No. 13-298

IN THE
SUPREME COURT OF THE UNITED STATES

ALICE CORPORATION PTY. LTD.,

Petitioner,

v.

CLS BANK INTERNATIONAL AND CLS SERVICES, LTD.,

Respondents.

On Writ of Certiorari to the United States Court of Appeals for the Federal Circuit

BRIEF FOR *AMICUS CURIAE* RONALD M. BENREY IN SUPPORT OF NEITHER PARTY

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QUESTION PRESENTED

Whether claims to computer-implemented inventions – including claims to systems and machines, processes, and items of manufacture – are directed to patent-eligible subject matter within the meaning of 35 U.S.C. § 101 as interpreted by this Court.

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INTEREST OF *AMICUS CURIAE*[1]

Gottschalk v. Benson, 409 U.S. 63 (1972), cited my book, *Understanding Digital Computers*, in support of the proposition:

> A digital computer, as distinguished from an analog computer, is that which operates on data expressed in digits, solving a problem by doing arithmetic as a person would do it by head and hand.

Benson, 409 U.S. at 65 n.3, citing R. Benrey, *Understanding Digital Computers* 4 (1964) (hereinafter *UDC*).[2] This principle was argued by the Solicitor General, based on a partial quotation taken out of context from *UDC*:

> A digital computer solves a problem by actually doing arithmetic in much the same way a person would by hand.

Brief of Solicitor General, *Gottschalk v. Benson*, 1972 WL 137527 *4 (U.S.) (hereinafter "Solicitor General Brief") (citing Benray [*sic*], *Understanding*

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[1] In compliance with Rule 37, counsel for both parties have deposited with the Clerk of this Court general consent to the filing of *amicus* briefs. No counsel for a party authored this brief in whole or in part, and no counsel or party made a monetary contribution intended to fund the preparation or submission of this brief. No person other than *amicus curiae*, its members, or its counsel made a monetary contribution to its preparation or submission.

[2] A copy of *UDC* has been deposited with the Supreme Court for future reference.

Digital Computers 4 (1964)) (hereinafter "the Benrey Quote").

I learned of the Court's mention of *UDC* in 1981 and was honored to see my words cited in a Supreme Court opinion. However, I was concerned that the quoted passage had been taken out of context, in support of an incorrect explanation of how computers operated. The quoted text was not meant to factually describe the inner workings of a digital computer, but rather as an easy-to-grasp analogy that would help lay readers understand the difference between digital and analog computers.

The portion of the *Benson* opinion based upon the Benrey Quote has been adopted by many courts as controlling legal principle, and unfortunately it has worked to extend the doctrine of mental steps to computer-implemented inventions.[3]

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[3] *Parker v. Flook*, 437 U.S. 584 (1978); *Bilski v. Kappos*, 130 S. Ct. 3218 (2010); *In re Sarkar*, 588 F.2d 1330 (C.C.P.A. 1978); *In re De Castelet*, 562 F.2d 1236 (C.C.P.A. 1977); *In re Comiskey*, 554 F.3d 967 (Fed. Cir. 2009); *In re Waldbaum*, 559 F.2d 611 (C.C.P.A. 1977); *In re Christensen*, 478 F.2d 1392 (C.C.P.A. 1973); *CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366 (Fed. Cir. 2011); *Ultramercial, Inc. v. Hulu, LLC*, 722 F.3d 1335 (Fed. Cir. 2013); *DealerTrack, Inc. v. Huber*, 674 F.3d 1315 (Fed. Cir. 2012); *Bancorp Servs., L.L.C. v. Sun Life Assur. Co. of Can.*, 771 F. Supp. 2d 1054 (E.D. Mo. 2011), aff'd, *Bancorp Servs., L.L.C. v. Sun Life Assur. Co. of Canada*, 687 F.3d 1266, (Fed. Cir. 2012); *Digitech Info. Sys. v. Bmw Fin. Servs. Na, LLC*, 864 F. Supp. 2d 1289 (M.D. Fla. 2012); *Perfect Web Techs., Inc. v. Infousa, Inc.*, 89 U.S.P.Q.2d (BNA) 2001 (S.D. Fla. Oct. 24, 2008); *Prometheus Labs. v. Mayo Collaborative Servs.*, 86 U.S.P.Q.2d (BNA) 1705 (S.D. Cal. Mar. 28, 2008);
(Footnote Continued)

Since the answer to the question presented necessarily requires an understanding of how computers operate, the Court is likely to revisit its prior cases, including *Benson*. As such, it is important that the Court appreciate the problems inherent in the premise that computers perform mental steps, as argued by the Solicitor General and adopted by the *Benson* Court. Thus, I submit this brief as *amicus curiae* in the hope of restoring the correct context and meaning to the Benrey Quote.

