08-7-2021

1) **What is Hashing?**
Hashing is a data structure is a two-s process! The hash function converts the ite into a small integer or hash value.
This integer is used as an index to st the original data. It stores the data in hash table. you can use a hash key to locate data quickly.

2) **What is collision?**
A collision occurs when more than one value to be hashed by a particular hash function hash to be same slot in the table or data structure (hash being generated by the hash function.

3) **What is different type of collision**
1) Open hashing / Closing
2) Close Hashing / Open addressing.

Different types of hashing functio

1) K Mod 10
2) K Mode N
3) Mid Square
4) Folding Method

42, 16, 91, 33, 18, 27, 36, 62.

k mode 10

42 mode 10 → 2

16 mode 10 → 6

91 mode 10 → 1

33 mode 10 → 3

18 mode 10 → 8

27 mode 10 → 7

36 mode 10 → 6

62 mode 10 → 2

36	0
91	1
42	2
33	3
	4
	5
16	6
27	7
18	8
1	9

$RK_0 = (RK + i^2) \bmod 10$

$(6 + 1^2) \bmod 10$

$(6+1) \bmod 10$

$7 \bmod 10$

$RK = (RK + i^2) \bmod 10$

$(6 + (2)^2) \bmod 10$

$10 \bmod$

2 $RK = (RK + i^2) \bmod 10$

$= (2 + 1^2) \bmod 10$

$3 \bmod 10$

3

$RK = (RK + i^2) \bmod 10$

$(3 + 2^2) \bmod 10$

$8 \bmod 10$

$RK = (RK + i^2) \bmod$

$(2 + (3)^2) \bmod 10$

$11 \bmod 10$?

$RK = (RK + i^2) \bmod 10$

$(2 + (4)^2) \bmod 10$

Past Paper

Insert the following keys in hash table using hash function

$h(x) = (2x+3) \bmod 10$

7, 10, 11, 17, 20, 23, 21, 25, 35, 42.

Chaining $h(x) = 2x+3 \bmod 10$ mod = n-1 (0-129)

① 7 · $(2(7)+3) \bmod 10$

$(14+3) \bmod 10$

$17 \bmod 10$

$10 \overline{)17}$ 1, $\frac{10}{7}$

② 10 $(2(10)+3) \bmod 10$

$(20+3) \bmod 10$

$23 \bmod 10$

$10 \overline{)23}$ 2, $\frac{20}{3}$

③ 11 $(2(11)+3) \bmod 10$

$(22+3) \bmod 10$

$25 \bmod 10$

$10 \overline{)25}$ 2, $\frac{20}{5}$

4) 17 $(2(17)+3) \bmod 10$

$(34+3) \bmod 10$

$37 \bmod 10$

$10 \overline{)37}$ 3, $\frac{30}{7}$

linear

~~RK = (RK+1) mod 10~~

5) 20 $(2(20)+3) \bmod 10$

$(40+3) \bmod 10$

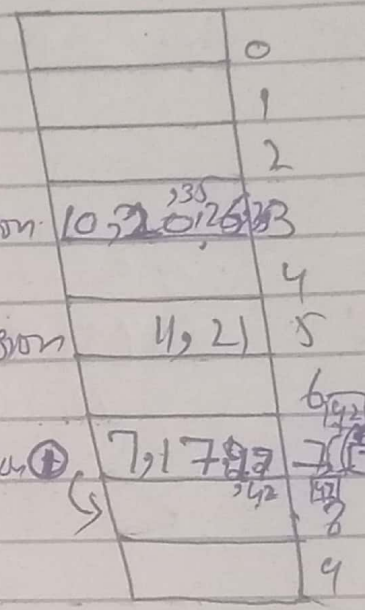
$43 \bmod 10$

$10 \overline{)43}$ 4, $\frac{40}{3}$

6) 22 $(2(22)+3) \bmod 10$

$(44+3) \bmod 10$

$47 \bmod 10$



$10 \overline{)17}$ 1, $\frac{10}{7}$

$10 \overline{)37}$ 3, $\frac{30}{7}$

$10 \overline{)43}$ 4, $\frac{40}{3}$

7) 21

$(2(21)+3) \bmod 10$

$(42+3) \bmod 10$

$45 \bmod 10$

$10 \overline{)45}$

5

45

8) 25 $(2(25)+3) \bmod 10$

$(50+3) \bmod 10$

$53 \bmod 10$

$10 \overline{)53}$

50

3

9) 35 $(2(35)+3) \bmod 10$

$(70+3) \bmod 10$

7

$10 \overline{)73}$

70

3

42 $2(42)+3) \bmod 10$

$(84+3) \bmod 10$

8

$10 \overline{)87}$

80

7

Linear

Linear.

