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Algorithms and big Os - A Comparison of Execution Times

Assuming that a basic operation takes 1nS.

This is a slightly futuristic assumption, but not unrealistic for the future. Although a modern pentium 4 has a clock speed of 4GHz, it can not do very much at all in one clock cycle; it certainly can not access anything from memory in 0.25nS.

A "basic operation" is the repeated unit of work done in a computation. When sorting it will be a few of array accesses and a comparison. For a matrix multiplication it will be a few array accesses and a multiplication and an addition. They generally come out roughly the same.

data size **(n)**	Algorithm Type							
	logarithmic **$\log_2(n)$**	linear **n**	n log n **$n \times \log_2(n)$**	quadratic **n^2**	cubic **n^3**	expon. **2^n**	**$n \times 2^n$**	combin. **n!**
10	3 nS	10 nS	30 nS	0.1 μS	1 μS	1 μS	10 μS	4 mS
20	4 nS	20 nS	80 nS	0.4 μS	8 μS	1 mS	20 mS	100 Yrs
30	5 nS	30 nS	0.1 μS	1 μS	30 μS	1 S	30 S	100 Uni
40	5 nS	40 nS	0.2 μS	2 μS	60 μS	15 min	10 hrs	5 gpu
50	6 nS	50 nS	0.3 μS	3 μS	0.1 mS	10 days	2 Yrs	¼ Gor
100	7 nS	0.1 μS	1 μS	10 μS	1 mS	¼ Uni	25 Uni	
200	8 nS	0.2 μS	2 μS	40 μS	8 mS	100 Mnk		
300	8 nS	0.3 μS	3 μS	0.1 mS	30 mS	8 Con		
1,000	10 nS	1 μS	10 μS	1 mS	1 S			
million	20 nS	1 mS	20 mS	15 min	30 Yrs			
billion	30 nS	1 S	30 S	30 Yrs	10 Sol			
trillion	40 nS	15 min	10 hrs	½ Dino	1 pu			

Special units made up for this table:

1 Dino = Time since the demise of the Dinosaurs: 65,000,000 years

1 Sol = Current (estimated) age of the Solar System: 4,500,000,000 years

1 Uni = Time (est.) until there is no matter of any kind left in the universe: even the black holes have evaporated, and all that's left is background microwave radiation at –450°F.

1 pu = (1 person-universe) If every person alive today owned a computer and they all worked together until the entire universe has gone dark for ever - there is nothing left that is warm enough to emit visible light.

1 gpu = (1 giga-person-universe) Like a pu (above), but everybody alive today has to dedicate a Billion computers to the job until the Universe is dead.

1 Mnk = (1 Monkey) If every person alive today owned a Billion monkeys, and every one of those monkeys owned a Billion computers, and all of those computers worked together until the entire universe has evaporated away to nothing.

1 Gor = (1 Gorilla) If every person alive today owned a Billion gorillas, and every one of those gorillas owned a Billion monkeys, and every one of those monkeys owned a Billion computers, and all of those computers worked together until the entire universe has died and gone dark for ever.

1 Con = (1 Contradiction) All the matter in the Entire Universe is ground up and reassembled into pieces the size of a small grain of sand, but every one of those grains acts as a whole computer, and every one of them works on the problem until the Entire Universe has evaporated away, and there is no matter of any kind left anywhere.