I will also address the implications that a proper understanding of digital computers has on the framework of patent eligibility that arose in light of *Benson*. I provide an analysis of Benson's invention in view of the Court's conclusion that it was not patent eligible, and whether that conclusion is consistent with a proper understanding of digital computers. Finally, I explore the historical basis of the mental steps doctrine as it has been applied to computers and whether the application of the doc-

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Prometheus Labs., Inc. v. Mayo Collaborative Servs., 581 F.3d 1336 (Fed. Cir. 2009); *SmartGene, Inc. v. Advanced Biological Labs., SA*, 852 F. Supp. 2d 42 (D.D.C. 2012) aff'd *Smartgene, Inc. v. Advanced Biological Labs.,* No. 13-1186 (Fed. Cir. Jan. 24, 2013); *CLS Bank Int'l v. Alice Corp. Pty, Ltd.*, 768 F. Supp. 2d 221 (D.D.C. 2011); *Big Baboon, Inc. v. Dell, Inc.*, 2011 U.S. Dist. LEXIS 155536 (C.D. Cal. Feb. 8, 2011); *Compression Tech. Solutions LLC v. EMC Corp.*, 2013 U.S. Dist. LEXIS 78338 (N.D. Cal. May 29, 2013); *Digitech Image Techs., LLC v. Konica Minolta Holdings, Inc.*, 2013 U.S. Dist. LEXIS 108010 (C.D. Cal. July 31, 2013); *Fuzzysharp Techs. Inc. v. Intel Corp.*, 2013 U.S. Dist. LEXIS 160897 (N.D. Cal. Nov. 6, 2013); *Lumen View Tech. LLC v. Findthebest.com, Inc.*, 2013 U.S. Dist. LEXIS 166852 (S.D.N.Y. Nov. 22, 2013).

trine is appropriate in view of the scientific bases of computers.

INTRODUCTION

I am a graduate of the Massachusetts Institute of Technology with a degree in electrical engineering. In late 1961, on the basis of my education and prior writing experience, I was commissioned by John R. Rider Publisher, Inc. to write an introductory guide to digital computers aimed at electronic hobbyists—non-technically-trained readers who enjoyed building the electronic projects such as described in *Electronics Illustrated* and other special-interest magazines of the day.

At the time, computers were not the commonplace necessities they are today; instead, most people only knew about computers from what they saw in science fiction movies—great, room-sized machines with panels of blinking lights, whirling tape reels, and stacks of punch cards being fed into the maw of the machine.

My editor and I both understood the growing importance of digital computers during the 1960s as useful tools in research laboratories, government facilities, and large corporations. We also believed that computers would soon serve smaller businesses and eventually individuals as well. Consequently, we decided to demystify computer operation for a broad audience of potential readers. We planned a book in which I would craft explanations that could be readily understood by lay individuals.

Understanding Digital Computers was published in 1964. As I stated in the preface, the book was written to "bridge the wide gap that exists between complete digital computer textbooks and elementary picture books." Accordingly, I provided a background and introduction to the history of computer devices, an overview of their operation and usages, and then detailed, yet easy-to-understand, explanations of how contemporary digital computers were designed. I included many technical illustrations of various logic circuits that are the necessary foundation by which all computers operate. I further explained how computers execute computer programs and how the computer programs control the operations of the logic circuits, essentially electronic switches.

The Solicitor General relied upon the Benrey Quote to argue that a computer performs essentially mental steps when performing calculations, and therefore that Benson's invention was ineligible for patent protection.

While the Solicitor General acknowledged that "the computer operates by physical equivalents of logical functions," the Solicitor General nonetheless maintained that "the functions themselves are the *same procedures* which a human being would perform in working the same computation, but reduced to the physical characteristics of the device." Solicitor General Brief, 1972 WL 137527, at *7 (emphasis added). The argument became the basis on which the Supreme Court extended the mental steps doctrine to computer-implemented inventions.

SUMMARY OF ARGUMENT

Gottschalk v. Benson set forth as a legal principle that a general purpose computer operating under program control to execute a given calculation performs essentially the same mental steps that a human would. The foundation for this principle is based at least in part on the Benrey Quote, which was taken out of context by the Solicitor General in its brief to the Supreme Court in *Benson*. The Court, on the authority of the Solicitor General, adopted the quote as a factual predicate informing its legal analysis of patent eligibility. While the Court did not directly rely on the Benrey Quote for its ultimate holding, the legal principle the Court set forth continues to be cited as controlling in many patents cases, and often results in claims on computer-implemented inventions being held invalid under § 101.

The Solicitor General Brief argued that Benson's claim was unpatentable because it covered merely the mental steps for a mathematical procedure, even though it recited specific computer operations by specific computer hardware. The argument was based on three premises: (1) that computers perform mental steps; (2) that Benson's claimed invention was a purely mathematical solution derived from axioms of mathematics; and (3) that all mathematical algorithms are scientific truths. These three premises are incorrect.

To support the first premise, that computers perform mental steps, the Solicitor General Brief took the Benrey Quote out of context. In reality, the quote was made in the context of an explanation of what the word *digital* meant, to explain that computers operate on digits, like other devices such as adding machines and abacuses. The reference to how humans perform arithmetic was simply made as a helpful analogy to aid the reader, not as a technical statement about the nature of the human mind or the specific operation of computers. I made clear in a number of places in *UDC* that computers do not "think" like people do but instead achieve their power from relatively simple operations performed repeatedly and at high speed. Computers do not perform calculations, even simple ones, using the "same procedures" as humans do, as argued by the Solicitor General. The first premise of the Solicitor General's argument is therefore incorrect.

Second, Benson's invention was *not* the algorithm for the conversion of binary-coded decimal to binary, as argued by the Solicitor General and as believed by the *Benson* Court. Benson clearly stated in his file history that the BCD-binary conversion algorithm was known and that his invention was a specific way of performing the algorithm using a fewer number of operations and digital logic elements than known in the art. Thus, the second premise of the Solicitor General's argument was incorrect.

