DICTIONARY

By Janie Lane Sabado

DICTIONARY

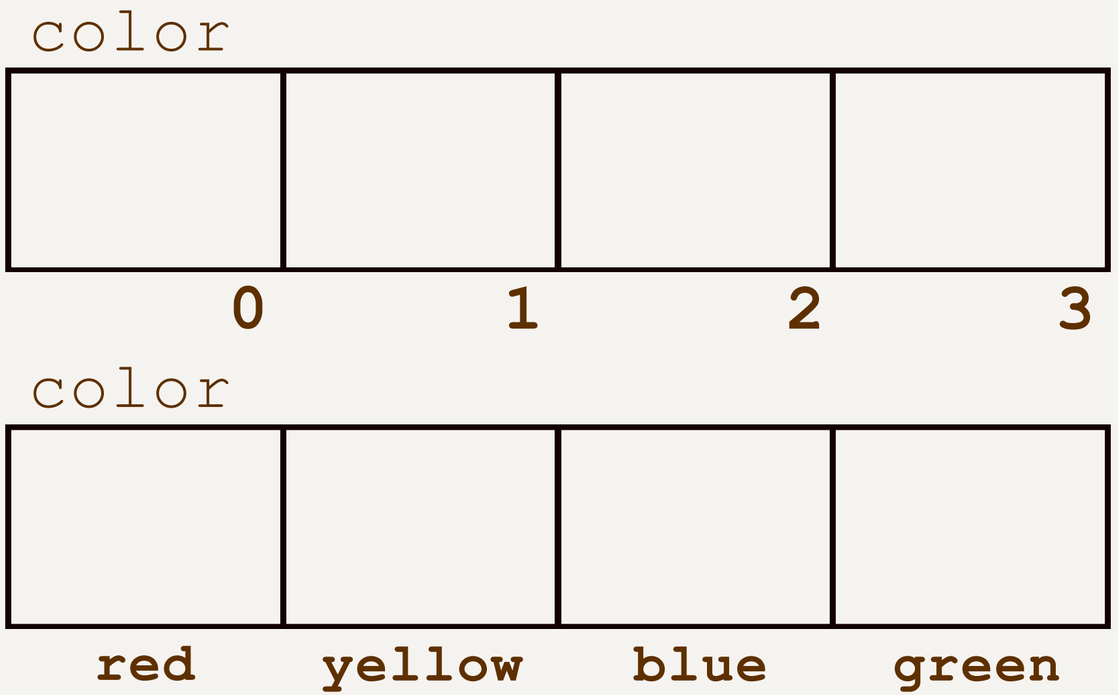
- fastest data structure
- a set with operations such as:
  - insert
  - delete
  - member

- Implementations:
  - Linked List
  - Array
  - Cursor-based
  - Hashing

PURPOSE?

