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Week 2 activities

Module 2

Read Chapter 1 and 2 in \The First Draft Report on the EDVAC" by John von Neumann and answer the following questions:

State and describe in you own words the partitions, modules or subdivisions of a digital computer described by Dr. Neumann.

The first partition of the digital computer described by Dr. Neumann is the central arithmetical part of the device. this part is used for the the basic operations of addition, subtraction, division and multiplication (CA). The second and most essential is the logical control of the device (CC). This insures the proper sequencing of the operations of carried out by the central control organ. Here Dr. Neumann tries to insure its elastic character by insuring the distinction of the specific instructions for a given and defining a problem and the general control control organs which see that these instructions are carried out. The central control mean the latter function and the organ which perform it are the logical control device.

The next part is memory. In any device that is to carry out long and complicated sequences of operations must have a robust and sizable memory (M). Dr. Neumann describes the memory of his device in phases. The first of these is the an intermediate memory to carry out the operations described and larger operations like square roots. The second phase is the instructions governing the complicated problems material and will need to be set to memory. The third will deal with tabled forms of functions/ In many cases be simpler and quicker to obtain values from functions in a fixed tabulation instead of computing them anew. For partial deferential equitations the initial conditions might have to have material set to memory as well throughout the problem. These deferential equations and problems might be carried over variables like time and would introduce another form of material that would also have to be set to memory. Approximations with successive remarks will also have to handled in a similar manner. Sorting problems and statistical experiments will require memory too.

The last components of Dr. Neumann's digital computer are that must maintain the input and output contact with a medium and the overall organs for output. The means to sense human action and store it is left to these devices. Outside recording of the medium of the device is referred by R and transferred by input. He also mentions that R should also be transferred in to M and not directly into C.

In section 2.9 Dr. Neumann compares M, R and he explains why they are needed. Technology has advanced a lot since 1945, do we still need M and R? Justify you answer with details.

To be honest I don't think that we in 1945 they were thinking about how complex these machines would become. In modern computers we need both a primary and secondary memory, but in 1945 Dr. Neumann was correct in proposing that we may might not need an expansive memory M. Today we have several digital devices, like calculators that do not require a M as described by Dr. Neumann to carry out the tasks he describes in his paper. This also has a lot to do with scale in my opinion. Memory in 1945 was very expensive on all accounts and was very hard to produce. The old saying that it took a building of computers in 1945 to do what a scientific calculator can do now is not too far off. I really feel that it is possible that we today we don't have to have M and R. Virtual machines can produce things with just that of RAM. On the application level of things the digital computer described by Dr. Neumann might be a thing of the past.

Could modern computers solve mathematical equations using methods other than numerical method? or is it still restricted to numerical methods? Support your answer with details

Maybe the question is ‘can computers solve mathematical equations analytically?’. I for one think it is possible for a computer to one day think and come to a conclusion with out the means of numerical methods, but I think it will be sometime far into the future. For instance asking a computer to guess what number you have behind your back still takes some form of numerical methods to produce an out come. I mean I guess what I am thinking in this case, is that say a computer was given a multiple choice question and the incorrect choices were obvious to us, as humans, having known the question presented, could a computer eliminate the erroneous answers to produce a positive answer with out using any numerical methods?? For now all my assumptions and knowledge say no, computers are still restricted to numerical methods.

Silicon manufacturing process: How does silicon manufacturing process/technology affect performance, power and reliability factors of a microprocessor.

(Read chapter 1 section 1.4 and 1.5 in from \Computer Architecture: A Quantitative Approach")

Silicon manufacturing process/ technology affect performance, power and reliability factors of a microprocessor in various ways. The manufacturing of silicon wafers has remained relatively unchanged, and the purity of the silicon is at its highest. They are still tested and chopped in dies that are packaged. In this way we see how to predict the number of good chips per wafer by finding how many dies fit on a wafer and those that will work.

One way that we see a increase in performance is in the transistor performance. Transistor performance increases due to a combined transistor count on a chip of a bout 40% to 55% a year. Integrated circuit are characterized by the feature size and have significantly decreased since the 1970 from 10 microns to 65 nanometer chips.

Manufacturing process of silicon where in the improved silicon manufacturing has allowed for better allocation of surface area of the wafer. Little more than 0.4 defects in an area of 1 square centimeter per 90 nm have improved with the maturity of the manufacturing.