Third, mathematical algorithms are not scientific truths *per se*. Laws of nature and scientific truths, such as Einstein's theory of special relativity, can be *expressed* by mathematical formulas such as $E=mc^2$, but that does not make all mathematical expressions scientific truths. Mathematics is a precise and formal language for describing quantitative aspects of the world. Most mathematical algorithms and formulas are for decidedly non-scientific problems, such as fuel-efficient aircraft approach procedures (U.S. Patent No. 8,442,707), compressing video for transmission on cell phones (U.S. Patent No 8,494,051), efficiently allocating farming resources (U.S. Patent No. 6,990,459), or calculating golf handicaps and the difficulty of golf courses (U.S. Patent No. 8,282,455). Mathematical expressions used in applications like these are not like laws of nature or scientific truths at all. The third premise of the Solicitor General's argument was incorrect.

The decision in *Benson* led to the widespread application of the mental steps doctrine to computer-implemented inventions. Historically, the mental steps doctrine was limited to claims that specifically recited or required the exercise of human judgment or faculties. Only with the premise that computers performed essentially mental steps was the expansion of the doctrine possible, and it has led to the incorrect view that certain mental processes, particularly those that involve computation, are interchangeable with digital computation.

The mental steps doctrine does not properly apply to computers. First, prior to digital computers there were many mechanical devices that performed mathematical calculations, and it would not be suggested that the operations on such machines would be ineligible for patenting. This is because in such machines the mechanical components (e.g., gears, rotors, dials, shafts, switches, cams, etc.) were the loci of the computation. However, the overall *sequence* of operations themselves would not have been patent eligible if they would have required the judgment or thinking of the human operator to control the machine. This was typically true prior to the invention of the programmable computer, and so early cases addressing patent claims to mathematical formulas were correct in their outcomes.

However, with the advent of the programmable computer, the control of the overall sequence of steps in a calculation became mechanized, for example by a computer program. Just as mechanization of the underlying calculation steps in an adding machine precludes them from being mental steps, so too does the mechanization of the overall control by a computer program—which essentially controls electrical switches inside the computer—preclude the operations from being mental steps. In both cases, this results in patent eligibility.

Further, the use of a general purpose computer to perform a calculation is not evidence that the claim is merely a mental process. Section 100(b) expressly states that patent eligible subject matter under § 101 includes processes performed using known machines, which thus includes conventional general purpose computers.

Finally, the fundamental tenets of computer science dictate that a general purpose computer executing a computer program to perform a calculation is the equivalent of a special purpose, hardwired computer performing the same calculation. Scientifically, these are the same, and thus should not be treated differently for purposes of patent eligibility.

Accordingly, inventions implemented by computers, including software executing on a general purpose computer, are statutory subject matter under § 101.

ARGUMENT

I. THE SOLICITOR GENERAL'S ARGUMENT IN *GOTTSCHALK* v. *BENSON* THAT PROGRAMMABLE DIGITAL COMPUTERS PERFORM MENTAL STEPS WAS BASED ON THREE INCORRECT PREMISES

In *Gottschalk v. Benson*, the Court ruled that Benson's algorithm was a mathematical procedure and that all mathematical algorithms were like scientific truths. The Court's discussion of the *Benson* decision in *Parker v. Flook* further confirms this analysis: "Reasoning that an algorithm, or mathematical formula, is like a law of nature, *Benson* applied the established rule that a law of nature cannot be the subject of a patent." *Parker v. Flook*, 437 U.S. 584, 589 (1978).

The source of this argument was primarily the Solicitor General Brief to the Court in *Benson* opposing Benson's patent application. The Solicitor General's main argument was that Benson's claimed process was "unpatentable because it is no more than a set of mental steps for carrying out mathematical procedures." Solicitor General Brief, 1972 WL 137527, at *18-31. This argument was based on three key premises: (1) that mathematical procedures carried out by a computer are nothing more than mental steps; (2) that Benson's claimed invention was nothing more than the pure mathematical procedure for converting binary-coded decimal to binary; and (3) that all mathematical procedures are themselves scientific truths. Only if these premises were true would it then follow that Benson's algorithm as claimed was purely mental steps. However, all three premises are false.

A. *Understanding Digital Computers* Did Not Assert That Computers Perform Mental Steps Like Humans

In 1964, "advances in electronic digital computer technology [had] made possible many spectacular scientific achievements that would have seemed like 'science fiction' three or four decades ago," and computers were "generally pictured as incredibly complex electronic machines, aglow with flashing lights." *UDC* at 2. My goal was to demystify computers and clearly explain that they "owe many of their capabilities to their inherent simplicity." *UDC* at 3. To provide a context for explaining digital computers, *UDC* begins with a short overview of the history of "computers" as devices that manipulate numbers, such as the abacus, the mechanical adding machine developed in the 1600s by Pascal and Leibniz, and the first automatic mechanical computer designed by Charles Babbage in 1812. *UDC* at 2.

A "digital computer," *UDC* next explains, "is a device that can perform arithmetic operations and make simple *logical decisions* according to *instructions* it has been given. The arithmetic operations include addition, subtraction, multiplication, and division. A typical logical decision might be to compare the size of two numbers, and indicate which of the two is larger." *UDC* at 3 (emphasis in original). *UDC* subsequently explains that "every digital computer is made up of five *functional units* that work together in close harmony: the Input section; the Output section; the Arithmetic section; the Control section; and the Memory section." *UDC* at 9 (emphasis in original). "The *arithmetic section* is the actual calculating mechanism which performs the arithmetic operations called for by the instructions. The arithmetic section is the functional core of a digital computer; the four other sections oversee its operation and control the flow of the problem numbers into it and results out of it." *Id.* (emphasis in original).

