Fractals

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1 Basic Algebra

1.1 Simon's Factroring Trick

Simon's Favorite Factoring Trick (SFFT) is best explained with an example:

Example 1.1. Find all positive integers x, y that satisfy

$$xy - 2x - 4y = 0.$$

Sloution Let us factor the first two terms:

$$x(y-2) - 4y = 0.$$

We want to find some way we can turn the y into a $y-2$. Let's see what happens if we do that:

$$x(y-2) - 4(y-2+2) = 0.$$

$$x(y-2) - 4(y-2) - 8 = 0.$$

$$x(y-2) - 4(y-2) = 8.$$

Now, we can factor:

$$(x-4)(y-2) = 8.$$

Because x, y are positive integers, we know that $x-4$ and $y-2$ are simply the positive factors of 8

$$x-4 = 1, y-2 = 8,$$
$$x-4 = 2, y-2 = 4,$$
$$x-4 = 4, y-2 = 2,$$
$$x-4 = 8, y-2 = 1,$$

Solving we get $\boxed{(x,y) \in \{(5,10),(6,6),(8,4),(12,3)\}.}$

Now for the formal statement:

Theorem 1 (SFFT). For all real numbers (although commonly used only for integers) x, y, a, b,

$$xy + xa + yb + ab = (x+a)(y+bk).$$

Two special common cases are: $xy+x+y+1 = (x+1)(y+1)$ and $xy-x-y+1 = (x-1)(y-1)$.