7, 10, 11, 17, 20, 22, 21, 25, 33, 42

25	0
	1
	2
10, 17, 33, 26	3
20	4
4, 37	5
21	6
7, 33, 37	7
17	8
22	9

① $h(n) = (2k+3) \bmod 10$
$(2(7)+3) \bmod 10$
$(14+3) \bmod 10$
$17 \bmod 10$

② 10. $(2(10)+3) \bmod 10$
$(20+3) \bmod 10$
$23 \bmod 10$

11 $(2(11)+3) \bmod 10$
$(22+3) \bmod 10$
$25 \bmod 10$
5

17 $(2(17)+3) \bmod 10$
$(34+3) \bmod 10$
$37 \bmod 10$
7

Linear.

$RK = (RK+i) \bmod 10$
$= (7+i) \bmod 10$
$8 \bmod 10$
8

20. $(2(20)+3) \bmod 10$
$(40+3) \bmod 10$
$43 \bmod 10$

$RK_2 = (RK+5) \bmod 10$
$(3+1) \bmod 10$
$4 \bmod 10$

22

$(2(22)+3) \bmod 10$
$44+3 \bmod 10$
$47 \bmod 10$

29-7-2021

Double hashing

$h_1(k) = k \bmod 11$

$h_2(k) = 8 - (k \bmod 8)$ — chuti no hoon

Collision formula : $(h_1(k) + 2 \cdot h_2(k)) \bmod 11$

20, 34, 45, 70, 56

$h_1 = k \bmod 11$

$20 \bmod 11$

11 | 20 (1, 9)

h_1 34 mod 11

11 | 34 (3, 33, 1)

using h_2 func

$8 - (k \bmod 8)$

$8 - (5)$

3

8 | 45 (5, 40, 5)

$(1 + 5 \cdot (3)) \bmod 11$

$(1+3) \bmod 11$

$4 \bmod 11$

$= 4$

34
56
45
70
20

70 — $70 \bmod 11$

11 | 70 (6, 66, 4)

$8 - (k \bmod 8)$

$8 - (70 \bmod 8)$ — 70 % 8 = 6

$8 - 6$

2

$(4 + 1 \cdot 2) \bmod 11$

$(4+2) \bmod 11$

6

11 | 6 (0, 6)

11 | 56 (5, 55, 1)

56

56 mod 11

11 | 56 (5
55
1

8 - (56 mod 8)
8 - 0 , 8

(6 + 1 · 8) mod 11
56 mod 11
9 mod 11

11 | 6 (0
6
(6 + 2 · 0) mod 11

(1 + 2 · 8) mod 11
17 mod 11

1
11 | 17
11
6

(1 + 3 · 8) mod 11
(1 + 24) mod 11
25 mod 11

2
11 | 25
22
3

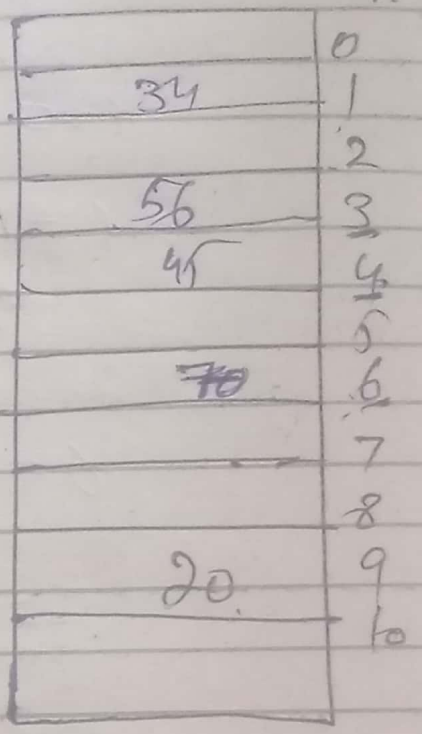
Double

20, 34, 45, 70, 56

$h_1(K) = K \bmod 11$

$h_2(K) = 8 - (K \bmod 8)$

Formula $(h_1(K) + i \cdot h_2(K)) \bmod 11$



$h_1(20) = 20 \bmod 11$

11 | 20 (1, 11)

9

$h_1(34) = 34 \bmod 11$

11 | 34 (3, 33)

1

$45 \bmod 11$

11 | 45 (4, 44)

1

$8 - (45 \bmod 8)$

$8 - 5$

$= 3$

8 | 45 (5, 40)

