A METHOD FOR DETERMINING

PRIME NUMBERS

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Prime numbers are :
2,3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59,61,67,71,73,79,83,89,97, ...

Let us examine composite numbers :

9/3*3 = 1   The sum 9+3+3 = 15   The product 9*15 = 135

$135 + 3^2 = 12^2$

Let $k_1 = 3$ and $k_2 = 3$ are two possible whole divisors of the composite number 9

And let $135 + x^2 = y^2$, that is to say x = 3 and y = 12

And let A = 9 (the composite number). A always be a whole odd number (even numbers are composite, because they are divided by 2 without remainder).

For A = 15 follows 15/3*5 = 1 $k_1 = 3$ and $k_2 = 5$

15*(15 + 3 + 5) = 15*23 = 345

$345 + 4^2 = 19^2$ therefore x = 4 and y = 19

Then for all numbers A valid is the system of equations :

$k_2 + x - (k_2 - k_1) = \rho$

$k_1 + k_2 = 2x$

$A = k_1k_2$

Where ρ is a whole number.

Therefore $x + k_1 = \rho$

We substitute and obtain :

$(k_1 + k_2)/2 + k_1 = \rho$

$3k_1 + k_2 = 2\rho$

$3k_1 + A/k_1 = 2\rho$ we multiply it $k_1>0$

$3k_1^2 + A = 2\rho k_1$

$3k_1^2 - 2\rho k_1 + A = 0$

$\Delta = 4\rho^2 - 12A \geq 0$ because k_1 is a real number and besides $\sqrt{\Delta}$ must be a whole number.

Therefore $4\rho^2 \geq 12A$

$\rho^2 \geq 3A$

$\rho \geq \sqrt{(3A)}$

$k_1 = (2\rho \pm \sqrt{(4\rho^2 - 12A)})/6$

от $3k_1 + k_2 = 2\rho$ we substitute and obtain :

$(3A)/k_2 + k_2 = 2\rho$ we multiply it $k_2>0$

$3A + k_2^2 = 2\rho k_2$

$k_2^2 - 2\rho k_2 + 3A = 0$

$\Delta = 4\rho^2 - 12A \geq 0$ because k_2 is a real number

$\sqrt{\Delta}$ is a whole number.

$k_2 = (2\rho \mp \sqrt{(4\rho^2 - 12A)})/2$

Experimentally is determined the equality :

$\rho \pm \sqrt{(\rho^2 - 3A)} = k$

We have eight variants of the equality :

I variant :

ρ + $\sqrt{(\rho^2 - 3A)}$ **= k2(+) = (2ρ +** $\sqrt{(4\rho^2 - 12A)}$ **)/2**

ρ + $\sqrt{(\rho^2 - 3A)}$ **= ρ +** $\sqrt{(\rho^2 - 3A)}$

0 = 0 indefinable case.

II variant :

ρ + $\sqrt{(\rho^2 - 3A)}$ **= k2(-) = (2ρ -** $\sqrt{(4\rho^2 - 12A)}$ **)/2**

ρ + $\sqrt{(\rho^2 - 3A)}$ **= ρ -** $\sqrt{(\rho^2 - 3A)}$

2$\sqrt{(\rho^2 - 3A)}$ **= 0**

ρ^2 - 3A = 0

ρ^2 = 3A

ρ = $\sqrt{(3A)}$ **with √Δ = 0 since Δ = 4ρ^2 - 12A = 12A – 12A = 0**

III variant :

ρ - $\sqrt{(\rho^2 - 3A)}$ **= k2(+) = (2ρ +** $\sqrt{(4\rho^2 - 12A)}$ **)/2**

ρ - $\sqrt{(\rho^2 - 3A)}$ **= ρ +** $\sqrt{(\rho^2 - 3A)}$

ρ = $\sqrt{(3A)}$ **with √Δ = 0**

IV variant :

ρ - $\sqrt{(\rho^2 - 3A)}$ **= k2(-) = (2ρ -** $\sqrt{(4\rho^2 - 12A)}$ **)/2**

ρ - $\sqrt{(\rho^2 - 3A)}$ **= ρ -** $\sqrt{(\rho^2 - 3A)}$

0 = 0 indefinable case.

