* Lookup tables are frequently used
* Trigonometric functions are often implemented via the [CORDIC](http://en.wikipedia.org/wiki/CORDIC) algorithm (either on the CPU or with a library). Note that usually sine and cosine are computed together, I always wondered why the standard C library doesn't provide a sincos function.
* Square roots use [Newton's method](http://en.wikipedia.org/wiki/Newton%27s_method) with some clever implementation tricks: you may find somewhere on the web an extract from the Quake source code with a mind bogging 1 / sqrt(x) implementation.
* Exponential and logarithms use exp(2^n x) = exp(x)^(2^n) and log2(2^n x) = n + log2(x) to have an argument close to zero (to one for log) and use rational function approximation (usually [Padé approximants](http://en.wikipedia.org/wiki/Pad%C3%A9_approximant)). Note that this exact same trick can get you matrix exponentials and logarithms. According to @Stephen Canon, modern implementations favor Taylor expansion over rational function approximation where division is much slower than multiplication.
* The other functions can be deduced from these ones. Implementations may provide specialized routines.
* pow(x, y) = exp(y \* log(x)), so pow is *not* to be used when y is an integer
* hypot(x, y) = abs(x) sqrt(1 + (y/x)^2) if x > y (hypot(y, x) otherwise) to avoid overflow. atan2 is computed with a call to sincos and a little logic. These functions are the building blocks for complex arithmetic.
* For other transcendental functions (gamma, erf, bessel, ...), please consult the excellent book[Numerical Recipes, 3rd edition](http://www.nr.com/) for some ideas. The good'old [Abramowitz & Stegun](http://en.wikipedia.org/wiki/Abramowitz_and_Stegun) is also useful. There is a new version at <http://dlmf.nist.gov/>.
* Techniques like Chebyshev approximation, continued fraction expansion (actually related to Padé approximants) or power series economization are used in more complex functions (if you happen to read source code for erf, bessel or gamma for instance). I doubt they have a real use in bare-metal simple math functions, but who knows. Consult Numerical Recipes for an overview.