There are Different Algorithms

- Is there a better way to do sorting?

**QUICKSORT**
- Fastest known sorting algorithm in practice
- Average case: $O(N \log N)$ (we don’t prove it)
- Worst case: $O(N^2)$
  - But, the worst case seldom happens.
- A divide-and-conquer recursive algorithm
- Video of selection vs quicksort: http://youtu.be/cVMXKoGu_Y

Different sorting algorithms and animations


Quicksort is the best: Divide and Conquer

- Divide step:
  - Pick any element (pivot) $v$ in $S$
  - Partition $S - \{v\}$ into two disjoint groups $S_1 = \{x \in S - \{v\} | x < v\}$ and $S_2 = \{x \in S - \{v\} | x \geq v\}$
- Conquer step: recursively sort $S_1$ and $S_2$
- Combine step: the sorted $S_1$ (by the time returned from recursion), followed by $v$, followed by the sorted $S_2$ (i.e., nothing extra needs to be done)

To simplify, we may assume that we don’t have repetitive elements, so to ignore the ‘equality’ case!
Different sorting algorithms and animations

This one is the parameterizable web page that has the same code and you can give different parameters for number of things to sort, speed of animation etc. http://www.cs.oswego.edu/~mohammad/classes/csc241/samples/sort/Sort2-E.html

- This one is one of the ‘dancing animations’ we looked at both bubble sort and quick sort. This shows the “recursion” in a better way
- Hungarian Folk Dance Quick Sort ttp://www.youtube.com/watch?v=ywWBy6J5g8

Why Does Bubble Sort Work?

- Why do you think it sorts?
  wa se wh g  c
  se wa wh g  c
  se wa wh g  c
  wa wh se  c
  wa wh se  c
  wa wh se  c
  g  wh wa se
  g  wh wa se
  g  wh wa se
  c  se wh wa
  c  se wh wa
  c  se wh wa
Why Does Bubble Sort Work?

- Why do you think it sorts?
- There are several passes through the data with a leading item fixed (marked with lines).
- Notice this property: After each pass, the leading item must be the smallest of all processed on the pass.
- The leading item is first the first item, then the second etc.
- Proof by induction.