V variant :

ρ + $\sqrt{(\rho^2 - 3A)}$ **= k1(+) = (2ρ +** $\sqrt{(4\rho^2 - 12A)}$ **)/6**

3(ρ + $\sqrt{(\rho^2 - 3A)}$ **) = ρ +** $\sqrt{(\rho^2 - 3A)}$

ρ^2 = ρ^2 - 3A

3A = 0

A = 0 which is impossible, since A>0

VI variant :

$\rho + \sqrt{(\rho^2 - 3A)} = k_1(-) = (2\rho - \sqrt{(4\rho^2 - 12A)})/6$

$3(\rho + \sqrt{(\rho^2 - 3A)}) = \rho - \sqrt{(\rho^2 - 3A)}$

$2\rho = - 4\sqrt{(\rho^2 - 3A)}$

$\rho = - 2\sqrt{(\rho^2 - 3A)}$

$\rho^2 = 4(\rho^2 - 3A)$

$3\rho^2 = 12A$

$\rho^2 = 4A$

$\rho = 2\sqrt{A}$ with $\rho = \sqrt{\Delta}$ since $\Delta = 4\rho^2 - 12A = 16A - 12A = 4A$

and $\sqrt{\Delta} = 2\sqrt{A} = \rho$

VII variant :

$\rho - \sqrt{(\rho^2 - 3A)} = k_1(+) = (2\rho + \sqrt{(4\rho^2 - 12A)})/6$

$3(\rho - \sqrt{(\rho^2 - 3A)}) = \rho + \sqrt{(\rho^2 - 3A)}$

$2\rho = 4\sqrt{(\rho^2 - 3A)}$

$\rho = 2\sqrt{(\rho^2 - 3A)}$

$\rho^2 = 4(\rho^2 - 3A)$

$3\rho^2 = 12A$

$\rho^2 = 4A$

$\rho = 2\sqrt{A}$ with $\rho = \sqrt{\Delta}$

VIII variant :

$\rho - \sqrt{(\rho^2 - 3A)} = k_1(-) = (2\rho - \sqrt{(4\rho^2 - 12A)})/6$

$3(\rho - \sqrt{(\rho^2 - 3A)}) = \rho - \sqrt{(\rho^2 - 3A)}$

$2\rho = 2\sqrt{(\rho^2 - 3A)}$

$\rho = \sqrt{(\rho^2 - 3A)}$

$\rho^2 = \rho^2 - 3A$

$3A = 0$

$A = 0$ which is impossible, since $A>0$

There should be noted the variants $\rho = \sqrt{(3A)}$ with $\sqrt{\Delta} = 0$ and

$\rho = 2\sqrt{A}$ with $\rho = \sqrt{\Delta}$, that are very important special cases.

We note a dependence too discovered experimentally, which however is a very rare case :

$\rho = \sqrt{(\frac{3}{2}(A + B))}$, where B is the next composite odd number after A.

Another dependence discovered experimentally is :

$\rho + \sqrt{\Delta} - 10 = 3$

$\rho - 13 = - \sqrt{\Delta}$

$(\rho - 13)^2 = 4\rho^2 - 12A$

$\rho^2 - 26\rho + 169 = 4\rho^2 - 12A$

$3\rho^2 + 26\rho - 169 - 12A = 0$

$\rho = (- 26 \pm \sqrt{(26^2 + 12 * 169 + 12 * 12A)})/6$

$\rho = (- 26 \pm \sqrt{(16 * 169 + 16 * 9A)})/6$

$\rho = (- 26 \pm 4\sqrt{(169 + 9A)})/6$

$\rho = (- 13 \pm 2\sqrt{(169 + 9A)})/3$

In some cases this dependence is correct.

Next dependence discovered experimentally is :

$6\rho - A = 15 + 4k_1$

$6\rho - A = 15 + (4(2\rho \pm \sqrt{\Delta}))/6$

$18\rho - 3A = 45 + 4\rho \pm 2\sqrt{\Delta}$

$14\rho - 3A - 45 = \pm 2\sqrt{\Delta}$

$196\rho^2 - 84\rho A + 9A^2 - 1260\rho + 270A + 2025 = 16\rho^2 - 48A$

$180\rho^2 - (1260 + 84A)\rho + 9A^2 + 318A + 2025 = 0$

$(-(1260 + 84A))^2 - 4*180(9A^2 + 318A + 2025) =$

$= 1587600 + 211680A + 7056A^2 - 6480A^2 - 228960A - 1458000 =$

$= 576A^2 - 17280A + 129600 = (24A - 360)^2$

$\rho = (1260 + 84A \pm (24A - 360))/360$

With (+) follows $\rho = (3A + 25)/10$

With (-) follows $\rho = (A + 27)/6$

Sometimes ρ **coincides with these values, if they are whole numbers.**

Dependence discovered experimentally is :

