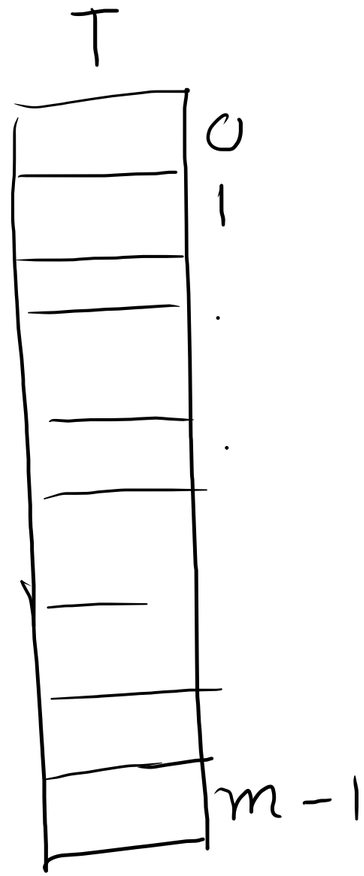
$h : S \rightarrow \{0, 1, \ldots, \text{tablesize} - 1\}$

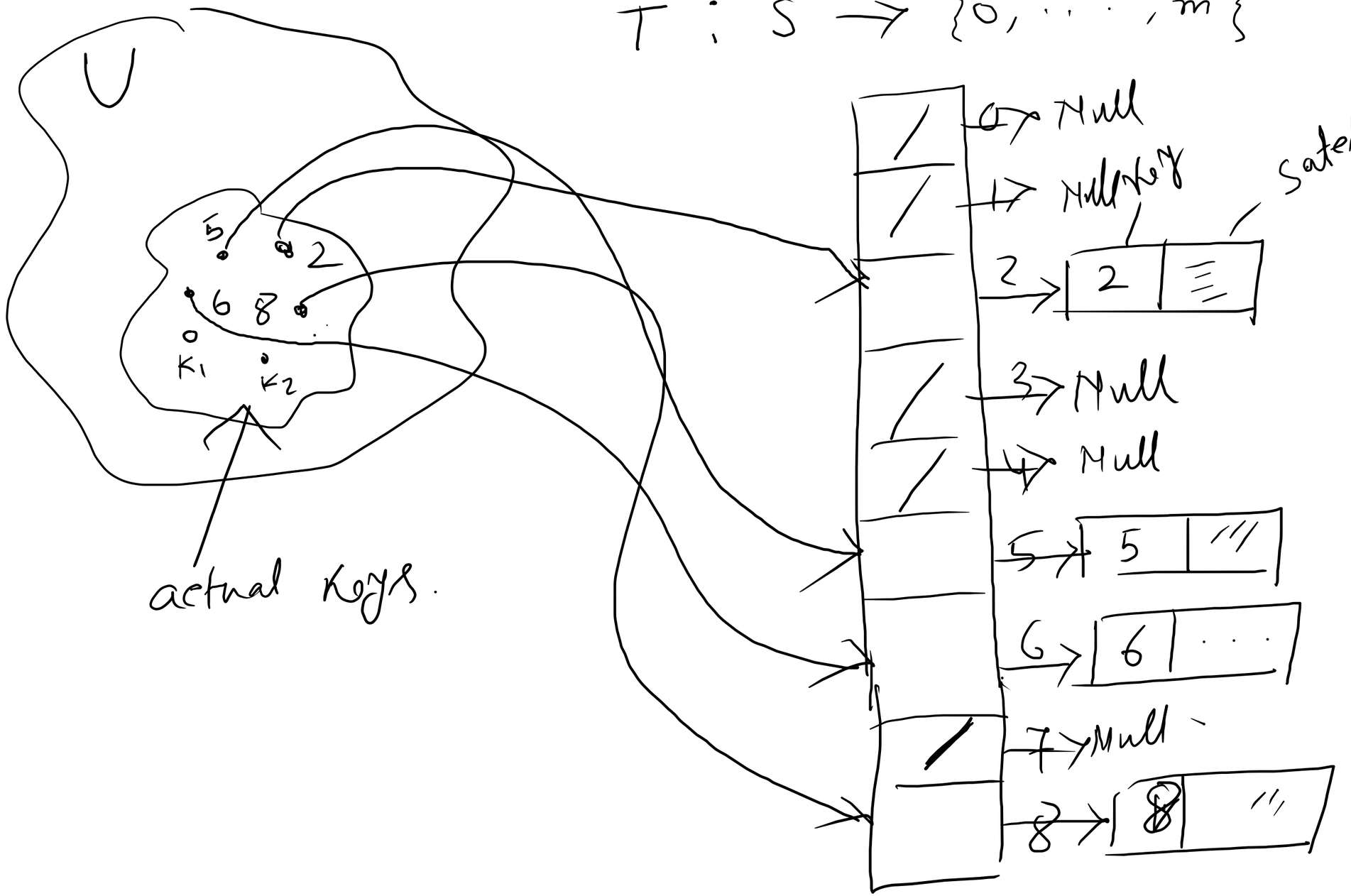
T is of size m

Direct addressing

- Each position / index of the table corresponds to a key.
- T[k] corresponds to the key k.
- if position k does not contain an element.
  then T[k] = Null



