Theorem: Ave # of inversions in an array of n distinct elements is $n(n-1)/4$.

$\frac{n^2-n}{4}$ $O(n^2)$

Assumptions
1. No duplicate elements
2. All elements are equally likely.

Proof:

- Consider a list L of n integers
- L_r reverse list
- For every pair of indices (i,j) either i,j is in L or it is in L_r
- Total # of inversions for both L & L_r is $\binom{n}{2} = \frac{n(n-1)}{2}$. ✓
- Average # of inversions. $\frac{n!}{2n!}\binom{n}{2} = \frac{n(n-1)}{4}$. ✓

Any algorithm that sorts adjacent elements is $\Omega(n^2)$ on average.

$\Omega(n^2)$: Insertion, Bubble, Selection. } exchange adjacent elements.