Data Structures + Algorithms

- *Data Structure*, from Wiki:
  - A data structure is a way of storing data in a computer so that it can be used efficiently.

- *Algorithm*, from Wiki:
  - Finite list of well-defined instructions for accomplishing some task.
Simple Data Structures

- Primitive types are the simplest
  - int, char, short int, float, double, ...

- C structures
  - typedef struct record {
      int age;
      double mass;
  } record;

- Higher level structures
  - Arrays, lists, trees, etc.
Consider the problem of deciding whether an array contains a value:

```c
for( i = 0; i < N; i++ )
    if( array[i] == value )
        printf( "YES!" );
```

```
5 2 9 6 1 7 4
```

In here?
Imagine the Array is “Special”

- Given a sorted array, how to answer the question efficiently?
We can think about the array as being a binary tree...
What If...
We Want a Growing Array?

- If we don't know how many elements are going to be in the array?
  - One option is to malloc/free every time!
  - Another one is to create a huge array and double its size every time it reaches its capacity
  - Yet another one would be to use a list
Linked Lists

- A linked-list is a data structure that stores values, and does not assume the number of elements to be stored.

```c
typedef struct node {
    int value;
    struct node *next;
} node;
```
Operation in Linked Lists

- We can add another element at the end:
Operation in Linked Lists

- We can add another element at the end:
  - Create a new node (malloc)
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- Fix the pointers
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Operation in Linked Lists

- We can erase an element:
Operation in Linked Lists

- We can erase an element:
  - Fix the pointers, keeping the one to erase
Operation in Linked Lists

- We can erase an element:
  - Fix the pointers, keeping the one to erase
Operation in Linked Lists

- We can erase an element:
  - Fix the pointers, keeping the one to erase
  - Erase the node (free)
Operation in Linked Lists

- We can erase an element:
  - Fix the pointers, keeping the one to erase
  - Erase the node (free)