colors{ “red” , “green” , “blue” }

color[0] **color[“red”]**



PROBLEM

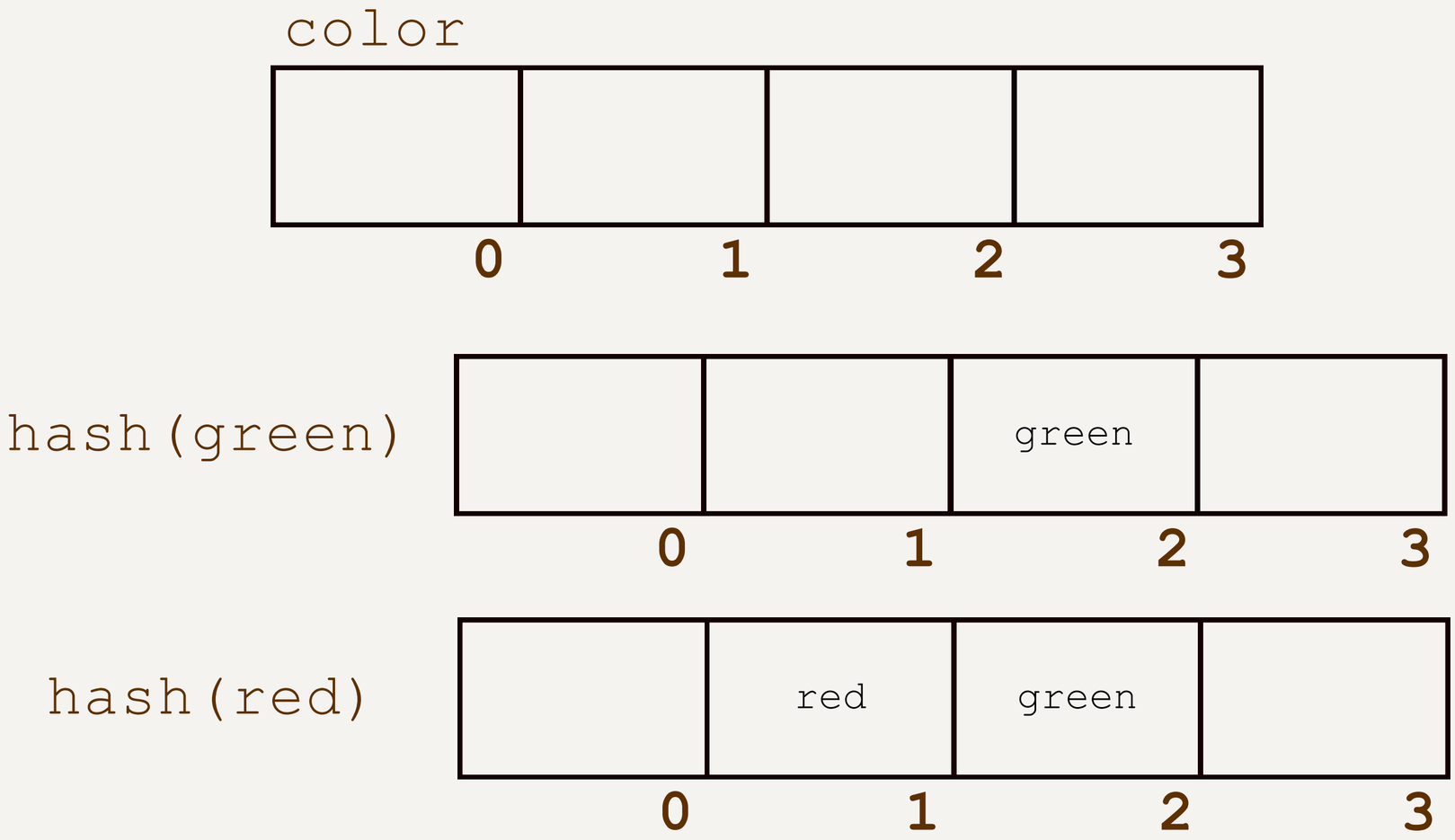
1. C is a structural language, not an object-oriented one

2. Index access is only integer values in C

SOL'N: HASHING

- a function that generates a unique key by determining the:
  - Location of the element
  - Starting point in searching for the location of the element
- generates the index
- does not know if the index being returned has value

HASH()



HASH() CONTEXT

the context of the hash() is dependent on the coding context

EXAMPLE. Hash() will return the digit of an integer in its ones place

```
int Hash(int num){
    return num%10;
}
```

HASH() CONTEXT

Try this out.

1. Hash returns a digit in its hundredths place
2. Hash accepts a last name and then it returns 0 if last name starts with A, 1 if B, ... , 25 if Z.
3. Hash accepts an RGB value and returns a digit constrained in a 64 palette size.

