Chapter 3, Case Studies:

- Linear-time sorting algorithms (**Monday and Wednesday (and Thursday)**)
- Disjoint sets and array forests (next week Monday)
- Priority queues (next week Wednesday and Friday)
- N-sets and bit vectors (next week Thursday in lab)

Today (and Friday):

- Finish iterators
- Recent quiz problem
- Intro to "case studies"
- Limitations of comparison-based sorting
- Counting sort
- (Lab: Bucket sort)
- Radix sort

	ArrayList	LinkedList
get()		
set()		
add()		

ADTs

List
Stack
Queue
Map
Set
Bag

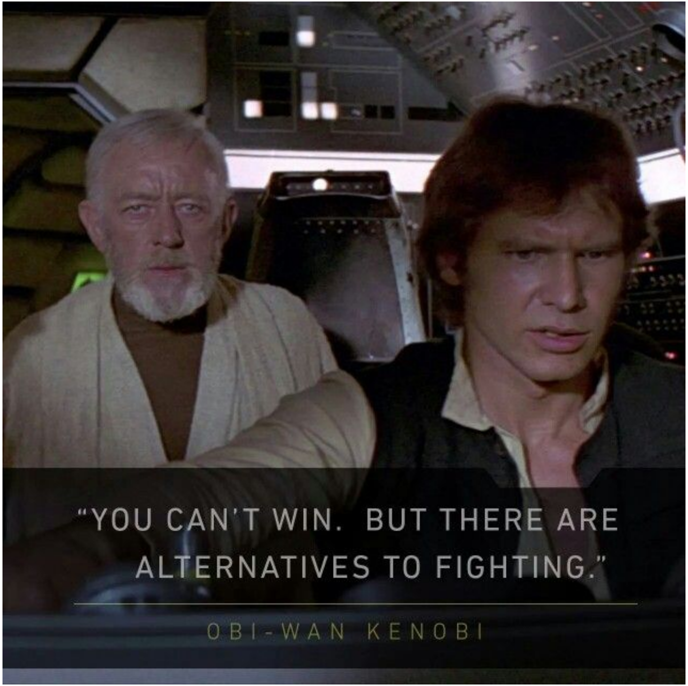
Data structures

Array
Linked list
Multi-dimensional array
Ring buffer

Can't you tell a good tree from a poor tree?

I have just been thinking, and I have come to a very important decision. These are the wrong sort of bees.

Good sorts	**Bad sorts**
Merge	Selection
Quick (expected case)	Insertion
Shell (unassigned project)	Bubble
Heap (Section 3.3)	



You can't comparison-sort in linear time. But there are alternatives to comparisons.

Meme from https://www.pinterest.com/pin/561542647262613858/

1 0 1 1 4 0 2 1 3 0 1 1 3 2 2 1 2 1 4 0 4 2 3 1 1 2 1 1 2 1 3 2 4 0 4

0. Alice 0
1. Bob 2
2. Carol 4
3. Dave 4
4. Eve 2
5. Fred 0
6. Georgia 0
7. Henry 1
8. Ida 4
9. Jack 2
10. Karen 4
11. Larry 0
12. Moira 2
13. Nate 3
14. Olivia 1
15. Pete 1
16. Queenie 1
17. Ralph 4
18. Sara 2
19. Trent 4
20. Ursulla 2
21. Vick 3
22. Wendy 1
23. Xavier 2
24. Yvette 0
25. Zeke 3

Coming up:

Do **Implementing ADTs Project** *(due this Friday, Sept 20)*
Do **Linear Sorting Project** *(due next week Wednesday, Sept 25)*

Due **Fri, Sept 20***: (end of day)*
Read Section 3.1
Do Exercises 2.(22–24)
Take sorting quiz

Due **Mon, Sept 23***: (end of day)*
Read Section 3.2
Do Exercises 2.(12 & 16) and 3.8.
Take disjoint sets quiz

```java
static Node arrayToList1(int[] array) {
    Node toReturn = new Node(array[0], null);
    for (int i = 1; i < array.length; i++) {
        Node current = toReturn;
        while (current.next() != null)
            current = current.next();
        current.setNext(new Node(array[i], null));
    }
    return toReturn;
}

Node arrayToList2(int[] array) {
    Node toReturn = null;
    for (int i = array.length - 1; i >= 0; i--)
        toReturn = new Node(array[i], toReturn);
    return toReturn;
}

static int[] listToArray(Node head) {
    int size = 0;
    for (Node current = head; current != null; current = current.next())
        size++;
    int[] toReturn = new int[size];
    int i = 0;
    for (Node current = head; current != null; current = current.next())
        toReturn[i++] = current.datum();
    return toReturn;
}
```

Invariant (Loop of `radix_sort`)

(a) i *is the number of iterations completed.*

(b) $\mathtt{r\_pow} = \mathtt{r}^{\mathtt{i}}$.

(c) $\forall\ k \in [0, n-1), \mathtt{sequence}[k] \mod \mathtt{r}^{\mathtt{i}} \leq \mathtt{sequence}[k+1] \mod \mathtt{r}^{\mathtt{i}}$

0110	1011	1100	0111	0001	1110	1001	1101

0110	1011	1100	0111	0001	1110	1001	1101

0110	1100	1110	1011	0111	0001	1001	1101

0110	1011	1100	0111	0001	1110	1001	1101

0110	1100	1110	1011	0111	0001	1001	1101

1100	0001	1001	1101	0110	1110	1011	0111

0110	1011	1100	0111	0001	1110	1001	1101

0110	1100	1110	1011	0111	0001	1001	1101

1100	0001	1001	1101	0110	1110	1011	0111

0001	1001	1011	1100	1101	0110	1110	0111

0110	1011	1100	0111	0001	1110	1001	1101

0110	1100	1110	1011	0111	0001	1001	1101

1100	0001	1001	1101	0110	1110	1011	0111

0001	1001	1011	1100	1101	0110	1110	0111

0001	0110	0111	1001	1011	1100	1101	1110