$(k_2^2 + (k_2^2 - k_1^2)/8)/k_1^2 - 1 = (k_2^2 - k_1^2)/8$

$k_2^2 - k_1^2 + (k_2^2 - k_1^2)/8 = k_1^2(k_2^2 - k_1^2)/8$

$8k_2^2 - 8k_1^2 + k_2^2 - k_1^2 = k_1^2k_2^2 - k_1^4$

$9k_2^2 - 9k_1^2 = A^2 - k_1^4$ **with** $k_2 \geq k_1$

$9k_1^2 - 9k_2^2 = A^2 - k_2^4$ **with** $k_1 \geq k_2$

Therefore $9k_2^2 - 9k_1^2 = A^2 - k_1^4$ **with** $k_2 \geq k_1$

$9[(4\rho^2 \mp 4\rho\sqrt{\Delta} + \Delta)/4 - (4\rho^2 \pm 4\rho\sqrt{\Delta} + \Delta)/36] = A^2 - k_1^4$

$36\rho^2 \mp 36\rho\sqrt{\Delta} + 9\Delta - 4\rho^2 \mp 4\rho\sqrt{\Delta} - \Delta = 4(A^2 - k_1^4)$

$32\rho^2 \mp 40\rho\sqrt{\Delta} + 8\Delta = 4(A^2 - k_1^4)$

$32\rho^2 \mp 40\rho\sqrt{\Delta} + 8\Delta - 4A^2 = - 4k_1^4$

$\pm 10\rho\sqrt{\Delta} - 8\rho^2 - 2(4\rho^2 - 12A) + A^2 = k_1^4$

$\pm 10\rho\sqrt{\Delta} - 16\rho^2 + A^2 + 24A = k_1^4$

$\pm 10\rho\sqrt{\Delta} - 16\rho^2 + A^2 + 24A = [(8\rho^2 \pm 4\rho\sqrt{\Delta} - 12A)/36][(8\rho^2 \pm 4\rho\sqrt{\Delta} - 12A)/36]$

$\pm12960\rho\sqrt{\Delta} - 20736\rho^2 + 1296A^2 + 31104A = 64\rho^4 \pm 32\rho^3\sqrt{\Delta} - 96\rho^2A \pm 32\rho^3\sqrt{\Delta} + 64\rho^4 - 192\rho^2A \mp 48\rho A\sqrt{\Delta} - 96\rho^2A \mp 48\rho A\sqrt{\Delta} + 144A^2$

$128\rho^4 - 384\rho^2A + 20736\rho^2 - 1152A^2 - 31104A = (\mp 64\rho^3 \pm 96\rho A \pm 12960\rho)\sqrt{\Delta}$

$(2\rho^4 - 6\rho^2A + 324\rho^2 - 18A^2 - 486A) (2\rho^4 - 6\rho^2A + 324\rho^2 - 18A^2 - 486A) = (\mp \rho^3 \pm 1{,}5\rho A \pm 202{,}5\rho) (\mp \rho^3 \pm 1{,}5\rho A \pm 202{,}5\rho) (4\rho^2 - 12A)$

$4\rho^8 - 12\rho^6A + 648\rho^6 - 36\rho^4A^2 - 972\rho^4A - 12\rho^6A + 36\rho^4A^2 - 1944\rho^4A + 108\rho^2A^3 + 2916\rho^2A^2 + 648\rho^6 - 1944\rho^4A + 104976\rho^4 - 5832\rho^2A^2 - 157464\rho^2A - 36\rho^4A^2 + 108\rho^2A^3 - 5832\rho^2A^2 + 324A^4 + 8748A^3 - 972\rho^4A + 2916\rho^2A^2 - 157464\rho^2A + 8748A^3 + 236196A^2 = 4\rho^8 - 6\rho^6A - 810\rho^6 - 6\rho^6A + 9\rho^4A^2 + 1215\rho^4A - 810\rho^6 + 1215\rho^4A + 164025\rho^4 - 12\rho^6A + 18\rho^4A^2 + 2430\rho^4A + 18\rho^4A^2 - 27\rho^2A^3 - 3645\rho^2A^2 + 2430\rho^4A - 3645\rho^2A^2 - 492075\rho^2A$