In the early 1960s, the concept of something being digital was foreign to most people. Moreover, my editor and I believed that many of the book's potential readers were familiar with analog computers, which had been in use for many years. Thus, before delving into the details of the structure of digital computers, I included a brief comparison of analog and digital computers. This included a short section labeled *What does "digital" mean?* This is the section from which the Solicitor General selectively quoted, and thus it is reproduced here in its entirety; the Benrey Quote is shown in italics:

> The "digital" in digital computer tells us a lot about how these devices calculate. As we have said, input numbers are fed into a digital computer and output numbers are taken out. But what happens inside?

> "Digital" describes any calculating mechanism that represents quantity with integers as it calculates. Another way of saying the same thing is that *a digital computer solves a problem by actually doing arithmetic, in much the same way a person would "by hand."*
>
> If you were to look inside a digital computer as it is performing a calculation (we will in later chapters) you would see different numbers represented by the mechanism at various times: At the start of the problem, the input numbers would be "visible." Then, as the calculation goes on, "intermediate" results would appear. Finally, the answer would pop into view, just before it is sent out through the output. In effect, the computer is "writing the numbers down" as it does the arithmetic.
>
> Notice that "digital" can be used to describe any calculating device that represents quantity in this fashion. Desk calculators, cash registers, abacuses and most mechanical counters, such as odometers, meet this requirement. These devices are actually mechanical digital computers. The abacus represents numbers with wooden beads, the others use gears or notched wheels.

UDC, at 4-5. (emphasis added).

As is clear from the entire context of this section, my goal was to explain that *digital* computers operate on *digits*—representations of discrete numbers. Moreover, as a full reading of the third paragraph makes clear, I used a simple analogy—arithmetic done with pencil and paper—to help lay readers understand this foundational concept. Obviously one cannot "look inside" a computer to "see" actual numbers "pop into view"—this is simply a useful metaphor—nor does the computer "write down" anything on paper.

My book was published two years before the first handheld calculators became available—a time when most people performed simple arithmetic using pencil and paper. I note this to point out that my pencil-and-paper analogy would have been instantly understood by every reader. That made it an effective and obvious figure of speech to help readers grasp an essential difference between analog and digital computers.

The focus of my explanation was merely on the use of digits by digital computers to perform arithmetic. I drove the point home by providing additional examples to illustrate the concept. I stated that many types of calculating devices familiar to 1960s readers can be considered digital: desk calculators, cash registers, abacuses, and even odometers in automobiles. Later on, I returned to the idea that devices that manipulate numbers can be considered digital, writing, "We learned in Chapter 1 that digital mechanisms actually represent within themselves, the numbers being manipulated. Pascal's adding machine, for example, represented the numbers with notched wheels. Each wheel had ten notches—one notch for each decimal digit." *UDC* at 28.

Thus, it is clear that the context of the Benrey Quote was as part of a larger discussion that provided my readers with a way of relating the meaning of digital to something they were familiar with—doing arithmetic. It was not intended as a statement of fact that computers operate like human brains, and such an assertion is plainly false.

Moreover, in other portions of *UDC* that were not cited by the Solicitor General, I expressly distinguished computers from human minds. Earlier in my introduction, I lamented that "newspapers are forever reporting the latest feat performed by an electronic brain. As a result amazing intellectual powers and super-human thinking abilities have been attributed to digital computers." *UDC* at 2. I then stated that "digital computers can not 'think,' and as we shall see, they are not as complicated as most people believe. In fact, computers owe many of their capabilities to their inherent simplicity." *UDC* at 3. I went on to explain that "No computer 'thinks for itself'; it only operates at high speed according to the instructions it has received." *Id.*

Finally, even if not taken entirely literally, the Solicitor General used the Benrey Quote to support a more general argument: "the functions themselves are the *same procedures* which a human being would perform in working the same computation, but reduced to the physical characteristics of the device." Solicitor General Brief, 1972 WL 137527, at *7 (emphasis added). This statement is false. The procedures performed by computer are entirely different both in form and process from what a human does, even if both would ultimately achieve the same results. For example, when a computer multiplies two numbers, the underlying procedures are entirely different from what a human would do. What a human does in a few operations to multiply two digits, say "9 x 8," requires dozens of operations at the level of individual logic gates (complexes of transistors). The very purpose of creating and programming a digital computer is to implement processes that are beyond the capabilities of a human being using paper and pencil—and thus take advantage of the computer's ability to perform its processes with speed and accuracy that exceed human capabilities.

Further, computers do not merely "speed up" calculations that a human could do by "head and hand." In many cases, the computer performs computations that are simply beyond human capability in any practical sense—calculations that would literally take the lifetimes of hundreds of humans can be done in a few hours by some computers. More to the point, the calculations are not performed as ends in themselves merely to produce some mathematical result. Instead, complex mathematical procedures typically represent real-world problems, such as navigational routes for airplanes, weather forecasts, or engineering calculations on the stresses that a building can withstand during an earthquake.

Thus, whether taken literally or more generally, the Benrey Quote does not support the arguments made by the Solicitor General and adopted by the

Supreme Court as the operations of digital computers in relationship to human minds.[4]

B. Benson's Invention Was Not a "Pure" Mathematical Algorithm Dictated by the Axioms of Mathematics

The second premise of the Solicitor General's argument, and one that was also adopted by the Court, was that Benson claimed to have invented the algorithm for binary coded decimal to binary conversion *per se*, and that this algorithm was derivative of the axioms of mathematics:

> The "discovery" which respondents claim here is nothing more than a sequence of mathematical steps which differ very little from the mental steps that an ordinary human being could be expected to follow. Their theorem follows automatically from the definitions of pure binary, decimal, and BCD numbers and from the axioms for or definitions of addition and multiplication in the binary system.

