**procedure** insertion sort\((a_1, a_2, \ldots, a_n:\text{ real numbers with } n \geq 2)\)

for \(j := 2\ to\ n\)

\(i := 1\)

while \(a_j > a_i\)

\(i := i + 1\)

\(m := a_j\)

for \(k := 0\ to\ j - i - 1\)

\(a_{j-k} := a_{j-k-1}\)

\(a_i := m\)

\(\{a_1, \ldots, a_n\text{ is in increasing order}\}\)
What is the runtime?

# of operations = \[\sum_{j=2}^{n} [\text{work done inside loop}]\]

\[
= \sum_{j=2}^{n} \left[1 + \sum_{i=1}^{j} 1 + \sum_{k=0}^{j-2} 1\right]
\]

\[
= \sum_{j=2}^{n} [1 + j + j - 1] = \sum_{j=2}^{n} [2j] = \frac{2(n+1)n}{2} - 2 = O(n^2)
\]