Data Structures
Hashing – Introduction

Team Emertxe

Hashing -Collision Resolution Technique

Concept

- **Collision Resolution Technique**
  - Open Addressing
    - Linear Probing
    - Quadratic Probing
  - Direct Chaining

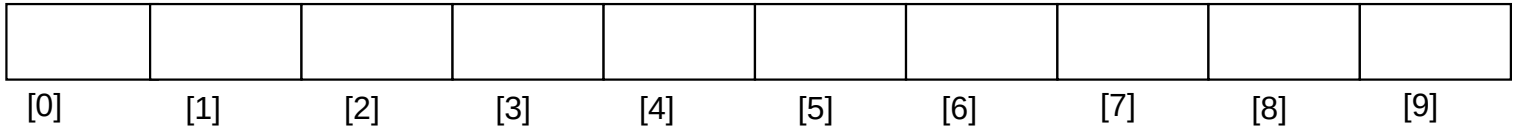
Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2

Hash Function h(x) =data % SIZE

Hash Table



ΣMERTXE

Concept

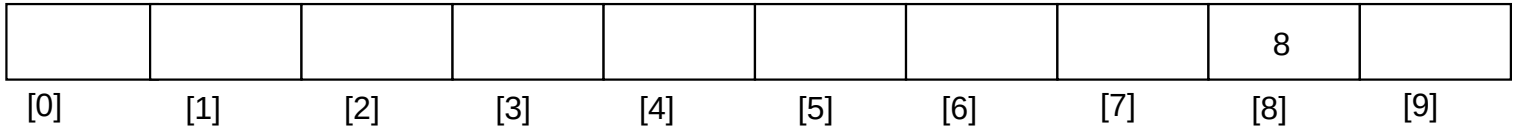
SIZE =10

Data Pool 8, 5 , 3 , 7, 2

Hash Function h(x) =data % SIZE

h(x) = 8 % 10 = 8

Hash Table



ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2

Hash Function h(x) =data % SIZE

h(x) = 8 % 10 = 8

h(x) = 5 % 10 = 5

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
					5			8	

EMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2

Hash Function h(x) =data % SIZE

h(x) = 8 % 10 = 8

h(x) = 5 % 10 = 5

h(x) = 3 % 10 = 3

h(x) = 7 % 10 = 7

h(x) = 2 % 10 = 2

Hash Table

		2	3		5		7	8	
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50

Hash Function h(x) =data % SIZE

h(x) = 8 % 10 = 8

h(x) = 5 % 10 = 5

h(x) = 3 % 10 = 3

h(x) = 7 % 10 = 7

h(x) = 2 % 10 = 2

h(x) = 50 % 10 = 0

Hash Table

50		2	3		5		7	8	
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

EMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h(x) = 8 % 10 = 8

h(x) = 5 % 10 = 5

h(x) = 3 % 10 = 3

h(x) = 7 % 10 = 7

h(x) = 2 % 10 = 2

h(x) = 50 % 10 = 0

h(x) = 22 % 10 = 2

Hash Table

50		2	3		5		7	8	
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

EMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h(x) = 8 % 10 = 8

h(x) = 5 % 10 = 5

h(x) = 3 % 10 = 3

h(x) = 7 % 10 = 7

h(x) = 2 % 10 = 2

Collision

h(x) = 50 % 10 = 0

h(x) = 22 % 10 = 2

Hash Table

50		2	3		5		7	8	
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

ΣMERTXE

Linear Probing

Linear Probing

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h'(x) = h(x) + i

h(x) = 2 % 10 = 2

h(x) = 22 % 10 = 2

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Linear Probing

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h'(x) = h(x) + i where i = 1,2.....SIZE

h(x) = 2 % 10 = 2

h'(x) = 2 + 1 = 3

h(x) = 22 % 10 = 2

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Linear Probing

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h'(x) = h(x) + i where i = 1,2.....SIZE

h(x) = 2 % 10 = 2

h'(x) = 2 + 2 = 4

h(x) = 22 % 10 = 2

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Linear Probing

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h'(x) = h(x) + i where i = 1,2.....SIZE

h(x) = 2 % 10 = 2

h'(x) = 2 + 2 = 4

h(x) = 22 % 10 = 2

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Linear Probing

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h'(x) = h(x) + i where i = 1,2.....SIZE

