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THE EXECUTIVE COMPUTER

THE EXECUTIVE COMPUTER; HOW TO IMPROVE A PC'S MATH SKILLS

By Erik Sandberg-Diment

THE heart of the current generation of I.B.M. PC's and their compatibles is the 8088 chip, which serves as their C.P.U., or central processing unit. This tiny piece of circuitry contains the arithmetic and logic unit, or A.L.U., some memory and the control unit that directs the operation of the computer and its peripherals.

Intel's 8088 is far from being the only C.P.U. ever to be used in microcomputers. Zilog's Z-80 microprocessor was chosen by the designers of the Kaypro II, the TRS-80 Model III and the Osborne I, while Apple employed the 6502 in its immensely successful Apple II. Both of these chips are now considered outdated: Apple's newer Macintosh uses the up-to-date Motorola 68000 chip.

Many factors having to do with price and performance affect the choice of the particular C.P.U. around which a computer will be designed. The most heralded of these is processing speed. In the old Z-80 versus 6502 battle, the former ran at two megahertz, or two million cycles per second, while the latter poked along at only one megahertz.

Then along came the 8088, which tore up the wires at 4.7 megahertz, making the old 6502 seem snail-like by comparison. The fact that the 6502, designed by Western Design Center, was originally conceived as a controller for large-scale appliances such as refrigerators and washing machines didn't help its image, either.

But Apple and the 6502 survived, thanks largely to Apple's astute marketing and to a profusion of outside vendors developing software for its machines. Another reason, however, was that processing speed alone does not necessarily make the fastest or the best C.P.U. A chip's internal design, or architecture, has a lot to do with its efficiency as a processor, and the 6502 performed better than might have been expected, going by just the numbers.

Even so, because many Apple users wanted to coax more speed out of their computers, they bought various accelerator cards. These featured a 6502C chip with a clock speed of 3.6 megahertz that, in its capacity as a C.P.U., noticeably speeded up such operations as spreadsheet recalculations. Because of its so-called pipeline architecture, the chip performed those calculations as fast as - in some cases, even faster than - the equivalent calculations performed by an I.B.M. PC.

Still, when push came to shove, all the early personal computers were rather slow at math. Slow not by human standards, of course, but when compared with what they should have been able to do. That was why the I.B.M. PC series was designed with a large empty socket sitting right next to the 8088 chip on the motherboard.

The socket is there to hold an 8087 math coprocessor, or, in the case of the I.B.M. PC-AT, an 80287. Numerology aside, both are specialized chips that take over from the 8088 when it comes to computational chores, and both are chips with a lot of promise for PC owners working in the business world. But most of their promise remains unfulfilled. As is so often the case, the shortfall can be laid at the door of software.

The 8087 chip does not replace the 8088. It works in conjunction with it. But it can do so only if the software being run has been specifically designed to support the math coprocessor. The point is, software will not automatically run faster simply because an 8087 chip has been installed in the computer.

Usually, a software package will specify whether a math coprocessor can be used with it. In the manual for the program Alcar: The Value Planner, under the "Equipment Requirements" heading is to be found the statement that a "math coprocessor is recommended." The program - a sophisticated financial analysis package aimed at corporations - entails a lot of iteration, in which an answer is determined by making repeated comparisons.

For example, to determine the square root of 15 by iteration, for example, one might say, "4 times 4 is 16, so it has to be less than 4, and 3 times 3 is 9, so it must be more than 3. But it has to be closer to 4. Maybe it's 3.8. Well, 3.8 times 3.8 is . . ." and so on. In iteration, a lot of numbers are crunched over and over again in the process of reaching every answer. IT might not be surprising that the math coprocessor would be a boon to programs like The Value Planner. But to computers, numbers are not just numbers. The machines also depend on trigonometric calculations and positional notation in order to "see" and "draw" in such applications as animation and color graphics. Computer-aided design, or CAD, programs also benefit greatly from the operation of an 8087 chip. With its assistance, complex shapes can be made to appear on screen in a flash rather than dawdling off-screen and materializing only slowly into view.

Data encryption, an area of growing interest in the business world, is a field where math coprocessors really shine. Typically, data encryption calls for large numbers to be used as keys, which, in effect, lock and unlock the code that disguises the material one wishes kept confidential. Enciphering a lengthy file could, under normal circumstances, mean starting the process and then going out for a three-hour lunch while the computer did its work. That wait can be reduced to only a few minutes through the use of a coprocessor.

The precision the 8087 contributes to processing, however, may be as important as the speed it adds. There is a natural assumption of accuracy associated with computing that in many cases can turn out to be misplaced.

Real numbers are stored in a computer in two parts. An exponent stores the magnitude of the number and defines where the decimal point will be placed, while a mantissa stores all the significant digits of which the number is composed. Without our pursuing a painful review of college math here, it should suffice to say that the 8087 chip permits the use of 64-bit mantissas, which in turn permit considerable precision in dealing with real numbers.

Consider the division of 1 by 3. The result expressed as 0.333333333 can affect a complex calculation quite differently from the way in which the same result expressed as 0.33 will affect it. Normally, the least significant digit of such a number must be rounded off, or in some cases simply chopped off, in order for the number to fit into the computer's limited memory. The more such truncated numbers are processed in the act of arriving at a final answer, the more significant an induced error becomes. Conversely, the greater the number of digits with which the processor can deal, the more dependable the results become.

The 8087 deals with other mathematical concepts that are not part of most of our lives but sometimes crucial for heavy number-crunchers - infinities derived by dividing numbers by zero, say, or numbers too large to process. In its capacity as a mathematical superpower, this chip makes a valuable addition to any numberjuggler's computer. Just remember the bottom line before installing the chip: Software to be utilized must be specifically designed to take advantage of all that extra calculating power.

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