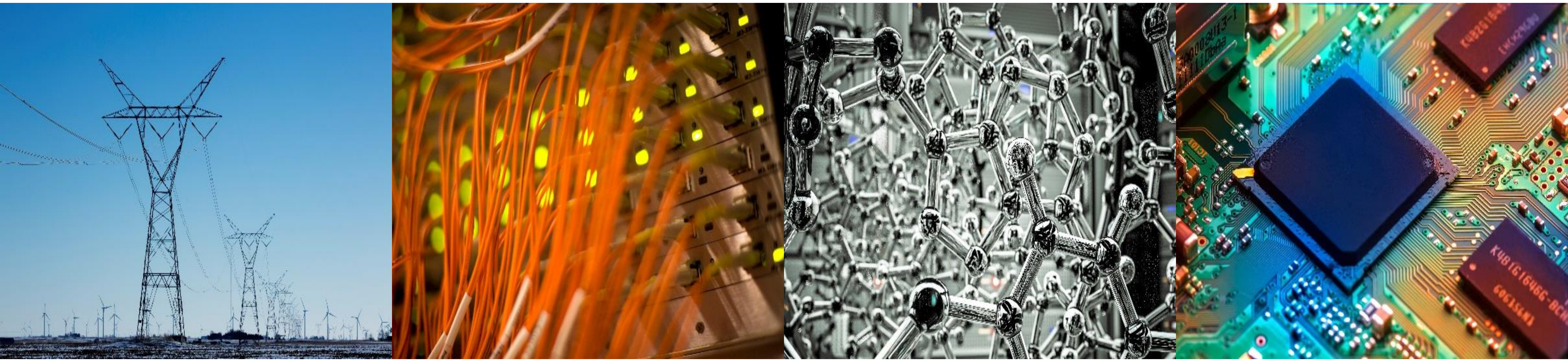
ECE 220 Computer Systems & Programming

Lecture 18 – Problem Solving with Linked Lists

October 29, 2024



- MT2 is on Thursday, 10/31 (lecture will be cancelled, office hours will end at 5pm)
- MP9 deadline is extended

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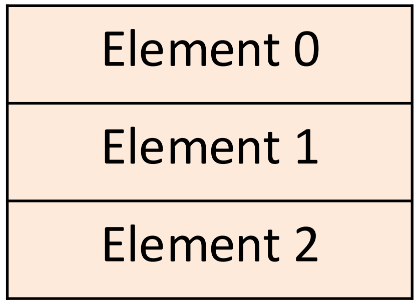
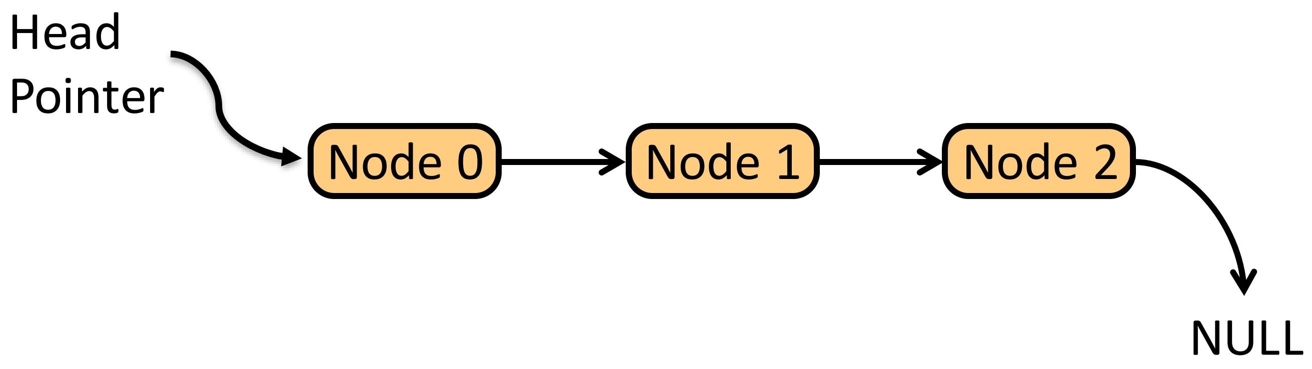
Array vs. Linked List

