SFU SIMON FRASER UNIVERSITY
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CMPT 120: Introduction to Computing Science and Programming 1

Sorting

How Fast is my Algorithm?

- There can be many algorithms to solve any problem – like linear search, binary search.

1. How do we choose the most efficient?
2. What is efficient?

- One measure is **how fast** our algorithm can determine the solution.
  - This is not the only measure, nor is it always the best measure.
  - How do we measure 'how fast'.

Introduction to Sorting

- Sorting: Arranging values into an order:
  - Alphabetical
  - Ascending numeric
  - Descending numeric
- There are many problems that can be solved quite quickly by first sorting the values – like Binary searching.
- There are many algorithms to taking a list of elements and putting those elements into ascending or descending order.
- One of the simplest algorithms is **Selection sort**.

Sorting a List: Ascending or Descending Order

Unsorted List of size 5:

20	*12*	*10*	*15*	*2*
lis[0]	*lis[1]*	*L{2]*	*lis[3]*	*lis[4]*

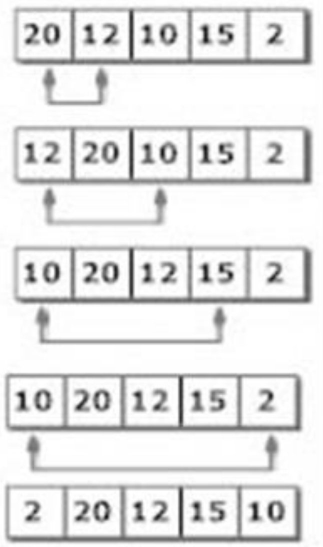
Sorted List: Descending order

20	*15*	*12*	*10*	*2*
lis[0]	*lis[1]*	*L{2]*	*lis[3]*	*lis[4]*

Sorted List: Ascending order

2	*10*	*12*	*15*	*20*
lis[0]	*lis[1]*	*L{2]*	*lis[3]*	*lis[4]*

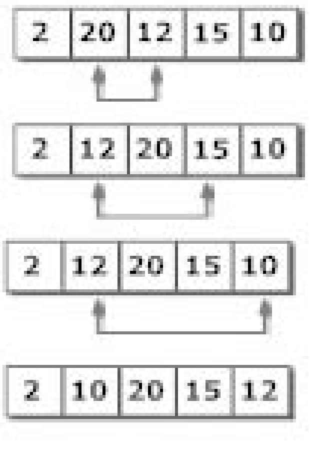
Selection Sort Example (Ascending Order)



Step 1

Iteration 1:

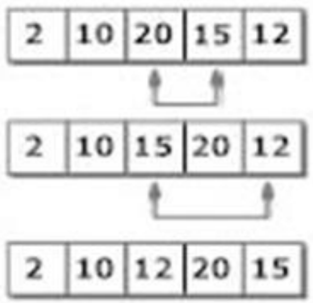
1. Find the smallest element between lis[0] and lis[4].
2. Swap if smaller.



Step 2

Iteration 2:

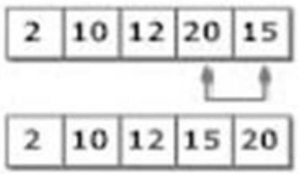
1. Find the smallest element between lis[1] and lis[4].
2. Swap if smaller.



Step 3

Iteration 3:

1. Find the smallest element between lis[2] and lis[4].
2. Swap if smaller.



Step 4

Iteration 4:

