index
h(66) =	15
h(28) =	11
h(43) =	9
h(29) =	12
h(44) =	10
h(69) =	1
h(19) =	2

Index	**Element**
0	
1	69
2	19
3	
4	
5	
6	
7	
8	
9	43
10	44
11	28
12	29
13	
14	
15	66
16	
17	