h(x) = 2 % 10 = 2

h'(x) = 2 + 2 = 4

h(x) = 22 % 10 = 2

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3	22	5		7	8	

ΣMERTXE

Linear Probing

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

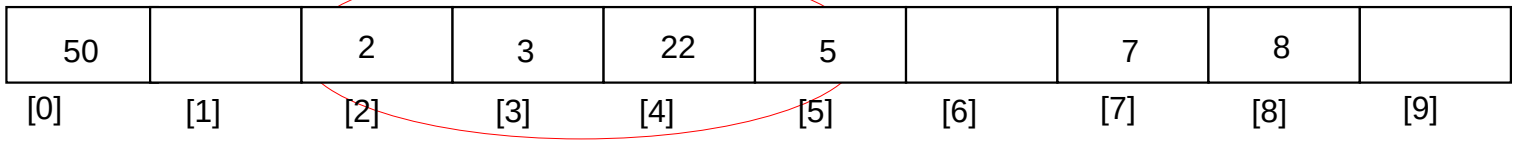
h'(x) = h(x) + i where i = 1,2.....SIZE

h(x) = 2 % 10 = 2

h'(x) = 2 + 2 = 4

h(x) = 22 % 10 = 2

Hash Table



Quadratic Probing

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h(x) = 8 % 10 = 8

h(x) = 5 % 10 = 5

h(x) = 3 % 10 = 3

h(x) = 7 % 10 = 7

h(x) = 2 % 10 = 2

Collision

h(x) = 50 % 10 = 0

h(x) = 22 % 10 = 2

Hash Table

50		2	3		5		7	8	
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]

ΣMERTXE

Quadratic Probing

EMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h(x) = 2 % 10 = 2

h(x) = 22 % 10 = 2

h'(x) = h(x) + i^2

Collision

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

$h'(x) = h(x) + i^2$ where i = 1,2.....SIZE

h(x) = 2 % 10 = 2

$h'(x) = 2 + 1^2 = 3$

h(x) = 22 % 10 = 2

Collision

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

$h'(x) = h(x) + i^2$ where i = 1,2.....SIZE

h(x) = 2 % 10 = 2

$h'(x) = 2 + 1^2 = 3$

h(x) = 22 % 10 = 2

Collision

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h(x) = 2 % 10 = 2

$h'(x) = h(x) + i^2$ where i = 1,2.....SIZE

$h'(x) = 2 + 2^2 = 6$

h(x) = 22 % 10 = 2

Collision

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5		7	8	

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22

Hash Function h(x) =data % SIZE

h(x) = 2 % 10 = 2

$h'(x) = h(x) + i^2$ where i = 1,2.....SIZE

$h'(x) = 2 + 2^2 = 6$

h(x) = 22 % 10 = 2

Collision

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5	22	7	8	

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22 ,32

Hash Function h(x) =data % SIZE

h(x) = 32 % 10 = 2

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5	22	7	8	

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22 ,32

Hash Function h(x) =data % SIZE

h(x) = 32 % 10 = 2

$h'(x) = h(x) + i^2$ where i = 1,2.....SIZE

$h'(x) = 2 + 1^2 = 3$

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5	22	7	8	

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22 ,32

Hash Function h(x) =data % SIZE

h(x) = 32 % 10 = 2

$h'(x) = h(x) + i^2$ where i = 1,2.....SIZE

$h'(x) = 2 + 1^2 = 3$

$h'(x) = 2 + 2^2 = 6$

Hash Table

[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5	22	7	8	

ΣMERTXE

Concept

SIZE =10

Data Pool 8, 5 , 3 , 7, 2,50 22 ,32

Hash Function h(x) =data % SIZE

h(x) = 32 % 10 = 2

$h'(x) = h(x) + i^2$ where i = 1,2.....SIZE

$h'(x) = 2 + 1^2 = 3$

$h'(x) = 2 + 2^2 = 6$

$h'(x) = 2 + 3^2 = 11$

Hash Table

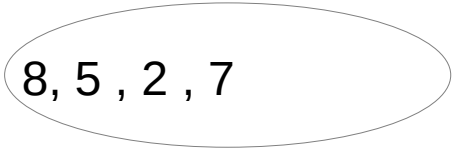
[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
50		2	3		5	22	7	8	

