Director Iancu:

I would like to thank you for your initiative to resolve part of the 101 chaos with your new Guidance. Your subject matter eligibility guidance will help with many of the 101 problems if interpreted and implemented properly by the examiners and PTAB judges.

There is no doubt that computer implemented inventions will change, are changing and have been changing our way of life and our economy. An example is how computer implemented inventions have changed the way we manage bank accounts. Many of us have not been inside a bank building for years to do our banking business. The same applies for shopping, of which a large portion is now done on-line. Banking and shopping are traditional human activities that have been completely modified by (often USA originated) inventions.

In a technical sense, traditionally engineered devices are now implemented in computer controlled devices. In smartphones, electronic filters that used to be made from components such as resistors, capacitors, coils and lots of wire are now digital filters, basically a set of formulas programmed on a processor.

The original intent of the Patent Clause is to promote rational inventions, to apply human inventiveness to create new devices and processes. This was the ideal of the Enlightenment: to use human knowledge and skills to improve life. The Founders had no idea that a formula or an expression that could be interpreted as an abstract idea could be realized on a device to do something practical or useful. But that is what computers do nowadays.

Mathematics is the language of science and engineering. There is no language more precise and useful in engineering and in engineering inventions than mathematical expressions. That is why it is unfortunate and somewhat bizarre that mathematical expressions have a questionable and scientifically dubious role in patent claims, but not in the specification. That is: it is actually good to fully explain the claimed invention with mathematical formulas, but it is risky to use these formulas in the claims, as it raises red flags in the context of patent eligibility.

Mathematical formulas have obtained this questionable status by way of judicial exception, not by constitutional or statutory reasons. This is particularly unfortunate, because technology trends (as in cryptography, digital signal processing, digital image processing, artificial intelligence, control theory, digital circuit design, CNC control, 3D printing and any optimization process) all move to an increasing use of implementations of mathematical formulas.

It is clear from most if not all patent applications directed to a computer implemented invention that the use of a mathematical formula serves a practical purpose and is not directed to evaluating a mathematical formula “per se” or “on its own.”

For practical purposes there are roughly 3 types of mathematical formulas or expressions:

1) pure math. Number theory may be considered one of pure mathematical theories, because a number does not exist in nature. The Extended Euclidean Algorithm (EEA) to determine for instance a multiplicative inverse was considered a pure mathematical theory without a practical application.

2) applied math that is used as a modeling tool. Calculus is an example of that. Formulas in this category describe or model physical reality, but as such do not perform anything. Einstein’s formula (often used as an example) $E=mv^2$ describes the equivalence of mass to its energy equivalent. However, evaluating the formula itself does not generate any energy. A more practical example perhaps is a formula that provides a transfer function that describes a relationship between output and input of an electrical filter. Evaluating the transfer function does not realize the filter, it only describes the behavior of the filter.

Using logic or Boolean logic to describe a switching circuit is another example of modeling by way of mathematical expressions.

3) operational math. Operational math is the evaluation of mathematical expressions and using the output of these evaluations, usually through signal conversion or generation, for practical purposes. Digital FIR and IIR filters are a good example of operational math. These filters are calculating machines provided with numbers, which are A/D converted signals, which are processed and then converted into appropriate output signals by a D/A converter. Practically, these computer implemented formulas with proper timing and A/D and D/A converters act like an electrical filter.

In cryptographic machines, computer implemented formulas, derived from abstract number theory, like determining a multiplicative inverse, becomes operational and useful in RSA cryptography. This is where the EEA moved from pure math into operational math.

One can build or emulate computer circuitry on a computer by using computer implemented logic expressions. A logic expression executed or evaluated by a processor is in actuality a performance of a switching operation. It is largely invisible to a general or casual user. It is like the fact that 0s and 1s do not exist inside a computer, but only physical states also called LOW and HIGH. For convenience named states 0 and 1 are commonly used, but on a technical level there is no 0 and there is no 1.

In fact, each and every operation on a computer, including the evaluation of a mathematical formula, is actually a physical processing of a signal by a circuit. A signal is not abstract and certainly not an abstract idea. The CAFC in re: Nuijten held that an apparatus that generates signals is "of course" a machine.

Increasingly inventions will be at their core the "operational math" implemented on a computer. Artificial intelligence and cryptography are real-life examples of that. Converters, sensors and actuators are ancillary and enabling to those inventions.

I believe that the USPTO in a broad sense is aware of the different applications of mathematics, but does not always act upon those distinctions. My impression is that Examiners often see mathematical expressions or mathematics related terminology as a red flag that triggers a 101 rejection. In most cases the claimed inventions are not directed to evaluating or performing mathematics "per se," but serve a useful purpose or "practical application."

<u>My Request</u>

My request is to provide guidance or instructions to the Examiner Corps not to immediately assume that use of a mathematical concept or expression in a claim directs that claim to an abstract idea. It would be useful to instruct Examiners to first look if a mathematical expression or concept in a claim is actually "operational math" on a computer and serves a practical purpose, such as generating a signal that does something useful. In fact, to strengthen validity of a claim before a Court, it would be helpful that an expert (the Examiner) explicitly states that it was found that while a mathematical concept or expression was used in a claim, the concept or expression is operational in nature that makes the computer implemented invention integrated in a practical application and thus patent eligible. Currently, when a 101 rejection has been overcome by arguments or amendment, no explicit acknowledgement is provided why the claimed invention is deemed to me patent eligible. Especially in cases wherein mathematics is used, a positive statement as to the patent eligibility status would be very helpful.

It is often difficult to argue against an opponent that a "mathematical expression" is not abstract if that opponent refuses to consider its purpose. However, when an Examiner concludes in a written response that the use of mathematics is operational and is integrated in a practical application, the presumption of validity has become much stronger. The burden of proof that it is not so is then placed on an opponent, and in most cases such an opponent will be unable to prove convincingly that the claimed mathematical expression is not integrated in a practical application, because it almost always is.

My Background

I have a Master of Science Degree in Electrical Engineering. I am a prolific inventor with over 50 USPTO issued patents, mostly in the field of machine logic. In my inventions I apply digital design theory as taught to me by Prof. Dr. G.A. ("Gerry") Blaauw. Dr. Blaauw was one of the co-architects, with Dr. Brooks and Dr. Amdahl, of the legendary IBM System/360.

Dr. Blaauw (together with Dr. Brooks) developed a computer design theory that distinguishes three levels. This is also explained in their book: "Computer Architecture: Concepts and Evolution."
On the highest first level there is the a) Architecture or what the User sees as functionality.
On the second level there is the b) Implementation or logic design of the computer. For instance, an Architecture may provide an adder capability. The implementation provides the logical structure of the adder, which may be a simple Carry Ripple Adder, or a more involved Carry-Look-Ahead adder.
The third level is c) the Realization which deals with the physical components and structure of the switching devices. Realization of digital circuitry used to be electromechanical relays in the past and nowadays is CMOS micro-electronics.

Accordingly, in "operational math" one can almost always find the physical circuitry that realizes the mathematical expression, even though it may not be apparent to a casual reviewer that such circuitry exists. In my personal opinion a computer implemented invention using operational mathematics is only patent ineligible if there is not a computer architecture that enables the claimed expression or concept.

A machine that meets the design requirements of Dr. Blaauw is the same apparatus held to be a machine by the CAFC in re: Nuijten.

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