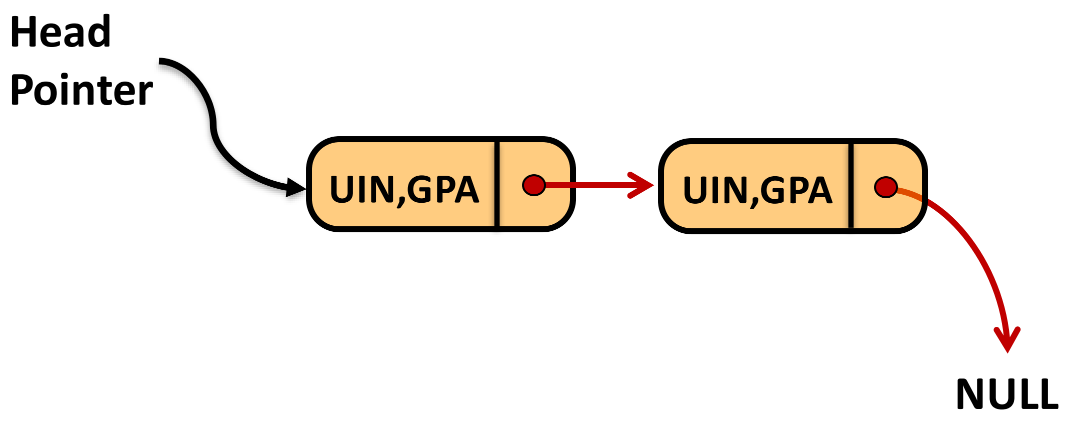




	Array	Linked List
Memory Allocation		
Memory Structure		
Memory Overhead		
Order of Access		
Insertion/Deletion		

From Lecture 17: Sorted List

```
typedef struct studentStruct Node;
struct studentStruct{
   int UIN;
   float GPA;
   Node *next;
};
```



We have a list of 200 student records (nodes) **sorted by UIN**

1. Find a particular student record by UIN
2. Add a new student record to the sorted list at the correct location
3. Delete a student record from the list

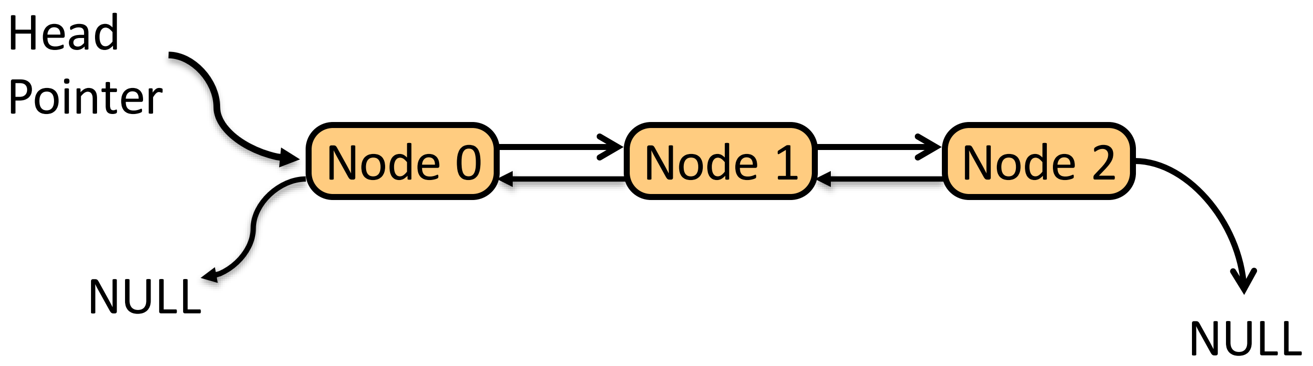
When do we need to use a double pointer?

```
int main(){
   /* add new node to a (sorted) linked list in main */
   Node *head;
   head = (Node *)malloc(sizeof(Node));
   head->UIN = 12345;
   head->GPA = 4.0;
   head->next = NULL;

   /* add new node by calling another function */
   add_node(&head, 11111, 3.0);

   /* memory deallocation omitted here for simplicity */
   return 0;
}
```

x6001	
x6002	
x6003	
x6004	
x6005	
x6006	
x6007	
x6008	
x6009	**head**
	Main's Bookkeeping Info

