How long does it take to multiply two 5 bit numbers?

\[
\begin{array}{c}
\phantom{10011} \\
\times \phantom{10101} \\
\hline
\phantom{1001} \\
\phantom{0000} \\
\phantom{1001} \\
\phantom{0000} \\
\phantom{1011} \\
\hline
\phantom{1000001111} \\
\end{array}
\]

number of adds: \(1 + 2 + 3 + 4 + 5 + 4 + 3 + 2 + 1\)

In general, with \(n\) bit numbers we will have:

\[
n + 2(n-1) + 2(n-2) + \cdots + 2 = n + 2 \frac{n(n-1)}{2}
\]

+ perhaps \((n-1)\) carries = \(n^2+n-1\) times

how long it take to add two one bit numbers.

Hence the time is \(O(n^2)\), meaning a quadratic in \(n\).

If we need to multiply 3 \(N\)-bit numbers, which requires 2 multiplies of \(N\)-bit numbers, the time is \(2n^2+2n-2\), which is also quadratic in \(n\), so \(O(n^2)\).