$2916\rho^6 - 59049\rho^4 - 13122\rho^4A - 81\rho^4A^2 + 177147\rho^2A + 1458\rho^2A^2 + 243\rho^2A^3 + 324A^4 + 17496A^3 + 236196A^2 = 0$

$36\theta^3 - (729 + 162A + A^2)\theta^2 + (2187A + 18A^2 + 3A^3)\theta + 4A^4 + 216A^3 + 2916A^2 =0$ with $\rho^2 = \theta$ and $\rho = \sqrt{\theta}$

$a_0\theta^3 + a_1\theta^2 + a_2\theta + a_3 = 0$

$\theta = \varepsilon - (a_1)/(3a_0)$

$\varepsilon^3 + p\varepsilon + q = 0$

$p = (3a_0a_2 - a_1^2)/(3a_0^2)$ и $q = (2a_1^3 + 27a_0^2a_3 - 9a_0a_1a_2)/(27a_0^3)$

$\nabla = p^3/27 + q^2/4$

With $\nabla>0$ $\varepsilon_1 = \sqrt[3]{(-\frac{q}{2}+\sqrt{\nabla})} + \sqrt[3]{(-\frac{q}{2}-\sqrt{\nabla})}$ = D + E because ρ,θ,ε are real numbers

With $\nabla < 0$ ε_1 = D + E $\varepsilon_{2,3}$ = - (D + E)/2 ± (D – E)($\sqrt{3}$)/2i where i = $\sqrt{(-1)}$

With $\nabla = 0$ $\varepsilon_1 = 2\sqrt[3]{(-\frac{q}{2})}$ $\varepsilon_{2,3} = -\sqrt[3]{(-\frac{q}{2})}$

With $k_1 \geq k_2$ follows $9k_1^2 - 9k_2^2 = A^2 - k_2^4$

$9[(4\rho^2 \pm 4\rho\sqrt{\Delta} + \Delta)/36 - (4\rho^2 \mp 4\rho\sqrt{\Delta} + \Delta)/4] = A^2 - k_2^4$

$4\rho^2 \pm 4\rho\sqrt{\Delta} + \Delta - 36\rho^2 \pm 36\rho\sqrt{\Delta} - 9\Delta = 4A^2 - 4k_2^4$

$\pm 40\rho\sqrt{\Delta} - 32\rho^2 - 8\Delta - 4A^2 = - 4k_2^4$

$8\rho^2 \mp 10\rho\sqrt{\Delta} + 2\Delta + A^2 = k_2^4$

$8\rho^2 \mp 10\rho\sqrt{\Delta} + 8\rho^2 - 24A + A^2 = k_2^4$

$16(16\rho^2 \mp 10\rho\sqrt{\Delta} + A^2 - 24A) = (8\rho^2 \mp 4\rho\sqrt{\Delta} - 12A)(8\rho^2 \mp 4\rho\sqrt{\Delta} - 12A)$

$256\rho^2 \mp 160\rho\sqrt{\Delta} + 16A^2 - 384A = 64\rho^4 \mp 32\rho^3\sqrt{\Delta} - 96\rho^2A \mp 32\rho^3\sqrt{\Delta} + 16\rho^2(4\rho^2 - 12A) \pm 48\rho A\sqrt{\Delta} - 96\rho^2A \pm 48\rho A\sqrt{\Delta} + 144A^2$

$(\pm \rho^3 \mp 1{,}5\rho A \mp 2{,}5\rho)\sqrt{\Delta} = 2\rho^4 - 4\rho^2 - 6\rho^2A + 2A^2 + 6A$

$(\pm \rho^3 \mp 1{,}5\rho A \mp 2{,}5\rho)(\pm \rho^3 \mp 1{,}5\rho A \mp 2{,}5\rho)(4\rho^2 - 12A) = (2\rho^4 - 4\rho^2 - 6\rho^2A + 2A^2 + 6A)(2\rho^4 - 4\rho^2 - 6\rho^2A + 2A^2 + 6A)$