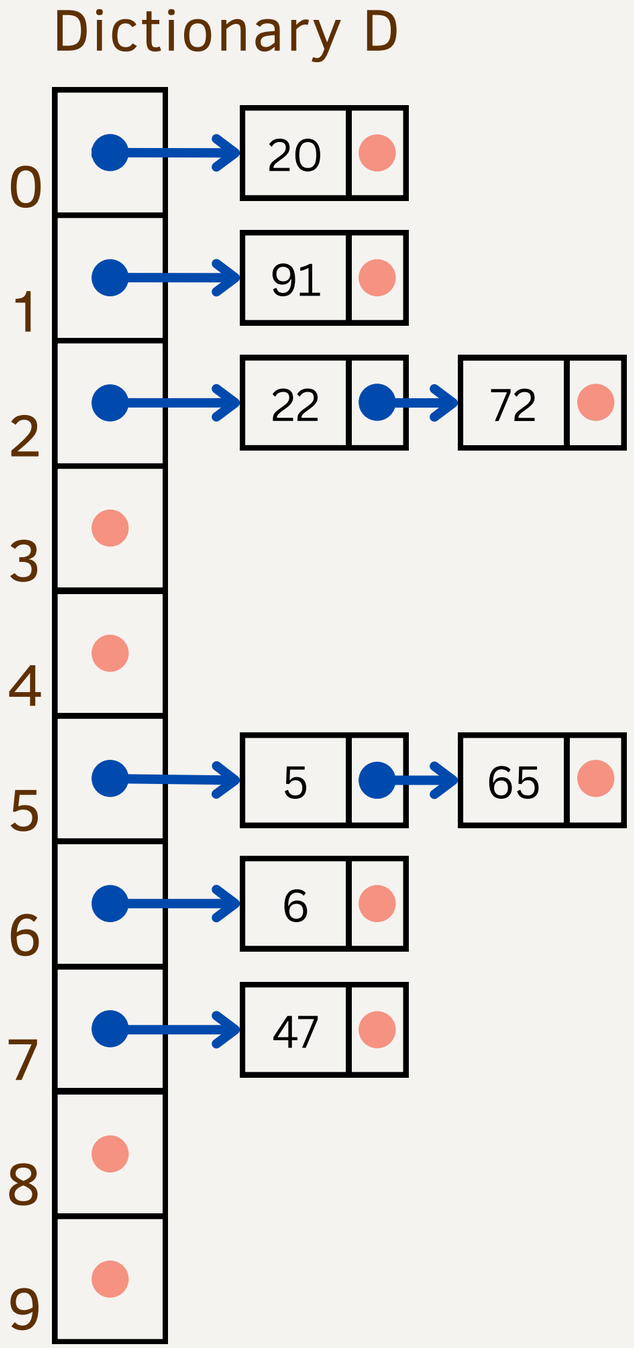
TWO TYPES

1. OPEN HASHING (External Hashing)
   - stores the set in potentially unlimited space
   - *Dynamic Array*, *Linked List*
2. CLOSED HASHING (Internal Hashing)
   - stores the set in a fixed space
   - Static *Array*, *Cursor-Based*

OPEN HASHING

OPEN HASHING

SET A =
{20, 47, 22, 5, 65, 72, 6, 91}



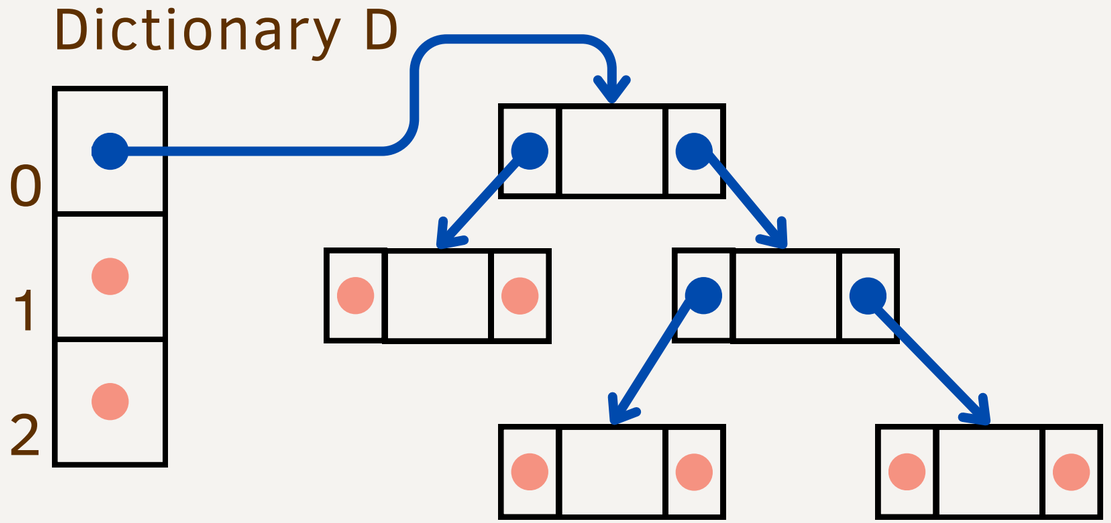
hash() -
generates a value through % of 10

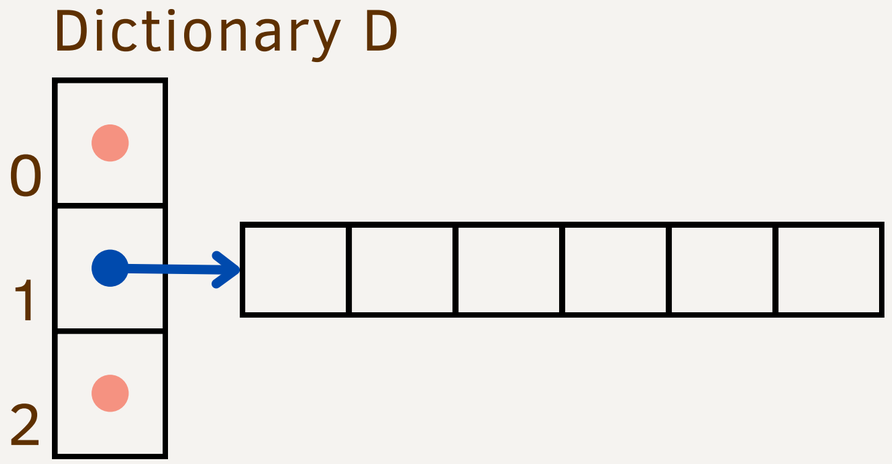
chaining

- solution to collisions
- uses linked list to chain values to its key
- Array of linked list