Doubly linked list

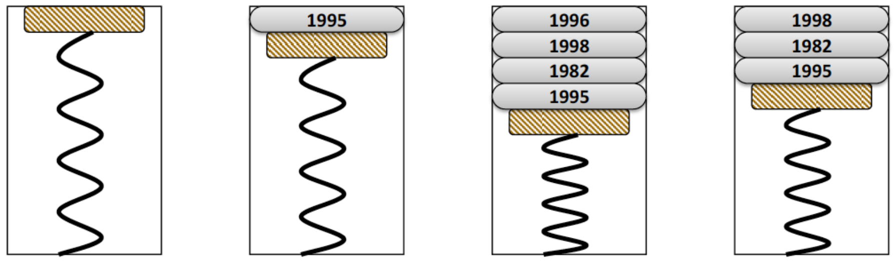
```
typedef struct studentStruct Node;
struct studentStruct{
   int UIN;
   float GPA;
   Node *prev;
   Node *next;
};
```



Stack & Queue abstract data types

Stack

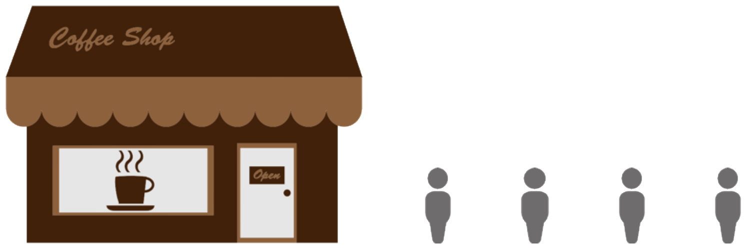
- First item in is the last item out - _______________
- Two operations for data movement: ___________ & ___________



Initial State After One Push After Three More Pushes After One Pop

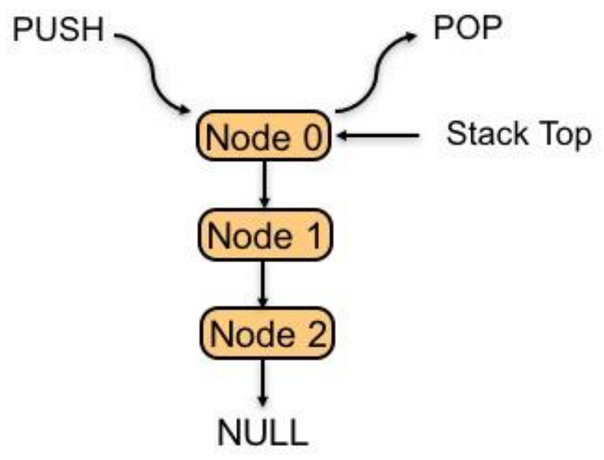
Queue

- First item in is the first item out - _______________
- Two operations for data movement: ___________ & ___________

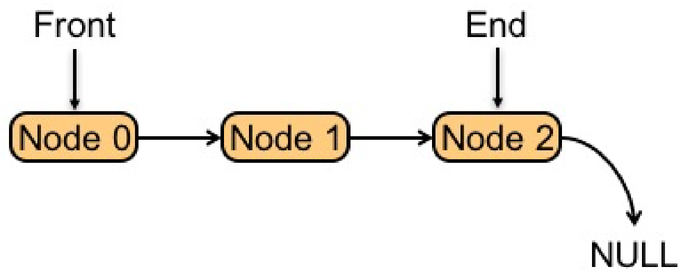


Implement abstract data types using linked list

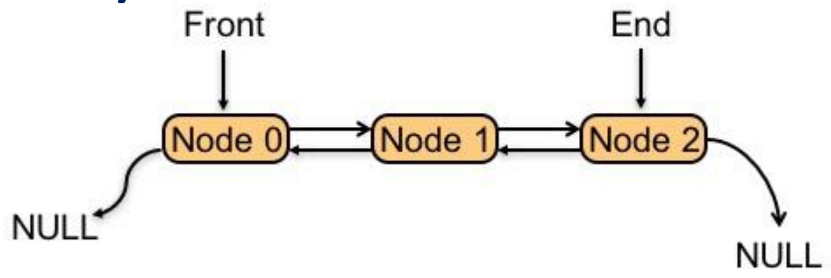
- **Stack**



- **Queue**



- **Deque ("Deck", double-ended queue)**



Stack implementation using a singly linked list

```
typedef struct nodeStruct node;
struct nodeStruct{
        int data;
        node *next;
};
node *top; /* global variable, init to NULL in main */
void push(int new_data); /* push a new node to stack */
int pop(); /* return data of the node pop from stack */
```