Asymptotic notation

These are used for f, g functions of some parameter, e.g. n or x, which, as here, is often suppressed in the notation. The limiting statements are meant as the parameter approaches some limit (most often $n \to \infty$); the others are for the parameter in some range (with the limit or range for the parameter either specified or clear from the context).

$f \sim g$: $f/g \to 1$
$f = O(g)$: $|f|/|g|$ is bounded above
$f = o(g)$: $f/g \to 0$
$f = \Omega(g)$: $g = O(f)$
(equiv: $|f|/|g|$ is bounded below by a positive constant)
$f = \omega(g)$: $|f|/|g| \to \infty$ (equiv: $g = o(f)$)
$f = \Theta(g)$: $f = O(g)$ and $g = O(f)$
(equiv: $|f|/|g|$ lies between two positive constants)
$f \lesssim g$: $\limsup f/g \leq 1$ (not sure we'll see this one)

We can then, for example, write simply $O(g)$ to mean any (perhaps unspecified) function whose absolute value is known to be bounded above by Cg for some fixed C. Big and little "Oh" are often used for error terms, for example

$$e^x = 1 + x + O(x^2) \quad \text{as} \quad x \to 0,$$

in which case the functions $O(\cdot)$, $o(\cdot)$ will often be negative. But more often than not f and g will be positive.