

DEMOCRAT  
 ↓ ↓ ↓ ↓ ↓ ↓  
 4 5 13 15 3 18

$$\text{hash}(T) = 11K \% 5 =$$

Problem #1

0 | E | → O | → T |

1 | A |

2

3 | M | → C | → R |

4 | D |

$$\rightarrow D \Rightarrow \text{hash}(4) = 44 \% 5 = 4$$

$$\rightarrow E \Rightarrow \text{hash}(5) = 55 \% 5 = 0$$

$$\rightarrow M \Rightarrow \text{hash}(13) = 143 \% 5 = 3$$

$$\rightarrow O \Rightarrow \text{hash}(15) = 165 \% 5 = 0$$

$$\rightarrow C \Rightarrow \text{hash}(3) = 38 \% 5 = 3$$

$$\rightarrow R \Rightarrow \text{hash}(18) = 198 \% 5 = 3$$

$$\rightarrow A \Rightarrow \text{hash}(11) = 11 \% 5 = 1$$

$$\rightarrow T \Rightarrow \text{has}(20) = 220 \% 5 = 0$$



R	E	P	U	B	L	I	C	A	N
18	5	16	21	2	12	9	3	1	14

Problem#2 hash function =  $h(k) \text{ Mod } M$

Letter	R	E	P	U	B	L	I	C	A	N
Function key	6	7	0	7	6	4	3	1	11	10

Hash table

M	
0	P
1	C
2	
3	I
4	L
5	
6	R
7	E
8	U
9	B
10	N
11	A
12	
13	
14	
15	

//using Linear Probing  
if key  $h(k)$  has value  
look for empty space in  
 $k+1, k+2, \dots$



# R E P U B L I C A N

Problem #3 Using the previous REPUBLICAN Table as reference

→ Insert  $17K \bmod 16$   $(\text{hashkey}(x) + i^2) \% 16$

$$R = (11 \cdot 18) \% 16 = 6$$

$$E = 7$$

$$P = 0$$

$$U = 7 \Rightarrow ((21 + 1^2) \cdot 11) \% 16 = 2$$

$$B = 6 \Rightarrow ((2 + 1^2) \cdot 11) \% 16 = 1$$

$$L = 4$$

$$I = 3$$

$$C = 1 \Rightarrow ((3 + 1^2) \cdot 11) \% 16 = 12$$

$$A = 11$$

$$N = 10$$

	Hash table
0	P
1	B
2	U
3	I
4	L
5	
6	R
7	E
8	
9	
10	N
11	A
12	C
13	
14	
15	



A N O T H E R X M P L  
 1 14 15 20 8 5 18 24 13 16 12

Prob #4

$h_1(x) \rightarrow$   
 hash function  $(11K \bmod 16)$

$h_2(x) \Rightarrow (K \bmod 3) + 1$

- $A = 11 \cdot 11 \bmod 16 = 11$
- $N = 14 \cdot 11 \bmod 16 = 10$
- $O = 15 \cdot 11 \bmod 16 = 5$
- $T = 20 \cdot 11 \bmod 16 = 12$
- $H = 8 \cdot 11 \bmod 16 = 8$
- $E = 5 \cdot 11 \bmod 16 = 7$
- $R = 18 \cdot 11 \bmod 16 = 6$
- $X = 24 \cdot 11 \bmod 16 = 8$

Using second function  
 if collision occurs

$$\hookrightarrow h_2 = (24 \% 3) + 1 = 1$$

- $M = 13 \cdot 11 \bmod 16 = 15$
- $P = 16 \cdot 11 \bmod 16 = 0$
- $L = 12 \cdot 11 \bmod 16 = 4$

0	P
1	X
2	
3	
4	L
5	O
6	R
7	E
8	H
9	
10	N
11	A
12	T
13	
14	
15	