OPEN HASHING

Other Variations



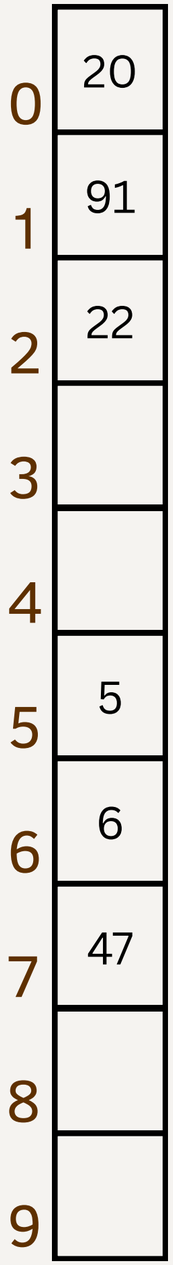


CLOSED HASHING

CLOSED HASHING

SET A =
{20, 47, 22, 5, 65, 72, 6, 91}

Dictionary D



hash() -
generates a value
through % of 10

Synonyms

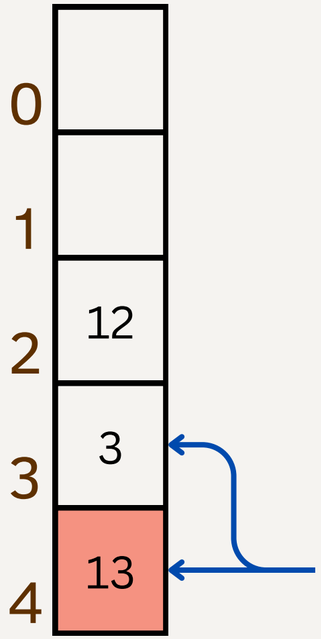
- 2 or more elements with the same hash value

Solution?

- Linear Hashing
- Progressive Overflow

LINEAR HASHING

- The element is placed in the next available position if collision occurs
- using concept of circular arrays



causes **Displacement**

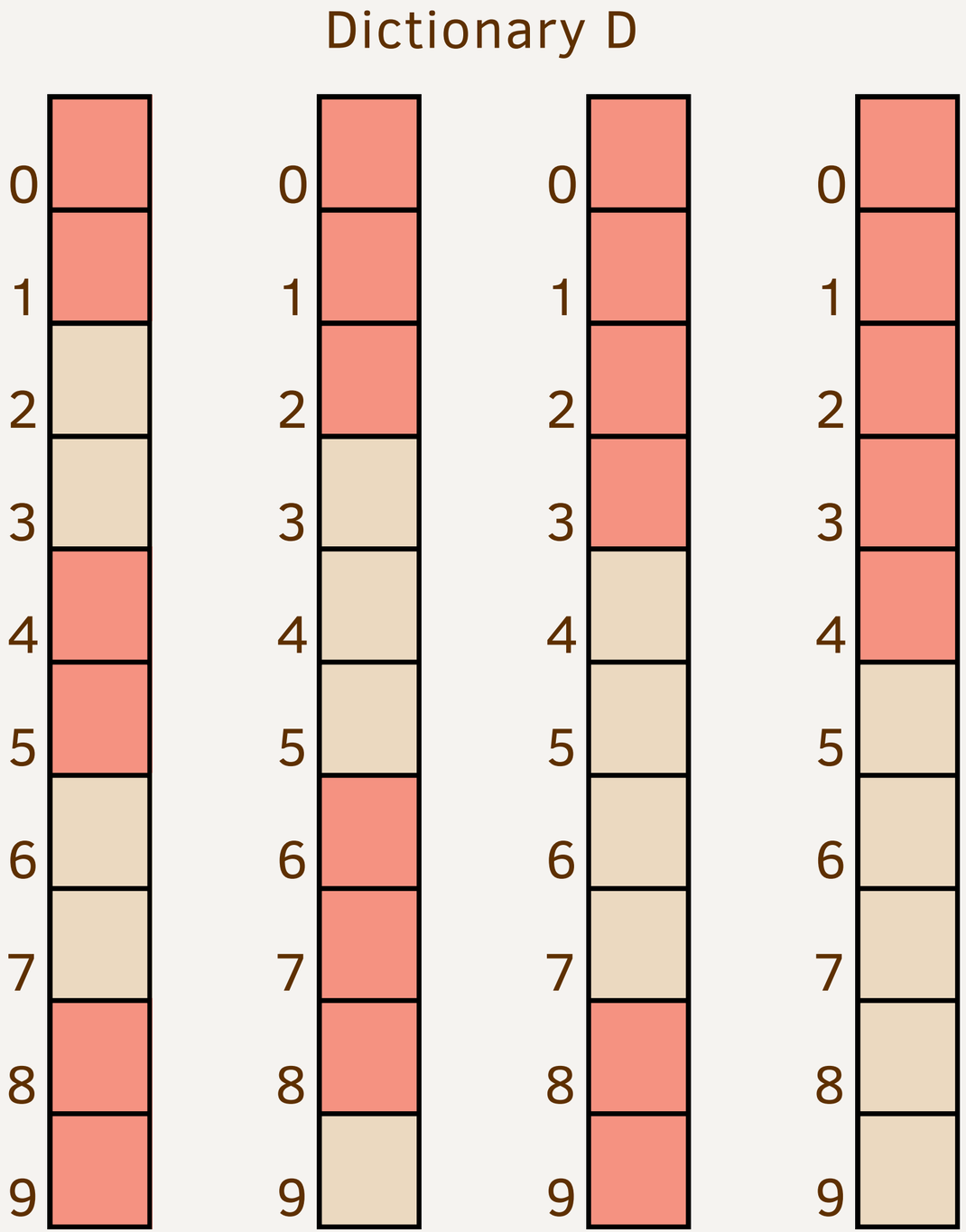
```
#define MAX 5;
hash(x) == (x+1)%MAX;

hash(3)  == 3
hash(12) == 2
hash(13) == 3
```