Solicitor General Brief, 1972 WL 137527 at *15.

> The applicants' process differs only in some minor respects from the mental steps that an ordinary human being could be expected to follow (see pp. 12-13, *supra*). In effect, they seek a patent grant on a theorem that follows

[4] For further details of the architecture of digital computers, *see UDC* at 9-11, 44-53, 64-105.

> automatically from the definitions of pure binary, decimal, and BCD numbers, and from the axioms for or definitions of addition and multiplication in the binary system.

Id. at *19.

> The respondent applicants vary the ordinary arithmetic steps that a human being would use to accomplish such a conversion, by changing the order in which they are accomplished, changing the symbolism for writing the multiplier used in some steps (using a blank space for a terminal zero), and by taking subtotals after each successive operation.

Id. at *12.

The *Benson* Court accepted these statements as authoritatively correct, and almost verbatim:

> The patent sought is on a method of programming a general purpose digital computer to convert signals from binary coded decimal form into pure binary form.

Benson, 409 U.S. at 65.

> The method sought to be patented varies the ordinary arithmetic steps a human would use by changing the order of the steps, changing the symbolism for writing the multiplier used in some steps, and by taking subtotals after each successive operation.

Benson, 409 U.S. at 67.

However, Benson *did not* claim that he discovered the algorithm for BCD-to-binary conversion but rather a specific way of performing that algorithm using a particular combination of hardware elements:

> The present case, it will be noted, does not describe the claimed method by means of a formula. Such a formula could be devised, but no real value would be promoted by doing so. The rejected claims do, however, use terms such as storing, shifting and adding. These terms, particularly adding, do have a mathematical flavor and do suggest a mathematical calculation. It should be noted, however, that the problem solved by appellants' invention is not a mathematical problem. *The translation of binary-coded decimal numbers to binary numbers was solved long ago, indeed, as soon as BCD numbers were thought of in the first instance. Rather, the problem solved by appellants' invention is a machine problem, the slow speed and large storage capacity required for prior art translators.* Appellants' solution to this problem is mathematical only in the sense that such a translation must be governed broadly by the required mathematical equivalences of the results. The inventiveness of the actual methods claimed, however, lies in the special use of the machine capabilities (adding, shifting, testing) to solve the problem. That is, ordering the machine operations as specified in appellants' claims does speed up the translation and does reduce the storage requirements.

Appeal to Board of Appeals, February 27, 1967, 84-85, found in Appendix to *Gottschalk v. Benson* at 75 (emphasis added). The file history in *Benson* explains: "More specifically, the present invention is directed toward simplifying such numerical conversions by simplifying the apparatus necessary to achieve this conversion and increasing the speed at which conversion can be accomplished." *Id.* at 52. Benson's counsel specifically discussed how previous methods of BCD-decimal conversion required significant use of memory, and Benson's invention improved over these by specific features:

> The Bird patent discloses several related means for translating or converting a binary number into the equivalent binary-coded decimal number. In the embodiment of FIG. 1 for example, the binary-coded decimal equivalent of each binary position is stored on drum 1. These equivalents are accumulated in shift register 9 for all those binary positions in which the binary number in shift register 4 has a "one". As noted by Bird (Col. 2, lines 23-30) this requires the storage of twenty-seven different decimal equivalents, each thirty-two digits long, a total of 864 digits to be stored. As noted in applicants' specification (page 1, lines 16-25) it is systems just such as Bird's which applicants' invention is intended to be an improvement over. The "memory table" on Bird's track 2 (864 digits) represents considerable storage. Moreover, each step requires a complicated addition operation, increasing the likelihood of error. It is also noted that applicants provide a method for converting BCD to

> binary while Bird is concerned with converting binary to BCD.
>
> Applicants require no separate storage of conversion values. The conversion value is instead available in the two simple "add one" instructions at store addresses 115 and 117 (Table, page 7). By shifting the number so as to make these simple additions at binary digit positions of successively greater significance, these same two instructions serve to generate all of the conversion value required. Moreover, since the overall conversion involves no more than the iteration of a short, simple sequence, less storage is required and errors are less likely to occur.

Id. at 20-21.

In short, Benson's algorithm was *not* dictated by the axioms of mathematics but rather was a specific improvement on existing BCD-decimal conversions, designed to take advantage of the speed differences of then-available shifting registers over memory circuits. Of course, had Benson's invention instead been the BCD-binary algorithm itself, then the Court's concern regarding a mathematical formula being like scientific truth in this specific case would have been well-founded, and the holding proper.

Thus, the second premise of the Solicitor General's argument was also factually incorrect.

