PRESSEMITTEILUNG

Hasso Plattner Institut
IT Systems Engineering | Universität Potsdam

Background

Top-level HPI research revolutionizes supercomputing processes

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Potsdam. **Two revolutionary changes** are currently underway in computer architecture, the likes of which have not been seen in almost 20 years, when distributed client-server systems almost entirely replaced large mainframes. This time the changes involve a leap in computing power and a shift in how large datasets are processed.

- The laws of physics prevent us from making computer CPUs (central processing units) significantly faster by raising their frequency, so computer scientists have turned to **multi-core processors** to improve computer performance. Multi-core processors integrate several cores in a single CPU, but they only improve peak performance if the CPU is processing several instruction streams at the same time.
- Second, today's computers have **vast amounts of RAM**, which can be additionally supplemented with SSDs (solid state drives), enabling large datasets to be loaded entirely into that computer's RAM (in-memory technology). Accessing external memory using an input/output system tends to lead to a bottleneck inside the computer, limiting processing speed.

Both developments promise to **accelerate most processing steps by a factor of 10-100**. A **new way of organizing databases**, **virtualization** (methods for clustering and distributing computer resources) and cloud computing are also making valuable contributions to bring about this technological leap. With **cloud computing**, users retrieve the computing power they need from external data centers via the Internet.

Enterprise software as fast as an iPhone?
Researchers at the Hasso Plattner Institute in Potsdam are working on this very question. Their goal is to reduce the response times of large business mainframes to just a few seconds so they can load applications as quickly as a smartphone does. Complex mission-critical analyses could then be made available at the click of a mouse, almost in real-time, instead of having to wait hours or days as is currently the case. Such a change would revolutionize strategy planning and processes for senior management.

Investigating potential synergies between computer architectures that employ new multi-core processor technologies and software that operates on the massive parallel model is the job of the **HPI's** new **top-level research lab**, which opens on June 16, 2010. Computer scientists from the HPI and special guest researchers from other institutions will be doing real-world research on promising **service-oriented computing (SOC)** concepts using new hardware and software provided by the R&D departments of large IT companies. An important aspect of these projects is that they assume a situation whereby the software applications are no longer being run at the enterprise's own data center or by end users, but by external service providers.

The subject of service-oriented systems engineering also unites the PhD students at the HPI Research School. The international research school currently hosts around 40 junior researchers from Potsdam, Haifa (Technion) and Cape Town (University of Cape Town). The research school's 5th annual symposium on future trends in service-oriented computing will take place from June 16 to 18. Research to be carried out at the HPI's new top-level lab in Potsdam will be one of the topics to feature at the symposium, which will be attended by leading scientists and businesspeople. One key concern will be **high availability and dependability of future industry standard servers**. Related research questions include: What happens during a processor outage? How does software tolerate those types of hardware problems? How can specific users be guaranteed access to pre-defined quantities of computing power?

A modern lab with the latest hardware and software
The HPI's top-level research lab is equipped with the latest server systems. Each of these systems integrates between four and eight multi-core processors with up to eight processor cores. Each of them can be further divided into two logical processor cores. With **up to 128 logical cores** – each of which is like a conventional CPU – the servers can each draw on up to two terabytes of RAM. The systems can be combined into clusters, theoretically allowing for an unlimited leap in performance. That is, as long as the software being used can handle it.

Besides sheer processing power, the speed of the input/output system is also a limiting factor in server systems. As the number of processor cores grows, so does the difficulty of giving all the processing units equally quick access to all data. More RAM and new SSDs (solid state drives) help reduce the number of accesses to the input/output system that would have normally been required. When application data is reorganized accordingly, multiple cores can quickly access the data simultaneously.

Students and researchers at the HPI have already shown what is possible in this domain. For example, they reduced the time needed to process a dunning run for a large enterprise with 100,000 customers down to one minute. Collecting the data of all the customers who were behind on their payments takes a normal system 20 minutes. Subsequent analyses by experts in the HPI's Enterprise Platform and Integration Concepts group suggest that correcting a few bottlenecks in memory management will cut the time down to just five seconds. Massively parallel hardware could even complete the process in about one second – 1,000 times faster than the process takes now.

Research with giant sets of real business data

The HPI analyzes very wide-reaching, highly complex datasets from real enterprises. Like medical researchers, who look at actual clinical cases, or engineers, who do real-world testing, the HPI's software specialists do not restrict themselves to hypothetical scenarios or small quantities of randomly-generated data. Instead, they have access to **300 million real commercial datasets** from the consumer goods industry. Once they have loaded the datasets into RAM, they can search them in 700 milliseconds. The next version of the underlying database system will be able to cut search time down to less than 100 milliseconds.

Of course information such as product names and numbers have been anonymized so that the HPI researchers cannot track any of the companies' business transactions. Changes to the distribution and characteristics of the data, however, have been kept to a bare minimum to accurately reflect actual situations. The whole project is taking place within the HPI and is not open to the public, and participants are required to sign confidentiality agreements for certain research tasks.

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