

Why Supercomputing?

Sept 19, 2016

Supercomputing is the silent power behind many recent innovations. Like, when we hear about discovery of a new drug or method to cure Cancer using personalized immunotherapy. Mapping of human genome has provided the insight and lead to various possibilities of exploring the potential gene mutations possible for a person based on his DNA and thus personalize medicine and treatment.

Or, the discovery of superlight materials for engineering applications like satellites and spacecrafts. We could possibly think of building space elevators too! Or if we could have a material that could exhibit superconductivity then signal transfers without loss could be a reality and change the way we communicate! In reality discovery of such materials can be very tedious and practically not possible in the span of a person's lifetime without these supercomputers.

Biological studies have immensely benefitted by the supercomputers. Computers by way of digital simulation allow us to model a living cell including all its activities. Doing so helps us understand a biological system without any experimentation of working on real living beings.

Or imagine the safest car that is virtually crash proof, emits clean air, uses optimal fuel and still can transport you in the fastest possible time! How does one get to achieve this without long turnaround times of physical prototype development and testing?

Yet another current example is that of bio-medical implants. Many older generation people's mortality rate has reduced but due to lifestyle changes and longevity issues degenerated joints is a common problem. However, one has to go for many consultations and mold generation to get a pair of knees replaced. And there is no guarantee of a perfect fit! Imagine you had a mechanism that could accurately measure out, build and implant perfect fit knees giving you a pain free life!

I am sure many of you would have enjoyed 3D movies with your children. What if you could generate virtual reality based classrooms to make their learning insightful and fun filled?

There are many more examples where, today we see how supercomputing has made a difference to our daily lives. One thing that supercomputers enable is faster computations which allow insights for decision making. For example, a standard weather modeling code can potentially run on a group of servers for months to generate data that can be used for weather prediction. However, the same code on supercomputers can finish in days and this makes way for realistic decision process. Apart from that it is the backbone for gaining insights in science and furthering research.

So what is supercomputing?

Let's try and understand in simple terms what supercomputing means.

Supercomputing relates to what one does with currently fastest computers. All computing devices are

not equal. One measures the supercomputing capability using the unit FLOPS. A FLOPS represents the number of floating point operations a computer can perform in one second. Floating point operations are heavily used in scientific computing and hence FLOPS was coined to measure a computer performance. Supercomputers are majorly used in scientific research and recently in business analytics too.

So how fast can a supercomputer be? Many of you own or have used a laptop and have a feel for the speed of it when you are browsing your favorite websites or writing your reports or even executing your college projects. Generally a standard desktop can compute at 80 GigaFLOPs. Today's fastest supercomputer is a million such desktops! Every year the list of world's fastest computers is generated and published on TOP500.org website. This year's fastest computer is hosted in Wuxi China and is called Sunway TaihuLight, the speed of which is 93PetaFlops. A petaflop is 10^{15} flops. In comparison, India's supercomputer which is in Bangalore, has a speed of 0.900PetaFlops.

Ofcourse a supercomputer is built differently as compared to a desktop. Since it is the combined power of all these computing processors, most supercomputers are built using high speed interconnect to efficiently transfer data among the executing processes. In terms of space, they can occupy significantly large space. For example a 20 PetaFlop machine can occupy the space of 196 almira's! Their power consumption also is high. The power consumed by the fastest machine of the world can light up 15000 homes!

A supercomputer can be expensive and hence needs careful deliberation and thought process to buy it. As with any computer, a supercomputer also has a short life, spanning 5 to 8 years and needs large maintenance investments in terms of power, space and people skills. And hence needs meticulous planning not only for purchase but also for end-use.

Depending on who announces newer systems, there is a likelihood that this year's fastest machine ceases to be called a supercomputer after several years. Like the supercomputer of year 1977 had computing power of 100 MegaFLOPS which is the capability of a smart phone now!

So where is the need of supercomputers? Supercomputers are now treated as the third leg of research, after theory and experiments. Supercomputers allow us to conduct research in areas where experimentation in reality is difficult or hazardous to perform. Areas where such systems are extensively being used are weather prediction, global warming assessment, Earthquake and Tsunami prediction, bio-medical and prosthetic implant design and delivery, drug discovery, computational genetics, astrophysics, etc. A good example to recollect, where supercomputing made a difference to our daily lives is the prediction of cyclone Hudhud that affected the state of Andhra Pradesh in the year 2014. Because of accurate prediction of the cyclone's landfall areas almost a week before, the state government could evacuate its population and thus save loss of lives.

In India, we are now opening up to establishing many such systems to enhance our scientific understanding realizing the potential impact supercomputing can play in the betterment of its citizen's lives. Our government has taken concrete steps to build robust computing infrastructure by initiating the National Supercomputing Mission. This initiative aims to not only establish supercomputing

installations, but also develop scientists and researchers who can use, manage and train for supercomputing. Through this program it is envisaged that in next five years we will promote scientific research by leaps and bounds. The National Supercomputing Mission is being lead by SERC, IISc and CDAC, as the implementing agencies.

With this I hope I have been able to give you a complete picture of what supercomputing means and what it can do.

References:

1. Real-World Examples of Supercomputers Used For Economic and Societal Benefits: A Prelude to What the Exascale Era Can Provide by Earl C. Joseph, Ph.D., Chirag Dekate, Ph.D., Steve Conway IDC OPINION, May 2014, IDC #248647