$T : S \to \{0, \ldots, m\}$



Direct_address_insert(T, k) ← key

$T[k] = k$

Direct_address_delete(T, x) ← item

$T[x.key] = Null$

Direct_address_search(T, x)

return $T[x.key]$

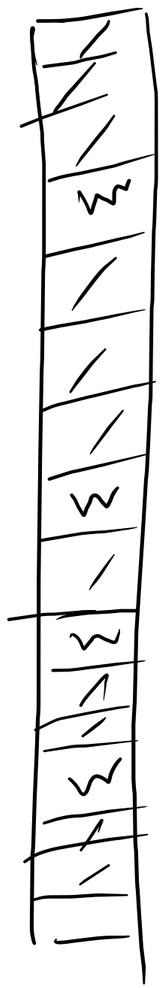
— Array indices are integers.

keys must be integers.

|| size of the table is equal to # keys.

Problem

= When the key space is very large.

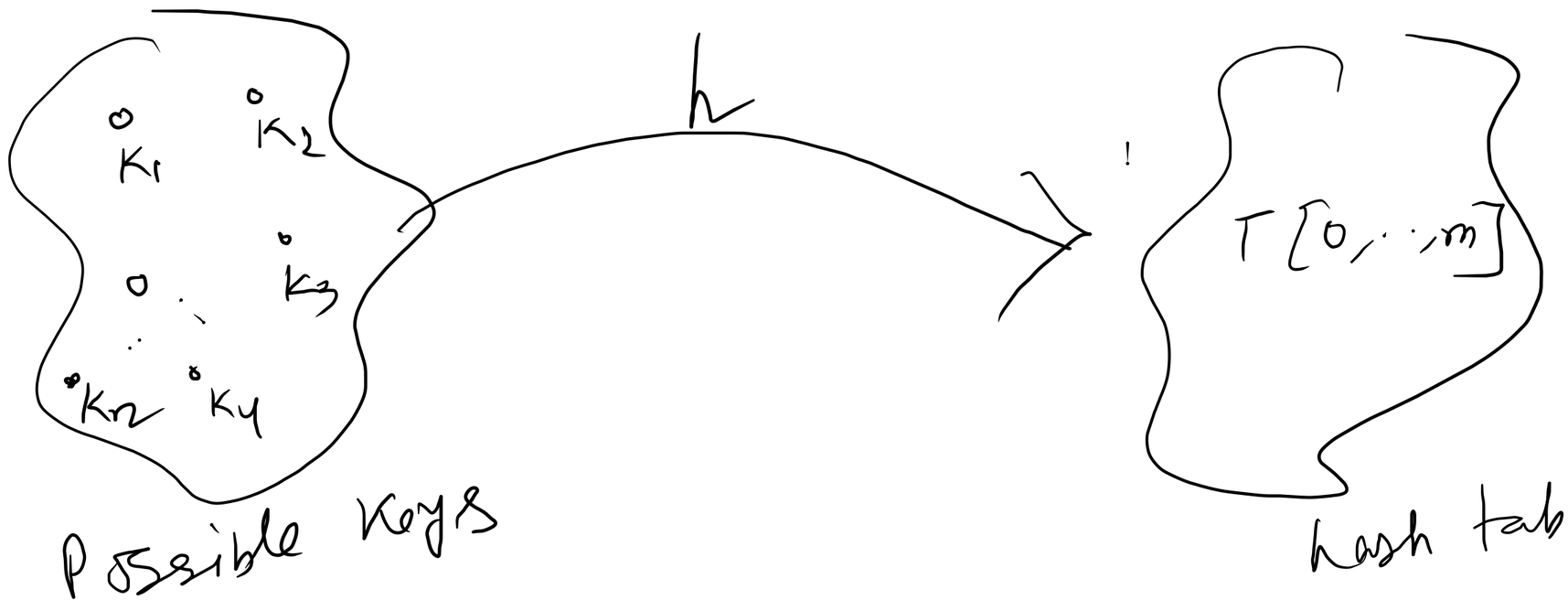


- Keys must be integers.

- Prehash.

Solution to Problem 2

hashing.



Possible keys

Hash table.

