HPCA Introduction

This lesson introduces computer architecture and it's importance to computer performance. It also discusses some basic concepts of computer design such as; Moore's Law, power considerations, and fabrication costs. These concepts are just as important as performance when making design decisions in computer architecture.

What is computer architecture? Designing a computer that is well suited for it purpose.

Why do we need computer architecture?

1. Improve performance,
2. Improve capabilities of the computer.

Computer Trends: Computer architects must be aware of computer trends and design for the future because of the time it takes to develop new products. If current technology is used the product will be obsolete by the time it is ready for the market place.

Moore's Law: Every 18 - 24 months techniques are developed that allow twice as many transistors to be placed within the same chip area. By extension it is expected that:

1. The processor speed doubles every 18 - 24 months.
2. The energy per operation consumption is halved every 18 - 24 months.
3. Memory capacity is doubled every 18 - 24 months.

Memory Wall: While improvements have been seen in the number of instructions per second and in the memory capacity, memory latency has only improved 1.1 times every two years. The result is processors have gotten much faster but memory devices have not. The hinderance to improved performance used to be processor speed, now it is memory latency, this is known as the *memory wall*. Caches are used to mitigate the effects of the memory wall.

Processor Performance is usually discussed in terms of speed. Fabrication costs and power consumption must also be considered when discussing performance.

Power Consumption:

Dynamic Power - power consumed by the part during active use.
Static Power - power consumed by the part when it is idle.

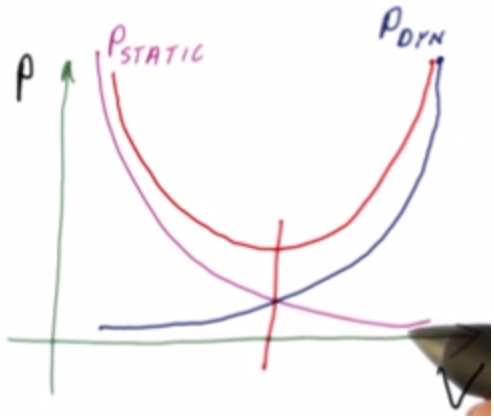
Active Power = Dynamic Power

$P = ½ C * V^2 * freq * alpha$

C = capacitance
V = power supply voltage
f = clock frequency
alpha = activity factor

Static Power - prevents lowering the power supply voltage too much.

As voltage decreased - power leakage increases.



There is an optimal point for the voltage, where there is maximum voltage for minimal leakage.

Fabrication Cost include the cost of manufacturing and the cost of defective parts. The larger the die the higher the percentage of defective parts.

Fabrication Yield = number of working chips / number of chips on the wafer

With Moore's Law -

1. drastically reduce the cost of a processor by making the same processor with a smaller area.
2. Use same area to make a better processor.