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Solutions for a Quadratic Equation

Executable Division

The operation q = z/n has to be executed.
Here we assume for the moment $z \geq 0$ and $n \geq 0$.
Let m be the largest absolute value of any real value in floating point format,
e.g. $m = max_2 = 1E4932$ for Intel FPUs, using the internal 10 byte format.
The actually used value (program below) may be smaller.
For IEEE single precision we have $max_2 = 1E38$ (e.g. for PostScript).
For $n \geq 1$ the division is always executable.
For $n < 1$ the division is executable if $z/n < m$.
This can be checked without division by $z < m \cdot n$.
If this inequality is false, then the division is not executable.

This doc:
http://www.fho-emden.de/~hoffmann/quadequ04062002.pdf

```
Procedure QuadEqu (p2,p1,p0: Single; Var r1,r2,i1,i2: Single; Var flag:Integer);
{ QuadEqu p2*x^2+p1*x+p0=0, Solution x1=r1+j*i1; x2=r2+j*i2                  }
{ Flag 2: 2 Sol.; -2: 2 complex Sol.; 1: 1 real Sol.; 0: No Sol.            }
{ x=-0.5*p1/p2+-Sqrt[(0.5*p1/p2)^2-(p0/p2)]                                 }
{ Starting by x1:=0+0*j; x2:=0+0*j                                          }
Const   max1=1E38; { for Single }
        max2=1E19;
Var     ap0,ap1,ap2,rak,sig: Single;
Begin
flag:=0; r1:=0; r2:=0; i1:=0; i2:=0;
ap0:=Abs(p0); ap1:=Abs(p1); ap2:=Abs(p2);
If (ap2>=1) Then flag:=2
    Else If (ap1<2*ap2*max1) And (ap0<ap2*max2) Then flag:=2
    Else If (ap1>=1)                            Then flag:=1
    Else If (ap0<ap1*max2)                      Then flag:=1;
Case flag Of
2:  Begin
    sig:=-0.5*p1/p2; rak:=Sqr(sig)-p0/p2;
    If rak>0 Then Begin r1:=sig+Sqrt(rak); r2:=sig-Sqrt(rak);              End Else
    If rak<0 Then Begin r1:=sig;r2:=r1; i1:=Sqrt(-rak);i2:=-i1; flag:=-2;  End Else
    { If rak=0 Then}Begin r1:=sig; r2:=r1; End;
    End;
1:  r1:=-p0/p1;
End;
End;
```

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Quadratic Equation / Algebraic Solution

$p_2 \cdot x^2 + p_1 \cdot x + p_0 = 0$

$x_{1/2} = - 0.5 \cdot p_1/p_2 \pm \mathrm{Sqrt}\ (\ (0.5 \cdot p_1/p_2)^2 \ - p_0/p_2\ )$

$x_1 = r_1 + j \cdot i_1$
$x_2 = r_2 + j \cdot i_2$

Quadratic Equation / Structogram

$r_1 = 0 \quad r_2 = 0 \quad i_1 = 0 \quad i_2 = 0$

$m_2 = m$ (for actual format) $\quad m_1 = \mathrm{Sqrt}(m_2)$

$a_2 = \mathrm{Abs}(p_2) \quad a_1 = \mathrm{Abs}(p_1) \quad a_0 = \mathrm{Abs}(p_0)$

$a_2 \geq 1$?

Yes	No		
	$a_1 < 2 \cdot a_2 \cdot m_1$?		
	Yes		No
	$a_0 < a_2 \cdot m_2$?		
	Yes	No	
		$a_1 \geq 1$?	
		Yes	No
			$a_0 < a_1 \cdot m_2$?
			Yes / No
$s = - 0.5 \cdot p_1/p_2$ $r = s^2 - p_0/p_2$ $t = \mathrm{Sqrt}(\ \mathrm{Abs}(r)\ )$			
$r \geq 0$?			
Yes	No		
$r_1 = s + t$ $r_2 = s - t$ flag = +2 2 real solutions	$r_1 = s$ $r_2 = s$ $i_1 = +t$ $i_2 = - t$ flag = -2 2 complex	$r_1 = -p_0/p_1$ flag = +1 1 real	flag = 0 None