collision

BUCKET

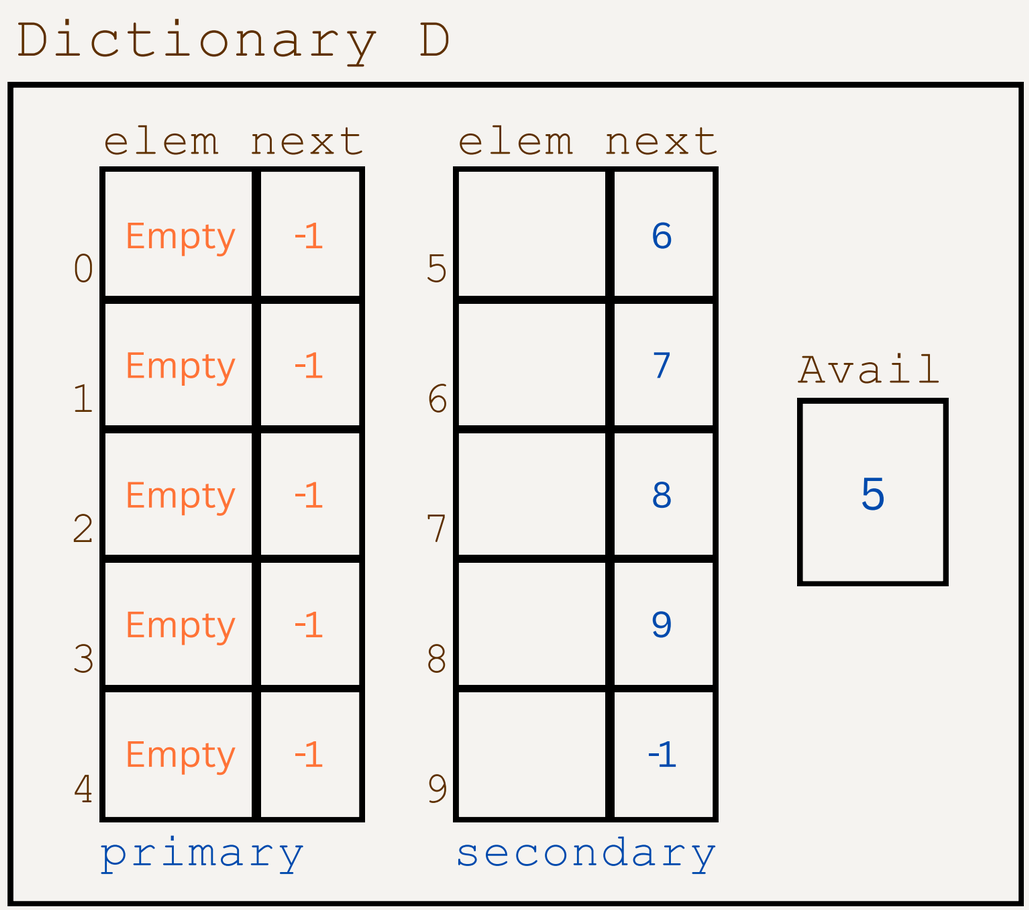
using a range of indexes to limit space use

hash() - adjust for the range of the bucket



PROGRESSIVE OVERFLOW

- dividing the space used into half, one used as the primary storage and the other as secondary storage



