Average Time to Build a Binary Search Tree

Consider the time it takes to insert $n$ items into an initially empty binary search tree.

**Worst-Case Time:**

$O(n^2)$

In the worst case, the items arrive in sorted order, and the tree amounts to a linked list, where it takes 0 comparisons to insert the first element, 1 comparison to insert the second element, 2 comparisons to insert the third element, ... and $n-1$ comparisons to insert the $n$th element, for a total of $n(n-1)/2 = \Omega(n^2)$ comparisons.

**Expected Time:**

$O(n\log(n))$

If the elements are inserted in random order, a proof by induction can be used to show that $< 1.4n\log_2(n)$ comparisons are used on average.