Computer Engineering 12
Class 14

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Project 4

So far, we have learned stack & queue (ADT)
We also finished linked list (data structure)
To practice what we've learned in the lecture =>

We'll implement a stack and a queue through linked list!

Overview of Project 4

Week 1: A maze!

- stack

: A sorting!

- queue

It's an amazing sorting project!

You need to implement the deque using a circular, doubly-linked list with a sentinel or dummy node.

Week 2:

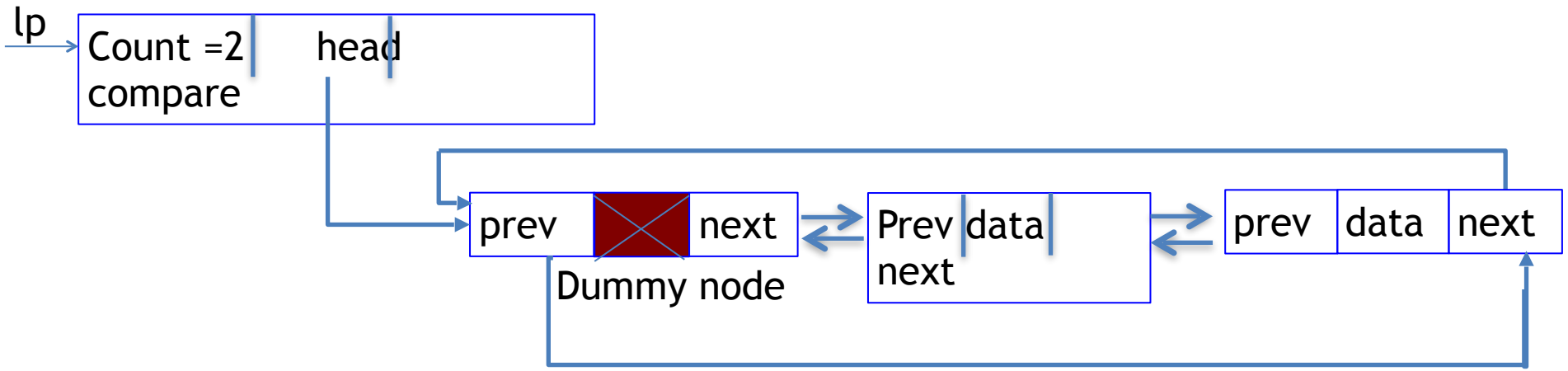
Since we've learned linked list, how about resolving collisions in your hash table by linked list (i.e. a chain).

Implement a generic SET ADT through hashing with chaining.

Implementation – A Deque(ADT)

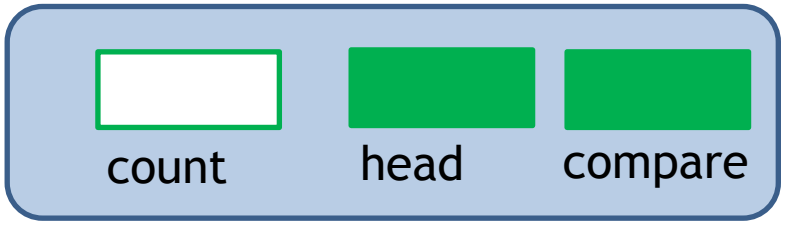
- Week one
  - Implement a deque that can be used as either a queue or a stack
    - using doubly linked circular list with a dummy node

The data structure of the deque:



Structures

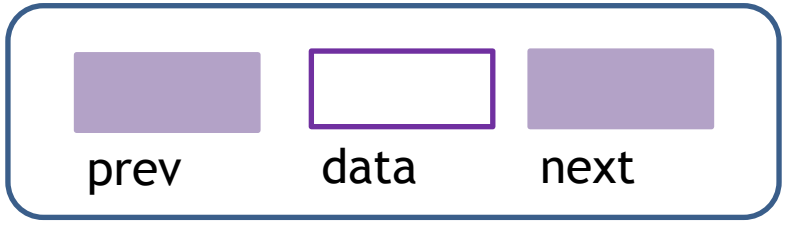
- List structure




```
struct list{
   int count;
   struct node *head;
   int (*compare)(); // function
pointer
};

typedef struct list List; // list.h
```