C. All Mathematical Algorithms Are Not Scientific Truths

The final premise of the Solicitor General's argument that was uncritically accepted by the Supreme Court was that all mathematical algorithms are scientific truths. The Solicitor General argued:

> Indeed, the Court has repeatedly held that a scientific principle, rule, formula or mathematical expression is not a patentable process, regardless of the novelty or importance of the discovery. *Le Roy v. Tatham*; *Mackay Radio & Tel. Co. v. Radio Corporation*; *O'Reilly v. Morse*; *Tilghman v. Proctor*; *Risdon Iron and Locomotive Works v. Medart.*

Solicitor General Brief, 1972 WL 137527, at *20-21 (citations omitted). Here, the Solicitor General states that the Court has "repeatedly held" that a "formula or mathematical expression" is not patent eligible. But that is *not* what the Court had "repeatedly held." First, mathematical expressions were not at issue in *Le Roy, O'Reilly, Tilghman,* or *Risdon*. Second, in *Mackay Radio* the invention was described in mathematical terms, but the Court was very careful in its phrasing: "While a scientific truth, *or the mathematical expression of it*, is not a patentable invention, a novel and useful structure created with the aid of knowledge of scientific truth may be." *Mackay Radio & Tel. Co. v. Radio Corp. of Am.*, 306 U.S. 86, 94 (1939) (emphasis added). The use of "or" results in a completely different meaning from that suggested by the Solicitor General. The *Mackay Ra-*

dio Court simply stated that a scientific truth, although it might be expressed by a mathematical formula, is not patent eligible, which is certainly the law. That is quite different from, and is not a holding that, *all* mathematical algorithms are ineligible as scientific truths, as suggested by the Solicitor General.

While the Court's opinion in *Benson* did correctly quote from *Mackay Radio*, the Court nonetheless appeared to have accepted the Solicitor General's interpretation of this statement as implying that mathematical expressions *are* scientific truths, rather than for it what it says—that they *can be used* to express them.

The difference between these interpretations is critical, and has fundamentally influenced the development of the patent law. Mathematics can certainly be used to describe laws of nature and scientific truths, such as $E=mc^2$, because it "is unique among languages in its ability to provide precise expression for every thought or concept that can be formulated in its terms." A. Adler, *Mathematics and Creativity*, The New Yorker, February 19, 1972, p. 39-45. But mathematics is also used to describe mundane things as well, such as fuel-efficient aircraft approach procedures (U.S. Patent No. 8,442,707), compressing video for transmission on cell phones (U.S. Patent No 8,494,051), efficiently allocating farming resources (U.S. Patent No. 6,990,459), or calculating golf handicaps and the difficulty of golf courses (U.S. Patent No. 8,282,455). Many of these mathematical algorithms are "models" that seek to represent reality in a form that can be understood by engineers, or in many cases that can then be manipulated by computers. No one would assert that such algorithms are "scientific truths": airplanes, video, farming, and golf are entirely human and social constructs, not *a priori* truths about nature, and specific algorithms in these fields are likewise human inventions. These are instead examples of *applied* mathematics ("Applied mathematics is a branch of mathematics that concerns itself with mathematical methods that are typically used in science, engineering, business, and industry," http:/en.wikipedia.org/wiki/Applied_math-ematics) rather than *pure* mathematics ("[P]ure mathematics is mathematics that studies entirely abstract concepts." http://en.wikipedia.org/wiki/Pure_mathematics).

Indeed, if all applied mathematical algorithms were in fact scientific truths, it would logically follow that any inventions that related to using computational methods would be ineligible, whether they were implemented in software or hardware. This certainly is not the right outcome and is completely inconsistent with the fact that there are thousands of patents directed to adding machines and calculators for performing addition, multiplication, division, and so forth. Further, it would mean that much of modern communications technology as used in smartphones and the Internet—communications protocols, encryption, audio and video compression—would likewise be no longer patent eligible.

The foregoing shows that the Solicitor General's arguments in *Benson*—about Benson's invention, about the nature of mathematical algorithms, and about the operation of computers—a theory that the

Supreme Court expressly adopted, were based on three factually and theoretically incorrect premises.

II. *BENSON* EXTENDED THE MENTAL STEPS DOCTRINE TO COMPUTER-IMPLEMENTED INVENTIONS

The holding in *Benson* primarily depended on the second and third premises set forth above:

> What we come down to in a nutshell is the following. It is conceded that one may not patent an idea. But in practical effect that would be the result if the formula for converting BCD numerals to pure binary numerals were patented in this case. The mathematical formula involved here has no substantial practical application except in connection with a digital computer, which means that if the judgment below is affirmed, the patent would wholly pre-empt the mathematical formula and in practical effect would be a patent on the algorithm itself.

Benson, 409 U.S. at 71-72.

Historically, the mental steps doctrine performed a useful screening function to exclude claims that directly set forth steps *necessarily* performed in the human mind, given the disclosure of the patent. The doctrine arose in cases involving inventions that occurred before the use of computers in business and industrial applications. The patent disclosures thus described the invention in terms of mathematical procedures that could only be performed mentally by "head and hand," or human judgments guided by mathematical or other considerations. That is, there was no disclosure of any way to perform the mathematical operations *except* by mental operations. See *In re Bologaro*, 20 C.C.P.A 845 (1931) (method for setting lines of type using a mathematical procedure to determine average number of spaces per line not patent eligible; no disclosure of any machine for performing claimed method); *Don Lee v. Walker*, 61 F.2d 58 (9th Cir. 1932) (method of determining the weights and positions of counterweights on engine balance shaft not patent eligible; no disclosure of any apparatus to perform the necessary calculations); *Haliburton Oil Well Cementing Co. v. Walker*, 146 F.2d 817 (9th Cir. 1944) (method of determining the location of an obstruction in a tube by observing time delays of echoes and solving a mathematical equation not patent eligible; "We think these mental steps, even if novel, are not patentable"); *In re Heritage*, 32 C.C.P.A. 1170, 1174 (1945) (method of "producing a porous coated fiber board" including a step of selecting particular amounts of coated fibers, with no disclosure of any apparatus or machine used to make the selection, not patent eligible; claims "are essentially directed to a purely mental process of making a selection of the amount of coating material to be used in coating a porous fiber board").