ΣMERTXE

Direct Chaining

Direct Chaining

Data Pool



Direct Chaining

Data Pool

8, 5 , 2 , 7

Hash Function

h(x) = data % SIZE

ΣMERTXE

Direct Chaining

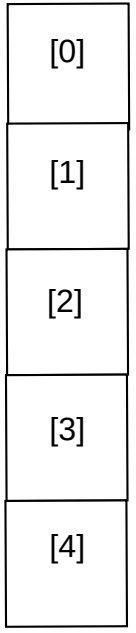
Data Pool

8, 5 , 2 , 7

Hash Function

h(x) = data % SIZE

Hash Table



ΣMERTXE

Direct Chaining

Data Pool

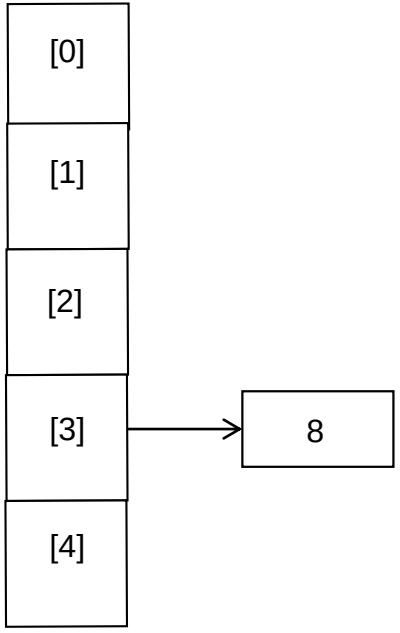
8, 5 , 2 , 7

Hash Function

h(x) = data % SIZE

h(x) = 8 % 5 = 3

Hash Table



ΣMERTXE

Direct Chaining

Data Pool

8, 5 , 2 , 7

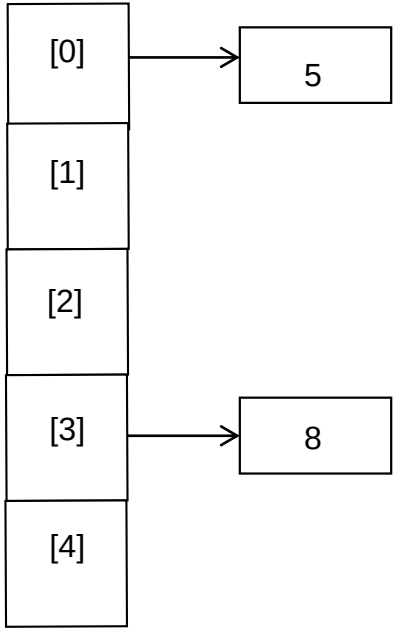
Hash Function

h(x) = data % SIZE

h(x) = 8 % 5 = 3

h(x) = 5 % 5 = 0

Hash Table



EMERTXE

Direct Chaining

Data Pool

8, 5 , 2 , 7

Hash Function

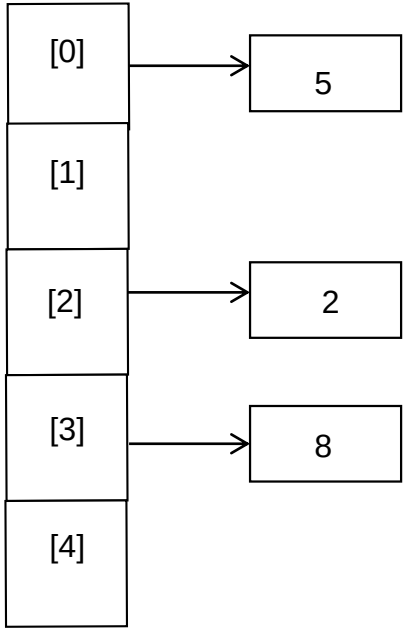
h(x) = data % SIZE

h(x) = 8 % 5 = 3

h(x) = 5 % 5 = 0

h(x) = 2 % 5 = 2

Hash Table



ΣMERTXE

Direct Chaining

Data Pool

8, 5 , 2 , 7

Hash Function

h(x) = data % SIZE

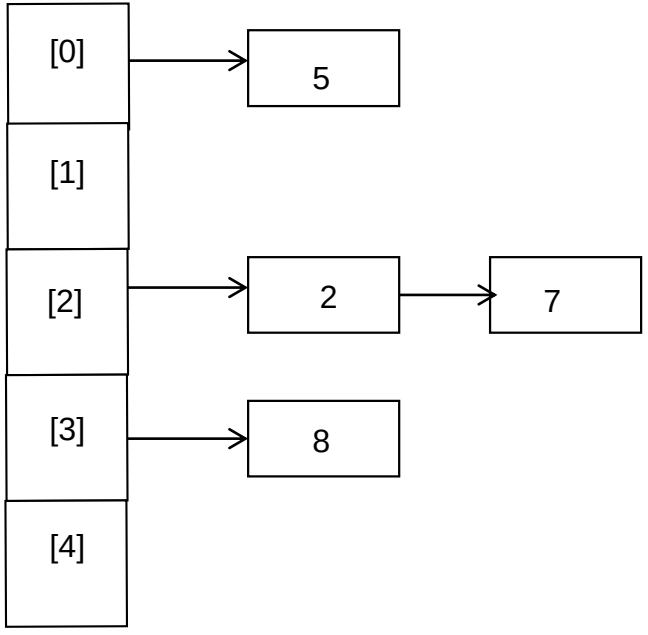
h(x) = 8 % 5 = 3

h(x) = 5 % 5 = 0

h(x) = 2 % 5 = 2

h(x) = 7 % 5 = 2

Hash Table



ΣMERTXE

Introduction

Operations

- create_hashtable : Create a Hashtable
- insert_hashtable: Insert an element in Hashtable
- search_hashtable: Search an element in Hashtable
- delete_hashtable : Delete the entire Hashtable

Hashing – Create hashtable