$4\rho^8 - 20\rho^6 - 12\rho^6A + 25\rho^4 + 30\rho^4A + 9\rho^4A^2 - 12\rho^6A + 60\rho^4A + 36\rho^4A^2 - 75\rho^2A - 90\rho^2A^2 - 27\rho^2A^3 = 4\rho^8 - 8\rho^6 - 12\rho^6A + 4\rho^4A^2 + 12\rho^4A - 8\rho^6 + 16\rho^4 + 24\rho^4A - 8\rho^2A^2 - 24\rho^2A - 12\rho^6A + 24\rho^4A + 36\rho^4A^2 - 12\rho^2A^3 - 36\rho^2A^2 + 4\rho^4A^2 - 8\rho^2A^2 - 12\rho^2A^3 + 4A^4 + 12A^3 + 12\rho^4A - 24\rho^2A - 36\rho^2A^2 + 12A^3 + 36A^2$

$4\rho^6 - (9 + 18A + A^2)\rho^4 + (27A + 2A^2 + 3A^3)\rho^2 + 4A^4 + 24A^3 + 36A^2 = 0$

$4\theta^3 - (9 + 18A + A^2)\theta^2 + (27A + 2A^2 + 3A^3)\theta + 4A^4 + 24A^3 + 36A^2 = 0$ with $\rho^2 = \theta$ and $\rho = \sqrt{\theta}$

Dependence discovered experimentally is :

I I N – T I – I N – S I I = I I I R I – S I – I I R I – T I I

Where $N = (\rho^2 - k_1^2)/6$ with $k_2 \geq k_1$

$N = (\rho^2 - k_2^2)/6$ with $k_1 \geq k_2$

$R = (\rho^2 - k_2^2)/6$ with $k_2 \geq k_1$

$R = (\rho^2 - k_1^2)/6$ with $k_1 \geq k_2$

$S = 9(k_2 – k_1)$ with $k_2 \geq k_1$

$S = 9(k_1 – k_2)$ with $k_1 \geq k_2$

$T = A – k_1^2$ with $k_2 \geq k_1$

$T = A – k_2^2$ with $k_1 \geq k_2$

With $k_2 \geq k_1$ for $S \geq 0$ follows $9(k_2 – k_1) \geq 0$ and $k_2 – k_1 \geq 0$ and $k_2 \geq k_1$ therefore $S \geq 0$

With $k_2 \geq k_1$ for $T \geq 0$ follows $A – k_1^2 \geq 0$ and $A \geq k_1^2$ and $k_1k_2 \geq k_1^2$ and $k_2 \geq k_1$ therefore $T \geq 0$

With $k_2 \geq k_1$ for $N \geq 0$ follows $(\rho^2 - k_1^2)/6 \geq 0$ and $\rho^2 \geq k_1^2$ and $\rho \geq k_1$ and $(3k_1 + k_2)/2 \geq k_1$ and $3k_1 + k_2 \geq 2k_1$ and $k_1 + k_2 \geq 0$ and ($k_1>0$ и $k_2>0$) therefore $N>0$

With $k_2 \geq k_1$ for $R \geq 0$ follows $(\rho^2 - k_2^2)/6 \geq 0$ and $\rho \geq k_2$ and $(3k_1 + k_2)/2 \geq k_2$ and $3k_1 + k_2 \geq 2k_2$ and $3k_1 \geq k_2$ therefore $R>0$ и $R=0$ и $R<0$ therefore $I R I \geq 0$

With $k_1 \geq k_2$ follows $S \geq 0$ and $T \geq 0$ and $N>0$ and $R>0$

Therefore for $k_1 \geq k_2$ the equality is :

$I\ I\ N – T\ I – I\ N – S\ I\ I = I\ I\ R – S\ I – I\ R – T\ I\ I$

Therefore for $k_2 \geq k_1$ the equality is :

$\pm (\pm (N – T) \pm (N – S)) = \pm (\pm (\pm R – S) \pm (\pm R – T))$

12 different variants

Therefore for $k_1 \geq k_2$ the equality is :

$\pm (\pm (N – T) \pm (N – S)) = \pm (\pm (R – S) \pm (R – T))$

8 different variants

With $k_2 \geq k_1$ follows :

(1) $19\rho^4 + 1188\rho^3 + (8748 - 42A)\rho^2 - 3780A\rho - 49A^2 - 34992A = 0$

$a_0\rho^4 + a_1\rho^3 + a_2\rho^2 + a_3\rho + a_4 = 0$

$\rho^4 + a\rho^3 + b\rho^2 + c\rho + d = 0$

$a = a_1/a_0$ $b = a_2/a_0$ $c = a_3/a_0$ $d = a_4/a_0$

$\lambda^3 - b\lambda^2 + (ac - 4d)\lambda + (4b - a^2)d = 0$

where λ_0 is 1 from the 3 decisions of the equation.

