Corporate Implications following Moore's Law's Progression

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Background

The first computer to be sold commercially was sold in 1971, the first computer with a microprocessor, was sold in 1973, nearly fifty years ago. Since then, computers have become ubiquitous. Their omnipresence is attributed to an industry pushing for innovation at every turn. The direction, drive, and scope of this innovation is recognized industry wide as having been mobilized by Moore's Law. This law, synthesized from speculation and observation, enabled the nascent, yet eager industry to set goals for itself. Microprocessors since then have closely followed this law, target after target, overcoming numerous physical obstacles, manufacturing obstacles, and economic obstacles. (Freiberger, Hemmendinger, Pottenger, Swaine, 2018)

Introduction

However, development has brought transistors to a near atomic level, proving a challenging obstacle for continued development. This limitation based on physics itself has allowed for a level of doubt not present before, in regards to the industry's continued goal to follow Moore's Law. This research seeks to assess and collect data on recent proposed solutions to this upcoming problem. Additionally, this research seeks to collect recent data and outlooks on the state of future microprocessors with respect to enterprise level businesses. (More from Moore, 2015)

Significance

The implications of this possible decrease in expected performance are wide reaching, specifically in this research, with regards to one of the largest consumers of microprocessors, the enterprise level. The enterprise level, or power users, purchase microprocessors in bulk, this research will follow their view and stance moving forward when looking at the decreasing benefit, tied to performance, of purchasing microprocessors.

Research Questions

What effects does a decrease in expected processor performance have on large businesses?
What are the possible solutions to this problem?
What precedents are there for overcoming these obstacles?
What are alternatives to processor performance?
What shifts in focus will occur in the industry, if any?
Will Moore's Law end?

Methods

Collecting the necessary data will involve a twofold approach.
Researching data to better determine the impossibility of this obstacle.
Collecting foundational data on the establishment and development of Moore's Law.
Collecting recent data on the topic of this obstacle.
Researching data on the business stance of a possible decrease in expected performance.
Asking large businesses questions on their current stance and outlook on microprocessor performance.
Requesting/Collecting data on large business processor upgrade cycles.

Anticipated Outcomes

My anticipations for this research are that microprocessor technology has already, in the past handful of years has begun to slow down.
I anticipate that Moore's Law will come to an end. I think that the enterprise microprocessor upgrade cycle will change to be less frequent. Consequently,
I anticipate that research and development will change to where performance gains are sought to be greatest, whether that continue to be in microprocessor technology, or be in software.
I believe that performance itself will begin to be derived from more efficient programming rather than sophisticated engineering.

Definitions & Technical Language

- **Microprocessor:**
    - A small, single integrated circuit that serves as the central processing unit (CPU).

- **Integrated Circuit:**
    - A circuit created on a semiconductor, commonly Silicon.

- **Semiconductor:**
    - An element that is similar to metal in its ability to conduct electricity, however becomes more conductive as temperature rises.

- **Transistor:**
    - A logic gate holding electrons to store information as yes or no, 1 or 0.

- **Moore's Law:**
    - A prediction of the future by Gordon E. Moore in 1965 predicting that the number of components, often looked at as the number of transistors, that will fit on a microprocessor will double roughly every two years.

- **Enterprise:**
    - A very large company, often with hundreds to thousands of employees and often creating software or dealing with computers in some fashion. These companies

usually don't seek in dealing with the common consumer and instead focus on providing for the larger businesses and providing tools and other utilities for large sales.

- **Power User:**
    - The user or group that has advanced skill and knowledge of computers and associated software and takes advantage of tools and utilities that the average user does not.

- **Performance:**
    - A broad metric referring to the speed that instructions are executed by a processor.

The image above on the left is of the Intel 4004 released in 1971. (Nguyen, 2016) The image above on the right is of the Intel i9 9900k processor released in October 2018. (Ngo, 2019)The difference in technology and efficiency and executing instructions is exponentially better.

The image above depicts several plotted sequences, Gold (G) characterized by an increasing linear path in reference to transistor count. Single-Thread performance, Blue (B), refers to the performance of the CPU characterized by a delayed root function as the increase in performance decreases over time. Frequency refers to the speed at which the CPU executes instructions and is characterized by a more severe root function. (Rupp, 2018)

The image above shows the two basic logic gates, and will conduct electricity depending on if both of its inputs are conducting electricity or just one, AND or OR.

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