Welcome!

COMP1511 18s1

Programming Fundamentals

COMP1511 18s1

— Lecture 17 —

Linked Lists

Andrew Bennett

<andrew.bennett@unsw.edu.au>

Overview

after this lecture, you should be able to…

have a better understanding of **linked lists**

write code to **create** a linked list

write code to **traverse** a linked list

solve simple problems using **linked lists**

(**note**: you shouldn't be able to do all of these immediately after watching this lecture. however, this lecture should (hopefully!) give you the foundations you need to develop these skills. remember: programming is like learning any other language, it takes consistent and regular practice.)

Admin

Don’t panic!

assignment 2

(if you haven’t started yet, start **ASAP**)

deadline extended to **Sunday 13th May**

assignment 1

tutor marking/feedback in progress

week 9 weekly test out now

don’t forget about **help sessions**!

see course website for details

Help Sessions

Wednesday

6-8pm, J17 201

Thursday

6-8pm, J17 201

Friday

10am-12pm, Brass Lab (J17 Level 3)

2pm-4pm, Brass Lab (J17 Level 3)

4pm-6pm, Oboe Lab (J17 Level 3)

note: Brass Lab = Bugle/Horn

a quick recap of yesterday

The node struct

```
struct node {
    int data;
    struct node *next;
};
```

Interacting with a node struct

```c
struct node {
    int data;
    struct node *next;
};

// "struct node hello" (no *)
// "hello" is an actual node in the function's memory
struct node hello;
hello.data = 10;
hello.next = NULL;

// in the function's memory
//        ______
// hello |  10  |
//       |------|
//       | NULL |
//       |______|
```

Making a new node

```c
// Allocates memory for a new node; returns its address
struct node *make_node(int value) {
    struct node *new = malloc(1 * sizeof(struct node));
    new->data = value;
    new->next = NULL;
    return new;
}

// "struct node * hello"
// "hello" is a pointer to a node,
// it just stores the _address_
// (of the memory we get from malloc)
struct node *hello = make_node(10);

// in the heap (malloced memory)
//        ______
// hello |  10  |
//       |------|
//       | NULL |
//       |______|
```

Freeing a node

```c
// In accordance with Newton's 3rd Law of Memory Allocation
// "For every malloc, there is an equal and opposite free"
void free_node(struct node *node) {
    free(node);
}

struct node *hello = make_node(10);
free_node(hello);
```

Node pointers vs allocated nodes

reference to a node

arrow

```
struct node *curr ...
```

vs

making (**allocating**) a new node

circle

```
... = malloc(1 * sizeof(struct node));
```

Node pointers vs allocated nodes

reference to a node

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struct node *curr ...
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... = malloc(1 * sizeof(struct node));
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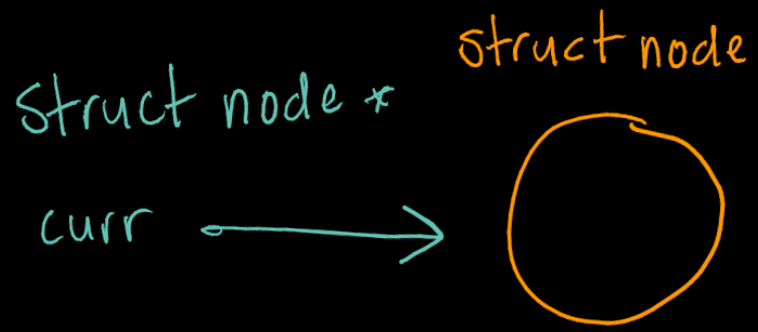
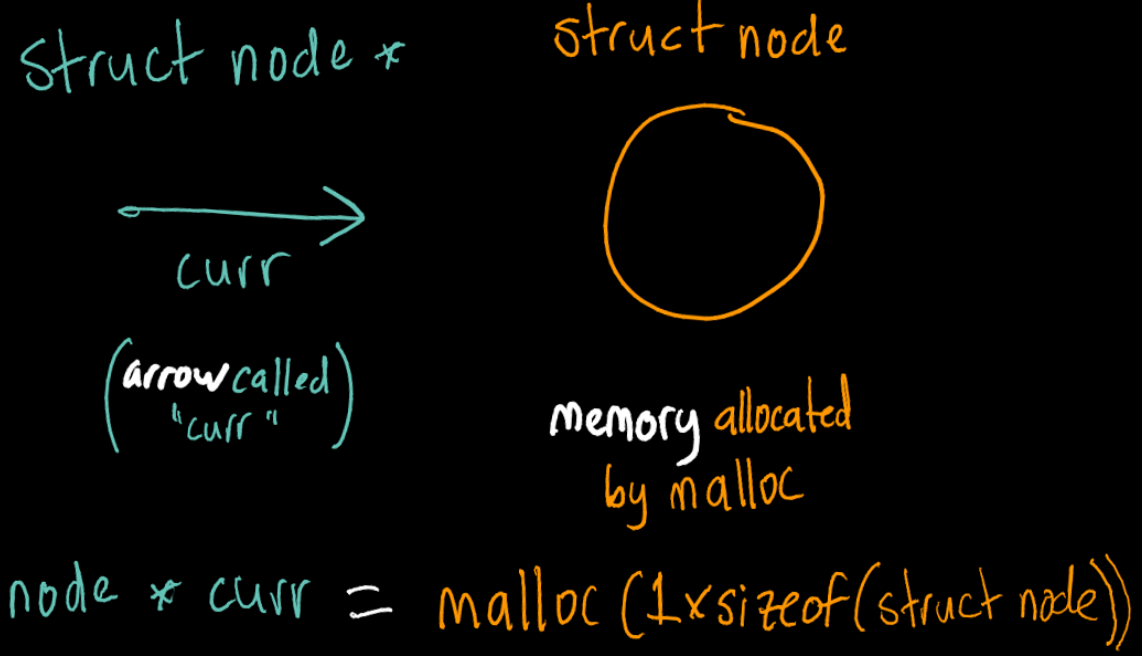


Node pointers vs allocated nodes

reference to a node (arrow) vs
making (**allocating**) a new node (circle)



array/list “traversal”

(going through every element)

Traversing… an Array

```
void fillArray (int array[ARRAY_SIZE], int value) {
    int i = 0;
    while (i < ARRAY_SIZE) {
        array[i] = value;  // set the value
        i++;               // move to next element
    }
}
```

Traversing… a Linked List

```
void fillList (struct node *list, int value) {
    struct node *curr = list;
    while (curr != NULL) {
        curr->data = value; // set the value
        curr = curr->next;   // move to next node
    }
}
```

and now for today's content...

The Standard List Loop

```
struct node *curr = list;

while (curr != NULL) {

    ?????

    curr = curr->next;
}
```

The Standard List Loop – List Length

How can we calculate the length of a list?

i.e. how many nodes are in the list

```
struct node *curr = list;

int num_nodes = 0;

while (curr != NULL) {

    num_nodes += 1;

    curr = curr->next;
}
```

The Standard List Loop – List Sum

How can we sum all of the elements in a list?

i.e. add the values of all of the nodes together

```
struct node *curr = list;

// int num_nodes = 0;
?????

while (curr != NULL) {

    // num_nodes += 1;
    ?????

    curr = curr->next;
}
```

Inserting Into a List

adding new nodes to our list....

insert at the **start**

insert at the **end**

insert in the **middle**

An aside: When things go wrong

what if our list is **empty**?

what would this look like in code?

An aside: Function Comments

it's important to **document** your functions:

what do they **assume**?

what does the **caller** need to do?

Building Blocks

we can construct **complex** list operations out of **simple** functions