$\rho_{1,2} = (- (a/2 + \varepsilon_0) \pm \sqrt{U})/2$

where $U = (a/2 + \varepsilon_0)^2 - (2\lambda_0 - 4x_0\varepsilon_0)$

$\rho_{3,4} = (- (a/2 - \varepsilon_0) \pm \sqrt{V})/2$

where $V = (a/2 - \varepsilon_0)^2 - (2\lambda_0 + 4x_0\varepsilon_0)$

where $x_0 = (2c - a\lambda_0)/(a^2 - 4b + 4\lambda_0)$

and $\varepsilon_0 = \sqrt{W}$ where $W = \lambda_0 + (a^2 - 4b)/4$

(2) $\rho = 2\sqrt{A}$

(3) $\rho^4 + 72\rho^3 + (1296 - 2A)\rho^2 - 216A\rho - 3A^2 - 5184A = 0$

(4) $11\rho^4 - 30A\rho^2 - 25A^2 = 0$

$11\theta^2 - 30A\theta - 25A^2 = 0$ with $\rho^2 = \theta$ and $\rho = \sqrt{\theta}$

(5) $7\rho^4 - 18A\rho^2 - 25A^2 = 0$

$7\theta^2 - 18A\theta - 25A^2 = 0$

(6) $\rho^4 - 72\rho^3 + (1296 - 2A)\rho^2 + 216A\rho - 3A^2 - 5184A = 0$

(7) $5\rho^4 - 54\rho^3 - (2187 + 36A)\rho^2 + 216A\rho + 64A^2 + 8748A = 0$

(8) $5\rho^4 - 50A\rho^2 + 121A^2 = 0$

$5\theta^2 - 50A\theta + 121A^2 = 0$

(9) $29\rho^4 - 258A\rho^2 + 529A^2 = 0$

$29\theta^2 - 258A\theta + 529A^2 = 0$

(10) $5\rho^4 - 216\rho^3 - (34992 – 6A)\rho^2 - 1080A\rho + A^2 + 139968A = 0$

(11) $18\rho^3 - (243 + A)\rho^2 - 72A\rho + 4A^2 + 972A = 0$

(12) indefinable case (0 = 0)

With $k_1 \geq k_2$ follows :

(13) $\rho = 2\sqrt{A}$

(14) $5\rho^4 + 216\rho^3 - (34992 – 6A)\rho^2 + 1080A\rho + A^2 + 139968A = 0$

(15) $77\rho^4 - 1404\rho^3 - (8748 + 390A)\rho^2 + 6588A\rho + 961A^2 + 34992A = 0$

(16) $125\rho^4 - 1410A\rho^2 + 5041A^2 = 0$

$125\theta^2 - 1410A\theta + 5041A^2 = 0$

(17) $7\rho^4 - 54A\rho^2 + 147A^2 = 0$

$7\theta^2 - 54A\theta + 147A^2 = 0$

(18) $6\rho^3 - (27 + A)\rho^2 - 24A\rho + 4A^2 + 108A = 0$

(19) $\rho^4 - 72\rho^3 + (1296 – 2A)\rho^2 + 216A\rho – 3A^2 - 5184A = 0$

(20) indefinable case (0 = 0)

Let us equate one of the divisors k_1 to one :

$k_1 = 1 = (2\rho \pm \sqrt{\Delta})/6$

$6 - 2\rho = \pm \sqrt{\Delta}$

$(6 - 2\rho)^2 = \Delta$

$36 - 24\rho + 4\rho^2 = 4\rho^2 - 12A$

$24\rho = 36 + 12A$

$2\rho = 3 + A$

$\rho = (3 + A)/2$ with $k_1 = 1$ and $k_2 = A$

If we equate the other divisor k_2 to one :

$k_2 = 1 = (2\rho \mp \sqrt{\Delta})/2$

$2 - 2\rho = \mp \sqrt{\Delta}$

$(2 - 2\rho)^2 = \Delta$

$4 - 8\rho + 4\rho^2 = 4\rho^2 - 12A$

$8\rho = 4 + 12A$

$2\rho = 1 +3A$

$\rho = (1 + 3A)/2$ with $k_2 = 1$ and $k_1 = A$

If we indicate with C some whole positive odd number ≥ 3 then applies the dependence $L = (C – 3)/2$, where L is the count of all preceding even numbers without the number two before C.

