Analysis of Algorithms: Solutions 1

```
                                              X
                                              X
                                              X
                                              X
                                              X
                                              X
                 X                            X
                 X                            X
number of        X        X                   X
homeworks        X        X  X        X  X     X
                 X        X  X  X  X  X  X  X  X
                 X        X  X  X  X  X  X  X  X
                 X  X  X  X  X  X  X  X  X
                 ------------------------------

                 0  1  2  3  4  5  6  7  8  9  10
                            grades
```

This histogram shows the distribution of grades (from 0 to 10) for the homeworks submitted on time; it does not include the late submissions.

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(1) Give an algorithm that determines the number of *distinct* elements in an array $A[1..n]$.
(2) Estimate the worst-case running time of your algorithm.

DISTINCT-COUNTER(A, n)	cost	times
$counter \leftarrow 0$	c_1	1
for $j \leftarrow 1$ **to** n	c_2	$n + 1$
do $i \leftarrow j + 1$	c_3	n
while $i < n + 1$ and $A[j] \neq A[i]$	c_4	$\leq \sum_{i=1}^{n}(n - i + 1) = \frac{n(n+1)}{2}$
do $i \leftarrow i + 1$	c_5	$\leq \sum_{i=1}^{n}(n - i) = \frac{(n-1)n}{2}$
if $i = n + 1$	c_6	n
then $counter \leftarrow counter + 1$	c_7	$\leq n$
return $counter$	c_8	1

$$
\begin{aligned}
T(n) &\leq c_1 + c_2(n + 1) + c_3 n + c_4 \frac{n(n + 1)}{2} + c_5 \frac{(n - 1)n}{2} + c_6 n + c_7 n + c_8 \\
&= \left(\frac{c_4}{2} + \frac{c_5}{2}\right)n^2 + \left(c_2 + c_3 + \frac{c_4}{2} - \frac{c_5}{2} + c_6 + c_7\right)n + (c_1 + c_2 + c_8) \\
&= \Theta(n^2)
\end{aligned}
$$