1. Find the smallest element between lis[3] and lis[4].
2. Swap if smaller.

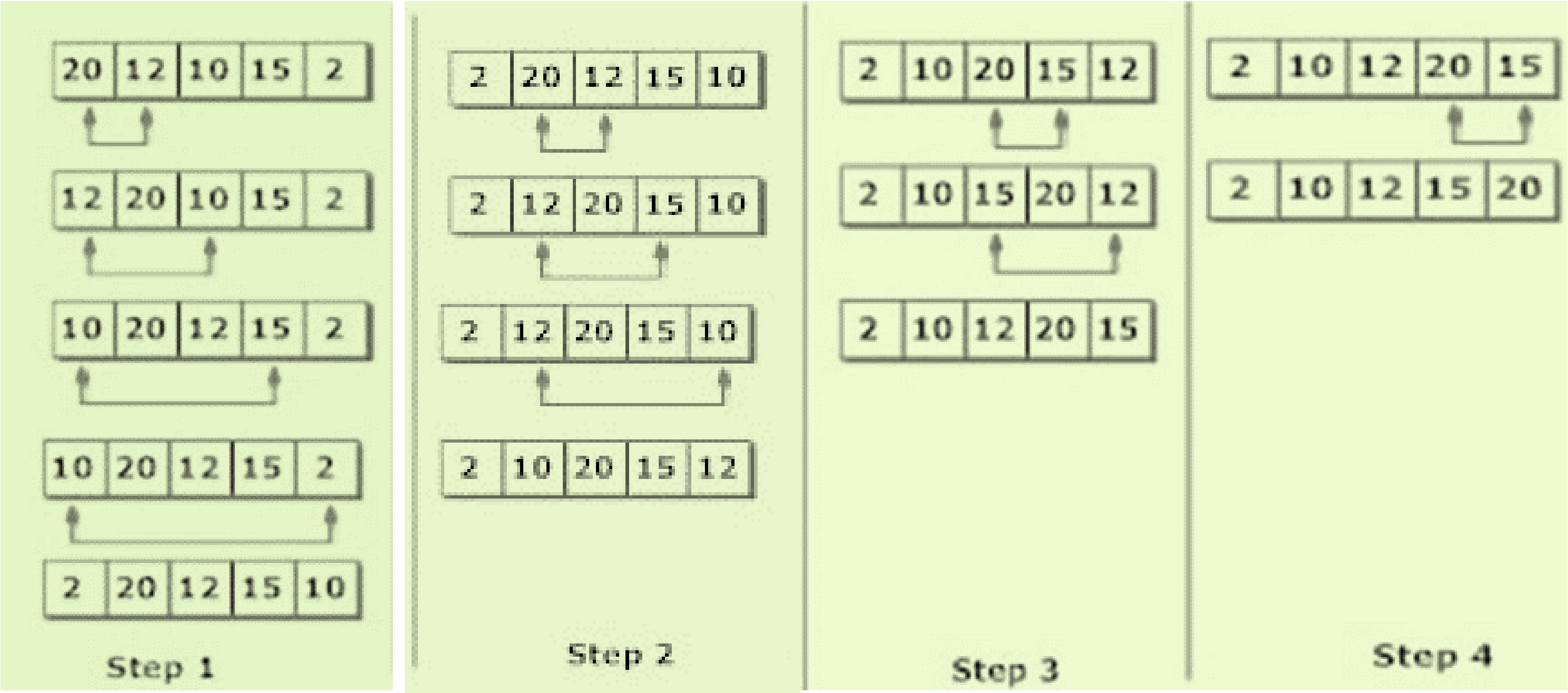
Selection Sort

- A method to arrange the unsorted list into a sorted list.
- The algorithm sorts an list by repeatedly:
  - finding the **minimum** element from unsorted part and putting it at the beginning (for ascending order.)
  - finding the **maximum** element from unsorted part and putting it at the beginning (for descending order).
- Imagine the algorithm maintains two subarrays.

1. The subarray which is already sorted.
2. Remaining subarray which is unsorted.

- In every iteration, the minimum/maximum element from the unsorted subarray is picked and moved to the sorted subarray.
- Size of unsorted array gradually decreases as shown on next slide.

Selection Sort: Unsorted Array Size



Size = 5 = M
UnSorSize = N = 5 = M

M = 5
N = 4 = M - 1

M = 5
N = 3 = M - 2

M = 5
N = 2 = M - 3

Selection Sort - Procedure

1. Selection sort algorithm **starts by** comparing first two elements of an array and swapping, if necessary.
2. Then, again **first** element and **third** element are compared and swapped if necessary.
3. This process goes on until **first** and **last** element of an array is compared.
4. If there are **N** elements to be sorted then, the process mentioned above should be repeated **N-1** times to get required result.
5. Finding the next lowest element requires scanning the remaining n – 1 elements and so on:

$$(n-1) + (n-2) + \ldots + 2 + 1 = n(n-1)/2 = = (n^2 - n)/2 = \Theta(n^2) \text{ comparisons.}$$

Selection Sort – Algorithm

```
for every element e from the list,
  for every element f from e to the end of the list,
      if f < smallest ,
              set smallest to f
      swap smallest and e
```

Canvas Post: Due by Monday, July 30, 11:59pm

- Implement the **selection sort** algorithm. You may refer to the **course Study Guide** *Figure 6.5* and *Figure 6.6* for selection sort algorithm and its implementation.
- Use the following list to test your program:

  [1, 6, 0, 7, 10]
- Post your Python program and its result on Canvas.

Questions?