The count M of all preceding numbers that end in five, before C, is determined by taking the next after C round number (ending in zero) and it is devided by ten. If C ends in a digit > 5 then the count of preceding before C numbers ending in five is M. If C ends in a digit $<$ 5 then the count of preceding before C numbers ending in five is M – 1. All numbers ending in five are devided by five without a remainder and therefore are composite numbers, that is to say, are not prime numbers.

To determine by how many numbers the number A must be devided in order to find whether it is composite according to the standart method, its lower divisor k of the divisors pair k_1 and k_2 must be taken, and to be equated to C , that is to say, k = C and therefore k – L – 1(we substract the number two) – 1(we substract the number one) – M(or M – 1 in the other cases) = the count of numbers(they are odd) by which the number A must be devided in order to find that it is composite. It should be noted , that from this count can be substracted also the preceding before k composite numbers (if we know which they are), without the composite numbers, that are divided without a

remainder by 2 and 5, which we have already excluded from the account and denoted as L and M(or M – 1 in the other cases).

EXAMPLE 1

Let us take as an example some whole positive odd number, that does not end in five, and examine it in order to understand whether it is a composite number. For example A = 4979. Whether it is divided by nine is easily determined when we know that its final reduction is equal to nine, then the number is also divided by nine. Red = 4 + 9 + 7 + 9 = 29 ; Red = 2 + 9 = 11 ; Red final = 1 + 1 = 2. Therefore A is not divided by nine without a remainder. Whether it is divided by eleven is also easily determined when we know the following situation : 79(the number composed by the last two digits of A) + 49(the number composed of the next two digits of A)(if A is with more digits they are grouped in couples forming two-digit numbers in a way similar to the described one) = 128 ; follows 28 + 01 = 29(we bring it to a two-digit format). This number 29 is not divided by 11 without a remainder , therefore and A is not divided by 11 without a remainder.

ρ ≥ $\sqrt{(3A)}$

ρ ≥ 122,2170201

Therefore ρ starts from 123

ρ = (3 + A)/2 = 2491

ρ = (1 + 3A)/2 = 7469

We check ρ = $\sqrt{(3A)}$ = 122,2170201 which is not a whole number

Therefore $\sqrt{\Delta}$ > 0

We check ρ = 2$\sqrt{A}$ = 141,1240589 which is not a whole number

Therefore ρ ≠ $\sqrt{\Delta}$

We check ρ = $\sqrt{(\frac{3}{2}(A + B))}$, by choosing B_1 = 4981

ρ = 122,2292927 which is not a whole number

With B_2 = 4983 (this number is divided by 11 without a remainder and therefore it is a composite number)

ρ = 122,2415641 which is not a whole number

We check $\rho = (- 13 \pm 2\sqrt{(169 + 9A)})/3$ = 137,0565924(+) is not a whole number and – 145,7232591(-) is not a whole number.

We check $\rho = (3A + 25)/10$ = 1496,2 which is not a whole number

We check $\rho = (A + 27)/6$ = 834,(3) which is not a whole number

We check $36\theta^3 - (729 + 162A + A^2)\theta^2 + (2187A + 18A^2 + 3A^3)\theta + 4A^4 + 216A^3 + 2916A^2 = 0$

We check $4\theta^3 - (9 + 18A + A^2)\theta^2 + (27A + 2A^2 + 3A^3)\theta + 4A^4 + 24A^3 + 36A^2 = 0$

We check (1)

We check (3)

We check (4)

We check (5)

We check (6)

We check (7)

We check (8)

We check (9)

We check (10)

We check (11)

We check (14)

We check (15)

We check (16)

We check (17)

We check (18)

We check (19)

Therefore we start to substitute ρ in $\sqrt{\Delta}$ from ρ = 123 and upwards.

ρ can be both even and odd, but it is obligatory a whole number. Whether it is a positive or a negative number ρ it is unimportant, since in Δ partakes as ρ^2. After a while we find that with ρ = 211 $\sqrt{\Delta}$ = 344 for which understanding it is necessary to use 89 numbers ρ. Prime numbers have only three pairs of divisors : k_1 = 1 and k_2 = 1 or k_1 = 1 and k_2 = A or k_1 = A and k_2 = 1.

