

PATENTS ACT 1977

APPLICANT Michael Adewunmi Idowu

ISSUE Whether patent application GB1420502.5 is excluded under section 1(2)

HEARING OFFICER H Jones

DECISION

Background

- 1 Patent application GB1420502.5, now published as GB2532441, was filed in the name of Dr Michael Adewunmi Idowu on 18 November 2014.
- 2 The examiner is of the view that the application relates to a mathematical method, a computer program, a discovery or the presentation of information as such, and is therefore excluded from patentability under section 1(2) or the Patents Act 1977. The application has not been searched. The applicant has made a number of submissions rebutting the section 1(2) objections but has failed to persuade the examiner of the patentability of the claims. Dr Idowu requested a hearing to decide the matter, which took place on 6 July 2021 and where Dr Idowu represented himself.

The invention

- 3 The most recent set of claims includes a single claim as follows:

According to the invention there is provided a device and method of modelling a Collatz based number dynamical system having a plurality of decision-based configurable functions and results thereupon by one or more other components, the device or method comprising the steps of

1. *determining the next odd number in the Collatz sequence from an input number – in an automated way, i.e. without actually calculating the next odd number*
2. *an algorithm that identifies groups of odd numbers congruent to $r \pmod{18}$, which works by iteratively adding the digits of the given number until a single digit result is produced; r is a member of $\{1, 5, 3, 13, 17, 15, 7, 11, 9\}$*
3. *configuring a completely optimised, number-theoretic Collatz based expert system*

Top d₁ ↓ 36 * n + 19 72 * n + 1 144 * n + 109 288 * n + 37 576 * n + 181 1152 * n + 1045 2304 * n + 469 4608 * n + 1621 9216 * n + 3925 18432 * n + 8533 36864 * n + 36181 73728 * n + 17749 147456 * n + 128341 294912 * n + 202069 589824 * n + 54613 1179648 * n + 993949 2359296 * n + 1529179 4718592 * n + 2708821 9437184 * n + 4864 18874368 * n + 108544 37748736 * n + 53248 75497472 * n + 285024 150994944 * n + 1496008 301989888 * n + 69208 603979776 * n + 163840 1207959552 * n + 2818048 2415919104 * n + 487920 4831838208 * n + 8126464 9663676416 * n + 14864 19327352832 * n + 328 38654705664 * n + 72 77309411328 * n + 16 154618822656 * n + 4 309237645312 * n + 1 618475290624 * n + 0	Top d₂ ↓ 36 * n + 23 72 * n + 37 144 * n + 77 288 * n + 5 576 * n + 137 1152 * n + 149 2304 * n + 729 4608 * n + 1181 9216 * n + 1877 18432 * n + 6485 36864 * n + 15701 73728 * n + 34133 147456 * n + 144725 294912 * n + 70997 589824 * n + 21365 1179648 * n + 80827 2359296 * n + 21843 4718592 * n + 375787 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number, before dropping via a series of divisions by two until an odd number is found, whereupon the sequence climbs again to a larger even number. A long-standing conjecture states that the Collatz sequence beginning with any natural number will always eventually reach the value one (and get into a $1 \rightarrow 4 \rightarrow 2 \rightarrow 1$ loop).

- 5 For a given input number, the application details how to quickly find its congruence class modulo 18, and for each congruence class r a number of sets $V_{r,m}$ are defined. The input integer is associated to one of these sets, and this allows the next odd number in the Collatz sequence to be quickly calculated. The outcome of the last step is a correspondence between the height (i.e. length of Collatz sequence until termination) of integers in different congruence classes modulo 18.

The law

- 6 The relevant provision is section 1(2) of the Patents Act 1977, which says that certain things cannot be protected by a patent:

1(2). It is hereby declared that the following (among other things) are not inventions for the purposes of this Act, that is to say, anything which consists of -

- (a) a discovery, scientific theory or mathematical method;*
- (b) a literary, dramatic, musical or artistic work or any other aesthetic creation;*
- (c) a scheme, rule or method for performing a mental act, playing a game or doing business, or a program for a computer;*
- (d) the presentation of information;*

but the foregoing provision shall prevent anything from being treated as an invention for the purposes of this Act only to the extent that a patent or application for a patent relates to that thing as such.

- 7 The Court of Appeal in *Symbian*¹ stated that the question of whether a computer-implemented invention is patentable has to be resolved by answering the question whether it reveals a technical contribution to the state of the art. It proceeded to answer the question with the aid of the four-step test set out in its earlier judgment in *Aerotel*², namely:

- (1) construe the claim;
- (2) identify the actual (or alleged) contribution;
- (3) ask whether it falls solely within the excluded subject matter;
- (4) check whether the actual or alleged contribution is actually technical in nature.

- 8 The fourth step of the test is to check whether the contribution is technical in nature. In paragraph 46 of *Aerotel* it is stated that applying this fourth step may not be necessary because the third step should have covered the question. This is because a contribution which consists solely of excluded matter will not count as being a "technical contribution" and thus will not, as the fourth step puts it, be "technical in nature". Similarly, a contribution which consists of more than excluded matter will be a "technical contribution" and so will be "technical in nature". In the present case, which concerns a computer-implemented invention, I shall consider whether the

¹ *Symbian Ltd. v Comptroller -General or Patents* [2008] EWCA Civ 1066

² *Aerotel Ltd v Telco Holdings Ltd and Macrossan's Application* [2006] EWCA Civ 1371

contribution is excluded alongside the question of whether the contribution is technical in nature, i.e. I will consider the third and fourth steps of *Aerotel* together.