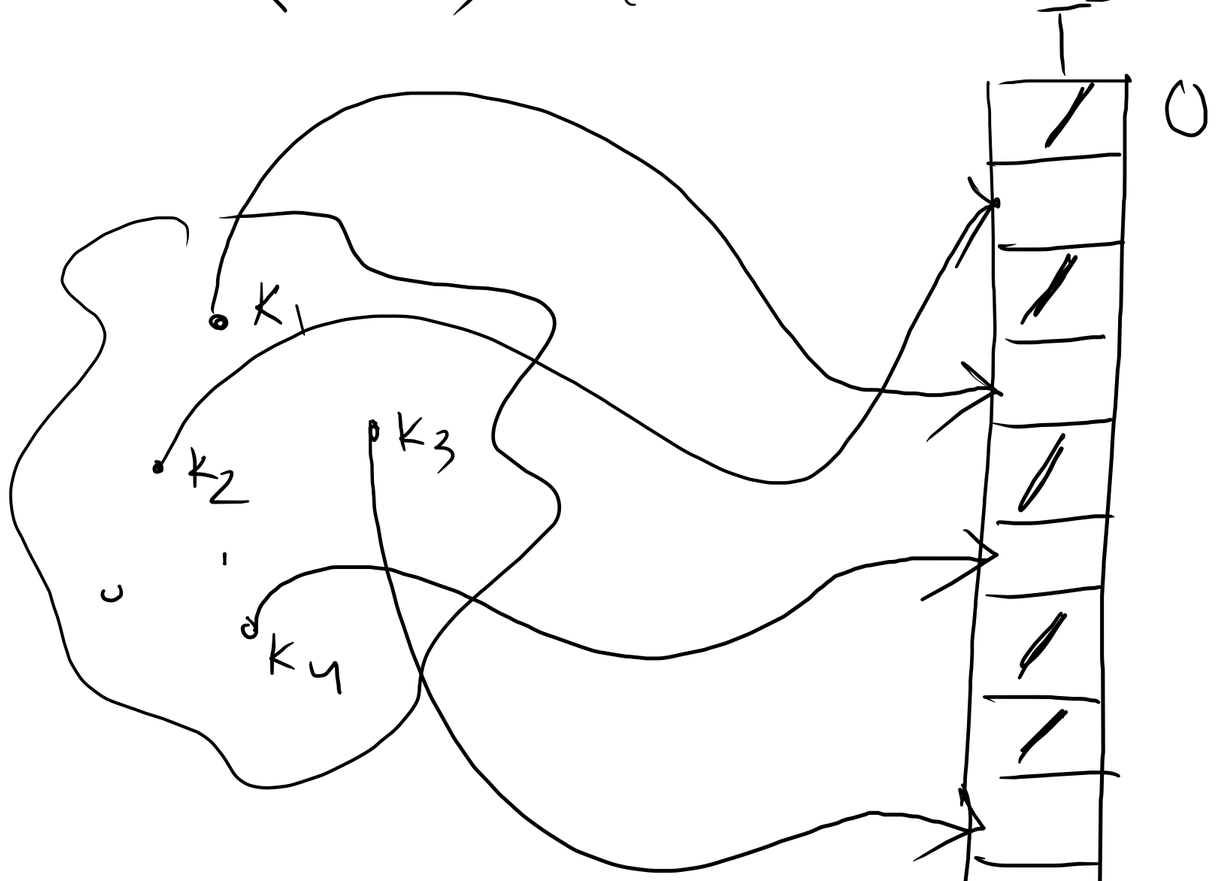
$m << n$

$h(k_i)$ = an integer in the range $[0, m-1]$

$h : K \longrightarrow \{0, \ldots, m-1\}$

Hash function

$$h : K \longrightarrow \{0, 1, \ldots, m-1\}$$



$h(k_i) = t \qquad t \in [0, m-1]$

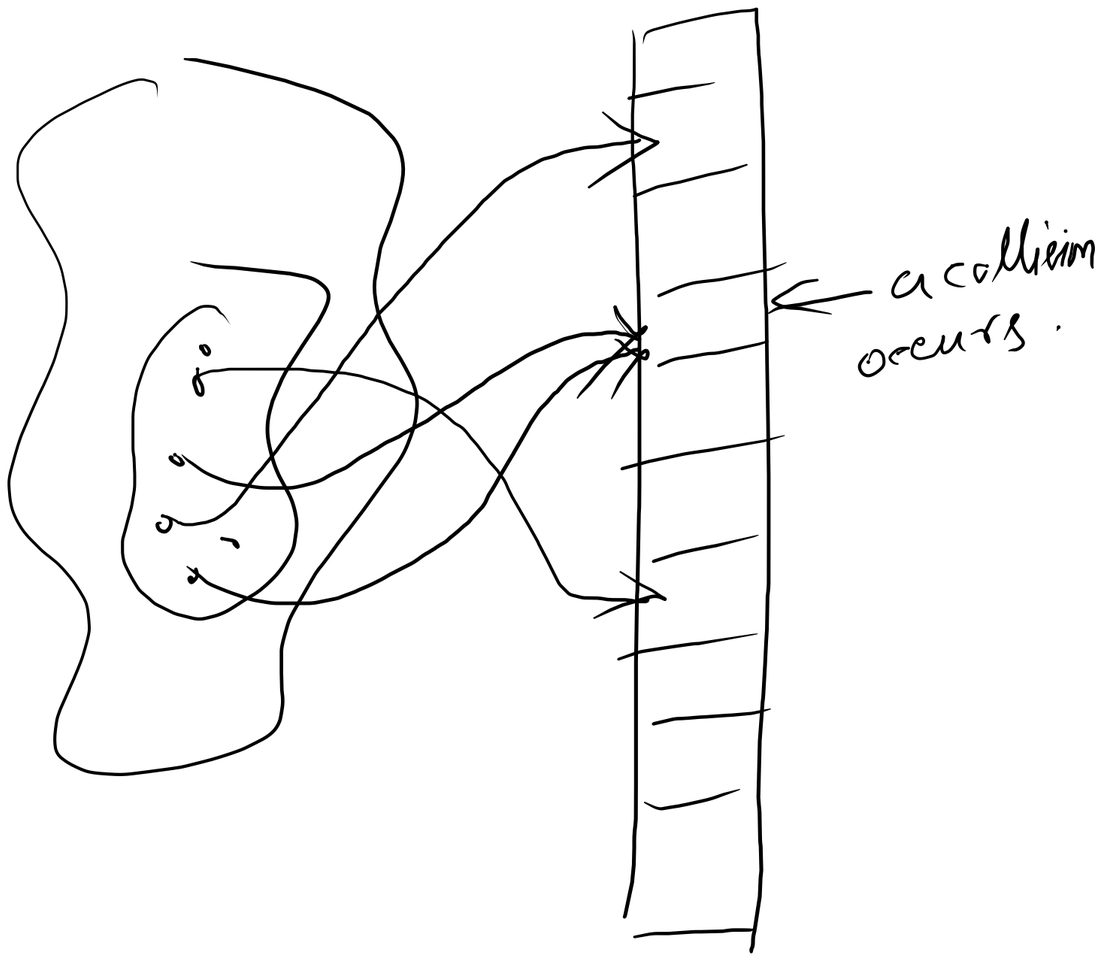
↑ hash value.

collision

- Two keys may hash to the same location.

Q: Is there any possibility of collision not to happen?

- no.
  because $m << n$



Task. 1

design some hash function to minimize the collision.

Task 2:

If collision occurs then how to resolve collision

Hash function methods

The division method.

$$h(k) = k \bmod m$$

a good choice of m is a prime not close to power of 2 or 10.

Exm Keys: 55, 6, 77, 10, 2,