This interpretation of the mental steps doctrine is confirmed, in an early treatise on the patent eligibility of software, by noted Professor Irving Kayton:

> Purely "mental steps" are considered to be steps which may only be performed in, or with the aid of, the human mind. This is quite in

> contrast to "purely physical steps" which may only be performed by physical means, machinery, or apparatus. Purely mental steps (e. g., "believing") are quite different from purely physical steps (e. g., "heating") in many respects, not the least of which is that the former are much less susceptible to specific definition or delineation. Between the purely mental and purely physical ends of the spectrum there lies an infinite variety of steps that may be either machine-implemented or performed in, or with the aid of, the human mind (e. g., "comparing" and "determining"). In ascertaining whether a particular step is "mental" or "physical," each case must be decided on its own facts, considering all of the surrounding circumstances, to determine which end of the spectrum that step is nearer. It may well be that the step of "comparing" may be "mental" in one process, yet "physical" in another. Disclosure of apparatus for performing the process without human intervention may make out a prima facie case that the disclosed process is not mental and is, therefore, statutory.

Kayton, *Patent Protectability of Software: Background and Current Law*, in The Law of Software 1968 Proceedings B-25 (1968).

Thus, until *Benson*, no court had expressly applied the mental steps doctrine to computer-implemented inventions. *Benson* has been understood to have extended the mental steps doctrine to computer-implemented inventions. *CyberSource*

Corp. v. Retail Decisions, Inc., 654 F.3d 1366, 1371 (Fed. Cir. 2011) ("in finding that the process in *Benson* was not patent-eligible, the Supreme Court appeared to endorse the view that methods which can be performed mentally, or which are the equivalent of human mental work, are unpatentable abstract ideas—the 'basic tools of scientific and technological work' that are open to all") (citing *Benson*, 409 U.S. at 67).

Accordingly, to extend the mental steps doctrine in this fashion, the Court in *Benson* necessarily relied on the assumption that the operations of a computer are "the same procedures which a human being would perform" by "head and hand." As shown above, this view was particularly set forth by the Solicitor General in his brief to the Court and provided a demonstrably false premise.

Unfortunately, the Benrey Quote continues to this day to be cited as authority and a statement of fact about how computers operate, and has continued to substantively impact both the case law and the outcome of many patent cases. For example, the Federal Circuit has stated:

> As the Supreme Court has explained, "[a] digital computer . . . operates on data expressed in digits, solving a problem by doing arithmetic as a person would do it by head and hand." *Benson*, 409 U.S. at 65. Indeed, prior to the information age, a "computer" was not a machine at all; rather, it was a job title: "a person employed to make calculations." Oxford English Dictionary, *supra*. Those

> meanings conveniently illustrate the interchangeability of certain mental processes and basic digital computation, and help explain why the use of a computer in an otherwise patent-ineligible process for no more than its most basic function—making calculations or computations—fails to circumvent the prohibition against patenting abstract ideas and mental processes.

Bancorp Servs., L.L.C. v. Sun Life Assur. Co. of Canada, 687 F.3d 1266, 1277 (Fed. Cir. 2012) (holding patent claims to a computer-implemented system non-statutory as mental steps). Here too, the Benrey Quote has been taken out of context and used in a manner at odds with my intended purpose and meaning. As should be clear, the digital operations of a computer are not interchangeable with the mental processes of a human. That both can be *described* in a common way does not *make* them the same in fact. A common description should not be surprising, since, after all, humans invented the formal symbolism of arithmetic, and likewise invented computers, using that formal symbolism to define their operations. If the programmed operations of a computer are interchangeable with the mental processes of a human, then so too are the mechanical operations of an adding machine, since these operations can likewise be described as the "same procedures" performed by a human. Clearly, this result is not correct, and thus it implies that the "interchangeability" premise is false.

III. THE MENTAL STEPS DOCTRINE DOES NOT APPLY TO PROGRAMMED GENERAL PURPOSE COMPUTERS

The mental steps doctrine is inapplicable to digital computers and computer-implemented inventions for several reasons.

First, prior to the widespread usage of the general purpose computer, many inventions were created, and many patents granted, for mechanical and electrical machines that performed calculations. For example, between 1900 and 1960, there were over 2,300 patents issued that related to mechanical computing devices. That such devices were patent-eligible subject matter seems beyond dispute, and *amicus* has been unable to identify any federal cases in which claims to such devices or their methods of operation were held to be ineligible subject matter. That calculating machines such as these were performing simple arithmetic that a human could easily do by "head and hand" using the "same procedures" as humans, did not disqualify them as patentable subject matter. This is because the mathematical operations had been mechanized into physical elements: the "locus of the operation" was in the mechanical or electrical elements of the machine.

Most calculating machines typically could only perform the individual mathematical operations, such as addition, subtraction, multiplication, division, logarithm, and so forth. To perform a complex series of mathematical calculations therefore required the human operator to control the sequence and execution of a series of calculations, as well as in many cases to store, typically on a notepad, intermediate results for later entry into the machine. In short, even though the locus of the operation was in the machine, the locus of control in those devices was always in the mind of the human operator, whether he was using a desk calculator, a slide rule, or an abacus.

Accordingly, in patent cases decided prior to the widespread application of computers, the courts were correct to hold that a claim to mathematical procedures or use of formula was essentially one for mental steps, because there was then no known way to have a machine automatically perform the entire mathematical process by itself.

