Sorting Algorithms

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1 Sorting Algorithms

- Insertion Sort
  - Starts by assuming the item in position 0 is already sorted
  - On each pass, for $n-1$ passes for a list of n items, the current item is checked against those already in the sorted sublist
  - We shift the elements greater than the current element to the right
  - When we reach an item that's smaller than the current, the current item is inserted
  - $O(n^2)$

```
def insertionSort(alist):
    for i in range(1, len(alist)):
        key = alist[i]
        j = i-1
        while j>=0 and key < alist[j]:
            alist[j+1] = alist[j]
            j -= 1
        alist[j+1] = key
```

- Selction Sort
  - Looks for the largest value as it makes the first pass
  - After the first pass, it puts that value into the correct position
  - The same is done for the next largest value until all values are in order
  - This process takes $n-1$ passes to sort a list of n items
  - $O(n^2)$

```
def selectionSort(alist):
    for i in range(len(alist)-1, 0, -1):
        max_pos = 0
        for j in range(1,i+1):
            if alist[j] > alist[max_pos]:
                max_pos = j

        tmp = alist[i]
        alist[i] = alist[max_pos]
        alist[max_pos] = tmp
```

- Quick Sort
  - In Quick Sort, the array is divided into sub arrays
    - This is done by taking the last element, called the pivot, and making one subarray containing all elements smaller than the pivot, and one containing the elements larger than the pivot
  - After the pivot (r) is chosen counter i is set to -1 and counter j is set to 0
  - Counter j will run from the first element to $r-1$
  - A comparison is them made between the element at position j and r (the counter)
    - If the element at j is larger than r, j increases by one
    - If the element at j is smaller than r, i increase by one, then the elements at position i and position j swap, then j increases by one
  - this is then repeated until j reaches the last element
  - At this point, r's position in the list will be at $i+1$