$h(k) = k \bmod 10$ ie $m = 10$

$k_1 = 55$

$h(k_1) = h(55) \equiv 55 \bmod 10$

$\equiv 5 \bmod 10$

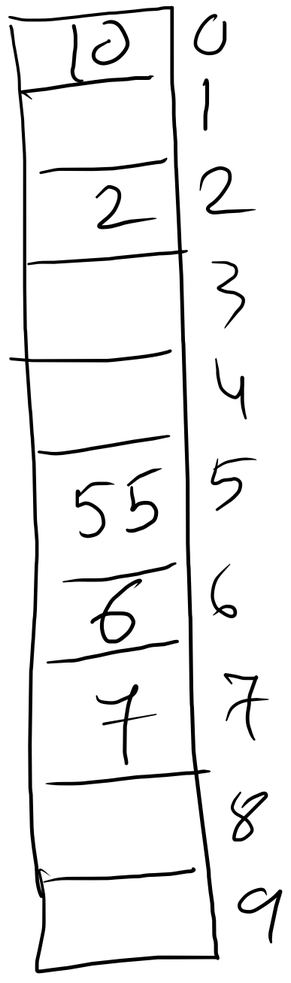
$= 5$

$6 \rightarrow 6$

$77 \rightarrow 7$

$10 \rightarrow 0$

$2 \rightarrow 2$



The multiplication method

$$h(k) = \lfloor m (kA \bmod 1) \rfloor \bmod m$$

- $0 < A < 1$
- $kA \bmod 1$ is the fractional part of kA

$$kA - \lfloor kA \rfloor$$

- choose a constant k s.t. $0 < A < 1$
- multiply k with A
- extract the fractional part of kA.
- multiply the result by m
- take floor of the result.
- take mod.

$K = 12$ $\quad m = 100$

$A = .321$

$KA = 3.852$

$KA \text{ mod } 1 = .852$

multiply with m.

$\lfloor 85.2 \rfloor$

85

$85 \mod 100$

$$K = 25963214 3896$$

$$m = 1000000$$