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Jamel Ghanouch
RIME department of Mathematics, Tunesia

Correspondence:
Jamel Ghanouch
RIME department of Mathematics, Tunesia

An elementary proof of Catalan-Mihailescu and Fermat-Wiles theorems and generalization to Beal conjecture

Jamel Ghanouch

Abstract
A proof of Fermat theorem is presented and a generalization to Beal conjecture is proposed. For this, we begin with Fermat and Fermat-Catalan equations and solve them.

Keywords: Diophantine; Fermat; Fermat-Catalan; Resolution.

1. The equation

The equation is $y^p = x^q \pm z^c = x^q + az^c$

Let $$w = \frac{\log(-az^c + \sqrt{z^{2c} + 4y^p x^q}) - \log(2) - \log(y^{p-2})}{\log(x)}$$

It exists and

$$\Rightarrow w\log(x) = \log(x^w) = \log(-az^c + \sqrt{z^{2c} + 4y^p x^q}) - \log(2) - \log(y^{p-2})$$

$$= \log\left(\frac{-az^c + \sqrt{z^{2c} + 4y^p x^q}}{2y^{p-2}}\right)$$

$$\Rightarrow x^w = \frac{-az^c + \sqrt{z^{2c} + 4y^p x^q}}{2y^{p-2}}$$

$$\Rightarrow 2y^{p-2}x^w + az^c = \sqrt{z^{2c} + 4y^p x^q}$$

$$\Rightarrow (2y^{p-2}x^w + az^c)^2 = z^{2c} + 4y^p x^q$$

$$= z^{2c} + 4y^{2p-4}x^{2w} + 4az^c y^{p-2}x^w$$

$$\Rightarrow y^p x^q - y^{2p-4}x^{2w} = az^c y^{p-2}x^w$$

$$\Rightarrow y^2 x^{q-w} - y^{p-2}x^w = az^c = y^p - x^q = y^{p-2}y^2 - x^{q-w}x^w$$

$$\Rightarrow (y^2 + x^w)(x^{q-w} - y^{p-2}) = 0$$

$$\Rightarrow x^{q-w} - y^{p-2} = 0$$

$$GCD(x, y) = 1$$

$$\Rightarrow w = q = \frac{\log(-az^c + \sqrt{z^{2c} + 4y^p x^q}) - \log(2) - \log(y^{p-2})}{\log(x)}$$

$$= \frac{\log(-az^c + \sqrt{z^{2c} + 4y^2x^q}) - \log(2)}{\log(x)} \in N$$

Catalan equation $y^p = x^q + 1$ leads to

$$az^c = 1 \Rightarrow q = w = \frac{\log(-1 + \sqrt{1 + 4y^2x^q}) - 0.69}{\log(x)} \in N \Rightarrow (x, y, q) = (2, \pm 3, 3)$$

And Fermat equation $y^n = x^n + az^n$ leads to

$$az^n = z^2 \Rightarrow n = w = \frac{\log(-z^2 + \sqrt{z^4 + 4y^2x^2}) - 0.69}{\log(x)} \in N$$

Leads to Fermat solutions for n>1.

2. Conclusion

We have solved both three equations by the same method and proved two theorems and one conjecture.

3. Reference

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