

The Pyramids and Swiss DALCO Supercomputer Albert²

High-performance computing systems, like Albert², are among the most significant engineering achievements of our modern era. In their own way, they are modern wonders of the world. They are "pyramids" of technology; built from multiple layers that include microprocessors, compute "nodes", and fast networks. The spatial scales span 8 orders of magnitude, ranging from less than 10^{-7} m (one tenth of one-millionth of a metre) between features on each silicon chip, up to the dimensions of a small truck for the complete system. Each single system is capable of performing over 12 Tera (that is, 1.2^{13} or 12 million times a million) arithmetic operations per second, every single second, for weeks on end.

This is so fast, and the numbers involved are so big, that it is impossible to visualize them from our human perspective. We like to compare Albert² with another pyramid, the only surviving one of the original "seven wonders of the world" - the Great Pyramid of Khufu, at Giza in Egypt. That too represented the pinnacle of engineering of its day, over four thousand five hundred years ago, and remains the largest building ever built.

The Great Pyramid of Cheops was built over a mere 20 years, using an estimated 2,300,000 blocks, with an average weight of 2.5 tonnes each. So its average building rate was about 13 blocks per hour, or 1 block about every four and a half minutes. Certainly this work involved a lot of parallelism, using 20,000 or more workers at a time! Albert² depends on parallelism for its performance too, simultaneously using 1024 processing "cores" in 256 separate compute "nodes".

If one arithmetic computer operation is equated to the laying of one block, then Albert² would be able to "build" about 4 million complete Great Pyramids per second or 25 billion pyramids over 20 years. Of course, it is easier to add or multiply two big numbers than to lay one 2.5 tonne block. Nevertheless, those 20,000 pyramid-builders would have to sweat to perform even one million calculations in the time it took them to lay one block. And Albert² is a billion times faster than that. This is just as well, because it is unlikely to survive quite as long as the Great Pyramids.

Short version:

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