// Honor Code : On my honor, I pledge that I have neither received nor provided improper assistance in the completion of this assignment.
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Lab 9

$T(2) = T(1) + 1$
$T(3) = T(2) + 2$
$T(4) = T(3) + 3$

$T(N) = T(N-1) + N-1$
$(N-1) + (N-1)$
$(N-1)$

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Problem 1 - insertion sort

$T(1) = 1$

$T(N) = T(N-1) + N - 1$

$T(N-1) = \underline{T(N-2) + N - 2}$

$T(N-2) = \underline{T(N-3) + N - 3}$

....

$T(2) = \underline{T(1) + 1 = 2}$

~~$T(N) = T(1) +$~~

$T(N) + T(N-1) + T(N-2) + T(N-3) + \dots T(3) + T(2) =$

$T(N-1) + T(N-2) + T(N-3) + \dots T(3) + T(2) + T(1) + \underline{T(N) - 1}$

$T(N) = T(1) + \underline{1 + 2 + 3 + \dots + (N-2) + (N-1)}$ (open form)

$T(N) = 1 + \underline{N(N-1)/2}$ (closed form)

$T(N) = \underline{O(N^2)}$ (big O)

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Problem 2.

$T(1)=1$

$T(N)=T(N-1)+2$

$T(N-1)=T(N-2)+2$

$T(N-2)=T(N-3)+2$

...

$T(2)=3$

$T(N)+T(N-1)+T(N-2)+T(N-3)+\dots+T(3)+T(2)=$

$T(N-1)+T(N-2)+T(N-3)+\dots+T(1)+2+2+\dots+2$

$T(N)=T(1)+2(n-1)$ (open form)

$T(N)=1+2n-2=2n-1$ (Closed form)

$T(N)=O(n)$ (Big O)

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Problem 3.

$T(0)=1$

$T(n) = T(n-1) + 1$

$T(n-1) = \underline{T(n-2) + 1}$

$T(n-2) = T(n-3) + 1$

$\cdots$

$T(2) = \underline{T(1) + 1 = 3}$

$T(1) = \underline{T(0) + 1 = 2}$

$T(n) + \underline{T(n-1) + T(n-2) + \cdots + T(1) = T(n-1) + T(n-2) + \cdots T(0) + 1 + 1 + \cdots + 1}$

$T(n) = \underline{T(0) + 1 + 1 + \cdots + 1}$ (open form)

$T(n) = \underline{T(0) + n = 1 + n}$ (closed form)

$T(n) = \underline{O(n)}$ (Big O)

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Problem 4.

$T(0)=1$

$T(1)=1$

$T(n) = T(n/2)+1$

$= T(n/4)+1+1 = T(n/4)+2$ since $T(n/2) = T(n/4)+1$

$= T(n/8)+1+1+1 = T(n/8)+3$ since $T(n/4) = T(n/8)+1$

$= T(n/16)+4$

....

$= T(n/2^k)+k$ in terms of $n, 2^k, k$

$T(1) \Rightarrow n/2^k = 1$

$n = 2^k$

$\log n = k$

$T(n) = 1+1+\dots+1+T(1)$ (open form)

$T(n) = \log(n)+T(1) = \log(n)+1$ (closed form)

$T(n) = O(\log(n))$ (Big O)