Continued Fractions are a bit weird….

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The best way to start a continued fraction is with a fraction

A representation for the number 1 could be:

$$1 = \frac{2}{3-1}$$

Replacing the ‘1’ in the denominator as $\frac{2}{3-1}$:

$$1 = \frac{2}{3-\frac{2}{3-1}}$$

Then the same again for the bottom 1:

$$1 = \frac{2}{3-\frac{2}{3-\frac{2}{3-1}}}$$

And hence, ‘1’ can be expressed as:

$$1 = \frac{2}{3-\frac{2}{3-\frac{2}{3-\frac{2}{3-\dots}}}}$$

(continued till infinity)

However,

A representation for the number 2 in a similar way could be:

$$2 = \frac{2}{3-2}$$

Replacing the ‘2’ in the denominator as $\frac{2}{3-2}$:

$$1 = \frac{2}{3-\frac{2}{3-2}}$$

And hence, in the exact similar way, ‘2’ can be expressed as:

$$1 = \frac{2}{3-\frac{2}{3-\frac{2}{3-\frac{2}{3-\dots}}}}$$

(continued till infinity)

Upon closer inspection we see that both of these are equal. So does that mean:

$$1 = 2 = \cfrac{2}{3 - \cfrac{2}{3 - \cfrac{2}{3 - \cfrac{2}{3 - \dots}}}}$$

Even if we were given this continued fraction as a question:

$$\cfrac{2}{3 - \cfrac{2}{3 - \cfrac{2}{3 - \cfrac{2}{3 - \dots}}}} = ?$$

We would solve it as:

$$\cfrac{2}{3 - \cfrac{2}{3 - \cfrac{2}{3 - \cfrac{2}{3 - \dots}}}} = x$$

$$\cfrac{2}{3 - x} = x$$

$$x^2 - 3x + 2 = 0 \implies x = 1 \text{ or } x = 2$$

So the question becomes, how do you find out the answer, is it 2 or is it 1 or *are they both equal?*