With the decrease in transistor surface area the density of the transistor has increased quadratically with the linear decrease in feature size. Density improvements have supported the the introduction of 64 bit processors as well as many innovations in pipelining and caches.

In modern 90nm technology fall between 32bit and 64 bit microprocessors. Low end embedded 32 bit processors are now as small as .25cm squared and and processors used for embedded systems are less then 0.1 cm squared. Improved manufacturing has lowered wafer cost, better yield and less defects.

Encoding: In this lecture we saw how decimal numbers are encoded using binary number. Modern personal computer support many languages and are capable of displaying graphics. How are alphabets and pictures represented in a computer?

Are there standards that governing how alphabets from various languages are represented? Support your answer with details.

Alphabets and pictures are resented numerically as bits in a digital computer. Pictures are represented in binary bits that indicated the color of pixel. For example a picture might have 6bit color which means that it has 64 ranges in color per pixel which is 2 to the 6th bits of color. Alphabets are also use binary bit encoding to represent numbers and letters. The first of these was introduced in the 1980s and was called ASCII which represented numbers and letters using a 7bits in binary numbers and a total of 128 different characters. This was then changed to the extended ASCII with the addition of 1 more bit, and then could support 8 bits which is 2 to the 8th or 256 numbers/symbols and letters in the English language.

As mentioned in the lecture some languages outside the ASCII letter numerical system are encoded now using the UNICODE. This allows for languages that use characters outside the English language to be represented. UNICODE uses standards allow for a greater range of characters to be represented. For example UTF-8 a code point can take between 1 and 4 bytes. This is a significant number of greater than the ASCII values of old and can better represent languages like Chinese which have a significantly greater number of characters.

Failure Analysis: In the DE0-Nano demo, the result of a simple subtractions came out to be a unexpected number, in the demo you saw 2 - 5 = 65533. Is this an error? if it is an error, investigate and explain where the error has occurred. Is it a software or a hardware error? Support your answer with details. Also, suggest a possible solution to x this error

Yes, this is an error. I believe that the system represented by the gui front 2.tcl, considered to be part of software, is misrepresenting the negative numbers. The cpu is employing a method called 2 compliment number to represent the sign of the number using a MSb, most significant bit 2 to the N-1. Here the GUI is misrepresenting the results of the binary addition. In the example the subtraction of 2-5 the resulting bits are misinterpreted, the significant bit that tells the output to be negative is somehow being output as a positive number decimal number.
To convert 5 into -5 we simply invert the numbers in binary and add 1. Then we need only add the positive 2 in binary.

so we have
 00000000000010
-00000000000101
____

which we use 2 compliment to get

  00000000000010
+11111111111011
____
  11111111111101
 the above number in decimal is 65533, which is what is being displayed by the GUI, but if it were converted to 2 compliment then we would result in
-0000000000000011
which is negative 3 and the correct output

A possible solution would be to employ 2 compliment to the output of the GUI and there for display the correct number in decimal form.

Power: What are the advantages and disadvantages of lowering V_{DD} in digital electronics?

What was once a matter of raw silicon area has now become a matter of power in energy consumption in transistors. The limitations of distributing power, removing heat and preventing hot spots have now become the issue of the microprocessor's ability to turn off the clock of inactive modules and conserve energy and dynamic power. This has lead to multiprocessing on a lower voltages and clock rates.

The power must be distributed around the chip, hundreds of pins and multiple inter connected layers for just power and ground are employed in modern microprocessors. Power is then dissipated as heat and must be removed. The power required per transistor is proportional to the product of the load capacitance of the transistor, square of the voltage and frequency of switching. Dynamic power and energy are greatly reduced by lowering the voltage. The increase in transistors increases the power even if they are turned off and leakage occurs with smaller transistors in processors.

Size: What is the effect of capacitance and is it possible to reduce or even eliminate capacitance in a digital circuit ?

The capacitive load is a function of the number of transistors connected to an output and technology which determines the capacitance of wires and transistors. As feature size gets smaller and the wires get shorter, the capacitance per length gets worse. Capacitance depend on aspects of process, geometry of a wire, and the placement of of other structures. Enhancements, such as the introduction of copper, which provide improvements in wire delay could reduce and even eliminate capacitance in a digital circuit.