- Data node structure

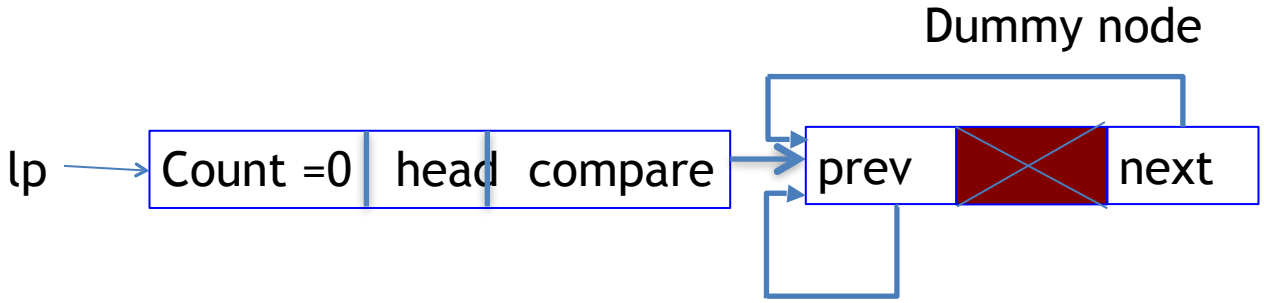



```
struct node{
   void *data;
   struct node *next;
   struct node *prev;
};

typedef struct node NODE; //
list.h
```

Create a List with a Dummy Node

- Allocate a list and initialize it.



- Code:

```
LIST *createList(int (*compare)())
{
        struct list *lp;
        lp = malloc(sizeof(struct list));
        assert(lp != NULL);
        lp->count = 0;
        lp->compare = compare;
        lp->head = malloc(sizeof(struct node));
        assert(lp->head != NULL);
        lp->head->next = lp->head;
        lp->head->prev = lp->head;
        return lp;
}
```

There is no NULL pointer!

Recall - Destroy List with No Dummy Node

```
void destroyList(struct list *pList) {
    assert(pList != NULL);
    while (pList->head!=NULL){
        pDel = pList->head;
        pList->head = pDel->next;
        free(pDel);
     }
     free(pList);
}
```

Destroying a deque in this way will cause a problem!

You'll never have pList->head == NULL

Destroy a deque

```
void destroyList(LIST *lp) {
    assert(lp != NULL);
    NODE *pDel;
    NODE *pPrev= lp->head->prev;
    do{
          pDel = pPrev;
          pPrev = pDel->prev;
          free(pDel);
    } while (pDel!=lp->head)
      free(lp);
}
```

Deleting the list from the last element.

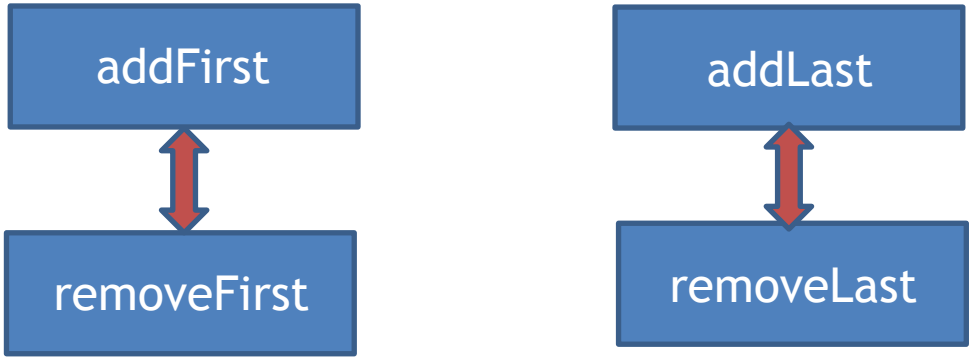
Other Functions

- extern LIST *createList(int (*compare)());
- extern void destroyList(LIST *lp);
- extern int numItems(LIST *lp);
- extern void addFirst(LIST *lp, void *item);
- extern void addLast(LIST *lp, void *item);
- extern void *removeFirst(LIST *lp);
- extern void *removeLast(LIST *lp);
- extern void *getFirst(LIST *lp);
- extern void *getLast(LIST *lp);
- extern void removeItem(LIST *lp, void *item);
- extern void *findItem(LIST *lp, void *item);
- extern void *getItems(LIST *lp);

Why do we need the same operation at both ends?

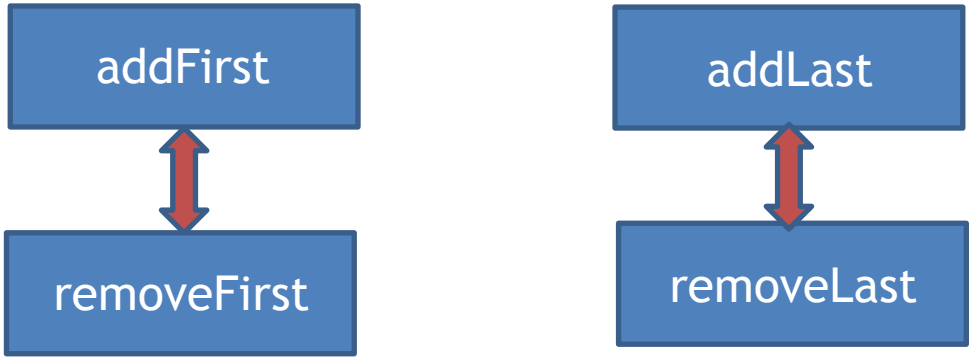
To Have a Stack

The outsider program (i.e. maze.c) needs to call a pair of functions for insertion and deletion



