# Orders of Growth

## Ten Orders of Growth

Let's assume that your computer can perform 10,000 operations (e.g., data structure manipulations, database inserts, etc.) per second. Given algorithms that require lg $n$, $n^{½}$, $n$, $n^2$, $n^3$, $n^4$, $n^6$, $2^n$, and $n!$ operations to perform a given task on $n$ items, here's how long it would take to process 10, 50, 100 and 1,000 items.

| | ***n*** | | | |
|---|---|---|---|---|
| | **10** | **50** | **100** | **1,000** |
| **lg *n*** | 0.0003 sec | 0.0006 sec | 0.0007 sec | 0.0010 sec |
| $n^{½}$ | 0.0003 sec | 0.0007 sec | 0.0010 sec | 0.0032 sec |
| ***n*** | 0.0010 sec | 0.0050 sec | 0.0100 sec | 0.1000 sec |
| ***n* lg *n*** | 0.0033 sec | 0.0282 sec | 0.0664 sec | 0.9966 sec |
| $n^2$ | 0.0100 sec | 0.2500 sec | 1.0000 sec | 100.00 sec |
| $n^3$ | 0.1000 sec | 12.500 sec | 100.00 sec | 1.1574 day |
| $n^4$ | 1.0000 sec | 10.427 min | 2.7778 hrs | 3.1710 yrs |
| $n^6$ | 1.6667 min | 18.102 day | 3.1710 yrs | 3171.0 cen |
| $2^n$ | 0.1024 sec | 35.702 cen | $4\times10^{16}$ cen | $1\times10^{166}$ cen |
| $n!$ | 362.88 sec | $1\times10^{51}$ cen | $3\times10^{144}$ cen | $1\times10^{2554}$ cen |

Table 1: Time required to process $n$ items at a speed of 10,000 operations/sec using eight different algorithms.

*Note:* The units above are seconds (sec), minutes (min), hours (hrs), days (day), and centuries (cen)!

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## The Explosive Growth of $2^n$

| ***n*** | | | | | | |
|---|---|---|---|---|---|---|
| **15** | **20** | **25** | **30** | **35** | **40** | **45** |
| 3.28 sec | 1.75 min | 55.9 min | 1.24 days | 39.8 days | 3.48 yrs | 1.12 cen |

Table 2: Time required to process $n$ items at a speed of 10,000 operations/sec using a $2^n$ algorithm.

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## The Explosive Growth of $n!$

| n | | | | | | |
|---|---|---|---|---|---|---|
| **11** | **12** | **13** | **14** | **15** | **16** | **17** |
| 1.11 hrs | 13.3 hrs | 7.20 days | 101 days | 4.15 yrs | 66.3 yrs | 11.3 cen |

Table 3: Time required to process *n* items at a speed of 10,000 operations/sec using an *n*! algorithm.