The evolution of computer architecture: past, present, and future by carol ho ess...

Design

To create a better future, we must first understand our past, what it has to offer, and where it could take us. In the field of computer architecture, this better future means advancements in (but not limited to) performance and cost. Through the years, the performance and cost has been redefined to create the next benchmark based on current technology. Let’s keep raising the bar! It’s human nature to want more.

This hunger is fed by a continuous demand for faster and cheaper devices. The demand creates a need for businesses who in turn fund our research and allow us to keep evolving technologically. Now, let’s hop in my DeLorean and travel back to 1981! Image processing demands fueled ideas in parallelism (MIMD/SIMD) and reconfigurable architectures (PASM) [15]. Now, we’ll catch up to Marty McFly in 1985! Architects working with signal processing applications realize that real-time calculations are indeed a need. The increasing algorithm complexity drove the need for more performance.

More research is put into novel architectures [1]. As more time progressed, so did electrical improvements. The architectural improvements did not advance as quickly to make use of the new technology [12, 16]. Breaking the bottleneck issue continues to be a problem. Working around physical pin bandwidth limitations brought a cause to creating more integration on a chip [4]. The multiprocessor on a chip idea contributed to higher performance [12].

Mobile devices emerged and so did the demand for embedded platforms drove new architectures to better utilize them [16]. Chip sizes began to shrink, leading more to embedded applications [14]. Presently, the need for

smaller devices continues to grow. The desire for embedded use leads to more research for smaller microprocessors.

Of course, cheap is always good, so the number of multiprocessors on a single chip continues to increase [11]. With devices being so small, more research is being done to increase power efficiency. As for the future, well, we might eventually have nano-bots swimming in our bodies to maintain our health. If this is the future, we can look forward to continued research in decreasing chip size, increasing power efficiency and performance, increasing algorithm complexity and, of course, reducing cost. Possibly, reviving old ideas which may have not been successful at their time would be an area of interest [9]. As for the state of the “ microprocessor art,” it continues to flourish. Today, it’s your multi-core desktop processor or highly functional embedded processor; tomorrow, it’s your Mimzy doll with “ Intel” imprinted on a microscopic chip. Eventually, the size shrinking will reach a limit and we’ll have to rely on better architectural improvements to squeeze every bit of performance out of each square nanometer (or cubic nanometer …) of silicon.

Every challenge presented and solved in the past eventually gave rise to a new challenge. This created a new benchmark which were the previous benchmarks being redefined. This is illustrated in how people always want more performance. This creates a market for a faster, better, and cheaper processor. “ Faster”, “ better”, and “ cheaper” being all relative terms of their time. This becomes a new standard, and people want to improve upon

it. Continuing on, feeding upon the previous goal to create a new one. When is it over? It’s NEVER over.

We will always want more. And as long as there is money to fund research, we will always get more. Evolution is part of life. The evolution of the microprocessor goes hand in hand with people’s and society’s need to nurture our knowledge as we evolve.