Sorting

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Lecture 07

Notes

Bubble sort method

Some one give us a vector of unsorted numbers.
We want to obtain the vector sorted in ascending order.

- assign `IndexOfTheLastToCheck` be the *index* of the vector end

1. start sweeping from the beginning of the vector
2. Compare the 2 consequent elements till we reach the `IndexOfTheLastToCheck`
3. if the left element is larger we swap these 2 elements
4. move to the next pair to the right i.e. move to the item 2
   - notice that at the end of the sweep the *index* of the last element to check holds the largest element
   - so next sweep does not have to be that long.
   - it is shorter by one element
   - i.e. the *index* of the last element to check should be decreased by 1
5. decrease `IndexOfTheLastToCheck` by 1
6. if `IndexOfTheLastToCheck` > 1 repeat from the item 1

$x = [3,1,4,5,2]$
first sweep
$x = [\widehat{3,1},4,5,2]$ swap
$x = [1,\widehat{3,4},5,2]$ after swap
$x = [1,\widehat{3,4},5,2]$ no swap
$x = [1,3,\widehat{4,5},2]$ no swap
$x = [1,3,\widehat{4,5,2}]$ swap
$x = [1,3,4,2,5]$ sweep done
new sweep
$x = [\widehat{1,3},4,2,5]$ no swap
$x = [1,\widehat{3,4},2,5]$ no swap
$x = [1,3,\widehat{4,2},5]$ swap
$x = [1,3,2,4,5]$ sweep done
new sweep
$x = [\widehat{1,3},2,4,5]$ no swap
$x = [1,\widehat{3,2},4,5]$ swap
$x = [1,2,3,4,5]$ sweep done
last sweep
$x = [\widehat{1,2},3,4,5]$ no sweep
$x = [1,2,3,4,5]$ sweep done

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Bubble sort properties

- This is the worst of all working algorithm!
- The execution time of this algorithm is $\mathcal{O}(N^2)$
- Never use it in the real life!
- However it is very simple to program, and does not require extra memory for execution.

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Quick sort method

Much better yet simple algorithm
Let's discuss recursive realization
We will name our sorting function as `qsort`.

- choose a pivot point value
  - let's choose the pivot at the middle of the vector
  - pivotIndex=floor(N/2)
  - pivotValue=x(pivotIndex)
- create two vectors which hold lesser and larger than pivotValue elements of the input vector.
- now concatenate the result of xs=[`qsort`(lesser), pivotValue, `qsort`(larger)]
- done

Notes

Quick sort summary

- usually fast
- typical execution time $\mathcal{O}(N \log_2 N)$
- but it is not guaranteed
  - However for certain input vectors execution time could be as long as $\mathcal{O}(N^2)$

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