- 9 The examiner has based his analysis on *Aerotel* and *Symbian*. He has also made reference to *Gale's Application*³ which I will discuss briefly below. There is no disagreement between the examiner and the applicant as to the relevant law.

Arguments and analysis

- 10 The examiner maintains that the claims define an invention which is excluded from patentability as it falls solely within the excluded categories as a program for a computer, discovery, mathematical method and/or presentation of information. His position is set out most recently in his pre-hearing report issued on 29 April 2021. Arguments against the examiner's position are contained in the submissions made by Dr Idowu and on file dated 19 January 2021, and were helpfully elaborated and expanded upon at the hearing.
- 11 Following the test set out in paragraph 7 above, I must first properly construe the claim. The examiner has had no difficulty in interpreting the claim as it would normally be understood in the art. I would add that the phrase "in an automated way" in step one appears to mean that the next odd number is determined in some way other than multiplying by three, adding one and repeatedly dividing by two until an odd number is reached. In the invention, a short-cut is used to find the highest power of two used in the division series, then divide by this power in a single step instead of iteratively dividing and checking parity.
- 12 Step two is construed such that the method includes a step of identifying the congruence class modulo 18 of a given input number by iteratively adding digits of the number until a single digit remains. It is noted that this doesn't necessarily happen after step one, and in the specific embodiment described in the application it appears that this is done in order to find which rules to apply for step one.
- 13 In step three I have difficulty construing what is meant by "a completely optimised, number-theoretic Collatz based expert system". In the claim this is followed by a series of vectors representing how an odd input number with a given congruence class modulo 18 is transformed to the next odd number in the Collatz sequence. In my view, this step is characterised by these vectors and represents a system configured with the aid of steps one and two to map odd input values to their next odd value in the Collatz sequence.
- 14 Step four is simply "Collatz height mapping configuration", followed by a list of vectors which show relationships between height values (minimum number of steps for the Collatz sequence starting at the input number to reach one) of input numbers in different congruence classes. This is construed as the step of compiling the list of said values to store in the expert system.
- 15 Step five of "reconfiguring the robust Collatz mapping system in a variety of other meaningful ways" has no enabling disclosure in the specification, so I am not able to put any weight on this step.

³ Gale's Application [1991] RPC 305

16 Moving on to the contribution, in his letter of 29 April 2021 the examiner has characterised the contribution as a new set of rules for an expert system to follow to allow it to more efficiently carry out its mathematical problems. At the hearing, Dr Idowu reiterated the points made in his written submissions on file, emphasising that the invention is not simply an algorithm. Dr Idowu contested the characterisation of the invention as a new set of rules, and instead argued that the invention is a new kind of expert system (based upon a knowledge base and inference rules) that is designed specifically for solving mathematical problems.

17 Jacob LJ outlined the considerations to be applied when identifying the contribution made by the claims in paragraph 43 of *Aerotel*:

“The second step – identify the contribution - is said to be more problematical. How do you assess the contribution? Mr Birss submits the test is workable – it is an exercise in judgment probably involving the problem said to be solved, how the invention works, what its advantages are. What has the inventor really added to human knowledge perhaps best sums up the exercise. The formulation involves looking at substance not form – which is surely what the legislator intended.”

18 Following this approach I can avoid preconceptions attached to terms such as “algorithm” and “expert system” and assess the actual contribution made by the claimed invention with reference to the problem to be solved, how the invention works, and its advantages. Regarding the problem to be solved, this was discussed at the hearing and the can be articulated as the design of a system that can solve mathematical problems that haven’t been solved in the past. However, looking at the specification and how the disclosed invention works, it seems that what has been added to human knowledge here is a particular method or system for understanding the mathematical dynamics of the Collatz function. I cannot see any disclosure that would define or enable a more general machine that relates to any other mathematical functions.

19 Therefore, I would describe the contribution as a method and system for understanding the dynamics of the Collatz function by determining rules to find the next odd number in the Collatz sequence from an input number using its congruence class modulo 18, and compiling the data on relationships between Collatz height values of input numbers in different congruence classes with the purpose of using the resulting system of rules to investigate the Collatz function and how it may be generalised to other mathematical functions.

20 Next I must assess whether the contribution is technical in the sense that it does not fall solely within the excluded categories.

21 It seems to me that at its heart this invention is concerned with a mathematical endeavour, in which a series of mathematical operations are performed in a computer to achieve the claimed configured system, with the purpose of investigating a mathematical problem. Following *Gale’s Application*, it is clear that the fact that the mathematical steps are performed on a computer does not prevent it from being excluded as a mathematical method. Indeed, the system which results from the application is itself a conventional computer implementation of a new mathematical framework. In this sense it is clear to me that the contribution is nothing more than a mathematical method and is not technical in the sense that it makes a contribution outside the categories of excluded subject matter outlined in section 1(2).

Conclusion

- 22 I have found that the invention described in the application is a computer implementation of a mathematical method, which falls wholly within the excluded subject-matter set out in section 1(2)(c). The application is refused under section 18(3).

Appeal

- 23 Any appeal must be lodged within 28 days after the date of this decision.

Huw Jones

Deputy Director, acting for the Comptroller