The advent of digital computers represented a fundamental change in where control of the operations is held. In a programmable computer, the locus of control is in the machine itself: A computer program controls the operation of the computer by sequentially changing the signals stored and manipulated by the computer. These signals are not representative of the mental states of a human but rather are signals that electronically represent low-level "instructions" that the computer can execute. At a minimum, just as the mechanical or electrical implementation of calculating machines would not be ignored in deciding patent eligibility, the implementation of a digital computer should not be ignored either.

The only reason to ignore the presence of digital computer elements, such as the shift register in *Benson*, or even a general purpose computer itself, is if one assumes that computers perform mental steps. Once this assumption is removed, there is no principled reason to distinguish between the mechanical nature of a calculating machine and the computer technology in digital computers. Both likewise contribute to patent eligibility.

Indeed, prior to the advent of programmable digital computers, there were several generations of electromechanical computers that used electromechanical devices, instead of integrated circuits. See R. Dorf, *Computers and Man* 13-23 (1974) (reviewing history of electro-mechanical computers leading up to the modern digital computer architecture developed by John Von Neumann in the 1940s). Certainly, if Benson's claim recited conventional electro-mechanical elements, such as relays and switches, instead of a shift register to perform the shifting and other steps, there would have been no doubt that the claim was sufficiently tied to a machine. There is no reason to discriminate against the use of conventional digital computer elements for patent eligibility, if such basic technology would suffice for a practical application.

The objection may be raised here that while a digital computer itself is patent eligible as an apparatus, what is disputed is whether a particular *way* of operating a digital computer under the control of a computer program is patent eligible, given that the digital computer is merely at that point a conventional apparatus used in the method.

This objection is answered in two ways. First, 35 U.S.C. § 100(b) states: "The term 'process' means process, art or method, and includes a new use of a known process, machine, manufacture, composition of matter, or material." Under § 101, a process is eligible subject matter if it is a *new use* of an existing machine, including if that machine is characterized as a "general purpose computer." That is, the statute does not exclude digital computers from the scope of "known machines" on which new, patent eligible processes can be implemented. There can be no dispute that a method of operating a digital computer under the control of a computer program to perform a specific function is performing a process under the statute.

Whereas the first answer is a result of the patent law, the second answer is a result of the underlying science of digital computers. One of the fundamental discoveries in computer science was made by Alan Turing. "The principle of the modern computer was first described by computer scientist Alan Turing, who set out the idea in his seminal 1936 paper." See "Computer," http://en.wikipedia.org/wiki/Computer (providing a detailed discussion of Turing's contribution to computer science, and his paper, Turing, A. M., *On Computable Numbers, with an Application to the Entscheidungsproblem* (1937) [Delivered to the Society November 1936]).

Turing proposed his "Turing machine," which is a generalized model of modern digital, programmable computers. Turing proved that a Turing machine, executing a computer program for an algorithm, can perform any calculation or any operation that a specific combination of logic circuits could perform. That is, a general purpose computer can be programmed to do any procedure or calculation that a "hardwired" computer had been designed to do.

Thus, from a scientific perspective there is no logical difference between a general purpose computer executing a computer program to perform a mathematical procedure and a specific computer hardware circuit that performs the same procedure without a computer program. From the standpoint of the relevant computer science principles, when a general purpose computer executes a computer program, it is equivalent to a specific hardware computer. Since there would be no dispute that a particular arrangement of logic circuits in the specific hardware computer is patent eligible, it makes no scientific sense to hold that a general purpose computer performing the equivalent method as the specific computer is likewise not patent eligible. To distinguish between these two ways of implementing a computer invention would make patent eligibility rest on the specific technological form of the implementation, even if these forms are considered equivalent by those of skill in the art.

This latter conclusion is precisely what the Federal Circuit held in *In re Alappat*, 33 F.3d 1526 (Fed. Cir. 1994) (en banc). The *Alappat* court was correct when it stated "programming creates a new machine, because a general purpose computer in effect becomes a special purpose computer once it is programmed to perform particular functions pursuant to instructions from program software." *Id.* at 1454. While the *technology* of computers has changed since 1994—they are smaller, faster, and more powerful—the underlying *science* of general purpose computers and their operation by computer programs has not changed since their conception by Turing in the 1930s and their subsequent realization in the first "stored program computers" in the early 1940s.

Indeed, the functional equivalence of hardware and software on a general purpose computer remains a vitally important aspect of modern technology. Electronic Design Automation (EDA) is a type of computer software used to design electronic systems, including integrated circuits. "Electronic Design Automation," http://en.wikipedia.org/wiki/Electronic_design_automation. Very generally, the desired functionality of a computer chip, including the most complex of today's microprocessors, is first defined using computer algorithms—in other words, in software. These algorithms are ultimately translated to the specific logic circuits—in other words, in hardware. This is only possible because of Turing's proof of the equivalence of a general purpose computer executing an algorithm and a corresponding specific computer circuit. Today, EDA is a multi-billion dollar industry, and almost every consumer, commercial, and industrial computer product is designed using EDA. It is not an exaggeration to say that, but for the equivalence of a general purpose computer executing a software program and a specific hardware computer, this Court still would be reading briefs printed on a mechanical printing press, from handset type.

CONCLUSION

The answer to the question presented is *Yes*. Inventions that are directed by their claim terms to computer implementations are and should be patent-eligible subject matter, regardless of whether the computer elements are conventional or not. The recitation of a process executed by a general purpose computer or its elements, such as a processor memory, data storage, and input/output devices, are sufficient, from a technological point of view, to articulate an invention restricted to a computer, rather than a mere abstract idea or purely mental process.

Respectfully submitted,
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