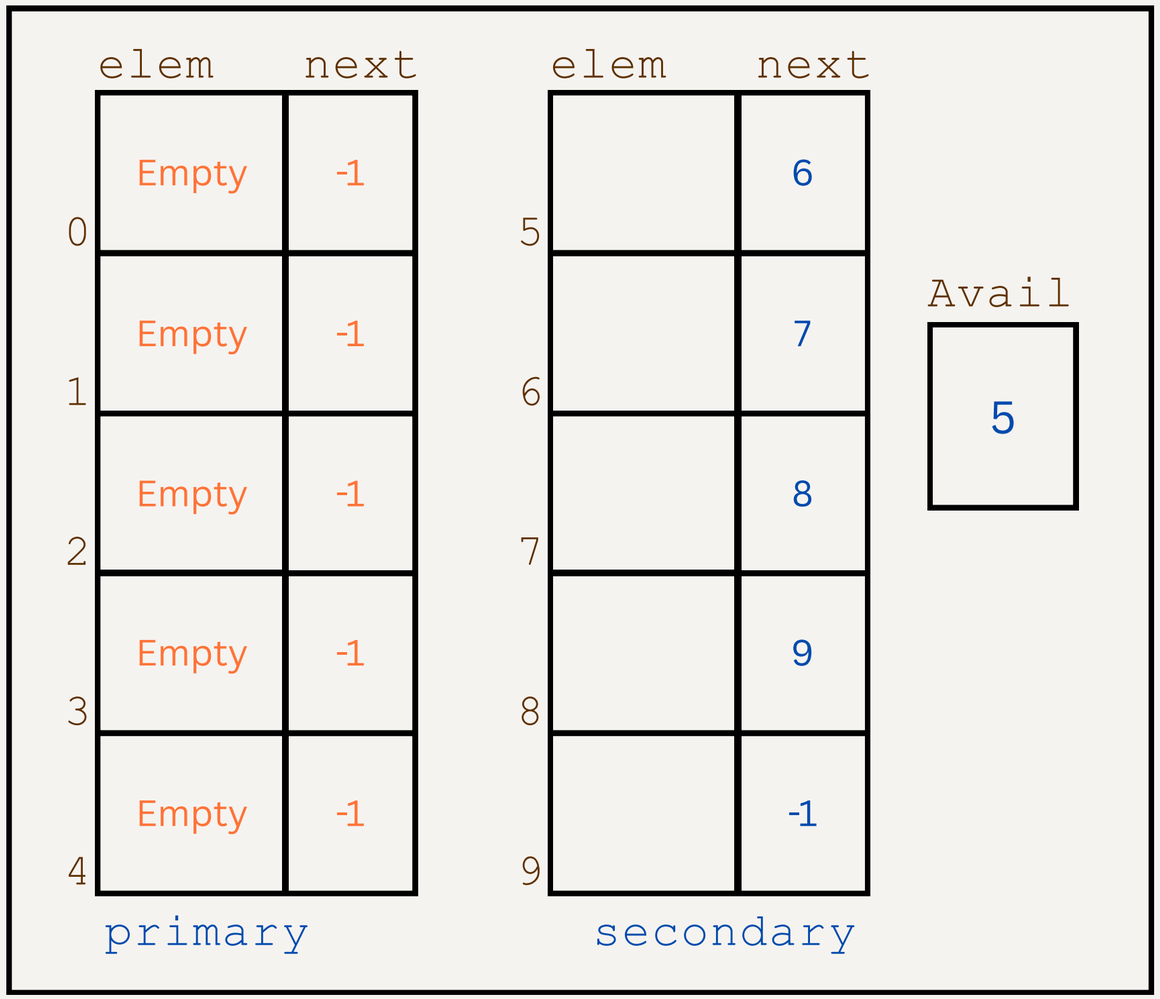

```
#define MAX 10
#define Empty " "
#define Delete -1
typedef struct{
  int elem;
  int next;
}node;
typedef struct{
  node table[MAX];
  int Avail;
}Dictionary
```

PROGRESSIVE OVERFLOW

SET A =
{20, 43, 22, 5, 65,
72, 6, 28, 91}

```
#define MAX 5;
hash(x) == x%MAX;
```