5

$(1 + (1 \cdot 3)) \bmod 11$

$(1 + 3) \bmod 11$

$4 \bmod 11$

4

$70 \bmod 11$

11 | 70 (6, 66)

4

$8 - (70 \bmod 8)$

$(8 - 6)$

2

8 | 70 (8, 64)

6

$(4 + 1 \cdot 2) \bmod 11$

$6 \bmod 11 = 6$

56

56 mod 11

5
11/56
55
1

8 - 56 mod 8

8 - 0

8

7
8/56
56
0

(1 + (1 · 8)) mod 4

(1 + 8) mod 4

(9) mod 11

9

1 + (2 · 8) mod 11

17 mod 11

1
11/17
11
6

1 + (3 · 8) mod 4

25 mod 4

2
11/25
22
3

Scanned with CamScanner

26-7-2021

Hashing

∴ eg. database for used data storage & used Pointer used.

1) store data
2) Retrieve data

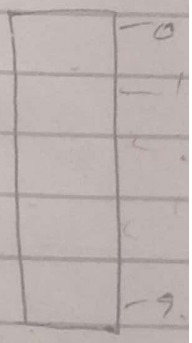
Different function are used to apply hashing / mapping

↓
before value are stored in smaller

Hashing

1) Key (Search Key)
2) hash table
3) Hash function

(2, 43, 123)



k mod 10

n-1 > 9

10-1

General function

ex. ex1

(24, 16, 8, 9, 11)

24 mod 10

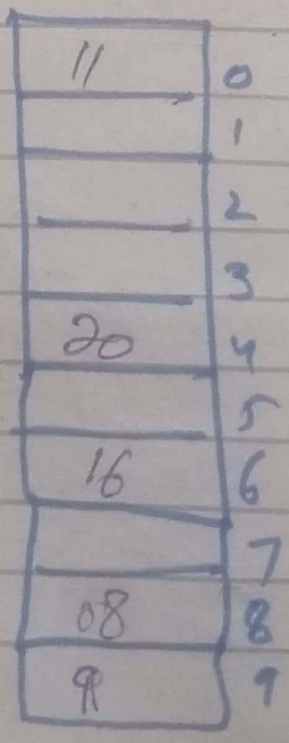
2 | 24

20
4

11 mod 10

1 | 11

10
1



1) What is hashing
2) What is collision
3) What is different types of collision
4) Different function of hashing

Function

1) K Mode 10 → values
2) K Mode N → n+1
3) Mid Square $2(2)2 \rightarrow 2^2 = 4$.
4) Folding Method
   ⇓ size / add of double

123456

123
456
579.

Types of collision

1) Chaining / open hashing
2) Open addressing (close hashing)
   1) Linear
   2) Quardatic
   3) Double.

