

Θ -notation usage

Assume that procedure `(proc n)` takes time $T(n)$. Note that $T(n)$ has units (like seconds). Suppose, in particular, the procedure makes $2n^2 + n$ multiplications.

Good usage

- $T(n)$ is $\Theta(n^2)$.
- The time taken by `(proc n)` is $\Theta(n^2)$.
- The number of multiplications performed by `(proc n)` is $\Theta(n^2)$.

Good reasoning

- The number of multiplications performed by `(proc n)` is $\Theta(n^2)$ because $n^2 \leq 2n^2 + n \leq 3n^2$ for $n \geq 1$.

The second inequality is because $n \leq n^2$, and so $2n^2 + n \leq 2n^2 + n^2 = 3n^2$.

- In this case, the run time is approximately proportional to the number of multiplications performed, since each recursive call to `proc` does either 1 and 2 multiplications. Hence, the running time for `(proc n)` is also $\Theta(n^2)$.

It is important that multiplications are sufficiently frequent that they are a fair measure of run-time.

Correct but poor usage

- The number of multiplications performed by `(proc n)` is $\Theta(2n^2)$.

Poor because $\Theta(n^2)$ is also correct and is simpler.

Incorrect usage

- The procedure `(proc n)` is $\Theta(n^2)$.

A procedure is not a mathematical function, and so cannot be described using Θ -notation. What about the procedure is $\Theta(n^2)$? the running time? the number of additions performed? the space used by the procedure?

- The big-theta notation for the procedure is $\Theta(n^2)$.

Simply wrong usage.