Sorting Algorithms and Complexity

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Outline

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Activity: Sort your cards

1. Layout the cards in front of you.
2. Using some technique which looks at one or two cards at once, put the cards into sorted order.
3. Repeat this a few times, until you are conscious of how you do it.

Activity: How did you sort?

1. Think about how you sorted your cards.
2. Try to write down the general idea about how it was done.

Activity: Produce Pseudocode of your technique

1. Create a directory `labs/week10`
2. In this directory, using your favorite editor, create a file named `mysort.txt`
3. Write pseudocode to describe the sorting method that you used.
4. Compare sorting methods with your neighbors. Who's sort looks better?

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- Many “official” sorting algorithms exist.
- These include:
  - Selection Sort
  - Bubble Sort
  - Merge Sort

Selection Sort

```
selction_sort(ar)
    for i = 0 to ar
        min=i
        for j = i+1 to ar.size()-1
            if ar[j] < ar[min]
                min = j
            end if
        end for
        swap ar[i] and ar[min]
    end for
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- Carry out selection sort with your cards.

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- Carry out selection sort with your cards.
- Intuitively, what is selection sort doing?

Bubble Sort

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bubble_sort(ar)
    do
        swapped = false
        for i=0 to ar.size()-2
            if ar[i+1] < ar[i]
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        end for
    while swapped
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Merge Sort

```
merge_sort(ar)
    if ar.size() <= 1
        retun
    end if

    mid = ar.size() / 2
    merge_sort(ar[0..mid])
    merge_sort(ar[mid+1 .. ar.size()-1)
    merge(ar[0..mid], ar[mid+1 .. ar.size()-1])

merge(left, right)
    While left and right are not empty
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2. Which sorting method seemed more efficient?

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- The standard is to rate the algorithm by the number of steps necessary to solve a problem of n size.

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- We instead compute an asymptotic bound.
- An algorithm is $O(g(n))$ if $f(n) \leq cg(n)$ for some constant c for all n above some threshold.
- Intuitively, $O(g(n))$ gives us the "worst case" run time.

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- Using a spreadsheet, let's see how these functions relate to each other.

Selection Sort Complexity

Find the time complexity of the following:

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    for i = 0 to ar
        min=i
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Bubble Sort Complexity

Find the time complexity of the following:

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    do
        swapped = false
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                swap ar[i+1] and ar[i]
                swapped = true
            end if
        end for
    while swapped
```

Merge Sort Complexity

Find the time complexity of the following:

```
merge_sort(ar)
    if ar.size() <= 1
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    mid = ar.size() / 2
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Activity: What is the complexity of your search algorithm?

1. Compute the time complexity of your own sorting algorithm.
2. Include your runtime and justification of your complexity in your text file.

Activity: Code a Sorting Algorithm

1. Code your favorite sorting algorithm.
2. Your program should do the following:
    1. Ask for 10 numbers, which it adds to a vector.
    2. Run your sorting algorithm.
    3. Print the sorted vector.