26-

Chaining

42, 19, 10, 12, 22, 32, 34

K mode 6

42 mod 6

7
6 | 42
42
0

6 | 19
18
1

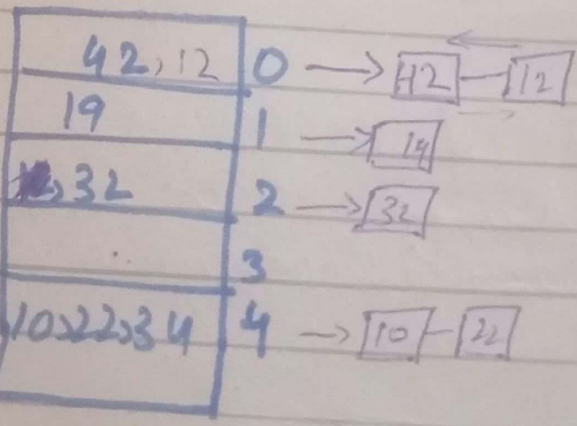
1
6 | 10
6
4

2 3
6 | 12 6 | 22
12 18
0 4

4
6 | 32
30
2

6 | 34
30
4

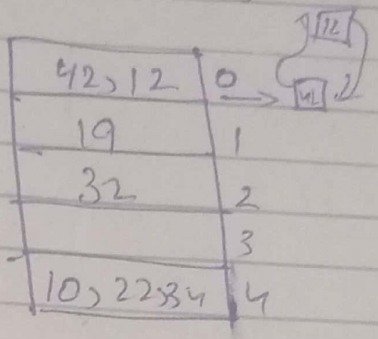
42, 12	0
19	1
32	2
	3
10, 22, 34	4



Solved

42, 19, 10, 12, 22, 32, 34 K mode 6

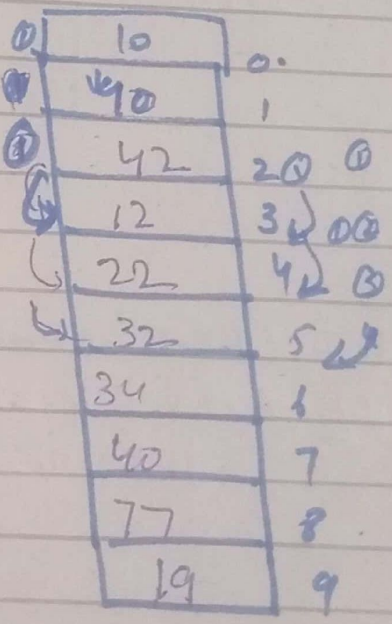
6-1=5



→ Linear

42, 19, 10, 12, 22, 32, 34, 40, 77 K mod

10) 42
40
2



Formula

not good approach

Advantage disadvantage

Open hashing

~~Close~~ Linear no

Formula

Linear

RH = (Rk + i) mod 10

Example

43, 135, 72, 23, 99, 19, 82

RK = (RK+i) mode 10

43

(43+1) mode 10

44 mod 10

10 | 44

40

4

135

(135+1) mode 10

136 mod 10

10 | 136

100

36

10 | 23

20

3

99	0
	1
72	2
43	3
43 29	4
135	5
82	6
	7
	8
99	9

23

RK = (RK+i) mod 10

(23+1) mode 10

24 mod 10

4

10 | 24

20

4

99

RK = (RK+i) mode 10

(99+1) mode 10

100 mode 10

82

RK = (RK+i) mod 10

(82+1) mode 10

83 mode 10

3

(82+2) mod 10

84 mod 10

8
10/84
80
4

(2+4) mod 10

6 mod 10

(RK)

i c/add of key

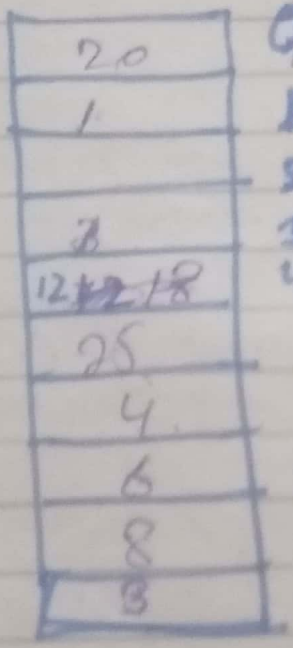
- ↳ j↑ value index

The keys 1, 3, 12, 4, 25, 6, 18, 20, 8 are inserted into empty hash table of length 10 using open addressing with hash function $H(i) = i^2 \bmod 10$ and linear probing

What is the resultant hash table and find the maximum probe value?

$H(i) = i^2 \bmod 10$

10 - 1 = 9



$H(1) = 1^2 \bmod 10$

$H(3) = 3^2 \bmod 10$

$3^2 \bmod 10$

$9 \bmod 10$

$12^2 \bmod 10$

$144 \bmod 10$

$4 = 4^2 \bmod 10$

$16 \bmod 10$

$10 \overline{)16}$ 1, remainder 6

$25 = 25^2 \bmod 10$

$625 \bmod 10$

$10 \overline{)625}$ 62, remainder 5

$= 5$

$6 = 6^2 \bmod 10$

$36 \bmod 10$

$10 \overline{)36}$ 3, remainder 6

$(RK+1) \bmod 10$

$(6+1) \bmod 10$

$7 \bmod 10$

$= 7$

$12 = 12^2 \bmod 10$

$144 \bmod 10$

$10 \overline{)324}$ 32, remainder 4

$20 = 20^2 \bmod 10$

$400 \bmod 10$

$10 \overline{)400}$ 40, remainder 0

$2 = 2^2 \bmod 10$

$4 \bmod 10$

$10 \overline{)4}$ 0, remainder 4

$RK = (RK+1) \bmod 10$

$(4+1) \bmod 10$

$5 \bmod 10$

$RK \neq (RK+1) \bmod 10$

$4 = (4+2) \bmod 10$

$6 \bmod 10$

20
1
8
12
25
4
6
17
3

Advantages of Hashing

1) more reliable and flexible method of data retrieval than any other data structure
2) faster than searching arrays and lists.
3) same space it can retrieve in its probes any stored in a tree that will otherwise take log n probes.
4) does not allow null values like hash map

Disadvantages of Hashing

Hash collision are practically unavoidable when hashing a random subset of a large set.

2) not effective when number of entries are very small

) take constant time on average,