To Have a Queue

The outsider program (i.e. radix.c) needs to call a pair of functions for insertion and deletion

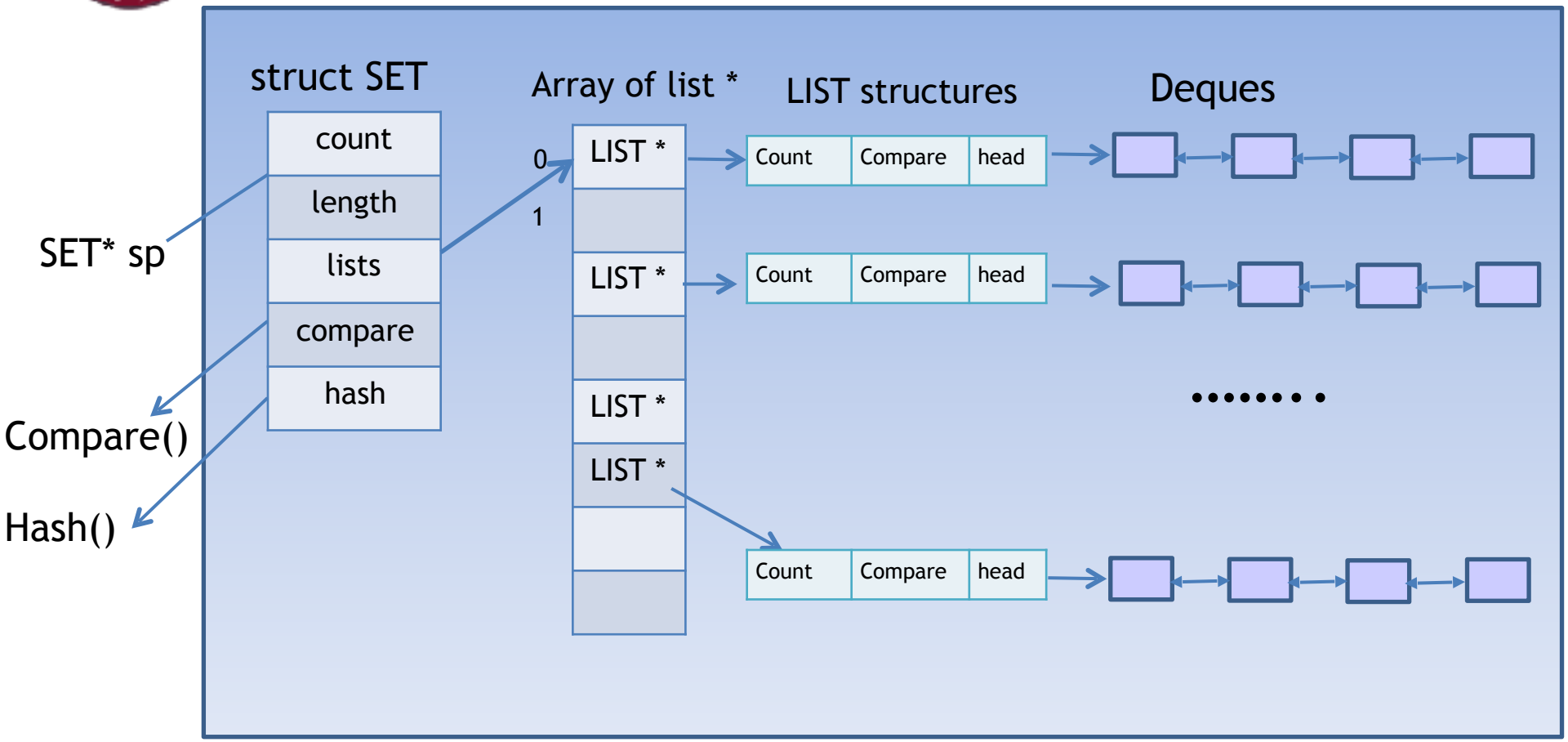


Week 2 – A Generic SET ADT

Since we've learned linked list, how about resolving collisions by using hash table with chaining?

Hint: the chain is the deque you have implemented in week 1.

The Data Structures



createSet

```
SET *createSet(int maxElts, int (*compare)(), unsigned (*hash)()){
        int i;
        SET *sp;
        assert(compare != NULL && hash != NULL);
        sp = malloc(sizeof(SET));
        assert(sp != NULL);
        //initialize length; count; compare and hash;
        sp->length =? ;
        sp->compare = compare;
        sp->hash = hash;
        sp->count = 0;

        //initialize array of lists: allocating memory for it.
        // for each element in the lists array (e.g. sp->lists[i]),
create a list,      //and let sp->lists[i] point to it.
        return sp;
}
```