Let us determine the divisors k_1 and k_2 for the considered example.

k_1 = (2*211 ± $\sqrt{(4 * 211^2 - 12 * 4979)}$)/6 = (2*211 ± 344)/6 = 127,(6) with (+) and 13 with (-)

k_2 = (2*211 $\mp$ 344)/2 = 39 with (-) and 383 with (+)

k_1 and k_2 are whole numbers and k_1k_2 = A therefore k_1 = 13 and k_2 = 383

k_1 – L – 1 – 1 – (M – 1) = 13 – 5 – 1 – 1 – (2 – 1) = 5 numbers , that is to say according to the standard method A is divided only by 5 numbers and is understood that A is a composite number, while in the described method 89 numbers ρ for the same purpose are used. Therefore the described method is appropriate only for large and very large numbers A with large and very large divisors, which are prime numbers.

EXAMPLE 2

Let us take for example an eight-digit number A = 24462187. Red = 2 + 4 + 4 + 6 + 2 + 1 + 8 + 7 = 34 ; Red final = 3 + 4 = 7 ; therefore A is not divided by nine without a remainder. 24 + 46 + 21 + 87 = 178 ; 78 + 01 = 79 ; 79 is not divided by 11 without a remainder, therefore and A is not divided by 11 without a remainder.

ρ ≥ $\sqrt{(3A)}$

ρ ≥ 8566,595648 therefore ρ starts from 8567

ρ = (3 + A)/2 = 12231095

ρ = (1 + 3A)/2 = 36693281

We check ρ = $\sqrt{(3A)}$ = 8566,595648 which is not a whole number

Therefore $\sqrt{\Delta}$ > 0

We check ρ = 2$\sqrt{A}$ = 9891,852607 which is not a whole number

Therefore ρ ≠ $\sqrt{\Delta}$

We check ρ = $\sqrt{(\frac{3}{2}(A + B))}$, by choosing B_1 = 24462189

Red = 2 + 4 + 4 + 6 + 2 + 1 + 8 + 9 = 36 ; Red final = 3 + 6 = 9 therefore B_1 is divided by 9 without a remainder and is the next composite number.

ρ = 8566,595823 which is not a whole number

We check ρ = (- 13 ± 2$\sqrt{(169 + 9A)}$)/3 = 9887,52307 (+) is not a whole number and - 9896,189737 (-) is not a whole number

We check ρ = (3A + 25)/10 = 7338658,6 which is not a whole number

We check ρ = (A + 27)/6 = 4077035,667 which is not a whole number

We check $36\theta^3 - (729 + 162A + A^2)\theta^2 + (2187A + 18A^2 + 3A^3)\theta + 4A^4 + 216A^3 + 2916A^2 = 0$

We check $4\theta^3 - (9 + 18A + A^2)\theta^2 + (27A + 2A^2 + 3A^3)\theta + 4A^4 + 24A^3 + 36A^2 = 0$

We check (1)

We check (3)

We check (4)

We check (5)

We check (6)

We check (7)

We check (8)

We check (9)

We check (10)

We check (11)

We check (14)

We check (15)

We check (16)

We check (17)

We check (18)

We check (19)

Therefore we start to substitute ρ in $\sqrt{\Delta}$ from ρ = 8567 and upwards.

We find out that with ρ = 9865 $\sqrt{\Delta}$ = 9784 for which understanding it is necessary to use totally 1299 numbers ρ.

Let us define the divisors k_1 and k_2 for the considered example.

k_1 = (2*9865 ± $\sqrt{(4 * 9865^2 - 12 * 24462187)}$)/6 = (2*9865 ± 9784)/6 = 4919 with (+) and 1657,(6) with (-)

k_2 = (2*9865 $\mp$ 9784)/2 = 4973 with (-) and 14757 with (+)

k_1 and k_2 are whole numbers and k_1k_2 = A therefore k_1 = 4919 and k_2 = 4973

Both numbers k_1 = 4919 and k_2 = 4973 are prime numbers.

k_1 – L – 1 – 1 – M = 4919 – 2458 – 1 – 1 – 492 = 1967 that is to say according to the standard method A is divided by 1967 numbers until it is found that A is a composite number, while according to the described method are used 1299 numbers ρ for the same purpose.

If we know which are the composite numbers to 4919 we can extract them from the count 1967 decreasing it , but we must not extract the composite numbers, that are divided whitout a remainder by 2 and 5, since we have

already extracted them from the account and denoted as L and M(or M – 1 in the other cases).

If $\sqrt{\Delta}$, is not a whole number or if $k_1 = k_2 = 1$ or $k_1 = 1$; $k_2 = A$ or $k_1 = A$; $k_2 = 1$, then A is a prime number.

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