

The f3 function above for the cube root assumed its input was negative. How could we generalize the cube root to work for any input? An even better solution would be a function that computes $f(x, p, q) = x^{p/q}$ for any real x , where p and q could be any integers.

Calc-50 is not designed for complicated programming. It doesn't have explicit loops or if statements, but as we did with the sum function to get a loop, we can sometimes use the select function like an if statement.

Define f3 to compute $x^{p/q}$ when p and q are integers.

It will give $x^{p/q}$ directly if $x \geq 0$.

It will give unknown if $x < 0$ and q is even (in lowest terms of p/q).

It will give $-(-x)^{p/q}$ if $x < 0$ and q is odd.

Use the select (sel) function, with f3 storing x in register 1, p in register 2, q in register 3.

f3: 1, func, 3, sto, roll, 2, sto, roll, 1, sto, 0, enter, e99, e^x, 7, func, 4, sel

f4: 1, func, 1, rcl, 2, rcl, 3, rcl, /, y^x

f5: 2, func, 2, rcl, 3, rcl, gcd, 4, sto, 2, rcl, 4, rcl, /, 2, sto, 3, rcl, 4, rcl, /, 3, sto, 6, f_n

f6: 2, func, 3, rcl, 2, mod, 7, func, 0, enter, 0, enter, 7, sel

f7: 1, func, -1, \sqrt{x}

f8: 1, func, 1, rcl, chs, 2, rcl, 3, rcl, /, y^x, chs

f3 stores the input arguments x, p, q in registers 1,2,3, then calls f4 if $x \geq 0$ or f5 if $x < 0$.

“e99, e^x” computes +overflow as the upper limit for the interval where f4 is called.

f4 computes $x^{p/q}$, used when $x \geq 0$

f5 reduces p/q to lowest terms by factoring out their gcd, then calls f6

f6 calls f7 if q is even, or f8 if q is odd

f7 returns unknown (by computing $\sqrt{-1}$)

f8 computes $-(-x)^{p/q}$

Testing f3 for several different cases:

-8, enter, 1, enter, 3, enter, 3, f _n	$(-8)^{1/3} = -2.00000000000000000000000000000000$
8, enter, 1, enter, 3, enter, 3, f _n	$(+8)^{1/3} = 2.00000000000000000000000000000000$
-8, enter, 2, enter, 6, enter, 3, f _n	$(-8)^{2/6} = -2.00000000000000000000000000000000$
-8, enter, 1, enter, 2, enter, 3, f _n	$(-8)^{1/2} = \text{unknown}$
8, enter, 1, enter, 2, enter, 3, f _n	$(+8)^{1/2} = 2.828427124746190097603377448419$