

Bubble Sort



Sort'in without Look'in

- 2-player game cooperative game
- **Objective: Sort the cards (in ascending order) without revealing the cards**
- Rules:
- Player 1 and 2 seated on opposite side, facing each other
- Player 1 (sorter), Player 2 (mystic)
- 7 Number cards lay out and faced down (paper cups?)
- Only mystic can see the cards, **only 2 cards at one time**
- Sorter starts by pointing to 2 cards.
- Mystic then knocks **twice** on the table if the card on the right side is greater than the card on the left,
- Sorter swaps the position of the 2 cards, still facing down, if the double knocking is heard
- The sorter and mystic continue their turns respectively, executing the same actions, until sorter exclaims **"BUBBLES"** and both players raise both hands.
- The fastest pair wins the game.

What are some strategies?

- Randomly comparing/swapping 2 cards (does not guarantee complete sorting)
- Systematically swapping pairs of elements down the row once (insufficient to ensure sorting since a card is only compared with the adjacent cards)
- Others?

What is bubble sort?

- A simple **sorting** algorithm that sorts elements in an unordered list by:
- Comparing adjacent elements in the list and swap them if they are not in order.
- E.g. starting with the first pair, if the first element is larger than the second, they will be swapped.

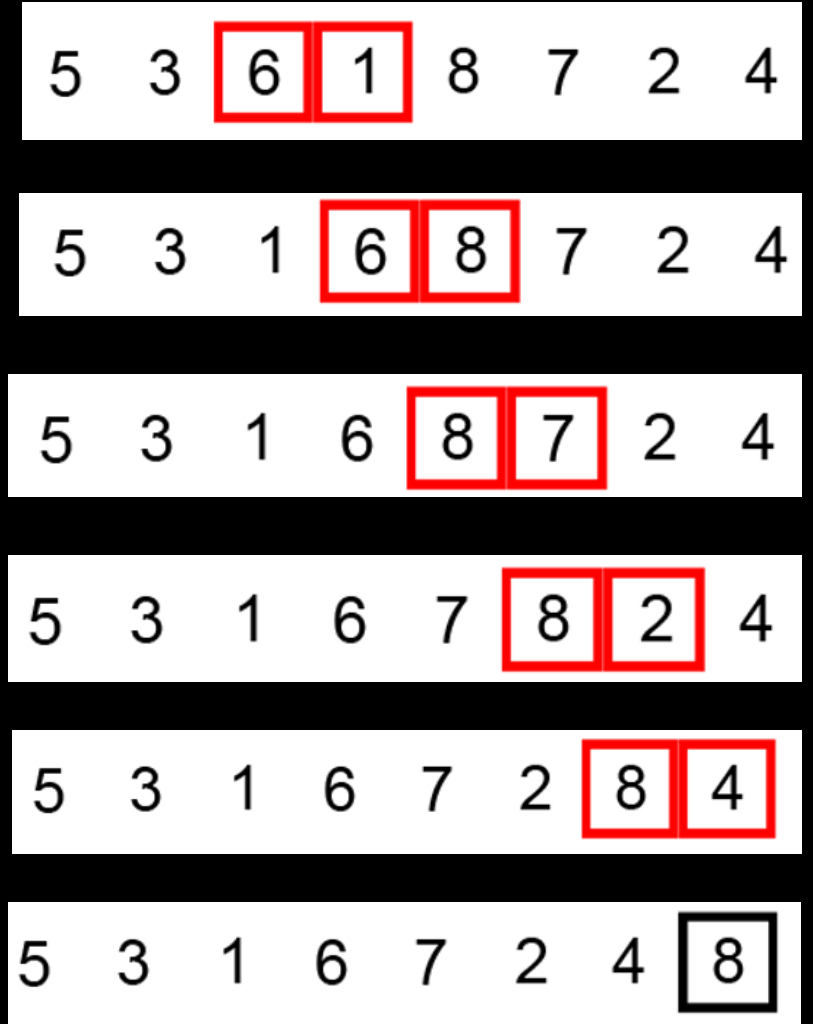
6 5 3 1 8 7 2 4

- The comparison then proceeds on with the next pair and so on....

5 6 3 1 8 7 2 4

What is bubble sort?

-until the last pair in the list.
- This way, the **largest element** will be sorted to the end of the list.
- The whole process is **repeated for the subsequence** (not inclusive of the last element) starting from the first two elements up until the largest element in this subsequence is sorted.
- And this process is repeated for the remaining subsequence until all elements are sorted.



Bubble sort Animation



5 2 4 6 1 3

<https://codepumpkin.com/bubble-sort/>

Is bubble sort in-place?

- What does it mean to be in-place?
- Bubble sort:
 - Elements doing mutual swap within the list
 - List is mutated
 - No additional memory space needed to store list during sorting
 - YES – Bubble sort is in-place

Is bubble sort stable?

- What does it mean to be stable?
- Consider a case where there are repeated elements within an unsorted list.
- [3, 1, 4, 5, 3, 6, 2]
- Stable:
- [1, 2, 3, 3, 4, 5, 6] #relative position remains unchanged
- Unstable:
- [1, 2, 3, 3, 4, 5, 6] #swap occurs for elements with same value
- Stability: Depends on its implementation, not the type of sort used

Order of growth bubble sort?

- Best case: $O(n)$
 - List already sorted, optimized bubble sort
- Average case: $O(n^2)$
- Worse case: $O(n^2)$
 - List is arranged in a reversed manner
 - Swapping occurs at every step
 - Sum of AP: $(n-1) + (n-2) + (n-3) + \dots + 1$