Dictionary D

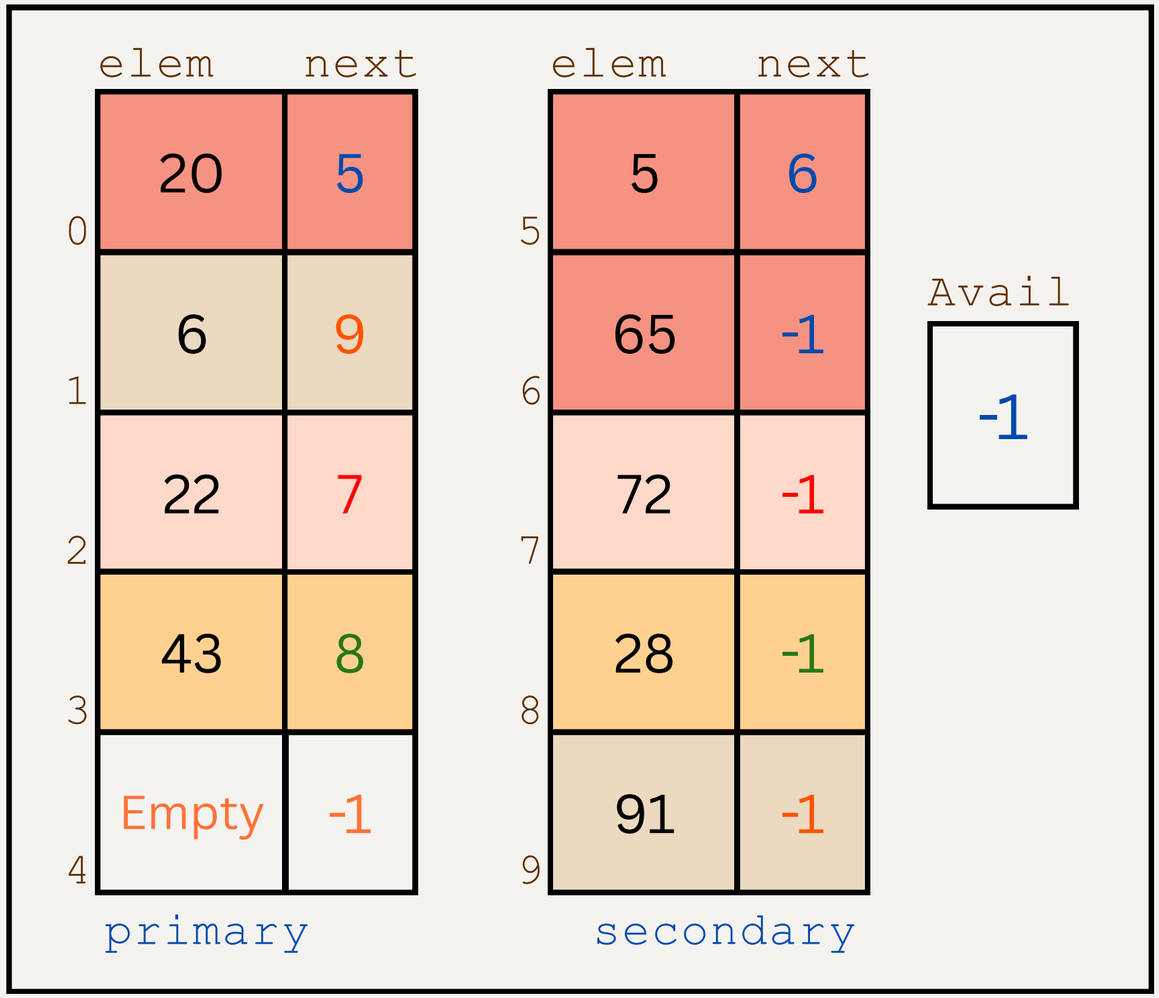


PROGRESSIVE OVERFLOW

SET A =
{20, 43, 22, 5, 65,
72, 6, 28, 91}

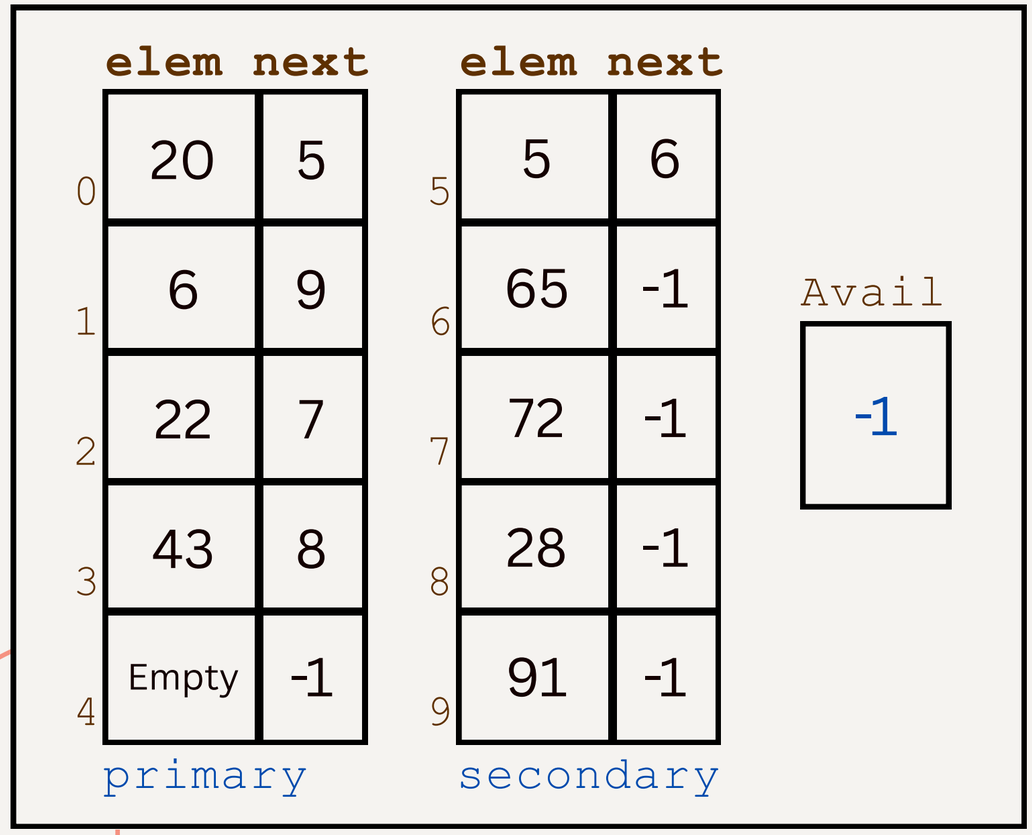
```
#define MAX 5;
hash(x) == x%MAX;
```

Dictionary D

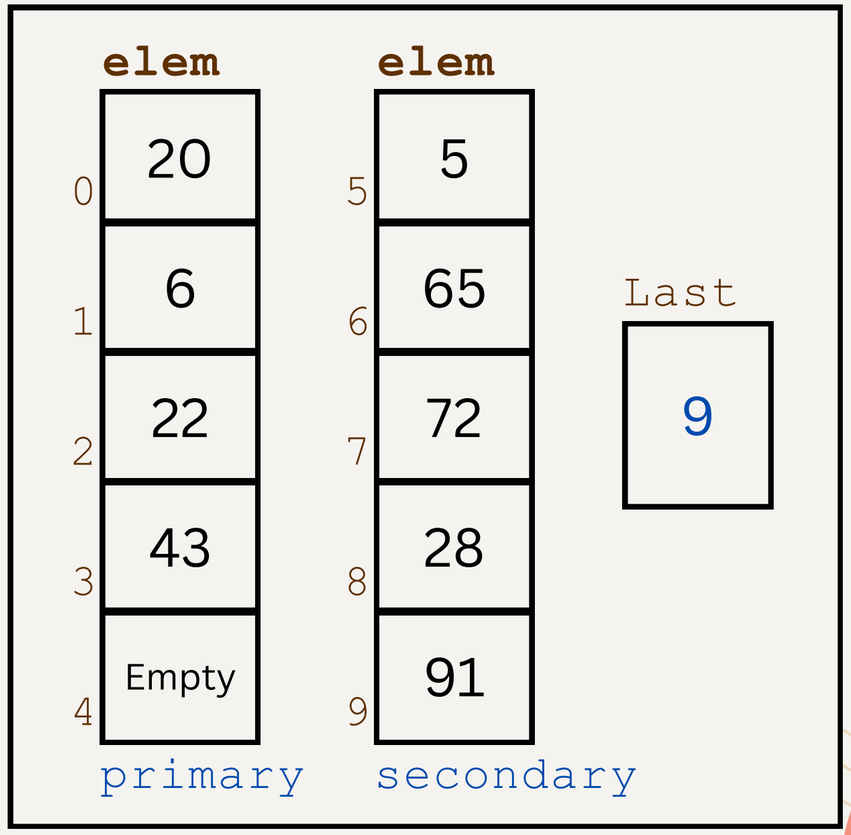


PROGRESSIVE OVERFLOW

Dictionary D



Dictionary D



PERFECT HASH?

PERFECT HASH

- when a hash function returns a unique value
- not possible to get a perfect hash

PACKING DENSITY

- ratio of num of elements to be stored to number of available space
- Perfect Ratio = 70:30 (only for closed hashing)

THANK YOU